# Aquatic insects comparison between three streams of Maliau Basin Conservation Area, Sabah, Malaysia.

**Sahana Harun[1], Maryati Mohamed[1], Arman Hadi Fikri[1] and Elczah Olivia Jimmy[2]**

*[1]Institute for Tropical Biology and Conservation, Universiti Sabah Malaysia, Locked bag 2073, 88999 Kota Kinabalu, Sabah, Malaysia.*

*[2]Fisheries Research Centre, 89400 Likas, Kota Kinabalu, Sabah.*

***ABSTRACT.*** This paper presents the preliminary findings of a study on the aquatic insects and water quality community at three main streams in Maliau Basin, Sabah during the Maliau Basin Scientific Expedition, in February 2005. A total of 254 individuals belonging to eight orders and 17 families were collected from Ginseng, Takob-Akob and Maliau Falls streams and tributaries. The aquatic insect communities were dominated by Ephemeroptera, Plecoptera, Trichoptera and Coleoptera. The areas within the proximity of the sampling sites were relatively undisturbed.

*Keywords:* Aquatic insects, Maliau Basin, Malaysia.

## INTRODUCTION

Aquatic insects constitute a heterogenous assemblage of animal phyla and consequently it is probable that some members will respond to physical, chemical and biological stresses (Loeb & Spacie, 1993) placed upon them. Many are sedentary; hence assist in detecting the accurate location of pollutant sources. Hellawell (1986) pointed out that some have relatively long life histories (measured in years) and this provide both a facility for examining temporal changes and also integrating the effects of prolonged exposure to intermittent discharges or variable concentrations of a pollutant.

According to Shabdin *et al.* (2001), invertebrate species diversity in most part of the world, especially in tropical countries, is inadequately known. The lack of knowledge is most probably due to reasons such as invertebrates are small and difficult to identify. Their great diversity and numerical abundance might contribute to them being overlooked during sampling.

As a result of high rates of population growth, industrialisation and modification of the natural environment, many tropical countries face a problem of decreasing river water quality. Bioindicators such as aquatic insects are increasingly being used for monitoring water quality as they are very sensitive to changes in habitat availability and quality. In Malaysia, biomonitoring of water bodies using macroinvertebrates, particularly aquatic insect is still in its infancy (DOE, 1999). This research is carried out to fill the gap and to promote the use of biological organisms as tools in monitoring the quality of freshwater ecosystems.

Wang *et al*. (1999) noted that the high development of biological indicators in river classification have advanced from the use of saprobic microorganisms (mainly protozoa and algae) as biological indicators, to the present-day non-saprobic system using higher trophic organism-based indicators (such as invertebrates and fish) and an ecosystem approach.

The objective of this study is to make an inventory of the aquatic insects in the Maliau Basin Conservation Area. This will serve as baseline documentation on the current status of the aquatic invertebrates from streams in Maliau Basin.

## METHODOLOGY

### Samples procedures

Aquatic insect collections were made at 12 selected stations. Selections of these stations were made based on their representation of the overall habitat and accessibility during the sampling period. At each station, a distance of approximately 100 m was sampled covering both riffles and pool areas. Kick net was used at all these stations. The net was placed against the current and about one $m^2$ substrates in front of the net was disturbed for approximately two minutes using kicking method.

All specimens were sorted in the field and placed in universal bottles containing 95% ethanol and later preserved in 70% ethanol. All aquatic insect specimens collected during this study period were deposited in BORNEENSIS, Institute for Tropical Biology and Conservation, Universiti Malaysia Sabah. Due to difficulties in the taxonomic identification of some of aquatic insects, it

**Table 1.** The characteristics of each station surveyed at 12 sampling stations in Ginseng, Takob-Akob and Maliau Falls streams.

| Station | Stream | Width (m) | Depth (m) | Description of sampling station |
|---|---|---|---|---|
| Station 1 | Sg. Ginseng (Downstream) | 6.05 to 10.33 | 0.28 to 0.52 | Consisted of riffles, runs and with small pools. Substrate: rock, gravel and sand. |
| Station 2 | | 6.85 to 11.10 | 0.12 to 0.45 | Some riffles, runs and small pools. |
| Station 3 | | 7.06 to 10.32 | 0.30 to 0.57 | Mixture of big riffles, deep flow and fast-flowing runs. Substrate: bedrock and sand. |
| Station 4 | | 6.35 to 10.11 | 0.23 to 0.45 | Abundant riffles and some pools. Substrate: rock and gravel. |
| Station 5 | Sg. Ginseng (Upstream) | 6.75 to 9.12 | 0.16 to 0.55 | Some riffles, runs and pools. Substrate: bedrock and sand. |
| Station 6 | | 5.38 to 8.55 | 0.46 to 0.63 | Some riffles and abundant pools. Substrate: gravel, sand and some mud. |
| Station 7 | | 5.32 to 7.33 | 0.35 to 0.58 | Abundant pools and some riffles. Substrate: pebble with some sand. |
| Station 8 | Sg. Takob-Akob | >10 | >5 | Some big riffles and small pools. Substrate: gravel, sand and some mud. |
| Station 9 | | >10 | >5 | Mixture of big riffles, deep flow and fast-flowing runs. Substrate: gravel, sand and mud. |
| Station 10 | | >10 | >5 | Abundant pools and some big riffles. Substrate: gravel, sand and some mud. |
| Station 11 | Maliau Falls | >20 | >5 | Abundant pools. Fast flowing runs. Substrate: rock, gravel and sand. |
| Station 12 | | >20 | >5 | Abundant pools. Substrate: rock, gravel and sand. |

was not possible to identify the species status of the invertebrates collected in this study.

**Statistical analysis**

Biotic indices were used in this study, and they were based on measures of the relative abundance of various taxa present or available at site and the associated tolerance value of these taxa combined in order to produce a numerical score (Canfield *et al.,* 1998). In this study, the indices used were Biological Monitoring Work Party (BMWP) and Average Score per Taxa (ASPT) to calculate the biotic indices for the aquatic insect community.

## RESULTS AND DISCUSSIONS

**River characteristics**

The characteristics and morphology of each station observed are described in Table 1. The water at most stations was clear with sandy, gravel and rocky bottom. The banks were lined by boulders and rocks, and there were stations with pools as well.

**Diversity of Aquatic Insects**

A total of 254 specimens belonging to eight orders and 17 families were collected from Ginseng, Takob-Akob and Maliau Falls streams (Table 2). The largest order, Ephemeroptera comprise a total of three families and account for 27.17% of the total number of aquatic insects discovered. Coleoptera, constitutes the second largest order, with six families (20.08%). The third largest order, Plecoptera had only one family (17.32%). The lowest group is the family Libellulidae of the order Odonata and formed as low as five individuals (1.97%).

Previous survey done by Yang *et al.* (1998) during the Maliau Basin Scientific Expedition in 1996 showed that at least 23 species from the order Hemiptera with seven families were collected. More than 50% from the dominant taxa were representatives of the Ephemeroptera, Plecoptera and Trichoptera (EPT). The EPT were primarily associated with clean and cool running waters. Many species from these groups were highly susceptible to water pollution and occur in very predictable kinds of environments (McCafferty, 1981). This is the reason that the EPT group has been proven to be very useful in the analysis or biomonitoring of water quality.

Due to rainy days and time limitation, sampling was done only for one day at each stream. This may cause the limitation of aquatic insects abundance. Rainfall will affect water levels and current strengths of aquatic insect habitats and create a number of more specialised and ephemeral aquatic habitats in some rather unlikely places. Net-spinning caddisflies and stoneflies suffered the greatest depressions during flood (Ward, 1992).

Based on the values of diversity indices, the diversity and abundance of aquatic insects were high at most stations (Table 3). In fact, the EPT taxa richness indicated that all stations were in good water quality categories (none impacted) where the EPT taxa richness value is greater than 10. Since the EPT are very common orders in undisturbed streams and intolerant to changes of water quality, it is possible to determine water quality fast and accurately using EPT taxa richness.

The Biological Monitoring Work Party (BMWP) values for two streams were in the good water categories (organic pollution unlikely). It was considered that the water of Maliau Basin Conservation Area streams was in natural condition and in the good quality water category.

## CONCLUSION

Based on this study, we concluded that diversity of aquatic insects in Maliau Basin

**Table 2.** List of abundance of aquatic insects by stations.

| Taxa/Order/Family | Sg. Ginseng | Sg. Takob-Akob | Maliau Falls |
|---|---|---|---|
| **1. Ephemeroptera** | | | |
| Ephemerillidae | 9 | 4 | - |
| Baetidae | 29 | - | - |
| Heptageniidae | 27 | - | - |
| **2. Coleoptera** | | | |
| Amphizoidae | 30 | 2 | - |
| Carabidae | - | 1 | - |
| Dryopidae | 2 | 6 | - |
| Dytiscidae | - | 1 | - |
| Hydrophilidae | 5 | 2 | - |
| Psephenidae | 2 | - | - |
| **3. Diptera** | | | |
| Simuliidae | - | 20 | - |
| Tipulidae | 3 | - | - |
| **4. Hemiptera** | | | |
| Pleidae | 10 | - | - |
| Vellidae | 2 | - | - |
| **5. Megaloptera** | | | |
| Corydalidae | 13 | - | - |
| **6. Odonata** | | | |
| Libellulidae | 2 | - | 3 |
| **7. Plecoptera** | | | |
| Perlodidae | - | 44 | - |
| **8. Trichoptera** | | | |
| Hydropsychidae | 29 | 8 | - |
| TOTAL | 163 | 88 | 3 |

**Table 3.** The biological indices of two main streams in MBCA streams.

| Station | Sg. Ginseng | Sg. Takob-Akob |
|---|---|---|
| Average Score Per Taxa (ASPT) | 6.9 | 7.9 |
| Biological Monitoring Work Party (BMWP) | 76 | 55 |

Conservation Area was high and abundant. The high abundance of aquatic insect group which is specific for clean water, such as order Ephemeroptera, Plecoptera and Trichoptera (EPT) obviously occurs at all stations. This indicates that the streams were undisturbed and have good water quality.

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