

Correlation Analysis on Water Quality Parameter with Aquatic Insects Abundance in Telipok River, Sabah, Malaysia.

KAMSIA BUDIN¹, AMRAN AHMED², NORAINI ABDULLAH² & MARYAM DAWALIH¹

¹ Environmental Science Programme

² Mathematic with Economic Programme

School of Science & Technology

Universiti Malaysia Sabah

Locked bag 2073, 88999 Kota Kinabalu,
SABAH, MALAYSIA

<http://www.ums.edu.my/>

Abstract:- This research was conducted to evaluate the association between aquatic insect with water parameter as pH, turbidity, dissolved oxygen and total suspended solids in Telipok River, Sabah. Sampling were done in September 2007 with 9 main station (6 sub sampling site) using kicking and dipping method to collect the aquatic insect which later on were identify with taxonomy keys. Logger[®]Pro meter was used to determine the water parameter value and it shows that station 1 and 2 were in Class IIA and station 3 to 9 were in Class III, based on INTERIM, Malaysia. Aquatic insects in order Ephemeroptera, Plecoptera and Tricoptera (EPT) were found abundant in station 1 and 2, Odonata were scattered evenly in all station and Diptera were found mainly in station 3 to 9. Pearson correlation shows that EPT abundance has a negative correlation with turbidity and total suspended solids but a positive correlation was observed between the EPT with dissolved oxygen. However, Odonata and Diptera shows a diverse results suggesting that the EPT existence are suitable to indicate any water quality changes especially on the dissolved oxygen, total suspend solid and turbidity in a river such as Telipok River better than Odonata and Diptera.

Key-Words:- Water Quality, Aquatic Insect, Ephemeroptera, Plecoptera, Tricoptera, Pearson Correlation Analysis.

1 Introduction

Freshwater pollution increase water shortage problem for daily use. Freshwater such as lake, river and streams are open to anthropogenic pollution. Agriculture, industrialization and construction along the river or streams can polluted and change its ecosystem. Streams can become polluted by water entering from the agricultural land or industrial sites, and the quality of the water will be reflected by the types of the creatures that can survive such as aquatic macroinvertebrate.

Aquatic macroinvertebrate are mainly aquatic insects that spent most of its life-cycle in the water. They are often used in indication of river water quality. They are good indicator because they can be affected by physical, chemical and biological conditions of a stream. They are low mobility organism which makes them susceptible to pollution and shows the effect of short and long term pollution events.

More over, this aquatic insects is a critical part of stream's food web and relatively easy to sample and identify. Some of these insects are more sensitive to pollution than others. Aquatic insects in Ephemeroptera, Plecoptera and Tricoptera (EPT) order were identified as more prone to pollution than the other order such as Odonata and Diptera. Consequently, the inhabitation of the EPT order in a stream shows that a pollution problem may occur in that habitat.

Thus, it is vital to identify the link of the aquatic insects with river water quality in a stream. Parameter such as dissolved oxygen (DO), total suspended solid (TSS), turbidity (T) and pH are some of the crucial indicator for water quality which have been collected in the Telipok River, together with the aquatic insects to investigate how the parameter could effect the existence of the EPT and other aquatic insects in the river.

2 Material and methods

2.1 Sampling site

Telipok river is 15km from Kota Kinabalu, Sabah. The river have low gradient bank with shallow run with riffles and riparian vegetation along the river. The river was divided into 9 sampling location and each were 50 meter long with 6 sub-sampling site.

2.2 Measurements of water parameters

Disolved oxygen, temperature, pH and turbidity were measured with Vernier logger pro meter. Gravimetric method as explain by APHA, 1995 [1] were used to analysis total suspended solid. Every sample for water parameters were collected along the river before aquatic insect sampling was conducted.

2.3 Sampling of insects

Aquatic insects were collected using kicking net and dipping method [2]. The samples were collected along the river which are representative of the approximately 75% of the total insect taxa from a habitat which is below standard error acceptable for benthic sampling [3]. Insects were sorted and placed in universal bottles with 80% ethanol in the field. They were identified in the laboratory using taxonomy keys [4, 5]

3 Results and discussion

3.1 Water parameters

The water quality study shows that the Telipok river can be divided into two groups the uncontaminated and the contaminated area. The first two sampling sites (station 1 and 2) which the upper streams have clear and good water quality. It is well oxygenated (DO, 6.40 – 6.48 mg/l) and turbidity (12.6 – 13.2 NTU) and very low with suspended solid (12 – 16 mg/l) (Table 1). This water quality placed the upper streams of the Telipok river as in Class IIA based on the INTERIM, Malaysia [6], which means it is a good water resource and no special treatment are needed.

Where as station 3 to station 9 shows a different state. Even though the pH along the river (station 1 to station 9) are in good condition (6.72 – 7.59), but other parameters

such as DO, turbidity and TSS are way off from the station 1 and 2 (Table1). Its DO were within 4.64 – 5.50 mg/l, the turbidity were in the range of 313.4 – 474.1 NTU and the suspended solid were more than 18X higher than station 1 and 2 (288 – 540 mg/l). This means that station 3 to 9 has put the Telipok River in the Class III and water treatment are vital before it can be used in our daily activities [6].

Table 1 : Water parameter for Telipok River

Station	pH	DO (mg/L)	Ty (NTU)	TSS (mg/l)
1	6.72	6.48	12.6	12
2	6.88	6.40	13.2	16
3	6.68	4.64	474.1	540
4	6.84	5.28	313.4	288
5	6.95	4.7	379.1	290
6	7.00	4.7	355.3	452
7	6.97	5.5	423.1	444
8	7.52	4.9	353.2	454
9	7.59	4.8	356.5	480

Key-words :-

DO – Disolved Oxygen

Ty – Turbidity

TSS – Total Suspended Solid

The water parameter difference between station 1 and 2 with station 3 to 9 were believed due to effluent input from poultry and pig farming, quarry activities and residential area along the station 3 to 9. Even from the observation, the river water from station 3 to 9 was sometimes blackish and murky with unpleasant smells

3.2 Aquatic insects

The basic principle in studying the aquatic insect abundance is that some of them are sensitive to pollution, especially to a condition that may effect the DO, pH, turbidity and other water parameter. As for this study, there are 5 orders of aquatic insects that have been identified exist in Telipok River.

They are Ephemeroptera (figure 1.1 and 1.2), Pleocoptera (figure 2.1 and 2.2), Tricoptera (figure 3.1 and 3.2), Odonata (figure 4.1 and 4.2) and Diptera (figure 5.1 and 5.2).



Figure 1.1



Figure 1.2

Figure 1.1 and 1.2 : Some of aquatic insects in order Ephemeroptera from Telipok River.

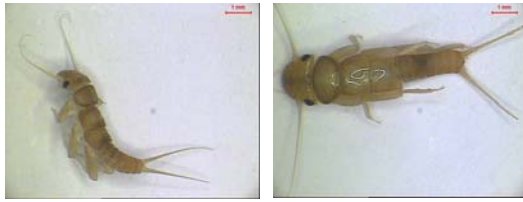


Figure 2.1

Figure 2.2

Figure 2.1 and 2.2 : Some of aquatic insects in order Plecoptera from Telipok River.



Figure 3.1

Figure 3.2

Figure 3.1 and 3.2 : Some of aquatic insects in order Tricoptera from Telipok River.



Figure 4.1

Figure 4.2

Figure 4.1 and 4.2 : Some of aquatic insects in order Odonata from Telipok River.



Figure 5.1

Figure 5.2

Figure 5.1 and 5.2 : Some of aquatic insects in order Odonata from Telipok River.

However, it seems that only particular order can be found in certain station. The EPT orders were only found mostly abundant in station 1 and 2 (Table 2). The Ephemeroptera were found only 7 in station 3, 23 in station 4, 3 in station 5, 1 in station 6 and 8 and none in station 7 and 9. The Plecoptera and Tricoptera were found only 2 in station 5 and 1 in station 4 respectively and none in the other station. Yet,

aquatic insect in order Odonata and Diptera were found in all station (Table 2).

Table 2 : Relative composition of aquatic insects group in Telipok River.

Station	E	P	T	O	D
1	56	9	23	8	9
2	79	1	7	19	17
3	7	0	0	14	94
4	23	0	1	10	49
5	3	2	0	38	72
6	1	0	0	35	48
7	0	0	0	41	22
8	1	0	0	26	29
9	0	0	0	39	42

Key-words :-

E – Ephemeroptera

P – Plecoptera

T – Tricoptera

O – Odonata

D – Diptera

Studies by entomologists [2, 6, 7] show that the first three orders Ephemeroptera, Plecoptera and Tricoptera were sensitive to water quality changes especially to DO and pH compare with Odonata and Diptera.

3.3 Statistical analysis

Pearson test verify that dissolved oxygen, conductivity, turbidity and total suspended solid of Telipok River are strongly influence the

Table 3: Correlation of water parameter and aquatic insects order in Telipok River

Parameter	pH	DO	Ty	TSS
P	-0.302*	0.513**	-0.524**	-0.554**
T	-0.376*	0.526**	-0.617**	-0.627**
O	0.235	-0.213	0.201	0.309*
D	-0.121	-0.532**	0.390**	0.471**

Ephemeroptera, Plecoptera and Tricoptera profusion in Telipok River (table 3).

** Correlation is significant at the 0.01 level (2 tailed)

* Correlation is significant at the 0.05 level (2 tailed)

Key-words :-

DO – Dissolved Oxygen

Ty – Turbidity

TSS – Total Suspended Solid

E – Ephemeroptera

P – Plecoptera

T – Tricoptera

O – Odonata

D – Diptera

Turbidity and total suspended solid have a strong negative correlation with the EPT, but a good positive correlation were observed between the EPT with dissolved oxygen. This can be explained as due to morphology or physical of the EPT insects, which have an external respiratory surface. Their gills can be located thoracic, abdominal, caudally or at the base of their legs [4, 8]. These gills can be easily clog with suspended solid (colloid or small particle that suspension in the water). Once it is clogged

the gills cannot function. It cannot extract oxygen from the water, and this could be lethal to the aquatic insects. Higher suspended solid means the water become cloudier and consequently, it will increase the turbidity of the water. While dissolved oxygen is vital for survival and growth of all aerobic organism like the aquatic insects such as the EPT.

Aquatic insects in order Odonata can survived in low oxygen and high TSS have a close tracheal system [7], it also can easily move to water surface and obtain atmospheric oxygen by trapping a bubble of air.

Diptera is a unique aquatic insects. If the oxygen were very low, they reduce feeding activities and focus more on the respiratory movements. It has breathing tube which be called as respiratory siphons [8]. This tube can reach the surface and use the atmospheric oxygen. Therefore if the TSS or turbidity is high, it wouldn't affect much on the odonata and diptera.

4 Conclusions

Based on this study, we concluded that the water quality parameter of Telipok River which are the dissolved oxygen, total suspended solid and turbidity strongly influence the EPT abundance in the river. This means that the EPT itself also can be as bioindicator for the water quality in the river.

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