Invited Review

ACTA ZOOLOGICA BULGARICA
Acta zool. bulg., 68 (3), 2016: 299-304

Current Knowledge of Tardigrades (Tardigrada: Heterotardigrada and Eutardigrada) from Bulgaria: Checklist and Distribution Data

Maria Yankova[1], Witold Morek[2], Dilian Georgiev[1]

[1] Department of Ecology and Environmental Conservation, University of Plovdiv, 24 Tzar Assen Street, 4000 Plovdiv, Bulgaria; E-mails: yankovva.m@gmail.com, diliangeorgiev@abv.bg
[2] Department of Entomology, Institute of Zoology, Jagiellonian University, Gronostajowa 9, 30-387 Kraków, Poland; E-mail: wmorek@op.pl

Abstract: An updated checklist of the tardigrade fauna in Bulgaria is presented. Data on 43 species are presented. The total number of limno-terrestrial species reported from the country is 37, including two species known only from Bulgaria, i.e. *Echiniscus glaber* Bartoš, 1937 and *Macrobiotus binieki* Kaczmarek, Gołdyn, Prokop & Michalczyk, 2011. So far, only five marine species have been recorded from the Bulgarian Black Sea coast. Further studies on the group are needed in order to expand our knowledge on tardigrades from Bulgaria.

Key words: Tardigrada, Bulgaria, checklist

Introduction

Tardigrades (or water bears) are microscopic aquatic invertebrates, usually up to 500 μm long (largest individuals seldom exceed 1000 μm). Some species, known as "limno-terrestrial", inhabit mosses, lichens or leaf litter; they have evolved a large variety of dormant stages adapted to diapause (encystment, cyclomorphosis and resting eggs) and cryptobiosis (anhydrobiosis, cryobiosis and anoxibiosis). Importantly, previous studies have shown that tardigrades, even in their active states, may be extremely tolerant to environmental stress (Horning *et al.* 1978; Guidetti *et al.* 2011; Møbjerg *et al.* 2011).

So far, only 43 water bear species have been recorded from Bulgaria. These constitute mainly records of limno-terrestrial taxa (37 species) reported by Bartoš (1937), Iharos (1961, 1973, 1982), McInnes (1994) and Kaczmarek *et al.* (2011). Additionally, one freshwater and five marine species were reported (Caspers 1951; Valkanov 1954, 1957; Rudescu 1969; 1972; Cvetkov & Gruncharova 1977; Hubenov 2015).

The present review article aims to provide comprehensive data about tardigrades recorded in Bulgaria, to present actual list of known species, with their correct names, taxonomic affiliation and localities, and to provide a basis for further studies on this group in the country.

Material and Methods

Detailed survey of literature was carried out to gather information concerning limno-terrestrial, marine and freshwater tardigrades reported from Bulgaria. The collection localities of found species and the available information about substrata were also included. Taxonomy follows Bertolani *et al.* (2014) and Degma *et al.* (2015). All names of authorities are kept as reported in the original papers.

Checklist of the taxa of the phylum Tardigrada from Bulgaria

Phylum Tardigrada Doyère, 1840
Class Heterotardigrada Marcus, 1927
Order Arthrotardigrada Marcus, 1927
Family Batillipedidae Ramazzotti, 1962
Genus *Batillipes* Richters, 1909

1. *Batillipes mirus* Richters, 1909

Batillipes mirus Richters, 1909: Valkanov (1954, 1957), Hubenov (2015): South Black Sea coast: from Camping Gradina to Sozopol, Kavatsite and Dyuni Resorts, from Stomoplo Marsh to Primorsko and Dyavolska Reka River.

Family Halechiniscidae Thulin, 1928
Genus *Halechiniscus* Richters, 1908

2. *Halechiniscus guiteli* Richters, 1908

Halechiniscus guiteli Richters, 1908: Valkanov (1954, 1957), Hubenov (2015): South Black Sea coast: from Camping Gradina to Sozopol, Kavatsite and Dyuni Resorts.

Genus *Stygarctus* Schulz, 1951

3. *Stygarctus bradypus* Schulz, 1951

Stygarctus bradypus Schulz, 195: Valkanov (1954, 1957), Hubenov (2015): Black Sea, without exact locality.

Order Echiniscoidea Richters, 1926
Family Echiniscoididae Kristensen & Hallas, 1980
Genus *Echiniscoides* Plate, 1888

4. *Echiniscoides sigismundi* (M. Schultze, 1865)

Echiniscoides sigismundi (M. Schultze, 1865): Valkanov (1954, 1957), Hubenov (2015): along almost the entire Bulgarian Black Sea coast, from Kaliakra Cape to Sinemorets village.

Genus *Cornechiniscus* Maucci & Ramazzotti, 1981

5. *Cornechiniscus cornutus* (Richters, 1907)

Pseudechiniscus cornutus Richt.: Iharos (1961): Rila Mts. (on the road to Musala Summit, 1800 – 2500 m a.s.l.), mosses from a rock near a stream; the Rhodopes (Asenovgrad Region), mosses from a shady and damp area.

Genus *Echiniscus* C.A.S. Schultze, 1840

6. *Echiniscus testudo* (Doyère, 1840)

Echiniscus testudo Doy.: Iharos (1961): Northern Black Sea coast (Sunny Beach Resort), mosses from sunlit stones; Rila Mts. (on the road to Musala Summit, 1800-2500 m a.s.l.), mosses from a rock near a stream; Stara Planina Mts. (town of Karlovo, 1400 m a.s.l.), mosses from a semi-shady place; Western Stara Planina Mts. (Lakatnik), mosses from sunlit rocks; *Echiniscus testudo*: Iharos (1973): Rila Mts. (Ivan Vazov Hut, 2300 m a.s.l.), mosses from a sunlit rock.

7. *Echiniscus trisetosus* Cuénot, 1932

Echiniscus trisetosus Cuénot: Iharos (1961): Northern Black Sea coast (city of Varna), mosses from a dry rock; the Rhodopes (Asenovgrad Region; Bachkovo Monastery), mosses from sunlit area and stones.

8. *Echiniscus blumi* Richters, 1903

Echiniscus canadensis J. Murr.: Iharos (1961): Rila Mts. (Borovets Resort, 1360 m a.s.l.; Musala Summit, 2930 m a.s.l.), mosses from a sunlit area; Vitosha Mts., mosses from dry creek bank stones. Remark: In a molecular study, Guil & Giribet (2009) found that *E. blumi* and *E. canadensis* are conspecific. The form known from Bulgaria exhibits the "*canadensis*" morphotype.

9. *Echiniscus merokensis merokensis* Richters, 1904

Echiniscus merokensis Richt.: Iharos (1961): Stara Planina Mts. (Karlovo, 1400 m a.s.l.), mosses from a sunlit rock.

10. *Echiniscus wendti* Richters, 1903

Echiniscus wendti Richt.: Iharos (1961): Northern Black Sea coast (Aladza Monastery), mosses from a sunlit rock; Stara Planina Mts., wet mosses from a creek bank and a tree trunk; Stara Planina Mts. (Karlovo, 800 m a.s.l.), mosses from a semi-shaded rock; Rhodopes (Asenovgrad Region; Bachkovo Monastery), mosses from moist soil and rocks and from a shady and damp area.

11. *Echiniscus granulatus* (Doyère, 1840)

Echiniscus granulatus Doy.: Iharos (1961): Rila Mts. (Rila Monastery), mosses from a sunlit area; the Rhodopes (Bachkovo Monastery), mosses from sunlit stones.

12. *Echiniscus glaber* Bartoš, 1937

Echiniscus glaber Bartoš, 1937: Bartoš (1937): Cape Kaliakra (North Black Sea coastal zone).

Genus *Pseudechiniscus* Thulin, 1911

13. *Pseudechiniscus suillus* (Ehrenberg, 1853)

Pseudechiniscus suillus Ehrbg.: Iharos (1961): Rila Mts. (Borovets Resort, 1360 m a.s.l., on the road to Musala Summit, 1800 – 2500 m a.s.l., Rila Monastery), mosses from a shady area, from moist soil and from a shaded rock; Stara Planina Mts., wet mosses from a creek bank and from a tree trunk; Stara Planina Mts. (Karlovo, 800 m a.s.l.), mosses from a semi-shaded rock; *Pseudechiniscus suillus* Iharos (1973): Rila Mts. (on the road to Seven Rila Lakes and Malyovitsa Summit, 1800 m a.s.l.; Ivan Vazov Hut, 2300 m a.s.l.), mosses from a sunlit rock and from a sunlit area.

Genus *Testechiniscus* Kristensen, 1987

14. *Testechiniscus spitsbergensis* (Scourfield, 1897)

Echiniscus spitzbergensis Scourf.: Iharos (1961): Stara Planina Mts. (city of Karlovo, 1400 m a.s.l.), mosses from a sunlit rock; the Rhodopes (Asenovgrad Region), mosses from a sunlit and dry area.

Echiniscus spinuloides J. Murr.: Iharos (1961): Stara Planina Mts. (town of Karlovo, 1400 m a.s.l.), mosses from a sunlit rock; the Rhodopes (Asenovgrad Region), mosses from a sunlit and dry area.

Class Eutardigrada Richters, 1926
Order Apochela Schuster, Nelson, Grigarick & Christenberry, 1980
Family Milnesiidae Ramazzotti, 1962
Genus *Milnesium* Doyère, 1840

15. *Milnesium* sp.

Milnesium tardigradum Doy.: Iharos (1961): Northern Black Sea coast (Varna Region; Golden Sands Resort), mosses from a dry rock and from sunlit stones; Rila Mts. (Borovets Resort, 1360 m a.s.l.; Rila Monastery), mosses from a sunlit area; Stara Planina Mts. (Karlovo, 1400 m a.s.l.), mosses from a semi-shady area; the Rhodopes (Bachkovo Monastery), mosses from sunlit stones. Remark: according to Michalczyk *et al.* (2012 a,b), in cases when the claw configuration, accessory points on the primary branches, number

of peribuccal lamellae, buccal tube shape and morphology of the cuticle surface are unknown, specimens reported as "*tardigradum*" should be referred as unidentified *Milnesium* (see also Morek *et al.* 2016).

Order Parachela Schuster, Nelson, Grigarick & Christenberry, 1980
Family Macrobiotidae Thulin, 1928
Genus *Macrobiotus* Schultze, 1834

16. *Macrobiotus* cf. *harmsworthi* Murray, 1907

Macrobiotus harmsworthi J. Murr.: Iharos (1961): Rila Mts. (on the road to Musala Summit, 1800-2500 m a.s.l.), mosses from dry creek bank stones; the Rhodopes (Bachkovo Monastery), moss from sunlit stones. Remark: *Macrobiotus* spp. of the *harmsworthi* group now belong to a new genus (Vecchi *et al.* 2016). Species of this group require determinations including egg morphology and should be carried out according to recent studies (Kaczmarek *et al.* 2011).

17. *Macrobiotus hufelandi hufelandi* Schultze, 1833

Macrobiotus hufelandi hufelandi Schultze, 1833: Kaczmarek *et al.* (2011): Vitosha Mts. with seven localities: A. half way between the Cherni Vrah Peak and the Sedloto Shelter, 2150 m a.s.l., 42°33'47" N, 23°16'08" E, mosses from a stone; B. near the entrance of the Sedloto Shelter, 2080 m a.s.l., 42°33'56.5" N, 23°15'29" E, mosses from a stone; C. near the Koniarnika ski lift, 1980 m a.s.l., 42°34'42" N, 23°14'52" E, mosses from a stone; D. near Koniarnika, forest upper limit, 1880 m a.s.l., 42°34'57" N, 23°14'46.5" E, mosses from a stone; E. half way between Koniarnika and the Kumata Shelter, 1770 m a.s.l., 42°35'27" N, 23°15'06"E, mosses from soil; F. near the Kumata Shelter, 1720 m a.s.l., 42°35'41"N, 23°15'01"E, mosses from a tree trunk; G. near the route from the Kumata Shelter to Zlatni Mostove, 1500 m a.s.l., 42°36'27" N, 23°14'31" E, mosses from a stone. Remark: for six of the mentioned seven localities, Kaczmarek *et al.* (2011) found only specimens and no eggs.

***Macrobiotus* cf. *hufelandi* Schultze, 1833**

Macrobiotus hufelandii S. Schultze: Iharos (1961): Northern Black Sea coast (Varna Region, Aladza Monastery, Golden Sands Resort), lichens from a tree trunk, mosses from a dry rock, from shaded stones and rocks, and from sunlit stones; Rila Mts. (Borovets Resort, 1360 m a.s.l.; on the road to Musala Summit, 1800-2500 m a.s.l.; Rila Monastery), mosses from a sunlit area, from a constantly damp area, from moist soil, from dry creek bank rocks and from a shaded rock; Vitosha Mts., mosses from a stream and creek bank, from dry creek bank stones and from a tree; Stara Planina Mts., wet mosses from a creek bank, from moist soil and wet stones, from a tree trunk, and lichens from a tree trunk; Stara Planina Mts. (Karlovo 800 m a.s.l., 1400 m a.s.l.), mosses from a semi-shaded rock and from sunlit rocks; the Rhodopes (Bachkovo Monastery), mosses from moist soil and rocks and from sunlit stones; Western Stara Planina Mts. (Lakatnik), mosses from sunlit rocks; *Macrobiotus hufelandii*: Iharos (1973): Rila Mts. (on the road to Seven Rila Lakes and Malyovitsa, 1800 m a.s.l.; 1900 m a.s.l.; Ivan Vazov Hut, 2300 m a.s.l.), mosses from sunlit rocks and from a sunlit area.

18. *Macrobiotus pallarii* Maucci, 1954

Macrobiotus pallarii Maucci 1954: Kaczmarek *et al.* (2011): Vitosha Mts., top of the Cherni Vrah Peak, 2290 m a.s.l., 42°33'50" N, 23°16'33" E, mosses from a stone.

19. *Macrobiotus binieki* Kaczmarek, Gołdyn, Prokop & Michalczyk, 2011

Macrobiotus binieki Kaczmarek *et al.* (2011): Vitosha Mts.: half way between the Cherni Vrah Peak and the Sedloto Shelter 2150 m a.s.l., 42°33'47" N, 23°16'08" E, mosses from a stone (type locality).

20. *Macrobiotus virgatus* Murray, 1910

Macrobiotus virgatus J. Murr.: Iharos (1961): the Rhodopes (Asenovgrad Region), mosses from a sunlit area.

21. *Macrobiotus ovidii* Bartoš, 1937

Macrobiotus ovidii Bartoš: Bartoš (1937): Cape Kaliakra (North Black Sea coastal zone).

Genus *Minibiotus* R.O. Schuster, 1980

22. *Minibiotus* cf. *intermedius* (Plate, 1888)

Macrobiotus intermedius Plate: Iharos (1961): Northern Black Sea coast (Aladza Monastery), mosses from shaded stones and rocks; Rila Mts. (on the road to Musala Summit, 1800-2500 m a.s.l., Rila Monastery), mosses from rocks near a stream and from a shaded rock; Vitosha Mts., mosses from dry creek bank stones; Stara Planina Mts., wet mosses from a creek bank; Stara Planina Mts. (Karlovo 800 m a.s.l., 1400 m a.s.l.), mosses from a semi-shaded rock and from a semi-shady place; the Rhodopes (Bachkovo Monastery), mosses from a shady and damp area; Western Stara Planina Mts. (Lakatnik), mosses from sunlit rocks; *Macrobiotus intermedius*: Iharos (1973): Rila Mts. (Seven Rila Lakes, 2300 m a.s.l.; on the road to Seven Rila Lakes and Malyovitsa Summit, 1800 m a.s.l.; 1900 m a.s.l.), mosses from sunlit rocks.

Remark: many early reports recorded this species without observing eggs. The species seems to be most often confused with very similar species (Claxton 1998).

Genus *Paramacrobiotus* Guidetti, Schill, Bertolani, Dandekar & Wolf, 2009

23. *Paramacrobiotus richtersi* Murray, 1911

Macrobiotus richtersi J. Murr.: Iharos (1961): Northern Black Sea coast (Varna Region), lichens from a tree trunk; Rila Mts. (Borovets Resort, 1360 m a.s.l.; on the road to Musala Summit, 1800-2500 m a.s.l.; Rila Monastery), mosses from a shady area, from a moist area and from a shaded rock; Vitosha Mts., mosses from dry creek bank stones; Stara Planina Mts., mosses from a dead tree trunk; Stara Planina Mts. (Karlovo 800 m a.s.l.), mosses from a semi-shaded rock; the Rhodopes (Bachkovo Monastery), mosses from a shady and damp area; Western Stara Planina Mts. (Lakatnik) mosses from sunlit rocks; *Macrobiotus richtersi*: Iharos (1973): Rila Mts., 2000 m a.s.l., mosses from the ground; *Macrobiotus richtersi* J. Murray, 1911: Iharos (1982): Plovdiv and Sofia cities, soil samples.

Genus *Richtersius* Pilato & Binda, 1989

24. *Richtersius coronifer* (Richters, 1903)

Macrobiotus coronifer Richt.: Iharos (1961): Rila Mts.

(on the road to Musala Summit, 1800-2500 m a.s.l.), mosses from moist soil; Stara Planina Mts., mosses from a dead tree trunk; Stara Planina Mts. (Karlovo 800 m a.s.l.), mosses from a semi-shaded rock.

Family Calohypsibiidae Pilato, 1969
Genus *Calohypsibius* Thulin, 1928

25. *Calohypsibius verrucosus* (Richters, 1900)

Hypsibius verrucosus Richt.: Iharos (1961): Stara Planina Mts., mosses from a dead tree trunk.

Family Hypsibiidae Pilato, 1969
Genus *Adropion* Pilato, 1987

26. *Adropion belgicae* (Richters, 1911)

Hypsibius belgicae Richt.: Iharos (1961): Rhodopes (Bachkovo Monastery), mosses from a shady and damp area.

27. *Adropion scoticum scoticum* (Murray, 1905)

Hypsibius scoticus J. Murr.: Iharos (1961): Rila Mts. (Borovets Resort, 1360 m a.s.l.; on the road to Musala Summit, 1800-2500 m a.s.l.; Rila Monastery), mosses from a sunlit area, from a rock near a stream and from a shaded rock; Vitosha Mts., mosses from dry creek bank stones; Stara Planina Mts. (Karlovo 800 m a.s.l.), mosses from a semi-shaded rock.

Genus *Astatumen* Pilato, 1997

28. *Astatumen trinacriae* (Arcidiacono, 1962)

Itaquascon trinacriae: Iharos (1973): Rila Mts., 2000 m a.s.l., mosses from the ground.

Genus *Diphascon* Plate, 1888

29. *Diphascon* cf. *pingue* (Marcus, 1936)

Hypsibius pinguis Marcus: Iharos (1961): Rila Mts. (on the road to Musala Summit, 1800-2500 m a.s.l.), mosses from moist soil; *Hypsibius pinguis*: Iharos (1973): Rila Mts., 1900-2000 m a.s.l., mosses from a sunlit rock and from the ground. Remark: the *pingue* group is a complex of very similar species and determinations should be based on recent literature (Pilato & Binda, 1998, 1999).

30. *Diphascon stappersi* Richters, 1911

Hypsibius stappersi Richt.: Iharos (1961): Rila Mts. (Borovets Resort, 1360 m a.s.l.), mosses from a shady area; the Rhodopes (Bachkovo Monastery), mosses from a shaded tree trunk.

Genus *Hypsibius* Ehrenberg, 1848

31. *Hypsibius convergens* (Urbanowicz, 1925)

Hypsibius convergens Urb.: Iharos (1961): Rila Mts. (on the road to Musala Summit, 1800-2500 m a.s.l.; Rila Monastery), mosses from rocks near a stream and from a shaded rock; Vitosha Mts., mosses from a stream and creek banks, from dry creek bank stones and from a tree, Stara Planina Mts., mosses from a tree trunk; Stara planina Mts. (Karlovo, 1400 m a.s.l.) mosses from sunlit rocks, Western Stara Planina Mts. (Lakatnik), mosses from sunlit rocks; *Hypsibius convergens*: Iharos (1973): Rila Mts. (Seven Rila Lakes, 2300 m a.s.l.), mosses from dry rocks; *Hypsibius convergens* (Urbanowicz, 1925): Kaczmarek *et al.* (2011): Vitosha Mts.: near the Kumata Shelter, 1720 m a.s.l., 42°35'41" N, 23°15'01" E, mosses from a tree/ trunk.

32. *Hypsibius dujardini* (Doyère, 1840)

Hypsibius dujardini Doy.: Iharos (1961): Rila Mts. (on the road to Musala Summit, 1800-2500 m a.s.l.), mosses from dry creek bank rocks; Vitosha Mts., mosses from a stream and creek banks; the Rhodopes (Asenovgrad Region), wet mosses near a waterfall.

33. *Hypsibius microps* Thulin, 1928

Hypsibius microps Thul.: Iharos (1961): Rila Mts. (on the road to Musala Summit, 1800-2500 m a.s.l.), mosses from moist soil; Stara Planina Mts. wet mosses from a stream bank; Stara Planina Mts. (Karlovo, 1400 m a.s.l.), mosses from sunlit rocks; *Hypsibius microps* Thulin, 1928: Iharos (1982): Plovdiv and Sofia cities, soil samples.

34. *Hypsibius pallidus* Thulin, 1911

Hypsibius pallidus Thul.: Iharos (1961): Northern Black Sea Coast (Varna Region), mosses from oak trees along a creek; Stara Planina Mts., mosses from a dead tree trunk; the Rhodopes (Asenovgrad Region; Bachkovo Monastery), mosses from moist soil and wet rocks, and from a shaded tree trunk.

***Hypsibius* sp. of Cvetkov & Gruncharova (1977)**

Hypsibius sp.: Cvetkov & Gruncharova (1977): Ropotamo River. Remark: *H. microps* and *H. pallidus* are very similar to each other and in the past their identification was based mostly on external claw morphology (identifications were very often doubtful and subjective). Apart from the claw morphology, *H. pallidus* differs from *H. microps* by the larger body size, wider buccal tube, longer placoids and placoid row, and a longer pharynx. These two species differ also from other species attributed to the *dujardini* group by having granular rather than rod-shaped macroplacoids and by the absence of a constriction in the first macroplacoid (Kaczmarek & Michalczyk 2009).

Genus *Halobiotus* Kristensen, 1982

35. *Halobiotus stenostomus* (Richters, 1908)

Halobiotus stenostomus (Richters, 1908): Valkanov (1954, 1957), Hubenov (2015): Black Sea without exact locality.

Genus *Isohypsibius* Thulin, 1928

36. *Isohypsibius schaudinni* (Richters, 1909)

Hypsibius schaudinni Richt.: Iharos (1961): Vitosha Mts., mosses from a stream and creek banks; Stara Planina Mts., wet mosses from a creek bank; Stara Planina (Karlovo, 1400 m a.s.l.), mosses from sunlit rocks; the Rhodopes (Asenovgrad Region), wet mosses near a waterfall.

37. *Isohypsibius nodosus* (Murray, 1907)

Hypsibius nodosus J. Murr.: Iharos (1961): Northern Black Sea coast (Varna Region), lichens from a tree trunk; Rila Mts. (Borovets Resort, 1360 m a.s.l.; on the road to Musala Summit, 1800-2500 m a.s.l.; Rila Monastery), mosses from a shady area, from moist soil and from a shaded rock; Stara Planina Mts., wet mosses from a creek bank; Stara Planina Mts. (Karlovo, 800 m a.s.l.), mosses from a semi-shaded rock.

38. *Isohypsibius mihelcici* (Iharos, 1964)

Hypsibius mihelcici: Iharos (1973): Rila Mts.(Seven Rila Lakes, 2300 m a.s.l.), mosses from dry rocks.

39. *Isohypsibius prosostomus* Thulin, 1928

Isohypsibius prosostomus Thulin, 1928: Kaczmarek *et al.* (2011): Sofia City, Zhitnitsa Street, 600 m a.s.l., 42°40'56" N, 23°16'24" E, mosses from pavement.

40. *Isohypsibius sattleri* (Richters, 1902)

Hypsibius bakonyiensis: Iharos (1973): Rila Mts. (on the road to Seven Rila Lakes and Malyovitsa, 1800 m a.s.l.), mosses from sunlit rocks.

Genus *Pilatobius* Bertolani, Guidetti, Marchioro, Altiero, Rebecchi & Cesari, 2014

41. *Pilatobius oculatus oculatus* (Murray, 1906)

Hypsibius oculatus J. Murr.: Iharos (1961): Rila Mts. (on the road to Musala Summit, 1800-2500 m a.s.l.), mosses from a shady area.

Family Ramazzottiidae Sands, McInnes, Marley, Goodall-Copestake, Convey & Linse, 2008

Genus *Ramazzottius* Binda & Pilato, 1986

42. *Ramazzottius oberhaeuseri* (Doyère, 1840)

Ramazzottius oberhaeuseri (Doyère, 1840): Kaczmarek *et al.* (2011): Vitosha Mts.:. half way between Koniarnika and Kumata Shelter, 1770 m a.s.l., 42°35'27" N, 23°15'06" E, mosses from soil.

***Ramazzottius* cf. *oberhaeuseri* (Doyère, 1840)**

Hypsibius oberhaeuseri Doy.: Iharos (1961): Northern Black Sea coast (Varna Region; Aladza Monastery; Golden Sands Resort), mosses from oak trees along a creek, from a dry rock, from a sunlit rock and from sunlit stones; Rila Mts. (Musala Summit, 2930 m a.s.l.; Rila Monastery), mosses from a sunlit area; Stara Planina Mts., lichens from a tree trunk; the Rhodopes (Asenovgrad Region), mosses from a dry area; Western Stara Planina Mts. (Lakatnik), mosses from sunlit rock; *Hypsibius oberhaeuseri*: Iharos (1973): Rila Mts. (Ivan Vazov Hut, 2300 m a.s.l.), mosses from a sunlit area and from a sunlit rock. Remark: old records of this species have to be re-examined. Specimens of the genus *Ramazzottius* should be determined based on eggs and adults, according to the recent study of Biserov (1998).

Discussion

The information about the limno-terrestrial tardigrades of Bulgaria is scarce. There are only 43 species recorded so far, which, in comparison with the over 120 valid taxa reported in the neighbouring Romania (Ciobanu *et al.* 2014), suggests that the Bulgarian number is highly underestimated. Many widely distributed and/or cosmopolitan species are still not recorded in Bulgaria. Also, two species known only from Bulgaria till now, *Echiniscus glaber* and *M. binieki,* and one species *Macrobiotus ovidii* reported also from Albania (Vargha 2011), show that new species with local distribution also could be found in the country.

Compared to limno-terrestrial species, the marine tardigrades along the Bulgarian Black Sea coast are even more poorly studied. Species of the genera *Styraconyx*, *Megastygarctides*, *Tanarctus*, *Coronarctus*, *Dipodarctus*, *Florarctus*, *Wingstrandarctus*, *Angursa* were reported from the Romanian, Ukrainian and Turkish sea waters (Băcescu *et al.* 1971; Kharkevych 2012, 2013), and these species could be found also in the Bulgarian marine environments after detailed studies.

Freshwater tardigrades of Bulgaria have never been studied systematically. There is only one record from Ropotamo River of "*Hypsibius* sp." by Cvetkov & Gruncharova (1977). Many aquatic species (i.e., from the genus *Dactylobiotus*) could be found in the inland water basins of the country.

In conclusion, concerning the world of tardigrade knowledge, the tardigrades from Bulgaria are understudied and there is an urgent need of investigation and further faunistic research in this region.

Acknowledgements: We are grateful to Łukasz Michalczyk for his kind help and useful comments on the manuscript. We also would like to thank Roberto Guidetti (University of Modena and Reggio Emilia) for his valuable review which improved the manuscript.

References

Băcescu M., Müller G. & Gomoiu M. T. 1971. Cercetări de ecologie bentală în marea Neagră – analiza cantitativa, calitativă şi comparată a faunei bentale pontice. – *Ecologie Marină*, **4**: 1-357.

Bartoš E. 1937. Die Tardigraden von Cap Caliacra (Rumanien), – *Zoologischer Anzeiger*, **118** (11/12): 301-304.

Biserov V. 1998. Tardigrades of the Caucasus with a taxonomic analysis of the genus *Ramazzottius* (Parachela: Hypsibiidae). – *Zoologischer Anzeiger*, **236**: 139-159.

Caspers H. 1951. Quantitative Untersuchungen über die Bodentierwelt des Schwarzen Meeres im bulgarischen Küstenbereich. – *Archiv für Hydrobiologie*, **45** (1-2): 1-192.

Ciobanu D., Moglan I., Zawierucha K. & Kaczmarek Ł. 2014. New records of terrestrial tardigrades (Tardigrada) from Ceahlău National Park with zoogeographical and taxonomical remarks on Romanian water bears. – *North-Western Journal of Zoology*, **10** (Supplement 1): 5-21.

Claxton S. 1998. A revision of the genus *Minibiotus* (Tardigrada: Macrobiotidae) with descriptions of eleven new species from Australia. – *Records of the Australian Museum* **50** (2): 125-160.

Cvetkov L. & Gruncharova T. 1977. Fouling in the Liman of the Ropotamo river. III. Composition and quantitative development of the zoocoenoses. – *Hydrobiology*, **8**: 26-43.

Degma P., Bertolani R. & Guidetti R. 2015. Actual checklist of Tardigrada species. www.tardigrada.modena.unimo.it/miscellanea/Actual checklist of Tardigrada.pdf

Guidetti R. & Bertolani R. 2005. Tardigrade taxonomy: an updated check list of the taxa and a list of characters for their identification. – *Zootaxa*, **845:** 1-46

Guidetti, R., Altiero T. & Rebecchi L. 2011. On dormancy strategies

in tardigrades – *Journal of Insect Physiology*, **57**: 567-576.

Guil N. & Giribet G. 2009. Fine scale population structure in the *Echiniscus blumi-canadensis* series (Heterotardigrada, Tardigrada) in an Iberian mountain range – When morphology fails to explain genetic structure. – *Molecular Phylogenetics and Evolution*, **51**: 606-613.

Horning D., Schuster R. & Grigarick A. 1978. Tardigrada of New Zealand. – *New Zealand Journal of Zoology*, **5**: 185-280.

Hubenov Z. 2015. Species composition of the free living multicellular invertebrate animals (Metazoa: Invertebrata) from the Bulgarian sector of the Black Sea and the coastal brackish basins. – *Historia Naturalis Bulgarica*, **21**: 49-168.

Iharos G. 1961. Grundlage der tardigradenfauna Bulgariens. – *Acta Zoologica Academiae Scientiarum Hungaricae*, 7: 111-118.

Iharos G. 1973. Angaben zur geographischen Verbreitung der Tardigraden. – *Opuscula Zoologica*, Budapest, **12**: 73-86.

Iharos G. 1982. Tardigradologische Notizen. I. – *Miscellanea Zoologica Hungarica*, **1**: 85-90.

Kaczmarek Ł. & Michalczyk Ł. 2009. Redescription of *Hypsibius microps* Thulin, 1928 and *H. pallidus* Thulin, 1911 (Eutardigrada: Hypsibiidae) based on the type material from the Thulin collection. *Zootaxa* **2275**: 60-68.

Kaczmarek Ł., Gołdyn B., Prokop Z. & Michalczyk Ł. 2011. New records of Tardigrada from Bulgaria with the description of *Macrobiotus binieki* sp. nov. (Eutardigrada: Macrobiotidae) and a key to the species of the harmsworthi group. – *Zootaxa*, **2781**: 29-39.

Kharkevych K. 2012. The first investigation of fauna and ecology of tardigrades (Tardigrada) of Karkinitsky Bay (Crimea, Black Sea). – *Optimization and Protection of Ecosystems. Simferopol: TNU*, 7: 45-54. (In Ukrainian).

Kharkevych K. 2013. Species composition and Ecology of the Tardigrades of the Black Sea. – *Natura Montenegrina*, **12** (2): 357-368.

McInnes S. 1994. Zoogeographic distribution of terrestrial/freshwater tardigrades from current literature. – *Journal of Natural History*, **28**: 257-352.

Michalczyk Ł., Wełnicz W., Frohme M. & Kaczmarek Ł. 2012a. Redescriptions of three *Milnesium* Doyère, 1840 taxa (Tardigrada: Eutardigrada: Milnesiidae), including the nominal species for the genus. *Zootaxa*, **3154**: 1-20.

Michalczyk Ł., Wełnicz W., Frohme M. & Kaczmarek Ł. 2012b. Corrigenda of Zootaxa, **3154**, 1-20: Redescriptions of three *Milnesium* Doyère, 1840 taxa (Tardigrada: Eutardigrada: Milnesiidae), including the nominal species for the genus. *Zootaxa*, **3393**: 66-68.

Morek W., Gąsiorek P., Stec D., Blagden B. & Michalczyk Ł. 2016. Experimental taxonomy exposes developmental variability and elucidates the taxonomic value of claw configuration in *Milnesium* Doyère, 1840 (Tardigrada: Eutardigrada: Apochela). *Contributions to Zoology* **85** (2):173-200.

Møbjerg N., Halberg K., Jørgensen A., Persson D., M. Bjørn M., H. Ramløv H. &. Kristensen R. 2011. Survival in extreme environments – on the current knowledge of adaptations in tardigrades – *Acta Physiologica* **202**: 409-420.

Pilato G. & Binda M. 1998. Two new species of *Diphascon* (Eutardigrada) from New South Wales (Australia). *New Zealand Journal of Zoology*, **25**: 171-174

Pilato G. & Binda M. 1999. Three new species of *Diphascon* of the pingue group (Eutardigrada, Hypsibiidae) from Antarctica. – *Polar Biology*, **21**: 335-342.

Rudescu L. 1969. Die Tardigraden des Schwarzen Meeres. – *Hidrobiologia*, **10**: 3-12.

Rudescu L. 1972. Tardigrada. – In: Mordukhay-Boltovskogo F. (Ed.): The Key for the Fauna of the Black and Azov Seas. 3. Kiev, Naukova dumka, 51-59. (In Russian).

Valkanov A. 1954. Die Tardigraden des Schwarzenmeeres. – *Arbeiten aus der Biologischen Meeresstation in Varna*, **18**: 59-61. (In Bulgarian with German summary).

Valkanov A. 1957. Katalog unserer Schwarzmeerfauna. – *Arbeiten aus der Biologischen Meeresstation in Varna*, **19**: 1-62. (In Bulgarian with German summary).

Vargha B. 2011. Data to the Tardigrada fauna of Albania. – *Folia Historico Naturalia Musei Matraensis*, **35**: 9-14.

Received: 28.01.2016
Accepted: 17.08.2016