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TAXONOMIC STUDY OF CHIRONOMIDAE (DIPTERA) LARVAE OF ZAYANDEHROOD RIVER, IRAN, AND EFFECTS OF SELECTED ECOLOGICAL FACTORS ON THEIR ABUNDANCE AND DISTRIBUTION*

M. EBRAHIMNEZHAD** AND F. FAKHRI

Biology Department, University of Isfahan, Isfahan, I. R. of Iran
E-mail: m.ebrahim@sci.ui.ac.ir

Abstract – To date, no comprehensive study has been carried out on the chironomid larval identification in running waters of the country, in particular in large rivers. Therefore, this article is the first of its kind in Iran that has come out in English. Samples were collected in 9 sites from the Zayandehrood River a distance of 230 Km down the Zayandehrood dam. The sampling was repeated four times: November 1998, February, May and August 1999. The samples were hand sorted in the laboratory and the larvae were identified to generic level, using available identification keys. To study the effects of sites and seasons, and selected ecological factors on chironomid larval abundance and distribution, data were analysed using a two way ANOVA. Twenty seven genera were identified in three subfamilies including 14 in Chironominae, 9 in Orthocladiinae and 4 in Tanypodinae, from which 20 genera are reported from the Zayandehrood River, Iran, for the first time. The results also revealed that the mean number of the larvae was significantly different according to sites ($P < 0.001$) and seasons ($P < 0.001$). The velocity, depth and substrate showed no significant effects on the larval abundance, but vegetation cover did, significantly.

Keywords – Chironomidae, chironomid genera, chironomid abundance, chironomid distribution, Zayandehrood River, Iran

1. INTRODUCTION

The Chironomidae or non-biting midges belong to the order of Diptera. The larvae of this family are among the most abundant holometabolous insects from both geographical and ecological points of view [1]. These insects spend the greatest part of their life cycle in larval form, occupying a wide range of habitats compared to other insects. Therefore, their identification and classification have fewer limitations in comparison to the adult stage [2]. The chironomid larvae are found in all aquatic ecosystems, including freshwaters, seawaters and lakes. They are also semi-aquatic and land dwellers [3]. These larvae play an important role in the degradation of food materials and nutrition cycle [4]. They are also partly used as food for other invertebrates and fishes [5]. Different species of chironomid larvae are used as lothic and lenthic water quality indicators, because their distribution is closely related to the different degrees of water depth, dissolved oxygen, organic matters and temperature [6]. Therefore, their presence in habitats can be used as indicators in lake classification, river zonation and water quality [7]. The chironomid study has special ecological importance [8]

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**Corresponding author

because of the wide distribution of the group, high abundance, and non-seasonal life cycle. However, in most studies the importance of the group has been ignored due to taxonomic problems related to their identification [5]. The separation and the identification of some species will be carried out only according to a small difference in egg, pupa [5] or adult stages, and even in genetic sequence [9]. Therefore, there is a need to do comprehensive taxonomic and life cycle studies which may result in the identification of some species [5].

The chironomid identification has been carried out rather completely in some parts of the world such as the northern hemisphere by Lobinske [3]. The studies are very limited in the Middle East, but they were studied more comprehensivly in India, China and Russia [3]. The southern hemisphere species are less studied. Little is known about the family in Iran. Mousavi (1995) has recently reported the *Chironomus* from the Caspian Sea shores [10]. Alvary (1997) reported 12 chironomid genera from ponds around Tehran, Iran [11]. Valypoor (1997) studied the abundance and distribution of chironomid larvae of the Anzali Swamp [12]. To date, no comprehensive study has been carried out on the identification of chironomid larvae in running waters, particularly in the large rivers of the country [11]. The main objectives of this study were first, collection of chironomid larvae from different sites of the Zayandehrood River in different seasons, and second, their taxonomic identification to the generic level. Most of the genera of this river are reported for the first time. The study of the effects of selected ecological factors on distribution and abundance of the chironomid larvae was another objective of the study.

2. MATERIALS AND METHODS

a) The study area

The Zayandehrood River is the largest river in the country which runs through the central part of the Iranian plateau. The river, which is about 350 km long, originates from the Zagros Mountain chain in the eastern slope of the Zardkooh mountain in the Chaharmahal-va-Bakhtiari province, and ends at the Gavkhooni Swamp, which is located in about 140 km east of Isfahan. The Zayandehrood River basin includes an area located in the southwest of the Iranian internal river basins between 31°, 30′ to 35°, 32′ northern latitude, and 49°, 30′ to 52°, 49′ eastern longitude [13]. The river drainage basin area is about 3600 km^2. The highest and lowest areas of the Zayandehrood river basin are about 4300 m and 1450 m, respectively. The altitude of the river origin is 2330 m in Chelgerd, with the mean slope of the river being 2.6 in 1000 m. The Zayandehrood dam is located about 80 Km north from the river's origin. The dam is constructed mainly for water reservation and partly for hydro-electrical purposes. Therefore, the greatest part of the river runs below the dam, as a regulated river.

b) Field works

Samples were collected from nine sites along 230 km below the Zayandehrood dam. The location of sampling sites on the river is shown in Fig. 1. The names of the sites are: Cham-Haydar (1), Cham-Asman (2), Zarin-Shahr (3), Polyacryle (4), Pole-Vahid (5), Pole-Chum (6), Pole-Sharifabad (7), Pole-Azhyeh (8) and Pole-Varzaneh (9).

Sampling was carried out with three replicates on each selected site (10 m long) using a dredge (20x50 cm frame) with a 1.4 mm mesh size and 60 cm deep net for 3 minutes. Samples were transferred to buckets with watertight lids and preserved with 5% formaldehyde in the field. The sampling was repeated four times: November, 1998, February, May and August, 1999.

The physical and environmental characteristics of each site, including temperature, flow velocity and depth, were measured at the sampling site. The current velocity was measured at the middle point of each transect using a portable current meter (Molinae). The instrument was positioned at 60% depth from the surface and the number of rotations was recorded over 30 seconds. The current velocity was then calculated using the following equation, paying particular attention to the instrument used, V=0.120 N + 0.005. Using a one meter wooden ruler, the water depths were measured every half meter along the sampling site. Therefore, the depth of each sampling point was taken as mean of the transect depth measurments. The proportion of substrate types at each site was composed of boulders (>20cm), cobbles (20-5 cm), gravel (5-0.1 cm), sand (<0.1 cm, coarse appearance) and silt (<0.1cm, smooth appearance) was estimated by eye in a 5 m^2 transect. The type and proportion of in stream vegetation cover were also estimated for each site in the same way [14].

c) 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 polyvinyle lacto phenol. The slides were investigated under the microscope (Wild) and identified to the generic level using the available keys [15-20]. The samples were sent to the college of Fishery Science, University of Troms∅, Norway, for final identification.

d) Analytical methods

In order to determine whether any significant differences existed between larval abundance of the sites and seasons, mean and SD of larval abundance were calculated for each sample in each site and season. The null hypothesis (that there was no difference between mean abundance of the larvae of the sites or seasons) was tested using a two way ANOVA and F test. The same statistics were used in order to determine whether any significant differences existed between ecological factors, larval abundance and distribution.

3. RESULTS

a) Taxonomy

Twenty seven genera were identified in this study. They belong to three subfamilies: Chironominae (14 genera), Orthocladiinae (9 genera) and Tanypodinae (4 genera). Subsfamilies, genera and tribes are shown in Table 1. Twenty genera are reported from the Zayandehrood River, Iran for the first time (these are marked by an asterisk in the table). The genera: *Chironomus, Cricotopus, Orthocladius, Polypedilum, Ablabesmyia, Cardiocladius* and *Brilla* were reported from ponds around Tehran by Alvary [11].

Table 1. Taxonomic diagram of chironomid larvae identified in nine sites from Zayandehrood River, Iran, in autumn 1998, winter, spring and summer 1999

FAMILY	SUBFAMILY	TRIBE	GENUS
CHIRONOMIDAE	Chironominae	Chironomini	*Chironomus* Meigen *Cryptochironomus** Kieffer *Demicryptochironomus** Lenz *Dicrotendipes** Kieffer *Kiefferulus** Goetghebuer *Microchironomus** Kieffer *Microtendipes** Kieffer *Paratendipes** Kieffer *Phaenopsectra** Kieffer *Polypedilum* Kieffer
		Tanytarsini	*Cladotanytarsus** Kieffer *Paratanytarsus** Thienemann & Bause *Rheotanytarsus** Thienemann & Bause *Tanytarsus** v. d. Wulp
	Orthocladiinae	Metriocenemini	*Parametriocenemus** Goetghebuer
		Orthocladiini	*Brillia* Kieffer *Cardiocladius* Kieffer *Cricotopus* v. d. Wulp *Lapposmittia** Thienemann *Nanocladius** Kieffer *Orthocladius* v. d. Wulp *Paraphaenocladius** Thienemann *Tvetenia** Kieffer
	Tanypodinae	Macropelopiini	*Procladius** Skuse
		Pentaneurini	*Ablabesmyia* Johannsen *Rheopelopia** Fittkan
		Tanypodini	*Tanypus** Meigen

*The genera that are reported from Iran for the first time

In order to describe the identified genera, head capsules and body characteristics of the larvae were studied under the microscope. Furthermore, hand and camera lucida drawings have been made for most of the key characteristics such as antenna, labrum, mandible and mentum, using a compound microscope. Microscopic color photographs were also prepared for each genus. Figs. 2-4 and 5-7 show the drawings and photographs of *Chironomus, Brilla* and *Ablabesmia* as representatives of the three subfamilies. The following short keys were also prepared to identify the three subfamilies and 27 genera.

b) Key to the Chironomidae subfamilies in the Zayandehrood River

1. Antenna retractile. Procercus length 7-8 times of its width. …...……Tanypodinae
- Antenna not retractile. Procercus short. ……..2
2. Ventromental plates well developed and striated. ……....Chironominae

- Ventromental plates very selender and not striated, and or reduced ….Orthocladiinae

c) Key to the Chironomidae genera

Chironominae (Figs. 2 & 5)

1. S I bases always fused and S II located on long pedestal. Antenna invariably 5- segmented. The ventromental plates always present and separated medially by less than width of median tooth……..……..……....11

- S I bases either fused or not, S II either located on long pedestal or antennal seta present, then antenna 6-segmented.Ventromental plates nearly always present, usually widely separated medially. ……..……..……..2

2. S I and S II simple and blade-like. Labral lamella absent. Pecten epipharyngis a simple plate or toothed, commonly small, without tooth. ……...9

- S I usually plumose and wide. S II never blade-like. Labral lamella present and well developed. Pecten epipharyngis is either a wide toothed plate or divided into 3 toothed plates.

……...…….……..3

3. Two pairs of ventral tubules present. Lateral tubules sometimes present. ……. *Chironomus*

- One pair of ventral tubules present. Lateral tubules absent ……..…..……..4

4. Antennae 6 segmented. Lauteborne organs large and placed on segments 2 and 3 ……..…….…….5

- Antenna 5 segmented. Lauteborne organs small and placed on segment 2. ……...6

5. Mentum with 3 pale median teeth. Mandible with 3 inner teeth. Pecten epipharyngis divided into at least 3 parts. …….……..…..…… *Microtendipes*

- Mentum with 4 median pale teeth of equal height. Pectin epipharyngis plates not serrated distally. S I bases fused. ……..…….*Paratendipes*

6. Ventromental plates narrower than mentum. Pectin epipharyngis with less than 13 broad, blunt teeth. ……..… *Dicrotendipes*

- Ventromental plates as wide as or wider than mentum. Pectin-epipharyngis with more than 15 slender, pointed teeth. …….……..7

7. Ventromental plates separated medially by 1/3 of mentum width. S I finely plumose. …… *Kiefferulus*

- Ventromentat plates separated medially by ½ of mentum width. S I plumose in both sides. ...…….……8

8. Mentum has 3 parts. The 4 median teeth set off from rest of mentum and in contact with median ends of ventromental plates ……*Phaenopsectra*

- Mentum undivided. Ventromental plates pointed. ……. *Polypedilum*

9. Premandible bifid, outer 2 or 3 pairs of mental teeth formeing a group, set forward in relation to slope of remaining teeth. Median tooth of mentum trifid.

…….…... *Microchironomus*

- Premandible with at least 3 teeth. Mentum not as above. ……..……..……10

10. Antenna 7 segmented. Mentum with broad, pale median area and 7 pairs of oblique, brown lateral teeth. ……..……..….. *Demicryptochironomus*

- Antenna 5-6 segmented. Pecten epipharyngis a triangular, serrated scale. ……...…….……*Cryptochironomus*

11. Premandible with 3-5 teeth ……..……...… 12

- Premandible with 2 teeth ……..…….... 13

12. Second segment of antenna wedge-shaped, shorter or equal to segment 3. Lauteborn organs large, situated on pedicels that are shorter than organs themselves.

...…… *Cladotanytarsus*

- The second segment of antenna cylindrical, longer than segment 3. Lauteborn organs small, situated on long pedicels. ……..…….……. *Tanytarsus*

13. Pecten epipharyngis with 3-5 rounded or pointed, but unserrated plates. Lauteborn organs placed on very short pedicels. ……..…..…..… *Paratanytarsus*

- Pecten epipharyngis with 3 separate and distally serrated parts or a single broad comb. Lauteborn organs placed on long pedicels. ……..….... *Rheotanytarsus*

Orthodacliinae (Figs. 3 & 6)

1. Mentum with at least 16 teeth. ……..…… *Lapposmittia*

- Mentum with no more than 15 teeth …….……..…2

2. Preanal segment extending backwards over anal segment, such that anal setae are directed posteriorly. ……..……..…….… *Paraphaenocladius*

- Posterior body segments normal. …….……...……..……3

3. Ventromental plates present, extending to the inner teeth laterally. …. *Nanocladius*

- Ventromental plates often reduced. ……..…4

4. S I simple or slightly serrated. Labral lamella not present. First pair of latero-mental teeth longer than the second one, while body setae ½ of the related segment.

……..……..…….… *Cardiocladius*

- S I distinctly bifid, plumose or pectinated. If S I simple, some of the body setae would be at least 1/2 of the related segment……..…….5

5. S I bifid and labral lamella present…….……..…6

- S I plumose, pectinated or simple. Labral lamella may be present……7

6. Some body segments with tufts of setae. …….. *Cricotopus*

- Body segments with only simple setae. ……. *Orthocladius*

7. Labral lamella present as pectinated lobes laying between S I bases and pecten-epipharyngis. ……. *Brillia*

- Labral lamella, if present, either simple or if pectinated, not laying between the bases of S I setae. …… 8

8. Premandible simple. ……..…….….. *Tvetenia*

- Premandible with at least 2 teeth. ……..…….... *Parametriocnemus*

Tanypodinae (Figs. 4 & 7)

1. Head rounded to oval. Dorsomentum with a row of teeth, with or without dorso-mental plates. ……..…….2

- Head longish and slender. Without row of teeth on mentum area…….…. 3

2. Cephalic index almost 1. Mandible expanded in basal ½, apical tooth short, about ½ length of mandible.Pseudoradula absent. Pectenhyopharyngisreduced.

……...…….. *Tanypus*

- Cephalic index less than 0.95. Mandible curved from base to apex, apical tooth at least ½ length of mandibule. M appendage and psuedoradula present. Pecten-hypopharyngis recognizable. ……..…….….. *Procladius*

3. Basal segment of maxillary palp divided into 2-5 segments. ……. *Ablabesmyia*
- Basal segment of maxillary palp not divided. ……..….. *Rheopelopia*

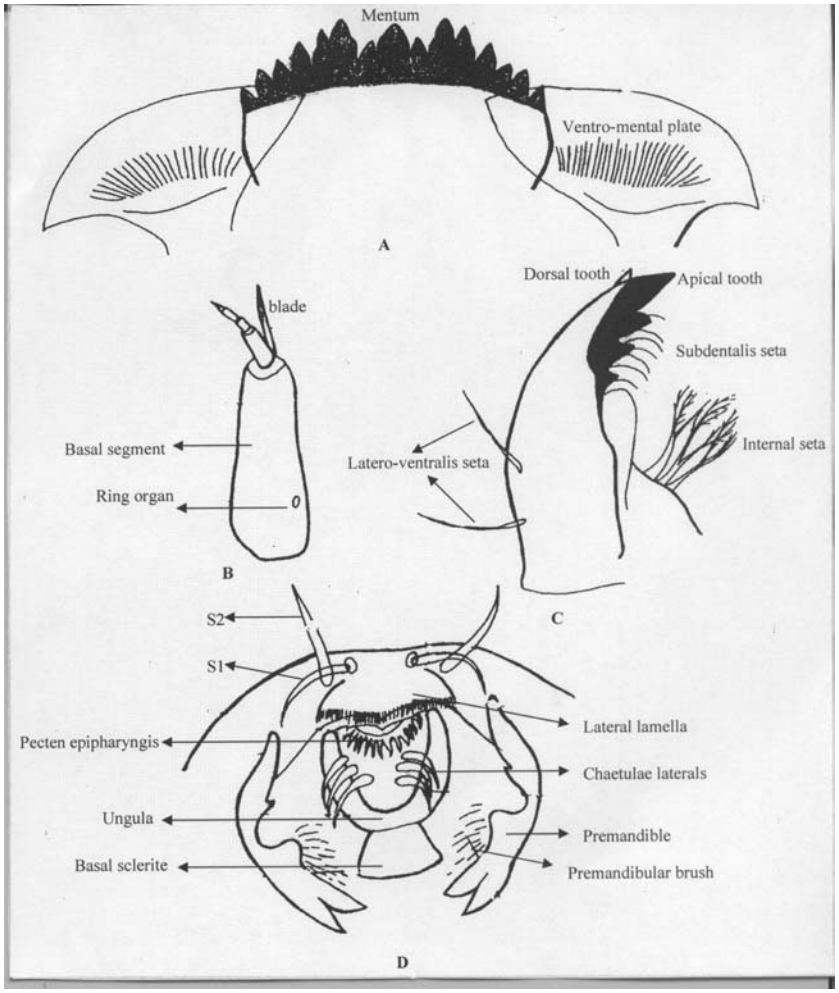

Fig. 2. Chironomus, A. Mentum, B. Antenna, C. Mandible, D. Labro-epipharyngial region

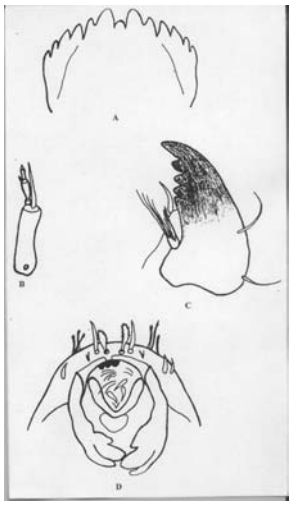

Fig. 3. Brillia, A. Mentum, B. Antenna, C. Mandible, D. Labro-epipharyngial region

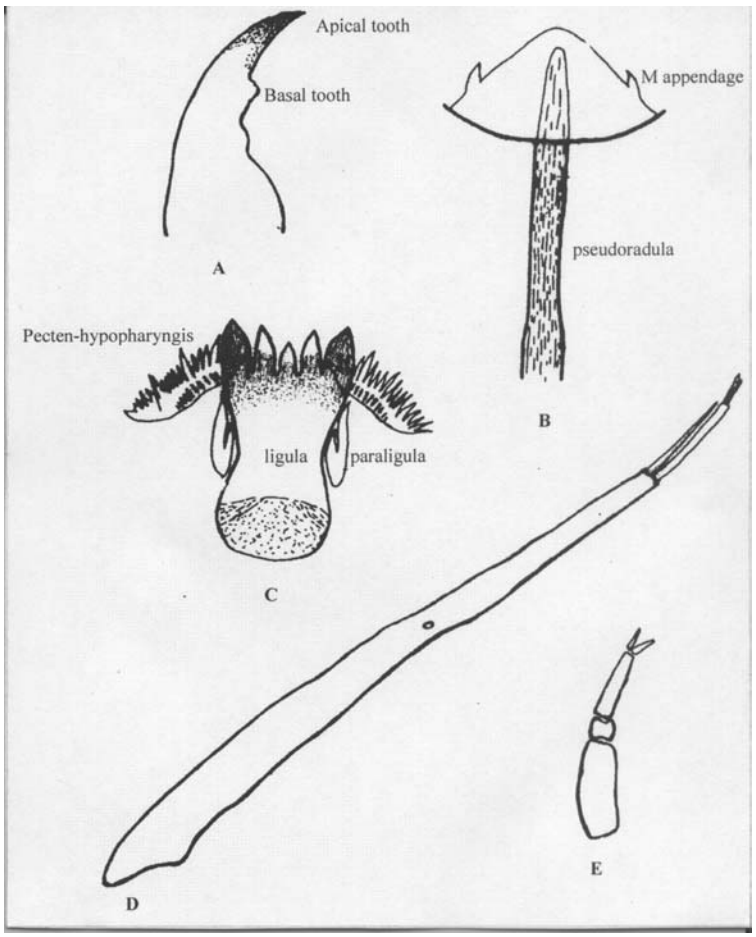

Fig. 4. *Ablabesmia*, A. Mandible, B. Mentum and M appendage, C. Pecten-hypopharyngis, D. Antenna, E. Maxillary palp

Fig. 5. Head capsule of *Chironomus* (x 400)

Fig. 6. Head capsule of *Brillia* (x 400)

Fig. 7. Head capsule of *Ablabesmia* (x 400)

d) Spatial and temporal distribution of the genera

Distribution of the identified genera is very diverse in different sampling sites. Site 4 with 14 genera is the most diverse site. Sites 7 and 8 with 11 and 10 genera are next. Sites 3 and 5 with 7 and 6 genera come after that. Sites 1 and 2 with 2 and 3 genera have the least diversity. Considering the seasonal diversity, 20, 18 and 16 genera were identified from spring, winter and summer, respectively. Autumn with 12 genera is the least diverse season (Table 2).

Table 2. Comparison of the distribution of Chironomidae genera in sites and seasons in Zayandehrood River, Iran (1998-1999)

SUBFAMILY	GENUS	SITE									SEASON			
		1	2	3	4	5	6	7	8	9	Au.	Wi.	Sp.	Su.
Chironominae	*Chironomus*				+		+		+	+	+	+	+	+
	Cryptochironomus				+++			+++	++	+	+	+	+	+
	Demicryptochironomus				+									
	Dicrotendipes				++			+++	+++		+	+	+	+
	Kiefferulus							+		+			+	+
	Microchironomus							+		+				+
	Microtendipes				++++	+					+	+	+	+
	Paratendipes	+											+	
	Phaenopsectra					+						+		
	Polypedilum	++			+				++	+	+	+	+	
	Cladotanytarsus				+								+	+
	Paratanytarsus				+			+++	+++			+	+	+
	Rheotanytarsus			++	+++	+		+++	++		+	+	+	+
	Tanytarsus	+		+				+				+	+	+
Orthocladiinae														
	Parametriocenemus				+	+					+	+		
	Brillia				+							+		
	Cardiocladius			+							+	+	+	+
	Cricotopus							+++	++		+	+	+	
	Lapposmittia					+						+		
	Nanocladius							+					+	
	Orthocladius		+	+	+	+		+	+	+	+	+	+	+
	Paraphaenocladius			+							+	+	+	+
	Tvetenia			+	+						+	+	+	+
Tanypodinae														
	Procladius		+						+				+	
	Ablabesmyia							+				+	+	
	Rheopelopia				+	+						+		+
	Tanypus								+					+

Au: Autumn, Wi: Winter, Sp: Spring, Su: Summer

e) Larval abundance

Mean and standard deviation of chironomid laval abundance from nine sites in four seasons are shown in Table 3. Since the standard deviations were very different, the log mean abundance was used to compare the effects of sites and seasons on larval abundance. The log mean abundances of four seasons are presented in Fig. 8. Larval abundance was lowest in autumn and highest in winter, the number was higher in summer than spring. The log mean of a 1 year abundance for nine sites is presented in Fig. 9. Larval abundance was very low in sites 1 and 2 and highest in site 6. It could be concluded that larval abundance increased downward in the river (except in site 9 that showed a decrease). Furthermore, the two way ANOVA results showed that larval abundance was significantly different in different seasons ($P<0.001$, $df=3$, $F=10.18$). The larval abundance was also significantly different in different sites ($P<0.001$, $df=8$, $F=23.3$).

Table 3. Seasonal Mean and SD* of larval abundance for Chironomidae in nine sites from the Zayandehrood River, Iran

Season Site	Autumn 1998	Winter 1998-1999	Spring 1999	Summer 1999	Total seasons
1	0	10.7	1.3	5.7	4.4
	0	8.3	1.2	9	6.8
2	4.3	1.7	0.7	1.7	2.1
	5.1	2.9	1.2	1.5	3
3	120	417.3	679.7	771	497
	133.3	222.9	1042.2	710.5	609.6
4	2	62.3	164	68.7	74.2
	2.6	44.9	141.7	44.2	89.7
5	29.7	1590	84	10	428.4
	28.5	790.8	37.3	5.3	778.2
6	209.3	349	3076	4146.7	1945.2
	293.5	185.2	751.4	632.9	1839.6
7	528.7	1880	171	51	657.7
	499	1155	38.6	47.6	930.3
8	242.7	1386	374.7	167	541.6
	191.4	644.8	249.1	71	599.3
9	10.3	1046.7	4	6	271.25
	2.1	828.1	1	7.9	588.1
Total sites	127.4	751.3	506.1	580.9	490.9
	243	860.9	1017.8	1332.9	964.5

* In each station first rows Mean, second rows SD

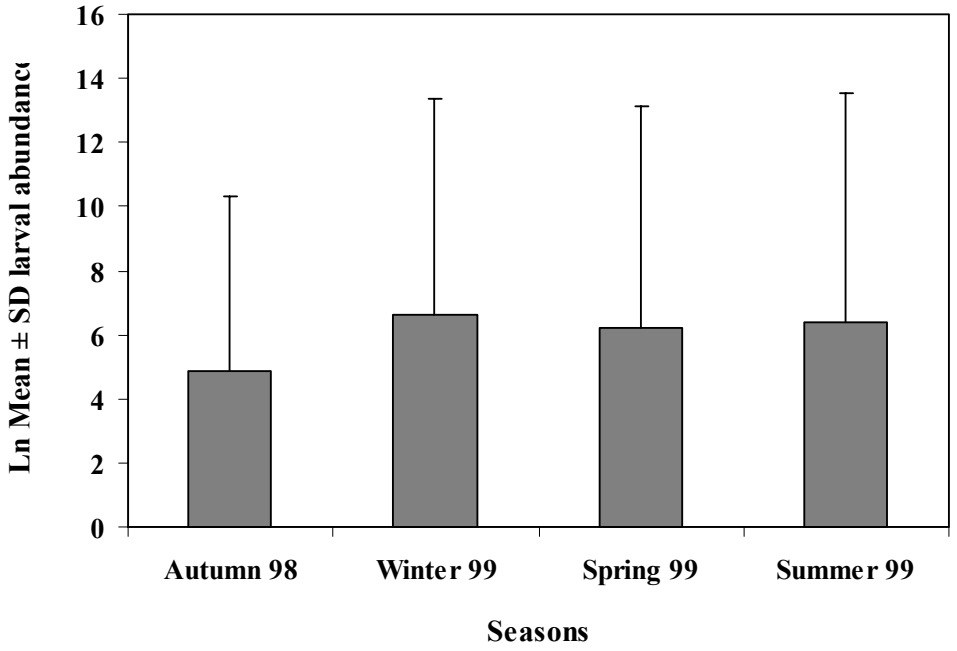

Fig. 8. Mean ± SD larval abundance of Chironomidae in four seasons From the Zayandehrood River, Iran (1998-1999)

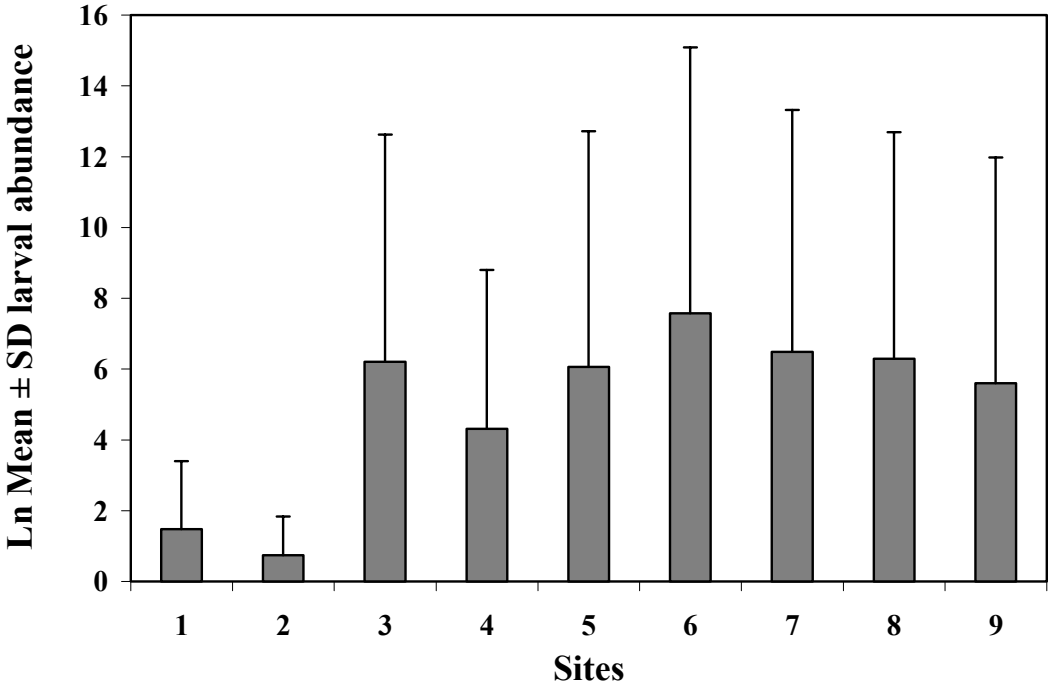

Fig. 9. Mean ± SD larval abundance of Chironomidae in nine sites
From the Zayandehrood River, Iran (1998-1999)

The ecological characteristics of sites in different seasons and the larval abundance are shown in Table 4. The ANOVA results based on these data revealed no significant differences in mean larval abundance for mean velocity ($P<0.19$, $df=1$, $F=1.76$), mean depth ($P<0.16$, $df = 1$, $F=2.01$) and the substrate ($P<0.41$, $df=4$, $F=1.01$). But the vegetation cover had a significant effect on mean larval abundance ($P<0.001$, $df=2$, $F=17.92$). Since the seasonal temperature difference between sites was low, the effect of temperature on larval abundance was ignored.

Table 4. Seasonal Mean larval abundance of Chironomidae and ecological features of the sites from the Zayandehrood River, Iran

Seasons	Sites	Mean abundance	Mean velocity (Cm/s)	Mean depth (Cm)	Temp. (C°)	Substrate *	Vegetation ** cover
Autumn 1998	1	0	109	43	12	C	C
	2	4.3	174	46	15	G	C
	3	120	212	50	14	GC	C
	4	2	133	45	17	GC	A
	5	29.7	131	53	16	S	A
	6	209.3	61	56	19	SI	B
	7	528.7	26	32	16	S	B
	8	242.7	74	32	15	SI	A
	9	10.3	4	34	14	SI	A
Winter 1998-99	1	10.7	101	44	6	S	A
	2	1.7	112	21	7	S	C
	3	417.3	154	31	10	C	A
	4	62.3	212	38	10	S	A
	5	1590	113	30	9	S	A
	6	349	111	27	9	GC	B
	7	1880	72	31	8	S	B
	8	1386	116	24	8	S	B
	9	1046.7	37	34	8	SI	A
Spring 1999	1	1.3	138	46	10	S	A
	2	0.7	163	40	13	GC	A
	3	679.7	199	34	15	GC	A
	4	164	144	77	10	GC	A
	5	84	159	63	13	G	A
	6	3076	76	38	19	SI	B
	7	171	63	35	22	GC	B
	8	374.7	66	36	22	SI	A
	9	4	8	50	20	SI	A
Summer 1999	1	5.7	167	54	17	S	C
	2	1.7	129	30	17	S	C
	3	771	152	32	17	GC	C
	4	68.7	121	60	18	S	A
	5	10	112	37	25	GC	A
	6	4146.7	104	26	27	SI	B
	7	51	3	17	24	SI	A
	8	167	0	13	25	SI	B
	9	6	8	24	22	SI	A

* C=Cobble, G =Gravel, GC =Gravel & Cobble, S=Sand, SI=Silt. **A = no macrophyte, B =macrophyte, C =Cladophora

4. DISCUSSION

a) Taxonomy

Three subfamilies: Chironominae, Orthocladinae and Tanypodinae, were identified from family Chironomidae from the Zayandehrood River. Chironominae with 14 genera was the most diverse subfamily. Alvary (1997) reported 3 genera of this subfamily from which *Chironomus* and *Polypedilum* are included in our study [11]. *Chironomus* has also been reported by Mousavi [10].

Thus, 12 out of 14 genera of the subfamily are being reported by us for the first time (Table 1). Orthocladinae with 9 genera was the medium diverse subfamily. Alvary (1997) reported 6 genera of the subfamily, 4 of which are present in the material of our study [11]. Thus, the remaining 5 genera of our study are being reported for the first time (Table 1). Tanypodinae, with 4 genera, is the least diverse subfamily from which only *Ablabesmia* is reported by Alvary (1997), and the remaining 3 are being reported here for the first time (Table 1) [11]. Hence, from the 27 genera in our study on the Zahyandehrood River, 20 are being reported for the first time from Iran.

b) Ecology

Chironominae genera had a very low diversity in sites 1, 2 and 9. They were absent in site 3. The larvae of this subfamily prefer habitats mostly with soft substrates and plants [21]. The low abundance of the larvae was probably due to the unfavorable conditions of these sites. The vegetation cover was absent from site 9 and the water quality of this site was very low. Water velocity was highest in site 3 (most of the time), which was not favorable to the larvae of this subfamily. *Chironomus* is univoltine species [7] and lives in habitats with high organic matters and low oxygen [22]. Larvae of this genus were found in site 6, which had nearly similar conditions in all seasons [23]. *Chironomus* larval abundance was lowest in autumn compared with other seasons. This was probably due to the emergence of adults from water in the warmer months of summer [24]. The low frequency of the genus in downstream sites was probably due to being drifted. *Cladotanytarsus, Cryptochironomus* and *Demicryptochironomus,* which are well adapted to deeper parts of the river, were found in site 4. Choosing downstream sites for spawning by adults is the main reason for distribution of other Chironominae genera [25].

The Orthocladiinae genera were found in all sites, except site 6. They are multivoltine, found in all seasons [21], and often live on macrophytes and rocky substrates [26]. Although site 6 had the highest quantity of vegetation cover [23], due to high pollution and low current velocity of the site [27], the larvae of this subfamily could not live in an oxygen deficit condition. *Cardiocladius* was found in all seasons in site 4 only. The larvae of this genus are free-living and are found in locations with high speed current [5]. The larvae of *Tvetenia* were found in all seasons. This genus produces more generations in a year and the larvae keep growing in the coldest months of the year [26].

Tanypodinae genera were found in all sites and seasons with low frequency. Unfavorable enviromental conditions could probably be the reason.

Statistical results showed that the larval mean abundance increased from 4.4 upstream (Site 1) to 271.3 toward the downstream (Site 9). Current velocity was very low in downstream sites, so the availability of soft substrate and the accumulation of detritus in these locations was favorable to Chironomidae larvae [28]. Studies by Ebrahimnezhad (1999) and Safaie Moghadam (1993) revealed that pollution and organic matters increase towards the downstream of the river [23, 27]. These areas provide ideal conditions for Chrionomidae larvae [21]. Vodopich and Cowell (1984) also reported that substrates with high organic matter support high populations of chironomid larvae [29]. The frequency of larvae increased exceptionally in site 3 (609.6), but had the highest value in site 6 (1945.2) and decreased in site 9 (271.25). Due to increased salts and water salinity at site 9, it is probable that osmotic regulation of the larvae was disordered, and as a result most of the larvae vanished, leading to a lower larval abundance. The water quality was also low and the substrate was mostly composed of cobbles and pebbles at site 3 [23]. The larvae of Orthocladinae, specially *Cardiocladius*, P*araphaenocladius* and *Tvetenia* which are adapted to such conditions [30], are more abundant at this site. Due to high amounts of organic matter and low oxygen at site 6, the number of

Chironomus was high at this site. *Chironomus* larvae with a high amount of heamoglobine could survive in the low oxygen condition. The number of larvae was lowest (127.4) in autumn and highest (751.3) in winter. The number of larvae was also high in spring and summer, but was higher in summer (580.9) than spring (506.1). Kornijow (1992) suggested that most epiphytic chironomids migrate into substrate in winter, because of water temperature reduction and macrophyte extermination [31]. The larvae of some subfamilies use macrophytes as habitat and also as a feeding place [32].

The results of this study showed that the vegetation cover significantly affected the number of larvae.

Twenty seven genera of Chironomidae larvae were found and identified from the Zayandehrood River in Isfahan. Of these, 20 proved to be the first report from the Zayandehrood River, Iran. Considering the large size of the group, this shows the need for an extensive work on the fauna of these insects in Iran.

The larvae also showed diversity and variation in their occurrence and abundance at different sites and seasons in which they were collected. This variation shows direct relation with some of the conditions of the site/season. Some references introduce effective factors to be different from those which were found as the result of data analysis in this project. This contradiction, plus the vast distribution of this taxon in Iran and a high habitat diversity, call for the continuation of such a study in Iran.

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