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**CHIRONOMIDAE DIVERSITY AND DISTRIBUTION
AT UPSTREAM OF SUNGAI LANGAT,
HULU LANGAT, SELANGOR, MALAYSIA**

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ABSTRACT

A study on the chironomids (Diptera:Chironomidae) diversity at pristine ecosystem was carried out at upstream of Sungai Langat, Selangor. The study determines chironomids distribution and composition at upstream of Sungai Langat spatially and temporally. Chironomid was sampled using Surber net at five sampling stations along the pristine area, and the most downstream sampling station was located within the populated area. Result of the study indicates that Chironomidae was represented by three subfamilies namely Chironominae, Orthocladiinae dan Tanypodinae, which comprising of 1438 individuals. The Chironominae was found to be the most dominant subfamily (1333 individuals) followed by Tanypodinae (90 individuals) and Orthocladinae (15 individuals). Due to taxonomic key restriction, Tanypodinae was only identified to the family level. Chironominae was dominated by *Polypedilum* spp. with 961 individuals, *Chironomus* spp. (269 individuals), *Cryptochironomus* spp. (2

individuals) and *Nilodrum* (1 individual). Another 100 individuals from Chironominae subfamily were unable to be confirmed to the genus level due to key limitation. The Chironominae is not affected by human disturbance and exhibits similar composition and distribution between pristine and populated or disturbed area. One-way ANOVA test indicates that Chironominae composition was not significantly different between spatial and temporal variation ($p=0.18$ and $p=0.51$ respectively, $\alpha=0.05$) Orthocladinae was only represented by three genus namely *Tvetenia* spp. (10 individuals), *Cricotopus* spp. (4 individuals) and *Eukiefferiella* spp. (1 individual).

Key words: Chironomid, Sungai Langat, Chironominae, Tanypodinae, Orthocladinae

ABSTRAK

Kajian ke atas kepelbagaian chironomid (Diptera:Chironomidae) pada ekosistem bebas cemar telah dijalankan di kawasan hulu, Sungai Langat, Selangor. Kajian ini adalah untuk mengenalpasti penyebaran dan komposisi chironomid pada hulu Sungai Langat mengikut ruang dan masa. Chironomid di sampel menggunakan jaring Surber pada lima stesen persampelan disepanjang bahagian hulu dan stesen persampelan yang paling bawah terletak pada kawasan yang mempunyai berpopulasi. Hasil kajian menunjukkan famili Chironomidae diwakili oleh tiga subfamili yang dikenali sebagai Chironominae, Orthocladinae dan Tanypodinae, yang mempunyai sejumlah 1438 individu. Chironominae dikenalpasti sebagai subfamili yang paling dominan (1333 individu) diikuti oleh Tanypodinae (90 individu) dan Orthocladinae (15 individu). Kekunci taksonomi yang terhad, membenarkan Tanypodinae dicamkan sehingga peringkat famili sahaja. Subfamili Chironominae didominasi oleh *Polypedilum* spp. dengan 961 individu, *Chironomus* spp. (269 individu), *Cryptochironomus* spp. (2 individu) and *Nilodrum* (1 individu). Sejumlah 100 individu lain daripada subfamili Chironominae tidak dapat dicamkan pada aras genus disebabkan masalah kekunci taksonomi yang terhad. Subfamili Chironominae tidak dipengaruhi

oleh aktiviti manusia dan menunjukkan keseragaman penyebaran dan komposisi antara kawasan bebas cemar dan terganggu. Ujian ANOVA satu-hala menunjukkan komposisi Chironominae tidak berbeza secara signifikan antara variasi ruang dan masa ($p=0.18$ dan $p=0.51$ pada $\alpha=0.05$). Orthocladinae hanya diwakili oleh tiga genus iaitu *Tvetenia* spp.(10 individu), *Cricotopus* spp (4 individu). dan *Eukiefferiella* spp (1 individu).

Kata kunci: Chironomid, Sungai Langat, Chironominae, Tanypodinae, Orthocladiinae

INTRODUCTION

Chironomidae (Order: Diptera) represents an important part of benthic communities in almost freshwater ecosystems due to its abundance, high diversity and ecological important. Chironomidae can provides various information on river assessment and classification and river water quality monitoring (Marcello Bazzanti and Franco Bambacigno, 1987). This family has been distinguished into 11 subfamilies but no world catalogs or full checklist have been published so far. Review of world collection records and species accounts confirms a total of 339 genera and 4,147 species which were mainly referring to specific biogeographic regions (Ferrington, 2008).

Malaysia is located in the oriental region and has been reported to have approximately 105 genera and 359 species (Ferrington, 2008). In Malaysia, study on indigenous chironomids are very limited and only few reports concerning distribution of Chironomids are available (Warrin Ebau et. al, 2008; Al-Shami et, al., 2009). Although Malaysia has variety of aquatic ecosystem types, but study on Chironomidae distribution and diversity is still scarce. Chironomidae has been reported as a potential biological indicator in river monitoring (Cranston, 1982), but lack of knowledge on its taxonomy and distribution limits the function.

Few recent studies done on chironomids in Malaysia such as by Ahmad et al., (2008), Al-Shami et, al., (2009), Vedamanikam and Shazilli (2008) and Warrin Ebau, et. al (2008) indicate that the chironomids have wide range of environmental gradients adaptation. They also found that Chironominae, Orthocladinae and

Tanypodinae were common subfamilies and abundance in tropical ecosystems with Chironominae was the most dominant one.

Study on Malaysian's Chironomidae is very important due to very limited information available to date. Al-Shami et, al., (2009) studied diversity and density of selected chironomids species in paddy field area. Vedamanikam & Shazilli,(2008) determined chironomid sensitivity to the toxicant in laboratory using foreign species, while Warrin Ebau, et. al., (2008) used local species. Their studies only emphasised on application and not for taxonomic work. Taxonomy study on Chironomidae does not receives major attention by many researchers due to limitation of the key available and fund especially in Malaysia where no specific key for local species has been published and so much so that most studies only refer to Cranston, (1982) and Martin (unpublished), which both based on Australasian region and Wiederholm (1983) which based on Holarctic region. Since Australia is located near to the oriental region of Malaysia, their taxonomy key is the most appropriate to be used for Malaysian's samples up todate.

This study was conducted to determine Chironomidae's larvae diversity and distribution at upstream site of Sungai Langat, Selangor. The area has wide ranges of habitats and good to moderate water quality. The study is considered very crucial in order to produce a comprehensive chironomids checklist, which could be useful for future related research especially on the potential use of Chironomidae as a biological indicator agents for river monitoring program.

MATERIALS AND METHODS

The study was conducted at upstream of Langat River with a total of 5 stations were sampled, which covers from the very upstream to the middle reach (Figure 1). Geographical coordinates for each sampling station is presented in Table 1. First station is located close to Langat Dam (03°11.00' N, 101°53.00' E) and the last station is located near comuter station, Universiti Kebangsaan Malaysia (02°56.26' N, 101°47.02' E). A total of six quantative sampling with one month interval was conducted from Mac 2009

to January 2010. All sampling and laboratory analysis protocols were conducted according to APHA (1992).

Chironomidae was sampled using Surber net (30cm x 30cm, mesh size 200µm), which is suitable for shallow water. Three replicate samples were collected at each station and preserved with ethanol 30% concentration. In the laboratory, samples were sorted manually and treated with potassium hydroxide (KOH) 10% concentration to remove soft tissue and then neutralised with acetate acid. Each chironomid sample was mounted on slide and sealed with formaldehyde for permanent slide preparation. The identification was undertaken according to Cranston (1982), Martin (unpublished) and Wiederholm (1983).

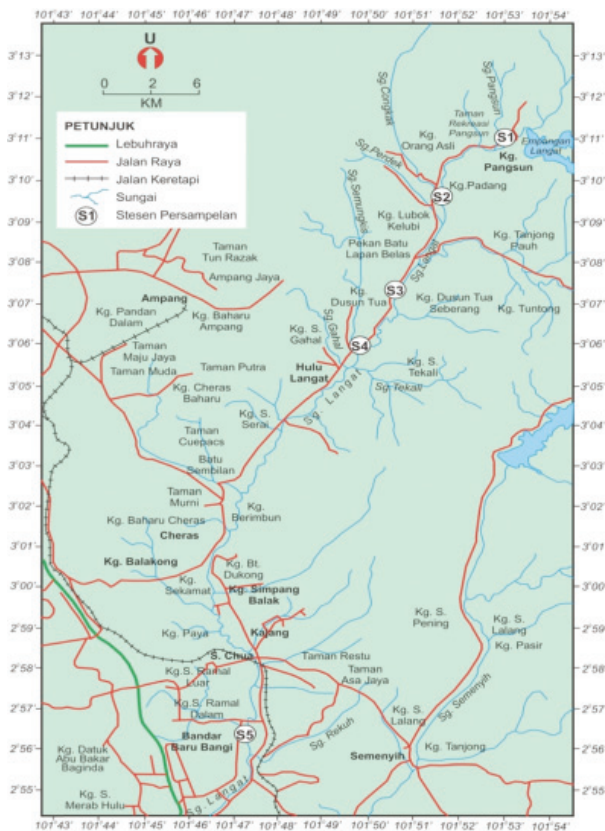


Figure 1. Sampling stations within upstream of Sungai Langat.

Table 1. Sampling stations at Sungai Langat.

Station	Geographical coordinate	Elevation (m)	Description
1	N 03° 12.90' E 101°53.01'	163	Downstream of Pangsoon reservoir
2	N 03° 10.04' E 101°51.03'	70	Kampung Jawa, Batu 18
3	N 03° 07.66' E 101°49.90'	62	Kampung Kenanga, Batu 15
4	N 03° 06.50' E 101°48.74'	49	Kampung Bistari, Batu 13
5	N 02° 56.26' E 101°47.02'	21	Near to UKM commuter station

RESULT AND DISCUSSION

A total of 1438 chironomid were collected, which consists of three subfamilies namely Chironominae, Tanypodinae and Orthocladiinae (Table 2). The subfamily of Chironominae was the most dominant and represented 93% (1333 individual) of the total chironomid samples. Members of the Tanypodinae was the second abundance followed by Orthocladiinae, which comprises of 6% (90 individual) and 1% (15 individual) respectively. From eleven subfamilies of Chironomidae recognized worldwide, only four namely the Chironominae, Tanypodinae, Orthocladiinae and Diamensinae were confirmed can be found in the Asian region (Cranston 1994). However, Diamensinae was reported present at very low density and with limited distributions.

The Chironominae exhibits robust distribution and does not affected by human disturbance. The one-way ANOVA indicates that Chironominae subfamily composition was not differ significantly either spatially or temporally ($p=0.18$ and $p=0.51$

Table 2. Chironomid compositions along Sungai Langat sampling sites.

Sampling	Subfamily	Stn 1	Stn 2	Stn 3	Stn 4	Stn 5	Total
Mac 09	Chironominae	13	1	-	3	29	46
	Orthocladinae	-	-	-	-	-	0
	Tanypodinae	-	-	-	-	-	0
May 09	Chironominae	27	-	4	6	1	38
	Orthocladinae	-	-	-	3	-	3
	Tanypodinae	1	1	3	3	4	12
July 09	Chironominae	9	5	18	24	187	243
	Orthocladinae	-	1	-	2	2	5
	Tanypodinae	3	1	19	7	4	34
Sept 09	Chironominae	-	6	27	16	74	123
	Orthocladinae	-	-	-	2	-	2
	Tanypodinae	-	-	-	2	-	2
Nov 09	Chironominae	419	10	5	5	50	489
	Orthocladinae	-	3	-	-	1	4
	Tanypodinae	-	-	4	4	5	13
Jan 10	Chironominae	77	24	14	45	234	394
	Orthocladinae	-	1	-	-	-	1
	Tanypodinae	1	1	2	25	-	29
Total	Chironominae	545	46	68	99	575	1333
	Orthocladinae	-	5	-	7	3	15
	Tanypodinae	5	3	28	41	13	90

respectively, $\alpha=0.05$). Identification to the genus level indicates that *Polypedilum* spp. exhibits large adaptation to environment gradients and recorded much higher than other genus in each sampling station including stress ecosystem (the most downstream station). Opposite pattern was exhibited by Tanypodinae, where mostly recorded within the pristine sites.

SUBFAMILY CHIRONOMINAE

Chironominae is ubiquitous and has world-wide in distribution (Cranston 1994). The study found that Chironominae was the most abundance and recorded in various habitat types. Ahmad et al., (2008) in their study at Congkak River (tributaries of Sungai Langat) reported that most chironomids recorded were from Chironominae subfamily followed by subfamily Tanypodinae and Orthocladiinae. Larvae collected in this study were found ranges from 2mm to 1cm and fourth instar larval was found not larger than 2cm. Individual collected from pristine (very upstream) ecosystem has smaller and paler body colour as compared to populated site. From this subfamily, *Polypedilum* spp. were the most dominant genus followed by *Chironomus* spp.

This subfamily is characterised by few noticeable morphologies such as a wide and large mentum with usually 8-16 well sclerotized teeth. Ventromental plates (vmp) are well developed and striated (Figure 2). However, Epler (2001) noted that vmp could be reduced or vestigial in some taxa. Morphologically, all larvae were look similar and very difficult to be separated into different genus or species based solely on morphological characteristics. However, using Wiederholm (1983) key, this study has confirmed at least two genus namely *Cryptochironomus* spp. and *Nilodrum* spp. (Figure 2a-c and 3a-e) were exist from the study area.

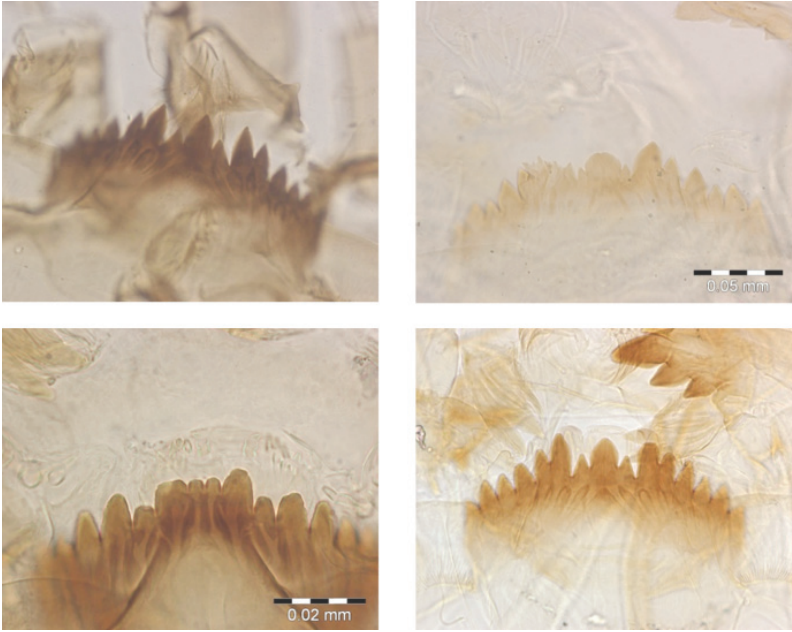


Figure 2. Variation of mentum structures found in Chironominae subfamilies. Scale: 400X

Cryptochironomus (Kieffer)

(Figs. 3a-c)

Cryptochironomus has mandible with no dorsal tooth but with long apical tooth and 2 inner teeth. Seta subdentalis is long and slender (Figure 3a). Antennae with 5 segments and premandible with five teeth (Figure 3a). *Cryptochironomus* has a broad mentum and central region is untoothed, pale flanked by oblique lateral combs of 6 dark teeth and first lateral tooth usually fused with pale median zone (Figure 2b). Ventromental plate is wider than mentum, tapering laterally and posterior end is finely striated (Figure 3c).

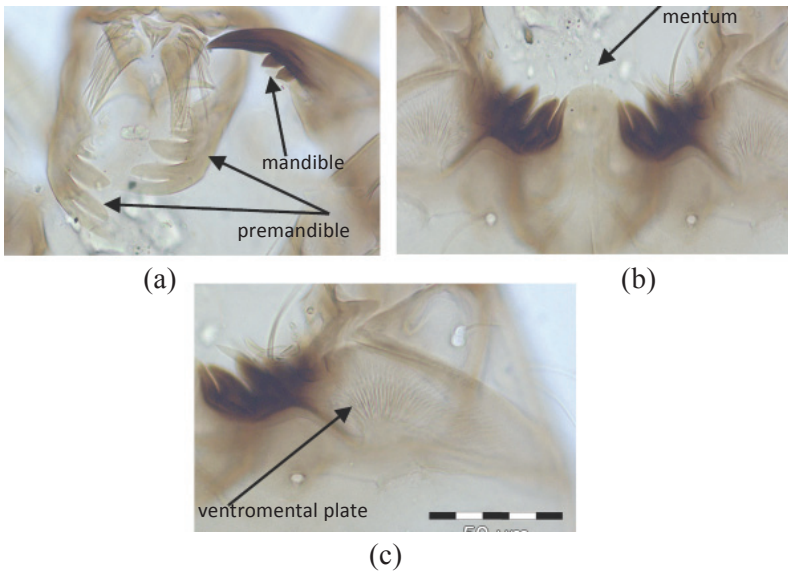


Figure 3. *Cryptochironomus* spp. (a) mandible and premandible (b) mentum (c) stirated ventromental plate. Scale: 1000X

Nilodrum (Kieffer)

(Figs. 4a-e)

Larvae of *Nilodrum* can be found in the sedimen of tropical and subtropical standing waters (Wiederholm, 1983). This genus characterised by 5 segmented antenna (Figure 4a), 6 pointed teeth premandibel (Figure 4b) and deeply palmate S1 (Figure 4c). This genus has pale mandible's dorsal tooth, large apical tooth and with 3 inner teeth. Seta subdentalis is short and broad, extending only slightly beyond inner margin of mandible (Figure 4b). The genus has mentum with laterally trifid median tooth and 6 pairs of lateral teeth (Wiederholm, 1983). The first lateral tooth is higher than median tooth (Figure 4d). The ventromental plate separated by the breadth of median tooth, slender and about 1.3X as wide as mentum; dorsal margin finely undulating (Figure 4e).

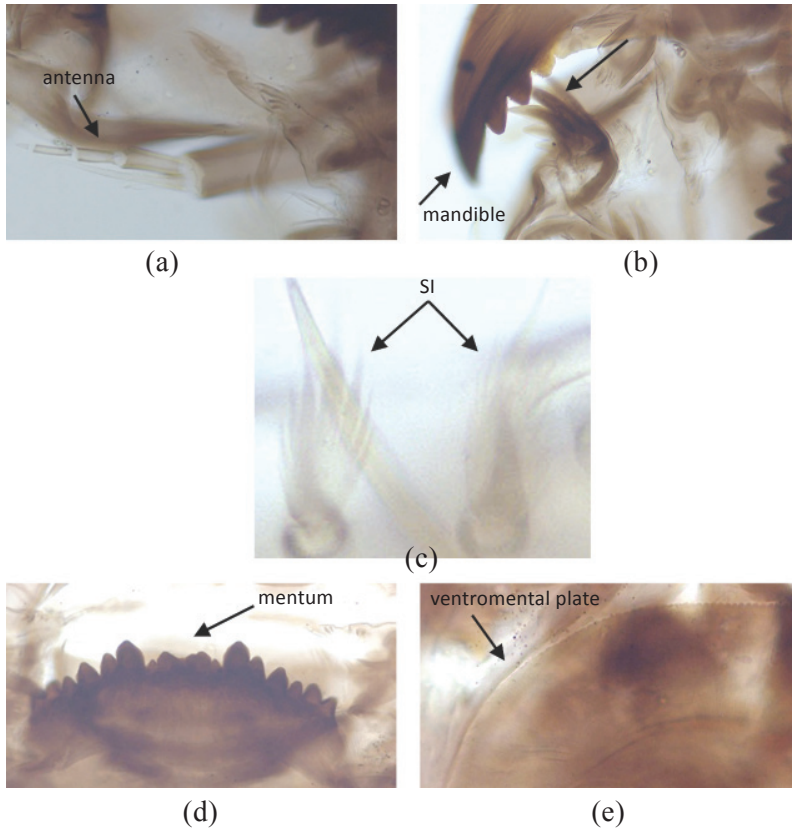


Figure 4. *Nilodrum* spp. (a) antenna (b) premandible (c) palmate S1 (d) mentum (e) undulating ventromental plate. Scale: 1000X

Subfamily Tanypodinae

This family is easily recognised by having retractile antennae, lack of premandibles, well developed ligula and proceri (Figure 5a). Tanypods are predacious and larvae can be found in various types of water bodies (Epler 2001). In this study, Tanypodinae was found in all type of habitats such as cobble, sand and silt substrates. Instead of having reversible antenna, this subfamily also easily recognised by having long and well develop proleg (Figure 5b).

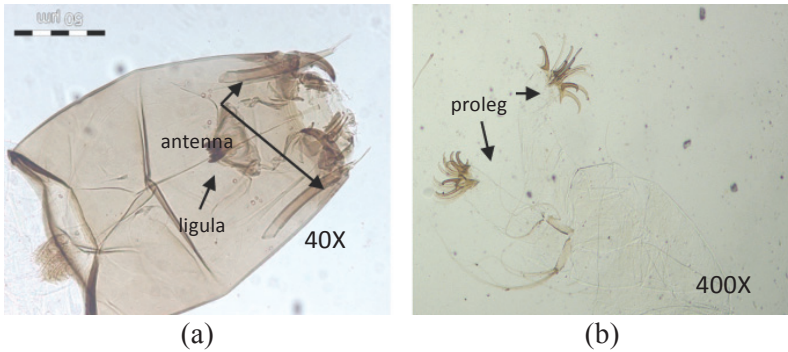


Figure 5. Tanypodinae (a) retractile antennae and well developed ligula (b) proleg

Subfamily Orthoclaadiinae

The members of subfamily *Orthoclaadiinae* are reported not abundance in the oriental region. As regards to this study, *Orthoclaadiinae* was quite uncommon and not found in pristine ecosystem (upstream sites) and was only recorded at lower reach. This subfamily was reported as morphologically and ecologically diverse in the Nearctic and Palearctic region (Ferrington, 1998). *Orthoclaadiinae* has well developed antennae with 3-7 segments, premandibles and mentum and with or without unstriated ventromental plates. This study recorded three genus namely *Eukiefferiella* spp., *Cricotopus* spp. and *Tvetenia* spp. and at small composition.

Eukiefferiella (Thiennemann)

(Figs. 6a- c)

Eukiefferiella spp. larvae have large mentum with convex shape and with small, narrow and unstriped ventromental plate. The mentum has two median teeth and five pairs of lateral teeth (Figure 6a). The S1 is simple and antenna is with 5 segments (Figure 6b). Mandible is without dorsal tooth but with apical tooth and four inner teeth (Figure 6c).

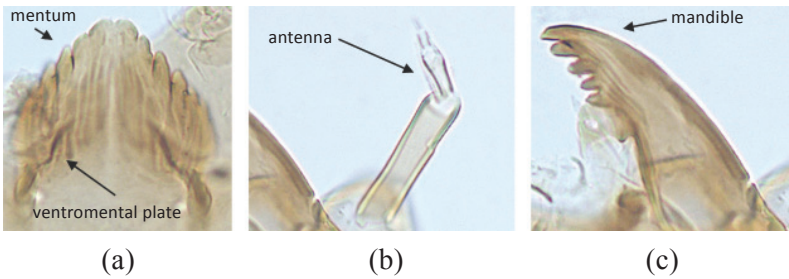


Figure 6. *Eukiefferiella* spp.(a) mentum and vmp (b) antenna (c) mandible. Scale: 1000X

***Cricotopus* (v.d. Wulp)**
(Figs. 7a-d)

Cricotopus spp. has convex mentum and large median tooth and 6 lateral teeth. The ventromental plate is long, narrow and pointed posteriorly (Figure 7a). The S1 is bifid and antenna with 5 segments (Figure 7b). The mandible has no dorsal tooth but with apical tooth and 3 inner teeth. The outer margin of mandible crenulated and the premandible is simple (Figure 7c).

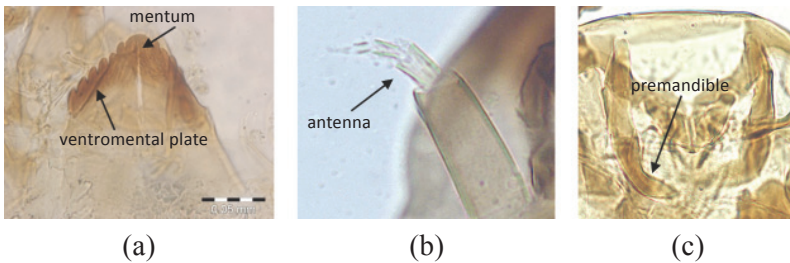


Figure 7: *Cricotopus* spp. (a) mentum and vmp (b) antenna (c) premandible. Scale: 1000X

***Tvetenia* (Kieffer)**

(Figs. 8a-d)

This genus is difficult to be separated from *Eukiefferiella*. The SI and procercus are two criteria that used to differentiate this genus. *Tvetenia* from this study has plumose SI and the mentum is with 2 median teeth and 5 pairs of lateral teeth (Figure 8a). Mandible is without dorsal tooth but with apical and three inner teeth. Seta subdentalis is peg-like (Figure 8b) and antenna has 5 segments (Figure 8c). Pecten epiphyrangis consists of 3 obvious scales or plate like (Figure 8d).

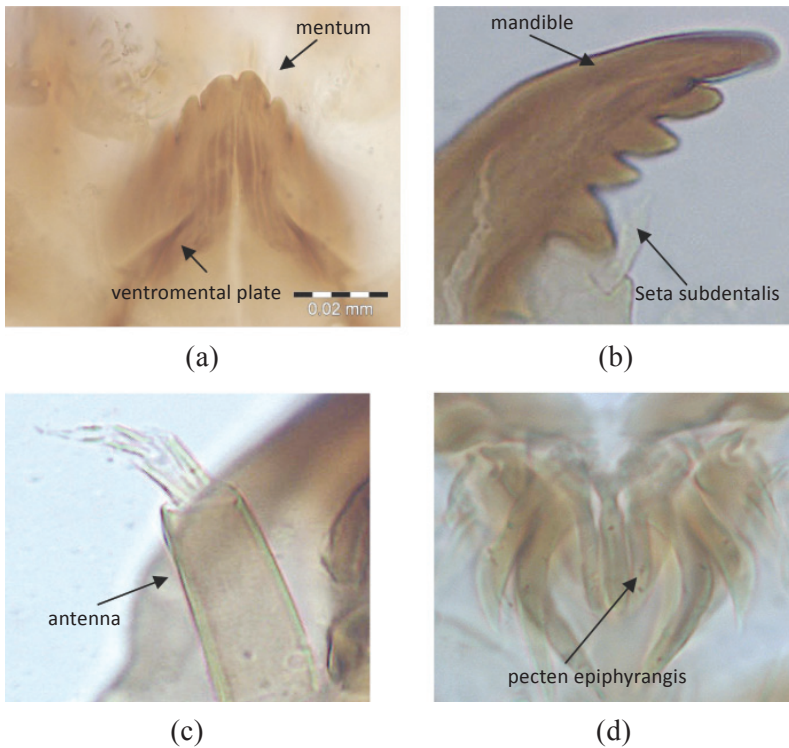


Figure 8: *Tvetenia* spp. (a) mentum and ventromental plate (b) mandible and seta subdentalis (c) antenna (d) pecten epiphyrangis. Scale: 1000X

CONCLUSION

Sungai Langat was dominated by Chironominae subfamily followed by Orthoclaadiinae and Tanypodinae. *Polypedilum* spp. from Chironominae subfamily was the most abundant genus and recorded along the study area. Genus *Chironomus*, *Cryptochironomus* and *Nilodrum* were also found in this study but at lower density as compared to *Polypedillum* spp. Chironominae subfamily was recorded in pristine and polluted ecosystem and exhibits large environmental gradient adaptation and can only be separated at species level. Only three common genus for tropical region were recorded from Orthoclaadiinae subfamily, they were *Tvetenia*, *Eukiefferiella* and *Cricotopus*.

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