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A PRELIMINARY SURVEY OF CHIRONOMIDS DIVERSITY AT HEADWATER OF LANGAT RIVER, SELANGOR

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ABSTRACT

A study on the chironomids (Diptera:Chironomidae) diversity at pristine ecosystem was carried out at headwater of Langat River. The objective was to establish a first checklist of Chironomidae from pristine area in Malaysia. A total of three subfamilies comprising of seven genera and 50 chironomid individual larvae were identified. The Chironominae exhibited the highest number of genera (4), comprising 43 individuals. *Polypedilum* dominated the area with 37 individuals, while other genera were present at very low number; *Chironomus* (3 individuals), *Cryptochironomus* (2 individuals) and *Einfledia* (1 individual). Orthocladiinae was represented by *Eukiefferiella* and *Cricotopus* by having one individual each, while Tanypodinae represented by *Zavrelimyia* (1 individual). Result also indicates that *Polypedilum* (Chironominae) was comparatively abundance in pristine ecosystem.

Key words: *Chironomidae*, Taxonomy identification, biodiversity, *Chironomus*

ABSTRAK

Kajian ke atas kepelbagaian chironomids (Diptera:Chironomidae) di ekosistem pristine telah dijalankan di kepala air Sungai Langat. Objektif kajian ini dijalankan ialah untuk menghasilkan senarai pertama Chironomidae dari kawasan pristin di Malaysia. Sejumlah tiga subfamily yang terdiri daripada tujuh genus dan 50 individu larva chironomid telah diperihalkan. Chironominae telah dicatatkan mempunyai genera tertinggi iaitu empat genus dengan 43 individu. *Polypedilum* mendominasikan kawasan tersebut dengan 37 individu sementara genus lain hadir dengan jumlah yang kecil; *Chironomus* (3 individu), *Cryptochironomus* (2 individu) and *Einfledia* (1 individu). Orthocladiinae telah diwakilkan oleh *Eukiefferiella* dan *Cricotopus* dengan satu individu setiap genus, sementara Tanypodinae terdiri daripada *Zavrelimyia* (1 individu). Keputusan akhir juga menunjukkan bahawa *Polypedilum* (Chironominae) adalah melimpah di ekosistem asal dan tidak tercemar.

Kata kunci: *Chironomidae,* Pengecaman taksonomi, kepelbagaian, *Chironomus*

INTRODUCTION

Chironomidae larval are the most abundant and widely distributed insects in freshwater ecosystems. Families of Chironomidae are holometabolous, passing through four different life stages i.e.: egg, larval, pupae and adult (Armitage 1995; Epler 2001; Coffman & Ferrington 1984). Midge larvae are usually in the ranges of 2-30 mm long (Williams et al. 1992). Adult Chironomidae resemble member of Culicoidea which is real mosquito by its morphology, but with obvious discrimination from the aspect of scale absence on the wing and the mouth's imperfection (Cranston 1995). Male Chironomidae are easily distinguished from female through plumose antenna and a much thinner with visible genitalia

(Cranston 1995). Due to the ability to adapt to extreme temperature, pH, salinity, depth, flow velocity and productivity, the chironomid can be found in many different environments (Cranston 1995). Chironomidae are from suborder Nematocera, which have eucephalic head with complete teeth formation of mandible teeth. However, the non-complete mandible caused this family cannot bite, so-called 'non-biting midge'. While, the presence of haemoglobin cell give the name of bloodworms (Armitage et al. 1995).

Information on chironomids distribution in the Malaysia ecosystems is very limited compared to the Holartic and Afrotropical regions (Ashe, 1990). Only a few publications are available such as Bishop, 1973, who studied in Gombak River, Cranston, 2004 (Malayan Region) and Siregar et al., 1999 at Kerian River. For Southeast Asia region, several publications were available (Ashe, 1990; Murray, 1995; Ekrem, 2002; Karunakaran, 1974). In Malaysia, researches on chironomids distribution within the paddy field were undertaken by Lim (1990), Rizana (2001), Che Salmah and Abu Hasan (2002) and Madziatul (2004). These researches have contributed some basic knowledge on chironomids biogeography within the Malaysian ecosystem.

Chironomids are well known to have high potential as biological indicators and been widely used in environmental pollution studies. However, information on chironomids biogeography, taxonomy, biology and ecology within the Malaysian ecosystem is scarce and limited. These problems need to be overcome in order to allow the use of chironomids as biological indicators for many purposes in Malaysia ecosystem. A survey on their distribution and abundance within various ecosystems condition are necessary to be understood and proper taxonomic identification need to be established. This study was undertaken to determine chironomids diversity in clean river system. Data obtained from this study is expected to provide basic information for chironomids biogeography in Malaysia river system.

STUDY AREA

Langat River originates from Nuang Mountain located at high elevation of the Hulu Langat district. The Nuang Mountain (1493m) is situated within the Langat Reserve Forest and ecologically important as water source for Langat River. The Langat River flows through dense forest, villagers and towns before joining sea at Kuala Selangor. The headwater of Langat River is located within the forest reserve and receives and considered very pristine. The Langat River has several main tributaries such as Gabai River, Lui River and Congkak River and all these are important rivers for recreational activities. It is surrounded by primary and secondary forest and some small houses along the river. The aborigine people are local people in this area and use forest natural sources as their incomes.

The Langat River and tributaries within the upstream area are considered free from any pollution since no anthropogenic activities are observed. Several previous studies on Langat River at very upstream area have indicated that the river is free from any chemical and biological contamination (Ahmad Abas et al., 1999). As such, this is an excellent opportunity to study chironomids diversity within the clean ecosystem. Information on biogeography within clean ecosystem explains the true organism's diversity. In contrast at the downstream reach of Langat River was reported to experience pollution stress from quarry and industrial activities.

The Langat River and tributaries at upstream area are characterized by fast flowing water with cobble and sand as dominant substrates and these made them suitable as a recreational area.

MATERIALS AND METHODS

Chironomid samples from Langat River were collected using Surber net with the size of 0.3m x 0.3m. The net is the most suitable tool since the river has shallow water and with cobble and sandy substrates. It was placed on the riverbed with the opening facing the flow. A total of 10 sampling units were collected along

the Langat River (within the upstream area). The collected materials were rinse with river water and then placed in a label waterproof plastic bag. The samples further were preserved in plastic bag filled with 4% ethanol and brought to the laboratory for further actions.

In the laboratory, redundant samples were rinsed with tab water to remove preservative reagent and chironomid samples were sorted in the white bottom tray. Chironomid were then extracted using 10% KOH and neutralized with glacial acetate acid to remove soft tissues. The samples were further prepared on the slide using formaldehyde resin for taxonomic identification. The sclerotized head capsule was very important for larval identification. The identification based on reference key proposed by Thorpe & Covich (1991); Epler (2001), and Wiederholm (1983).

RESULTS

A total of 50 chironomid individuals belonging to three subfamilies (Chironominae, Orthocladiinae and Tanypodinae) and seven genera were identified. *Polypedilum* was the most dominant taxa followed by *Zavrelimyia, Chironomus, Cryptochironomus, Pseudochironomus, Eukiefferiella and Cricotopus* (Table 1). The Chironominae subfamily seems to be contributed 86% of the total chironomid individuals collected from the sampling.

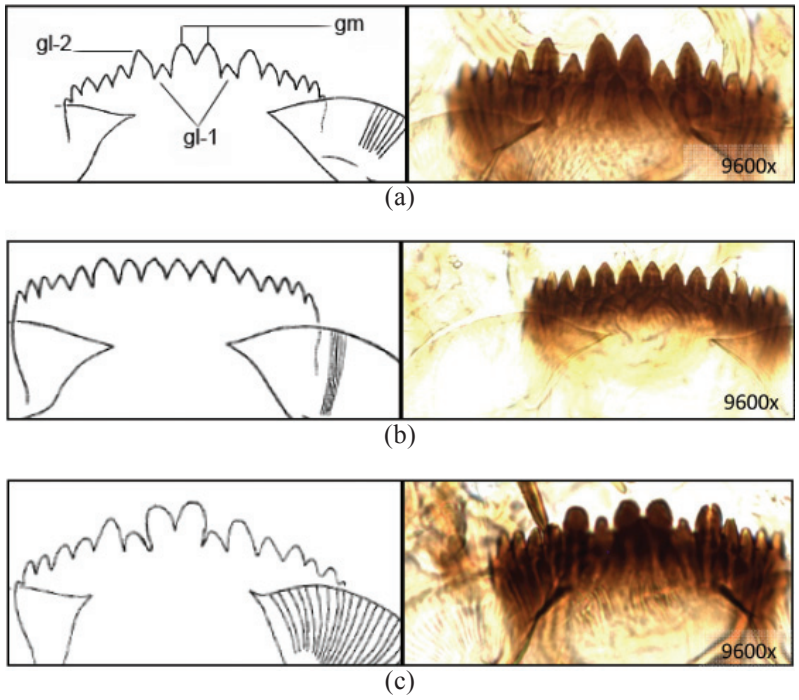
Table 1: List of Chironomidae's subfamilies, genera and total number of individual recorded from Langat River, Hulu Langat District, Selangor, Malaysia.

Subfamili	Genus	Total of individual
Chironominae	*Chironomus*	3
	Polypedilum	37
	Cryptochironomus	2
	Pseudochironomus	1
Orthocladiinae	*Eukiefferiella*	1
	Cricotopus	1
Tanypodinae	*Zavrelimyia*	5
3	7	50

Subfamily Chironominae
Tribe Chironomini

***Polypedilum* Kieffer**
(Figs. 1a-c**)**

A total of 37 individuals of *Polypedilum* were successfully identified. Larvae lengths are in the range of 0.5 to 0.7 cm and slightly smaller than *Chironomus*. The larvae are brownish in colour. Head capsule are globule shaped. Identification to the species level is difficult because the absence of complete key and high expertise needed. With regards to the Wiederholm (1983), three different species were identified that are *Polypedilum I, Polypedilum leei* and *Polypedilum scalaenum*.



Figs. 1: Mentum structure of (a) *Polypedilum* I; (b) *Polypedillum leei* (c) *P. scalaenum*

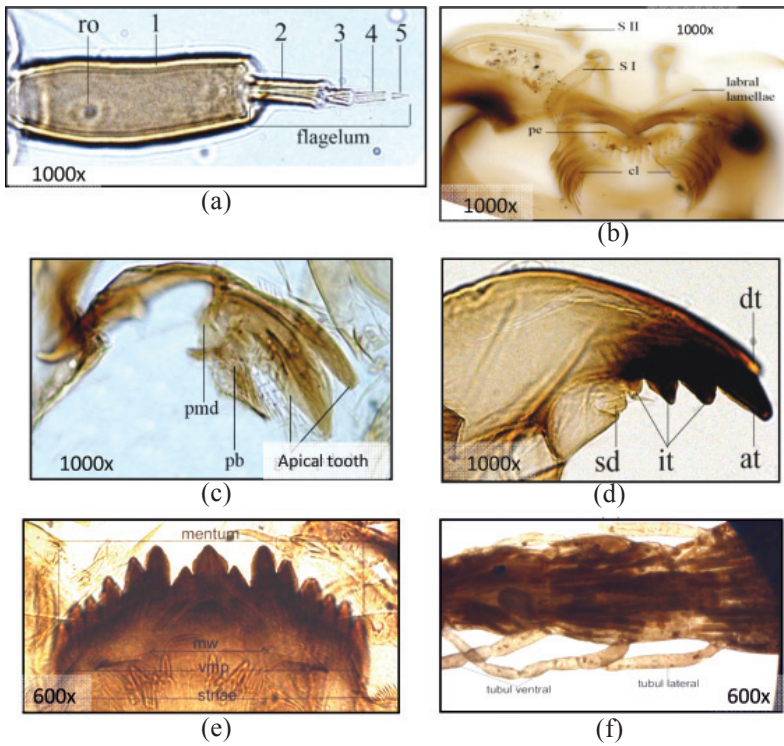
From 37 individuals collected, majority were *Polypedilum I*, by having the mentum with two median teeth (gm) and pair of second lateral teeth (gl 2) longer than first lateral teeth (gl 1) (Figure 1a). *Polypedilum leei* has mentum with uniform teeth and median teeth not differ from lateral teeth (Figure 1b). This species also has premandible with five teeth. *Polypedilum scalaenum* has teeth arrangement similar to *Polypedilum I*, but first and second median tooth are different in shape compared to *Polypedilum I* (Figure 1c).

Chironomus (Meigen)

(Figs. 2a-f)

A number of three individuals were recorded. Larvae lengths were range from 0.5 to 1.0 cm and less pigmented and brighter. Antenna

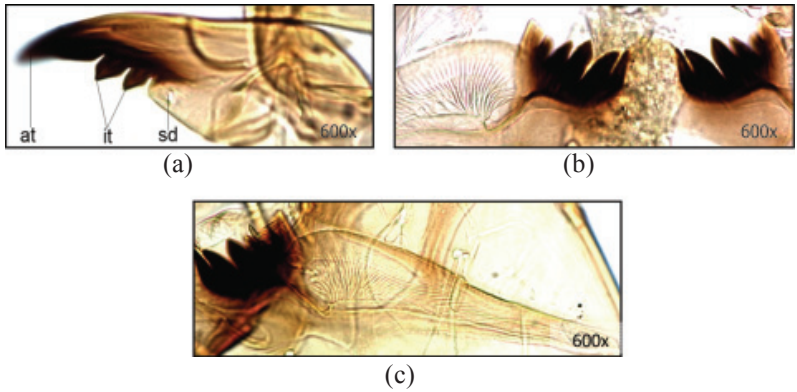
is five segmented (Figure 2a). All individuals have mentum with trifid median teeth and six pairs of lateral teeth (Figure 2e), which are common characters for *Chironomus* spp. Pecten epipharyngis is comb-like with various teeth number and can be regular or irregular (Figure 2b). Mandible has single dorsal and apical tooth, but with various internal teeth number (Figure 2d). A pair of lateral tubule are appear at segment 8 and two pairs of ventral tubule are appear at segment 9 (Figure 2f). Premandible is bifid with bundle of setae (Figure 2c). Ventromental plate (vmp) full and complete, with length approximately 2.5 X of its width (Figure 2e). Due to the limitation of taxonomic key available, the individuals were only identified to genera level.



Figs. 2: (a) Antenna; (b) labrum; (c) premandible; (d) mandible; (e) mentum dan (f) posterior segment of sample larvae Chironominae from Langat River

Cryptochironomus (Kieffer)
(Figs. 3a-c)

Only two individuals of *Cryptochironomus* were recorded. In contrast to *Chironomus* and *Polypedilum*, *Cryptochironomus* were lack of mandible dorsal teeth. *Cryptochironomus* only has an apical teeth, two internal teeth and long and clear seta subdentalis (sd). Premandibel is with five teeth, progressively declining in size towards base (Figure 3a). The most obvious character that separates this genus from others genera are the structure of mentum and ventromental plate. Mentum is haggard shaped with the lateral teeth pointing in. Mentum is broad and pale in color and untoothed at the central region, flanked by oblique lateral combs of 6 dark teeth and first lateral tooth usually fused with pale median zone (Figure 3b). Ventromental plate wider than mentum, tapering to point laterally and finely striated posteriorly (Figure 3c).



(a) (b)

(c)

Figs. 3: (a) Mandible; (b) mentum and (c) ventromental plate for *Cryptochironomus*

Einfeldia (Kieffer)

There are four other genera from the Chironominae subfamily which were sharing common morphology with *Chironomus*

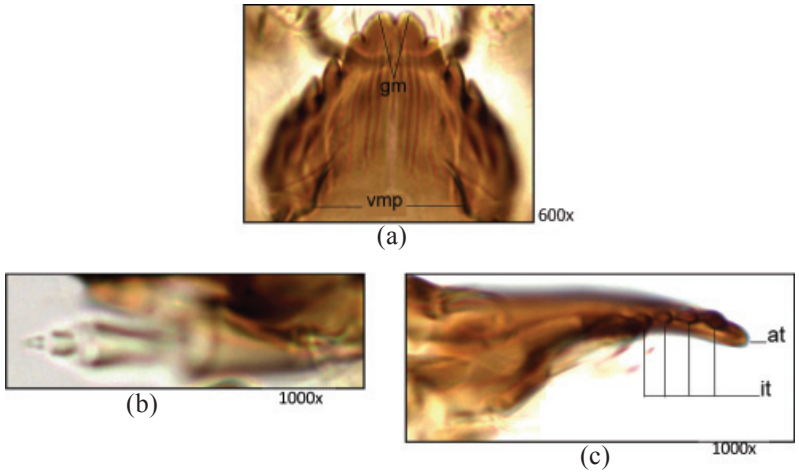
namely the *Einfeldia, Camptochironomus, Baeotendipes* and *Goeldichironomus* (Wiederholm 1983). *Einfeldia* is different from *Chironomus* since it does not has a lateral tubule and if present just exist in a pair of ventral tubule (Wiederholm 1983). *Camptochironomus* differ in the form of seta I (SI) that is plumose only single sided (Wiederholm 1983). *Baeotendipes* does not have either lateral tubule or ventral tubule. *Goeldichironomus* differ with respect to the presence of labral sclerite 1 which is absence on Chironomus and seta subdentalis which is large and sickle shaped (Wiederholm 1983). However, there was no *Einfeldia* individual successful in this study.

Subfamily Orthocladiinae

Only two individuals were collected for Orthocladiinae subfamily, which represented by *Eukiefferiella sp.* and *Cricotopus sp*.

***Eukiefferiella* (Thiennemann)**
(Figs. 4a-c)

Eukiefferiella larvae usually were found in the area of flowing water especially at moss gap and algae. Some identified taxons are tolerance with polluted environment. The specimens were identified based on large mentum and convex shaped with small ventromental plate (vmp), narrow and unstriped. There are two median teeth (gm) on the mentum and five pairs of lateral teeth. There are some straight belts longitudinally arranged below the mentum teeth (Figure 4a). Antenna with four segment (Figure 4b). Mandible has no dorsal but with apical tooth (at) and four small inner teeth (it) (Figure 4c).



Figs. 4: (a) Mentum dan ventromental plate; (b) antenna and (c) mandible for *Eukiefferiella* sp.

Cricotopus **(v.d.Wulp)**

(Figs. 5a-e)

Convex shaped mentum, median teeth (gm) dark pigmented and larger than lateral teeth. First lateral teeth (gl 1) fused to the median teeth (Figure 5a). Long and narrow ventromental plate (Figure 5b). Mandible have shorter apical tooth (at) than combined width of three inner teeth (it) and molar area (Figure 5c). Mandible edge margin has dented properly (Figure 5d). This feature is very important to distinguish *Cricotopus* from other genera such as *Orthocladius* and *Paratrichocladius*. Premandibel have simple end, not bifid (Figure 5e). There also exist three long teeth on the pecten epipharyngis.

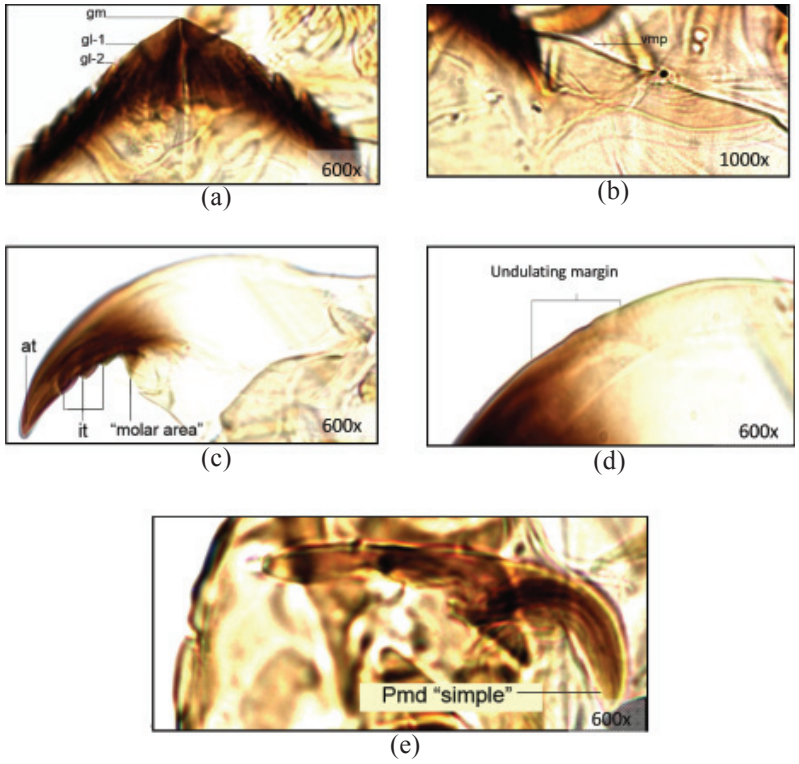


Figure 5: (a) Mentum; (b) ventromental plate; (c) mandible; (d) mandible edge margin and (e) premandibular of *Cricotopus* sp.

Subfamily Tanypodinae

Most of this subfamily members live freely as predator, while some of them also live as excavator under sediment or other substrates. Tanypodinae was reported to live in variety of habitats such as phytotelmata and aquatic habitat such as lake, pond and river.

Zavrelimyia (Fittkau)

(Figs. 6a-d)

Five specimens calculated from this study were identified as *Zavrelimyia*. This genus were found in spring water area, spring

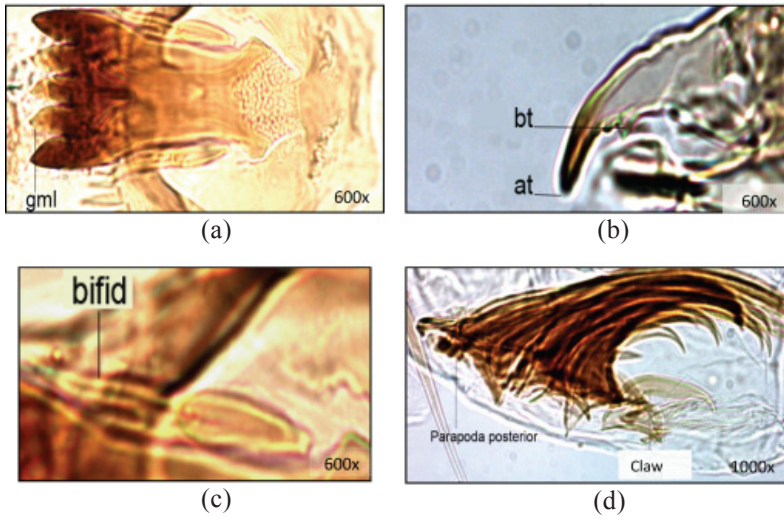


Figure 6: (a) Ligula; (b) mandible; (c) paraligula and (d) claws at posterior parapod of *Zavrelimyia* sp. Note:bt= basal tooth, at= apical tooth, gml= external median teeth

reservoir, lake, river and rapid water flow area (Wiederholm 1983). Antenna retractile into head capsule. Labral lamellae and ventromental plate is absent. Mentum have large M appendage and triangle in shaped. The parapoda anterior and posterior completely expanded. Anus tubule usually only established completely on freshwater species (Wiederholm 1983). Ligula has 4-7 large teeth on prementum. Teeth on ligula is uniform in size, with the external median teeth (gml) taper outward and points of medial and internal teeth may be paler (Figure 6a). Paraligula bifid and slender (Figure 6c). Dorsomental teeth, if exists, are as a separate vertical plate or fused. Ring organ situated about 0.5 or more from maxillary palp (mp) base. Base length of maxillary palp is about quadruple over its width. Mandible moderately curved with large apical tooth (at), and basal tooth (bt) (Figure 6b). *Zavrelimyia* is generally characterized by the possession of a bifid claw on the posterior parapod (Figure 6d). The larvae body without fringe of swim-setae.

DISCUSSION

The preliminary result indicates that the chironomids samples collected from the pristine ecosystem consists of various taxa is dominated by individual of the Chironominae subfamily. This study found that *Polypedilum* is the most common genus in Chironominae subfamily and the result is in agreement with Cranston (2007), whose studied chironomids in tropical water. This genus contributes 74% of total Chironomidae collected. However, further taxonomic study for *Polypedilum* is needed since they have been given various different names all this while (Cranston, 2007). Majority of *Polypedilum* found in this study is from *Polypedilum I* (Figure 3a). We cannot confirm the species but follow grouping proposed by Epler (2001).

Species of Chironomidae vary significantly in the responses of different species to environmental factors (Johnson, 1995). Although various studied indicate that this subfamily favor organic enrich area, this study demonstrates that they also abundance in clean ecosystem. *Chironomus riparius* and *C. tentans* were reported an excellent indicators for organic pollution study. Only three *Chironomus* individuals collected from this study, however we unable to confirm the species. The important characteristics that we used to confirm this up to at least to genus are the presence of striae at the base of mandible and plumose S1 (one side).

Although most of samples only identified up to genera level, the information provides is very useful future study. The result indicates that various genera from Chironominae subfamily are present in the clean ecosystem, although they were previously reported to be abundance in organically polluted ecosystems. Thus further detail taxonomic identification work should be undertaken to clarify the species diversity within the Malaysia ecosystem specifically and South East Asia generally.

CONCLUSION

The present study demonstrates that Chironominae subfamily has high diversity and intriguingly inhabitant in the clean ecosystem.

This proves that Chironomidae has wider environmental gradient tolerances. However, an alternative approach in confirming the species is necessary to be done.

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