TISCIA 35, 49-54

THE DYNAMICS OF CHIRONOMIDAE LARVAE (DIPTERA) AND THE WATER QUALITY IN MERIC RIVER (EDIRNE/TURKEY)

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Ozkan, N. and Camur-Elipek, B. (2006): The dynamics of Chironomidae larvae (Diptera) and the water quality in Meric River (Edirne/Turkey). – *Tiscia 35, 49-54*

Abstract. The dynamics of Chironomidae (Diptera) larvae and some physicochemical features of water were investigated in Meric River (Edirne/Turkey) from September 1995 to August 1996. Also, the relation between the number of larvae and physicochemical parameters as studied.
The larval Chironomidae fauna was found to be 498 individuals in per m^2 for 65 different species. Polypedilum scalaenum was determined to be dominant.
According to Shannon-Wiener diversity index Meric River had diversity 1.23. Furthermore, according to Pearson correlation index, water temperature ($r = +0.71$, $P<0.05$), pH ($r = +0.61$, $P<0.05$) and Chloride ($r = +0.61$, $P<0.05$) had direct proportional while NO_2-N ($r = -0.73$, $P<0.05$) had inverse proportional with the number of larvae.

Key words: Chironomidae larvae, Meric, Maritza, Evros, River.

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Introduction

Larval period of Chironomidae is the longest period of life cycle of these insects. Chironomidae larvae are quite important in production of benthic biomass and they can be found in a many different environments because of their ability to adapt to extremes of some physicochemical composition of water. However, the dynamics and biomass production of these larvae vary in different types of water bodies.

In Turkish streams, Sahin (1980, 1984, 1987, 1991), Tanatmis (1989), Kirgiz and Guher (1992), Ozkan and Kirgiz (1995) discussed the Chironomidae larvae until the present.

In this study, the composition of species and the number of occurrence of Chironomidae larvae in Meric River (Turkey) were examined by considering some ecological factors.

This paper is an introduction to investigations that are planned for the following years in Meric River.

Methods

Study Area

Meric River (Maritza, Evros) is located in European part of Turkey. The river rises in Bulgaria and draws a border among Bulgaria-Greece-Turkey (Fig. 1). Also, it makes an important wetland between Greece and Turkey, and then is poured out to Aegean Sea. The length of the river is 185 km in Turkey. It has 60-520 cm depth and 130-300 m width. Meric River has a lot of tributaries and never dries during summer. The structure of bottom and habitat type varies along the river because it is surrounded by agricultural areas, settlements and a few textile factories. Sewage water of them is poured out to Meric River.

Eight different stations that characterized the river were chosen for this investigation. The material was sampled from these locations between September 1995 and August 1996 at monthly intervals. Nevertheless, the sampling could not been done in February 1996 because of excessive rain.

Station 1: Meric River enters to Turkey from Bulgaria. The structure of bottom consists of sand and mud.

Station 2: There are some Textile Factories around this location. Its bottom has only mud, brownish-black colour of water and fast water flow as compared with the other stations.

Station 3: Arda Stream joints to Meric. The structure of bottom consists of sand and stone.

Station 4: Tunca Stream joints to Meric. Bottom of this location has sand and mud.

Station 5: Edirne city. There are a lot of settlements around this location. Bottom structure consists of sand, mud and detritus.

Station 6: There are a lot of agricultural areas around this location. Water of the river is used for irrigation. The structure of bottom consists of mud and detritus.

Station 7: Also, there are a lot of agricultural areas around this location. Bottom has mud and detritus.

Station 8: Sazlidere Stream which is known as polluted joins to Meric. A lot of industrial factories around Sazlidere are poured out their sewage water to the stream.

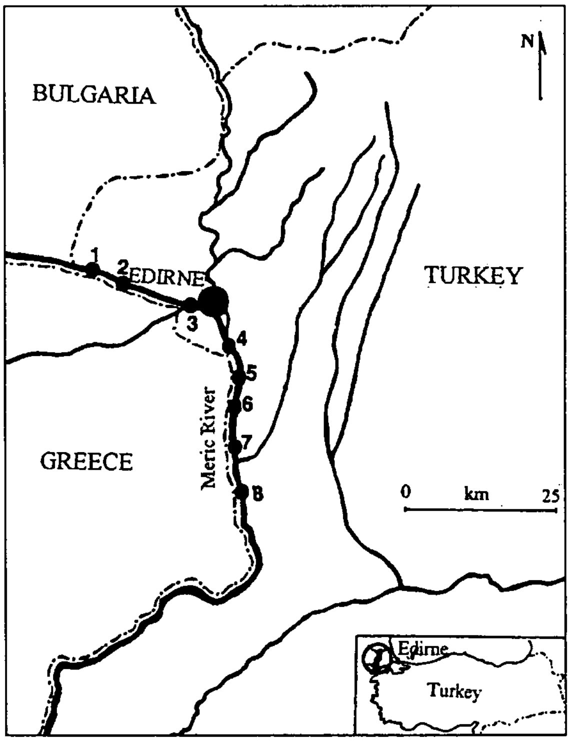

Fig. 1. Geographical situation of Meric River and sampling stations.

Sampling

Samples were collected by using an Ekman Drage (15 cm × 15 cm) twice at each station, sieved on a 0.5 mm sieve and the remaining Chironomidae larvae were preserved in 70 % Ethanol. Larvae were sorted in the laboratory into different species and were evaluated for per m^2. Publications of Chernovskij (1961), Fittkau (1962), Beck and Beck (1969), Bryce and Hobart (1972), Seather (1977), Fittkau and Reiss (1978), Moller and Pillot (1978-1979, 1984), Sahin (1980, 1984, 1987, 1991), Fittkau and Roback (1983), Sahin *et al.* (1988) were utilized for taxonomical diagnosis of the samples. For determining the larval Chironomidae fauna in Meric, sampling was also conducted out of the stations but it was not calculated.

Shannon-Wiener diversity index was applied to obtain statistical data about the distribution of Chironomidae larvae.

Furthermore, preference for substratum type of larvae was recorded.

Distributions of larval Chironomidae in the bottom of river, like other benthic organisms, are related with water qualities. For this aim, at each station water temperature, electrical conductivity and pH of surface water in Meric were measured at the time when benthic sample was taken at monthly. Also, water samples which were taken by a Ruttner water sampler were carried to laboratory in special bottles and dissolved oxygen, biochemical and chemical oxygen demands, Calcium, Magnesium, Chloride, NO_3-N, NO_2-N, Phosphate and Chromium were analyzed.

Pearson correlation index was used to determine if there was any relation between the numbers of Chironomidae larvae and the physicochemical composition of water.

Result and discussion

Between September 1995 and August 1996, 498 individuals in per m^2 for 65 different larval Chironomidae species were found in Meric River (Table 1). The dominant species are *Polypedilum scalaenum* with 24.3% abundancy. It is followed by *P. aberrans* (13.0%), *Chironomus anthracinus* (8.1%) and *Cryptochironomus defectus* (8.1%) (Table 2).

In addition, *Potthastia gaedii, Cryptochironomus conjugens, Zalutschia* sp. and *Micropsectra* sp. were found at outside of the stations.

At all the sampling stations considerable differences were observed for the dynamics of

Table 1. Distribution of Chironomidae larvae in Meric River in the period of investigations as numerically (monthly and stations).

Mths/ Stat	1st	2nd	3rd	4th	5th	6th	7th	8th	Ave	NS	SWI
Aug.	177	-	817	186	112	84	7752	1996	1391	33	1.45
Sep.	243	-	355	71	242	293	216	238	207	16	1.14
Oct.	24	31	1082	34	123	208	498	387	299	13	1.07
Nov.	-	-	82	73	65	38	373	373	124	11	0.99
Dec.	348	38	339	63	-	-	1119	-	239	18	1.22
Jan.	86	-	546	315	284	36	-	-	159	18	1.23
Mar.	322	37	160	84	54	94	-	-	94	15	1.16
Apr.	937	52	175	212	223	399	111	-	264	23	1.32
May	2254	370	410	200	2304	655	1101	2210	1188	35	1.50
Jun.	254	70	359	306	53	183	1228	628	385	19	1.20
Jul.	5616	20	920	244	170	1323	412	380	1136	22	1.28
Ave.	932	56	476	162	330	301	1165	564	498		1.23
NS	36	15	35	27	36	31	35	20			
SWI	1.47	1.13	1.49	1.40	1.50	1.43	1.482	1.21			

(Ave.= Average number of larvae, NS= Number of species, SWI= Shannnon-Wiener Index)

Chironomidae larvae (both species and numbers) because of the fact that the character of different substratum structures and water quality. Species number was the highest at stations 1 and 5 while it was the lowest at station 2. On the other hand, especially at 7th station, the average number of larvae was found very high because it was clear as compared with the other stations. Also, at station 2 average number of Chironomidae larvae was found very poor because of sewage water of the textile factories pours, having a substratum with only mud, brownish-black colour of water and fast water flow as compared with the other stations. Species number was the highest in May while it was the lowest in November. The greatest average number of larvae was observed in summer whereas decreased during winter. It was observed that an average number of larvae increased especially in August, and it decreased in March because of this group have multivoltin species.

These results were also supported by statistically. Shannon-Wiener diversity index was determined the highest at station 5 and in May while was found the lowest at station 2 and in November (Table 1). Although the number of species is equal at stations 1 and 5, the diversity index result is lower at station 1 because of high number of individuals. It is not surprise that the diversity was determined the highest at station 5 because of the hydromorphological structures, type of bottom and habitat conditions are little better which is compared with the others. The reason of the poorest diversity at station 2 is that sewage water of textile factories. As known, Chironomidae larvae are bioindicator in aquatic environments. Only some species live in extreme conditions (like pollution) of water. In this study, only 15 species (*T. punctipennis, Procladius* sp., *Krenopelopia* sp., *C. bicinctus, L. pusillus, C. anthracinus, C. viridicollis, C. plumosus, C. tentans, P. scalaenum, P. nubeculosum, P. convictum, E. pagana, Beckiella* sp. and *P. lauterborni*) were found at station 2 in low number. Diversity index was determined the poorest in November because of the activities of some predator macroinvertebrates increase in this period. Seasonal variations affect the features of the water and the dynamics of benthic macroinvertebrates. Only 11 species (*T. punctipennis, Procladius* sp., *C. bicinctus, C. anthracinus, P. convictum, P. intermedius, P. connectens, M. chloris, R. demeijerei, S. longipugionis*, and *C. defectus*) were found in November while 35 species were found in May.

Furthermore, 49 species were found in substratum with sand (S), 17 species were found in substratum with mud (M), 13 species were found in substratum with sand-mud (SM), 3 species were found in substratum with sand-stone (SSt), 25 species were found in substratum with sand-detritus (SD), 12 species were found in substratum with mud-detritus (MD), 22 species were found in substratum with sand-mud-detritus (SMD), and 5 species were found in every type (E) of substratum (Table 2).

To determine any relation between the number of larvae and the features of the water, some physicochemical parameters were measured in Meric River. Water temperature, pH, Calcium, Magnesium, Chloride and Chromium were found at normal levels in the course of this study. Electrical conductivity was low quality level in November, December and March. Dissolved oxygen was found inverse proportional with water temperature (when the water temperature increased in the summer months,

Table 2. Taxonomical list of larval Chironomidae in Meric River and their dominancy and preference for substratum.

1-*Tanypus punctipennis* (M,SD,MD,SMD) (0.2%)	34-*Chironomus tentans* (S, M, SD, MD, SMD) (1.6%)
2-*Tanypus kraatzi* (SMD) (0.01%)	35-*Polypedilum aberrans* (S, M, SSt, SD) (13.0%)
3-*Procladius* sp. (S, M, SM, SD, MD, SMD) (2.0%)	36-*Polypedilum scalaenum* (E) (24.3%)
4-*Psectrotanypus varius* (S) (0.01%)	37-*Polypedilum nubeculosum* (S, M, SD) (0.6%)
5-*Krenopelopia* sp. (M) (0.01%)	38-*Polypedilum convictum* (S, M, SD, SMD) (0.8%)
6-*Natarsia punctata* (SD) (0.01%)	39-*Polypedilum bicrenatum* (S, SD, SMD) (0.4 %)
7- *Pentaneurella katterjokki* (S) (0.2%)	40-*Polypedilum exsectum* (SM, SSt) (0.4%)
8- *Smittia aquatilis* (S, SD) (0.2%)	41-*Rheocricotopus fuscipes* (S) (0.01%)
9-*Bryophaenocladius virgo* (S) (0.01%)	42-*Einfeldia pagana* (S, SM, SSt, SD, MD) (3.1%)
10- *Cricotopus bicinctus* (E) (2.5%)	43- *Dicrotendipes nervosus* (S, SM, SD) (0.2%)
11-*Cricotopus fuscus* (S, SM) (0.4%)	44-*Dicrotendipes tritomus* (S, M, SD) (0.2%)
12-*Cricotopus flavocinctus* (S) (0.01%)	45- *Parachironomus arcuatus* (S, SMD) (0.4%)
13-*Cricotopus vierriensis* (S, SM) (0.2%)	46-*Parachironomus longiforceps* (S) (0.01%)
14-*Cricotopus annulator* (SMD) (0.01%)	47-*Beckiella* sp. (S, SM, SD) (0.6%)
15-*Cricotopus reversus* (S) (0.01%)	48-*Paratendipes albimanus* (S) (0.01%)
16-*Cricotopus sylvestris* (S, SD, MD, SMD) (1.0%)	49-*Paratendipes intermedius* (S,M,SD, SMD) (4.9%)
17-*Paratrichocladius rufiventris* (S) (0.2%)	50-*Paratendipes* sp.(S, MD, SMD) (0.2%)
18-*Hydrobaenus pilipes* (S, M, SM, MD) (0.4%)	51-*Paratendipes connectens* (S, SD) (0.4%)
19-*Psectrocladius calcaratus* (SD) (0.2%)	52- *Microtendipes chloris* (SD) (0.01%)
20-*Psectrocladius barbimanus* (S) (0.01%)	53- *Robachia demeijerei* (S, SM) (0.2%)
21-*Psectrocladius limbatellus* (S) (0.01%)	54-*Harnischia fuscimana* (S, SM, SMD) (0.8 %)
22-*Psectrocladius stratiotis* (S) (0.01%)	55-*Cryptotendipes holsatus* (MD) (0.01%)
23-*Limnophyes pusillus* (S, SD, MD) (0.4%)	56-*Stictochironomus longipugionis* (S,M,SD) (0.6%)
24-*Microcricotopus bicolor* (S,SM,SMD) (0.8%)	57-*Cryptochironomus defectus* (S,M,SM,SD,SMD) (8.1%)
25-*Thienemaniella vittata* (S) (0.01%)	58-*Cladotanytarsus mancus* (S, M, SMD) (2.4%)
26-*Paracladius conversus* (SMD) (0.01%)	59-*Cryptochironomus* sp. (S, SD, MD, SMD) (0.6%)
27-*Orthocladius thienemanni* (S, SD) (0.8%)	60- *Cryptocladopelma laccophila* (S) (0.2%)
28-*Chironomus halophilus* (S, M, SD) (0.2%)	61-*Cladotanytarsus mancus* (S, M, SMD) (1.2%)
29-*Chironomus reductus* (S, SMD) (0.4%)	62-*Paratanytarsus lauterborni* (S,SM,MD,SMD) (0.6%)
30-*Chironomus thummi* (MD) (0.4%)	63-*Tanytarsus gregarius* (S, M, SD, SMD) (3.3%)
31-*Chironomus anthracinus* (E) (8.1%)	64- *Virgotanytarsus arduensis* (S, M, SMD) (4.9%)
32-*Chironomus viridicollis* (E) (4.9%)	65- *Rheotanytarsus* sp. (S) (0.2%)
33-*Chironomus plumosus* (E) (1.0%)	

(S=Sand, M= Mud, SM=Sand-Mud, SSt=Sand-Stone, SD=Sand-Detritus, MD=Mud-Detritus, SMD=Sand-Mud-Detritus, E=Every type of substratum)

dissolved oxygen was found as low). BOD was generally found at first quality level whereas COD was generally found at second quality level (only at station 2, it had third quality level). NO_3-N was generally found second and third quality levels (only in May and July, it had fist quality level). NO_2-N was generally found at third and fourth quality levels. Phosphate was found at second quality level (Table 3).

According to Pearson correlation index, the value of p was determined as <0.05 for water temperature (r=+0.71), pH (r=+0.61), Chloride (r=+0.61) and NO_2-N (r=-0.73). Otherwise, the relations between the number of Chironomidae larvae and water temperature, pH and Chloride have direct proportional whereas the relation between number of larvae and NO_2-N has inverse proportional. On the other hand, the relation between number of larvae and the other physicochemical values were not found to be statistically significant.

Until the present, there is not a similar to this study which is performed in Meric River in Turkey. If this study is compared to the study which is performed about Chironomidae larvae in the other rivers in Turkish Thrace: Kirgiz and Guher (1992) evaluated total Chironomidae larvae as a group and determined 515 Chironomidae larvae per m^2 in Sazlidere Stream. The other studies are interested in larval Chironomidae only taxonomically.

Industrious factories, settlements, agricultural areas around the Meric River, which can effect qualitative and quantitative distributions of Chironomidae larvae, are potential danger for the river. The pollution of the river is very important for the Meric Wetland and organisms which are living in.

Consequently, limnological studies should be performed periodically in Meric River. We hope, this will be the previous study for the others which are performed in Meric River in the future.

Table 3. Some physicochemical compositions of the water of Meric River in the period of investigation.

Months/Stations Parameters	WT (°C)	E.C. (µS)	pH	D.O. (mg.l^{-1})	BOD (mg.l^{-1})	COD (mg.l^{-1})	Ca^{+2} (mg.l^{-1})	Mg^{+2} (mg.l-1)	Cl^{-1} (mg.l^{-1})	$NO_3^{-1}N$ (mg.l^{-1})	$NO_2^{-1}N$ (mg.l^{-1})	PO_4^{-3} (mg.l^{-1})	Cr^{+6} (mg.l^{-1})
Aug.	26	242	8	7	4	60	57	26	56	17	0.06	0.17	0.04
Sep.	22	257	7	5	3	53	75	21	47	20	0.02	0.14	0.02
Oct.	17	143	7	5	3	46	80	56	47	19	0.01	0.21	0.04
Nov.	8	116	7	6	3	27	61	14	37	9	0.02	0.10	0.01
Dec.	5	110	8	9	4	46	59	18	41	10	0.03	0.09	0.02
Jan.	4	201	7	9	3	12	64	16	45	8	0.03	0.09	0.04
Mar.	5	135	8	10	6	25	60	16	47	10	0.05	0.05	0.07
Apr.	13	155	7	8	3	46	48	16	45	8	0.06	0.12	0.04
May	20	205	8	5	2	38	50	14	44	6	0.19	0.07	0.02
Jun.	26	284	7	5	3	51	75	19	50	9	0.05	0.12	0.03
Jul.	29	385	8	12	11	57	42	20	81	3	0.24	0.04	0.08
1st station	15	175	8	7	3	45	58	25	38	15	0.03	0.13	0.03
2nd station	15	200	7	7	4	68	61	24	51	15	0.09	0.12	0.04
3rd station	15	171	7	8	3	38	49	17	36	7	0.02	0.05	0.03
4th station	16	222	7	8	4	44	69	26	56	14	0.05	0.12	0.03
5th station	16	203	7	8	5	36	64	23	51	12	0.04	0.12	0.03
6th station	17	213	8	8	5	32	63	22	47	11	0.09	0.13	0.03
7th station	17	217	7	8	4	31	60	16	54	8	0.05	0.05	0.04
8th station	17	226	7	7	4	38	61	16	57	6	0.17	0.14	0.06

(WT=Water temperature, E.C.: Electrical conductivity, D.O.: Dissolved oxygen, BOD: Biochemical oxygen demand, COD: Chemical oxygen demand)

Acknowledgement

We would like to thank T. Kirgiz for his guidance. This paper is a part of Ozkan's PhD Thesis.

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