IJST (2013) A1: 45-52
Iranian Journal of Science & Technology

http://www.shirazu.ac.ir/en

A study on Chironomid larvae (Insecta- Diptera) of Golpayegan River (Isfahan-Iran) at generic level

M. Ebrahimnezhad and E. Allahbakhshi*

Department of Biology, University of Isfahan, Isfahan, Iran
Department of Biology, Izeh branch, Islamic Azad University, Izeh, Iran
E-mail: eallahbakhshi@yahoo.com

Abstract

Little is known about Chironomidae in Iran. This article is the second one on chironomid larval identification in running waters of Iran. Samples were collected from five sites in the Golpayegan River, (Isfahan-Iran), about 55 km along the river course. The sampling was done four times: February and November 2003, May and July 2004. Samples were hand sorted in the laboratory and the larvae identified at generic level, using available identification keys. Thirty five genera were identified in four subfamilies, including Chironominae (15 genera), Orthocladinae (13 genera), Tanypodinae (5 genera) and Diamesinae (2 genera). 17 genera of these are reported from the Golpayegan River for the first time.

***Keywords**:* Chironomidae; chironomid genera; Golpayegan River; Iran

1. Introduction

Chironomidae is a large and world-wide family of Diptera and the most abundant group of insects inhabiting all sorts of running waters, both in number of species and number of individuals. Chironomidae larvae are found in a variety of freshwater habitats including streams, rivers, lakes and ponds [1-3]. Chironomid larvae, pupae and adults are important parts of food chain in aquatic habitats that are used as food for larger invertebrates, as well as fishes, amphibians and birds. Many chironomid larvae have giant chromosomes and are used in genetic studies [4]. For benthologists, chironomids are bio indicators of lotic and lentic waters [5].

Therefore, many studies considering identification and ecology of this family have been carried out in most parts of the world, and many genera and species have been identified. Chironomid identification keys to genera and species of Holarctic region were written by Cranston and Reiss in 1983 [6], Cranston et al. in 1983 [7], Pinder, 1983 [8], Pinder and Reiss in 1983 [9] and Fittkau and Roback in1983 [10]. Epler has also studied the Chironmidae larvae of North America, and published the results as identification keys in 2001 [4 and 11-14]. The studies have also been made in Japan by Sasa and Susuki in 2001 and 1174 species of the family were identified [15]. Little is known about this family in Iran. Alvary reported 12 chironomid genera from ponds around Tehran, Iran [16]. Valypoor studied the abundance and distribution of chironomid larvae of the Anzali Swamp [17]. Ebrahimnezhad and Fakhri studied the chironomid larvae of the Zayandehrood River, Isfahan, Iran and reported 27 genera [18]. The objective of this project was to study the chironomid larvae of Golpayegan River in different seasons, and to identify them at generic level.

*Corresponding author
Received 13 November 2011 / Accepted: 27 November 2012

2. Materials and Methods

2.1. The study area

Golpayegan River, about 105 Km long is the largest river in Golpayegan basin, situated in Isfahan province of Iran. The river runs from the south and southwest to the north and northeast, between 51°, 15´ latitude and 40°, 41´, 50" longitude. The river source is in the west, where the branches of the Dez, Karoon and Zayandehrood Rivers begin. The altitude of the river origin is 2500 m, with the mean slope angle 1.11 over a 1000 m long. Salt Lake in the Khansar area is the river destination. The maximum and minimum annual discharges of the river are 30.37 m^3/s and 0.3 m^3/s respectively, with the mean annual discharge 4.15 m^3/s. The Golpayegan Dam is located about 30 km far from the River's origin and is constructed mainly as a

water storage to supply potable and irrigation water [19].

2.2. Field works

In total, six samplings in four seasons were performed. Originally eight samplings were planned, but due to unfavorable environmental conditions, only six samplings were possible. The kinds of substrates and the vegetation cover were used to select the sampling sites. Samples were collected from five sites along 55 Km of the river course. The location of sampling sites on the river is shown on Fig. 1. The names of the sites are: above the Mine (1), the Mine (2), Abasabad (3), Pole balla (4) and Koochehray (5). Sampling was carried out with three replicates on each selected site (10 m long) using a dredge (20×50 cm frame) with 0.7 mm mesh size and 60 cm deep net. Samples were transferred to buckets with watertight lids and preserved with 5% formaldehyde in the field. The sampling was done four times: November and February 2003, May and July 2004.

2.3. Laboratory works

The chironomid larvae were hand sorted in a large white tray, then counted and identified. The larvae were macerated in a hot 10% solution of potash (KOH) for 5-10 minutes. The head capsules were removed and mounted on the slides, using polyvinyl lacto phenol. In order to describe the identified genera, head capsules and body characteristics of the larvae were studied using Zeiss Axio Lab. A1 microscope and the specimens identified at generic level using available keys [4, 6-9 and 11-14]. Furthermore, microscopic color photographs were also prepared for each genus. Microscopic slides were sent to Governmental Zoology Collection in Munich, Germany for final identification and were verified by Dr. Martin Spise. After identification the slides were deposited in the Zoology Laboratory Collection of Isfahan University.

3. Results

3.1. Taxonomy

Thirty five genera were identified in this study, belonging to four subfamilies: Chironominae, 15 genera, Orthocladinae, 13 genera, Tanypodinae, 5 genera, and Diamesinae, 2 genera (Table 1). Seventeen genera are reported from the Golpayegan River for the first time (marked with an asterisk). Identification of two groups, *Cricotopus/Orthoclandius* and *Orthocladius/ Paratrichocladius* in Orthocladinae and three genera, *Conchapelopia*, *Hayesomyia* and *Trissopelopia* in Tanypodinae could not be certainly verified

Figures 2-37 show the head capsules of the genera and posterior parapods. The following short key was also prepared to identify the 30 genera. Differences in generic level were naturally observed between the available identification keys and the Iranian specimens, and the short keys were provided according to our Iranian specimens. The relationship between distribution and environmental factors is not studied here.

Table 1. Chironomidae larvae in five sites of Golpayegan River, Isfahan-Iran (2003-2004)

Subfamily	Genus
Chironominae	*Cladotanytarsus* (Kieffer, 1921) *Cryptochironomus* (Kieffer, 1918) *Cryptotendipes** (Lenz, 1941) *Demicryptochironomus* (Lenz, 1941) *Harnischia** (Kieffer, 1921) *Micropsectra** (Kieffer, 1976) *Paratanytarsus* (Thienemann & Bause, 1913) *Paratendipes* (Kieffer, 1911) *Phaenopsectra* (Kieffer, 1921) *Polypedilum* (Kieffer, 1912) *Rheotanytarsus* (Thienemann & Bause, 1913) *Stempellina** (Brundin, 1947) *Stictochironomus** (Kieffer, 1919) *Tanytarsus* (V.d. Wulp, 1874) *Virgatatanytarsus** (Pinder, 1982)
Orthocladiinae	*Cardiocladius* (Kieffer, 1912) *Cricotopus* (V.d. Wulp, 1874) *Eukiefferiella** (Thienemann, 1926) *Nanocladius* (Kieffer, 1913) *Orthocladius* (V.d. Wulp, 1874) *Paracladius** (Hirvenoja, 1973) *Parametriocnemus* (Goetghebuer, 1932) *Paraphaenocladius* (Thienemann, 1924) *Paratrichocladius** (Santos Abreu, 1918) *Rheocricotopus** (Thienemann & Harnisch, 1932) *Tvetenia* (Kieffer, 1922) *Cricotopus*(Kieffer,1912)*/Orthocladius*(V.d. Wulp, 1874)* *Orthocladius* (V.d. Wulp, 1874)*/ Paratrichocladius* (Santos Abreu, 1918)*
Tanypodinae	*Ablabesmyia* (Johannsen, 1905) *Procladius* (Skuse, 1889) *Conchapelopia**? (Fittkau, 1957) *Hayesomyia**? (Murry &Fittkau 1985) *Trissopelopia**? (Kieffer, 1923)
Diamesinae	*Diamesa** (Meigen, 1835) *Sympotthastia** (Magast, 1947)

*: Genera reported from Iran for the first time
?: Identification not verified

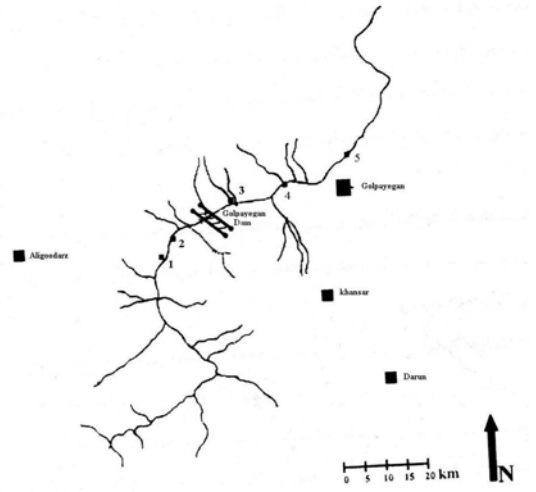

Fig.1. The location of sampling sites on Golpayegan River

3.2. Key to the Chironomidae subfamilies in Golpayegan River

1. Antenna retractile. Large sclerotized ligula present ……..*Tanypodinae*
- Antenna not retractile. Ligula not present ……...……..…...2
2. Third antennal segment annulated, premandible present, procercus short or vestigial .. ***Diamesinae***
- Third antennal segment not annulated.….....3
3. Ventromental plates well developed and striated, no beard present near ventromental plates ……...……....***Chironominae***
-Ventromental plates if present very selender and not striated, beard either present or not ……..…..***Orthocladiinae***

3.3. Key to the Chironomidae genera (based on characteristics of the Iranian genera)

3.3.1. Chironominae (Figs. 2-17)

1. SI bases fused, SII located on long pedestal, antenna 5-segmented and situated on a long base, lauteborne organs usually well developed and situated on either short or long pedestal…….....2
- SI bases usually separate and SII not situated on a pedestal, antenna 4-8 segmented, lauteborne organs not situated on long pedestal…….....……8
2. Ventromental plates squat and at least separated by the width of three median teeth, lauteborne organs arise apically from antennal segment 2, antennal base with multispined process on it. Chlypeal setae bifid…….....***Stempellina***.
- Ventromental plates extended and meet each other in the middle, mentum with 5 pairs (or more) lateral teeth……..……..3
3. Premandible with 3 or more apical teeth…….....4
- Premandible bifid……..……..……..….6
4. Posterior parapods claws simple, lauteborne organ pedestals usually long ……..…***Tanytarsus***.
- One or more posterior parapods claws pectinate with inner spines ……..……..……..……..5
5. Some posterior parapods claws with single row of inner teeth, lauteborne organs pedestals short ….……..…..……..……***Cladotanytarsus***
- Some posterior parapods claws with multiple rows of inner teeth, lauteborne organs pedestals long ……..…***Virgatatannytarsus***
6. Pecten epipharyngis is a 5-lobed plate, lauteborne organs situated on a very short pedestal, 3 central teeth of mentum not projecting above lateral teeth ……..….. ***Paratanytarsus***
- pecten epipharyngis a single multitoothed comb, or 3 small plates with neumerous apical teeth ……..…..…….... 7
7. Lauteborne organs on pedestals shorter than flagellum, pecten epipharyngis a single multitoothed comb, ventromental plates striated often appearing block-like ……..***Rheotanytarsus***
- Lauteborne organs located on long pedecels, pecten epipharyngis 3 multi-toothed plates, ventromental plates striated not appearing block-like ……..……..…….***Micropsectra***
8. Antenna 6-segmented, large lauteborne organs at the apices of segments 2 and 3 .....……. 9
- Antenna 4-7 segmented, if 6-segmented, then without lauteborne organs on segments 2 and 3 ……..…..……. 10
9. Mentum with 4 dark median teeth, of which the outer pair are higher than lateral teeth ……..…...***Stictochironomus***
- Mentum with 4 median teeth and the central pair equal or higher than the outer median teeth, SI bases located on common trianguler plate, mandible with one dorsal tooth …….……***Paratendipes***
10. SI simple, SII often large and blade-like, mandible without dorsal tooth, labral lamella usually absent, pecten epipharyngis a single plate that may be simple, serrated or notched ……..… 11
- SI plumose or fringed on at least one margin, SII usually not large and blade-like, labral lamella present, antenna 5-segmented, mandible usually with a dorsal tooth, pecten epipharyngis 3 small plates that are usually apically toothed …..……. 14
11- Mentum concave, with broad pale median tooth, lateral teeth well sclerotized that point inward ……2
- Mentum convex or linear, ventromental plates is at least 3x wider than the length ……..…..13
12. Antenna 7-segmented and mentum with 7 pairs of dark lateral teeth …….***Dimicryptochironomus***
- Antenna 5-segmented, mentum with 5 pairs of dark lateral teeth, pecten epipharyngis a 3-lobed

scale, SI well developed and at least half of SII, premandible with weak brush ..***Cryptochironomous***
13. Mentum linear, antenna 5-segmented, premandible with 5 inner teeth, antennal segments 2 and 3 subequal, ventromental plates weakly striated ……..……..***Harnischia***
- Mentum convex, antenna 5-segmented, premandible bifid, median tooth of mentum broadly rounded or lateraly noted to appear trified, antennal basal segment about 2-2.5x longer than wide ……..***Cryptotendipes***
14. Mentum with an even number of teeth or median tooth bifid, first lateral teeth lower than the median and second lateral teeth, or mentum with teeth mostly equal in size, gradually smaller laterally ……..…… ***Polypedilum***
- Mentum with 14 teeth, 4 median teeth separated by a line that runs posteriorly to the anteromedian corner of the ventromental plates, mandible with 3 inner teeth and a deep incision proximal to basal inner tooth ….…….……..... ***Phaenopsectra***

3.3.2. Orthocladinae (Figs. 18-29)

1. Lauteborne organs well distinct, mandible apical tooth equal or slightly longer than 3 inner teeth width, median mental tooth may be pale and broad ……...***Paracladius***
- Apical tooth of mandible shorter than width of 3 inner teeth, mentum with 2 median teeth …….. 2
2. Antenna 5-segmented, SI bifid, ventromental plates well distinct, beard well developed ……***Rheocricotopus***
- Beard is not present beneath or adjacent to ventromental plates ….…….. 3
3. Ventromental plates well developed, extenteding well beyond lateral margin of mentum ……..….4
- Ventromental plates vestigial or absent .....…..... 6
4. Mentum with a small pair of median teeth which are often well-separated from lateral teeth, ventromental plates elongate, all S setae simple …….…….…. ***Nanocladius***
- Ventromental plates appear dual ….……..… 5
5. Mentum with dual median tooth, antennal basal segment long, AR>1.25 and antennal blade shorter than flagellum ..……..….. ***Parametriocnemus***
- Mentum with single or dual median tooth, antennal basal segment short, AR: 0.5-1, antennal blade sabequal to or longer than flagellum …….....***Paraphaenocladius***
6. Abdominal segments with long single setae, SI with several apical teeth, mandible with 3 inner teeth and inner margin with several spines ….…….…….…….***Tevetina***
- Abdomen without long single, setae …..……..7
7. SI simple …..……...….8
- SI bifid, or with several apical teeth, or plumose ……..…….……11
8. Procersus reduced, with 2 setae thicker than the rest on each procersus, setae interna of mandible with long stalk that branches near apex, mentum with 5 pairs of lateral teeth ……..… ***Cardiocladius***
- Procersus at least as long as wide, setae about equally thick, setae interna of mandible usually divided near base …….……. 9
9. Mentum with 4 pairs of lateral teeth ……. ***Eukifferiella***
- Mentum with 5 pairs of lateral teeth ……..... 10
10. Antenna 4 segmented …… ***Eukifferiella***
- Antenna 5 segmented, anal setae longer than posterior parapods, antennal blade extended beyond segment 2, supraanal setae longer than anal tubes ……...…… ***Eukifferiella***
11. SI bifid, mentum with more than 15 teeth ……..***Orthocladius***
- SI bifid, mentum with at most 13 teeth, mentum with single median tooth, antennal third and fourth segments are subequal, antennal blade shorter or subequal to flagellum ……..….... 12
12. Mandible inner margin serrated …. ***Cricotopus***
- Mandible inner margin smooth ..…….…… 13
13. Some abdominal segments with a tuft of setae, lauteborne organs not developed to appear as circles, first lateral teeth of mentum not appressed to median tooth ……..……... ***Cricotopus***
- Abdominal segments with short setae …… 14
14. Head capsule light brown to dark brown, overall of the mandible dark ……..... ***Orthocladius***
- Head capsule yellow to light yellow-brown, mandibles with dark apex and inner teeth, and light color base, premandible simple ……. 15
15. Mentum with second lateral tooth appressed to first lateral tooth ……...…... ***Cricotopus***
- Mentum not as above …….……..…… 16
16. Mentum with first lateral teeth constricted at base, so that they appear wider in the middle than at bottom, minute spines present at base of setae subdentalis, head capsule with heavily sclerotized area latteral to mentum …… ***Paratrichocladius***
- The width of bottom and middle of first lateral tooth of mentum are equal ….....7
17. Mentum triangular in outline or with median and first latteral teeth projecting above remaining lateral teeth, setae submenti located below lateral margin of mentum …… ***Orthocladius***
- Mentum with a convex arch, median and first lateral teeth not projecting above remaining lateral teeth, setae submenti located more towards center line of mentum …….…… ***Cricotopus***

3.3.3. Tanypodinae (Figs. 31-32)

1. Head capsule elongate, dorsomentum without well developed teeth, maxillary palp with 2-6 sclerotized segment, pseudoradula not broadened

posteriorly with granules often arranged in longitudinal rows ……..…….***Ablabesmyia***
- Head capsule rounded to oval, dorso-mental teeth present in well developed transverse plates, M appendage with a pseudoradula, mandible with basal tooth and 1-2 accessory teeth, ligula with 5 teeth, ring organ of maxillary palp located near middle or apex, paraligula with teeth on outer side ……..... ***Procladius***

3.3.4. Diamesinae (Figs. 36-37)

1. Premandible apically simple, median mental tooth less than 4 × width of first lateral tooth, maxilla with galea bearing mostly setae-like lamella ..……...***Sympotthastia***
- Premandible with numerous apical and inner teeth, mentum with median teeth subequal, pecten epipharyngis with 5 scales ……..…..***Diamesa***

4. Discussion

Thirty five genera belonging to four subfamilies were identified including Chironominae 15 genera, Orthocladinae 13, Tanypodinae 5 and Diamesinae 2. Ebrahimnezhad et al. [18] have reported 14 genera of Chironominae, 9 genera of Orthocladinae and 2 genera of Tanypodinae from the Zayandehrood River. In this study, 6 new genera of Chironominae and 6 new genera of Orthocladinae were reported. Five genera of Tanypodinae were studied, 5 of them are reported here for the first time. Only 2 genera of Diamesinae were found, both of which are reported for the first time. In total, from 35 genera in our study on the diversity of Chironomidae in Golpayegan River, 17 are being reported for the first time in Iran (Table 1).

Distribution of the identified genera was very diverse in different sites. Site 1 with 27 genera was the most diverse one. Site 2 with 22 genera was next in importance. Sites 3 and 4 with 19 genera come after that and site 5 with 16 genera had the least diversity. By considering the seasonal diversity, summer with 25 genera was the most diverse season, autumn with 22 genera was the second most diverse season, spring with 21 genera was next and winter with 14 genera was the least diverse season (Table 2).

Fig. 2-13. Head capsules of chironomid genera, 2. *Cladotanytarsus*, 3. *Cryptochironomus*, 4. *Cryptotendipes*, 5. *Demicrptochironomus*, 6. *Harnischia*, 7. *Micropsectera*, 8. *Paratanytarsus*, 9. *Paratendipes*,10. *Phaenopesctra*, 11. *Polypedilum*, 12. *Rheotanytarsus*, 13. *Stempellina*.

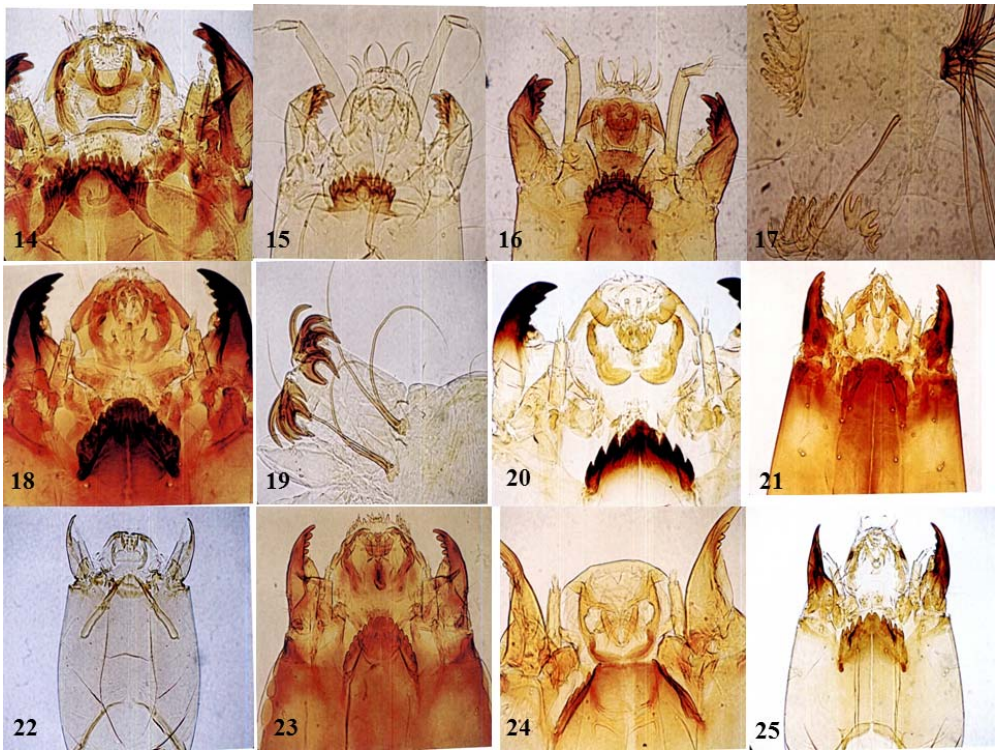

Fig. 14-25. Head capsules of chironomid genera, 14. *Stictochironomus*, 15. *Tanytarsus*, 16. *Virgatatanytarsus*, 17.*Virgatatanytarsus*, (posterior parapods), 18. *Cardiocladius*, 19.Cardiocladius (posterior parapods), 20. *Cricotopus*, *21. Eukiefferiella*, *22.Nanocladius*, *23. Orthocladius*, *24. Paracladius*, *25. Parametriocnemus.*

Fig. 26-37. Head capsules of chironomid genera, 26. *Paraphaenocladius*, 27. *Paratrichocladius*, 28. *Rheocriciotopus*, 29. *Tvetenia*, 30. *Orthocnadius/Cricotopus*, 31. *Abalbesmyia*, 32. *Procladius*, 33. *Conchapelopia*, 34. *Hayesomyia*, 35. *Trissopelopia*, 36 .*Diamesa*, 37. *Sympotthastia.*

Table 2. Seasonal distribution of Chironomidae larvae in five sites of Golpayegan River, Iran (2003-2004)

Subfamily	Genus	Site					Season			
		1	**2**	**3**	**4**	**5**	**Au.**	**Wi.**	**Sp.**	**Su.**
Chironominae	*Cladotanytarsus*	++	+						+	+
	Cryptochironomus	++	++		+		+	+		+
	Cryptotendipes		+							+
	Demicryptochironomus		+		+	+			+	
	Harnischia			+			+			
	Micropsectra	+++	+	++	++	+++	+	+	+	+
	Paratanytarsus	+	+	+	+		+		+	
	Paratendipes					++	+		+	
	Phaenopsectra		+					+		
	Polypedilum	++++	+++	+			+		+	+
	Rheotanytarsus		++	++++	+++	+	+	+	+	+
	Stempellina		+						+	
	Stictochironomus	+++					+		+	+
	Tantarsus	+++	++	+	+++	+		+	+	+
	Virgatatanytarsus		+		++	+			+	+
Orthocladiinae	*Cardiocldlus*	+	+	++	+	+	+			+
	Cricotopus	+++	++	++	+	+		+	+	+
	Eukiefferiella	+++	+++	++++	+++++	++++	+	+	+	+
	Nanocladius			++			+			+
	Orthocladius	++++++	+++++	++++	+++++	+	+	+	+	+
	Paracladius	+	++				+	+		+
	Parametriocnemus	++		+	+++	+	+			+
	Paraphaenocladius		+			+	+		+	
	Paratrichocladius	+++	++	+	+			+	+	+
	Rheocricotopus	+	+	++	++++	+	+			+
	Tvetina	++	+	+	++++++	+++	+	+	+	+
	Cricotopus/orthocladius	++++++	++++	++	+++	+	+	+	+	+
	Ortocladius/paratricocladius	+				+			+	
Tanypodinae	*Ablabesmyia*				+		+			
	Procladius		+							+
	Hayesomyia	++	++++	+	++		+		+	+
	Conchapelopia	++	++	+	++		+		+	+
	Trissopelopia	+								+
Diamesinae	*Diamesa*		+	+				+		+
	Sympotthastia	+	+				+	+		

Cricotopus and *Orthocladius* are two dominant genera from Orthocladinae. There are many intergeneric variations among them, and it is very difficult to separate them due to the many similarities between them [13]. In this study there were many specimens whose precise identification was impossible, because their characteristics were intermediate between two genera or they had no typical generic features; therefore they are presented as generic groups, such as *Cricotopus/Orthocladius* group. Mentum is one of the significant characteristics for identification of these genera. The mentum of the specimen of the group was not identical to any of those mentioned in the available keys and the precise identification of the genera would be possible only with the study of the pupa and adult forms [20]. *Orthocladius/Paratrichocladius* group was another group with the same problem and could be done the same way [20, 13]. *Conchapelopia*, *Hayesomyia* and *Trissopelopia* in Tanypodinae could not be certainly identified and the study of the IV instar larva and pupa form would be necessary for their precise identification. Regarding Iran's geographical position, there are many inter- and intra- variations among these genera. The Holarctic or Palearctic identification keys do not cover these variations completely. As a result, the precise identification of these genera, based on these keys, is impossible (Personal communication, 2005, Spise).

Acknowledgments

This work is part of the M. Sc. thesis of E. Allahbakhshi conducted at the Biology Department, University of Isfahan, Iran. We thank the

University of Isfahan authorities for funding the project.

References

[1]. Freimuth, S. & Bass, D. (1994). Physicochemical conditions and larval Chironomidae (Diptera) of an urban pond. *Proc. Okla. Aca. Sci. 74*, 11-16.

[2]. Roque, F. O., Correia, L. C. S., Strixino, S. T. & Strixino, G. (2003). A review of Chironomidae studies in lentic systems in state of Sao Paulo. Brazil. *Biota Neotrop*, *4*, 1-19.

[3]. William, D. D. & Feltmate, B. W. (1992). *Aquatic Insects*., Michigan, Saginaw, pp. 358.

[4]. Epler, J. H. (2001). Identification manual for larval Chironomidae (Diptera) of north and south Carolina. Introduction and key to subfamilies. *North Carolina Department of Environment and Natural Resources, 1*, 1-43.

[5]. Marques, M., Barbosa, F. A. R. & Callisto, M. (1999). Distribution and abundance of Chironomidae (Diptera) in an impacted watershed in South-East Brazil. *Braz. J. Biol*., *59*(4): 553-561.

[6]. Cranston P. S. & Reiss F. (1983). The larvae of Chironomidae (Diptera) of the Holarctic region, keys to subfamilies. *Ent. Scand. Suppl. 19*, 11-15.

[7]. Cranston, P. S. Oliver, D. R. & Saether, O. A. (1983). The larvae of Orthocladinae (Diptera: Chironomidae) of the Holarctic region-keys and diagnoses. *Ent. Scand. Suppl*. *19*, 149-291.

[8]. Pinder, L. C. V. (1983). The larvae of Chironomidae (Diptera) of Holoarctic region. *Ent. Scand. Suppl*. *19*, 7-10.

[9]. Pinder, L. C. V. & Reiss, F. (1983). The larvae of Chironominae (Diptera: Chironomidae) of the Holartic region-keys and diagnoses. *Ent. Scand. Suppl*. *19*, 293-435.

[10]. Fittkau, E. J. & Roback, S. S. (1983). The larvae of Tanypodinae (Diptera: Chironomidae) of the Holarctic region-Keys and diagnoses. *Ent. Scand. Suppl*. *19*, 33-110.

[11]. Epler, J. H. (2001). Identification manual for the larval Chironomidae (Diptera) of North and South Carolina, Subfamily of Tanypodinae. North *Carolina Department of Environment and Natural Resourses*, *4*, 1-79.

[12]. Epler, J. H. (2001). Identification manual for the larval Chironomidae (Diptera) of North and South Carolina. Subfamily of Diamesinae. *North Carolina Department of Environment and Natural Resources, 5*, 1-13.

[13]. Epler, J. H. (2001). Identification manual for the larval Chironomidae (Diptera) of North and South Carolina. Subfamily of Orthocladinae. *North Carolina Department of Environment and Natural Resources, 7*, 1-164.

[14]. Epler, J. H. (2001). Identification manual for the larval Chironomidae (Diptera) of North and South Carolina. Subfamily of Chironominae. *North Carolina Department of Environment and Natural Resources, 8*, 1-77.

[15]. Sasa, M. & Susuki, H. (2001). Systematic studies on species of Chironomidae recorded from Japan during the Period from September 1997 to August 2000. *Med. Entomol*. *Zool*. *52*, 1-9.

[16]. Alvary, G. (1991). Study and identification of Chironomidae from ponds around Tehran, Iran. M.Sc. thesis. University of Tarbiat Moddaress (in Persian).

[17]. Valypoor, A. (1997). Abundance and distribution of Chironomidae larvae in Anzali Swamp. *Iranian Bulletin of Fisheries Sciences*, *2*, 22-75 (in Persian).

[18]. Ebrahimnezhad, M. & Fakhri, F. (2005). Taxonomic study of Chironomidae (Diptera) larvae of Zayandehrood River, Iran, and effects of selected ecological factors on their abundance and distribution. *IJST, Trans. A*, *22*(A1), 89-105.

[19]. Mosayebi, M. (1992). Study of the Golpayegan River natural geography with emphasis on hydroclima. M. Sc. Thesis, Department of Geography, University of Isfahan, Iran (in Persian).

[20]. Boothroyd, I. K. G. (2002) *Cricotopus* and *Paratrichocladius* (Chironomidae insecta) in New Zealand, with description of *C. hollyfordensis* n. sp., and redescription of adult and immature stages of *C. zealandicus* and *P. phriserialis*. *N. Z. J. Mar. Freshwat. Res*. *36*, 775-788.