

New and additional records of earthworms (Oligochaeta: Lumbricidae) from Bulgaria: First finding of endemic species *Cernosvitovia munteniana* on the Balkan Peninsula

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Abstract. Identifying the earthworm material recently collected from different parts of Bulgaria (Rila Mountain, Danube plain, Thracian Lowland and Sub-Balkan valleys) resulted in twelve records of lumbricids, including two earthworm species discovered for the first time in the country. The occurrence of *Cernosvitovia munteniana* Zicsi & Pop, 1991 in Bulgaria and also on the territory of the Balkan Peninsula is firstly recorded. The peregrine compost-worm, *Eisenia andrei* Bouché, 1972, proved to be another new finding for the country. By including these new records, the number of earthworm species known from Bulgaria is raised to 48.

Key words: earthworms, Oligochaeta, Lumbricidae, Bulgaria.

Introduction

Bulgaria is situated in southeastern Europe on the Balkan Peninsula. The relief is extremely varied in its comparatively small territory. The climate in northern Bulgaria is moderately continental, while in southern Bulgaria it is intermediate-continental, tending to Mediterranean climate. The climate is alpine in regions with an altitude of ≥ 2000 meters a.s.l.

The first data of earthworms in Bulgaria were published by Rosa (1897). His work was followed by Černosvitov (1934, 1937). Subsequently, some other scientists presented data about earthworms from Bulgaria (Plisko 1963, Mihailova 1964, 1965, 1966, 1968, Šapkarev 1986, Zicsi & Csuzdi 1986, Kvavadze & Milojkova 1993, Delchev et al. 1998). Recently, Stojanović et al. (2012), Szederjesi (2013) and Valchovski (2012, 2014) published new records on the earthworm fauna in this area reporting altogether 46 earthworm species, all belonging to the family Lumbricidae. In 2014-2015, the first author carried out additional sampling in different parts of Bulgaria (Rila Mountain, Danube plain, Thracian Lowland and Sub-Balkan valleys). The aim of the present paper is to report on these collections, including two species new for the earthworm fauna of Bulgaria, and also to present new information on the distribution and diversity of earthworms of Bulgaria.

Material and Methods

The field investigations were carried out during the 2014-2015 period. Earthworms were collected by the diluted formaldehyde method (Raw 1959), complemented with digging and hand-sorting. The combination of both methods provides a more complete sampling of species, because the formalin method alone is not efficient in collecting species living in horizontal burrows. The specimens were killed in 70% ethanol, fixed in 4% formalin solution and in 96% ethanol, then transferred into 75% ethanol.

New findings of *Cernosvitovia munteniana* and *Eisenia andrei* were deposited in the National Museum of Natural History, Sofia, Bulgaria, Invertebrates Department (NMNHS) and in the Hungarian Natural History Museum, Budapest (HNHM). The other records were deposited in Institute of Soil Science, Agrotechnologies and Plant Protection "N. Poushkarov", Sofia, Bulgaria in private earthworm collection of Hristo Valchovski (PCHV). Specimens were described and dissected under low power microscope. Identification of species was done in accordance with Mršić (1991).

Results

Class Oligochaeta

Family Lumbricidae Rafinesque-Schmaltz, 1815

Genus *Allolobophoridella* Mršić, 1990

Allolobophoridella eiseni (Levinsen, 1884)

Lumbricus eiseni Levinsen, 1884: 241.

Eisenia parva: Plisko 1963: 427.

Bimastus beddardi: Mihailova 1966: 193.

Allolobophoridella eiseni: Mršić 1991: 255.

Material examined: PCHV/46 3 ex. Rila Mt., Kirilova meadow, under bark of fallen logs, 1488 m, N42° 09' 16, E23° 23' 58, 06 May 2014, leg. H. Valchovski.

Genus *Aporrectodea* Örley, 1885

Aporrectodea caliginosa caliginosa (Savigny, 1826)

Enterion caliginosum Savigny, 1826: 180.

Allolobophora nocturna: Mihailova 1966: 189.

Allolobophora caliginosa f. *typica*: Plisko 1963: 429; Mihailova 1966: 187.

Aporrectodea (Aporrectodea) caliginosa caliginosa: Mršić 1991: 321.

Aporrectodea caliginosa caliginosa: Mršić 1991: 321; Stojanović et al. 2012: 9.

Aporrectodea caliginosa: Stojanović et al. 2013: 639.

Material examined: PCHV/47 3 ex., Kneza town, uncultivated land, 111 m, N43° 29' 27, E24° 04' 51, 01 October 2014, leg. H. Valchovski.

Aporrectodea jassyensis (Michaelsen, 1891)

Allolobophora jassyensis Michaelsen, 1891: 15; Plisko 1963: 430; Mihailova 1966: 188; Šapkarev 1986: 82.

Aporrectodea jassyensis jassyensis: Valchovski 2012: 89.

Aporrectodea jassyensis: Stojanović et al. 2012: 9; Szederjesi 2013: 77.

Material examined: PCHV/49 2 ex., Mihilci village, in coniferous forest roadside W of the village, 377 m, N42° 31' 17 E24° 47' 13, 12 April 2015, leg. H. Valchovski. PCHV/50 2 ex., beside Striama River near Bania town, 286 m, N42° 32' 26 E24° 49' 17, 12 April 2015, leg. H. Valchovski. 1 ex., PCHV/51 Bojurishte town, poplar forest, 557 m, N42° 44' 53 E23° 13' 04, 20 April 2015, leg. H. Valchovski.

Aporrectodea rosea (Savigny, 1826)

Enterion roseum Savigny, 1826: 182.

Allolobophora rosea: Plisko 1963: 428.

Allolobophora prashadi: Mihailova 1964: 167.

Eisenia rosea var. *typica*: Mihailova 1966: 185.

Eisenia rosea var. *macedonica* (Rosa): Mihailova 1966: 186.

Aporrectodea rosea: Stojanović et al. 2012: 9; Valchovski 2014: 3.

Material examined: PCHV/50 1 ex. beside Striama River near Bania town, 286 m, N42° 32' 26 E24° 49' 17, 12 April 2015, leg. H. Valchovski.

Genus *Cernosvitovia* Omodeo 1956

Cernosvitovia munteniana Zicsi & Pop, 1991

Cernosvitovia munteniana Zicsi & Pop, 1991: 125; Mršić 1992: 22.

Material examined: HNHM/17046 1 ex.,

PCHV/47 1 ex., Kneza town, uncultivated land, 111 m, N43° 29' 27, E24° 04' 51, 01 October 2014, leg. H. Valchovski.

External characteristics. Length 89–112 mm, diameter 5–6 mm; number of segments 236–290. Setae closely paired. Prostomium epilobous ½ closed. First dorsal pore in intersegmental furrow 8/9. Colour greyish. Clitellum on ½24, 25–37. Tubercula on 25–36. Setal arrangement after the clitellum: *aa:ab:bc:cd:dd* = 22:1.5:9.5:1:34.5. Male pore on segment 30. Genital papillae around setae *ab, cd* on 10–15.

Internal characteristics. Dissepiments 5/6–8/9 strongly thickened. Two pairs of testes in 10, 11, covered with perioesophageal testis sac. Four pairs of vesicles in 9–12, the first two pairs much smaller than the last two pairs. Spermathecae six pairs in 9/10–14/15 open near setal line *d*, most of them duplicated or triplicated. Calciferous diverticula in segment 10. Last pair of hearts in 11 with a pair of small extraoesophageals in segment 12. Typhosolis large, trilobed. Nephridial bladders J-shaped with forward oriented ental part. Longitudinal musculature of fasciculated type.

Remarks. Our specimens differ from the original description in case of the number of spermathecae (6 vs. 8 pairs). Examination of some paratype specimens in the Hungarian Natural History Museum revealed that the number of spermathecae of *C. munteniana* can vary between 6 and 8 pairs.

This species is new for the fauna of Bulgaria.

Genus *Dendrodrilus* Omodeo, 1956

Dendrodrilus rubidus rubidus (Savigny, 1826)

Enterion rubidum Savigny, 1826: 182.

Dendrodrilus rubida: Plisko 1963: 434.

Dendrodrilus rubidus rubidus: Šapkarev 1986: 78; Valchovski 2012: 93.

Material examined: PCHV/48 1 ex., Hisarya town, under the bark of fallen logs, 351 m, N42° 29' 51 24° E42' 13, 11 April 2015, leg. H. Valchovski.

Genus *Eisenia* Malm, 1877

Eisenia andrei Bouché, 1972

Eisenia fetida andrei Bouché, 1972: 381 (nom. nov. pro.)

Eisenia foetida var. *unicolor*: André 1963: 24.

Eisenia andrei: Hackenberger Kutuzović & Hackenberger Kutuzović 2013: 12.

Material examined: PCHV/45 4 ex., HadjiDimitrovo village, near vermicompost farm, 450 m, N42° 40' 04 E25° 21' 19, 06 April 2014, leg. H. Valchovski.

External characteristics. Length 42–53 mm, di-

ameter 2.5–3.5 mm; number of segments 78–92. Prostomium epilobous ½ open. First dorsal pore in intersegmental furrow 4/5. Colour purple-reddish with no stripes in the intersegmental grooves. Setae closely paired. Setal arrangement after the clitellum: *aa:ab:bc:cd:dd* = 5:1:5:1:16.5. Clitellum saddle-shaped on 25–32. Tubercula on 28, 29–30, 31. Male pore on segment 15. Spermathecal pores in 9/10 10/11 near the mid-dorsal line.

Internal characteristics. Four pairs of seminal vesicles in 9–12. Spermathecae two pairs in 9, 10 open near the mid-dorsal line. Calciferous glands in segment 10–12. Hearts in 7–11. Typhosolis large, lamelliform. Nephridial bladders simple. The crop occupies 15–16 and the gizzard in segment 17–18. Longitudinal musculature of pinnate type.

Remarks. Differentiation of *Eisenia fetida* and *E. andrei* is very difficult due to the high morphological similarity (Römbke et al. 2016). According to the results of recent molecular studies (Pérez-Losada et al. 2005, Domínguez et al. 2005, 2015), here we treat *Eisenia andrei* as a separate species. Therefore, this species is new for the fauna of Bulgaria.

Eisenia fetida (Savigny, 1826)

Enterion fetidum Savigny, 1826: 182.

Eisenia foetida: Mihailova 1966: 184; Šapkarev 1986: 78.

Eisenia fetida: Stojanović et al. 2012: 9; Valchovski 2014: 4.

Material examined: PCHV/48 2 ex., Hisarya town, under the bark of fallen logs, 351 m, N42° 29' 51" 24° E42' 13", 11 April 20015, leg. H. Valchovski.

Eisenia lucens (Waga, 1857)

Lumbricus lucens Waga, 1857: 161.

Eisenia submontana (Vejdovský): Černosvitov 1934: 71; Mihailova 1966: 184.

Eisenia lucens: Plisko 1963: 428; Šapkarev 1986: 78; Szederjesi 2013: 80; Valchovski 2014: 4.

Material examined: PCHV/50 1 ex., beside Striama River near Bania town, under the bark of fallen logs, 286 m, N42° 32' 26" E24° 49' 17", 12 April 2015, leg. H. Valchovski.

Genus Eiseniella Michaelsen, 1900

Eiseniella tetraedra (Savigny, 1826)

Enterion tetraedrum Savigny, 1826: 184.

Eiseniella tetraedra f. *typica*: Mihailova 1966: 182.

Eiseniella tetraedra tetraedra: Šapkarev 1986: 84; Zicsi & Csuzdi 1986: 120; Stojanović et al. 2012: 9; Valchovski 2014: 5.

Eiseniella tetraedra: Plisko 1963: 433; Szederjesi

2013: 80.

Material examined: PCHV/50 1 ex., on river-bank beside Striama River near Bania town, 286 m, N42° 32' 26" E24° 49' 17", 12 April 2015, leg. H. Valchovski.

Genus Lumbricus Linnaeus, 1758

Lumbricus terrestris Linnaeus, 1758

Lumbricus terrestris (part.) Linnaeus, 1758: 647.

Lumbricus terrestris: Černosvitov 1937: 90; Plisko 1963: 438; Zicsi & Csuzdi 1986: 120; Stojanović et al. 2012: 9; Szederjesi 2013: 80; Valchovski 2014: 5.

Material examined: PCHV/51 1 ex., Bojurishte town, poplar forest, 557 m, N42° 44' 53" E23° 13' 04", 20 April 2015, leg. H. Valchovski.

Genus Octolasion Örley, 1885

Octolasion lacteum (Örley, 1881)

Lumbricus terrestris var. *lacteus* Örley, 1881: 584.

Octolasion lacteum: Černosvitov 1934: 76; 1937: 89; Plisko 1963: 432; Mihailova 1966: 193; Zicsi & Csuzdi 1986: 120.

Octolasion tyrtaeum: Mršić 1991: 347.

Octolasion lacteum: Šapkarev 1986: 84; Stojanović et al. 2012: 9; Szederjesi 2013: 81; Valchovski 2014: 6.

Material examined: PCHV/51 1 ex., Bojurishte town, poplar forest, 557 m, N42° 44' 53" E23° 13' 04", 20 April 2015, leg. H. Valchovski.

Discussion

The present survey recorded altogether 12 earthworm species, from which two species proved to be new for the fauna of Bulgaria.

Cernosvitovia munteniana was described by Zicsi & Pop (1991) from the Romanian part of the Danube plain. This endemic species was discovered for the first time on the Balkan Peninsula, on the country of Bulgaria, and this new record represents the southernmost occurrence of this species (Fig. 1.). The new record also suggests that *Cernosvitovia munteniana* possess a wider range than it was previously thought. It is possible to find this species even in the Serbian part of the Lower Danube plain (Kladovo or Negotin counties).

The genus *Cernosvitovia* was created as a subgenus of *Allolobophora* by Omodeo (1956), with type species *Allolobophora rebelii* Rosa, 1897, however the subgenus lacked concrete, well-defined characteristics. Examining the type specimens of *C. rebelii*, Zicsi (1981) noticed the backward shifted position of the male pore and based on this character he raised the subgenus to genus level. How-

ever, recent molecular studies revealed that the backward-shifted male pore is probably a homoplasy (Pop et al. 2008, Cech et al. 2014) and the investigated species of *Cernosvitovia* are scattered among the species of the genus *Serbia* described by Mršić & Šapkarev (1988) (Pop et al. 2006, Cech et al. 2014). The two genera share several common characteristics such as larger body, the shape of the nephridial bladders (U- or J-shaped bladders with forward-oriented ental part) and the high number of segments.



Figure 1. Distribution of *Cernosvitovia munteniana*. Black dot = type locality, black square = new record.

The *Cernosvitovia* species are distributed on the Balkan Peninsula, in the Southern Carpathians and Asia Minor (Csuzdi & Zicsi 2003, Csuzdi et al. 2011). Among the seven Balkanic species, four are present in Bulgaria: *C. rebeli* (Rosa 1897), *C. dobrogeana* (Pop 1938), *C. biserialis* (Černosvitov 1937) and now also *C. munteniana* Zicsi & Pop, 1991. Probably *C. rebeli* has the widest range, occurring in Bulgaria, Serbia, Greece and Albania (Mršić 1991). *C. dobrogeana* was described from Constanta, Romania (Pop 1938) and later it was also found in the southern part of Dobrudja (Mihailova 1965). *C. biserialis* is from Primorsko (Kjuprija) (Černosvitov 1937) and was later found in southern (Mihailova 1966) and western Bulgaria (Šapkarev 1986), as well as in Serbia (Stojanović et al. 2008).

The peregrine compost-worm, *Eisenia andrei*, is another new finding for the country of Bulgaria. This ubiquitous lumbricid species is common in vermicomposting farms, so the present new record is not surprising.

With the new records of *Cernosvitovia munteniana* and *Eisenia andrei* the number of earthworm species present in Bulgaria is raised to 48. According to the biogeographical evaluation of

Valchovski (2012) and Stojanović et al. (2013), the lumbricid fauna of Bulgaria is dominated by peregrine species (34%). Endemic earthworms comprise 27% and followed by the Trans-Aegean species with 12% of the Bulgarian earthworm fauna.

Our knowledge of the earthworm fauna of Bulgaria, however, is still insufficient, and the lumbricid inventory of Bulgaria is far from complete. More detailed investigations are needed because large areas in the country have not been explored yet for earthworms.

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