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## Distribution of the Ponto-Caspian Amphipods in Turkish Fresh Waters: An Overview

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### Abstract

To date, 13 amphipod species [*Dikerogammarus haemobaphes* (Eichwald, 1841); *D. istanbulensis* Özbek & Özkan, 2011; *D. gruberi* Mateus & Mateus, 1990; *Echinogammarus ischnus* Stebbing, 1899; *Pontogammarus robustoides* (Sars, 1894); *P. maeoticus* (Sowinsky, 1894); *P. aestuarius* (Derzhavin, 1924); *Obesogammarus turcarum* Stock, 1974; *Amathillina cristata* Sars, 1894; *Chelicorophium curvispinum* Sars, 1895; *C. maeoticum* (Sowinsky, 1898); *C. robustum* Sars, 1895 and *Orchestia cavimana* Heller, 1865] were reported from Turkey as the representatives of Ponto-Caspian amphipod fauna. Previous records and current distributional patterns of Ponto-Caspian amphipod crustaceans in Turkish inland waters were investigated. Three new localities were revealed as one of the southernmost points in distributional area of *Pontogammarus robustoides* (Sars, 1894).

**Keywords:** Amphipoda; Ponto-Caspian; Invader; Anatolia; Turkey.

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### Introduction

Turkey is one of the countries having long coastal strip to the Black Sea. The length of the coast between Bulgaria and Georgia is almost 1685 km on west-east direction. Naturally, various aquatic habitat types, such as lagoons, deltas and shores, are seen in this long coast. Each of them acts as a shelter for the unique animal species of this region.

During the past ages, Black and Caspian seas had turned into lake several times and then back to sea again (ZAITSEV, 2008). As a result of these changes, the faunal com-

position of the area became very specialized (MORDUKHAY-BOLTOVSKOY, 1964b). Today, Ponto-Caspian area is approved as one of the most important gene sources of the world. There are at least 335 species of metazoan animals in the basin belonging to the autochthonous faunistic complex (MORDUKHAY-BOLTOVSKOY, 1964a). Among the faunal composition, Crustaceans have a great importance in this complex.

Distributional extensions of Ponto-Caspian amphipods and mysids in Europe have been greatly facilitated by intentional introductions and the junction of river basins due

to man-made canals (BIJ DE VAATE *et al.*, 2002). Many species of the Ponto-Caspian complex had spread far up the rivers: 25 or 30 species penetrated into their middle- and some of them even into the upper stream (MORDUKHAY-BOLTOVSKOY, 1964a). Among them, the most ecologically successful and aggressive immigrants in European inland waters are Ponto-Caspian amphipods of the family Pontogammaridae and mysids (GUMULIAUSKAITĖ & ARBAČIAUSKAS, 2008; BIJ DE VAATE *et al.*, 2002; DICK *et al.*, 2002; JAZDZEWSKI *et al.*, 2004).

Studies carried out on the distribution of Ponto-Caspian amphipod species in Turkish inland waters are less in number. MORDUKHAY-BOLTOVSKOY (1964b) documented some Ponto-Caspian amphipod species from the lakes Apolyont, Iznik, Sapanca, and Manyas, situated along the southern and eastern coasts of the Sea of Marmara. Later, STOCK (1974) described a new species of amphipod, *Obesogammarus turcarum*, belonging to the Ponto-Caspian complex from Ağrı province near Turkish - Armenian border. Similarly, MATEUS & MATEUS (1990) described a new species, *Dikerogammarus gruberi*, from the Lake Sapanca, Western Anatolia. KOCATAS *et al.* (2003) reported a pontogammarid amphipod *Pontogammarus maeoticus* (Sowinsky, 1894) as a new species for the Turkish fauna. Similarly, ÖZBEK *et al.* (2004a) stated the existence of another pontogammarid species *Pontogammarus aestuarius* (Derzhavin, 1924) in Taskisigi Lake, NW Anatolia. Özbek *et al.* (2004b) reported another amphipod representative of Ponto-Caspian complex, *Chelicorophium maeoticum* (Sowinsky, 1898), from Turkey for the first time. ÖZBEK *et al.* (2004) carried out the distribution of Malacostraca species in the lakes Apolyont and Iznik. Later, ÖZBEK & USTA OĞLU (2005) reported the existence of some amphipod

species belonging to the Ponto-Caspian complex in the water bodies placed in Lake District of Turkey. ÖZBEK & ÖZKAN (2010, 2011) reported the latest studies on the Ponto-Caspian amphipod species in Turkish inland waters: *Amathillina cristata* was reported as a new record for Turkey and *Dikerogammarus istanbulensis* ÖZBEK & ÖZKAN (2011) as a new species, consequently.

In this paper, the author compiled the previous records of the Ponto-Caspian amphipod species from Turkish inland-waters, indicated them in a map, discussed the reasons affected the existence of the representatives of the complex in Anatolian freshwaters, and presented three new localities which can be revealed as one of the southernmost spots in general distributional area of *P. robustoides*.

## Material and Methods

The investigated amphipod materials were sampled during the various limnological studies of the Hydrobiology Department of Fisheries Faculty, Ege University. The studies were conducted between 1996 and 2007 in the western part of Anatolia. The sampling data were as follows: Buldan Reservoir on 31.06.1996 (ESFM MALI/96-13), Adıgüzel Reservoir on 24.05.2007 (ESFM MALI/07-02) and Tahatalı Reservoir on 08.02.2007 (ESFM MALI/07-22) (Fig. 1). All of the samples were collected from the littoral zones of the reservoirs by a hand net, which has 0.5 mm mesh size. Amphipod samples were deposited in the ESFM (Museum of Faculty of Fisheries, Ege University, Bornova, İzmir).

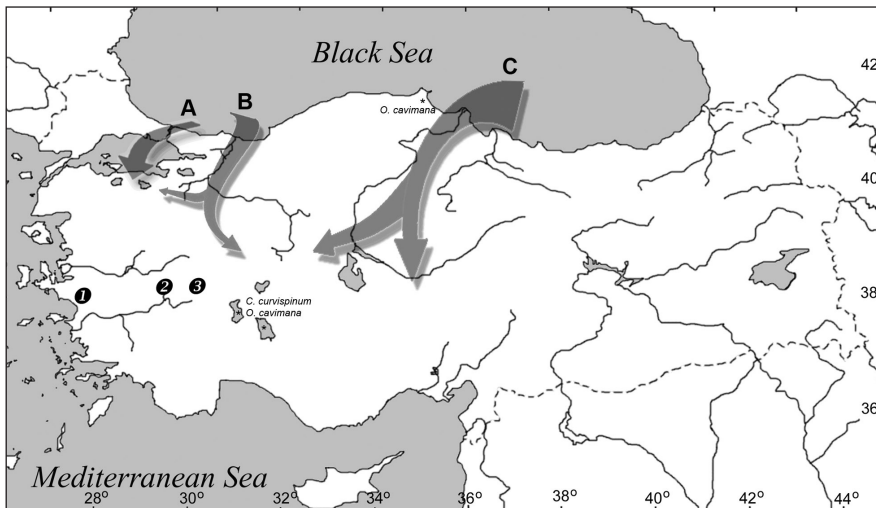
## Results and Discussion

To date, 13 amphipod species have been reported from Turkey as the representatives

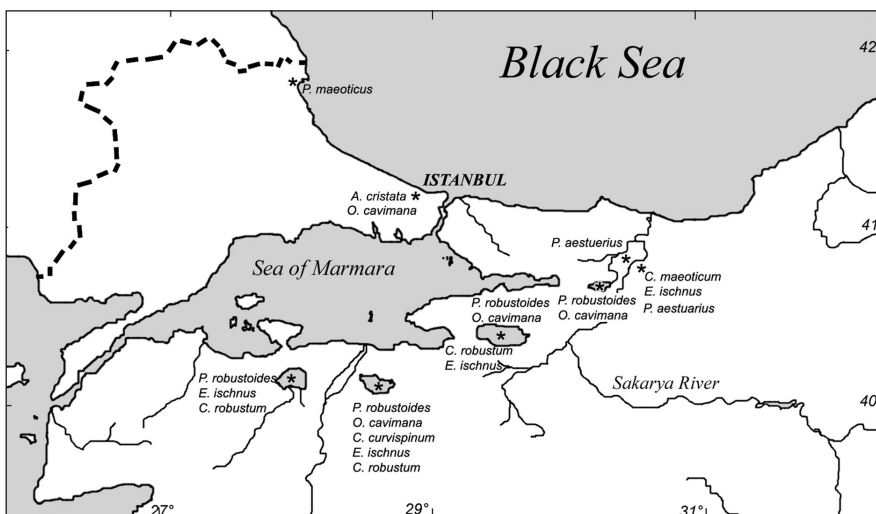
of the Ponto-Caspian amphipod fauna (Table 1). Although, *P. robustoides* and *E. ischnus* (the most abundant ones) were known from many localities, some of the others such as *A. cristata*, *P. maeoticus* and *D. istanbulensis*

were reported from only one locality in Turkey (Fig. 2).

Three new localities [Buldan (38° 08' 37" N – 28° 50' 53" E) and Adıgüzel (38° 09' 51" N – 29° 12' 30" E) reservoirs in Denizli province;



**Fig. 1:** Likely three routes (A: Sea of Marmara, B: Sakarya River, C: Kızılırmak and Yeşilırmak rivers) of the Ponto-Caspian amphipod species to reach the north-western and central Anatolian basins. Numbers indicate the localities where *P. robustoides* found in this study (❶: Tahtalı Reservoir, ❷: Buldan R., ❸: Adıgüzel R.).



**Fig. 2:** Distribution of Ponto-Caspian amphipod species in the Marmara Region, NW Anatolia.

**Table 1**

**Taxonomic status, habitat and general distribution of Ponto-Caspian amphipod species reported from inland waters of Turkey up to date (1: Fresh-water epigeal, 2: Brackish-water epigeal), (AS.: Anatolia; M.: Mediterranean Sea; B.: Black Sea; M.: Sea of Marmara).**

Taxonomic Status	Habitat	Distribution	References
<b>Familia:</b> Gammaridae Latreille, 1802			
<b>Genus:</b> <i>Echinogammarus</i> Stebbing, 1899			
<i>E. ischnus</i> Stebbing, 1899	1, 2	B.	Mordukhay-Boltovskoy, 1964b; Jazdzewski, 1980; Özbek <i>et al.</i> , 2004; Özbek & Ustaoglu, 2005; Özbek, 2008;
<b>Genus:</b> <i>Amathillina</i> Sars, 1894			
<i>A. cristata</i> Sars, 1894	2	B.	Özbek & Özkan, 2010
<b>Familia:</b> Pontogammaridae Bousfield, 1977			
<b>Genus:</b> <i>Dikerogammarus</i> Martynov, 1925			
<i>D. haemobaphes</i> (Eichwald, 1841)	2	B.	Jazdzewski, 1980
<i>D. istanbulensis</i> Özbek & Özkan, 2011	1	B.	Özbek & Özkan, 2011
<i>D. gruberi</i> Mateus & Mateus, 1990	1	B.	Mateus & Mateus, 1990
<b>Genus:</b> <i>Pontogammarus</i> Sowinsky, 1904			
<i>P. robustoides</i> (Sars, 1894)	2	B.	Mordukhay-Boltovskoy, 1964b; Jazdzewski, 1980; Özbek <i>et al.</i> , 2004; Özbek & Ustaoglu, 2005
<i>P. maeoticus</i> (Sowinsky, 1894)	2	B.	Kocataş <i>et al.</i> , 2003
<i>P. aestuarius</i> (Derzhavin, 1924)	2	B.	Özbek <i>et al.</i> , 2004a; Özbek, 2008
<b>Genus:</b> <i>Obesogammarus</i> Stock, 1974			
<i>O. turcarum</i> Stock, 1974	2	AS.	Stock, 1974
<b>Familia:</b> Corophiidae Leach, 1814			
<b>Genus:</b> <i>Chelicorophium</i> Bousfield & Hoover, 1997			
<i>C. curvispinum</i> Sars, 1895	2	B.	Özbek <i>et al.</i> , 2004; Özbek & Ustaoglu, 2005
<i>C. maeoticum</i> (Sowinsky, 1898)	2	B.	Özbek <i>et al.</i> , 2004b; Özbek, 2008
<i>C. robustum</i> Sars, 1895	2	B.	Mordukhay-Boltovskoy, 1964b
<b>Familia:</b> Talitridae Rafinesque, 1815			
<b>Genus:</b> <i>Orchestia</i> Leach, 1814			
<i>O. cavimana</i> Heller, 1865	1,2	M., B.	Akbulut & Sezgin, 2000; Özbek <i>et al.</i> , 2004; Özbek & Ustaoglu, 2005; Çamur-Elipek & Kırğız, 2008

Tahtalı Reservoir (38° - 08' 17" N – 27° 05' 53" E) in İzmir province] are reported as one of the southernmost spots in the general distributional area of *Pontogammarus robustoides*.

As a consequence of various field works conducted between 1996 and 2007 *Pontogammarus robustoides* was found at three localities in the western part of Anatolia, Turkey. The Buldan and Adıgüzel reser-

voirs are in the catchments area of the Büyük Menderes River which has also a mysid species (*Paramysis kosswigi* Bacescu, 1948) belonging to the Ponto-Caspian complex.

The other locality, Tahtalı Reservoir, is located near the city of Izmir and has been used as drinking water source for the city. The presence of *P. robustoides* at the mentioned locality can be explained by the activities of the General Directorate of State Hydraulic Works (DSI) in Turkey. This institution is mainly responsible for construction and management of the reservoirs as well as recruitment fish species to the reservoirs. During their activities, some invertebrate species or aquatic plants have been introduced to the reservoirs intentionally or unintentionally. Similarly, when we studied the limnological characteristics of the area before the reservoir construction in 1996, there was no *P. robustoides* specimen in the river basin. However today it is the only amphipod species of the reservoir (unpublished data). While the changed ecological condition (river to reservoir) is an important factor on amphipod composition of the area, high adaptation and competition capabilities of *P. robustodeis* must be also an important factor. All of the localities studied indicate the southernmost range of the species' world distribution and are shown in the map (Fig. 1).

Most of the members of the Ponto-Caspian amphipod fauna have been reported from the lakes (Manyas, Apolyont, Iznik and Sapanca) and rivers in the Marmara region (MORDUKHAY-BOLTOVSKOY, 1964b; ÖZBEK *et al.*, 2004). In the lower basin of Sakarya River some small lakes are exist and we found some of the representatives of the Ponto-Caspian amphipods at these localities (ÖZBEK *et al.*, 2004a, b) (Fig. 2). Additionally, there is another study on the distribution of the Ponto-Caspian amphipod fau-

na at the lakes located in Lake District, Central Anatolia (ÖZBEK & USTAOĞLU, 2005).

Most probably, there can be three main water ways used by the Ponto-Caspian representatives in order to reach the Anatolian lakes in the past (Fig. 1). One of them is the Bosphorus. It might be used by the representatives of the faunal components of the Black Sea in order to reach the lakes located near the Sea of Marmara. Fluctuations in the water levels of the Black Sea during the past times and connections of the lakes (e. g. Sapanca, Iznik and Manyas) with the Sea of Marmara through streams might help the Ponto-Caspian amphipods to invade these lakes. Sakarya River (a length of 824 km) is another important water way to reach the inner part of Anatolia. The Ponto-Caspian amphipods are still an important component of benthos of the water bodies located in the lower parts of this river (ÖZBEK *et al.*, 2004a, b). The other water way can be Kızılırmak River which arises near Sivas and has a 1355 km length (Fig. 1). The river passes from Central Anatolia just above Tuz Lake and runs out to the Black Sea, near Samsun (Fig. 1). Yeşilirmak River, which has a 519 km length, and Kızılırmak River can be the two probable water ways to reach to the central Anatolian lakes for the faunal elements of the Black Sea during the ancient times. High adaptation and competition capabilities of the Ponto-Caspian amphipods may make this assumption possible. More studies on the distribution of these animals will help to solve this puzzle.

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