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Research Article

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Seasonal Dynamics of the Zooplankton Community in the Ikizcetepeler Reservoir (Balıkesir, Turkey) Related to Certain Physicochemical Parameters

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Abstract Seasonal dynamics in the zooplankton community and its relations with certain physicochemical parameters (water temperature, Secchidisk transparency, conductivity, total nitrogen (TN), total phosphorus (TP), pH and chlorophyll-a) were studied in the eutrophic Ikizcetepeler Reservoir from February 2007 to March 2008. *Daphnia longispina, Bosmina longirostris, Ceriodaphnia pulcella* and *Cyclops vicinus* was dominant throughout the year; *Acanthocyclops robustus* was dominant in fall and summer and *Asplanchna priodonta* was dominant in fall and spring at all stations. Canonical correspondence analysis (CCA) showed that *Cyclops vicinus* had high correlations to water temperature, *Bosmina longirostris* and *Daphnia longispina* were correlated to pH the dominant species were cosmopolitan and characteristic to the eutrophic temperate lake zooplankton community members.

Keywords Canonical correspondence analysis, Ikizcetepeler Reservoir, physicochemical parameters, zooplankton

Introduction

The functioning of an aquatic ecosystem depends mainly on the biological diversity of the system [1]. Zooplankton community is an important biotic component of aquatic ecosystems, as it occupies a critical link between primary producers and consumers and significantly contributes to the recycling of nutrients [2].

The major freshwater zooplankton groups are Cladocera, Copepoda and Rotifera. Many rotifers are sensitive to environmental changes and are indicators of water quality [3]. Cladocerans are known for their ability to survive in extreme conditions [4]. Copepods are key prey items for the young fish and they feed on intermediate consumers, mainly ciliates [5-6]. Contrary to filter feeders, copepods can select their food particles individually based on size, motility and chemical quality [7].

The distribution and diversity of zooplankton in aquatic ecosystem depend mainly on the distribution of phytoplankton and the physicochemical properties of the water [8]. The temporal variations may depend on changes in the availability of edible phytoplankton which often vary depending on the physical processes and nutrient availability [9].

The inadequate knowledge of plankton and their dynamics is a major handicap for a better understanding of the functioning and structure of freshwater bodies. An understanding of such patterns will better allow us to predict the dynamics of zooplankton community structure under future scenarios of anthropogenically induced changes in lake and reservoirs. The goal of this study was to assess the seasonal dynamics of zooplankton community in relation to certain physical, chemical and biological parameters in the eutrophic Ikizcetepeler Reservoir, Balıkesir, Turkey.

Materials and Methods

Study Area

Ikizcetepeler Reservoir is a mesotrophic [10] man-made lake with annual mean chlorophyll concentration of 5.5 µg L^{-1} and Secchi disk depth of 1.75 m. It is located at latitude of 39º 29' N and longitude of 27° 56' E, 15 kilometers southwest of Balıkesir, Turkey (Fig. I). It is 175 m above the sea level. The reservoir has a maximum depth of 25 m, a length of 6.34 km and a surface area of 10 km^2. It is mainly fed by Kile Stream. The maximum inflow (5 10^3 m^3 s^{-1}) to the reservoir occurred in spring and the minimum (25 m^3 s^{-1}) in fall. The reservoir was built in 1992 and it is used for irrigation and drinking water [11].

Figure 1: The map of the Ikizcetepeler Reservoir and the location of sampling stations

Sampling Procedure and Analysis

Sampling was started in February 2007 and ended in March 2008. Zooplankton was sampled with vertical net hauls using a 0.30 m diameter net with 60 μm mesh size at three stations. Vertical tows were carried out from the bottom to the surface. Samples were fixed and preserved with 4%formaldehyde in 500 ml plastic bottles immediately after collection.

Zooplankton specimens were identified and counted under an inverted microscope in the Plankton Laboratory of the Fisheries Faculty, Mustafa Kemal University, Iskenderun, Turkey. Counting was done in Petri dishes from 4 ml sub-samples. The following taxonomic keys were used for zooplankton identification: Stemberger (1979) [12] and Koste (1978) [13] for Rotifera; Borutsky (1964) [14], Dussart (1969)[15] and Kiefer (1978) [16] for Copepoda; Scourfield, Harding (1966) [17], Negrea (1983) [18] and Amoros (1984) [19] for Cladocera.

Measurements of water temperature, conductivity, pH and chlorophyll-*a* were taken using a YSI water quality multi-probe. Water transparency was measured using a Secchi disk. Total phosphorus (TP) concentrations were determined from non-filtered water as orthophosphateafter persulphate-acid hydrolysis at 135 ◦C for 2 h. Total nitrogen (TN) concentrations were determined from water samples after digestion by the Kjeldahl method [20].

Canonical Correspondence Analysis (CCA) was applied to the data to determine the relationships between the dominant zooplankton species and water temperature, conductivity, Secchi disk transparency, pH, TP,TN and chlorophyll-*a* using the CANOCO [21]. Pearson correlations between the measured physical and chemical variables were determined using SPSS (ver. 11.0) software.

Results

Chlorophyll-a concentrations ranged from 0.8 µg/L to 14 µg/L at the first station, from 1.2 µg/L to 12 µg/L at the second station and from 0.6 µg/L to 15 µg/L at the third station (Fig. 2). Secchi disk depth ranged from 0.3 m to 1.5 m at the first station and it ranged from 0.6 m to 1.9 m at the second and third stations (Fig. 3). Water temperature ranged from 4.5 ^oC to 27.6 ^oC at all stations (Fig. 4). Conductivity ranged from 0.3 mS cm^{-1} to 0.6 mS cm^{-1} at all stations and it was lower in the winter than the other seasons (Fig. 5). pH ranged from 7.4 to 11.6 (Fig. 6).

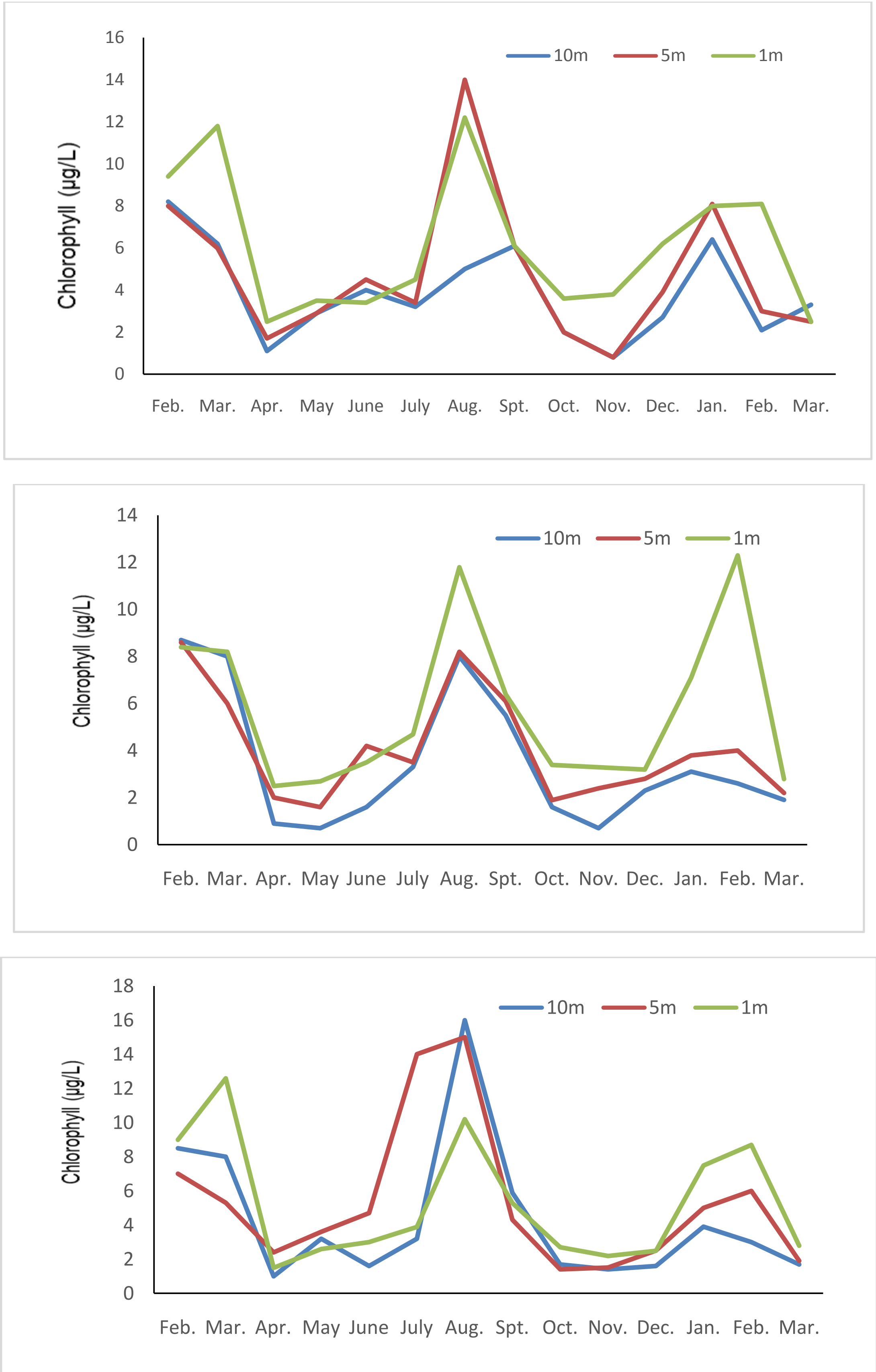


Figure 2: Chlorophyll-a concentrations of the Ikizcetepeler Reservoir

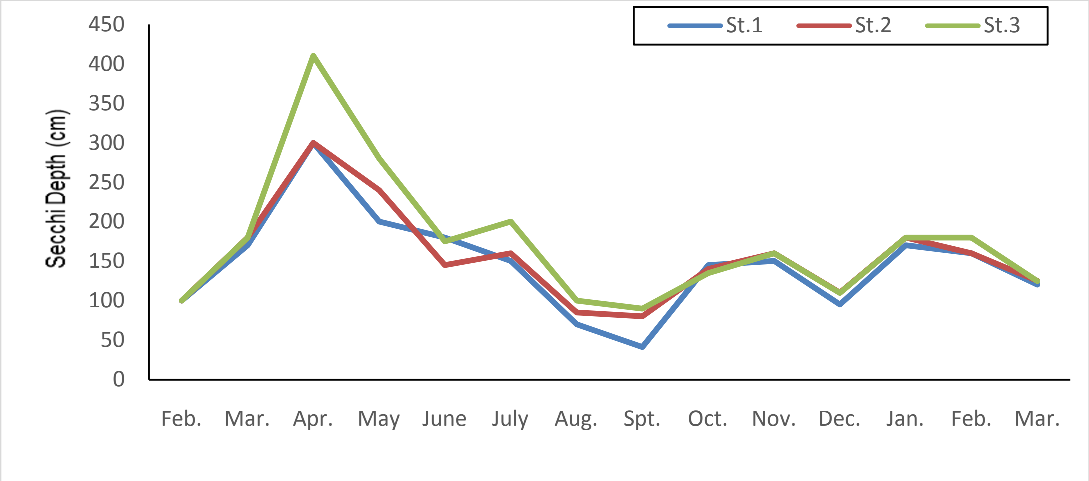
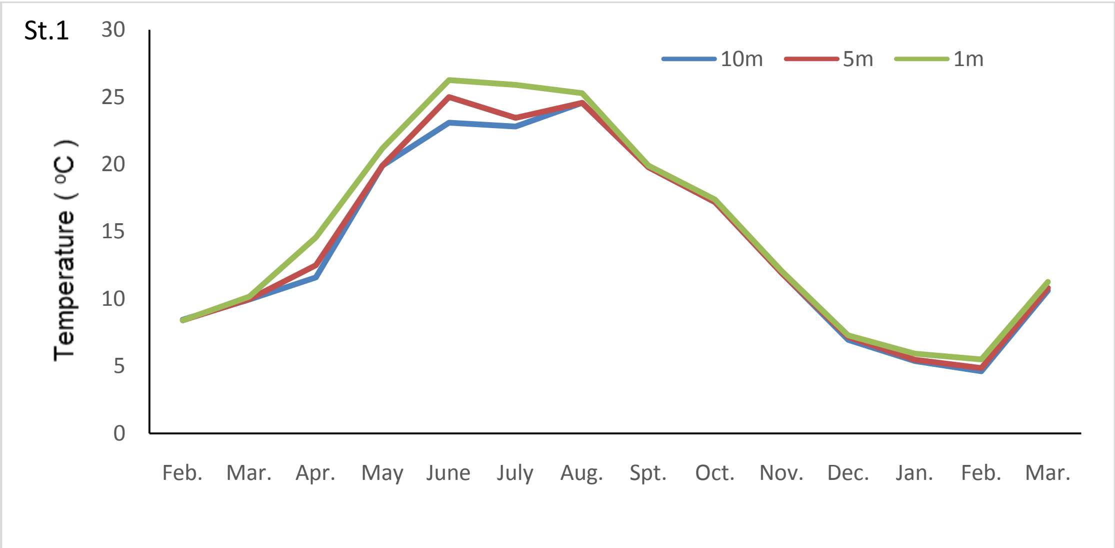
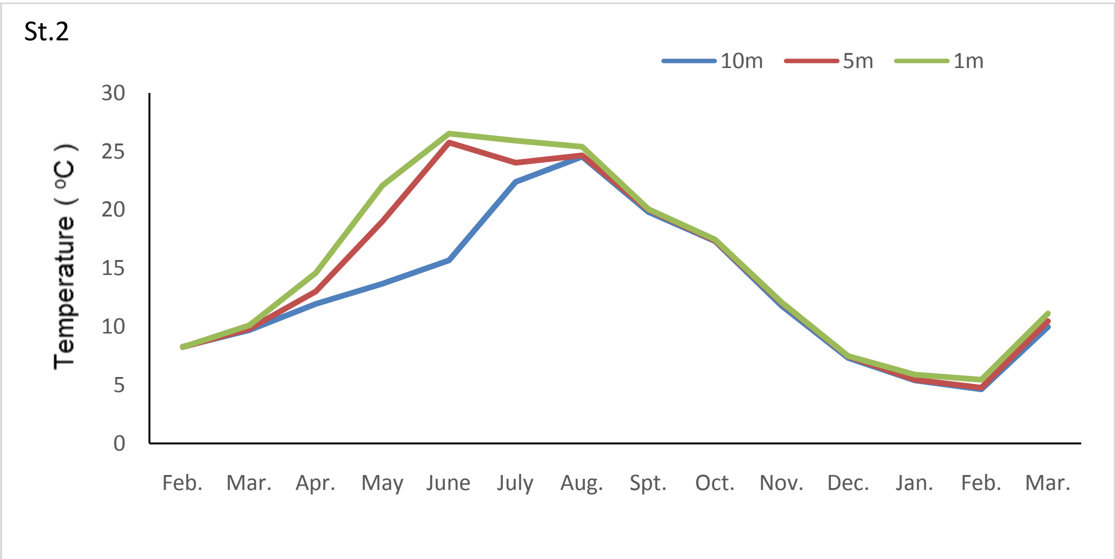


Figure 3:Secchi disk values of the Ikizcetepeler Reservoir





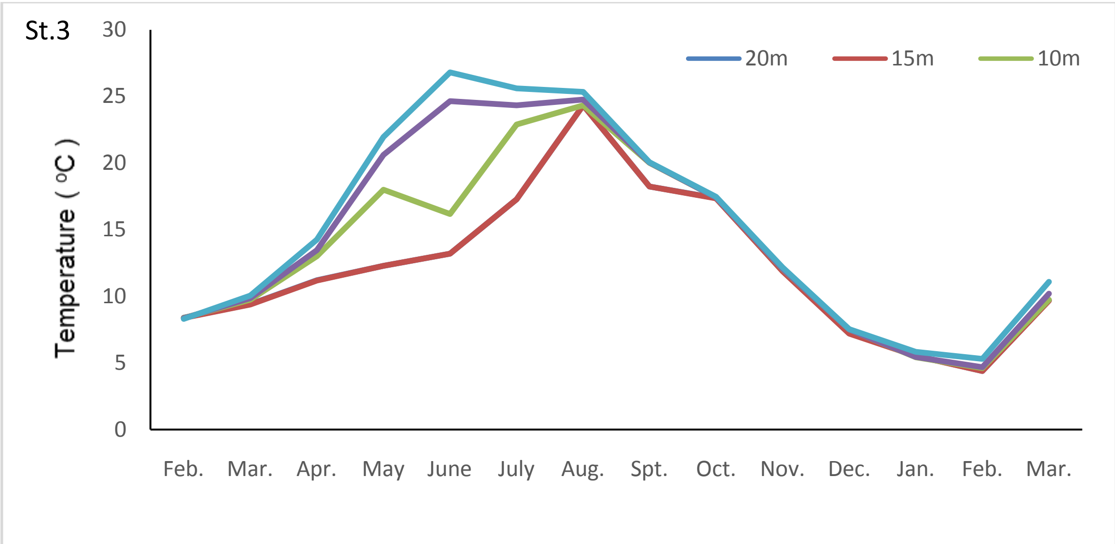
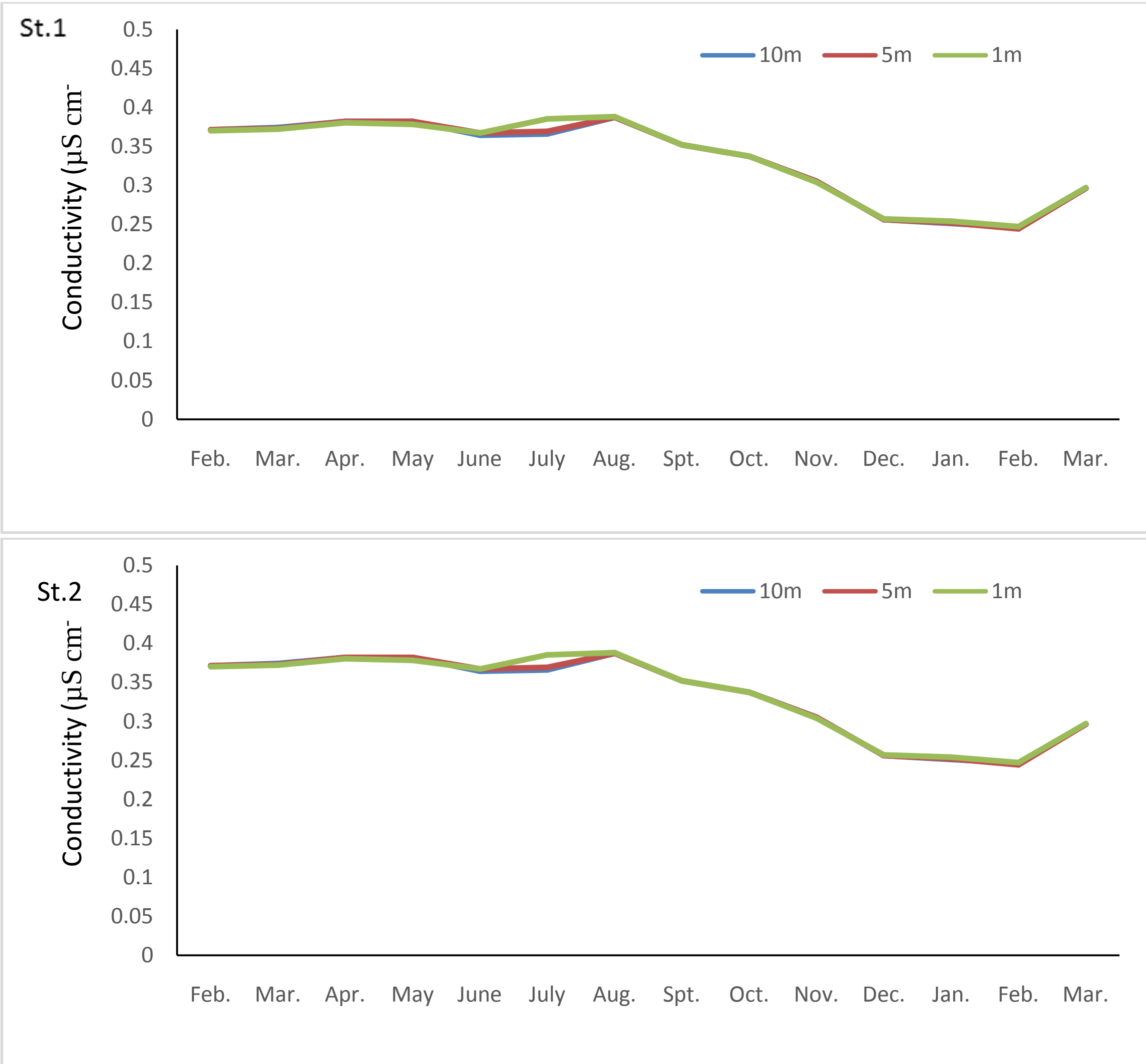


Figure 4: Water temperature (^0C) values of the Ikizcetepeler Reservoir



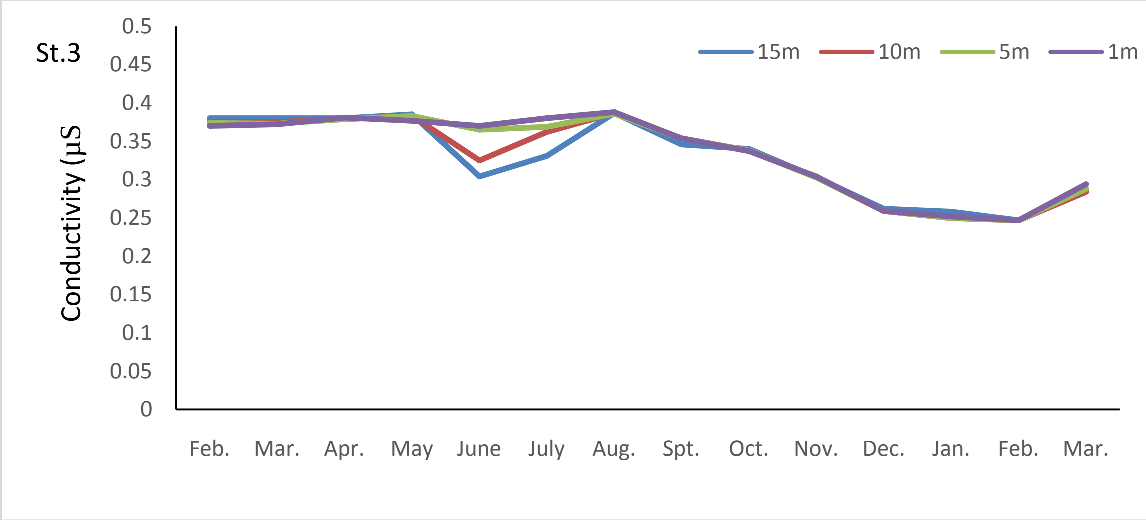
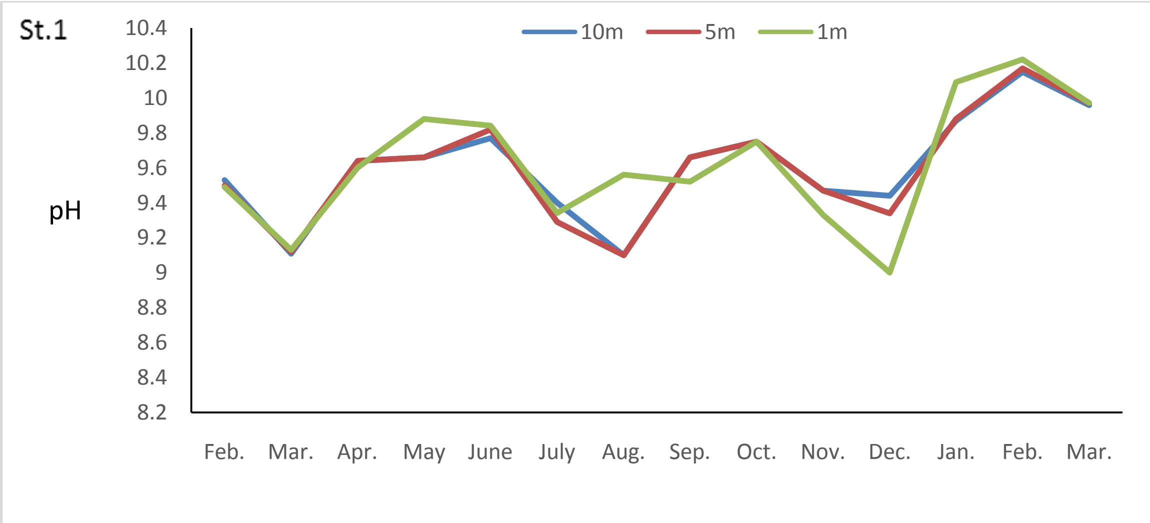
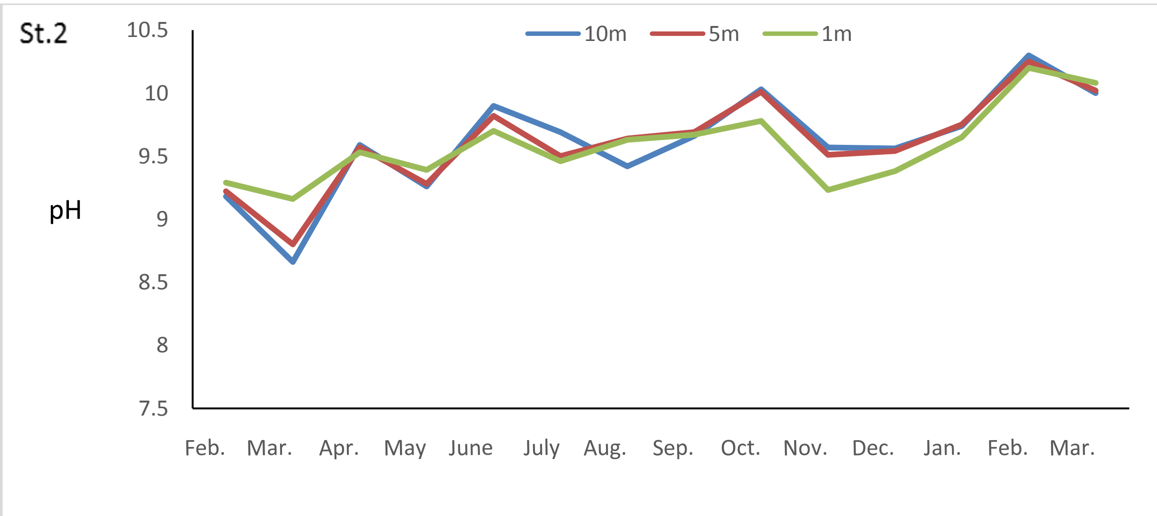


Figure 5: Conductivity (µS cm^{-1}) values of the Ikizcetepeler Reservoir





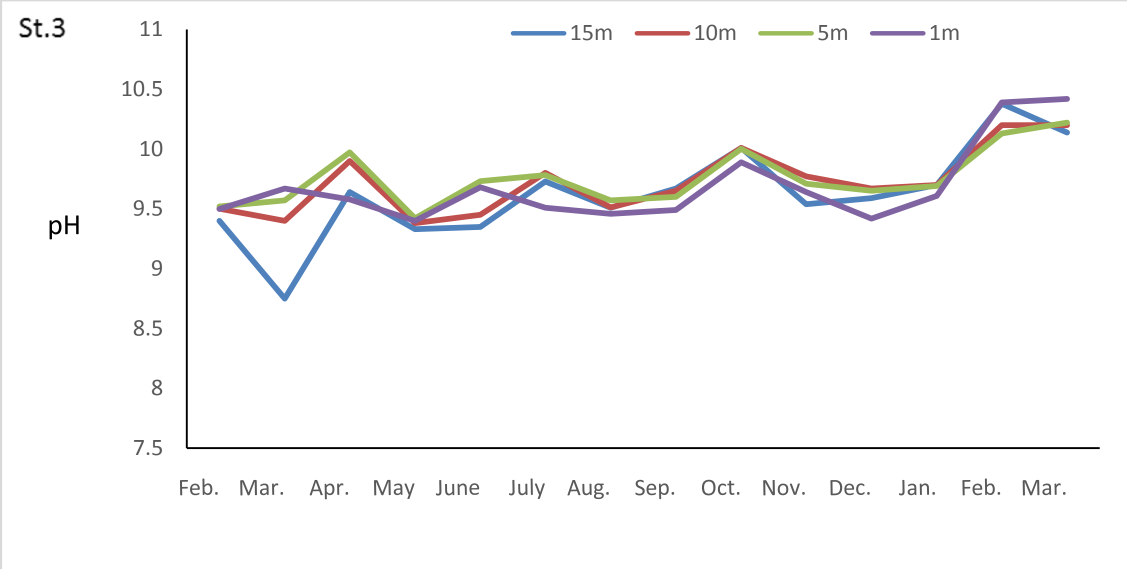
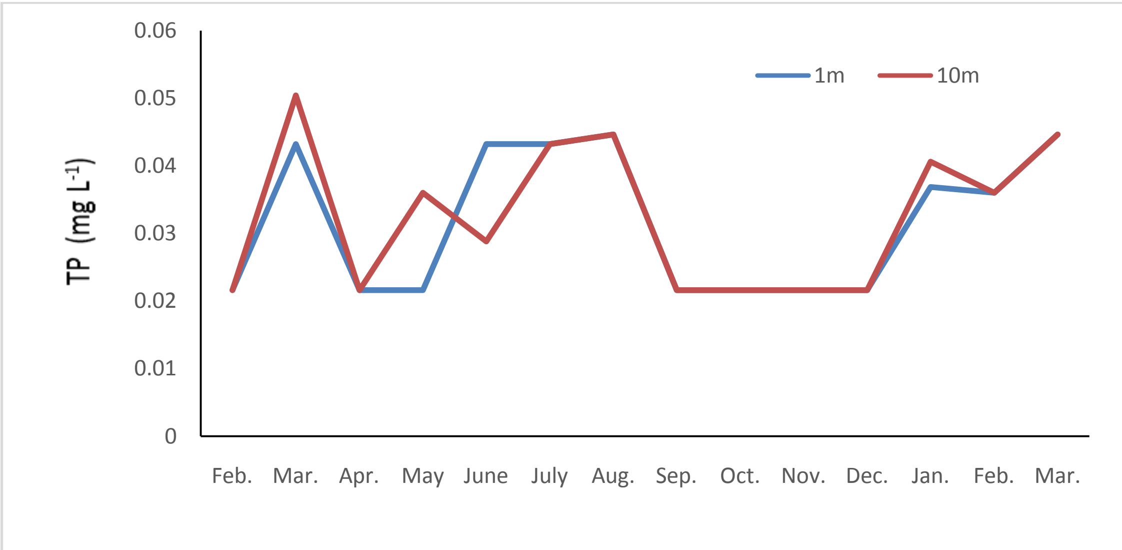
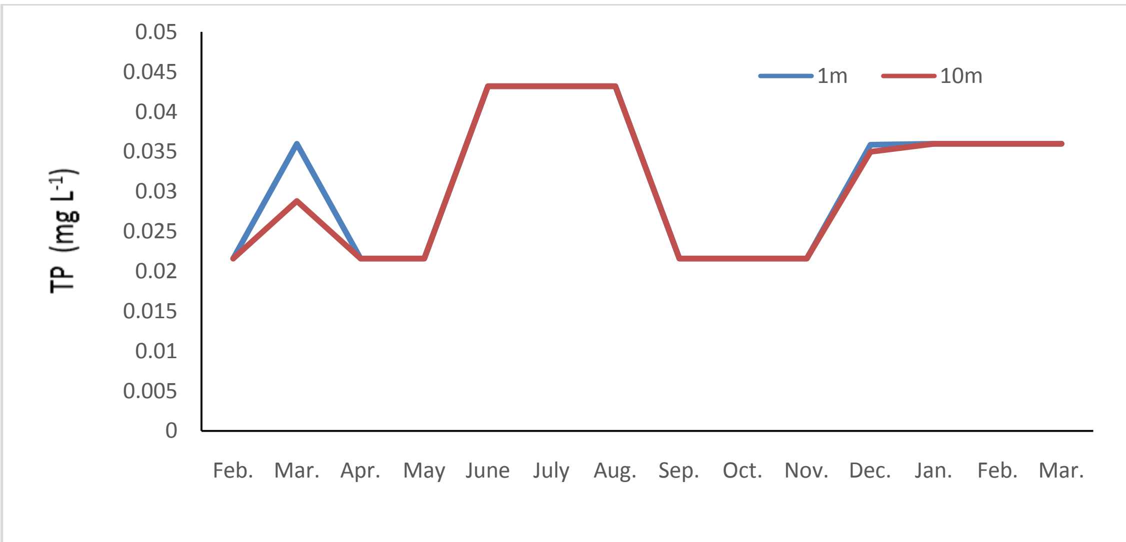


Figure 6: pH values of the Ikizcetepeler Reservoir





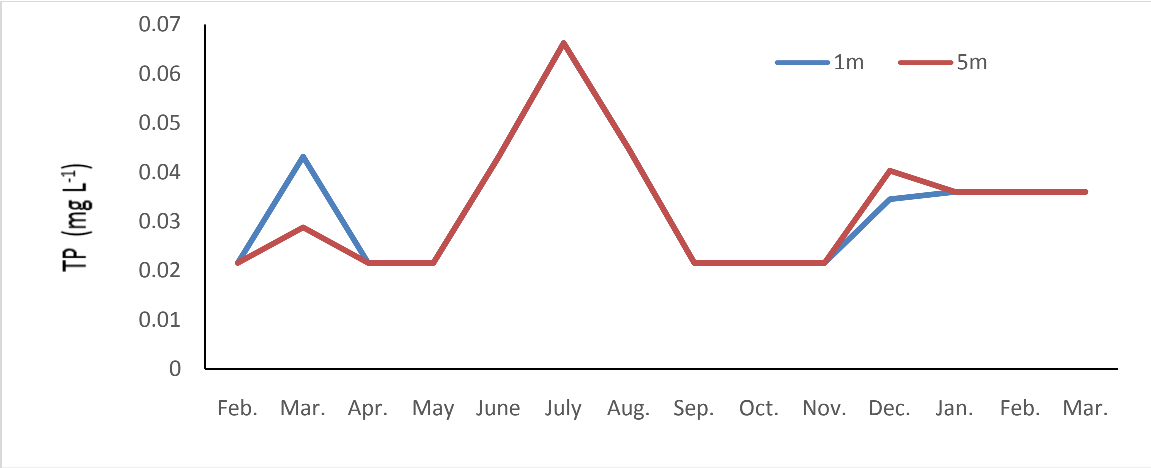
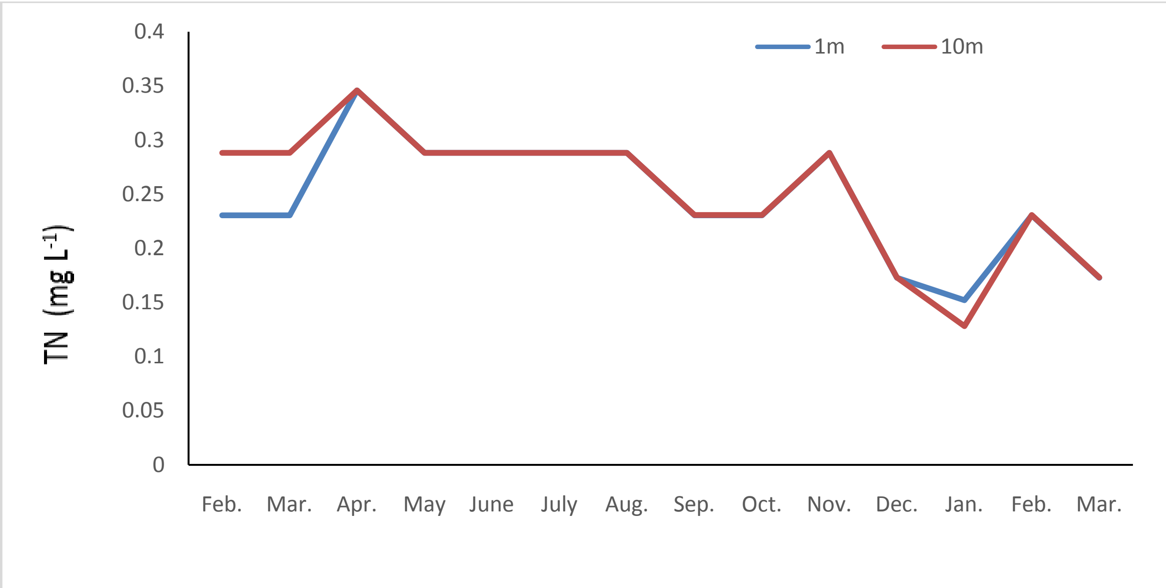
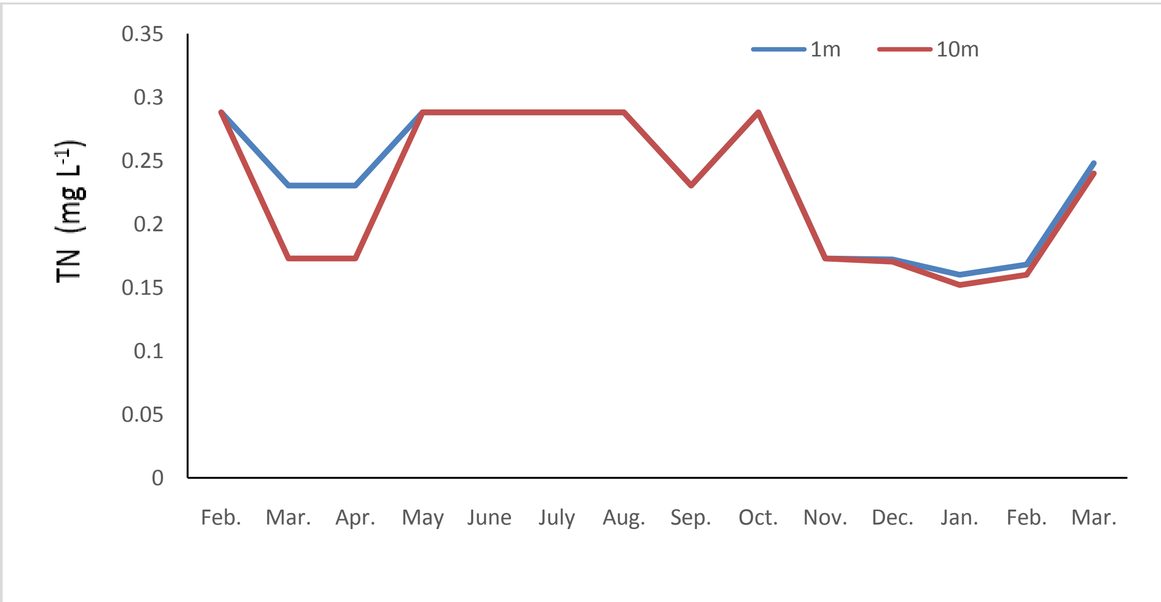


Figure 7: TP (mg L^{-1}) values of the Ikizcetepeler Reservoir





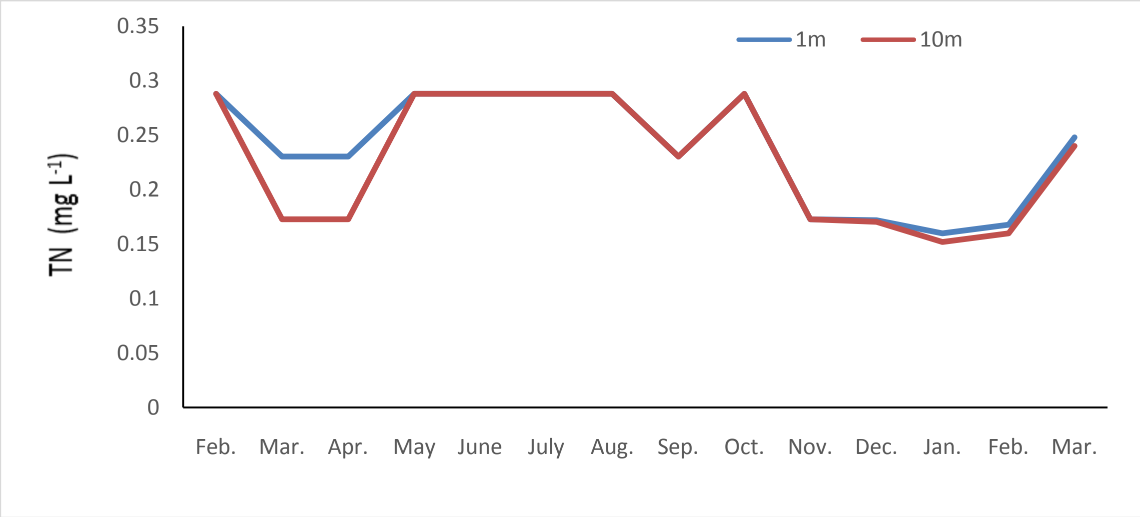
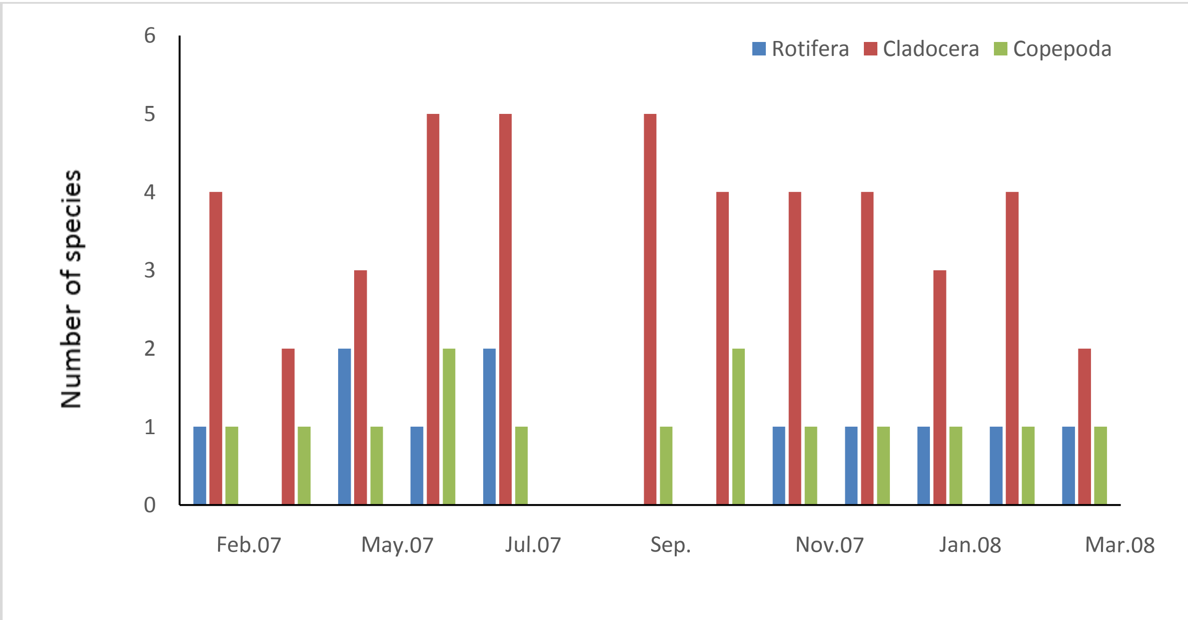


Figure 8: TN (mg L^{-1}) values of the Ikizcetepeler Reservoir

At the first station, TP range from 0.0216 mg L^{-1} in February April, Sptember, October and November 2007 to 0.05 mg L^{-1} in March 2007. It ranges from 0.0216 mg L^{-1} in February April, September, October and November 2007 to 0.043 mg L^{-1} in June, July and August 2007 at the second station and from 0.0216 mg L^{-1} in February April, September, October and November 2007 to 0.066 mg L^{-1} in July and 2007 at the third station (fig. 7). At the first station, TN range from 0.12 mg L^{-1} in January 2008 to 0.34 mg L^{-1} in April 2007. It ranges from 0.15 mg L^{-1} in February 2008 to 0.0.28 mg L^{-1} in February, May, June, July, August and November 2007 at the second and third stations (fig. 8).

At the first station, the number of species ranged from 3 in March 2007 to 8 in July 2007. The number of individuals ranged from 16500 individuals M^{-3} in February 2007 to 77500 individuals M^{-3} in March 2008 (Fig. 9). At the second station, the number of species ranged from 3 in March and April 2007 to 8 in September 2007. The number of individuals ranged from 5500 individuals M^{-3} in December 2007 to 49234 individuals M^{-3} in March 2008 (Fig. 10). At the third station, the number of species ranged from 1 in April 2007 to 8 in June, July and August 2007. The number of individuals ranged from 25 individuals M^{-3} in December 2007 to 184419individuals M^{-3} in February 2008 (Fig. 11).



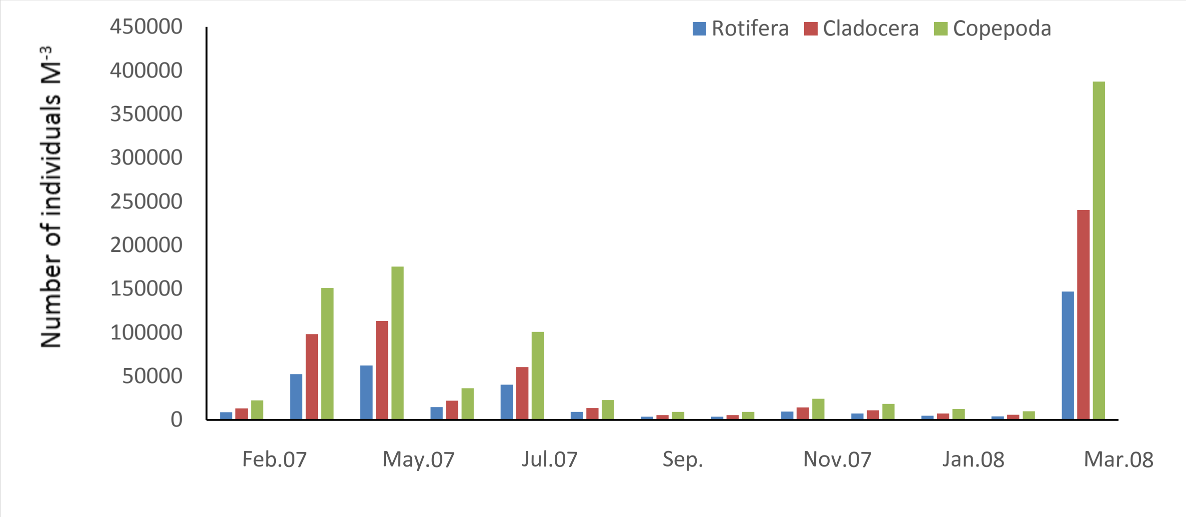
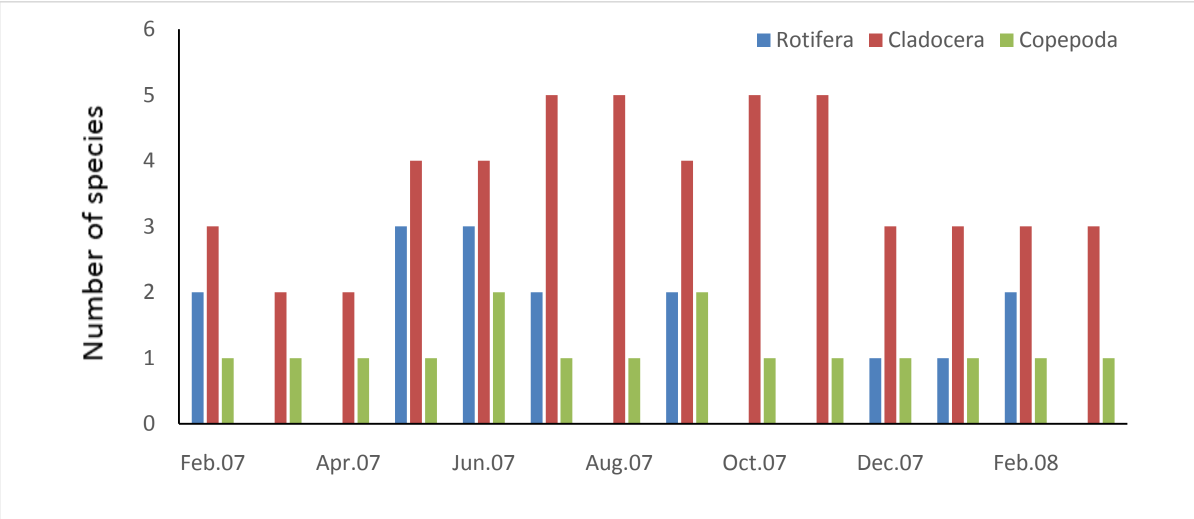


Figure 9: Number of species and individuals of the Ikizcetepeler Reservoir at the first station



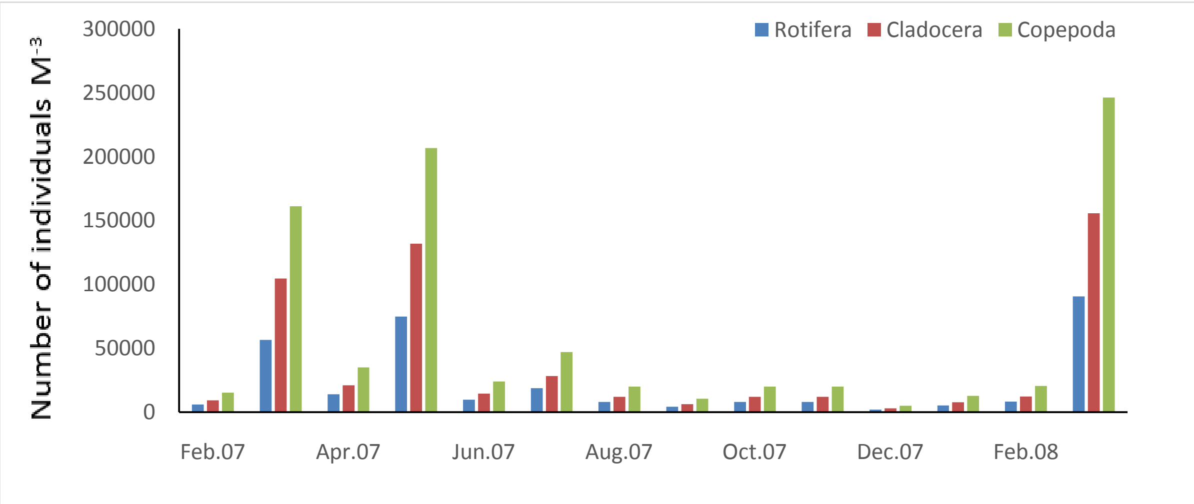


Figure 10: Number of species and individuals of the Ikizcetepeler Reservoir at the second station

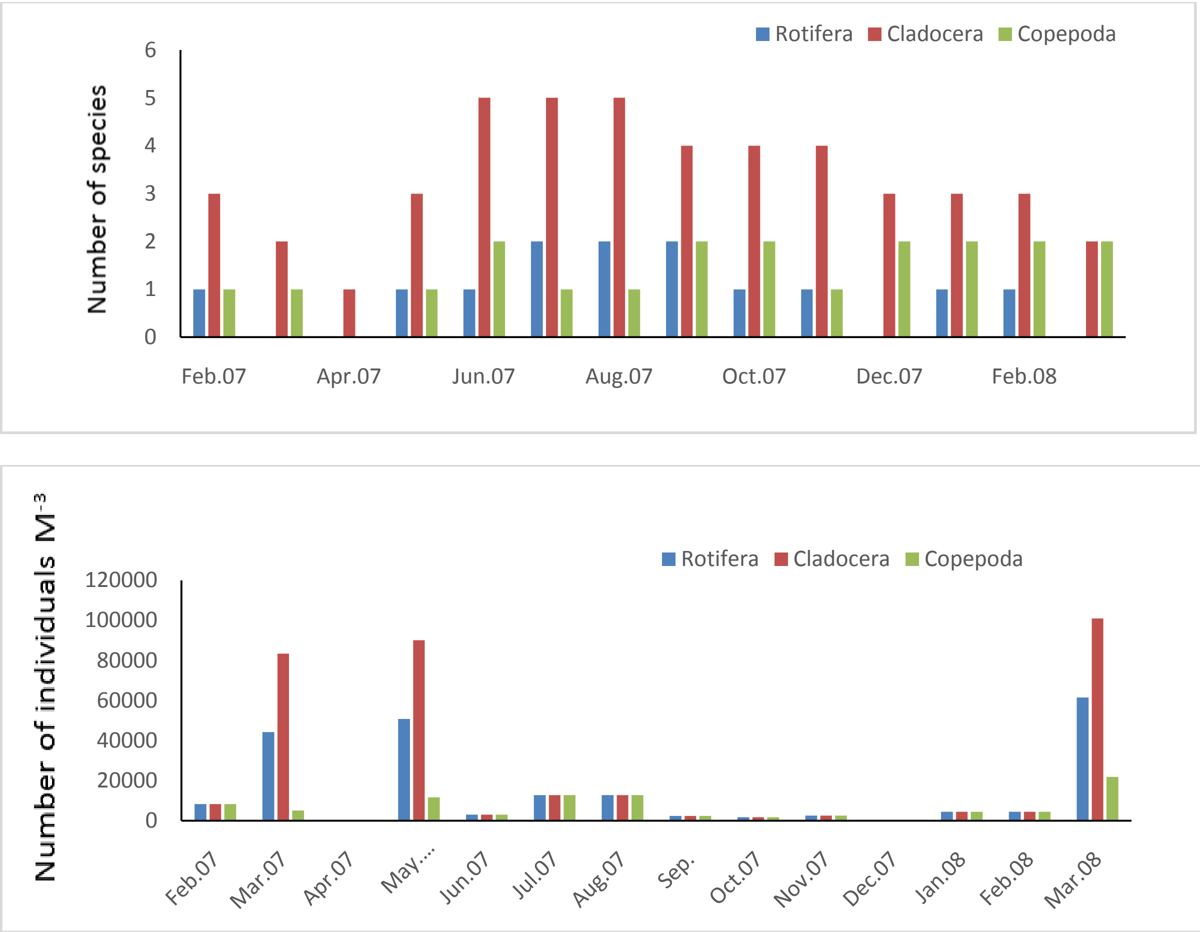


Figure 11: Number of species and individuals of the Ikizcetepeler Reservoir at the third station

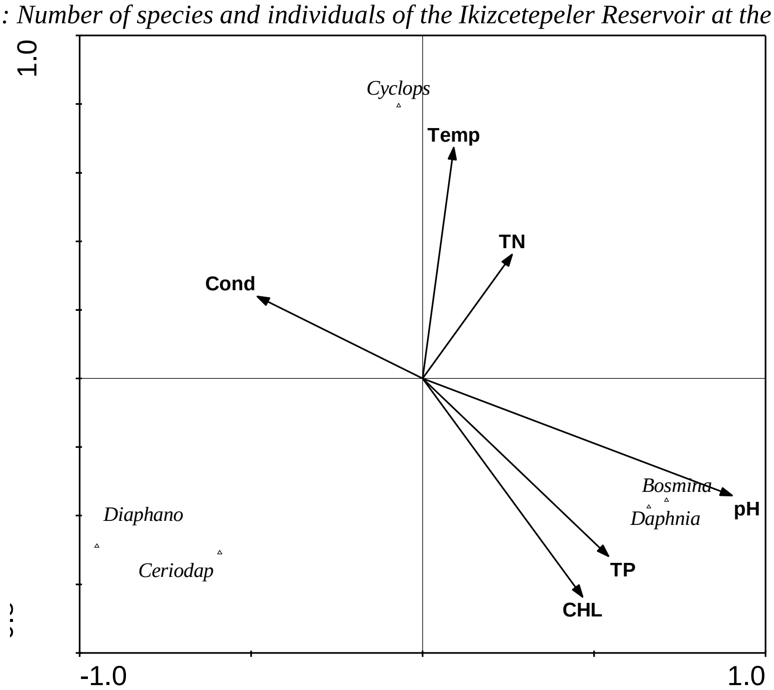


Figure 12: The diagram of ***C****anonical Correspondence Analysis (CCA) showing the relationships between the environmental variables and the dominant zooplankton species in the Ikizcetepeler Reservoir. Abbreviation for species: Cyclops, Cyclops vicinus; Bosmina, Bosmina longirostris; Daphnia, Daphnia longispina; Ceriodap, Ceriodaphnia pulcella; Diaphano, Diaphanosoma brachyurum*

Daphnia longispina, *Bosmina longirostris* and *Cyclops vicinus* were dominant throughout the year at all stations. At the first station, *Asplanchna priodonta* was dominant in fall; *Moina micrura* was dominant in summer. At the second station, *Asplanchna priodonta* was dominant in summer; *Diaphanosoma brachyurum* was dominant in fall and summer.At the third station, *Asplanchna priodonta* was dominant in fall; *Ceriodaphnia pulcella* was dominant in summer.

CCA showed that that *Cyclops vicinus* had high correlations to water temperature, *Bosmina longirostris* and *Daphnia longispina* were correlated to pH, the other dominant species were not correlated to any measured physicochemical parameters (Fig 12).

Discussion

Based on chlorophyll-a content and Secchi disk transparency, Ikizcetepeler Reservoir can be classified asmesophic [10]. Secchi disk depth was negatively correlated with TP and TN concentrations at all stations. As nutrient levels rise the abundance of phytoplankton increase, which absorb light causing reduced water transparency [22].

There was a positive correlation between conductivity nutrient concentrations. Conductivity is often considered as parameter showing the degree of nutrient loading [23]. Intensive agriculture has been practiced in the drainage basin of the Ikizcetepeler Reservoir. Agricultural nonpoint sources are a major contributing factor to surface water eutrophication worldwide.

Bosmina longirostris, *Cyclops vicinus* and *Daphnia longispina* were dominant throughout the year at all stations. The small-sized cladoceran *Bosmina longirostris* is cosmopolitan species and can reach high abundance in eutrophic temperate lakes [24]. *Cyclops vicinus* and *Daphnia longispina* are common members of zooplankton community characteristic to temperate lakes [25, 26].

The Ikizcetepeler Reservoir is a mesophic temperate reservoir providing suitable habitat for these cosmopolitan crustaceans. The ecological features of these species shows that they are cosmopolitan in habitants of Turkish in land waters. In conclusion, all of the dominant species identified in the Ikizcetepeler Reservoir were cosmopolitan and characteristic to the eutrophic temperate lake zooplankton community members.

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