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The Chironomid Limnofauna (Diptera, Chironomidae) a part of Kızılırmak River near Nevsehir (Turkey)

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Abstract: Samples of Chironomid larvae were collected at five stations between August 2013 and May 2014 seasonally. A total of 11 taxa belonging to three subfamilies of Chironomidae were recorded. The average proportions of the total larvae were 97.68% Chironominae, 2.06% Orthocladiinae, and 0.26% Tanypodinae. Chironomidae communities at most sites were dominated by gatherers-collector. The most abundant taxa were Tribelos intextum (51.80%), Tanytarsus gregarius (19.33%) and Polypedilum nubeculosum (12.37%). Tanypus puctipennis were found in Site 1 only with one individual.

Keywords: Nevsehir, Macroinvertebrates, Chironomid larvae, Kızılırmak river.

Introduction

Macroinvertebrates are one of the key groups of organisms recommended by the European Union Water Framework Directive 2000/60/EC (WFD) for assessment of ecological status of surface waters (CEC, 2000). The variability of environmental conditions under which Chironomids are found is more extensive than for any other group of aquatic insects (Shandoock and Al-Sariy, 2014). Chironomidae are probably the most widely distributed and species rich family constituting between 10% and 50% of the biomass of aquatic macro-invertebrates (Odume and Muller, 2011). Immature stages of Chironomidae generally live on or in the sediment, feeding on organic detritus and associated microfauna and micro-flora.

Chironomidae occupies an important position in the trophic dynamics of aquatic ecosystem, recycling nutrients in the sediment and modifying the composition of particulate organic matter (Silva et al., 2008). Chironomid larvae are especially important as a significant food source in winter food webs because of the scarcity of other food sources during this time (Benigno and Sommer, 2008).

In this study, the species composition and the number of occurrence of Chironomid larvae in Kızılırmak River (Turkey) were discussed by considering feeding ecological factors.

Materials and Methods

The samples of Chironomid larvae were seasonally collected at five sites between August 2013 and May 2014. The catchment area total basin of the Kızılırmak River is about 78180 km^2, and has 1355 km length. The study area is located in Nevşehir city (Fig. 1). This part of the river is also the dumping zone for domestic effluents of the nearby settlements.

Samples were collected with a 0.5 mm mesh sized hand net. Samples were collected from each site to represent all of the substrate types of each area. A total of 20 samples were collected.

Chironomids and other macroinvertebrates were separated from substrate materials in samples using a sieve of 250 μm, and using thin long-nosed tweezers; sieved specimens were then fixed in 4% formalin. The samples brought to the laboratory were divided into groups and then preserved in 70% ethyl alcohol solution (Welch, 1948). Samples were sorted, identified and enumerated in the laboratory using both dissecting and compound microscopes. With the exception of damaged/incomplete specimens, all Chironomid larvae

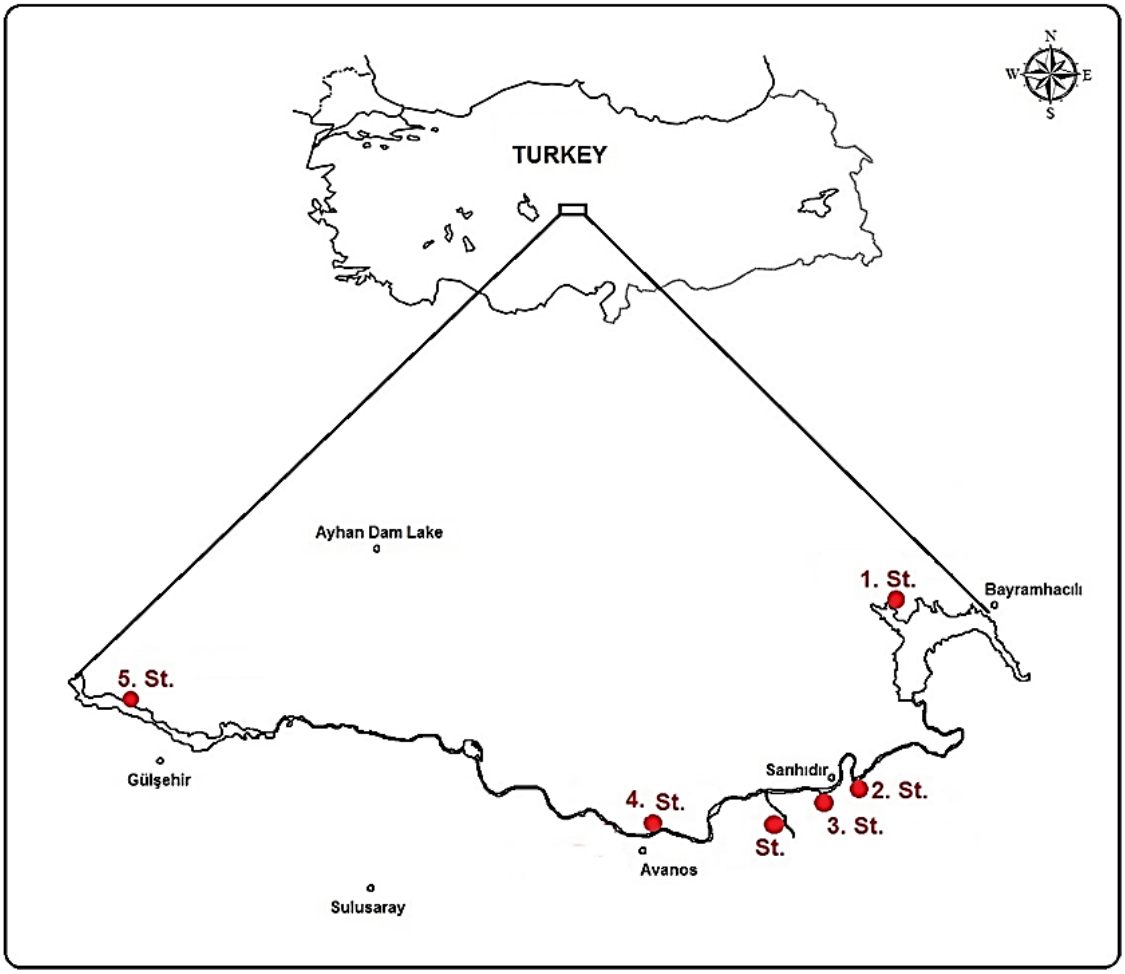

Figure 1. The sampling stations of the Kızılırmak River located in Nevsehir.

sorted from benthic samples were identified to the lowest possible taxonomic level, usually to genus or species. The chironomid larvae were fixed on slides with glycerol, separating the head capsule from the rest of the body. The taxa were identified using the keys of Epler (2001), Wiederholm (1983) and Orendt and Spies (2012).

Each taxon was assigned to a functional feeding group (shredder-herbivore (SH), collector-gatherer (GC), collector-filterer (CF) or predator (P)) according to Merritt and Cummins (1996a; b), Barbour et al. (1999) and Cummins and Merritt (2005). The average density (number of individuals per m^2) of Chironomid taxa was calculated for each site.

Results

The relative abundance and distribution of chironomid species recorded at each of the sampling sites during each of the sampling seasons are presented in Table 1. In winter, chironomid larvae was not found at sites.

A total of 388 individuals, 11 taxa, 11 genera and 3 subfamilies (Chironominae, Tanypodinae and Orthocladiinae) of chironomid larvae were found. The chironomid larvae of the Kızılırmak River mainly consisted of Chironominae comprising 97.68% abundance (9 taxa) of the total chironomid larvae. This was followed by Orthocladiinae and Tanypodinae comprising 2.06% (1 taxa) and 0.26% abundance (1 taxa), respectively.

The results showed that *Tribelos intextum* (201 individuals total) was the most abundant species within the chironomid assemblage. *Tanypus puctipennis* was the rarest species (1 larvae total). Different species were found in study sites. The species *Polypedilum nubeculosum* was found only at two sites.

The highest diversity of taxa richness (7 taxa) was found at Site 1 followed by Site 5 and the lowest richness (1 taxa) occurred at Sites 2, 3 and 4. The greatest average number of larvae was observed in summer whereas

Table 1. Relative abundance and distribution of chironomids sampled during the sampling seasons at each of the sampling sites in the Kızılırmak River. Abbreviations: SP = spring, SU = summer, AU = autumn.

Taxon	Site 1 (S1)			Site 2 (S2)			Site 3 (S3)			Site 4 (S4)			Site 5 (S5)		
	SU	AU	SP	SU	AU	SP	SU	AU	SP	SU	AU	SP	SU	AU	SP
Chironominae															
Polypedilum nubeculosum (Meigen, 1804)	29.75		100												
Dicrotendipes fumidus (Johannsen, 1905)															20
Tribelos intextum (Walker, 1856)													100		
Cryptotendipes holsatus Lenz, 1959					100										
Cryptochironomus defectus (Kieffer, 1918)	3.80														
Cladopelma sp	12.03														
Tanytarsus gregarious (Kieffer, 1909)	45.56									100					
Paracladopelma sp.								100							
Microchironomus sp.	8.22														
Tanypodinae															
Tanypus puctipennis Meigen, 1818	0.64														
Orthocladinae															
Cricotopus bicinctus Meigen, 1818															80
Number of taxa	6	-	1	-	1	-	-	1	-	1	-	-	1	-	2
Total	158		1		1			14		3			201		10

Table 2. Functional Feeding Groups of Chironomid larvae.

Taxa	Functional Feeding Groups	
Polypedilum nubeculosum		GC
Cryptochironomus defectus		P
Cladopelma sp		GC
Tanytarsus gregarius		CF
Microchironomus sp		GC
Tanypus puctipennis		P
Tribelos intextum		GC
Cryptotendipes holsatus		GC
Paracladopelma sp		GC
Dicrotendipes fumidus		GF
Cricotopus bicinctus		GC
Proportion of functional feeding taxa	GC	63.64
	P	18.18
	CF	9.09
	GF	9.09

decreased during the other seasons. Considering the seasonal diversity, 7, 2 and 3 species were identified from summer, autumn, and spring respectively. Autumn with 2 species is the lowest diverse season (Table 1).

The functional feeding groups (shredder, collector-gatherer, collector-filterer, scraper or predator) according to Merritt and Cummins (1996a; b), Barbour et al. (1999) and Cummins and Merritt (2005) are shown in Table 2. Gatherers-collectors (GC) predominate the feeding groups with 63.64% in the river. Predators represent

18.18%, collectors-filterers 9.09% and gatherers-filterers 9.09%.

Discussion

The relative abundance and distribution of chironomid species recorded at each of the sampling sites during each of the sampling seasons are presented in Table 1. In winter, chironomid larvae was not found at sampling sites. A total of 388 individuals, 11 taxa, 11 genera and 3 subfamilies (Chironominae, Tanypodinae and Orthocladiinae) of chironomid larvae were found. The chironomid larvae of the Kızılırmak River mainly consisted of Chironominae comprising 97.68% abundance (9 taxa) of the total chironomid larvae. This was followed by Orthocladiinae and

Three subfamilies, including Chironominae, Orthocladinae and Tanypodinae were identified from the Kızılırmak River. Chironominae was the most diverse subfamily with 9 species. The larvae also showed variations 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. Chironomid communities in Kızılırmak River are deeply affected by high organic matter and nutrient enrichment which cause seasonal fluctuations in both physicochemical and biological conditions. The results are in agreement with Odume and Muller (2011) who reported more Chironominae in polluted waters. Settlements and agricultural areas around the Nevsehir city, which can effect negative qualitative and quantitative distributions of Chironomid larvae, are potential danger for the river life.

The highest mean densities of chironomids were observed in S5 and S1 respectively. S5 and S1 stations may be attributed to the increase in wasted waters from settlements and agricultural areas. Flow rate of both of the sites was extremely slow. Bottom of the sites were composed of mainly mud and organic matter. The observed results showed that agricultural activities, sewage system and uncontrollable anthropogenic deposits influence the structure of the chironomid community positively resulting in high individual number and low taxonomic diversity. The impact of organic pollution on the reduction of both chironomid species and richness in this study are consistent with the findings of Özkan et al. (2010) and Arslan et al. (2010) who reported similar trends.

Large numbers of pollution-tolerant chironomids are often indicative of poor water quality (characterized by low dissolved oxygen and high nutrient concentrations) (Langdon et al., 2006).

Seasonal variations affect the quality of the water and the dynamics of benthic macroinvertebrates. Only 3 species (*Cricotopus bicinctus*, *Dicrotendipes fumidus*, and *Polypedilum nubeculosum*) were found in spring while 7 species were found in summer. Chironomid maturation, flow rate, temperature and the other factors are because of this.

Tribelos intextum was the most numerous organisms in our study. *Tribelos* genus of Chironominae prefers organic pollution and soft acid water generally. They are associated with water that is polluted by both agricultural and sewage inputs (Rae, 1989).

Cricotopus bicinctus which is species of Orthocladinae, also abundant in the enriched reach, has been reported in great numbers under high enrichment caused by organic pollution (Maasri et al., 2008).

There was a high proportion of gatherers-collectors and which included 7 taxa in our study. The high proportion of gatherers-collectors was probably related to the abundant organic matter, which is supplemented by fine particulate allochthonous inputs of agricultural origin that usually offer considerable nutritional value. As is known, macroinvertebrates may change their mode of feeding on food availability, quality and even ontogeny (Rawer-Jost et al., 2000).

Tanypodinae, are commonly depicted as predators on other benthic macroinvertebrates. *Tanypus puctipennis* species is one of the predators by 1 ind/m^2 in our study. Although most instance of predation is attributed to Tanypodinae, *Cryptochironomus* is frequently reported to feed primarily on animal material (Armitage et al., 1995). In our study *Cryptochironomus defectus* was the most abundant predator by 6 ind/m^2.

The present results showed that the study area is exposed to organic pollution load. In general, gatherers-collectors were predominant in the place where with low flow speed and high organic matter.

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