

Freshwater Amphipod Species of Western Anatolia, Marmara and Turkish Thrace Regions

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ABSTRACT

To determine the Amphipoda (Crustacea) fauna of the inland waters of Western Anatolia, Marmara and the Turkish Thrace Region, field studies were conducted between May 2014 and March 2019. Seven field studies were conducted. Samplings were conducted at 291 localities and amphipod specimens were found at 127 of them. As a result, 11 amphipod species (*Echinogammarus stocki* G. Karaman, 1970, *Gammarus aequicauda* (G. Karaman, 1970), *Gammarus anatoliensis* Schellenberg, 1937, *Gammarus arduus* G. Karaman, 1975, *Gammarus balcanicus* Schäferna, 1923, *Gammarus dorsosetosus* Mateus & Mateus, 1990, *Gammarus gonensis* Özbek, 2016, *Gammarus komareki* Schäferna, 1923, *Gammarus lacustris* G.O. Sars, 1863, *Gammarus pulex pulex* (Linnaeus, 1758), *Gammarus uludagi* G.S. Karaman, 1975) were determined. The new records can be listed as: *E. stocki* for Ekinanbarı, *G. anatoliensis* for Uşak, *G. arduus* for Bolu and Düzce, *G. balcanicus* for Kocaeli and Sakarya, *G. dorsosetosus* for Bolu, *G. gonensis* for Istanbul and Manisa, *G. komareki* for Düzce and Kocaeli, *G. lacustris* for Istanbul, *G. pulex pulex* for Bolu, Kırklareli, Kocaeli, Sakarya and Uşak, and *G. uludagi* for Aydın, Bilecik, Sakarya and Yalova provinces. The observed morphological features and the detailed drawings of the determined taxa are presented. Additionally, a map showing the distribution of the obtained species is also given.

Keywords: Inland-water, river, Peracarida, benthos, Malacostraca

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INTRODUCTION

The order Amphipoda constitutes 30% of the Malacostraca class, with more than 30,000 species worldwide. The number of marine, freshwater, brackish and terrestrial species (except Amphipoda with 22 species) is 10,247 worldwide (Horton et al., 2021). The taxonomy of the order Amphipoda has been finalized consisting of six suborders by the study of Lowry and Myers (2017). All of the amphipod species reported from the inland waters of Türkiye belong to the suborder Senticaudata.

The pioneering study on the freshwater amphipod species of Türkiye was reported by Vávra (1905) who described *Gammarus argeus* from the Erciyes Mountains. After this initial study, many studies have been reported. The last

study regarding the inland water amphipods of Türkiye was on the identification of *Rhipidogammarus gordankaramani* Özbek & Sket 2019 which was reported in Antalya.

In the present study, it is aimed to determine the Amphipoda fauna of the inland waters of Western Anatolia, Marmara and the Turkish Thrace Region.

MATERIAL AND METHODS

Seven field studies were conducted between May 2014 and March 2019 at 291 localities and amphipod specimens were found at 127 of them (Figure 1).

Samples were fixed in 96% ethyl alcohol in the field and then sorted in the laboratory using a



Leica EZ4 stereomicroscope and then kept in 96% ethyl alcohol. During the field study, altitudes, and geographical coordinates of the sampling localities were also noted (Table 1). Temporary slides of mature male specimens were prepared using pure glycerol. The photographs of the extremities were taken with a digital camera (Kameram21) attached to a microscope (Nikon Eclipse 80i) and processed with image processing programs. A digitizer board (Wacom CTE-440) connected to a PC and its standard pen were used to draw illustrations on a transparent layer of the original photo of each extremity. Coleman (2003, 2006, 2009) was followed while drawing illustrations. Scale bars were marked using a micrometric slide for each magnification ratio of the microscope.

Karaman and Pinkster (1977a, 1977b, 1987), Bellan-Santini et al. (1982), Özbek (2011) and Pinkster (1993) were followed for the taxonomic identification.

The collected samples are stored in the laboratory of the Faculty of Science and Letters of Eskisehir Osmangazi University, Eskisehir, Türkiye.



Figure 1. Distribution of the determined amphipod species (◆*Echinogammarus stocki*, ⊕*Gammarus aequicauda*, ■*Gammarus anatoliensis*, ⊗*Gammarus arduus*, ⊠*Gammarus balcanicus*, ⊞*Gammarus dorsosetosus*, ⊛*Gammarus gonensis*, ⊙*Gammarus komareki*, ⊚*Gammarus lacustris*, ⊛*Gammarus pulex pulex*, ⊕*Gammarus uludagi*).

RESULTS AND DISCUSSION

A total of 11 gammaridean taxa [*Echinogammarus stocki* G. Karaman, 1970, *Gammarus aequicauda* (G. Karaman, 1970), *Gammarus anatoliensis* Schellenberg, 1937, *Gammarus arduus* G. Karaman, 1975, *Gammarus balcanicus* Schäferna, 1923, *Gammarus dorsosetosus* Mateus & Mateus, 1990, *Gammarus gonensis* Özbek, 2016, *Gammarus komareki* Schäferna, 1923, *Gammarus lacustris* G.O. Sars, 1863, *Gammarus pulex pulex* (Linnaeus, 1758), *Gammarus uludagi* G.S. Karaman, 1975] were recorded.

G. arduus was the most common species and sampled at 33 localities. *G. komareki*, *G. pulex pulex*, and *G. uludagi* were observed at 22, 21, and 18 localities, respectively. The distribution of the determined taxa and the information of the stations are presented (Figure 1, Table 2). The observed morphological features of the determined taxa are as follows:

E. stocki: A small species. The maximum body length is about 11mm in adults. The antenna I reach half of the body and peduncle segments bear long setae along the posterior margins; the main and accessory flagellum consists of 20 and 4-5 segments, respectively. The fourth and fifth peduncle segments of antenna II bear 7-8 groups of long setae along the posterior margin, and the length of these setae are more than twice as long as the diameter of the segments on which they are implanted. Calceoli is absent. The mandibular palp has the characteristic C-setae. Endopodite of uropod III elongated and prominently as long as 1/5 of the exopodite and its length is three times as long as the wide. Exopodite with many plumose setae on both margins. Telson lobes are deeply cleft and about twice as long as their width.

Examined material: St. 2: 2 ♀♀, 2 ♂♂, 17.v.2014; St. 3: 30 ♀♀, 30 ♂♂, 17.v.2014.

G. aequicauda: The maximum body length is about 14-15 mm in adults. The main and accessory flagellum of antenna I consist of 28 and 6 segments, respectively. The fourth and fifth peduncle segments of antenna II bear many groups of long curled and simple setae on the posterior margins. Calceoli is absent. The third segment of the mandibular palp bears 2 groups of A-setae, 1 group of B-setae, 26 D-setae, and 4 E-setae. Gnathopod I is smaller than gnathopod II; propodus of the gnathopods I-II elongated and pyriform with a flask-shaped medial palmar spine. Pereiopods V-VII with long setae on the anterior margin. The basis of the pereiopod V-VI with 3-4 and 7-8 short setae on the postero-interior surface. Rami of the uropod III bears many plumose and simple setae. Telson lobes are very deeply cleft and about three times as long as their width. Each lobe with 2 groups of spines and setae on the outer margin, and 3 spines and 6-7 long setae on the terminal; setae longer than spines.

Examined material: St. 2: 43 ♀♀, 62 ♂♂, 17.v.2014; St. 3: 8 ♂♂, 17.v.2014; St. 125: 16 ♀♀, 12 ♂♂, 20.xii.2018; St. 126: 1 ♂♂, 20.xii.2018.

G. anatoliensis: The maximum body length is about 14-15mm in adults. Within the *Gammarus balcanicus*-group, it can be easily distinguished from the others by the elevated and crenulated dorsoposterior margins of the metasomal segments. Addition-

Table 1. Taxonomic status, abbreviations (Abbr.) and newly recorded provinces of the determined taxa.

Taxonomic status		Abbr.	Newly recorded locality
Gammaridae Leach, 1814	Genus: <i>Echinogammarus</i> Stebbing, 1899		
	<i>E. stocki</i> G. Karaman, 1970	E.s.	Ekinanbarı
	Genus: <i>Gammarus</i> Fabricius, 1775		
	<i>G. aequicauda</i> (Martynov, 1931)	G.ae.	--
	<i>G. anatoliensis</i> Schellenberg, 1937	G.an.	Uşak
	<i>G. arduus</i> G. Karaman, 1975	G.ar.	Bolu and Düzce
	<i>G. balcanicus</i> Schäferna, 1923	G.b.	Kocaeli and Sakarya
	<i>G. dorsosetosus</i> Mateus & Mateus, 1990	G.d.	Bolu
	<i>G. gonensis</i> Özbek, 2016	G.g.	Istanbul and Manisa
	<i>G. komareki</i> Schäferna, 1923	G.k.	Düzce and Kocaeli
	<i>G. lacustris</i> G.O. Sars, 1863	G.l.	Istanbul
	<i>G. pulex pulex</i> (Linnaeus, 1758)	G.p.p.	Bolu, Kırklareli, Kocaeli, Sakarya and Uşak
	<i>G. uludağı</i> G.S. Karaman, 1975	G.u.	Aydın, Bilecik, Sakarya and Yalova

Table 2. The names, localities, sampling dates, geographical locations, and altitudes of the stations.

No	Locality	Date	Latitude	Longitude	Taxon
1	Fountain (Paşa Valley)	12.05.2014	37°56'34.0"N	27°53'31.8"E	G.u.
2	Ekinanbarı Spring	17.05.2014	37°14'42.58"N	27°41'9.09"E	E.s., G.ae.
3	Bafa Lake	17.05.2014	37°28'37.13"N	27°29'8.28"E	E.s., G.ae.
4	Hona Creek	23.05.2015	38°14'28.40"N	27°14'0.84"E	G.u.
5	Karasu Spring	25.07.2015	39°50'28.90"N	29°58'38.73"E	G.b.
6	Mezit Creek-1	25.07.2015	39°54'49.48"N	29°48'54.57"E	G.b.
7	Mezit Creek-2	25.07.2015	39°54'55.71"N	29°49'7.25"E	G.b.
8	Creek (Berçin)	25.07.2015	39°47'18.96"N	29°35'40.63"E	G.b., G.p.p.
9	Sorkun Creek	26.07.2015	39°34'13.23"N	29°27'10.86"E	G.p.p.
10	Creek (Harmancık)	26.07.2015	39°40'28.84"N	29° 9'0.70"E	G.b., G.p.p.
11	Fountain	26.07.2015	39°35'26.64"N	27°29'25.22"E	G.u.
12	Creek (Dereçi)	27.07.2015	39°41'11.83"N	27°9'51.93"E	G.u.
13	Creek (Hanlar)	27.07.2015	39°43'27.49"N	27°11'0.61"E	G.u.
14	Fountain (Hanlar)	27.07.2015	39°43'9.95"N	27°10'60.00"E	G.u.
15	Fountain (Huriyeoğulları)	27.07.2015	39°40'18.01"N	27°6'42.31"E	G.u.
16	Fountain (Talimalanı)	27.07.2015	39°40'16.57"N	27°5'52.54"E	G.u.
17	Hasanboğuldu Creek-1	27.07.2015	39°38'42.05"N	26°55'6.62"E	G.u.
18	Hasanboğuldu Creek-2	27.07.2015	39°38'47.01"N	26°55'4.78"E	G.u.
19	Pınarbaşı Creek	30.07.2015	39°37'15.10"N	26°52'49.86"E	G.u.
20	Bıçkı Creek	30.07.2015	39°45'20.34"N	26°48'17.07"E	G.u.
21	Ayazma Creek	30.07.2015	39°44'46.90"N	26°50'35.03"E	G.u.
22	Kocaköy Creek	31.07.2015	39°56'17.26"N	27°13'54.72"E	G.g.
23	Kaz Creek	31.07.2015	39°58'53.66"N	27°7'22.62"E	G.u.
24	Fındıklı Creek-1	31.07.2015	40°24'29.76"N	26°34'6.56"E	G.ar.
25	Fındıklı Creek-2	31.07.2015	40°25'6.98"N	26°33'46.82"E	G.ar.
26	Burgaz Creek-1	1.08.2015	40°24'54.65"N	26°30'38.75"E	G.ar.
27	Burgaz Creek-2	1.08.2015	40°24'55.05"N	26°30'39.28"E	G.ar.
28	Gölcük Creek	1.08.2015	40°41'31.22"N	27°5'47.02"E	G.ar.
29	Fountain (Hasan Engin)	2.08.2015	40°42'21.08"N	26°34'0.98"E	G.ar.
30	Fountain (Erikli)	2.08.2015	40°38'17.99"N	26°27'24.08"E	G.ar.
31	Babadere Creek	2.08.2015	40°39'25.52"N	26°32'57.66"E	G.k.
32	Dere-1 (Hasköy)	2.08.2015	40°39'55.49"N	26°19'2.88"E	G.ar.
33	Ova Creek	2.08.2015	40°40'25.32"N	26°11'16.75"E	G.ar.

Table 2. Continue.

No	Locality	Date	Latitude	Longitude	Taxon
34	Fountain (Hacı Hüseyin)	3.08.2015	40°53'45.95"N	26°22'3.71"E	G.ar.
35	Fountain (H. Seyit Kâhya)	3.08.2015	40°53'45.68"N	26°22'3.90"E	G.ar.
36	Fountain (Sultan)	3.08.2015	41°1'43.83"N	26°26'56.51"E	G.ar.
37	Balabancık Creek	3.08.2015	41°1'57.94"N	26°24'36.97"E	G.ar.
38	Fountain (Uzunköprü)	3.08.2015	41°16'26.39"N	26°39'44.88"E	G.ar.
39	Bölükler Creek	3.08.2015	41°10'29.46"N	26°40'3.40"E	G.k.
40	Fountain	3.08.2015	41°17'52.27"N	26°57'7.73"E	G.ar.
41	Fountain-1 (Danişment)	3.08.2015	41°18'14.14"N	26°54'2.21"E	G.ar.
42	Fountain-2 (Danişment)	4.08.2015	41°18'25.93"N	26°54'9.89"E	G.ar.
43	Fountain (Akarca)	4.08.2015	41°20'2.88"N	26°55'20.23"E	G.ar.
44	Kaynarca Creek	4.08.2015	41°33'2.16"N	27°25'44.24"E	G.ar.
45	Fountain (Sofuhali)	4.08.2015	41°26'38.24"N	27°9'22.33"E	G.ar.
46	Çilingir Creek-2	4.08.2015	41°26'39.95"N	27°9'16.44"E	G.ar.
47	Fountain(Menekşesofular)	5.08.2015	41°45'42.36"N	26°38'37.00"E	G.ar.
48	Sofular Creek	5.08.2015	41°45'43.03"N	26°38'35.86"E	G.ar.
49	Sinanköy Creek	5.08.2015	41°44'16.29"N	26°39'52.99"E	G.k.
50	Karayusuf Creek	5.08.2015	41°43'53.89"N	26°41'39.67"E	G.ar.
51	Fountain (Demirhanlı)	5.08.2015	41°41'55.66"N	26°44'2.00"E	G.k.
52	Fountain (Özmen Ailesi)	5.08.2015	41°43'58.18"N	26°50'52.46"E	G.ar.
53	Fountain (Bostanlı)	5.08.2015	41°36'37.50"N	26°58'16.91"E	G.ar.
54	Fountain (Hazinedar)	5.08.2015	41°33'45.41"N	27°0'22.42"E	G.ar.
55	İnce Creek-2	5.08.2015	41°33'39.96"N	27°0'51.59"E	G.k.
56	Fountain (Çaydere)	6.08.2015	41°42'6.52"N	27°30'41.63"E	G.ar.
57	Fountain (Gendarmerie Tower)	6.08.2015	41°46'7.71"N	27°41'0.73"E	G.k.
58	Velika Creek	6.08.2015	41°46'55.45"N	27°42'26.07"E	G.p.p.
59	Asker Creek	6.08.2015	41°51'7.86"N	27°48'24.55"E	G.k.
60	Değirmen Creek	6.08.2015	41°49'18.09"N	27°45'4.25"E	G.p.p.
61	Fountain-2 (Sergen)	6.08.2015	41°41'19.10"N	27°42'33.41"E	G.ar.
62	Fountain (Okçular)	7.08.2015	41°33'14.82"N	27°49'29.08"E	G.ar.
63	Kazan Creek	7.08.2015	41°37'51.54"N	27°53'4.20"E	G.ar., G.k.
64	Kömürköy Spring	7.08.2015	41°38'13.10"N	27°53'33.97"E	G.k.
65	Pabuç Creek	7.08.2015	41°41'6.01"N	27°52'58.25"E	G.k.
66	Dere (Kışlacık)	7.08.2015	41°40'50.65"N	27°57'17.80"E	G.k.
67	Kızılcaali Creek	9.08.2015	41°13'58.72"N	28°33'19.17"E	G.l.
68	Sofular Creek	9.08.2015	41°10'26.41"N	29°29'24.97"E	G.k.
69	Dere (Kızılcaaköy)	9.08.2015	41°9'16.14"N	29°32'37.80"E	G.p.p.
70	Kızılca Spring	9.08.2015	41°9'15.66"N	29°32'37.77"E	G.p.p.
71	Ballıkaya Creek	10.08.2015	40°50'21.70"N	29°31'2.21"E	G.b.
72	Oruçoğlu Creek	11.08.2015	41°3'54.89"N	29°28'26.88"E	G.k.
73	Übeyli Dere	11.08.2015	41°5'58.00"N	29°46'56.20"E	G.g.
74	Taşlıgeçit Creek	11.08.2015	41°6'16.85"N	30°28'34.40"E	G.p.p.
75	Kiraz Stream	12.08.2015	40°42'5.52"N	29°59'40.90"E	G.p.p.
76	Kazan Dere	12.08.2015	40°38'22.03"N	29°57'37.37"E	G.k.
77	Armutlu Creek-3	13.08.2015	40°32'44.61"N	28°50'30.68"E	G.g.
78	Fountain (Selimiye)	13.08.2015	40°30'51.86"N	28°58'55.44"E	G.g.
79	Soğukdere Creek-1	13.08.2015	40°31'17.71"N	28°59'11.82"E	G.u.
80	Soğukdere Creek-2	13.08.2015	40°31'17.08"N	28°59'11.29"E	G.p.p.
81	Boğaz Creek	14.08.2015	40°14'58.02"N	29°42'53.54"E	G.p.p., G.d.
82	Papatya Creek (Göksu Stream)	14.08.2015	40°14'34.27"N	29°44'22.95"E	G.p.p.
83	Fountain (Pelitözü)	14.08.2015	40°10'37.23"N	29°57'27.46"E	G.p.p.
84	Hamsu Creek-1 (Çakırpınar)	14.08.2015	40°8'40.66"N	29°57'47.67"E	G.p.p.

Table 2. Continue.

No	Locality	Date	Latitude	Longitude	Taxon
85	Hamsu Creek-2 (Selöz)	15.08.2015	40°7'51.45"N	29°55'49.31"E	G.p.p.
86	Hamsu Creek-3 (Ulupınar)	15.08.2015	40°7'15.06"N	29°53'15.29"E	G.p.p.
87	Fountain (Ulupınar)	15.08.2015	40°6'39.34"N	29°52'59.33"E	G.p.p.
88	Fountain (Karadede)	15.08.2015	40°5'12.68"N	29°50'49.86"E	G.p.p.
89	Günyurdu Creek	15.08.2015	40°4'32.17"N	29°50'27.55"E	G.p.p.
90	Fountain (Büyükelmalı)	15.08.2015	40° 3'9.11"N	29°48'25.90"E	G.u.
91	Fountain (Küplü Bridge)	5.12.2015	40°00'36.118"N	30°39'54.38"E	G.an.
92	Küplü Creek (Mayıslar)	5.12.2015	40°01'29.168"N	30°39'16.609"E	G.an.
93	Sorgun Creek	5.12.2015	40°20'24.34"N	31°14'22.44"E	G.p.p.
94	Mudurnu Stream-1	5.12.2015	40°31'26.641"N	31°14'33.935"E	G.p.p.
95	Dere-1 (Uğurköy)	6.12.2015	40°44'3.294"N	31°12'51.735"E	G.k.
96	Dere-2 (Uğurköy)	6.12.2015	40°44'16.807"N	31°12'28.224"E	G.ar.
97	Creek (Gelenöz)	6.12.2015	40°55'57.80"N	31°19'38.43"E	G.k.
98	Creek (Ahmetçiler)	6.12.2015	40°58'33.194"N	31°26'5.346"E	G.k.
99	Creek (Tıraşlar)	6.12.2015	41°00'37.326"N	31°24'52.136"E	G.k.
100	Edilli Creek	8.12.2015	41°4'15.00"N	31°4'18.05"E	G.k.
101	Karaburun Creek	8.12.2015	41°4'12.32"N	31°1'0.14"E	G.k.
102	Akçay Stream	8.12.2015	40°34'54.58"N	30°45'19.88"E	G.u.
103	Fountain (Çamyurdu)	8.12.2015	40°35'32.50"N	30°56'16.35"E	G.b.
104	Çağşak Creek	9.12.2015	40°33'2.03"N	31°0'17.27"E	G.p.p.
105	Fountain (Tosunlar)	9.12.2015	40°33'1.99"N	31°0'17.74"E	G.p.p.
106	Gök Dere-1 (Çavuşdere)	9.12.2015	40°30'7.26"N	31°2'45.90"E	G.p.p.
107	Gök Dere-2 (Yeşilyazı)	9.12.2015	40°27'20.19"N	30°58'11.10"E	G.ar.
108	Gök Dere-3 (Sünnet)	9.12.2015	40°26'31.63"N	30°57'38.21"E	G.p.p.
109	Hebirler Creek	9.12.2015	40°18'49.69"N	30°51'22.56"E	G.p.p.
110	Gelinkaya Creek	25.04.2016	39°18'56.44"N	29°58'39.10"E	G.p.p.
111	Fountain (Yaylaköy)	25.04.2016	39°5'22.39"N	29°28'15.68"E	G.u.
112	Fountain (Akçaalan)	25.04.2016	39°4'13.56"N	29°24'11.96"E	G.u.
113	Fountain (Aşağıyoncağağaç)	25.04.2016	39°13'54.39"N	29°14'47.00"E	G.u.
114	Creek (Emet)	25.04.2016	39°20'14.72"N	29°17'31.51"E	G.g.
115	Fountain (Oysu)	26.04.2016	38°58'1.80"N	29°54'54.70"E	G.g.
116	Fountain (Saraycık)	26.04.2016	38°59'4.10"N	29°50'53.30"E	G.an.
117	Banaz Stream-1	27.04.2016	38°22'0.87"N	29°19'40.89"E	G.an.
118	Creek (Kıranyer)	28.04.2016	37°48'19.30"N	28°48'37.80"E	G.u.
119	Bozüyük Pınarbaşı Creek	29.04.2016	37°17'44.68"N	28°7'39.24"E	G.b.
120	Banaz Stream-2	12.05.2016	38°32'58.12"N	29°37'26.00"E	G.p.p.
121	Hamam Creek	12.05.2016	38°46'43.20"N	29°49'11.90"E	G.p.p.
122	Dere (Zafertepeçalköy)	12.05.2016	38°56'46.60"N	30°5'20.30"E	G.an.
123	Çitalan Creek	17.04.2018	39°24'5.30"N	27°36'26.20"E	G.g.
124	Yağcılı Creek	18.04.2018	39°14'15.07"N	27°31'56.03"E	G.g.
125	Karina Lagoon	20.12.2018	37°37'13.18"N	27°11'54.00"E	G.ae.
126	Tuzburgazı Spring	20.12.2018	37°37'15.88"N	27°11'54.46"E	G.ae.
127	Creek (Soğanlı)	16.03.2019	38°32'7.20"N	28°26'8.92"E	G.p.p.

ally, the basis of the pereopod VII bears few setae on the posteroventral side. The main and accessory flagellum of antenna I consist of 21-25 and 3-4 segments, respectively. The flagellum of antenna II consists of 11-13 segments; with few flag-like brush setae on the posterior margins. Calceoli can be present or absent. The third segment of the mandibular palp bears 1 group of A-setae, 1 group of B-setae, 23-25 D-setae, and 4-5

E-setae. C-setae is absent. Pereiopod III and IV have a weak setation. Pereiopods V-VII bears the only spine on the anterior margin in segments 3-6, the setae is usually absent, if there is any, it is shorter than the spines. Rami of the uropod III is weakly armed. Telson lobes are cleft and more than twice their width. Each lobe has 2-3 spines and 4-5 setae on the terminal and usually 2 plumose setae on the lateral margin.

Examined material: St. 91: 5 ♀♀, 10 ♂♂, 5.xii.2015; St. 92: 9 ♀♀, 18 ♂♂, 5.xii.2015; St. 115: 28 ♀♀, 34 ♂♂, 26.iv.2016; St. 116: 6 ♀♀, 7 ♂♂, 26.iv.2016; St. 117: 26 ♀♀, 40 ♂♂, 27.iv.2016 St. 121: 2 ♂♂, 12.v.2016; St. 122: 5 ♂♂, 12.v.2016.

G. arduus: The body length is 14-15 mm in adults. Within the *Gammarus pulex*-group, it can be easily distinguished from the others by the antenna II that has a slender flagellum, and the epimeral plate II bears densely setae on the outer surface and distal margin, and especially basis of the pereopod VI-VII bear setae on the postero-ventral side. Sometimes segments of the metasome II and III bear setae on the dorsal margin. Peduncles of the antenna I have a weak setation like flagellum. The main and accessory flagellum consists of 26-30 and 3-5 segments, respectively. Calceoli is absent. The third segment of mandibular palp bears 1 group of A-setae, 2 groups of B-setae, 25-27 D-setae, and 4-6 E-setae. C-setae is absent. Pereiopod III and IV are slender and have short dactylus. Epimeral plates I-III can be slightly pointed on the posterodistal corner. Epimeral plate II with numerous setae on the outer surface. The Rami of uropod III has many simple and plumose setae. The telson lobes are deeply cleft and about 3 times their width.

Examined material: St. 24: 28 ♀♀, 29 ♂♂, 31.vii.2015; St. 25: 52 ♀♀, 52 ♂♂, 31.vii.2015; St. 26: 49 ♀♀, 57 ♂♂, 1.viii.2015; St. 27: 29 ♀♀, 32 ♂♂, 1.viii.2015; St. 28: 37 ♀♀, 37 ♂♂, 1.viii.2015; St. 29: 21 ♀♀, 26 ♂♂, 2.viii.2015; St. 30: 43 ♀♀, 84 ♂♂, 2.viii.2015; St. 32: 15 ♀♀, 21 ♂♂, 2.viii.2015; St. 33: 44 ♀♀, 58 ♂♂, 2.viii.2015; St. 34: 29 ♀♀, 54 ♂♂, 3.viii.2015; St. 35: 14 ♀♀, 35 ♂♂, 3.viii.2015; St. 36: 23 ♀♀, 66 ♂♂, 3.viii.2015; St. 37: 82 ♀♀, 144 ♂♂, 3.viii.2015; St. 38: 5 ♀♀, 28 ♂♂, 3.viii.2015; St. 40: 61 ♀♀, 68 ♂♂, 3.viii.2015; St. 41: 43 ♀♀, 68 ♂♂, 3.vii.2015; St. 42: 46 ♀♀, 57 ♂♂, 4.viii.2015; St. 43: 21 ♀♀, 29 ♂♂, 4.viii.2015; St. 44: 61 ♀♀, 64 ♂♂, 4.viii.2015; St. 45: 32 ♀♀, 65 ♂♂, 4.viii.2015; St. 46: 60 ♀♀, 83 ♂♂, 4.viii.2015; St. 47: 10 ♀♀, 24 ♂♂, 5.viii.2015; St. 48: 14 ♀♀, 11 ♂♂, 5.viii.2015; St. 50: 28 ♀♀, 124 ♂♂, 5.viii.2015; St. 52: 23 ♀♀, 49 ♂♂, 5.viii.2015; St. 53: 1 ♀♀, 2 ♂♂, 5.viii.2015; St. 54: 18 ♀♀, 37 ♂♂, 5.viii.2015; St. 56: 20 ♀♀, 33 ♂♂, 6.viii.2015; St. 61: 18 ♀♀, 28 ♂♂, 6.viii.2015; St. 62: 13 ♀♀, 46 ♂♂, 7.viii.2015; St. 63: 12 ♂♂, 7.viii.2015; St. 96: 10 ♀♀, 55 ♂♂, 6.xii.2015; St. 107: 6 ♀♀, 22 ♂♂, 9.xii.2015.

G. balcanicus: The maximum body length is about 12-13mm in adults, a relatively small species. The antenna II is slender and has fewer setae. The pereopods III-IV bear a few short setae, the pereopods V-VII bear almost no seta, if any seta is present, it is always shorter than the spines. Epimeral plates I-III can be slightly pointed on the posterodistal corner and bear the only spine. The antenna I has a weak setation; the main and accessory flagellum consists of 21-25 and 3-4 segments, respectively. Antenna II bears short and fewer setae. The flagellum consists of 10-14 segments; the length of the setae is shorter than the diameter of the segments on which they are implanted. Calceoli can be present or absent. The third segment of the mandibular palp bears 2 groups of A-setae, 1 group of B-setae, 22-26 D-setae, and 4-5 long E-setae. C-setae is absent. Gnathopod I and II bear a small numerous of setae. The rami of uropod III bears only simple setae on both margins; there are no plumose setae. The telson lobes are deeply cleft and about 2 times their width.

Examined material: St. 5: 18 ♀♀, 47 ♂♂, 25.vii.2015; St. 6: 1 ♀, 1 ♂, 25.vii.2015; St. 7: 10 ♀♀, 22 ♂♂, 25.vii.2015; St. 8: 21 ♀♀, 17 ♂♂, 25.vii.2015; St. 10: 20 ♀♀, 29 ♂♂, 26.vii.2015; St. 71: 36 ♀♀, 29 ♂♂, 10.viii.2015; St. 82: 10 ♀♀, 11 ♂♂, 14.viii.2015; St. 102: 6 ♂♂, 8.xii.2015; St. 103: 29 ♀♀, 42 ♂♂, 8.xii.2015; St. 119: 49 ♀♀, 62 ♂♂, 29.iv.2016.

G. dorsosetosus: The body is smooth and its length is up to 10-11mm in adults. Within the *Gammarus balcanicus*-group, it can be easily distinguished from the others by the presence of long setae on the dorsoposterior margin of the metasome segments, which is a distinguishing morphological character for these species. The antenna I has a weak setation and the main and accessory flagellum consists of 20-23 and 2 segments, respectively. Antenna II bears fewer setae. The flagellum consists of 11 segments. Calceoli is absent. The third segment of mandibular palp bears one group of A-setae, one group of B-setae, 23-24 D-setae, and 4-5 E-setae. C-setae is absent. The lengths of pereopod V-VII are almost the same, the length of the basis is 1.5 times their width, but the pereopod V is relatively quadrangular in form and slightly longer than the width. The endopodite of the uropod III is about as long as 3/5 of the exopodite; the rami bear some plumose setae. The telson lobes are cleft and about 2.5 times their width.

Examined material: St. 81: 5 ♀♀, 16 ♂♂, 14.viii.2015; St. 84 : 7 ♀♀, 18 ♂♂, 14.viii.2015; St. 85 : 10 ♀♀, 8 ♂♂, 15.viii.2015; St. 86 : 2 ♀♀, 11 ♂♂, 15.viii.2015; St. 93: 2 ♂♂, 5.xii.2015.

G. gonensis: The body is smooth, medium to large, and up to 13-14 mm in adults. It belongs to the *Gammarus pulex*-group and is similar to *Gammarus uludagi* except for bearing many setae along the anterior margins of pereopods 5-7, bearing less setose on the peduncle segments of the antenna II, bearing more setae on the propodus of the gnathopod II and having longer antenna I. The main and accessory flagellum of antenna I consist of 30 and 4 segments, respectively. Peduncles and flagellum have a weak setation. The flagellum of antenna II consists of 11 slightly swollen segments. Calceoli present on the segments 1-7. The third segment of the mandibular palp bears 1 group of A-setae, 2 groups of B-setae, 29 D-setae, and 6 E-setae. C-setae is absent. Endopodite of the uropod III is about as long as 3/4 of the exopodite with numerous plumose setae on both margins. The telson lobes are deeply cleft and about 2.5 times their width.

Examined material: St. 22: 28 ♀♀, 40 ♂♂, 31.vii.2015; St. 73: 13 ♀♀, 11 ♂♂, 11.viii.2015; St. 77 : 5 ♀♀, 13 ♂♂, 13.viii.2015; St. 78 : 6 ♀♀, 41 ♂♂, 13.viii.2015; St. 114: 24 ♀♀, 41 ♂♂, 25.iv.2016; St. 115: 5 ♀♀, 11 ♂♂, 26.iv.2016; St. 123: 18 ♀♀, 15 ♂♂, 17.iv.2018; St. 124: 19 ♀♀, 23 ♂♂, 18.iv.2018.

G. komareki: The body is smooth, medium to large, and up to 15mm in adults. It belongs to the *Gammarus pulex*-group and the most distinguishing morphological character is that the peduncles and flagellum of the antenna II have a very densely and long setation. The antenna I has a weak setation. There is Metasome III with some spinules on the dorsoposterior margin. The antenna I is long and as long as 2/3 of the total body length. Peduncles and flagellum have a weak setation. The main and ac-

cessory flagellum consists of 35-38 and 4-5 segments, respectively. The second and third peduncles and flagellum segments of the antenna II have a very dense, long and curled setation. The transverse rows of setae of the flagellum are 3 times the diameter of the segment on which they are implanted. The flagellum consists of 13 slightly swollen segments. Calceoli is absent. The third segment of the mandibular palp bears 1 group of A-setae, 1-2 groups of B-setae, 35 D-setae, and 4-6 E-setae. C-setae is absent. The endopodite of the uropod III is about as long as 3/4 of the exopodite; rami with some spines and numerous plumose setae on both margins. The telson lobes are deeply cleft and about as long as twice their width.

Examined material: St. 31: 37 ♀♀, 55 ♂♂, 2.viii.2015; St. 32: 47 ♀♀, 44 ♂♂, 2.viii.2015; St. 35: 36 ♀♀, 33 ♂♂, 3.viii.2015; St. 39: 55 ♀♀, 46 ♂♂, 3.viii.2015; St. 49: 42 ♀♀, 70 ♂♂, 5.viii.2015; St. 51: 8 ♀♀, 18 ♂♂, 5.viii.2015; St. 55: 27 ♀♀, 49 ♂♂, 5.viii.2015; St. 57: 6 ♀♀, 9 ♂♂, 6.viii.2015; St. 59: 26 ♀♀, 12 ♂♂, 6.viii.2015; St. 63: 13 ♀♀, 7 ♂♂, 7.viii.2015; St. 64: 9 ♀♀, 49 ♂♂, 7.viii.2015; St. 65: 56 ♀♀, 58 ♂♂, 7.viii.2015; St. 66: 30 ♀♀, 85 ♂♂, 7.viii.2015; St. 68: 32 ♀♀, 84 ♂♂, 9.viii.2015; St. 72: 9 ♀♀, 54 ♂♂, 11.viii.2015; St. 76: 2 ♀♀, 2 ♂♂, 12.viii.2015; St. 95: 31 ♀♀, 63 ♂♂, 6.xii.2015; St. 97: 26 ♀♀, 34 ♂♂, 6.xii.2015; St. 98: 8 ♀♀, 40 ♂♂, 6.xii.2015; St. 99: 6 ♀♀, 6 ♂♂, 6.xii.2015; St. 100: 13 ♀♀, 21 ♂♂, 8.xii.2015; St. 101: 3 ♀♀, 8 ♂♂, 8.xii.2015.

G. lacustris: The body is smooth and large and up to 24mm in adults. It belongs to the *Gammarus pulex*-group and is similar to *Gammarus pulex pulex* except for bearing not flag-like brush setae, it has relatively short and slender antennae, has more sharply pointed Epimeral plates, and slender dactylus. Metasome II and III with some spinules on the dorsoposterior margin. The antenna I is relatively short and slightly exceeds 1/3 of the total body length. The Peduncles and flagellum have a weak setation. The main and accessory flagellum consists of 27 and 3-4 segments, respectively. The fourth and fifth peduncles of the antenna II are almost equal in length with few setae, implanted in 3-4 longitudinal rows. Calceoli is present. There is no calceoli in some periods of the year as given information in the literature. The third segment of the mandibular palp bears 1 group of A-setae, 1 group of B-setae, 27 D-setae, and 4 E-setae. C-setae is absent. Endopodite of the uropod III reaches about 3/4 of the exopodite; rami with numerous plumose setae. The telson lobes are cleft and about as long as three their width.

Examined material: St. 67: 40 ♀♀, 73 ♂♂, 9.viii.2015.

G. pulex pulex: The body is smooth and large and is up to 25-30mm in adults. The Antenna II with a swollen compressed flagellum bears flag-like brush setae on the posterior margin; the swollen and compressed flagellum consists of 11-12 segments; each segment bears a transverse row of setae; Peduncles and flagellum of antenna I have a weak setation. The main and accessory flagellum consists of 25 and 5 segments, respectively. Calceoli is absent or present. The third segment of the mandibular palp bears 1 group of A-setae, 1 group of B-setae, 28 D-setae, and 5 E-setae. C-setae is absent. Pereiopods III-IV with long and curled setae. Rami of uropod III has a dense setation. The telson lobes are deeply cleft and about as long as three their width.

Examined material: St. 8: 21 ♀♀, 17 ♂♂, 25.vii.2015; St. 9: 15 ♀♀, 39 ♂♂, 26.vii.2015; St. 10: 9 ♀♀, 17 ♂♂, 26.vii.2015; St. 58 : 45 ♀♀, 50 ♂♂, 6.viii.2015; St. 60: 45 ♀♀, 67 ♂♂, 6.viii.2015; St. 69: 21 ♀♀, 43 ♂♂, 9.viii.2015; St. 70: 7 ♀♀, 22 ♂♂, 9.viii.2015; St. 74: 10 ♀♀, 30 ♂♂, 11.viii.2015; St. 75: 13 ♀♀, 28 ♂♂, 12.viii.2015; St. 80: 16 ♀♀, 20 ♂♂, 13.viii.2015; St. 81: 7 ♀♀, 4 ♂♂, 14.viii.2015; St. 83: 1 ♀, 1 ♂♂, 14.viii.2015; St. 84: 9 ♀♀, 8 ♂♂, 14.viii.2015; St. 85: 10 ♀♀, 25 ♂♂, 15.viii.2015; St. 86: 4 ♀♀, 27 ♂♂, 15.viii.2015; St. 87: 10 ♀♀, 27 ♂♂, 15.viii.2015; St. 88: 4 ♀♀, 6 ♂♂, 15.viii.2015; St. 89: 17 ♀♀, 29 ♂♂, 15.viii.2015; St. 93: 25 ♀♀, 35 ♂♂, 5.xii.2015; St. 94: 13 ♀♀, 14 ♂♂, 5.xii.2015; St. 104: 16 ♀♀, 37 ♂♂, 9.xii.2015; St. 105: 8 ♀♀, 23 ♂♂, 9.xii.2015; St. 106: 17 ♀♀, 40 ♂♂, 9.xii.2015; St. 108: 30 ♀♀, 55 ♂♂, 9.xii.2015; St. 109: 7 ♀♀, 11 ♂♂, 9.xii.2015; St. 110: 17 ♀♀, 23 ♂♂, 25.iv.2016; St. 116: 15 ♀♀, 17 ♂♂, 26.iv.2016; St. 120: 8 ♀♀, 30 ♂♂, 12.v.2016; St. 121: 17 ♀♀, 18 ♂♂, 12.v.2016; St. 122: 17 ♀♀, 23 ♂♂, 12.v.2016; St. 127: 3 ♀♀, 1 ♂, 16.iii.2019.

G. uludagi: The body smooth and medium-large is 13mm in adults. It is very similar to *G. fossarum* and *G. gonensis* at first sight, but it has flag-like brush setae on the flagellum of the antenna II and long setae on the peduncle segments. The fourth and fifth peduncles are almost equal in length and bear 4-5 groups of long setae with transverse rows on the posterior margin and these setae are about as long as or longer than the diameter of the segments on which are implanted. The swollen and compressed flagellum of antenna II consists of 11-12 segments; each segment bears a transverse row of setae. With a very characteristic feature, the telson lobes are deeply cleft and longer than twice their width. Each lobe has 2-3 groups of setae and 2 short plumose setae on the outer lateral margin, 2-3 groups of setae on the inner lateral margin, and additionally to 1 spine and 4-5 setae on the terminal; these setae are about as long as or longer than the length of the lobes. Peduncles and flagellum of antenna I have a weak setation. The main and accessory flagellum consists of 32 and 6 segments, respectively. Calceoli is absent. The third segment of the mandibular palp bears 1 group of A-setae, 1 group of B-setae, 27 D-setae, and 6 E-setae. C-setae is absent. Endopodite of the uropod III is about as long as 3/5 of the exopodite; The rami bear simple setae on both margins.

Examined material: St. 1: 18 ♀♀, 20 ♂♂, 12.v.2014; St. 4 : 27 ♀♀, 42 ♂♂, 23.v.2015; St. 11: 26 ♀♀, 23 ♂♂, 26.vii.2015; St. 12: 19 ♀♀, 41 ♂♂, 27.vii.2015; St. 13: 16 ♀♀, 71 ♂♂, 27.vii.2015; St. 14: 26 ♀♀, 42 ♂♂, 27.vii.2015; St. 15: 21 ♀♀, 43 ♂♂, 27.vii.2015; St. 16: 7 ♀♀, 59 ♂♂, 27.vii.2015; St. 17: 22 ♀♀, 20 ♂♂, 27.vii.2015; St. 18: 22 ♀♀, 11 ♂♂, 27.vii.2015; St. 19: 55 ♀♀, 48 ♂♂, 30.vii.2015; St. 20: 26 ♀♀, 55 ♂♂, 30.vii.2015; St. 21: 49 ♀♀, 53 ♂♂, 30.vii.2015; St. 23: 31 ♀♀, 51 ♂♂, 31.vii.2015; St. 79: 6 ♀♀, 6 ♂♂, 13.viii.2015; St. 90: 5 ♀♀, 9 ♂♂, 15.viii.2015; St. 102: 3 ♀♀, 14 ♂♂, 8.xii.2015; St. 111: 13 ♀♀, 33 ♂♂, 25.iv.2016; St. 112: 14 ♀♀, 27 ♂♂, 25.iv.2016; St. 113: 13 ♀♀, 39 ♂♂, 25.iv.2016; St. 118 : 30 ♀♀, 40 ♂♂, 28.iv.2016.

Diagnostic key

1. a) Endopodite of the uropod III is less than 1/4 of the length of the exopodite(*Echinogammarus*)
..... *Echinogammarus stocki* G. Karaman, 1970
- b) Endopodite of the uropod III is longer than 1/4 of the length of the exopodite(*Gammarus*) 2

2. a) Eyes elongated, kidney-shaped..... *Gammarus aequicauda* (Martynov, 1931)
- b) The eyes are round or oval 3
3. a) Posterior margins of the pereopod III-IV poorly setose.....(*Gammarus balcanicus*-group).....4
- b) Pereiopod III-IV with numerous long setae..... (*Gammarus pulex*-group) 6
4. a) Inner surface of basal segment of the pereopod VII with setae..... *Gammarus anatoliensis* Schellenberg, 1937
- b) Inner surface of basal segment of the pereopod VII with out setae 5
5. a) Metasome segments with a few long setae on dorsoposterior margins..... *Gammarus dorsosetosus* Mateus & Mateus, 1990
- b) Metasome segments without long setae on dorsoposterior margins *Gammarus balcanicus* Schäferna, 1923
6. a) Inner surface of basal segment of the pereopod VI-VII with setae *Gammarus arduus* G. Karaman, 1975
- b) Inner surface of basal segment of the pereopod VI-VII without setae 7
7. a) Peduncle and flagellum segments of antenna II densely set with brushes of very long setae *Gammarus komareki* Schäferna, 1923
- b) Peduncle and flagellum segments of antenna II with shorter setae 8
8. a) Inner surface of palm of the gnathopod II with many long curled setae 9
- b) Inner surface of palm of the gnathopod II without curled setae 10
9. a) Peduncles of the antenna II bear long setae (as long as or longer than the diameter of the segments) *Gammarus uludagi* G.S. Karaman, 1975
- b) Peduncles of the antenna II with short setae *Gammarus gonensis* Özbek, 2016
10. a) Flagellar segments of antenna II swollen bearing flag like setae. Epimeral plate II-III with rectangular to weakly pointed *Gammarus pulex pulex* (Linnaeus, 1758)
- b) Flagellar segments of antenna II without flag like setae. Epimeral plate II-III with sharply pointed posteroinferior corners *Gammarus lacustris* G.O. Sars, 1863

E. stocki is one of the most difficult species to find because it inhabits a very narrow zone on the verge of freshwater and brackish or marine waters as stated in the literature (Pinkster, 1993). The type locality of the species is a salt spring in Cres Island (Karaman, 1970). In Türkiye, it was firstly recorded in the Bafa Lake by Karaman (1971). Then, several recordings were reported from the lake (Geldiay et al., 1977; Kocataş & Katağan, 1978; Bellan-Santini et al., 1982; Ustaoglu et al., 1998; Sarı et al., 2001). In this study, the species was reported from a spring in the Ekinanbarı village for the first time. The species was previously confused with *E. acarinatus*, then Karaman (1970) eliminated this confusion when he revealed the presence of C-seta in the mandibular palp which is an important character distinguishing it from the other *Echinogammarus* species. Although it was stated that the sample from France has setae on the anterior margin of the epimeral plate I and the ventral margins of the epimeral plates II-III (Pinkster, 1993), these setae were absent in our samples (Figure 2).

The type locality of *G. aequicauda* is Donuzlav Lake in Crimea. In Türkiye, it was firstly recorded from a brackish water pool in Mersin province by Stock (1967). The species is abundant, especially in Western Anatolia (from Çanakkale to Muğla provinces) and there are several records from Mersin and Antalya in the Mediterranean, Sinop and Samsun in the Black Sea, Çanakkale, Edirne and Istanbul in Thrace region (Altınışlı et al., 2017; Akbulut et al., 2002, 2009a, 2009b; Balık et al., 2006; Bat et al., 2000; Karaman, 2003, Kocataş & Katağan, 1978; Mateus & Mateus, 1990; Özbek 2011; Özbek & Ustaoglu, 1998, Özbek et al., 2015, 2016; Sarı et al., 2001; Ustaoglu et al., 1998, 2000). It was also reported from the Gökçeada Island (Aegean Sea) (Özbek & Özkan, 2017). Considering the morphological features of *G. aequicauda* given in the literature, the brackish water forms reported from Crimea and Mersin look similar, while the freshwater form from southern France has weaker setation than the others (Stock, 1967). The samples we studied are similar to those recorded from the Mersin province in terms of the length of the base of pereopods V-VII. On the other hand, the present specimens differ from those reported from southern France in terms of the length of the basal segments of pereopods V-VII and the setation of the anterior margins of the mentioned segments (Figure 2).

The type locality of *G. anatoliensis* is a torrent in Akşehir, Konya (Schellenberg, 1937). It is an endemic species of Türkiye. *G. anatoliensis* is widespread in the Lake District Region of Türkiye, but it was also recorded from the Marmara, the Black Sea, the Aegean, and the Mediterranean regions of Türkiye (Karaman & Pinkster, 1987, Özbek & Ustaoglu, 2005, 2008, 2011; Özbek et al., 2009; Ekinci & Miroğlu 2016; İpek et al., 2017). In the present study, the species was recorded from the Uşak province for the first time. *G. anatoliensis* was detected at 7 localities in our study. The present specimens are almost identical with Karaman and Pinkster's (1987) description, but some variations were also observed (such as the absence of calceoli).

The type locality of *G. arduus* is a fountain in Malkara, Tekirdağ (Karaman 1975) in Türkiye. The species was also recorded from the Ordu and Samsun provinces in the Black Sea Region of Türkiye (Chertoprud & Palatov, 2017; Gözal, 2004; Karaman & Pinkster, 1977; Mateus & Mateus, 1990; Karaman, 2003; Özbek et al., 2017;

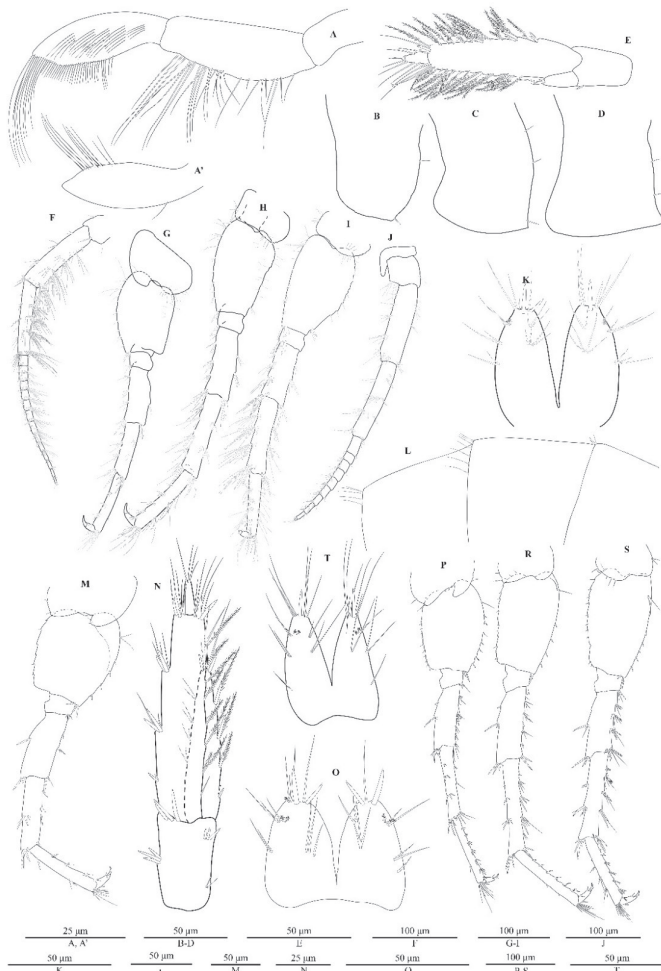


Figure 2. Some extremities (original) of *E. stocki* (A-E) (St.2), *G. aequicauda* (F-I) (St.2), *G. arduus* (J-K) (St.62), *G. dorsosetosus* (L-N) (St.93), *G. komareki* (O-S) (St.31), *G. lacustris* (T) (St.67). Male. A: mandibular palp; A': inner surface of the third segment of mandibular palp; B: epimeral plate I; C: epimeral plate II; D: epimeral plate III; E: uropod III; F: antenna II; G: pereopod V; H: pereopod VI; I: pereopod VII; J: antenna II; K: telson; L: metasoma somites I-III; M: pereopod V; N: uropod III; O: telson; P: pereopod V; R: pereopod VI; S: pereopod VII; T: telson.

Özkan, 2009; Yeşilmen & Kırgız, 1996). In this study, the species was reported from Bolu and Düzce provinces for the first time. The specimens examined in this study have no calceoli.

The type locality of *G. balcanicus* is a spring in Kolašin, Montenegro (Schäferna, 1923). In Türkiye, it was first recorded from the Erçiyas Mountain by S. Karaman (1934). Then, it was reported from several localities from the Strandja Mountains in Thrace to Bayburt in the Black Sea region, from İzmir in the Aegean to Hatay on the Mediterranean coast and to Van in eastern Anatolia (Akbulut et al., 2009b; Akbaba & Boyacı, 2015; Aygen & Balık, 2005; Balık et al., 2006; Baytaşoğlu & Gözler, 2018; Chertoprud & Palatov, 2017; Ekinci & Miroğlu, 2016; İpek & Şirin, 2009; İpek et al.,

2017; Karaman, 2003, Karaman & Pinkster, 1987; Öntürk & İpek, 2018; Özbek & Ustaoglu, 2005, 2008, 2011; Özbek et al., 2004, 2009; Ustaoglu et al., 2004, 2008). In this study, the species was recorded from the Kocaeli and Sakarya provinces for the first time.

Karaman and Pinkster (1987) showed that the species has calceoli on the flagellum of the antenna II, but they mentioned that it is a variable character. Calceoli is also absent in our samples. The wide distribution of the species and its presence in various environments indicate the high tolerance of the species, as mentioned by Karaman and Pinkster (1987).

The type locality of *G. dorsosetosus* is the Amanos Mountains, Hatay province (Mateus & Mateus, 1990), and it is an endemic species for Türkiye. The species was also reported from the Burdur and Karaman provinces (Özbek & Topkara, 2007). In this study, the first record of the species from the Bolu province is documented. The slightly elevated metasome segments and the presence of long setae on the dorsoposterior margins are the characteristic features of the species (Figure 2). Mateus and Mateus (1990) did not provide detailed drawings of this species. However, Özbek and Topkara (2007) gave detailed drawings of the morphological characteristics of this species.

The type locality of *Gammarus gonensis* is the Gönen Stream in Balıkesir (Özbek 2016). It was also recorded from Çanakkale, and Tekirdağ (Özbek et al., 2017), Kütahya (İpek et al., 2017) provinces. In this study, the species was firstly recorded from the Istanbul (in Thrace), and Manisa provinces. *G. gonensis* is similar to the *G. uludagi* however, it can be easily distinguished from *G. uludagi* by the absence of long setae on the peduncle segments of antenna II, and by the presence of densely and curved setae on the inner surface of the propodus of the gnathopod II. In our study, the species was determined as a result of sampling made among the stones on the ground of streams with vegetation as Özbek (2016) stated.

The type locality of *G. komareki* is in Belovo Village near Pazarzik, Bulgaria (Schäferna, 1923). In Türkiye, it was firstly recorded by Karaman (1975) from a fountain in Malkara, Tekirdağ. Although it is mostly located in Thrace in our country, it has records from the Marmara and Black Sea regions in Anatolia (Akbulut et al., 2009b; Aslan et al., 2018; Chertoprud & Palatov, 2017; Ekinci & Miroğlu, 2016; Gözal, 2004; Karaman, 1975, 2003; Mateus & Mateus, 1990; Odabaşı et al., 2016; Özbek, 2008, 2011; Özbek & Özkan, 2017; Özbek et al., 2017; Yeşilmen & Kırgız, 1996). By the present study, the species was recorded for the first time from the Düzce and Kocaeli provinces. In the samples we examined, the telson lobes were wider and P5-7 were without long setae on the anterior margins. We omitted it as it is a variation (Figure 2).

The type locality of *G. lacustris* is Scandinavia (Sars, 1863) was firstly recorded in Türkiye by Tareen (1974) from the Gölçük Lake in İzmir. Despite the presence of several records of the species from Anatolia (Karaman, 1975, 2003; Özbek & Ustaoglu, 2005, 2011; Özbek & Ustaoglu, 1998; Özbek et al., 2007), it was firstly recorded from the Thrace Region of Türkiye in the present study. The samples we examined have setae on the telson lobes that

were absent in Karaman and Pinkster's (1977a) report (Figure 2). Considering the previous studies, the setation of the telson in the samples in Lake Dimon and Venerocolo in Italy and especially in Lake Lame and the Lake District Region (Turkiye) is similar to our samples (Ruffo 1951; Özbek & Ustaoglu, 2005).

The type locality of *G. pulex pulex* is in Öland Island, Sweden (Linnaeus, 1758). *G. pulex pulex*, which gives its name to the *G. pulex*-group and is a typical representative of the group, is one of the members of the genus *Gammarus* with the greatest distribution in the world. It has a wide distribution in Turkiye (Karaman, 1975; Karaman & Pinkster, 1977; Bat et al., 2000; Akbulut et al., 2002, 2009b; Ekinci & Miroglu, 2016; Özbek & Ustaoglu, 2005; Özbek et al., 2017). In our study, it was identified from the provinces of Kırklareli in Thrace, and Kocaeli, Sakarya, and Uşak in Western Anatolia for the first time except for the regions previously identified.

The type locality of *G. uludagi* is the Uludağ Mountain in Bursa (Karaman, 1975). It is an endemic species of Turkiye. Also, several records were given from the western parts of Anatolia, the island of Lesbos on the Anatolian coast, and the Black Sea Region of Turkiye (Akbulut et al., 2009b; Karaman, 1975; Karaman & Pinkster, 1977; Özbek & Ustaoglu, 1998; Özbek et al., 2015, 2017; Şirin et al., 2009). In the present study, it was firstly recorded from a fountain in the Pasha Plateau on the Aydın Mountains, and Bilecik, and a stream in Sakarya.

CONCLUSION

In this study, in which amphipod species are distributed in Western Anatolia, Marmara and Thrace regions of Turkiye were investigated, a total of 11 species were determined. This study, which aims to support the discovery of Turkish freshwater amphipod biodiversity, can be a resource for native amphipod researchers. It is obvious that rivers and lakes are under adverse conditions due to human pressure and global climate change. Several species living in Turkish rivers and lakes under the threat of pollution and frost are adversely affected by these changes, and some of them are completely eliminated. Under these conditions, the detection of biodiversity and the protection of our biological richness are of great importance. The authors believe that biodiversity studies should be supported and their numbers should be increased. Afterwards, sustainable management strategies can be developed.

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REFERENCES

Akbaba, G. & Boyacı, Y. Ö. (2015). The seasonal change of macrobenthic fauna in Işıklı Lake (Denizli). *Journal of Egridir Fisheries Faculty* 11(2), 8–19. [in Turkish] [CrossRef]

Akbulut, M., Öztürk, M. & Öztürk, M. (2002). The benthic macroinvertebrate fauna of Sarıkum lake and spring waters (Sinop). *Turkish Journal of Marine Sciences*, 8, 103–119.

Akbulut, M., Çelik E. Ş., Odabaşı, D. A., Kaya, H., Selvi, K., Arslan, N. & Sağır-Odabaşı, S. (2009a). Seasonal distribution and composition of benthic Macroinvertebrate communities in Menderes Creek,

Çanakale, Turkiye. *Fresenius Environmental Bulletin*, 18(11a), 2136–2145.

Akbulut, M., Ustaoglu, M. R. & Çelik, E.Ş. (2009b). Freshwater and brackishwater Malacostraca (Crustacea-Arthropoda) fauna of Sinop and Samsun. *Journal of the Black Sea/Mediterranean Environment*, 15(1), 47–60.

Altınışağı, S., Yardımcı, C. H., Altınışağı, S. & Paçal, F.P. (2017). The species list belonging to some benthic invertebrate groups in a coastal lagoon: Kamil Abduş lagoon (Istanbul, Turkiye). *Journal of Entomology and Zoology Studies*, 5(6), 307–313.

Aslan, H., Gonulal, O., Can-Yılmaz, E., Elipek, B., Baytut, O., Tosunoglu, M., Karabacak, E. & Kurt, Y. (2018). Species diversity in lentic, lotic, marine and terrestrial biotopes of Gokceada Salt Lake wetland (Canakkale, Turkiye). *Fresenius Environmental Bulletin*, 27(5), 2853–2866.

Aygen, C. & Balık, S. (2005). Crustacea fauna of Işıklı Lake and springs (Çivril, Denizli). –*Ege Journal of Fisheries and Aquatic Sciences*, 22(3-4), 371–375. [in Turkish]

Balık, S., Ustaoglu, M. R., Özbek, M., Yıldız, S., Taşdemir, A. & İlhan, A. (2006). Determination of pollution at lower basin of Küçük Menderes River (Selçuk, İzmir) by using macro benthic invertebrates. *Ege Journal of Fisheries and Aquatic Sciences*, 23(1-2), 61–65 [in Turkish]

Bat, L., Akbulut, M., Çulha, M. & Sezgin, M. (2000). The macrobenthic fauna of Sirakaraağaçlar Stream flowing into the Black Sea at Aklıman, Sinop. *Turkish Journal Marine Sciences*, 6(1), 71–86.

Baytaşoğlu, H. & Gözler, A. M. (2018). Seasonal changes of Malacostraca Crustacea fauna of the upper Coruh River basin Bayburt province Turkiye and its ecological characteristics. *Turkish Journal of Fisheries and Aquatic Sciences*, 18(3), 1–9. [CrossRef]

Bellan-Santini, D., Karaman, G., Krapp-Schickel, G., Ledoyer, M., Myers, A.A., Ruffo, S. & Schiecke, U. (1982). Part I Gammaridea (Acanthonotozomatidae to Gammaridae). In: S. Ruffo (Ed.), *The Amphipoda of Mediterranean* (pp. 1–364). Memoires de l'Institut Océanographique, Monaco.

Chertoprud, M.V. & Palatov, D. M. (2017). Stream macrozoobenthic communities of the eastern Balkans. *Inland Water Biology*, 10(3), 286–295. [CrossRef]

Coleman, C. O. (2003). "Digital inking": How to make perfect line drawings on computers. *Organisms Diversity and Evolution*, Electronic Supplement 14, 1–14. [CrossRef]

Coleman, C. O. (2006). Substituting time-consuming pencil drawings in arthropod taxonomy using stacks of digital photographs. *Zootaxa*, 1360, 61–68. [CrossRef]

Coleman, C. O. (2009). Drawing setae the digital way. *Zoosystematics and Evolution*, 85(2), 305–310. [CrossRef]

Ekinci, M. & Miroglu, A. (2016). Study on freshwater Gammaridea (Crustacea, Amphipoda) fauna of Ordu (Turkiye). *Ordu University Journal of Science and Tecnology*, 6(2), 158–169 [in Turkish].

Geldiy, D., Kocataş, A. & Katağan, T. (1977). The species of Peracarida and Holocarida (Crustacea, Malacostraca) from Bafa Lake. *Ege University Journal of the Faculty of Science*, Series B, 1(4), 311–318. [in Turkish]

Gözal, S. (2004). Investigations on Gammaridae (Amphipoda) fauna of some running waters in Thrace. MSc Thesis, Eskişehir Osmangazi University, Turkiye, 44 p. [in Turkish]

Horton, T., Lowry, J., De Broyer, C., Bellan-Santini, D., Coleman, C. O., Corbari, L., Costello, M. J., Daneliya, M., Davin, J.-C., Fişer, C., Gasca, R., Grabowski, M., Guerra-García, J. M., Hendrycks, E., Hughes, L., Jaume, D., Jazdzewski, K., Kim, Y.-H., King, R., . . . Zeidler, W. (2021). World Amphipoda database. Available at: <http://www.marinespecies.org/amphipoda> (accessed 10.20.21)

İpek, M., Özbek, M. & Şirin, Ü. (2017). A preliminary study on freshwater Amphipods (Crustacea) of Kütahya province. In: *1st International Symposium on Limnology and Freshwater Fisheries Symposium (LIMNOFISH 2017)* (pp. 155). Egridir, Isparta, Turkiye.

- İpek, M. & Şirin, Ü. (2009). Gammaridea (Crustacea-Amphipoda) records from Eskişehir province and its near around. *Ege Journal of Fisheries and Aquatic Sciences*, 26(4), 241–246.
- Karaman, G. S. (1970). XXV. prilog poznavanju Amphipoda Kriticka zapazanja o vrstama *Echinogammarus acarinatus* (S. Kar. 1931) i *Echinogammarus stocki* n. sp. Poljoprivreda I Sumarstvo, Titograd, 16(1-2), 193–214.
- Karaman, G. S. (1971). XXX. Beitrag zur Kenntnis der Amphipoden, Über einigen Amphipoden aus Griechenland und Kleinasien. *Acta Musei Macedonici Scientiarum Naturalium*, 12(2), 1–55.
- Karaman, G. S. (1975). *Gammarus* species from Asia Minor (Fam. Gammaridae), (56. Contribution to the knowledge of the Amphipoda). *Bolletino del Museo Civico di Storia Naturale di Verona*, 1, 311–343.
- Karaman, G. S. (2003). New data on some Gammaridean Amphipods (Amphipoda, Gammaridea) from Palearctic (Contribution to the knowledge of the Amphipoda 245). *Podgorica*, 15, 21–37.
- Karaman, G. S. & Pinkster, S. (1977). Freshwater *Gammarus* species from Europe, North Africa and adjacent regions of Asia (Crustacea - Amphipoda), Part I *Gammarus pulex* Group and related species. *Bijdragen Tot De Dierkunde*, 47(1), 1–164. [CrossRef]
- Karaman, G. S. & Pinkster, S. (1987). Freshwater *Gammarus* species from Europe, North Africa and adjacent regions of Asia (Crustacea - Amphipoda), Part III *Gammarus balcanicus* Group and related species. *Bijdragen Tot De Dierkunde*, 57(2), 207–260. [CrossRef]
- Karaman, S. (1934). Über asiatische Süßwassergammariden. *Zoologischer Anzeiger*, 106(5-6), 127–134.
- Kocataş, A. & Katağan, T. (1978). *Littoral benthic Amphipods on Turkish seas and their distributions*. Project No: TBAG-223. TÜBİTAK Research Institute for Fundamental Sciences, Ankara, 63 pp. [in Turkish]
- Linnaeus, C. (1758). *Systema Naturae, per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis*. Editio decima, reformata (10th revised edition). Holmiae: Laurentius Salvius, 824 pp. [CrossRef]
- Lowry, J. K. & Myers, A. A. (2017). A Phylogeny and classification of the Amphipoda with the establishment of the new order Ingolfiellida (Crustacea: Peracarida). *Zootaxa*, 4265, 1–89. [CrossRef]
- Mateus, A. & Mateus, E. (1990). Etude d'une collection d'amphipodes, spécialement du sud-ouest asiatique, du Museum d'Historie Naturelle de Vienne (Autriche). *Annales des naturhistorischer Museum Wien*, 91B, 273–331.
- Odabaşı, S., Odabaşı, D. A., Çakır, F. & Bal, D. (2016) A preliminary investigation on the lipid content and fatty acid composition of *Gammarus komareki* (Schaferna 1922), (Crustacea: Amphipoda). *Turkish Journal of Aquatic Sciences*, 31(2), 59–67. [CrossRef]
- Öntürk, T. & İpek, M. (2018). Investigations on the Eskişehir and its surroundings Amphipoda fauna. *International Journal of Environmental Research and Technology*, 1(1), 35–41.
- Özbek, M. (2008). Malacostraca (Crustacea) fauna of some lakes in western Black Sea region. *Ege Journal of Fisheries and Aquatic Sciences*, 25(4), 311–314. [in Turkish] <http://doi.org/10.12714/egejfas.2008.25.4.5000156614>
- Özbek, M. (2011). An overview of the *Gammarus* Fabricus (Gammaridae: Amphipoda) species of Türkiye, with an updated checklist. *Zoology in the Middle East*, 53, 71–78. [CrossRef]
- Özbek, M. (2016). Epigeal amphipod fauna of Gönen stream (western Anatolia, Türkiye), with the description of *Gammarus gonensis* sp. nov. *Turkish Journal of Zoology*, 40, 336–344. [CrossRef]
- Özbek, M., Balık, S. & Topkara, E. T. (2009). Contribution to the knowledge on the distribution of Malacostraca (Crustacea) species of central and southern Anatolia, with some ecological notes. *Turkish Journal of Zoology*, 33, 47–55.
- Özbek, M., Balık, S. & Ustaoglu, M. R. (2004). Malacostraca (Crustacea) fauna of Yuvarlak Stream (Köyceğiz- Muğla). *Turkish Journal of Zoology*, 28, 321-327.
- Özbek, M., Bakır, K. & Ustaoglu, M. R. (2016). Malacostraca fauna of the Karina Lagoon (Aydın). *Ege Journal of Fisheries and Aquatic Sciences*, 33(1), 13–19 [in Turkish]. [CrossRef]
- Özbek, M. & Özkan, N. (2017). Amphipoda (Crustacea: Malacostraca) fauna of the inland-waters of Gökçeada Island. *Ege Journal of Fisheries and Aquatic Sciences*, 34(1), 63–67 [in Turkish]. [CrossRef]
- Özbek, M., Özkan, N. & Çamur-Elipek, B. (2017). Freshwater and brackish amphipods (Crustacea: Amphipoda) from Turkish Thrace region (including Çanakkale province). *Acta Zoologica Bulgarica*, 69(4), 493–499.
- Özbek, M., Öztürk, H. H. & Özkan, N. (2015). Gammaridae (Amphipoda) fauna of the inland-waters of Marmara and Paşalimanı islands and Kapıdağ peninsula. *Ege Journal of Fisheries and Aquatic Sciences*, 32(4), 213–216 [in Turkish]. [CrossRef]
- Özbek, M. & Sket, B. (2019). A new *Rhipidogammarus* (Crustacea: Amphipoda) species from Türkiye: first record of the genus from the Eastern Mediterranean Region, with an identification key for the genus. *Glasnik Odjeljenja prirodnih nauka*, 23, 83–98.
- Özbek, M., Topkara, E. T. (2007). Supplementary data on morphology, distribution, and ecology of *Gammarus dorsosetosus* Mateus and Mateus, 1990 (Amphipoda, Gammaridae). *Crustaceana*, 80, 641–653. [CrossRef]
- Özbek, M. & Ustaoglu, M. R. (1998). The Amphipoda (Crustacea-Arthropoda) fauna of İzmir and adjacent areas inland-waters. *Ege Journal of Fisheries and Aquatic Sciences*, 15(3-4), 211–231. [in Turkish]
- Özbek, M. & Ustaoglu, M. R. (2005). Taxonomical investigation of Lake District inland waters Malacostraca (Crustacea-Arthropoda) fauna. *Ege Journal of Fisheries and Aquatic Sciences*, 22(3-4), 357–362. [in Turkish].
- Özkan, N. (2009). Chironomidae (Diptera) and Gammaridae (Amphipoda) fauna in Dupnisa Cave (Sarpdere Village, Demirköy, Kırklareli). *Ege Journal of Fisheries and Aquatic Sciences*, 26(1), 7–10.
- Pinkster, S. (1993). A revision of the genus *Echinogammarus* Stebbing, 1899, with some notes on related genera (Crustacea, Amphipoda). *Memorie Del Museo Civico Di Storia Naturale*, (ser 2) 10, 1–185.
- Ruffo, S. (1951). Sulla presenza di *Gammarus (Rivulogammarus) lacustris* G. O. Sars nell'Appennino ligure e nuovi reperti della specie per laghi alpine. *Doriana*, 1(19), 1–8.
- Sarı, H. M., Balık, S., Özbek, M. & Aygen, C. (2001). The macro and meiobenthic invertebrate fauna of Lake Bafa. *Anadolu University Journal of Science and Technology*, 2(2), 285–291. [in Turkish]
- Sars, G. O. (1863). Beretning om en i Sommeren 1862 foretagen zoologisk Reise i Christianias og Trondhjems Stifter. *Nyt Magazin for Naturvidenskaberne*, 12, 193–252.
- Schäferna, K. (1923). Amphipoda balcanica, spolu s poznámkami o jiných sladkovodních Amphipodech. *Mémoires de la Société Royale des Sciences de Bohême Prague Année 1921-1922*, 12, 1–111.
- Schellenberg, A. (1937). Kritische Bemerkungen zur Systematik der Süßwassergammariden. *Zoologische Jahrbucher. Abteilung für Systematik, Ökologie und Geographie der Tiere*, 69, 469–516.
- Stock, J. H. (1967) A revision of the European species of the *Gammarus locusta* group (Crustacea, Amphipoda). *Zoologische Verhandlungen*, 90, 1–56.
- Şirin, Ü., Çalışkan, H. & İpek, M. (2009). On the occurrence of *Gammarus uludagi* G. Karaman, 1975 (Amphipoda, Gammaridae) in Kazdağları. *Sakarya University The Journal of Arts and Science*, 11(2), 29–34.
- Tareen, I. U. (1974). Limnological investigations of Gölçük Lake (Ödemiş-Türkiye). PhD Thesis, Ege University, Türkiye, 122 p. [in Turkish]
- Ustaoglu, M. R., Balık, S. & Özbek, M. (1998). Malacostraca (Arthropoda-Crustacea) fauna of Bafa Lake. *Ege Journal of Fisheries and Aquatic Sciences* 15(3-4). 263–267. [in Turkish]
- Ustaoglu, M. R., Balık, S. & Özbek, M. (2000). Malacostraca (Arthropoda-Crustacea) fauna of Akgöl and Lake Gebekirse (Selçuk-İzmir). In: *XV. National Biology Congress* (pp. 217–222). Ankara University, Türkiye. [in Turkish]

- Ustaođlu, M. R., Balık, S. & Özbek, M. (2004). Contributions to the knowledge of Malacostraca (Crustacea) fauna of the Taurus Mountains district (Southern Anatolia). *Turkish Journal of Zoology*, 28, 91–94.
- Ustaođlu, M. R., Balık, S., Sarı, H. M., Özdemir Mis, D., Aygen, C., Özbek, M., İlhan, A., Taşdemir, A., Yıldız, S. & Topkara, E. T. (2008). A faunal study of the glacier lakes and rivers on Uludağ (Bursa) Mountain. *Ege Journal of Fisheries and Aquatic Sciences*, 25(4), 295–299. [in Turkish]
- Vávra, V. (1905). *Rotatorien und Crustaceen*. Wien: Annalen des K. K. Naturhistorischen Hofmuseums, 20, 106–113.
- Yeşilmen, T. Ö., Kirgiz, T. (1996). Freshwater Gammarus (Gammaridae) species of Kırklareli province. *Turkish Journal of Zoology*, 20(Supplement), 315–318.