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New data on the distribution and checklist of fresh- and brackishwater Gammaridae, Pontogammaridae and Behningiellidae (Amphipoda) in Bulgaria

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With 2 figures

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Schlagwörter: Gammaridae, Pontogammaridae, Behningiellidae, Amphipoda, Crustacea, Rhodopen, Bulgarien, Verbreitung, Faunistik

New data on the distribution of 10 gammarid species are presented based on 15 sampling sites from Bulgaria, including the Danubian Plain, Stara Planina Range, Rhodope Massif and the Black Sea Coast. Among the findings also *Gammarus frater*, the only Bulgarian endemic among species has been identified. An updated checklist of the Bulgarian Gammaridae (13 species and subspecies) Pontogammaridae (11 species) and Behningiellidae 1 species) is provided.

1 Introduction

Distribution and taxonomy of gammarids in surface waters of Bulgaria is poorly known. Most of literature concerns the Danube River, coastal lagoons and lakes (limans) or estuarine sections of rivers emptying to the Black Sea, inhabited mainly by endemic Ponto-Caspian species. However even in this case older papers prevail (Carausu 1943, Carausu et al. 1955, K"neva-Abadžieva 1965, 1972, K"neva-Abadžieva & Marinov 1967, Valkanov 1954) with still low number of recent studies (Kovachev & Uzunov 1981, Kovachev et al. 1999, Stoichev 1998, Stoykov & Uzunova 1999, Uzunova 1999).

Knowledge about the gammarid fauna of inland waters is yet more limited. Most data are historical and deal with few species only (Arndt 1943, Russev 1959, Schäferna 1922, K"neva-Abadžieva 1965, 1966). Present informations are of more general nature with insufficient information on local distribution of taxa (Karaman & Pinkster 1977a,b, 1987). Recent papers are very scarce (Andreev 2001). Thus, all new gammarid records are of high value to understand the present and past distribution of this group in Bulgaria.

The aim of this paper is to present new faunistic data on Bulgarian Gammaridae, Pontogammaridae and Behningiellidae, based on several recently collected and historical samples, as well as to list all species of the above families known from Bulgaria.

2 Material and methods

The presented materials come from several collections. A set of samples was collected by the second author in April 2006. Others were gathered by first author on occasion of sampling in Romania in August/September 2005. Some material was supplied by Christoph Schubart and Silke Reuschel from University of Regensburg, Germany, collected in 2005. All the above samples remain in the collection of the Department of Invertebrate Zoology & Hydrobiology, University of Lodz, Poland. Museum material was loaned from Natural History Museum in Berlin, Germany, and returned to this institution.

For all localities, either exact or approximated (museum material) geographical coordinates are given. More detailed habitat data are available only for the samples collected by the authors of this study. All the material, fixed in ethanol, was examined carefully under Nikon SMZ-800 steromicroscope and identified by the first author, using available literature and, when necessary, compared to original descriptions or redescriptions (Carausu 1943, Carausu et al. 1955, Goedmakers 1972, Karaman 1975, Karaman & Pinkster 1977a,b, 1987, Pinkster 1970, Schäferna 1922). All species localities are shown on the figure 1.

3 Description of the 15 sampling sites

Danube River at front of Corabia (N43°46'18", E26°31'23"), coll. E. Dobreanu, Natural History Museum in Berlin (BZM), sample reference number 25028.

Durankulak Swamp (Durankulasko Blato) near Vaklino village (N43°40'39", E28°32'15"), coll. M. Grabowski, 04.09.2005, salinity ca. 0,5 PSU, water temperature 23.4°C, muddy bottom with gravel and stones, very rich submerged vegetation (*Myriophyllum* sp., *Spirodela* sp.) and reeds.

Black Sea at Shablanska Tuzla (N43°33'30", E28°35'49"), coll. M. Grabowski, 04.09.2005, salinity ca. 10 PSU, water temp. 24.1°C, sandy bottom with sumberged log.

Shabla Lake (Shablansko Jezero) (ca. N43°33', E28°33'), coll. W. Arndt, 6.10.1943, BZM, sample ref. no 25375.

Batova River valley (ca. N43°24, E27°59'), coll. E. Dobreanu, BZM, sample ref. no 25024, 25025.

Goljama Kamcija (N42°56'23.52", E26°38'1.86"), coll. C. Schubart & S. Reuschel, 04.06.2005.

Stara Reka I, between Kotel and Stara Reka village (N42°55'18", E26°22'51"), coll. C. Schubart & S. Reuschel, 04.06.2005.

Stara Reka II, between Kotel and Stara Reka village (N42°54'23", E26°16'43"), coll. C. Schubart & S. Reuschel, 04.06.2005.

Ivanovo, tributary of Harmanlijska Reka (N41°51'53", E25°53'07"), coll V. Pesic, 25.04.2006, muddy bottom with gravel and stones.

Dolno Cerkoviste near Krumovgrad (N41°37'60", E25°52'00"), coll. V. Pesic, 25.04.2006, captured spring (used as a drinking basin for cattle).

Golema Reka near Krumovgrad (N41°26'22", E25°34'04"), coll. V. Pesic, 24.04.2006, muddy bottom with gravel and stones, very rich reed cover.

Malkata Reka I, near Malko Popovo village (N41°35'02", E25°55'06"), coll. V. Pesic, 25.04.2006, bottom with gravel and stones covered by mosses.

Malkata Reka II, near Senoklas (N41°36'29", E25°57'09"), coll. V. Pesic, 25.04.2006, captured spring (used as a drinking basin for cattle), without vegetation, bottom covered with partially decomposed organic matter.

Asenovgrad, tributary of Cepelarska Reka (N42°01'00", E24°52'00"), coll. V. Pesic, 23.04.2006, bottom with gravel and stones.
Jugovo near Asenovgrad (N41°52'60", E24°48'00"), coll. V. Pesic, 23.04.2006, captured spring (used as a drinking basin for cattle) and spring-stream.

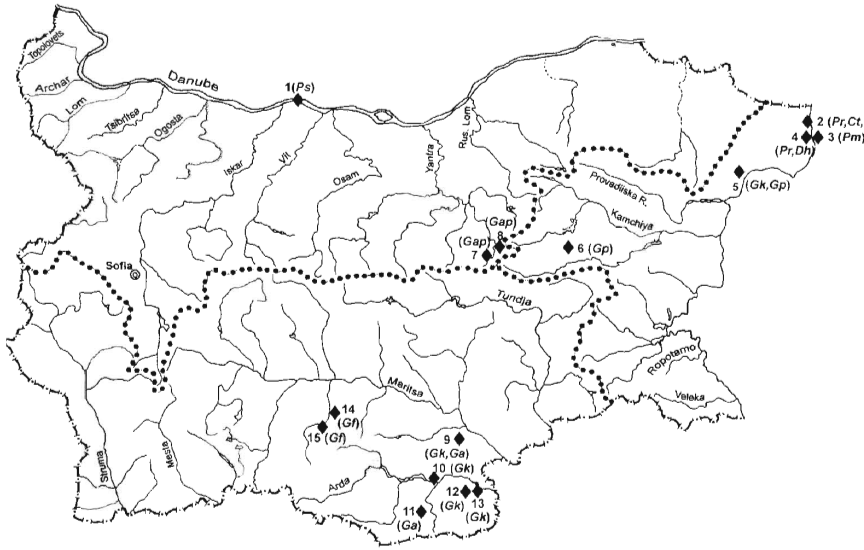

Fig 1: Sampling localities: 1 = Danube River in Corabia, 2 = Durankulak Swamp, 3 = Black Sea at Shablanska Tuzla, 4 = Shabla Lake, 5 = Batova River, 6 = Goljama Kamcija n. Varbica, 7 = Stara Reka I, 8 = Stara Reka II, 9 = Ivanovo, 10 = Dolno Cherkovishte, 11 = Golema Reka, 12 = Malkata Reka I, 13 = Malkata Reka II, 14 = Asenovgrad, 15 = Jugovo
Gammarid species: Ci = *Chaetogammarus ischnus*, Ct = *C. trichiatus*, Dh = *Dikerogammarus haemobaphes*, Ga = *Gammarus arduus*, Gap = *G.* aff. *pulex*, Gf = *G. frater*, Gk = *G. komareki*, Gp = Gammarus pulex, Pm = *Pontogammarus maeoticus*, Pr = *P. robustoides*, Ps = *P. sarsi*. Base map adopted from Hubenov (2006), changed

4 Results and discussion

4.1. New data on distribution of Bulgarian Gammaridae and Pontogammaridae

Family: GAMMARIDAE Leach, 1813
Chaetogammarus ischnus (Stebbing, 1899)
Material: Durankulak Swamp – 298 ind.
Distribution: Originally a Ponto-Caspian endemic: lower reaches of Ponto-Caspian rivers, coastal lagoons e.g. in Danube Delta. Occurs in fresh and brackish waters (Carausu et al. 1955). Migrating far usptream, already in 1928 noted in the Vistula River (when it migrated through the Pripet-Bug canal, joining the Black and the Baltic Sea basins), in the 1970s recorded in the North Sea drain-

age system, reaching the Rhine delta in 1991. Now being a common invader in Baltic and West European countries (Bij de Vaate et al. 2002). The examined material fits well features given by Carausu et al. (1955) and by Pinkster (1993).

Chaetogammarus trichiatus **(Martynov, 1932)**
Material: Durankulak Swamp – 232 ind.
Distribution: Originally a Ponto-Caspian endemic in coastal lagoons of Black and Azov Sea, Danube Delta. In Bulgaria known from several coastal lakes. Also known to be invasive in Western Europe, where it migrated upstream the Danube river, colonising the Rhine river by 2001 (Bij de Vaate 2002). The examined material fits well features given by Carausu et al. (1955).

Gammarus arduus **G. Karaman, 1975**
Material: Ivanovo – 57 ind., Golema Reka – 16 ind.
Distribution: Most probably Balkan endemic. The species was described from Tekirdag village (coast of Marmara Sea, European part of Turkey), however its distribution was described erroneously as Asia Minor (Karaman 1975). Later found in Greece, Albania and in southern Bulgaria (Karaman & Pinkster 1977a). Based on drawings and descriptions given by Carausu et al. (1955) and attributed to *G. komareki*, suspected to occur also in southern and western part of Romania (Karaman & Pinkster 1977a). The examined material fits well the descriptions given by Karaman (1975) and by Karaman & Pinkster (1977a). This is a first record of that species in the Rhodopi Mountains.

Gammarus frater **Karaman & Pinkster, 1977**
Material: Asenovgrad – 24 ind., Jugovo – 22 ind.
Distribution: Bulgarian endemic. Described from springlets in Asenovgrad, besides found only in the nearby Backovski Monastyr. Our second localisation, Jugovo, lays only some 20 km south-west from Asenovgrad and 15 km from Backovski Monastyr. All examined individuals fit perfectly the original description (Karaman & Pinkster 1977a).

Gammarus komareki **Schäferna, 1922**
Material: Batova River – 15 ind., Ivanovo – 18 ind., Dolno Cerkoviste – 11 ind., Malkata Reka I – 6 ind., Malkata Reka II – 31 ind.
Distribution: Specien known in Europe from southern Balkan Peninsula (Greece, Bulgaria, Turkey), also locally from Moldavia, possibly from Crimean Peninsula, also many localities known from Middle East: Turkey, Iran, Caucassus (Karaman & Pinkster 1977a), however in our opinion taxonomy of these forms should be closely examined. In Bulgaria recorded in various, mostly southern, parts of the country (K"neva-Abadžieva 1966).

Gammarus pulex pulex **(Linnaeus, 1758)**
Material: Batova River – 1 ind., Goljama Kamcija – 6 ind.
Distribution: Widely distributed Palearctic species, its natural range encompasses almost entire Europe including Balkan Peninsula, also Siberia, greater part of China, foothills of Himalaya, Middle East (Karaman & Pinkster 1977a). In Bulgaria known also the subterranean subspecies *G. pulex cognominis* Karaman & Pinkster 1977, found in caves in Lovec district (Karaman & Pinkster 1977a). Taking into account extremely wide distribution range and morphological variability observed, the taxonomy of this species requires further studies. The examined individuals correspond well with the key features (Karaman & Pinkster 1977a) and the published redescription (Pinkster 1970).

Gammarus **aff.** *pulex* **(Linnaeus, 1758)**
Material: Stara Reka I – 5 ind., Stara Reka II – 4 ind.
The forms collected in Stara Reka are difficult to classify with certainty. Some important taxonomic features (e.g. prominent flag-like brush on swollen and compressed segments of flagellum in antenna 2, shape of 2nd epimeral plate) allow to classify the material as *G. pulex*, while others are rather similar to *G. fossarum* (ratio length endopod versus exopod in uropod 3 from 0.6 to 0.7, lack of plumose setae on outer margin of exopod in uropod 3) (fig. 2).

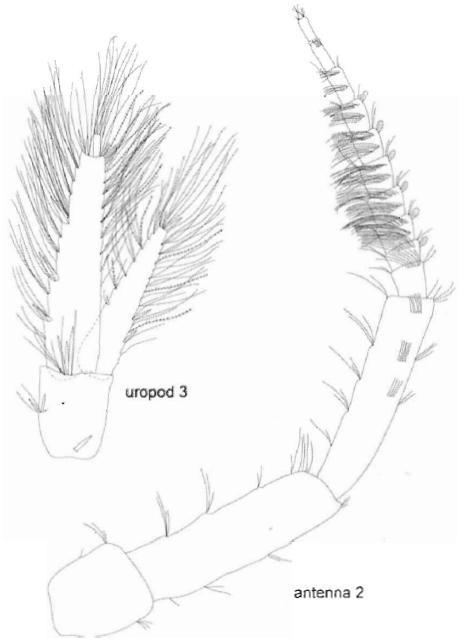

Fig. 2: Antenna 2 and uropod 3 of *Gammarus* aff. *pulex*, ♂ 13 mm, Locality: Stara Reka

The analysed material comes from the mountains, some hundred kilometers from the above mentioned lowland localities where the nominative subspecies was collected. The occurrence of *G. pulex* in the Balkans is scattered with many local isolated populations (Karaman & Pinkster 1977a). Thus there is a possibility that the incongruence in observed features is either an effect of phenotypic plasticity, or an indication of some local subspecies. However, larger collection should be gathered from the area to assess the morphological variability in the population and to reveal its taxonomic entity.

Family: PONTOGAMMARIDAE Bousfield, 1977

***Pontogammarus robustoides* (G. O. Sars. 1894)**

Material: Shabla Lake – 16 individuals, Durankulak Swamp – 44 ind.

Distribution: Originally a Ponto-Caspian endemic: Caspian Sea and lower sections of its affluents, Azov Sea, Black Sea and lower reaches of its affluents. Widespread in the Danube Delta, in Bulgaria recorded from coastal lagoons and river estuaries (K"neva-Abadžieva 1965, 1972, Stoichev 1998, Uzunova 1999). Introduced to artificial reservoirs in Ukraine and Lithuania as fish food base (Jażdżewski 1980). Now invasive in Central Europe: Baltic countries, Poland, Germany, in fresh and brackish waters (e.g. Baltic inshore waters) (Bij de Vaate et al. 2002, Jażdżewski et al. 2002, 2004, 2006). The examined material fits well features given by Carausu (1943) and by Carausu et al. (1955).

***Pontogammarus sarsi* (Sowinsky, 1898)**

Material: Danube River in Corabia – 4 ind.

Distribution: Originally a Ponto-Caspian endemic: Caspian Sea and lower sections of its affluents, Azov Sea, Black Sea, Danube deltaic branches and lower sections of the river (K"neva-Abadžieva 1965, Carausu 1943, Carausu et al. 1955). Occurs in fresh and brackish waters (Carausu et al. 1955). Similar form found in Yugoslavian section of the Danube (Karaman 1953), however this observation were not supported by more recent findings (Nesemann et al. 1995). The examined material fits well features given by Carausu (1943) and by Carausu et al. (1955).

***Pontogammarus maeoticus* (Sowinsky, 1894)**

Material: Black Sea at Shablanska Tuzla – 1 ind

Distribution: Ponto-Caspian endemic: Caspian Sea, Azov Sea, Black Sea and their coastal lagoons (limans). Occurs in the Danube Delta and in coastal lagoons in Romania, in Bulgaria recorded from the littoral of the Black Sea and from few coastal lakes (K"neva-Abadžieva 1972). Occurs in fresh, brackish waters and marine waters (Carausu et al. 1955). The examined material fits well features given by Carausu (1943) and by Carausu et al. (1955).

Dikerogammarus haemobaphes (Eichwald, 1841)
Material: Shabla Lake – 1 ind.
Distribution: Originally a Ponto-Caspian endemic: Caspian Sea, Azov Sea and lower reaches of their affluents, deltaic systems around Black Sea, coastal lagoons. In Bulgaria known already from coastal lakes and from the Danube (Carausu et al. 1955, K"neva-Abadžieva 1972). Introduced to artificial reservoirs in Ukraine and Lithuania as fish food base (Jażdżewski 1980). Now invasive in Central Europe: Baltic countries, Poland, Germany, in fresh and brackish waters (e.g. Baltic inshore waters), also migrates far upstream the Danube (Bij de Vaate et al. 2002, Jażdżewski et al. 2002, 2004, 2006, Nesemann et al. 1995). The examined material fits well features given by Carausu (1943) and by Carausu et al. (1955).

Summarizing the above data, 4 species (*Pontogammarus robustoides*, *P. sarsi*, *P. maeoticus*, *Dikerogammarus haemobaphes*) belonging to family Pontogammaridae, and two of Gammaridae (*Chaetogammarus ischnus*, *C. trichiatus*) were restricted only to the coastal region (Black Sea and coastal lakes) to the Danube river. They are all members of the relic Ponto-Caspian group of species associated with brackishwater conditions, or with large rivers of raised ionic content and thus not entering typical inland waters e.g. smaller rivers or streams.

Among other Gammaridae, only members of genus *Gammarus* were found inland. *Gammarus arduus* was found in eastern Rhodope Massif, *G. komareki* both in Eastern Rhodopes and along the coast, *G. pulex* in Stara Planina and along the coast. *Gammarus frater*, the only Bulgarian endemic among these species was restricted only to Asenovgrad region in Western Rhodopes, that is in fact its *terra typica*.

4.2. Cheklist of Bulgarian fresh- and brackishwater Gammaridae, Pontogammaridae and Behningiellidae

The species list of freshwater and brackishwater Gammaridae, Pontogammaridae and Behningiellidae in Bulgaria presented below has been compiled based on data from Andreev (2001), Carausu (1943), Carausu et al. (1955), Karaman & Pinkster (1977a,b, 1987), K"neva-Abadžieva (1965, 1966, 1972), Schäferna (1922) and Uzunova (1999). Bulgarian endemics are marked with asterix (*). The family concept has been accepted after Väinölä et al. (in press).

Family: Gammaridae Leach, 1813
Chaetogammarus ischnus (Stebbing, 1899)
Chaetogammarus placidus (G. O. Sars, 1896)
Chaetogammarus trichiatus (Martynov, 1932)
Gammarus arduus G. S. Karaman, 1975
Gammarus balcanicus Schäferna, 1922

Gammarus fossarum Koch, in Panzer, 1836
Gammarus frater G. S. Karaman & Pinkster, 1977*
Gammarus komareki Schäferna, 1922
Gammarus pulex cognominis G. S. Karaman & Pinkster, 1977*
Gammarus pulex pulex (Linnaeus, 1758)
Gammarus roeselii Gervais, 1835
Lanceogammarus andrussovi (G. O. Sars, 1896)
Shablogammarus chablensis (Carausu, 1943)*

Family: Pontogammaridae Bousfield, 1977
Dikerogammarus bispinosus Martynov, 1925
Dikerogammarus haemobaphes (Eichwald, 1841)
Dikerogammarus villosus (Sowinsky, 1894)
Niphargogammarus intermedius (Carausu, 1943)
Paraniphargoides abreviatus (G. O. Sars, 1896)
Paraniphargoides motasi (Carausu, 1943)
Pontogammarus borceae Carausu, 1943
Pontogammarus maeoticus (Sowinsky, 1894)
Pontogammarus robustoides (G. O. Sars, 1894)
Pontogammarus sarsi (G. O. Sars, 1898)
Stenogammarus similis (G. O. Sars, 1894)

Family: Behningiellidae Kamaltynov, 2001
Cardiophilus baeri G. O. Sars, 1896

Looking at this compiled checklist of Gammaridae and Pontogammaridae species recorded in Bulgaria, one may notice lack of widespread species *Gammarus balcanicus* and *G. roeselii* in our samples. The former occurs rather in western Bulgaria, the latter is found either on the Danube Plain or also in the western part of the country. Other species, gammarid *Chaetogammarus placidus*, *Lanceogammarus andrussovi* and *Shablogammarus chablensis* or pontogammarid *Dikerogammarus bispinosus*, *Paraniphargoides abreviatus*, *Pontogammarus borceae*, *Stenogammarus similis*, *Niphargogammarus intermedius*, and *Paraniphargoides motasi* are relic Ponto-Caspian endemics and may be considered rather rare or local in Bulgaria. In fact, *S. chablensis* was described and reported only from the Shabla Lake by Carausu (1943), however more recent survey by Uzunova (1999) has not proved its presence in that waterbody.

Altogether 13 species or subspecies of Gammaridae have been recorded in Bulgaria, among which 5 are Ponto-Caspian endemics, and remaining 7 are typically freshwater species belonging to genus *Gammarus*. Two species and one subspecies are Bulgarian endemics. Of Pontogammaridae, 11 species has been found in Bulgaria so far, all being originally Ponto-Caspian endemics, among which some has invaded Central and Western Europe using artificial canals joining basins of Black, Caspian, Baltic and North seas (Bij de Vaate et al. 2002). Another Ponto-Caspian endemic is *Cardiophilus baeri* of the family Behningiellidae, a very interesting commensal species living inside cockle (*Cerastoderma* spp.) shells (Carausu et al. 1955, Mirzajani & Vonk 2006).

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