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Macrobenthic Community Structure and Distribution in the Gunung Berlumut Recreational Forest, Kluang, Johor, Malaysia.

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Abstract: The macro invertebrate community structure was surveyed at Sungai Dengar sub-catchment which is located at Gunung Berlumut Recreational Forest in Kluang , Johor from 08 to 11 August 2009 by using surber net. Based on the results, it shows that Chironomidae were abundant at the pristine-pristine site which is the most up-stream (undisturbed) located on the Gunung Berlumut and also at the station B2 which is pristine station located at the toe of Gunung Berlumut but nevertheless the number of individual taxa are much higher at impact sites (C1 & C2). The highest Shannon-Wiener diversity Index was at the impact station (C2) which is located at the palm oil area and the lowers value located at the most cleaned site (A) which is located on the top of Gunung Belumut. Simpson Dominance Index and Margalef Richness Index was also highest at station C2 which is the impact sites and station A also recorded the lowest value. So, even though station C2 which was categorized as the impact station recorded the highest Shannon-Wiener Diversity Index and Margalef Richness Index but it also shows that some of the species dominated the area, which means the taxa distribution was not evenly distributed. The result also shows that both stations which was the cleanest (reference) and the impact did not fulfill Ephemeroptera, Plecoptera and Trichoptera (EPT) Index requirement which both stations did not have EPT taxa. Station B1 recorded the highest EPT index (9.4) and followed by station B2 (0.9) and the lowers was station C1 (0.4). Based on the above results, we can suggest that, macro invertebrate community structure does not depend solely on water quality of the river but it also depends on other factors such as habitat characteristics, river morphology, river riparian, canopy cover, etc., especially river substrate compositions.

Key words: macro invevtelorate, Species diseasing richness, evenness, dominance.

INTRODUCTION

The concern on river water quality in Malaysia has risen over the last few decades as rivers play an important role in our daily life as well as in the life of other living organisms. In addition, river also has a very fragile ecosystem (Pauzi-Abdullah *et. al*, 2000). Unfortunately, clean fresh water is becoming scarce. This is due to various kinds of land development which have taken a toll on our riverine habitats, the very systems that provide sustenance to our socio-economic well-being and to the natural inhabitants of our forests and aquatic environment (Fatimah and Zakaria-Ismail, 2005). When talking about healthy eco- system in river rehabilitation process, it is not only observing the water quality of the river alone but also river eco-systems. Changes of river quality as well as river eco-systems, depends very much on land use activities in the catchment areas. Various pollutants in a catchment area will determine river water quality as well as river eco-systems. A healthy river is said to be that which favours aquatic life in the river.

Good physico-chemical quality of river water does not ensure the health of aquatic life in the rivers and clean water itself is not a sufficient indicator for the health of the rivers. The presence and healthy living of aquatic species in the rivers is the key references for river rehabilitation. In order to determine the health of the river not only the physical and chemical qualities of the health of the river must be taken into account but also the biological aspects. Biological monitoring is an essential element needed to assess the environmental health of aquatic eco-systems. Biological organisms are diagnostic in determining the health of aquatic eco-systems and they can be measured quantitatively. Ecologically, the concept of niche space provides the

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theoretical framework for understanding the importance of biological monitoring to any evaluation of environmental health. The organisms that inhabit aquatic eco-systems are the fundamental sensors that respond to any stress affecting that system. The health of an aquatic eco-system is reflected in the health of the organisms that inhabit it. Any stress imposed on an aquatic eco-system manifests its impact on the biological organisms living within that ecosystem (Loeb, 1990). Benthic macro-invertebrates are good bio-indicators, since they are very sensitive to changes in their habitat. In polluted water, the tolerant species will survive in abundance but the sensitive species will perish. Under normal clean water condition, more species are found to survive, unlike in polluted water condition where only one or two species can survive but with a higher density (Rahim-Ismail, 1994).

Sungai Dengar is a good river to study macrobhentic community structure and distribution due to the river system which has a condition of undisturbed and disturbed in the same catchment and in the same river. Sungai Dengar flows down from the Gunung Belumut to joint Sungai Sembrong before it flows to the sea. The river was a perennial river with spring fed origin from the top of Gunung Belumut and it passes through palm oil plantation as it flows down stream. Thus, the objective of this study is to determine and compare the macrobhentic community structure and distribution in difference elevation and difference land uses for Sungai Dengar is located at Gunung Belumut Forest Reserved Area.

MATERIALS AND METHODS

Study Site:

This study was conducted within Sungai Dengar sub-catchment located at Gunung Belumut Recreational Forest in Kluang , Johor (Figure 1). There were a total of three sampling sites (A, B & C) with two sampling stations per site except for the most up-stream station with one station and three sampling points per station were identified. Station A is the most up-stream station located about 300 meter above mean sea level, station B is located at the foot of Gunung Belumut at the altitude of about 75 meters above mean sea level, while the most down-stream station is located in the palm oil estate. The distance between station A and station B is about 2.5 kilo meters, while the distance between station B and station C is about 1.5 km.

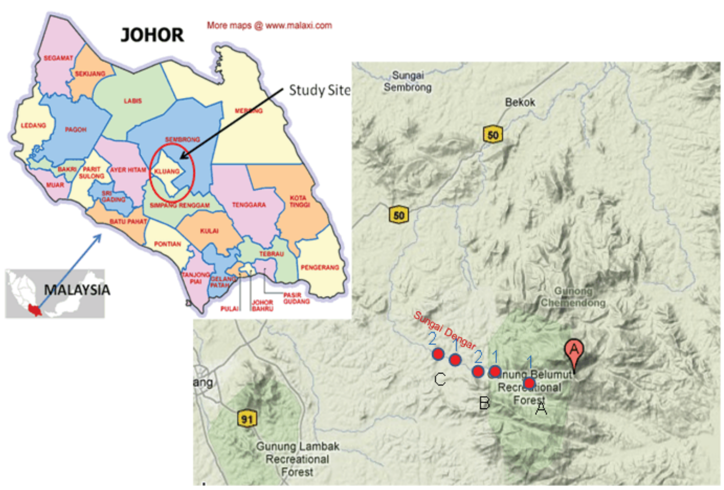

Fig. 1: Sampling Stations at Sungai Dengar

Methods:

A 500 meter reach of the stream was selected for each sampling site or sampling reach. One sampling reach comprised of two sampling stations where one station at the upper reach, another station at the lower reach. Each station comprised of three sampling points, one at the right bank, one at the middle and one at the left bank. All three samples in each sampling station were composite as one sample, so meaning that two samples for each sampling reach were obtained for macro invertebrate. One sample for upper reach and one for lower reach. Benthic macro invertebrate sample was sent to laboratory for identification. The sampling was conducted from 08 to 11 August 2009.

Surber Net with 500 micron mesh size combined a rectangular quadrate with the size of 30 cm x 30 cm (0.09 m^2) to delineate the area of bed to be sampled and a net into which the disturbed benthic invertebrates were swept by the current used was used. The purpose of two triangular wings of netting, linking the lateral margins of the two frames was to reduce the loss of sample around the sides of the net. Sampling protocols basically followed the Karr Protocol with minor modifications to suit local conditions.

Sampling methods employed were as follows: (i) placing Surber Sampler on the selected spot with the opening of the nylon net facing upstream by bracing and holding the frame firmly on the creek bottom, (ii) lifting the larger rocks resting within the frame and brushing off crawling or loosely attached organisms so that they would drift into the net. Once the larger rocks were removed, the substrate would be vigorously disturbed (only on the surface) with a trowel or large spike for about 60 seconds to loosen organisms in the interstitial spaces, washing them into the net. The final step was lifting the Surber Net out of water, tilting the net up and out of the water while keeping the open end upstream. Substrates dominated by rocks larger than 50 cm in diameter will be avoided.

Sampling points that were closed to the bridges and other large human-made structural features were avoided. If it was unavoidable, sampling would be made at least 50 meters upstream and 200 meters down stream of a bridge. Chosen sampling point was not included major tributaries discharging to the stream in the study area. The next point of sampling would be approached from the down stream, or in other words, the movement of investigator was from down stream to up stream and not the other way round. This sampling technique served as the quality assurance and quality control to ensure sample representativeness and reliability. The sample in the Surber Net was then poured into a sieve with the same mesh size (500 micron) and then all the fine sediments and unwanted materials were washed. Remaining sample in the sieve was then poured into the plastic sample. A 20% ethanol was added in to the sample for preservation and to be used for identification purposes. In the laboratory the sample was then rinsed with tap water to remove the preservative and then sorted out into major taxa. The sorted organisms were stored in 10 ml glass bottle containing 70% ethanol for preservation and later identification.

In order to keep collected data representative and reliable at all times, Quality Assurance and Quality Control of the sampling techniques were strictly followed. This was ensure by carrying out the samplings from the lower parts of the rivers to minimize the possible effect of benthic macro invertebrate drift by currents. Sampling duration always remained within one hour and involved the same number with the same investigators in order to keep sampling constant. To ensure sediment agitation time was consistent, stop watch was used. Other than that, the researcher performed a close visual inspection of the sample net before each sampling to ensure that net was clean of organisms. Sieve was also inspected thoroughly to ensure that all the organisms were in the sampling bags, left over organisms in the sieve were picked up manually by forceps. All the indices were analyzed using *Species Diversity and Richness software* developed by Henderson, P. A. from University of Oxford, Department of Zoology and RMH Seaby PISCES Conservation Limited and Excel Programme. The programme was developed based on Shannon-Weiner Index for Diversity Indices, Hill Index for Evenness, Margalef Index for Richness and Simpson Index for Dominance Indices.

RESULTS AND DISCUSSION

Table 1 shows the number of taxa found at all the sampling stations with the use of Surber Net. Site A was located on the Gunung Belumut with an altitude of 300 meter above mean sea level, whereas site B was located at the toe of Gunung Belumut with an altitude of 75 meter and the last site which was site C is located further down-stream at the palm oil plantation area. Site A was basically representing a pristine-pristine area, whereas site B for pristine area and site C was for disturbed area. Chironomidae was the dominant taxa at the stations A, B2, C1 and C2. The results have shown that not always the case where Chironomidae and other Dipterants were abundant at severely polluted sites as discussed by Davis (2003). Based on the results, it showed that Chironomidae were abundant at the prestine-prestine site which was the most up-stream (undisturbed) that are located on the Gunung Belumut. Same scenario occurred at the prestine station B2 located at the toe of Gunung Belumut but nevertheless the number of individual taxa was much higher at impact sites.

Clean water taxa that was found abundant at pristine-pristine station is Ephermeroptera of the genus Pseudocloen and Plecoptera of the genus Neoperla. Ephemerella was also found to dominate the clean water taxon at pristine station (B1), whereas Pseudiron dominated the pristine station (B2). On the other hand, Diptera (Chironomidae) dominated the most polluted site at stations C1 & C2.

Table 1: Macroinvertebrate Taxa for Each Sampling Station

						Stations				
Phylum	Class	Order	Family	Subfamily	Genus	A	B1	B2	C1	C2
Arthropoda	Insecta	Ephermeroptera	Baetidae		Pseudocloen	1	22			
Arthropoda	Insecta	Ephermeroptera	Ephemerellidae		Ephemerella		6	3	7	2
Arthropoda	Insecta	Ephermeroptera	Heptageniidae		Pseudiron		3	6	21	5
Arthropoda	Insecta	Ephermeroptera	Potamanthidae		Potamanthus				18	3
Arthropoda	Insecta	Plecoptera	Perlidae		Neoperla		13	2	4	
Arthropoda	Insecta	Trichoptera	Hydropsychidae		Macrostemum		3			
Arthropoda	Insecta	Trichoptera	Hydroptilidae		Leptocella			1	3	3
Arthropoda	Insecta	Trichoptera	Hydropsychidae		Hydropsyche			1		1
Arthropoda	Insecta	Odonata	Gomphidae		Dromogomphus	1			1	
Arthropoda	Insecta	Odonata	Gomphidae		Hagenius			1		
Arthropoda	Insecta	Odonata	Lebellulidae		Somatochlora					2
Arthropoda	Insecta	Coleoptera	Elmidae		Stenelmis	1	2	1		4
Arthropoda	Insecta	Coleoptera	Gyrinidae		Gyrinus		2			
Arthropoda	Insecta	Diptera	Chironomidae	Chironominae		41	2	4	131	10
Arthropoda	Insecta	Diptera	Chironomidae	Tanypodinae			3	11	6	7
Arthropoda	Insecta	Diptera	Tipulidae		Tipula				1	2
Arthropoda	Insecta	Diptera	Tabanidae		Tabanus				1	
Mollusca	Malacostraca	Decapoda	Atyiedae		M. Pillimanus	8				
Mollusca	Malacostraca	Decapoda	Palaemonidae		Macrobrachium	5				
Mollusca	Gastropoda	Mesogastropoda	Lymnaeidae		Lymnaea		1			

Table 2 shows the Shannon-Wiener diversity Index, Simpsons Dominance Index, Margalef Richness Index and Ephemeroptera, Plecoptera and Trichoptera (EPT) Index. The highest Shannon-Wiener diversity Index is at the impact station (C2) located at the palm oil area and the lowers value located at the most cleaned site (A) located on top of Gunung Belumut. This result is not in-line with the finding from Jhingran, *et. al* (1986), where he found that if Shannon-Wiener Index greater than 3, water conditions were clean, if index fall within 1 to 3, water conditions were moderately polluted and if index less than 1, water conditions were heavily polluted. Simpson Dominance Index and Margalef Richness Index were also found to be the highest at the impact station C2, meanwhile, station A recorded the lowest value. So, even though station C2 which was categorized as the most polluted station recorded the highest Shannon-Wiener diversity Index and Margalef Richness Index but it also shows that some of the taxa were dominated the area. This have shown the unevenness of taxa distribution at the area.

The result also shows that both stations the cleanest and polluted did not fulfill EPT Index requirement which both stations did not have EPT taxa. Table 2, shows that Station B1 recorded the highest EPT index (9.4) and followed by station B2 (0.9) and the lowers was station C1 (0.4). The results did not alsoconfirmed to the finding from Davis (2003), where he stated that, EPT, crustacean and isopoda were much higher at the unpolluted area.

Table 2: Diversity Index

Index	Stations				
	A	B1	B2	C1	C2
Total Number of Individual, N	57	57	30	193	39
Total Number of Species, S	6	10	9	10	10
Total Number of EPT Taxa	-	47	13	53	-
Total Number of Chironomidae	-	5	15	137	-
Shannon-Wiener	0.94	1.83	1.82	1.18	2.10
Simpsons (Dominance Index)	1.86	4.75	5.44	2.08	8.14
Margalef (Richness Index)	1.24	2.23	2.35	1.71	2.46
EPT Index	-	9.4	0.9	0.4	-

Based on the above results, we can suggest that, the application of diversity indices alone to assess river water quality is not sufficient; it has to be together with Evenness Index. We can also suggest that, macro invertebrate community structure is not solely dependent on water quality of the river but it also depends on other factors such as habitat characteristics, river morphology, river riparian, canopy cover, etc. This is also in-line with Richards, (1994) finding, where he found that, distribution of particles size for river substrate was crucial to determine macro-invertebrate structure. This statement can be visualized through the results from pristine-pristine station (A) which has a very high water quality, very good canopy and river riparian buffers but the substrate composition mostly bedrock and boulders, so that very low number of clean water taxa can be found. Whereas at pristine stations B1 & B2 which has a smaller substrate sizes and has a good compositions which range between sand to cobble has a diverse EPT taxa.

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