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Chironomid Spatial Distribution within the upstream of Sungai Langat Catchment

(Taburan Reruang Kironomid dalam Kawasan Hulu Tadahan Sungai Langat)

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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 7 streams and river within the upstream site of Langat Catchment. Chironomid was sampled using Surber net and water quality was measured based on Malaysia WQI. The result indicated that* Chironomidae *was represented by three subfamilies namely* Chironominae, Orthocladiinae *and* Tanypodinae*, which comprises of 2502 individuals.* Chironominae *was the most dominant subfamily (1619 individuals) followed by* Orthocladinae *(629 individuals) and* Tanypodinae *(254 individuals).* Polypedilum *(subfamily:* Chironominae*) is the most dominant genus found followed by* Rheocricotopus *(subfamily:* Orthocladiinae*),* Microtendipes *and* Cryptochironomus. Polypedilum *was abundant in all stations except Sg. Langat 3 which was dominated by* Rheocricotopus. *Sungai Langat 3 has the highest number of individual (1113) which is (44.5%) from total chironomid individuals and followed by Sg. Lolo with 468 individual that were dominated by* Polypedilum.

Keywords: Chironomid; Chironominae*;* Orthocladiinae*; Sungai Langat;* Tanypodinae

ABSTRAK

Kajian ke atas kepelbagaian chironomid (Diptera:Chironomidae) *dalam ekosistem bebas cemar telah dijalankan di kawasan hulu, Sungai Langat, Selangor. Kajian ini adalah untuk mengenal pasti penyebaran dan komposisi kironomid pada 7 sungai dan anak sungai di kawasan tadahan Sungai Langat. Kironomid disampel menggunakan jaring Surber dan kualiti air yang diukur adalah berdasarkan piawai WQI Malaysia. Hasil kajian menunjukkan famili* Chironomidae *diwakili oleh tiga subfamili yang dikenali sebagai* Chironominae, Orthocladiinae *dan* Tanypodinae *yang mempunyai sejumlah 2502 individu.* Chironominae *dikenal pasti sebagai subfamili yang paling dominan (1619 individu) diikuti oleh* Orthocladinae *(629 individu) dan* Tanypodinae *(254 individu).* Polypedilum *(subfamili:* Chironominae*) adalah genus yang paling dominan yang diperoleh diikuti oleh* Rheocricotopus *(subfamili:* Orthocladiinae*),* Microtendipes *dan* Cryptochironomus. Polypedilum *mempunyai kelimpahan yang tinggi pada setiap stesen kecuali bagi Sg. Langat 3 yang didominasi oleh* Rheocricotopus. *Sungai Langat 3 mempunyai jumlah yang paling tinggi iaitu 1113 individu dan ini merupakan (44.5%) daripada jumlah keseluruhan individu kironomid dan diikuti oleh Sg. Lolo dengan 468 individu yang didominasi oleh* Polypedilum.

Kata kunci: Kironomid; Chironominae*;* Orthocladiinae*; Sungai Langat;* Tanypodinae

Introduction

Chironomidae (Order:Diptera) is an important organism of benthic communities in almost freshwater ecosystems due to its abundance distribution, high density and potential used as indicator in Europe and United States countries (Marjut et al. 2005; Mora & Szivak 2012; Verbruggen et al. 2011). Chironomidae can provides various information on river assessment and classification and river water quality monitoring (Odume & Muller 2011). This family has been distinguished into 11 subfamilies but only 4 are commonly reported within oriental region. 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). Although Malaysia has a variety of aquatic ecosystem type, not many studies on Chironomidae distribution and diversity have been carried out because lack of information on its taxonomy, distribution and function in ecosystem. In Malaysia, study on chironomids is very limited and only few reports concerning distribution of Chironomids are avalaible (Al-Shami et al. 2009; Warrin Ebau et al. 2008) and none of them focus on taxonomy specifically.

Few recent studies have been 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) and indicate that chironomids have a wide range of environmental gradients adaptation. They also found that Chironominae, Orthocladinae and Tanypodinae were common subfamilies and abundant in tropical ecosystems where Chironominae was the most dominant subfamily.

Study on Malaysian's Chironomidae is very important due to very limited information available. Al-Shami et al. (2009) studied diversity and density of selected chironomids species in paddy field area. Vedamanikam and 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 receive great attention by researchers due to limitation of the key available especially in Malaysia where no specific key for local species has been published and so much rely on 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.

This study was conducted to determine the Chironomidae larvae spatial distribution at upstream of Sungai Langat, Selangor. The area has wide ranges of habitats and extensively being used as recreational area. The study is important in order to produce a comprehensive chironomids checklist within pristine area, 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

Sampling was conducted at upstream area of Sg. Langat catchment and a total of 5 rivers were sampled with consists of 7 stations (Figure 1). Sampling was conducted in 1-year period which started on April 2010 and completed on Feb 2011. River water was sampled and analysed according to

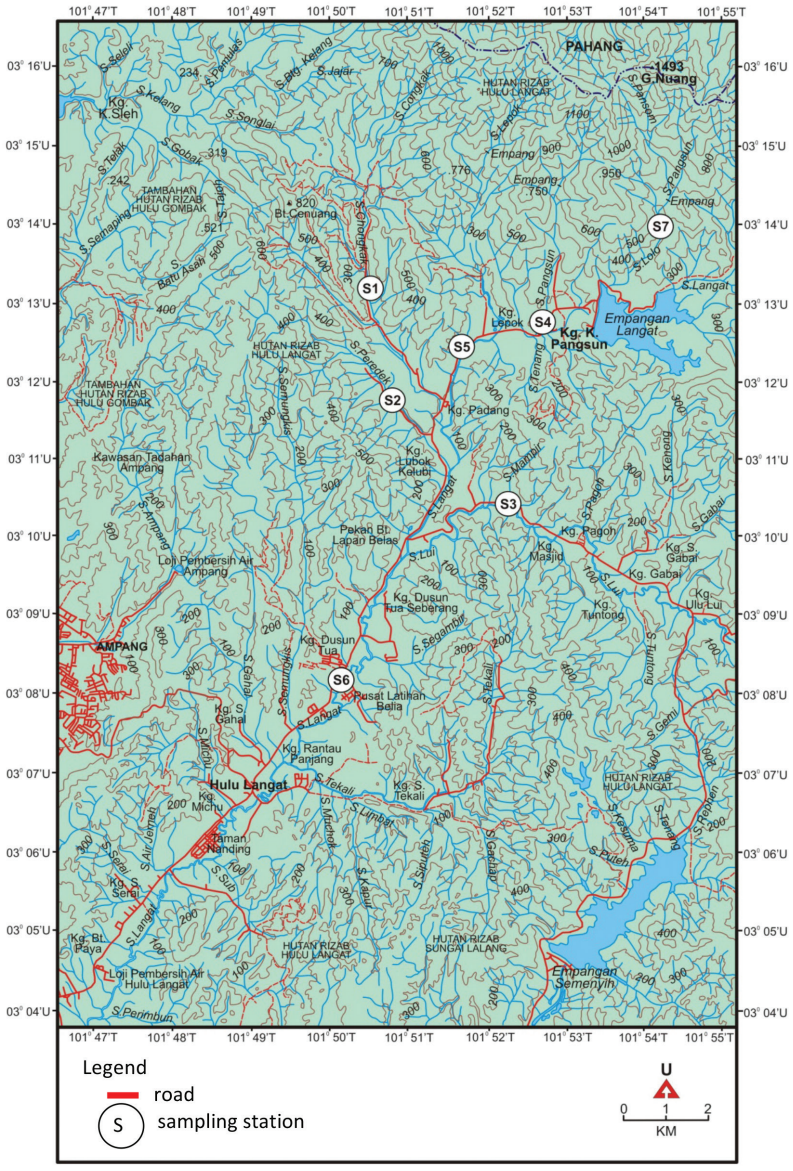

FIGURE 1. Seven sampling stations within upstream of Sungai Langat Catchment

APHA (1998). The Malaysian water quality index (FIGURE) was calculated based on six selected parameter namely chemical oxygen demand (COD), ammonium-nitrogen (NH_3-N), total suspended solids (TSS), biochemical oxygen demand (BOD), dissolved oxygen (DO) and pH. The WQI was calculated according to the following formula;

$$WQI = 0.22(siDO) + 0.19(siBOD) + 0.16(siCOD) + 0.15(siAN) + 0.16(siTSS) + 0.12(sipH).$$

The final summed value was used to classify the river water quality. Chironomidae larvae was sampled using Surber net (30cm × 30 cm, mesh size 250 µm), which is suitable for shallow water. Three sample units were collected at each station and preserved with ethanol. In the laboratory, samples were sorted manually and treated with potassium hydroxide (KOH) 10% concentration prior to identification to remove soft tissue and neutralised with acetate acid. Each chironomid sample was mounted on slide and sealed with formaldehyde resin for permanent slide preparation. The identification was undertaken according to Cranston (1982), Epler (2001) and Wiederholm (1983).

RESULTS AND DISCUSSION

The result for WQI is tabulated in Table 1. From 38 stations, only 9 stations have WQI values less than 92.7 (Figure 2), which were classified as class IIA. Others were classified in class I which indicates excellent quality. Sungai Lolo has the highest average WQI value (98) while the lowest WQI value (91) came from Sungai Langat 1. According to the Malaysian WQI criteria, class I to class IIA explains excellent and good water quality, which exhibits the suitability for recreational activities.

A total of 2502 chironomid were collected, which consists of three subfamilies namely Chironominae, Tanypodinae and Orthocladiinae (Table 2). Chironominae was the most dominant subfamily and represents 65% (1619 individual) of the total chironomid collected. Orthocladiinae subfamily was the second abundant followed by Tanypodinae, which were 25% (629 individual) and 10% (254 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 Oriental region but, however only three were found in this study. Diamensinae

TABLE 1. WQI parameters for seven stations at Langat river

Station/ River	NH_3-N (mg/L)	pH	DO (%)	BOD_5 (mg/L)	COD (mg/L)	TSS (mg/L)	WQI
Congkak	0.12 ± 0.04	7.16 ± 0.08	90.74 ± 2.81	0.69 ± 0.27	1.64 ± 0.66	0.004 ± 0.001	96.05
Perdik	0.06 ± 0.02	6.39 ± 0.04	90.92 ± 1.88	2.09 ± 0.33	16.47 ± 3.96	0.007 ± 0.002	92.39
Lui	0.08 ± 0.01	6.66 ± 0.13	86.76 ± 1.40	0.46 ± 0.18	2.12 ± 1.20	0.021 ± 0.007	96.16
Lolo	0.03 ± 0.01	7.23 ± 0.08	94.02 ± 1.22	0.28 ± 0.20	1.45 ± 0.66	0.008 ± 0.003	98.42
Langat 1	0.27 ± 0.03	7.33 ± 0.02	81.23 ± 3.16	0.28 ± 0.07	5.32 ± 2.01	0.008 ± 0.006	91.72
Langat 2	0.10 ± 0.01	7.19 ± 0.04	83.74 ± 1.16	0.29 ± 0.11	0.91 ± 0.43	0.005 ± 0.003	95.81
Langat 3	0.07 ± 0.04	7.16 ± 0.19	87.01 ± 5.18	0.62 ± 0.46	3.30 ± 4.06	0.014 ± 0.009	96.06
Average value ± std dev	0.10 ± 0.08	7.02 ± 0.35	87.77 ± 4.44	0.67 ± 0.65	4.46 ± 5.50	0.01 ± 0.01	96.05

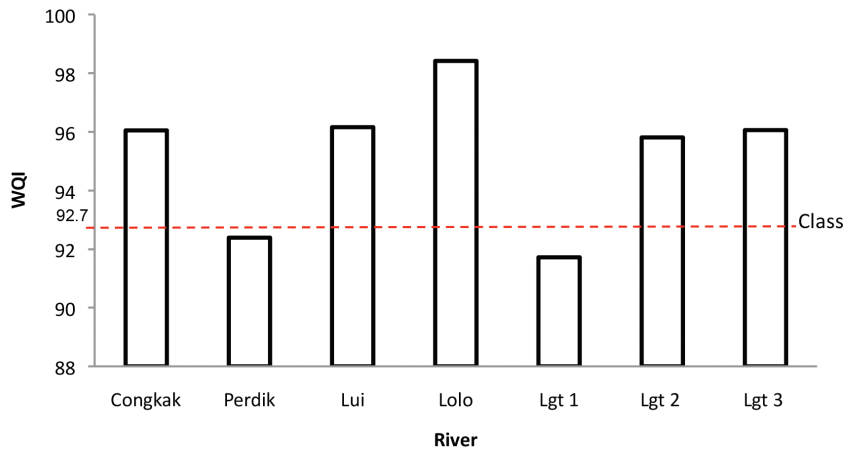

FIGURE 2. Comparison on WQI values between sampling stations

TABLE 2. Chironomidae composition and distribution within Sg. Langat upstream Catchment

Subfamily	Tribe	Genus	Tributries					Main		Total
Chironominae			Sg. Congkak	Sg. Perdik	Sg. Lui	Sg. Lolo	Sg. Lgt 1	Sg. Lgt 2	Sg. Lgt 3	
	Tanytarsini	*Cladotanytarsus*	1	25	3	3		4	84	120
		Rheotanytarsus	4	6	22	1		10	28	71
		Tanytarsus	1	9		4	1		3	18
		Sublettea		1					1	2
		Genus X1		1	1				2	4
	Chironomini	*Polypedilum*	38	43	108	388	131	49	214	971
		Microtendipes	1	2	6		104	15	23	151
		Chironomus		8	62		1	1	15	87
		Stictochironomus			4					4
		Stenochironomus						1		1
		Glypotendipes			1					1
		Shangomyia					1			1
		Cryptochironomus			1			4	143	148
		Saetheria	6	9				1	1	17
		Demicryptochironomus	1					6		7
		Harnischia genus C			1	5				6
		Harnischia							1	1
		Robackia			1					1
		Paracladopelma		1						1
		Genus X2		1		3		3		7
Orthocladiinae										
		Rheocricotopus	1		19	14	3	3	379	419
		Cricotopus	3	17	5		1	23	79	128
		Parametriocnemus	3			14	4		1	22
		Eukiefferiella			4		1	2	8	15
		Thienemanniella						6	8	14
		Nanocladius			1	1		2	8	12
		Tvetenia				11			2	13
		Parakiefferiella		1						1
		Xylotopus				1				1
		Corynoneura							1	1
		Genus X3					1	1	1	3
Tanypodinae										
		Genus X4	8	10	33	23	37	33	110	254
		Total individual	67	134	272	468	285	164	1112	2502
		Genus number	10	11	14	10	9	14	18	28

subfamily that was also reported in Asia is formerly present at very low density and with limited distributions (Cranston 2004). *Dimensa cranstoni* is only one species that was collected at high elevation on Mount Kinabalu, Sabah (Willasen 1988).

Study by Azrina et al. (2006) at upstream of Sungai Langat indicates that Ephemeropteran and Dipteran were most abundant orders. The Dipteran was represented mostly by chironomid. Similar result was also reported by Yap et al. (2003) at pristine area of Sungai Semenyih. Both orders were the most dominant and chironomid was among the most dominant group.

TAXA RICHNESS AND COMPOSITION

Chironomid sampling have been conducted at 7 stations (4 stations at tributries and 3 stations at main stream). Three tributries (Sg. Congkak, Sg. Perdik and Sg. Lui) have variable chironomid composition and taxa richness except for Sg. Lolo. It was dominated by *Polypedilum* with 16% of total individual and 40% of total *Polypedilum* collected. Although all stations located within the upstream of catchment, the result indicated a variety of chironomids distribution and compositions. This study showed that within the micro scale of the ecosystem, aquatic insects exhibits large variation of distribution and composition. This study elaborates more detail on what Vannote et al. (1980) noted on their river continum concept (RCC). They said that these three different groups along the river stretch and upstream catchment can be generalised as allochthonous system which dominated by specific feeding group. However, this study exhibits variability of taxa richness and several feeding groups. This study showed that although with upstream site, invetebrates with variable feeding groups were recorded with various proportion.

Sungai Lolo which is the most elevated (460-569 m asl) has the second higest chironomid composition (468 individual, 12 genus). Cluster analysis isolates this stream from others (Figure 3). Other streams (Sg. Congkak, Sg. Perdik, Sg. Lui, Sg. Langat 1 and Sg. Langat 2) were classified together in one group. This study showed the chironomid distribution within the same catchment. Only Sg. Langat 3 station exhibits different criteria in term of chironomid richness and composition (Figure 3). The most downstream site has the highest composition and richness. This site exposed to human interference but still has high chironomid diversity. This is in agreement with Hawkins et al. (1982) that, lesser canopy cover river has higher invetebrates composition and richness. From this study, four different conditions were observed i.e. high elevation with large canopy cover, low elevation stream with high canopy cover, low elevation stream with very minimum canopy cover and hot spring water source. Cluster analysis using Euclidean distance method clearly demonstrates this classification (Figure 3). A similar test was constructed using chironomids richness and result indicates Langat river was dominated by *Polypedilum* followed by *Rheocricotopus, Cryptochironomus, Microtendipes* and *Cricotopus* (Figure 3). Although high elevation stream reported to have less diversity by Hawkins et al. (1982), this study found that Sg. Lolo has the second richest composition.

CHIRONOMID DISTRIBUTION

As regards to chironomid distribution, *Polypedilum* (Chironominae: subfamily) exhibits good dispersion (Figure 4). This genus presents in all stations but most abundant at Sg. Lolo (high elevation and high canopy cover), followed by Sg. Langat 3 (low elevation and poor canopy cover). This indicates the genus does not influence

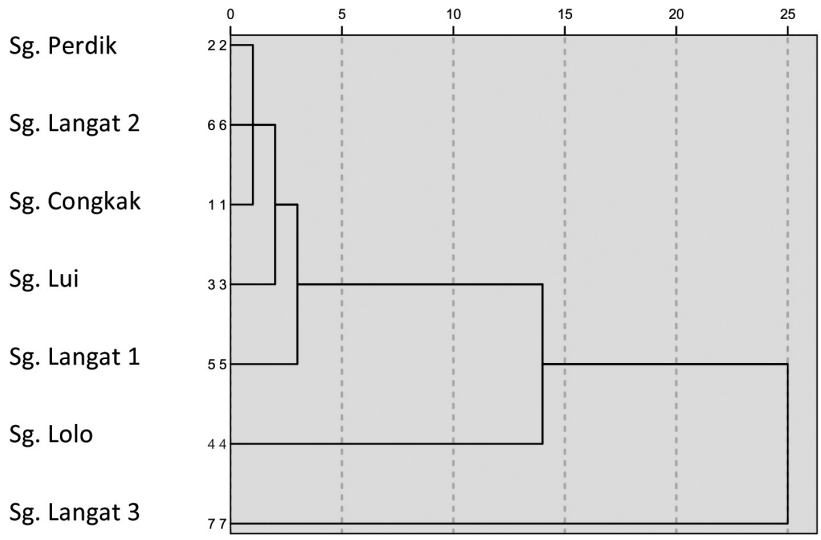

FIGURE 3. River classification based on composition

by either elevation or canopy cover. Other common genus recorded in this study were *Rheocricotopus*, *Cryptochironomus*, *Microtendipes* and *Cricotopus*. Majority were recorded at most downstream site which has less canopy cover. Roque et al. (2010) reported that invetebrates were lesser in high canopy cover, high pH and conductivity and less particles. Sungai Langat 3 has higher particles and water were slightly warmer due to direct exposure to sun light. Research on diversity and distribution of Chironomidae at Sungai Langat by Ahmad et al. (2012) reported that *Polypedilum* were the dominant genus and only three Orthocladiinae taxa found are *Tvetenia*, *Eukiefferiella* and *Cricotopus*. This study demonstrates that within a micro distribution in upstream catchment of Sg. Langat, *Polypedilum* was the most dominant genus and this genus does not exhibit clear habitat preferences as other genus were only found dominant of warmer and least canopy cover (Figure 4). Instead of Chironominae subfamily, Orthocladiinae was also a dominant subfamily in upstream of Langat river. Several studies (Ashe et al. 1987; Eggermont & Heiri 2012; Pinder 1986) reported this subfamily are more abundant in cold water in tropical river system.

Conclusion

Sungai Langat was dominated by Chironominae subfamily followed by Orthocladiinae and Tanypodinae. *Polypedilum* spp. from Chironominae subfamily was the most abundant genus and recorded along the study area. Genus *Rheocricotopus*, *Microtendipes and Cryptochironomus* were also found in this study but at lower density. *Polypedilum* exhibits that elevation and physical characteristic do not affect its present and composition within good water zone. This shows the potential use of the genus as indicator for good water quality for monitoring purposes.

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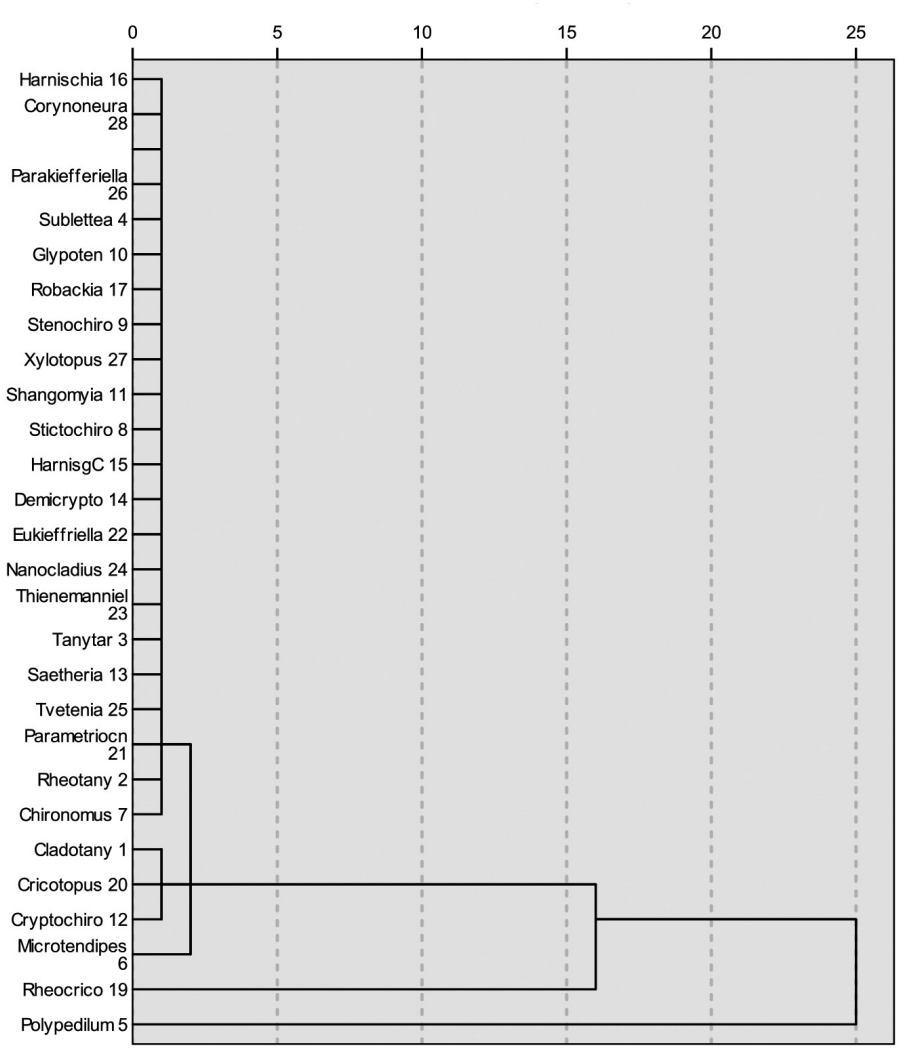

FIGURE 4. Taxa richness of family Chironomidae

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