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Distribution of Cladocera Species in Different Waters of Turkey

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ABSTRACT

Species diversity and distribution of Cladocera collected from river, dam lake, lake, marshes and well, in different regions of Turkey have been reported. Forty-four samples collected from 31 different localities contained 37 species belonging to six families. Chydoridae was the most species rich family with 18 species followed by Daphniidae with 11 species. *Bosmina coregoni*, a rare species for Turkey inland waters, is a new record for Mediterranean region of Turkey.

Keywords: Cladocera, freshwater, *Bosmina coregoni*

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Türkiye'nin Farklı Sularında Kladoser Türlerinin Dağılımı

Öz: Türkiye'nin farklı bölgelerindeki nehir, baraj, göl, sazlık ve kuyulardan, farklı dönemlerde toplanan Kladoser türlerinin çeşitliliği ve dağılımı belirlenmiştir. 31 farklı lokaliteden toplanan 44 örnekten, 6 familyaya ait 37 tür belirlenmiştir. Chydoridae 18 türle en çok tür barındıran familya olmuş, bunu 11 türle Daphnidae takip etmiştir. Türkiye içsularında nadir bulunan *Bosmina coregoni*, Türkiye'nin Akdeniz Bölgesi için yeni kayıttır.

Anahtar kelimeler: Cladocera, tatlısu, *Bosmina coregoni*

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Introduction

The Cladocera species, which create an important proportion of zooplanktonic organisms, are found in almost all kind of aquatic habitats such as rivers, lakes, ponds, streams, wetlands and other bodies of water. Cladocerans are known as essential components of the food chain for the freshwater ecosystem, because they are the most important grazers of phytoplankton, and thus herbaceous material is diverted to animal material through these zooplankton. For this reason, these species are biological indicators of the water systems where they are found (Güher 2000). On the other hand, living cladoceran communities and their fossil remains preserved in lake sediments reflect their aquatic habitat in similar ways (Kattel et al. 2006; Davidson et al. 2007).

Cladocerans are small-sized (0.2–6 mm) except *Leptodora kindtii*, branchiopod crustaceans, inhabiting pelagic, littoral, and benthic zones. Four cladoceran orders are recognised (Frey 1987): Anomopoda, Ctenopoda, Onychopoda, and the monotypic Haplopoda. The trunk and appendages of most cladocerans (Anomopoda and Ctenopoda) are enclosed in a bivalved carapace. Tagmosis of the body is mostly obscure, and a single eye and ocellus are usually present. Cladocerans are important components of the fauna of fresh waters; they are particularly significant in the food web of stagnant waters.

Most species are filter-feeders; onychopods and haplopods are predatory. They usually reproduce by cyclical parthenogenesis, and populations are mostly dominated by females. Sexual

dimorphism is normally rather distinct. Sexually produced diapausing eggs are resistant to desiccation and other unfavourable conditions, and may even survive passage through the digestive track of birds (Figuerola and Green 2002); thus, they are important propagules for passive dispersal (Forro et al. 2008).

A number of studies of Cladocera fauna of Turkey have been previously conducted by Gündüz (1991, 1997); Temel (1996); Göksu et al. (1997); Güher (1999, 2000, 2002, 2014); Tellioğlu and Şen (2001); Ustaoğlu et al (2001 a, b); Bekleyen (2003, 2006); Ustaoğlu (2004); Tellioğlu and Yılmaztürk (2005); Aladağ et al (2006); Saler and Arslan (2007). Alper et al (2007); Dirican and Musul (2008); Bozkurt et al (2009); Saler and İpek (2009); Yıldız et al (2010); Günsel and Emir Akbulut (2012); Kaya et al (2012); Apaydın Yağcı (2013); Saler and Alış (2014); Apaydın Yağcı et al (2015); Güher and Çolak (2015); Gürel and Saler (2015).

Materials and Methods

The samples of cladocerans were collected from 31 different freshwater localities using 60 μm plankton net. The samples were fixed with 4% formaldehyde. An Olympus CH40 microscope and a camera were used for drawings of the species. Measurements were made with a Zeiss microscope and camera. Body measurements of *Bosmina coregoni* specimens were made from head to end of mucro, and carapace height. The species were identified with the aid of Scourfield and Harding (1966), Smirnov (1974), Negrea (1983), Korinek (1987) and Pennak (1989). All sampling points are freshwater except Titreyen Lake (Side, Antalya), slightly brackish water in the property. The sampling localities and sampling dates are given in Table 1.

Table 1. Sampling localities and sampling dates.

No	Sampling localities and Sampling date
1.	Çatal Pond (Feke, Adana): 18.8.2005
2.	Kocagöl Pond (Kozan, Adana): 18.8.2005
3.	Küçükgöl Pond (Kozan, Adana): 18.8.2005
4.	Pınargözü (Kozan, Adana): 21.8.2005, 25.03.2011,22.03.2014
5.	Mustafabeli Drainage Channel (Ceyhan, Adana): 19.5.2005
6.	Ceyhan Pond (Adana, Ceyhan): 12.05.2005
7.	Well1 (Kozan, Adana), (37°41’00.99’’K, 35°59’09.10’’D): 17.8.2006, 24.10.2006, 26.08.2006, 17.8.2007, 12.04.2015
8.	Well2 (Kozan, Adana), (37°41’09.63’’K, 35°59’06.59’’D): 17.8.2007, 12.04.2015
9.	Titreyen Lake (Side, Antalya): 17.08.2006, 06.08.2010, 20.08.2012
10.	Yeniyurt Creek (Dörtyol, Hatay): 22.6.2006, 22.4.2008, 12.06.2015
11.	Gölköy Channel (Dörtyol, Hatay): 28.4.2006, 26.7.2008
12.	Puddle (Çarşamba, Samsun): 14.04.2007
13.	Ceyhan River (Ceyhan, Adana): 09.06.2007
14.	Gebere Dam (Niğde): 8.08.2010
15.	Manavgat River (Manavgat, Antalya) :15.08.2012
16.	Aladağ Dam (Bolu): 26.09.2012
17.	Yalıntaş Dam (Gülşehir, Nevşehir): 19.01.2012
18.	Karkamış Dam (Gaziantep): 22.03.2012
19.	Şuğul Creek (Gürün, Sıvas): 10.09.2012
20.	Gölköy Dam (Bolu): 26.9.2012
21.	Yarıkkaya Creek (İskenderun, Hatay): 26.11.2011, 28.12.2011, 30.01.2012, 26.02.2012, 21.03.2012, 16.04.2012
22.	Sarıseki Wetlands (İskenderun, Hatay): 26.11.2011, 30.01.2012, 26.02.2012, 21.03.2012, 18.04.2012, 28.12.2012, 12.06. 2015
23.	Cimis Drainage Channel (Hatay): 23.10.2011, 25.10.2011, 01.12.2011, 30.12.2011, 02.02.2012, 30.03.2012
24.	38°00’54.51’’K, 35°50’37.15’’D (Feke, Adana): 30.10.2014
25.	36°56’09.85’’K, 36°02’48.21’’D (Erzin, Hatay): 22.4.2014
26.	Well3 37°41’05.52’’K, 35°59’08.46’’D (Kozan, Adana): 17.04.2015
27.	Keban Dam (Elazığ): 08.02.2015
28.	Kırksu Creek (Kozan, Adana): 12.04.2015
29.	Deliçay (Dörtyol, Hatay): 11.06.2015
30.	Döngel (Kahramanmaraş): 13.05.2015
31.	Fırat River (Birecik, Şanlıurfa): 21.06.2015

Results

The samples collected from 31 different localities that consists of lakes, dam lakes, streams, ponds, wells and springs. A total of 37 species of Cladocera were determined. Detected six families Chydoridae was the most species rich family with 18 species followed by Daphniidae with 11 species. Moinidae had the least species followed by Bosminidae and Sididae. The species and their localities are as Table 2.

Table 2. Detected species and localities.

Species	Localities
Family: Bosminidae	
Bosmina longirostris (Müller, 1776)	5, 10,11, 12,13, 14, 16, 17, 21, 22, 23, 27, 28, 31
Bosmina coregoni Baird, 1857	10, 18
Family: Daphniidae	
Ceriodaphnia pulchella Sars, 1862	10, 19, 11, 16, 23, 31
Ceriodaphnia quadrangula (Müller, 1785)	28
Daphnia ambigua Scourfield, 1947	16
Daphnia carinata King, 1852	1, 2, 3
Daphnia cucullata Sars 1862	18
Daphnia galeata Sars, 1864	27
Daphnia longispina (Müller, 1776)	5, 10, 16, 18
Daphnia magna Straus, 1820	23
Daphnia pulicaria Forbes,1893	12
Scapholeberis kingi Sars, 1888	25
Simocephalus vetulus (Müller, 1776)	5, 12, 19, 29, 31
Family: Sididae	
Diaphanosoma birgei Korinek, 1981	18, 19, 27
Diaphanosoma brachyurum (Liévin, 1848)	6
Family: Moinidae	
Moina micrura (Jurine, 1820)	1, 6, 9, 13, 16, 23
Family: Chydoridae	
Acroperus angustatus Sars 1863	19
Alona costata Sars, 1862	22, 23
Alona guttata Sars, 1862	5, 9, 15, 19, 20, 31
Coronatella rectangula (Sars, 1862)	2, 4, 9, 10, 11, 13, 14, 19, 20, 21,22, 23, 27
Alona quadrangularis (Müller, 1776)	4, 30
Alonella exigua (Lilljeborg, 1853)	11
Alonella excisa (Fischer, 1854)	10, 20, 22, 23
Biapertura affinis (Leydig 1860)	19
Camptocercus uncinatus Smirnov, 1971	9, 10, 20, 22, 31
Chydorus sphaericus (Müller, 1776)	4, 10, 11, 12, 14, 19, 20, 21, 22, 23, 24, 25, 26, 31
Disparalona rostrata (Koch, 1841)	23
Dunhevedia crassa King, 1853	9
Eurycercus lamellatus (Müller, 1776)	31
Graptoleberis testudinaria (Fischer, 1848)	18, 31
Leydigia acanthocercoides (Fischer, 1854)	23, 27
Pleuroxus aduncus (Jurine, 1820)	7, 8, 11, 12, 14, 19, 20, 23, 26
Picripleuroxus laevis (Sars, 1862)	10, 20, 21,22, 31
Oxyurella tenucaudis (Sars, 1862)	4, 11, 20
Family: Macrothricidae	
Ilyocryptus sordidus (Liévin, 1848)	23, 27
Macrothrix laticornis (Jurine, 1820)	13, 23
Macrothrix groenlandica Lilljeborg 1900	17

Altough Bosminidae family has approximately fourty species in the world, So far the only 2 species, *Bosmina longirostris* (Müller, 1776) and *B. coregoni* Baird, 1857 have been reported from Turkish inland waters.

It was recorded that the most found species *Bosmina longirostris* and *Chydorus sphaericus* (Müller, 1776) in 14 localities followed by *Coronatella rectangula* (Sars, 1862) in 13 localities and *Pleuroxus aduncus* (Jurine, 1820) in 9 localities. The species found only 1 localities was *Daphnia ambigua* Scourfield, 1947, *Daphnia cucullata* Sars 1862, *Daphnia galeata* Sars, 1864, *Daphnia magna* Straus, 1820, *Daphnia pulicaria* Forbes, 1893, *Scapholeberis kingi* Sars, 1888, *Diaphanosoma brachyurum* (Liévin, 1848), *Acroperus angustatus* Sars 1863, *Alonella exigua* (Lilljeborg, 1853), *Biapertura affinis* (Leydig 1860), *Disparalona rostrata* (Koch, 1841), *Dunhevedia crassa* King, 1853, *Eurycercus lamellatus* (Müller, 1776) and *Macrothrix groenlandica* Lilljeborg 1900 (Table 2).

Body of female *Bosmina coregoni* short and wide (Figure 1A), with length 0.54-0.90 mm. Carapace sculptured with longitudinal lines on the head shield. Highness of valves about 1.5 times that of body. Valves with evenly curved dorsal edge. Ventral edge of valve slightly convex, with a series of stout setae, the bases of which are located on its internal surface. Posterior edge practically straight, about 2.5 times shorter than largest length of valve. Mucro (Figure 1B) spiniform, relatively short, its basis considerably extended. On its tip, two concentric series of pointed tubercles. Frontal edge of head convex, rostrum short and blunt. Antennules rather short, slightly folded, posteriorly directed, with powerful basis and pointed tips. Frontal sensory setae relatively long. Frontal head pore located between these setae, the median pore on the frontalmost point of the head (Figures 1C). Second antennae with powerful basal part, with cross series of denticles and short branches, and also girdled by similar rows. Lateral head pore located near articulation of mandible. Eye of female roundish, large, located closer to basis of second antenna than to frontal edge of head. Postabdomen of adult female strongly compressed, lamelliform, its width equal along all its length (Figure 1Da). Distal edge nearly directly truncated. Anus opening on this edge as a long, wide, vertical slit. A conical projection with two long postabdominal claws on ventral surface of postabdomen (Figure 1Db). A row of rather large denticles present on their basal part, continued in a group of 3-5 small-sized denticles on base of claws (Figure 1Db). Several rows of thin delicate setae located on internal and external surface of claws. Back and dorsal edges of postabdomen covered by cross interrupted series of relatively long thin setules (Figure 1Dc). Such series present near basis of postabdomen on the plate, situated over the post-abdominal setae.

Thirty female specimens of *B. coregoni* examined from Yeniyurt Creek (Dörtyol, Hatay) and Karkamış Dam Lake (Gaziantep). Length of body: 0.54-0.90 mm, Heigth of body: 0.34-0.64 mm.

Discussion

In this study a total of 31 water bodies, river, dam lake, lake, marshes, pond and well were sampled and a total of 37 cladocer species were identified, with 18 Chydoridae species, 11 Daphnidae species, 3 Macrothricidae species, 2 Bosminidae and Sididae species, 1 Moinidae species (Table 2). The species appear to contain typical tropical as well as cosmopolitan and littoral inhabiting (Ryding and Rast 1989). They were widespread in Turkey and worldwide because they were found almost all regions of Turkey (Güher 2000; Alper et al. 2007; Dirican and Musul 2008; Bozkurt et al. 2009; Saler and İpek 2009; Yıldız et al. 2010; Günsel and (Emir) Akbulut 2012; Kaya et al. 2012; Apaydın Yağcı 2013; Güher 2014; Saler and Alış 2014; Apaydın Yağcı et al. 2015; Güher and Çolak 2015; Ustaoğlu 2015; Gürel and Saler 2015).

B. coregoni, rare species inland waters of Turkey, was reported first time by Güher and Kırgız (1989) from Edirne province inland waters, and later it was reported by Özbay and Kılınç (2008) from Aktaş Lake (Ardahan).

It was reported third times from Turkey, *B. coregoni* is widespread, small-bodied, filter-feeding cladocerans common in the open-water areas of both the littoral and pelagic zones of oligotrophic and mesotrophic freshwater lakes and ponds, and distributed in the northern and middle holarctic (DeMott and Kerfoot 1982).

The presence and distribution of the species in the study even holarctic *B. coregoni* is quite closely related to the ecological characteristics of the species, and all species in the study are widespread.

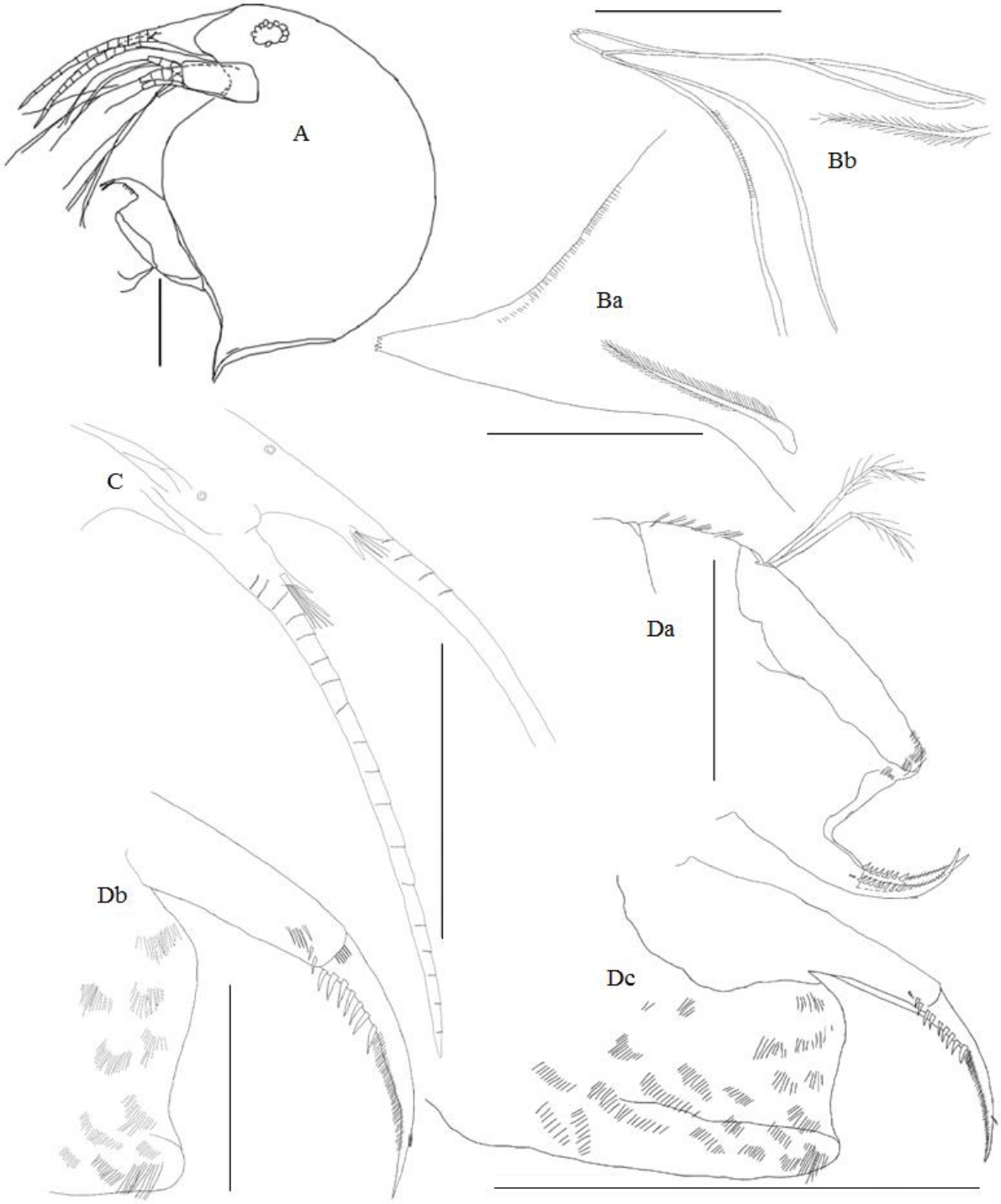

Figure 1. Full body and body parts of female *Bosmina coregoni*. (A) Female body, bar 250 µ; (Ba, Bb) Mucro, bar 60 µ; (C) Antenna I and head pores, bar 250 µ; (Da) Postabdomen of adult female, bar 250 µ; (Db) Claws, bar 60 µ; (Dc) Setules on postabdomen, bar 250 µ.

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