

The Investigation of Zooplanktonic Organisms (Rotifera, Copepoda, Cladocera) of Meric River (Turkey)

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Abstract: This study aims to determine the zooplankton fauna of Meric river where the samples were collected in monthly intervals March 2011 to February 2012 from 8 stations. At the end of the study, 52 species from Rotifera, 22 species from Cladocera and 12 species from Copepoda were observed. And also some chemical and physical parameters as pH, dissolved oxygen, water temperature and conductivity were determined and found to be in suitable values for zooplankton life.

Key words: Cladocera, copepoda, Meric river, monthly distribution, rotifera

INTRODUCTION

Rotifera, Cladocera and Copepoda are the main groups of Zooplankton. These groups are important source of food chain. Therefore, the abundance of zooplankton is an indicator for eutrophication and pollution level since the abundance and composition of zooplankton are closely associate with water quality and show increasing and decreasing pattern based on trophic levels of lakes. For his reason, many researchers have been conducted in terms of both taxonomical and ecological, aspects on zooplanktonic organisms.

In Turkey a lot of studies have been done on the zooplanktonic organisms of lenthic habitats (Altindag and Ozkurt, 1998; Yigit, 2002; Bekleyen, 2003; Yalim, 2006; Kaya and Altindag, 2007; Ustaoglu *et al.*, 2011). But there were very few studies on river zooplankton (Goksu *et al.*, 1997; Akbulut and Yildiz, 2005; Altindag *et al.*, 2009; Bozkurt and Guven, 2010; Kaya *et al.*, 2010). Especially, there is no study done a comprehensive on Meric river in Turkey. Some researchers have provided only record of zooplankton of lakes in Thrace of Turkey (Segers *et al.*, 1992; Guher, 2000; Erdogan and Guher, 2005, 2012; Guher and Erdogan, 2008).

Meric in Turkish, Evros in Greece and Maritza in Bulgarian is known as a river. This river rises on the slopes of Mount Rila in Bulgaria, the highest mountain in the Balkans and the river is the largest river in the Balkan Peninsula after the Danube. Meric river flows into the Aegean sea after a total course of 539 km, the last 185 km of which form the Greek-Turkish frontier. Because of it is expected that the Meric river includes organisms that

belong to aquatic fauna of three countries, owing to streams from Greece, Bulgaria and Turkey. In this study, researchers aim to identify the zooplanktonic organisms (Rotifera, Cladocera and Copepoda) and its monthly composition of Meric river where no earlier relevant data are available.

MATERIALS AND METHODS

The Meric (Evros, Maritza) is with a length of 539 km the longest river that runs solely in the interior of the Balkans. It flows East and Southeast across Bulgaria for 275 km forms the Bulgaria Greece frontier for a distance of 16 km and then becomes the Greece Turkey frontier for another 185 km. At Edirne it changes direction, flowing South and then Southwest to enter the Aegean sea. it makes an important wetland between Greece and Turkey, Major tributaries are the Arda, Tunca and Ergene rivers.

In this study, 180 km long river forms the border Turkey-Greece were selected eight different stations (Fig. 1 and Table 1). Zooplankton sample were collected monthly from 8 stations during March 2011 to February 2012 using a hand net and standard plankton net (mesh diameter 55 µm) and fixed 4% with formaldehyde. In Meric river, some physical-chemical parameters such as water temperature (measured by ordinary thermometer), pH (by Lovibond mark CG 837 of pH meter), dissolved oxygen (by Lovibond 3040 of oxygen meter) and conductivity were measured at sampling time. Identification of the zooplankton organisms was made according to Kolisko (1974), Koste (1978), Segers (1995) for Rotifera, Smirnov (1992), Margaritora (1983), Korinek (1987) for Cladocera, Dussart (1969) and Kiefer (1978) for Copepoda.

Table 1: Sampling stations and geographical coordinates in Meric river

Stations	Coordinates	
Station 1: Meric river enters to Turkey from Bulgaria	41°0'42'591"N	26°0'22'155"E
Station 2: There are some textile factories around this location	41°0'41'179"N	26°0'24'563"E
Station 3: After Arda river joints to Meric	41°0'39'890"N	26°0'32'938"E
Station 4: Edime city	41°0'37'578"N	26°0'34'853"E
Station 5: After Tunca river joints to Meric	41°0'34'694"N	26°0'35'841"E
Station 6: There are a lot of agricultural areas around this location	41°0'25'173"N	26°0'37'779"E
Station 7: There are a lot of agricultural areas around this location	41°0'14'998"N	26°0'21'299"E
Station 8: After Ergene river joints to Meric river	40°0'59'368"N	26°0'20'778"E

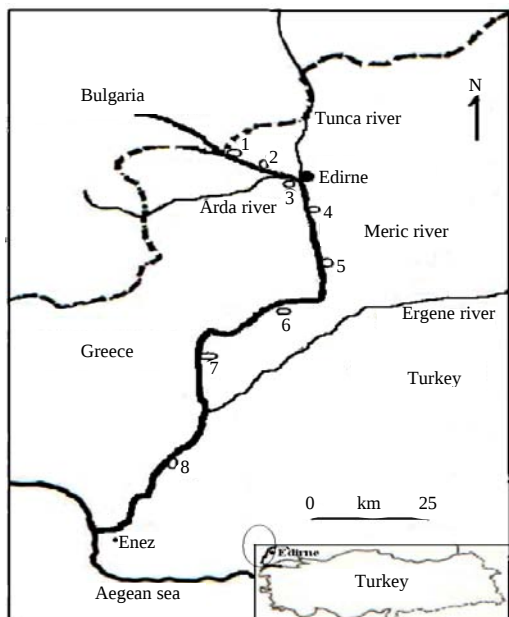


Fig. 1: Location of Meric river and the sampling stations

RESULTS AND DISCUSSION

As a result of the examination of zooplankton samples a total of 52 species from Rotifera, 22 species from Cladocera and 12 species from Copepoda have been identified. The list of these species and monthly distributions is given in Table 2.

While examining monthly distributions of Rotifera samples collected from meric river, most species were found in May (33 taxa), followed by April, July (32 taxa) and the least in October (12 taxa). *Brachionus calyciflorus*, *Keratella cochlearis*, *Notholca squamula*, *Rotaria neptunia*, *Mytilina mucronata*, *Synchaeta oblonga* were present in every month. *Kellicottia longispina*, *Platyas quadricornis* *Trichotria pocillum*, *Trichotria tetractis*, *Lepadella ovalis*, *Lepadella patella*, *Trichocerca tenuior* and *Cephalodella gibba* were observed only in 1 month (Table 2).

Most Cladocera were observed during May and July (16 taxa), October (14 taxa), June and August (12 taxa) and the least were found on April (8 taxa) while *Simocephalus vetulus* was dominant in every months excluding June, *Chydorus sphaericus*, *Diaphanosoma brachyurum* and *Bosmina longirostris* were seen in 11 months. *Monopsilus dispar* in 1 month *Leydigia leydigi* in 2 months, *Scapholeberis kingi* and *Alona quadrangularis* were observed in 3 months (Table 2).

According to the examination of monthly distributions of Copepoda, taxa were found in March, April, October and February (10 taxa), followed by May, June and August (9 taxa), July and September (8 taxa), December (5 taxa), November and January (4 taxa). *Acanthocyclops (Megacyclops) viridis* was determined for the every month during the study period excluding *Acanthocyclops robustus* (8 months) and *Cyclops vicinus*, *Cyclops abyssorum*, *Eucyclops serrulatus*, *Diacyclops bicuspidatus* and *Arctodiaptomus wierzejsku* (10 months) followed it. *Nitocra hibernica*, *Nitocra* sp. were found only in 1 month (Table 2).

The physicochemical parameters measured in Meric river vary as follows: pH 7.96-9.8; conductivity 295.6-686.3 μScm^{-1} ; dissolved oxygen 3.01-7.27 mgL^{-1} and water temperature 4.31-26.3°C (Table 3). The physicochemical parameters were found in suitable values for zooplanktonic organisms life.

In the other studies, 18 rotifers and 9 cladocerans from the zone which situated in Adana country border of Seyhan river (Goksu *et al.*, 1997); 12 rotifers, 18 cladocerans and 6 copepods from the rivers of North Aegean region 16 rotifers from Komurhan region of Fyrat river 36 rotifers from the zone which situated in Hatay country border of Asi river (Bozkurt *et al.*, 2002) 46 rotifers, 14 cladocerans and 8 copepods from some rivers in Mediterranean region 65 rotifers from Euphrates river basin (Akbulut and Yildiz, 2005) 34 rotifers, 2 cladocerans and one copepod from Karaman stream (Altindag *et al.*, 2009) and 58 rotifers, 16 cladocerans and 15 copepods from Asi river (Bozkurt and Guven, 2010) were reported.

Table 2: The monthly distribution of zooplankton species identified from Meric river

Zooplankton species	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.
Rotifera												
<i>Anuraeopsis coelata</i> (De Beuchamp, 1932)					+	+	+			+	+	
<i>Anuraeopsis fissa</i> (Gosse, 1851)		+	+	+	+	+	+	+		+	+	+
<i>Brachionus angularis</i> (Gosse, 1851)	+	+	+	+	+		+			+	+	+
<i>Brachionus bidentatus</i> (Anderson, 1889)		+	+	+	+	+	+	+				
<i>Brachionus budapestinensis</i> (Daday, 1885)					+	+	+					
<i>Brachionus calyciflorus</i> (Pallas, 1766)	+	+	+	+	+	+	+	+		+	+	+
<i>Brachionus falcatus</i> (Zacharias, 1898)	+	+	+			+	+					
<i>Brachionus leydigii leydigii</i> (Cohn, 1862)		+	+	+	+	+	+		+	+	+	
<i>Brachionus plicatilis</i> (O.F. Muller, 1786)	+	+	+		+	+			+		+	+
<i>Brachionus quadridentatus</i> (Hermann, 1783)	+	+	+		+	+	+			+	+	+
<i>Brachionus urceolaris</i> (O.F. Muller, 1773)		+	+		+	+	+					
<i>Keratella cochlearis</i> (Gosse, 1851)	+	+	+		+	+	+	+	+	+	+	+
<i>Keratella tropica</i> (Apstein, 1907)	+		+								+	
<i>Keratella quadrata</i> (O.F. Muller, 1786)	+		+		+					+		+
<i>Kellicottia longispina</i> (Kellicott, 1879)			+									
<i>Notholca acuminata</i> (Ehrenberg, 1832)			+		+							
<i>Notholca squamula</i> (O.F. Muller, 1786)	+	+	+	+	+	+	+		+	+	+	+
<i>Platyas quadricornis</i> (Ehrenberg, 1832)		+										
<i>Rotaria rotatoria</i> (Pallas, 1766)			+	+	+	+						
<i>Rotaria neptunia</i> (Ehrenberg, 1832)	+	+		+	+	+	+	+	+	+	+	+
<i>Euchlanis incisa</i> (Carlin, 1939)		+	+			+	+			+	+	+
<i>Euchlanis dilatata</i> (Ehrenberg, 1832)			+	+	+	+	+		+			
<i>Euchlanis deflexa</i> (Gosse, 1851)	+	+	+	+	+	+						+
<i>Euchlanis lyra</i> (Hudson, 1886)	+	+	+	+				+		+		
<i>Mytilina mucronata</i> (O.F. Muller, 1773)	+	+	+	+	+	+	+	+	+		+	+
<i>Mytilina ventralis</i> (Ehrenberg, 1832)		+	+	+	+	+	+	+		+		+
<i>Trichotria pocillum</i> (O.F. Muller, 1776)			+									
<i>Trichotria tetractis</i> (Ehrenberg, 1830)											+	
<i>Lepadella ovalis</i> (O.F. Muller, 1786)				+								
<i>Lepadella acuminata</i> (Ehrenberg, 1834)	+	+	+					+	+	+		
<i>Lepadella patella</i> (O.F. Muller, 1786)		+										
<i>Colurella uncinata</i> (O.F. Muller, 1773)		+	+	+	+	+				+	+	+
<i>Colurella adriatica</i> (Ehrenberg, 1831)			+						+		+	
<i>Lecane bulla</i> (Gosse, 1886)	+	+					+	+				+
<i>Lecane closterocerca</i> (Schmarda, 1859)	+				+	+						
<i>Lecane hastata</i> (Murray, 1913)	+	+	+	+						+		
<i>Lecane flexilis</i> (Gosse, 1886)		+										+
<i>Lecane lamellata</i> (Daday, 1893)		+	+		+		+					+
<i>Lecane lunaris</i> (Ehrenberg, 1832)					+					+	+	+
<i>Lecane hamata</i> (Stokes, 1896)									+	+	+	+
<i>Notommata copeus</i> (Ehrenberg, 1834)		+			+	+			+		+	+
<i>Trichocerca tigris</i> (O.F. Muller, 1786)		+							+			
<i>Trichocerca bicristata</i> (Gosse, 1887)		+	+		+		+					
<i>Trichocerca capucina</i> (Wierjeski and Zacharias, 1893)	+	+										
<i>Trichocerca tenuior</i> (Gosse, 1886)								+				
<i>Cephalodella gibba</i> (Ehrenberg, 1838)					+							
<i>Synchaeta pectinata</i> (Ehrenberg, 1832)	+	+	+		+							
<i>Synchaeta oblonga</i> (Ehrenberg, 1831)	+	+	+	+	+	+	+	+		+	+	+
<i>Polyarthra vulgaris</i> (Carlin, 1943)	+	+	+						+		+	+
<i>Asplanchna priodonta</i> (Gosse, 1850)				+	+		+			+	+	+
<i>Testudinella patina</i> (Hermann, 1783)	+				+	+				+	+	+
<i>Ascomorpha ovalis</i> (Bengendahl, 1892)					+		+					
Cladocera												
<i>Diaphanosoma brachyurum</i> (Lievin, 1848)	+	+	+		+		+	+		+	+	+
<i>Bosmina longirostris</i> (O.F. Muller, 1785)	+	+	+	+	+		+	+	+	+	+	+
<i>Moina micrura</i> (Kurz, 1874)				+	+	+	+					
<i>Moina brachyata</i> (Jurine, 1820)			+	+	+	+	+					
<i>Daphnia magna</i> (Straus, 1920)	+	+	+							+	+	+
<i>Daphnia pulex</i> (Leydig, 1860)	+	+	+	+					+			+
<i>Daphnia longispina</i> (O.F. Muller, 1785)	+	+							+			+
<i>Daphnia cucullata</i> (Sars, 1862)	+	+				+		+				+
<i>Simocephalus vetulus</i> (O.F. Muller, 1776)	+	+	+	+	+	+	+	+	+	+	+	+
<i>Simocephalus exspinosus</i> (Koch, 1841)	+		+	+	+	+	+	+				
<i>Scapholeberis kingi</i> (Sars, 1903)			+	+			+					
<i>Ceriodaphnia quadrangula</i> (O.F. Muller, 1785)			+		+	+	+	+	+	+	+	
<i>Ceriodaphnia reticulata</i> (Jurine, 1820)					+	+	+	+		+	+	
<i>Ilyocryptus agilis</i> (Kurz, 1878)	+		+	+		+	+	+				+
<i>Ilyocryptus sordidus</i> (Lievin, 1848)			+	+	+	+	+	+	+			

Table 2: Continue

Zooplankton species	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.
<i>Leydigia leydigi</i> (Schodler, 1863)				+	+							
<i>Chydorus sphaericus</i> (O.F. Muller, 1776)	+	+	+	+	+	+	+	+	+	+	+	+
<i>Monopsilus dispar</i> (Sars, 1862)			+									
<i>Pleuroxus aduncus</i> (Jurine, 1820)			+	+	+	+	+	+	+	+	+	
<i>Alona costata</i> (Sars, 1862)			+		+	+		+		+	+	
<i>Alona guttata</i> (Sars, 1862)					+				+	+	+	
<i>Alona quadrangularis</i> (Muller, 1785)			+		+	+						
Copepoda												
<i>Halicyclops neglectus</i> (Kiefer, 1935)	+	+	+									+
<i>Cyclops vicinus</i> (Uljanin, 1875)	+	+	+	+	+	+	+	+	+			+
<i>Cyclops abyssorum</i> (G.O. Sars, 1863)	+	+	+	+	+	+	+	+	+			+
<i>Acanthocyclops robustus</i> (Sars, 1863)	+	+	+	+	+	+	+	+		+	+	+
<i>Acanthocyclops</i> (Megacyclops)	+	+	+	+	+	+	+	+	+	+	+	+
<i>viridis</i> (Jurine, 1820)												
<i>Macrocyclus albidus</i> (Jurine, 1820)	+	+		+	+	+	+	+				+
<i>Eucyclops serrulatus</i> (Fischer, 1851)	+	+	+	+	+	+	+	+		+		+
<i>Thermocyclops crassus</i> (Fischer, 1853)	+	+	+	+	+	+	+	+				+
<i>Diacyclops bicuspidatus</i> (Claus, 1857)	+	+	+	+	+	+			+	+	+	+
<i>Arctodiaptomus wierzejskii</i> (Richard, 1888)	+	+	+	+				+	+	+	+	+
<i>Nitocra hibernica</i> (G.S. Brady, 1880)								+				
<i>Nitocra</i> sp.							+					

Table 3: Some physicochemical parameters of the water in Meric river

Parameters	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.
Water temperature (°C)	9.31	13.80	20.30	25.50	28.30	26.30	23.40	12.00	6.30	7.60	4.31	5.25
pH	7.96	8.13	8.40	9.80	8.48	8.41	8.34	8.16	8.26	8.45	8.86	8.17
D.O. (mg L ⁻¹)	5.09	3.01	4.92	5.16	4.99	7.27	6.99	6.28	6.82	5.87	4.73	5.31
Conductivity (µS cm ⁻¹)	411.20	417.10	539.10	619.80	649.20	618.30	686.30	453.70	510.10	484.00	295.60	349.70

CONCLUSION

More zooplankton species were identified in Meric river when compared with other rivers in Turkey. One of the main causes is probably the width of the Meric river basin and Arda river (in Greece), Tunca river (in Bulgaria) and Ergene river (in Turkey) joints to Meric river. The 86 of zooplankton species identified in Meric River are also seen in Balkan countries (Zarfdjian and Economidis, 1989; Zarfdjian *et al.*, 1990; Maria-Heleni *et al.*, 2000; Cadjo *et al.*, 2008; Kozuharov *et al.*, 2009). Rotifera Cladocera and Copepoda species distribute widely in the world because of eggs can be carried easily everywhere by streams, birds, other animals and wind. In addition to these, Northeast South bird migration route passing through Turkish Thrace and Arda from Greece, Tunca and Meric from Bulgaria pouring into Aegean sea by crossing the region cause the species which are common in Balkans appear in Meric river well. Therefore, zooplankton of the Meric river is similar to Balkan fauna.

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