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Distribution of Chironomidae (Diptera) Larvae in Hazar Lake, Turkey

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Abstract

Density and species composition of chironomidae larvae fauna at different depths in Hazar Lake were studied. Sampling was monthly done from June 2002 to May 2003. Totaly 10 species were determined belonging to subfamilies Tanypodinae and Chironominae of family Chironomidae. *Chironomus plumosus* (32%) were the most abundant of chironomidae larvae and dominated at all depths. Chironomidae larvae showed considerable seasonal variations abundance. Non-parametric test of total abundance showed a significant seasonal ($F= 11$, $P<0.01$) and depth effect ($F= 4$, $P<0.05$). The quantitative data on distribution of chironomid larvae were analyzed in relation to the environmental parameters.

Key words: Chironomidae larvae, seasonal variation, depth distribution, Hazar Lake

INTRODUCTION

The bottom sediment in a freshwater lake is a highly dynamic system where several groups of organisms coexist. For the majority of those lakes where the benthic communities have been studied, insects and particularly their larval stages are a very important component of the benthos community in terms of biomass and energy transference [1, 2].

The abundance of insects and their organisms in the benthos varies according to many factors (acting alone or in combination) such as the distance from the littoral zone, depth, oxygenation and water quality, predation by certain groups, sediment composition, altitude of the lake and the organisms life history [3, 4].

Chironomids are the most abundant and species reach invertebrate group in freshwater. In many aquatic habitats this group constitutes more than half of the total number of macroinvertebrate species present [5]. Chironomids are also one of the most important food item for fish and waterbirds and thus of great significance in the structure and function of lake and river ecosystems. The predictable response of certain species to different levels of a variety of pollutants has resulted in the use of larval chironomids as biological indicators of water quality. Among the benthic organisms moreutilized in the classification of the lakes are the Chironomidae [6, 7].

The purpose of this study was to determine the species composition, population density, and depth related distribution of the chironomidae larvae fauna from the Hazar Lake (Turkey).

MATERIAL AND METHODS

Hazar Lake in one of the largest lakes in the Eastern Anatolia situated 1248 m above the sea level. The lake is 20 km long and 4 km wide located in a tectonic depression between the Taurus mountain. Its surface area is 78.440.625 m^2 and its basin covers an area of 273 km^2. At maximum water level (1242 m), the maximum volume of water of the lake is $7X10^9$ m^3 [Fig. 1]. Different figures between 80 m and 3000 m are given for its maximum depth whilst average depth of the lake is calculated as 93 m [8].

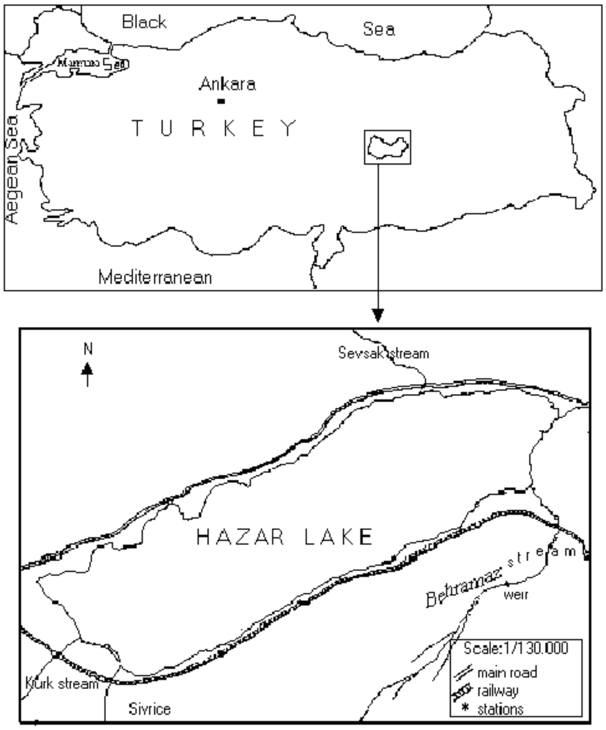

Figure 1. Map of Hazar Lake

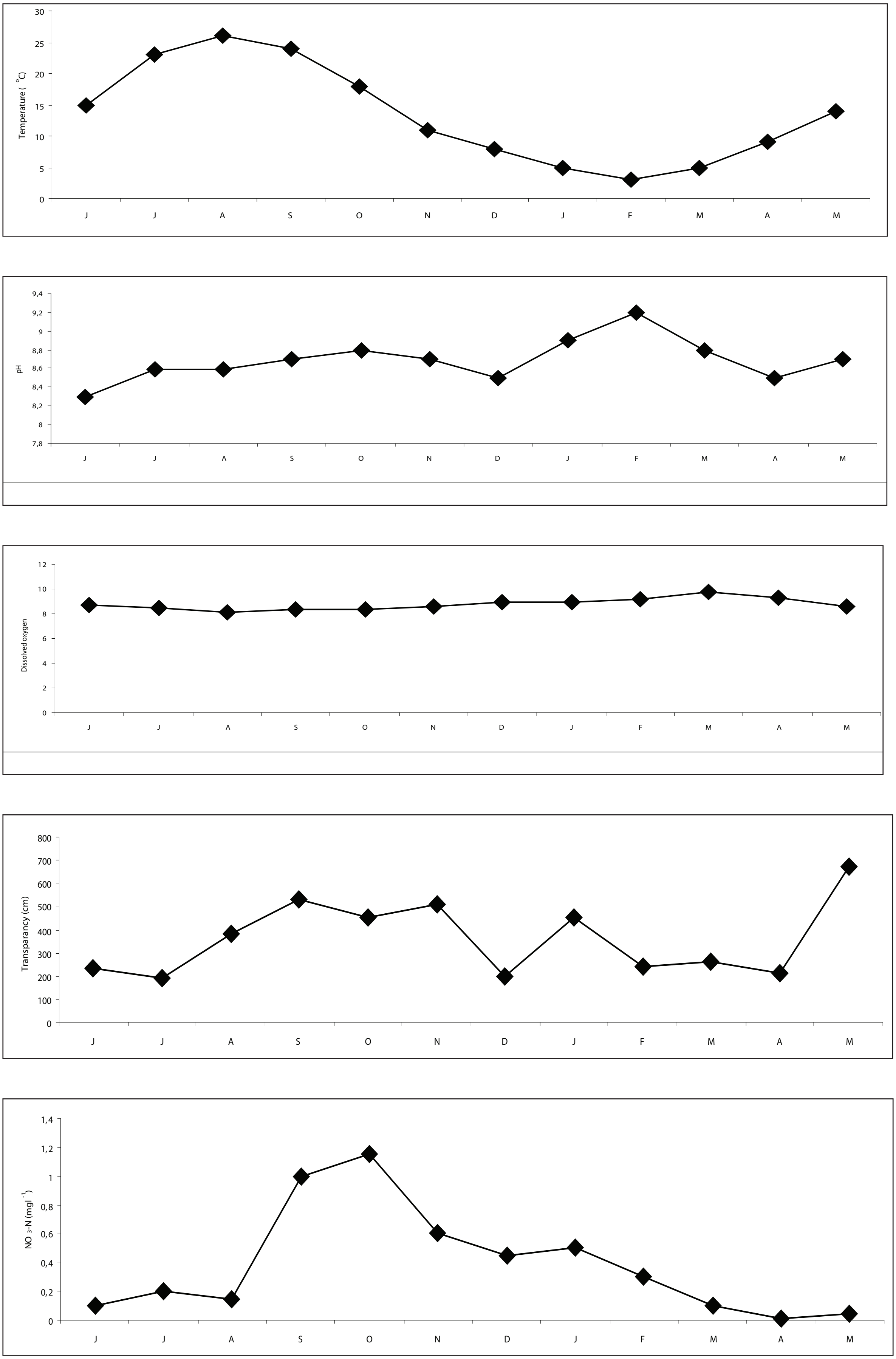

Figure 2. Seasonal variations in water temperature, pH, dissolved oxygen, transparancy and NO3-N in the Hazar Lake, from 2002 to May 2003.

In this study, chironomidae larvae were collected monthly from June 2002 to May 2003 a 5 different depths in the Hazar Lake. The collect of samples used Ekman's grab. Chironomidae larvae samples were fixed with 4% neutralized formaldehyde. Various environmental parameters were also at Hazar Lake. Identification and count of chironomidae larvae were performed under a dissecting microscope. For statistical comparison between months and depths abundances of chironomidae larvae, non-parametric test using SPSS programme was applied and p-values of less than 0.05 was considered statistically significant. Correlation between abundances of chironomidae larvae and the environmental variables (surface water temperature, pH, dissolved oxygen, transparency, NO_3-N) was examined by Pearson rank correlation analysis.

RESULTS

Environmental

The surface water temperature showed seasonal variation, ranging from 3 ^{o}C (minimum) in February to 26 ^{o}C (maximum) in August [Fig. 2]. Transparency values ranged from 190 cm (minimum) in July to 670 cm (maximum) in May [Fig. 2]. Dissolved oxygen 8.1 – 9.8 mgl^{-1}, pH (8.3 – 9.2) and NO_3-N (0.01 – 0.20 mgl^{-1}) did not vary significantly during June 2002 – May 2003 (Fig. 2).

Abundance

Chironomidae from Hazar Lake were represented by 10 taxa belonging to two subfamilies; Tanypodinae and Chironominae [Table 1]. The subfamily Chironominae (7 taxa) was the more varing. Also, Chironominae was the more abundant subfamily with 58.93% than Tanypodinae (41.07%). Chironomidae larvae were the most diverse at 5 m depth (9 taxa) and the least diverse at 15 m depth (4 taxa) [Table 1]. Comparing different depths [Table 1] 5 m depth was largest number of Chironomidae species (9 taxa).

Average abundance of Chironomidae, varied from 2206 ind/m^2 in june to 178 ind/m^2 in october. Comparing different depths chironomids were the most abundant at 10 m depth (3213 ind/m^2) [Table 2]. The most abundant species of Chironomidae were the following: *Chironomus plumosus*, *Tanypus punctipennis* and *Procladius* sp. with 43.85%, 19.38% and 14.28% contribution of Chironomidae total mean density, respectively [Table 3].

Table 1. Species composition of chironomidae larvae in different depths of Hazar Lake

Diptera_ Chironomidae Species	5 m	10 m	15 m	20 m	25 m	All depths
Subfamily: Tanypodinae						
Tanypus sp.	+	+			+	
Tanypus punctipennis Mg.	+	+	+	+	+	+
Procladius sp.	+	+	+	+	+	+
Subfamily: Chironominae						
Chironomus lulmosus L.	+	+	+	+	+	+
Cryptochironomus defectus K.	+	+		+	+	
Stictochironomus histrio Fabr.	+	+		+	+	
Paratanytarsus lauterborni K.	+					
Cladotanytarsus mancus (Walk)		+				
Chironomus thummi K.	+					
Chironomus holsatus Lenz	+	+	+			

Table 2. Mean density and number of Chironomidae species on different depths in Hazar Lake

Subfamily	5 m	10 m	15 m	20 m	25 m
Tanypodinae	3	3	2	2	3
Chironominae	6	5	2	3	3
Total number of species	9	8	4	5	6
Mean density	3097	3213	2383	1998	1229

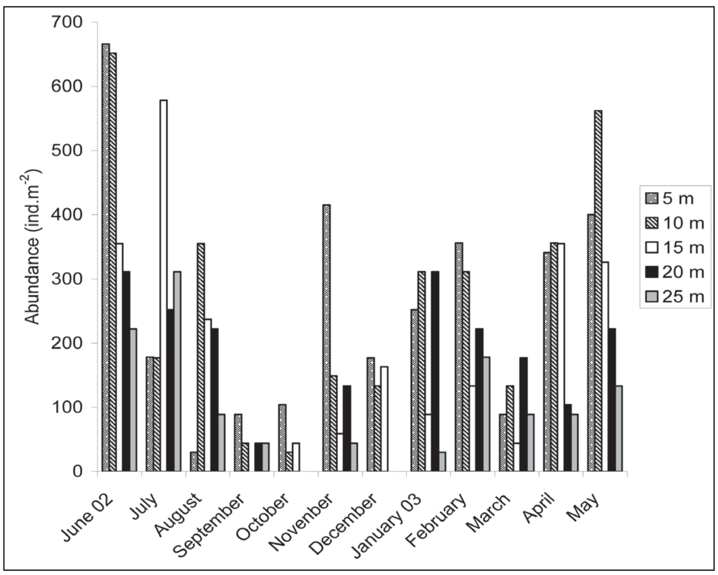

Figure 3. Monthly and depth variation in abundance of Chironomoid larvae.

Table 3. Relative contribution (% of total mean density) of the chironomidae species in Hazar Lake

Diptera-Chironomidae	Relative Contribution (% of total mean density
Tanypus sp.	6.46%
Tanypus punctipennis Mg.	19.38%
Procladius sp.	14.38%
Chironomus plumosus L.	43.85%
Cryptochironomus defectus K.	5.46%
Stictochironomus histrio Fabr.	3.74%
Paratanytarsus lauterborni K.	1.39%
Cladotanytarsus mancus (Walk)	0.25%
Chironomus thummi K.	0.62%
Chironomus holsatus Lenz	4.47%
Total	100%

When seasonal variations inquisition, the lowest number of Chironomidae larvae was found in autumn, while the highest number was observed in summer [Fig.3]. Analyses of seasonal variations of Chironomidae larvae showed [Fig. 3]. Non-parametric test for Chironomidae larvae showed that season ($P<0.01$) and depth ($P<0.05$) had a significant effect on abundance.

The result of the Pearson correlation demonstrated that the dissolved oxygen, pH and transparancy did not with the Chironomidae larvae, and surface water temperature ($P<0.05$) and NO_3-N ($P<0.01$)correlated with the Chironomidae larvae.

The result in presented paper suggested that the timing of maximum and minimum abundance for Chironomidae larvae is determined by temperature, depth and NO_3-N.

DISCUSSION

The present study provides a comprehensive picture of distribution in time (annual) and depth of populations of Chironomidae larvae in relation to the environmental parameters in the Hazar Lake.

In this investigation, we found that abundance Chironomidae larvae [Fig.3] were significantly by season and depth. Chironomidae larvae at 5 m and 10 m depths reached a maximum in summer months.

For most lakes and reservoirs, both the abundance and the number of Chironomidae species are highest in the littoral zone and decreases as the depth increases [9]. In fact, Chironomidae usually live in zones less than 10 meters deep, with only few species going down to 30 m [9]. Distribution obviously reflects the ecological characteristics of the different beds in the littoral region [10]. In Hazar Lake too, distribution of the Chironomidae species was mainly related to depth. Namely, chironomids were much more abundant at 5 and 10 meters deep. Also, higher number of Chironomidae species was founded in littoral layers of Hazar Lake than in the deeper layers [Table 2]. This is probably due to heterogeneous distribution of bottom sediment to the homogeneous condition in deep layers. Literature data also showed that the mentioned species are presented in profundal of many other lakes and reservoirs [11] where they are probably adapted to hypolimnetic conditions of reduced oxygen content during summer stratification.

Mentioned *Chironomus plumosus* was dominant Chironomidae species in Hazar Lake, presented in all depth. *Chironomus plumosus* was much more abundant in deeper than in littoral layers. *Chironomus plumosus* larvae are more common in eutrophic reservoir with a lower oxygen concentracion in the bottom water, and the capacity of these insects to live at very low oxygen concentrations and their anoxic metabolism are well known [12].

These results indicate better condition in littoral and appreciable worsening of the environmental conditions in the deepest part of the lake. Namely, strong summer-autumnal hypolimnetic deoxygenating limited the diversity of the chironomidae fauna in the deeper part of the lake.

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