BENTHIC MACROINVERTEBRATE COMMUNITY STRUCTURE AND DISTRIBUTION IN SUNGAI PICHONG, GUNUNG CHAMAH, KELANTAN, MALAYSIA.

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Abstract

The study was to assess the Benthic macroinvertebrate species and compositions in the highland river (Sungai Pichong) which located about 800 meter above mean sea level to be used as biological indicators for water quality assessment and also to determine the physical water quality factor that influence benthic organism compositions and distributions. The study was carried out on 25 July 2011 till 27 July 2011. Four sampling points 200 meters apart were fixed by Global Positioning Systems (GPS). There was no significant difference for in-situ water quality reading between sampling station as well as the date of sampling. Based on in-situ parameters which was compared with Interim National Water Quality Standard for Malaysia was found that Sungai Pichong could be categorized under Class I, river which has excellent water quality. In addition, a total of nine families and 137 individual taxa were identified and of these, three families belonged to the order ephermeroptera (caenidae, baetidae and siphlonuridae) and dipteral (chironominae, tabanidae and tipulidae), two families to coleopteran (elmidae and gyrinidae) and one family to odonata (aeshnidae). Only one taxa present to indicate an excellent river health namely ephermeroptera. Normally, there were three taxa namely ephermeroptera, plecoptera and trichoptera (EPT) present in healthy river. On the other hand, the SIGNAL score at all stations was recorded between 5 and 6 which was fall under mild pollution category.

Keywords : macroinvertebrate benthic, genus, limiting factor, physicochemical water quality, Gunung Chamah.

INTRODUCTION

Benthic macroinvertebrates, or more simply "benthos", are animals without backbones that are larger than ½ millimeter. These animals live on rocks, logs, sediment, debris and aquatic plants during some period in their life. The benthos include crustaceans such as crayfish, mollusks such as clams and snails, aquatic worms and the immature forms of aquatic insects such as stonefly and mayfly nymphs. Benthic macroinvertebrate**s** are good indicators of watershed health because they live in the water for all or most of their life, are easy to collect, differ in their tolerance to amount and types of pollution/habitat alteration, can be identified in laboratory, often live for more than one year; have limited mobility, and are integrators of environmental condition (Lenat and Barbour 1994, Richards and Host 1994, Sivaramakrishnan 2000, Davis 2003, Ajmal Khan, *et al*. 2004, Thompson 2005, Pacific Northwest Aquatic Monitoring Partnership, PNAMP 2007, Dinakaran and Anbalagan 2007 and Everard 2007). Its distribution highly depends on physical nature of the substratum, nutritive content, degree of stability, oxygen content and level of hydrogen sulphide (Anbuchezhian, *et. al.* 2009).

The small changes in the environment will have considerable response on the benthic community and it avails to measure the degree of pollution (Coull 1973 and Fernando 1981). The presence and numbers of the different types of benthic macroinvertebrates provide accurate information about the health of a stream and watershed. The water quality, drift of aquatic insects and common dragonflies and damselflies at the Hulu Selai River, Endau-Rompin National park, Johor Malaysia were studied (Fatimah and Zakaria 2005 and Norma and Sofian 2005). As there is no assessment on benthic macroinvertebrate in Sungai Pichong, hence the present study has been undertaken to indentify the community structure and distribution of benthic macroinvertebrate in relation to physicochemicals water quality.

MATERIALS AND METHODS

Study Site

The study area was situated in Gunung Chamah (2171 meter), Gua Musang Kelantan.

The sampling station was located in the Sungai Picong which located about 800 meter above mean sea level on the Gunung Chamah (**Figure 1**).

Stations 1(a) is the most upstream station which located at the Sungai Picong main river next to the Picong Waterfall, meanwhile, station 1(b) was located at the tributary of Sungai Picong where both stations were located infront of the base camp for Chamah Exploration 2011. Meanwhile, station 2 located about 200 meter downstream of station 1(a) and station 3 located about 200 meter downstream of station 2. Sungai Picong is undisturbed, clean and healthy river with very minimal pollution except decayed leaves and animal excreta as well as disturbance from the researcher activities at the base camp.

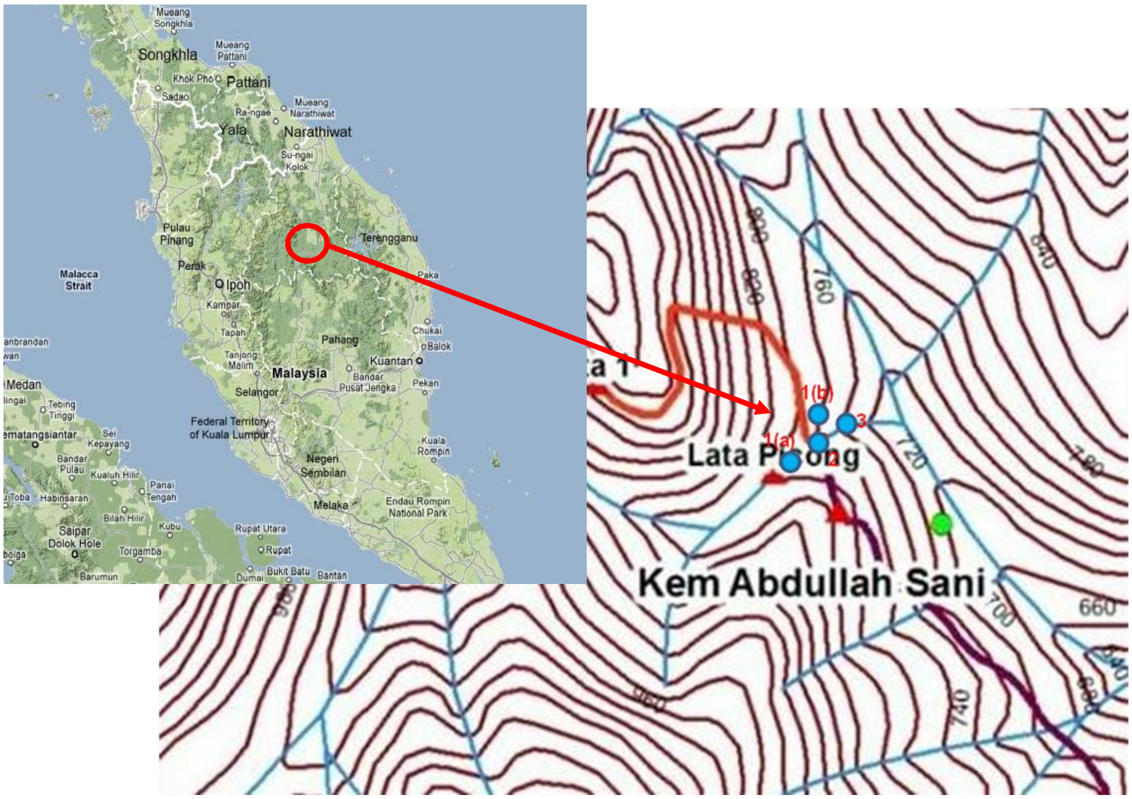

Figure 1: Sampling Stations

Methods

The **s**ampling was conducted from 25 to 27 July 2011 at four identified sampling stations at Sungai Pichong, Chamah Highland, Kelantan. Surber Net with 500 micron mesh size combines a rectangular quadrate with the size of 30 cm x 30 cm (0.09 m^2) was used to sample macroinvertebrate. Each station comprises of three sampling points for macroinvertebrate sampling, one at the right bank, one at the middle and the other one at the left bank. All three samples in each sampling station was composite as one sample. Benthic macro invertebrate sample was preserved in 80% ethanol before sending to laboratory for identification. In the laboratory the sample was identified up to family level (Edmondson 1959, Cook *et. al.* 1971, McCafferty 1981, Merritt and Cummins 1984, Needham 1962, Thorp and Covich 1991, Henderson 1989, Wiederholm 1983, Robert 1953, Gooderham and Tsyrlin 2002). SIGNAL score was calculated using Gooderham and Tsyrlin (2002). For water quality, at each station, six in-situ parameters were measured following the standard procedure of U. S. Environmental Protection Agency (2007). The parameters were Temperature, Dissolved Oxygen (DO), pH, Turbidity and Salinity which was measured by using a multi parameters probe Model YSI 6920 with 650 MDS Display/Logger as well as single parameter probe. Type of substrates, river depth and river width were also measured using simple measuring tape. Meanwhile, river water quality was also measuring by using SIGNAL method (Stream Invertebrate Grade Number – Average Level) based on Gooderham and Tsyrlin (2002).

RESULTS

Physico-chemicals Water Quality

Surface water dissolved oxygen content ranged from 6.66 mg/l to 7.58 mg/l. Meanwhile, the maximum value of pH was recorded as 7.21 and minimum of 6.72. In other hand, the maximum surface temperature was recorded as 21.44 ^{o}C and minimum of 20.96 ^{o}C. Salinity was also one of the parameter measured during the study but it was not detected. Turbidity was the last parameter measured in the list during the study. The turbidity of water ranged from 1.46 NTU to 2.61 NTU. The reading of in-situ parameters were shown in **Table 1**.

Table 1: Physical water quality data of Sungai Pichong, Chamah Highland, Kelantan.

Parameters	Sampling Date												
	25 July 2011				26 July 2011				27 July 2011				
	Station 1 (a)	Station 1 (b)	Station 2	Station 3	Station 1 (a)	Station 1 (b)	Station 2	Station 3	Station 1 (a)	Station 1 (b)	Station 2	Station 3	INWQS (Class I & II)
Physical WQ													
Temperature (^{o}C)	20.96	21.06	20.97	21.14	21.22	21.24	21.35	21.44	21.32	21.12	21.24	21.36	
2. DO (mg/l)	7.45	7.54	7.58	7.65	6.66	7.16	7.36	7.34	7.29	7.23	7.34	7.57	5 - 7
3. Sal ($^{o}/_{oo}$)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.5 - 1
4. Turbidity (NTU)	2.22	1.68	1.49	1.46	1.55	1.57	1.69	1.50	2.13	1.55	2.61	1.70	5 - 50
5. PH	6.94	7.08	7.20	7.00	6.96	7.02	7.03	7.01	6.72	7.21	7.18	7.05	6 - 9

Benthic macroinvertebrate compositions

Table 2 shows the number of taxa found at all sampling stations with the use of Surber Net. Elmidae was the dominant taxa at all the stations but the most abundant was in station 1(a) followed by station 2, 1(b) and 3. Siphlonuridae was the second dominant taxa at all the sampling stations. The third dominant taxa was chironominae followed by gyrinidae and caenidae. Clean water taxa that was found abundant at all sampling stations is ephermeroptera of the family caenidae, baetidae and siphlonuridae. In addition, a total of nine families and 137 individual taxa were identified and of these, three families belonged to the order ephermeroptera and dipteral (chironominae, tabanidae and tipulidae), two families to coleopteran (elmidae and gyrinidae) and one family to odonata (aeshnidae). Station 1(a) recorded the highest number of family (eight) followed by the other (each station comprises of five families). On the other hand, station 1(a) and 2 recorded the highest number of individual taxa followed by station 1(b) and 3.

Table 2 : Macroinvertebrate taxa for each sampling station

				Stations			
Phylum	**Class**	**Order**	**Family**	**1(a)**	**1(b)**	**2**	**3**
Arthropoda	Insecta	Ephermeroptera	Caenidae	3	2		1
Arthropoda	Insecta	Ephermeroptera	Baetidae	3		1	
Arthropoda	Insecta	Ephermeroptera	Siphlonuridae	4	2	9	3
Arthropoda	Insecta	Odonata	Aeshnidae	1			
Arthropoda	Insecta	Coleoptera	Elmidae	38	13	32	6
Arthropoda	Insecta	Coleoptera	Gyrinidae	1	1	6	
Arthropoda	Insecta	Diptera	Chironomidae	2	1	5	1
Arthropoda	Insecta	Diptera	Tipulidae				1
Arthropoda	Insecta	Diptera	Tabanidae	1			

SIGNAL (Stream Invertebrate Grade Number – Average Level) Score

SIGNAL stands for Stream Invertebrate Grade Number – Average Level. Grade for every invertebrate family was use to calculate the SIGNAL score and will be further interpreted using SIGNAL score interpretation published by Gooderham and Tsyrlin (2002). Station 1(a) recorded 5.0, 1(b) recorded 5.6, station 2 and 3 recorded 5.8 respectively (**Table 3**). The SIGNAL score ranged between 5 to 5.8, which could categorized as mild pollution.

Table 3 : SIGNAL Score for each sampling station

				SIGNAL Grades			
Phylum	**Class**	**Order**	**Family**	**1(a)**	**1(b)**	**2**	**3**
Arthropoda	Insecta	Ephermeroptera	Caenidae	4	4		4
Arthropoda	Insecta	Ephermeroptera	Baetidae	5		5	
Arthropoda	Insecta	Ephermeroptera	Siphlonuridae	10	10	10	10
Arthropoda	Insecta	Odonata	Aeshnidae	4			
Arthropoda	Insecta	Coleoptera	Elmidae	7	7	7	7
Arthropoda	Insecta	Coleoptera	Gyrinidae	4	4	4	
Arthropoda	Insecta	Diptera	Chironomidae	3	3	3	3
Arthropoda	Insecta	Diptera	Tipulidae				5
Arthropoda	Insecta	Diptera	Tabanidae	3			
Sum of Individual SIGNAL Grades				40	28	29	29
Number of Families				8	5	5	5
SIGNAL Score				**5**	**5.6**	**5.8**	**5.8**

DISCUSSION

The species composition of benthic macroinvertebrate in the study showed the dominants of insecta especially elmidae and siphlonuridae. The number of individual taxa and species richness were recorded highest at the most upstream station and decreasing as it flows downstream and the lowest was recorded at the most downstream station. This was believed to be due to river substrate compositions where upstream has more small particles compared to large particles and vice versa. Coleoptera especially elmidae was the most abundance followed by siphlonuridae of ephermeroptera and chironominae. This result was in-agreement with Aweng *et al.* (2010) finding where they found that density of elmidae was higher in the sandy substrate but it was not in-line in terms of the number of chironominae recorded in their study. Works by Aweng *et al.* (2010) shows that, chironominae was the most abundant taxa in the highland river but not in this study. This was believed to be due to the different in temperature where Sungai Picong (20.96 oC - 21.36 oC) recorded lower temperature compared to Sungai Dengar in Gunung Berlumut, Johor (23 oC). The composition difference in benthic macroinvertebrate was also believed to be due to the different in altitude.

On the other hand, the finding from Davis (2003) was also not in-line with the result obtained from this study where he found out that ephemeroptera, plecoptera and trichoptera (EPT), crustacea, and isopoda order were much higher at the reference site or unpolluted area. Meanwhile, this study was only recorded one taxa namely ephermeroptera instead of three. In addition, this result was also not in-agreement with the finding from Azrina *et al.* (2006), where they found that the up-stream of Langat River was dominated by ephemeroptera and chironomid, while this study recorded the abundant of coleopteran instead of ephermeroptera. On the other hand, the SIGNAL score at all stations was recorded between 5 and 6 which was fall under mild pollution category. At the same time, the results obtained have shown that all the in-situ parameters were in-agreement with the finding from Aweng *et al.* (2011) where they found that physicochemical water quality for highland river (Sungai Gunung Berlumut) comply with Class I, Interim National Water Quality Standard (INWQS) for Malaysia excepted temperature.

CONCLUSION

It could be suggested that the natural habitat of Sungai Picong may have been disturbed because the SIGNAL score ranged between 5 to 5.8 which was categorized as mild pollution in terms of river health. This was further strengthen by the healthy taxa found in the area where only one healthy taxa was found namely ephermeroptera, healthy river should have three taxa present in one time namely epheremroptera, plecoptera and trichoptera (EPT). Habitat alteration might occurred directly due to human activities direct to the river ecosystems or indirectly, where human disturbance created changes of physical water quality especially temperature and physical characteristics of river especially the changes of river substrate compositions.

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