J. Entomol. Res. Soc., 19(3): 95-107, 2017 *ISSN:1302-0250*

Contribution to the Knowledge of Ephemeroptera (Insecta) of the Eastern Black Sea Region

Caner AYDINLI

Anadolu University, Faculty of Science, Department of Biology, 26470, Eskişehir/Turkey,
e-mail: caydinli@anadolu.edu.tr

ABSTRACT

This study was carried out in order to contribute to the Ephemeroptera (Insecta) fauna of the Eastern Black Sea region and Turkey. As a result, 2.129 larvae specimens from provinces of the Eastern Black Sea region were collected in 2009, and 26 species belonging to 14 genera from 8 families were determined. Eight of these species are new records for the region, namely *Baetis vernus, B.* (*Nigrobaetis*) *niger, Procloeon bifidum, P. pennulatum, Rhithrogena savoiensis, Ecdyonurus venosus, Choroterpes picteti, Ephemera vulgata*. Moreover, *Rhithrogena savoiensis* Alba-Tercedor and Sowa, 1987 is a new record for the Turkish fauna. Thus, the number of mayfly species in Turkey increased to 158.

Key words: Mayfly larvae, fauna, Turkey, new record, *Rhithrogena savoiensis.*

INTRODUCTION

Ephemeroptera is one of the most evolutionary primitive orders of the extant insect groups as well as an ancient lineage of insects. The dominant stage in the life cycle of mayflies is the larval one, as they and the larvae inhabit all types of freshwaters. Mayflies are distributed all over the world excluding Antarctica and some remote oceanic islands. Even though Ephemeroptera is represented by more than 3.000 described species, their taxonomical and faunistical studies are still in progress (Barber-James *et al*., 2008).

The shoreline of the Eastern Black Sea Region is a refuge for the Caucasian fauna consisting of Siberian and cold steppe elements migrating towards the temperate areas during the glacial periods in Anatolia (Bahadır and Emet, 2013). Therefore, boreal elements of the European fauna have spread to the Black Sea shoreline by way of the Macedonia-Thrace (Balkans) immigration route (Demirsoy, 2002). Consequently, this region has a rich fauna that contains both European and Caucasian species.

The Eastern Black Sea Region has a large number of rivers and streams due to its rainy climate and topographic characteristics. This feature is also a prerequisite feature for the high diversity of the aquatic fauna of this region.

Therefore, the objective of this study was to contribute to the knowledge of the Ephemeropteran fauna of the Black Sea region and Turkey.

MATERIALS AND METHODS

Field investigations were conducted in 2009- from 24 June to 03.07.2009. Mayfly larvae were qualitatively sampled using hand nets and sieves. A total of 2.129 specimens were collected from 16 sites of the Eastern Black Sea Region (Fig. 1). Information about sampling sites is given in the Table 1.

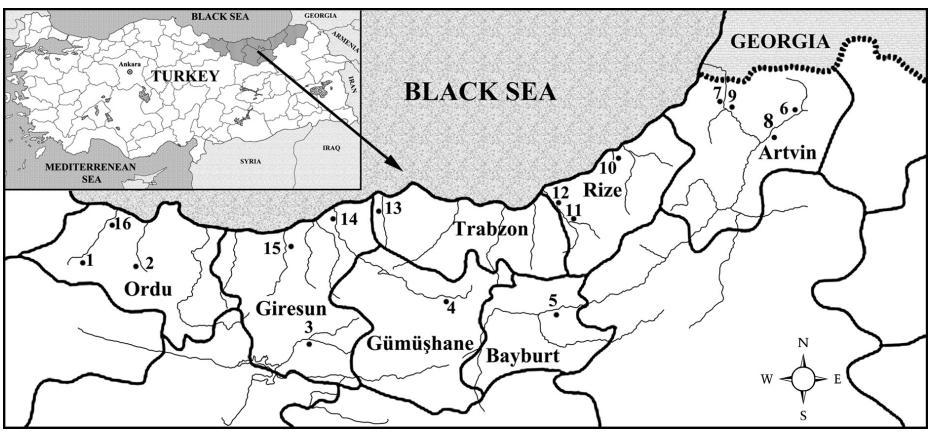

Fig. 1. Sampling stations from the Eastern Black Sea Region, Turkey.

Table 1. Geographical information of sampling stations.

Locality No	Locality	Latitude Longitude	Altitude (m)
1	Ordu, Gökçebayır village	40.42.50 N – 37.02.00 E	923
2	Ordu, Alacalar village	40.40.51 N – 37.27.13 E	919
3	Giresun, Alucra	40.19.00 N – 38.40.37 E	1477
4	Gümüşhane, Kelkit	40.24.31 N – 39.36.10 E	1271
5	Bayburt, Erikdibi village	40.26.06 N – 40.15.36 E	1582
6	Artvin, Kaçkol bridge	41.16.59 N – 42.13.58 E	674
7	Artvin, Borçka	41.24.17 N – 41.47.35 E	829
8	Artvin, Şavşat	41.15.55 N – 42.21.45 E	945
9	Artvin, Karagöl	41.23.13 N – 41.51.12 E	1480
10	Rize	41.07.05 N – 40.54.06 E	88
11	Rize, İyidere	40.54.11 N – 40.25.12 E	113
12	Rize	40.58.00 N – 40.21.14 E	16
13	Trabzon, Tonya	40.56.34 N – 39.17.35 E	401
14	Giresun, Görele	40.59.15 N – 38.59.53 E	67
15	Giresun, Dereli	40.48.12 N – 38.28.07 E	142
16	Ordu, Ünye	41.05.05 N – 37.13.15 E	124

All materials were preserved in 80% ethanol and deposited in the Zoological Museum of Anadolu University (AUZM), Eskişehir.

They were examined using a Leica MZ12.5 stereomicroscope and Leica DM LS2 microscope which were then identified at the species level using available references (Bauernfeind (1994; 1995), Bauernfeind and Soldán (2012); Belfiore (1983), Belfiore and Buffagni (1994), Bogoescu (1958), Braasch (1979), Eiseler (2005), Elliott *et al*. (1988), Grandi (1960), Harker (1989), Haybach (1999), Keffermüller and Sowa (1984), Kluge (1988; 1994; 1997), Landa (1969), Malzacher (1984), Müller-Liebenau (1969), Studemann *et al*. (1992), Soldán and Landa (1999), Ujhelyi (1959), Webb and McCafferty (2008) and Zurwerra *et al*. (1986). The digital image of the comb-shaped bristles of galea-lacinia was taken by digital camera (Olympus Camedia C-7070 Wide Zoom) attached to the microscope (Olympus BX51 TF).

The site number of the collected materials is given in parentheses in the results section right after the number of examined specimens.

RESULTS

Taxa List

Family: BAETIDAE Leach, 1815

Genus: *Baetis* Leach, 1815

Subgenus: *Baetis* Leach, 1815

Baetis (*B.*) *fuscatus* (Linnaeus, 1761)

Material examined: 24.06.2009, 11 la (1); 25.06.2009, 6 la (3); 25.06.2009, 1 larva (4); 01.07.2009, 6 la (12); 02.07.2009, 4 la (13); 02.07.2009, 17 la (14); 03.07.2009, 3 la (15).

Baetis (*B.*) *lutheri* Müller-Liebenau, 1967

Material examined: 24.06.2009, 29 la (2); 25.06.2009, 7 la (3); 25.06.2009, 2 la (4); 26.06.2009, 29 la (5); 28.06.2009, 8 la (6); 29.06.2009, 3 la (7); 29.06.2009, 35 la (8); 29.06.2009, 7 la (9); 30.06.2009, 48 la (11); 02.07.2009, 38 la (13); 02.07.2009, 16 la (14); 03.07.2009, 16 la (15); 03.07.2009, 6 la (16).

Baetis (*B.*) *vernus* Curtis, 1834

Material examined: 25.06.2009, 11 la (4); 29.06.2009, 60 la (7); 29.06.2009, 96 la (8); 29.06.2009, 27 la (9); 30.06.2009, 3 la (10); 03.07.2009, 7 la (16).

Subgenus: *Rhodobaetis* Jacob, 2003

Baetis (*Rh.*) *rhodani* (Pictet, 1843)

Material examined: 24.06.2009, 45 la (1); 24.06.2009, 25 la (2); 25.06.2009, 15 la (3); 25.06.2009, 64 la (4); 26.06.2009, 8 la (5); 28.06.2009, 14 la (6); 29.06.2009, 26 la (8); 30.06.2009, 8 la (10); 30.06.2009, 71 la (11); 01.07.2009, 4 la (12); 02.07.2009, 17 la (13); 03.07.2009, 8 la (15); 03.07.2009, 62 la (16).

Subgenus: *Nigrobaetis* Novikova & Kluge, 1987

Baetis (*N.*) *muticus* (Linnaeus, 1758)

Material examined: 26.06.2009, 51 la (5); 28.06.2009, 3 la (6); 29.06.2009, 8 la (9); 30.06.2009, 2 la (10); 03.07.2009, 2 la (16).

Baetis (*N.*) *niger* (Linnaeus, 1761)

Material examined: 25.06.2009, 8 la (3).

Genus: *Procloeon* Bengtsson, 1915

Procloeon bifidum (Bengtsson, 1912)

Material examined: 03.07.2009, 6 la (16).

Procloeon pennulatum (Eaton, 1870)

Material examined: 03.07.2009, 5 la (16).

Family: OLIGONEURIIDAE Ulmer, 1924

Genus: *Oligoneuriella* Ulmer, 1924

Oligoneuriella rhenana (Imhoff, 1852)

Material examined: 29.06.2009, 31 la (8); 03.07.2009, 2 la (16).

Family: HEPTAGENIIDAE Needham, 1901

Genus: *Ecdyonurus* Eaton, 1865

Subgenus: *Ecdyonurus* Eaton, 1865

Ecdyonurus (*E.*) *venosus* Fabricius, 1775

Material examined: 29.06.2009, 7 la (7); 29.06.2009, 24 la (8); 29.06.2009, 39 la (9); 30.06.2009, 6 la (10).

Subgenus: *Helvetoraeticus* Eaton, 1865

Ecdyonurus (*H.*) *picteti* (Meyer-Dür, 1864)

Material examined: 30.06.2009, 4 la (10);

Genus: *Electrogena* Zurwerra & Tomka, 1985

Electrogena affinis Eaton, 1883

Material examined: 24.06.2009, 3 la (1); 24.06.2009, 6 la (2); 25.06.2009, 5 la (3); 25.06.2009, 5 la (4); 02.07.2009, 8 la (14); 03.07.2009, 5 la (15); 03.07.2009, 58 la (16).

***Electrogena quadrilineata* (Landa, 1969)**

Material examined: 03.07.2009, 22 la (16).

Genus: *Epeorus* Eaton, 1881

Subgenus: *Caucasiron* Kluge, 1997

***Epeorus* (*C.*) *alpestris* (Braasch, 1979)**

Material examined: 29.06.2009, 10 la (7).

***Epeorus* (*C.*) *znojkoi* (Tshernova, 1938)**

Material examined: 24.06.2009, 25 la (1); 25.06.2009, 2 la (4).

Subgenus: *Epeorus* Eaton, 1881

***Epeorus* (*E.*) *zaitzevi* Tshernova, 1981**

Material examined: 24.06.2009, 7 la (1); 25.06.2009, 15 la (3); 25.06.2009, 18 la (4); 26.06.2009, 52 la (5); 29.06.2009, 1 larva (8).

Genus: *Rhithrogena* Eaton, 1881

***Rhithrogena beskidensis* Alba-Tercedor & Sowa, 1987**

Material examined: 02.07.2009, 1 larva (13).

***Rhithrogena puytoraci* Sowa & Degrange, 1987**

Material examined: 24.06.2009, 2 la (1).

***Rhithrogena savoiensis* Alba-Tercedor & Sowa, 1987**

Material examined: 25.06.2009, 12 la (3); 25.06.2009, 37 la (4); 29.06.2009, 16 la (7); 30.06.2009, 11 la (10); 03.07.2009, 1 larva (15).

Note: New record for the Turkish fauna.

Family: LEPTOPHLEBIIDAE Banks, 1900

Genus: *Choroterpes* Eaton, 1881

Subgenus: *Choroterpes* Eaton, 1881

***Choroterpes* (*Ch.*) *picteti* Eaton, 1871**

Material examined: 02.07.2009, 3 la (14); 03.07.2009, 17 la (16).

Genus: *Habroleptoides* Schönemund, 1929

Habroleptoides confusa Sartori & Jacob, 1986

Material examined: 28.06.2009, 6 la (6); 29.06.2009, 5 la (7); 29.06.2009, 17 la (9); 01.07.2016, 1 larva (12).

Genus: *Habrophlebia* Eaton, 1881

Habrophlebia lauta Eaton, 1884

Material examined: 24.06.2009, 4 la (1); 24.06.2009, 36 la (2); 01.07.2009, 2 la (12).

Family: EPHEMERIDAE Latreille, 1810

Genus: *Ephemera* Linnaeus, 1758

Ephemera vulgata Linnaeus, 1758

Material examined: 24.06.2009, 11 la (1); 24.06.2009, 11 la (2); 25.06.2009, 10 la (3); 29.06.2009, 4 la (8); 03.07.2009, 1 larva (15).

Family: POTAMANTHIDAE Albarda in Selys-Longchamps, 1888

Genus: *Potamanthus* Pictet, 1843

Potamanthus luteus (Linnaeus, 1767)

Material examined: 02.07.2009, 26 la (14); 03.07.2009, 5 la (15).

Family: EPHEMERELLIDAE Klapálek, 1909

Genus: *Ephemerella* Walsh, 1862

Subgenus: *Serratella* Edmunds, 1959

Ephemerella (*S.*) *ignita* (Poda, 1761)

Material examined: 24.06.2009, 50 la (1); 24.06.2009, 84 la (2); 25.06.2009, 10 la (3); 25.06.2009, 178 la (4); 29.06.2009, 13 la (7); 29.06.2009, 3 la (9); 30.06.2009, 15 la (10); 30.06.2009, 37 la (11); 01.07.2016, 4 la (12); 02.07.2009, 42 la (13); 02.07.2009, 2 la (14); 03.07.2009, 30 la (15); 03.07.2009, 7 la (16).

Family: CAENIDAE Newman, 1853

Genus: *Caenis* Stephens, 1835

Caenis macrura Stephens, 1836

Material examined: 24.06.2009, 7 la (1); 24.06.2009, 30 la (2); 25.06.2009, 4 la (3); 25.06.2009, 17 la (4); 29.06.2009, 12 la (8); 02.07.2009, 2 la (14); 03.07.2009, 2 la (15); 03.07.2009, 7 la (16).

DISCUSSION

As a result of this study, 26 species belonging to 14 genera and 8 families were reported from the Eastern Black Sea region of Turkey. Among them *Rhithrogena savoiensis* Alba-Tercedor and Sowa, 1987 is a new record for the Turkish fauna. According to Salur *et al*. (2016) and Kazancı and Türkmen (2016) the number of Ephemeroptera species in Turkey is 157. However, this number has increased up to 158 as a result of this study.

According to previous studies conducted in this region, 10 species were reported from Artvin, 6 from Bayburt, 29 from Giresun, 9 from Gümüşhane, 27 from Rize and 21 from Trabzon (Table 2) (Kazancı, 1984; Sowa *et al*., 1986; Kazancı and Braasch, 1988; Kazancı, 2001a; 2001b; 2009; Kazancı and Türkmen, 2011; Ekingen and Kazancı, 2012; Türkmen and Kazancı, 2015; Godunko *et al*., 2015). Even though Salur *et al*. (2016) have reported the presence of *B. fuscatus* in Bayburt, there is no such record in the cited article (Kazancı, 1984; Salur *et al*., 2016).

Since no mayfly records have been acquired from the Ordu province until today, all of the species identified here (18 species) are new records for this province. In addition, eleven of the identified species are first records for Artvin, two for Bayburt, four for Giresun, six for Gümüşhane, four for Rize and two for Trabzon (Table 3).

R. savoiensis, has been reported from some regions of Europe such as France, Poland (Alba-Tercedor and Sowa, 1987), Switzerland (Sartori, 1988), Austria (Bauernfeind, 1990), Bulgaria (Russev and Vidinova, 1994), Germany (Haybach, 1996), Slovenia (Zabric and Sartori, 1997), Macedonia (Vidinova, 1998), Czech Republic (Soldan and Putz, 2000) and Ukraine (Godunko, 2000). However, no record was given from Asia Minor and other parts of Asia until today (Fig. 2) and the first record from Asia has been obtained in this study. It is possible that this species spreading in Europe has reached to the Eastern Black Sea region by way of the Danube or Sarmatic Inland Sea (Black Sea of today) via the Macedonian-Thrace (Balkans) refugium during the last glacial period. However, when the localizations of the samples were analyzed for Turkey, it was observed that this species has remained in a very limited area in Anatolia.

Specimens with inconspicuous irregular crenulation along of outer margin of gill I (absent plica) from among the *Rhithrogena* genus specimens within the collected larvae were attributed to the *Rhithrogena diaphana* species-group. Although *R. beskidensis*, the closest species to *R. savoiensis* in *R. diaphana* group, have been reported from our country, these specimens were identified as *R. savoiensis* since they have 5-7 teeth on comb-shaped bristles (Lacinial scrapes) (Fig. 3) compared to 10-13 teeth for *R. beskidensis* (see Eiseler, 2005: 80-81; Bauernfeind and Soldan, 2012: 336).

Table 2. Mayfly fauna of the Eastern Black Sea region (ø Previously reported, ∆ Reported in this research, ○ First record for the province, ¤ First record for the region, ● First record for Turkey).

Species	Artvin	Bayburt	Giresun	Gümüşhane	Ordu	Rize	Trabzon
Baetis (*B.*) *alpinus*	-	Ø	-	-	-	-	-
B. (*B.*) *buceratus*	-	Ø	-	-	-	-	-
B. (*B.*) *fuscatus*	-	-	Ø∆	Ø∆	○	Ø∆	Ø∆
B. (*B.*) *lutheri*	○	○	Ø∆	Ø∆	○	Ø∆	Ø∆
B. (*B.*) *lutheri georgiensis*	Ø	-	-	-	-	-	-
B. (*B.*) *vardarensis caucasicus*	-	-	-	-	-	-	Ø
B. (*B.*) *vernus*	○ ¤	-	-	○ ¤	○ ¤	○ ¤	-
B. (*L.*) *tricolor*	Ø	-	-	-	-	-	-
B. (*Rh.*) *gemellus*	-	-	Ø	Ø	-	Ø	Ø
B. (*Rh.*) *milani*	-	-	-	Ø	-	Ø	Ø
B. (*Rh.*) *rhodani*	○	Ø∆	Ø∆	Ø∆	○	Ø∆	Ø∆
B. (*Rh.*) *vadimi*	-	-	-	-	-	Ø	-
B. (*N.*) *muticus*	Ø∆	○	Ø∆	-	○	Ø∆	Ø∆
B. (*N.*) *niger*	-	-	○ ¤	-	-	-	-
Procloeon bifidum	-	-	-	-	○ ¤	-	-
P. pennulatum	-	-	-	-	○ ¤	-	-
Oligoneuriella rhenana	○ ¤	-	-	-	○ ¤	-	-
O. tskhomelidzei	Ø	-	-	-	-	-	-
Ecdyonurus (*E.*) *autumnalis*	Ø	-	-	-	-	-	-
E. (*E.*) *macani*	-	-	Ø	-	-	-	-
E. (*E.*) *starmachi*	-	-	Ø	-	-	Ø	-
E. (*E.*) *venosus*	○ ¤	-	-	-	-	○ ¤	-
E. (*H.*) *helveticus*	-	-	Ø	-	-	Ø	-
E. (*H.*) *picteti*	-	-	Ø∆	-	-	Ø∆	-
Electrogena affinis	-	-	Ø∆	○	○	Ø∆	Ø∆
E. hakkarica	-	-	-	-	-	Ø	-
E. pseudaffinis	-	-	-	-	-	-	Ø
E. quadrilineata	-	-	Ø∆	-	○	Ø∆	Ø∆
Epeorus (*C.*) *alpestris*	Ø∆	-	-	-	-	-	-
E. (*C.*) *caucasicus*	Ø	-	Ø	Ø	-	Ø	Ø
E. (*C.*) *magnus*	-	-	-	-	-	Ø	-
E. (*C.*) *znojkoi*	-	-	Ø∆	○	○	Ø∆	Ø∆
E. (*E.*) *sylvicola*	-	-	Ø	Ø	-	Ø	Ø

Table 2. Continued.

Species	Artvin	Bayburt	Giresun	Gümüşhane	Ordu	Rize	Trabzon
E. (*E.*) *zaitzevi*	○	ØΔ	ØΔ	ØΔ	○	-	-
E. (*I.*) *alpicola*	-	-	Ø	-	-	Ø	Ø
Rhithrogena beskidensis	-	-	-	-	-	ØΔ	○
R. germanica	-	-	Ø	-	-	Ø	Ø
R. iridina kownackorum	-	-	Ø	Ø	-	Ø	Ø
R. loyalaea	Ø	-	-	-	-	-	-
R. puytoraci	-	-	ØΔ	-	○	ØΔ	ØΔ
R. savoiensis	●	-	●	●	-	●	-
R. semicolorata	-	Ø	Ø	-	-	Ø	Ø
R. zelinkai	-	-	Ø	-	-	Ø	Ø
R. znojkoi	Ø	Ø	-	-	-	-	-
Choroterpes (*C.*) *picteti*	-	-	○ ¤	-	○ ¤	-	-
Habroleptoides confusa	○	-	ØΔ	-	-	ØΔ	ØΔ
H. kavron	-	-	-	-	-	Ø	-
Habrophlebia fusca	Ø	-	-	-	-	-	-
H. lauta	-	-	ØΔ	-	○	○	ØΔ
Ephemera danica	-	-	Ø	-	-	-	-
Ephemera vulgata	○ ¤	-	○ ¤	-	○ ¤	-	-
Potamanthus luteus	-	-	ØΔ	-	-	-	-
Ephemerella (*S.*) *ignita*	○	-	ØΔ	○	○	ØΔ	○
Caenis luctuosa	-	-	Ø	-	-	-	-
C. macrura	○	-	ØΔ	○	○	-	-
C. martae	-	-	Ø	-	-	-	-

Table 3. The first records by province.

Species	Artvin	Bayburt	Giresun	Gümüşhane	Ordu	Rize	Trabzon
Baetis (*B.*) *fuscatus*					✣		
B. (*B.*) *lutheri*	✣	✣			✣		
B. (*B.*) *vernus*	✣			✣	✣	✣	
B. (*Rh.*) *rhodani*	✣				✣		
B. (*N.*) *muticus*		✣			✣		
B. (*N.*) *niger*			✣				
Procloeon bifidum					✣		
P. pennulatum					✣		

Table 3. Continued.

Species	Artvin	Bayburt	Giresun	Gümüşhane	Ordu	Rize	Trabzon
Oligoneuriella rhenana	✣				✣		
Ecdyonurus (*E.*) *venosus*	✣					✣	
E. (*H.*) *picteti*							
Electrogena affinis				✣	✣		
E. quadrilineata					✣		
Epeorus (*C.*) *alpestris*							
E. (*C.*) *znojkoi*				✣	✣		
E. (*E.*) *zaitzevi*	✣				✣		
Rhithrogena beskidensis							✣
R. puytoraci					✣		
R. savoiensis	✣		✣	✣		✣	
Choroterpes (*C.*) *picteti*			✣		✣		
Habroleptoides confusa	✣						
Habrophlebia lauta					✣	✣	
Ephemera vulgata	✣		✣		✣		
Potamanthus luteus							
Ephemerella (*S.*) *ignita*	✣			✣	✣		✣
Caenis macrura	✣			✣	✣		

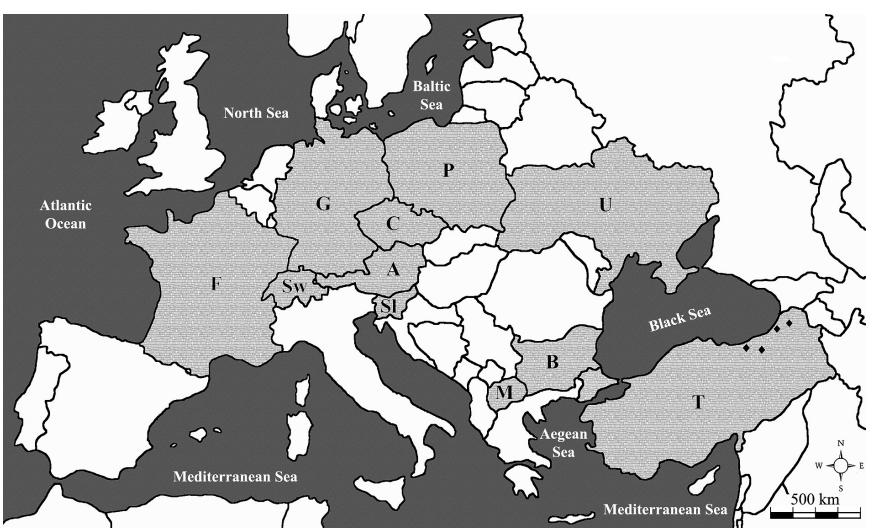

Fig. 2. Distribution of *R. savoiensis* (A: Austria, B: Bulgaria, C: Czech Republic, F: France, G: Germany, M: Macedonia, P: Poland, Sl: Slovenia, Sw: Switzerland, T: Turkey, U: Ukrain, •: Collecting sites of *R. savoiensis*).

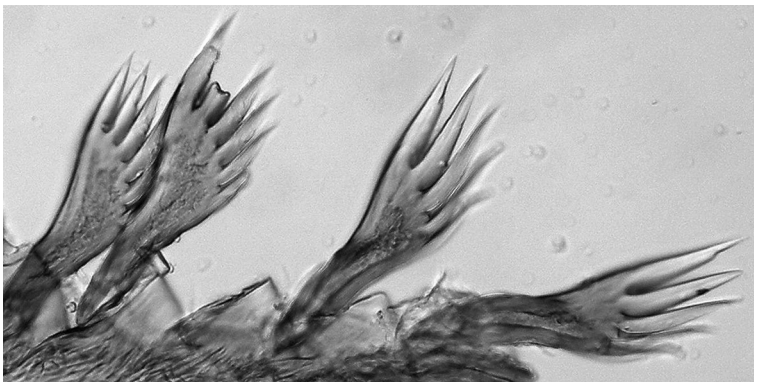

Fig. 3. Comb-shaped bristles of *R. savoiensis.*

ACKNOWLEDGEMENTS

I express my deep gratitude to Dr. RJ Godunko for his support, comments and suggestions for the identification of *R. savoiensis*; also to Dr. P Sroka, Dr. M Paunović and PhD L Hrivniak for their help in checking some identified species of genus *Epeorus*.

REFERENCES

Alba-Tercedor, J., Sowa, R. 1987. New Representatives of the *Rhithrogena diaphana*-Group from Continental Europe, with a Redescription of *R. diaphana* Navás, 1917 (Ephemeroptera: Heptageniidae). *Aquatic Insects*, 9: 65-83.

Bahadır, M., Emet, K. 2013. Anadolu'da yayılış gösteren omurgalı endemik fauna elemanlarının CBS ile dağılış alanlarının haritalanması, *The Journal of International Social Research*, 6: 34-50.

Barber-James, H. M., Gattolliat, J. L., Sartori, M., Hubbard, M. D. 2008. Global diversity of mayflies (Ephemeroptera, Insecta) in freshwater, *Hydrobiologia*, 595: 339-350.

Bauernfeind, E. 1990. Einige für Österreich neue oder wenig bekannte Eintagsfliegen (Insecta: Ephemeroptera), *Linzer Biology Beitrӓge*, 22(2): 341-347.

Bauernfeind, E. 1994. Bestimmungsschlüssel für die österreichischen Eintagsfliegen (Insecta: Ephemeroptera), *Teil 1, Wasser und Abwasser*, 4: 1-92.

Bauernfeind, E. 1995. Bestimmungsschlüssel für die österreichischen Eintagsfliegen (Insecta: Ephemeroptera). *Teil 2, Wasser und Abwasser*, 5, 1-96.

Bauernfeind, E., Soldán, T. 2012. *The Mayflies of Europe (Ephemeroptera)*. Ollerup, Denmark, Apollo Books, 781 pp.

Belfiore, C. 1983. *Efemerotteri (Ephemeroptera), Guide per il Riconoscimento Delle Specie Animali Delle Acque Interne Italiane*. Consiglio Nationale Delle Ri-Cerche, Progetto finalizzato "Promozione della qualita dell'ambiente, AQ/1/201, 24, 113 pp.

Belfiore, C., Buffagni, A. 1994. Revision of the Italian species of the *Ecdyonurus helveticus* group: taxonomy of the nymphs (Ephemeroptera, Heptageniidae), *Mitteilungen Der Schweizerischen Entomologischen Gesellschaft*, 67: 143-149.

Bogoescu, C. 1958. *Ephemeroptera*. *In:* Fauna Republicii Populare Romine, Insecta vol. 7(3). Bucarest, Academia Republicii Populare Romine, 187 pp.

Braasch, D. 1979. Beitrag zur Kenntnis der Gattung *Iron* EATON im Kaukasus (UdSSR) (III) (Ephemeroptera, Heptageniidae), *Reichenbachia*, 17: 283-294.

Demirsoy, A. 2002. *Genel Zoocoğrafya ve Türkiye Zoocoğrafyası "Hayvan Coğrafyası"*. 5th ed. Meteksan, Ankara, Turkey, 1007 pp.

Eiseler, B. 2005. Identification key to the mayfly larvae of the German Highlands and Lowlands, *Lauterbornia*, Heft: 53.

Ekingen, P., Kazancı, N. 2012. Benthic macroinvertebrate fauna of the Aksu Stream (Giresun, Turkey) and habitat quality assessment based on European Union Water Framework Directive criteria, *Review of Hydrobiology*, 5(1): 35-55.

Elliott, J. M., Humpesch, U. H., Macan, T. T. 1988. *Larvae of The British Ephemeroptera: A Key With Ecological Notes*, No: 49. Freshwater Biological Association, London, 145 pp.

Godunko, R. J. 2000. Little known species of the genera *Rhithrogena* and *Electrogena* (Ephemeroptera, Heptageniidae) from Ukraine, *Vestnik Zoologii*, 14(1): 60-66.

Godunko, R. J., Palatov, D. M., Martynov, A. V. 2015. Mayflies of the Caucasus Mountains. III. A new representative of the subgenus *Rhodobaetis* Jacob, 2003 (Baetidae: *Baetis*) from the South-Western Caucasus, *Zootaxa,* 3948(2): 182-202.

Grandi, M. 1960. *Ephemeroidea. In:* Fauna D'Italia III. Bologna: Sattogli dell'Accademia Nazionale Italiana di Entomologia e dell'Unione Zoologica Italiana, Bologna, 474 pp.

Harker, J. 1989. *Mayflies, Naturalist's Handbook 13*. Richmond Publishing Co. Ltd., Slough, England, 56 pp.

Haybach, A. 1996. Zur Kenntnis der Eintagsfliegenfauna (Insecta: Ephemeroptera) von Rheinland-Pfalz - 2. Ergänzungen und Korrekturen, *Lauterbornia*, 27: 11-20.

Haybach, A. 1999. Beitragzur Larval taxonomie der *Ecdyonurus venosus*-Gruppe in Deutschland, *Lauterbornia*, 37: 113-150.

Kazancı, N. 1984. New Ephemeroptera (Insecta) records from Turkey, *Aquatic Insects*, 6(4): 253-258.

Kazancı, N. 2001a. *Inland waters of Turkey, Series V, Ephemeroptera Fauna (Insecta) of Gümüşhane, Erzurum, Erzincan, Artvin, Kars Provinces*. Imaj Press, Ankara, 80 pp.

Kazancı, N. 2001b. *Inland waters of Turkey, Series VI, Ephemeroptera fauna (Insecta) of Turkey* (*Ed.* Kazancı, N.). Imaj Press, Ankara, Turkey, 72 pp.

Kazancı, N. 2009. Ephemeroptera (Insecta) Fauna of Turkey: Records from Eastern Anatolia (Turkey), *Review of Hydrobiology*, 2: 187-195.

Kazancı, N., Braasch, D. 1988. On some Heptageniidae new for Anatolia (Turkey), *Faunistische Abhandlungen Staatliches Museum für Tierkunde Dresden*, 15: 131-135.

Kazancı, N., Türkmen, G. 2011. *Habroleptoides kavron* sp. n., a new species (Ephemeroptera, Leptophlebiidae) from Eastern Black Sea Region (Turkey) with ecological notes, *Review of Hydrobiology*, 4(2): 63-72.

Kazancı, N., Türkmen, G. 2016. Comments on "An annotated catalogue of the mayfly fauna of Turkey (Insecta, Ephemeroptera)", *Review of Hydrobiology*, 9(2): 85-121.

Keffermüller, M., Sowa, R. 1984. Survey of Central European Species of the Genera Centroptilum Eaton and Pseudocentroptilum Bogoescu (Ephemeroptera, Baetidae), *Polskie Pismo Entomologiczne*, 54: 309-340.

Kluge, N. J. 1988. Revision of genera of the family Heptageniidae (Ephemeroptera) 1.Diagnoses of tribes, genera and subgenera of the subfamily Heptageniinae, *Entomologicheskoe Obozrenie [Revue d'Entomologie de l'URSS]*, 67: 291-313.

Kluge, N. J. 1994. Habrophlebiinae subfam. n. with description of a new species of Habroleptoides from the Caucasus (Ephemeroptera: Leptophlebiidae), *Zoosystematica Rossica*, 3: 35-43.

Kluge, N. J. 1997. *Order mayflies-Ephemeroptera. In:* S.J. Tsalolikhin (Ed). Key to Fresh water Invertabrates of Russia and Adjacent Lands: Arachnids and Lower Insects. Zoological Institute Russian Academy of Science, St. Petersburg, pp. 176-220.

Landa, V. 1969. *(Jepice) Ephemeroptera, Fauna CSSR 18*. Cesk Akademie Ved, Praha, 352 pp.

Malzacher, P. 1984. Die Europaischen Arten der Gattung Caenis Stephens (Insecta:Ephemeroptera). *Stuttgarter Beitrage zur Naturkunde Serie A*, 373: 1-48.

Müller-Liebenau, I. 1969. Revision der europaischen Arten der Gattung *Baetis* Leach, 1815 (Insecta: Ephemeroptera), *Gewasser und Abwasser*, 48/49: 1-214.

Russev, B., Vidinova, Y. 1994. New representatives of the order Ephemeroptera (Insecta) for the fauna of Bulgaria, *Lauterbornia*, 15: 85-87.

Salur, A., Darılmaz, M. C., Bauernfeind, E. 2016. An annotated catalogue of the mayfly fauna of Turkey (Insecta, Ephemeroptera), *ZooKeys*, 620: 67-118.

Sartori, M. 1988. Quelques compléments à la faune des Ephéméroptères de Suisse (Insecta, Ephemeroptera), *Mitteilungen Der Schweizerischen Entomologischen Gesellschaft*, 61: 339-347.

Soldán, T., Landa, V. 1999. A key to the Central European species of the genus Rhithrogena (Ephemeroptera: Heptageniidae), *Klapalekiana*, 35: 25-37.

Soldán, T., Putz, M. 2000. Karyotypes of some Central European mayflies (Ephemeroptera) and their contribution to phylogeny of the order, *Acta Societatis Zoologicae Bohemicae*, 64: 437-445.

Sowa, R., Soldán, T., Kazancı, N. 1986. *Rhithrogena pontica* sp. n. (Ephemeroptera: Heptageniidae) from Turkey, *Aquatic Insects*, 8(2): 67-69.

Studemann, D., P. Landolt, M. Sartori, D. Hefti, I. Tomka. 1992. *Ephemeroptera.- In:* "Insecta Helvetica" 9. Schweizerischen Entomologischen Gesellschaft. Fribourg, 174 pp.

Ujhelyi, S. 1959. *Kereszek Ephemeroptera. In:* Fauna Hungariae. Budapest, 49: 1-96.

Türkmen, G., Kazancı, N. 2015. Additional records of Ephemeroptera (Insecta) species from the Eastern Part of Black Sea Region (Turkey), *Review of Hydrobiology*, 8(1): 33-50.

Vidinova, Y. 1998. New Rhithrogena-species (Ephemeroptera: Heptageniidae) for the fauna of Macedonia, *Lauterbornia*, 33: 49-51.

Webb, J. M., McCafferty, W. P. 2008. Heptageniidae of the World. Part II: Key to the Genera, *Canadian Journal of Arthropod Identification*, 7: 1-55.

Zabric, D., Sartori, M. 1997. First contribution to the mayfly fauna from Slovenia (Ephemeroptera). *In:* Landolt, P., Sartori, M. (Eds.). Ephemeroptera and Plecoptera, Biology-Ecology-Systematics, MTL, Fribourg, Switzerland, 147-151.

Zurwerra, A., Tomka, I., Lampel, G. 1986. Morphological and Enzyme Electrophoretic Studies on the Relationships of the European *Epeorus* Species (Ephemeroptera, Heptageniidae), *Systematic Entomology*, 11: 255-266.

Received: March 14, 2017 *Accepted: August 01, 2017*