

## Diversity of earthworms (Clitellata: Lumbricidae) from Sredna Gora Mountain (Bulgaria)

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**Abstract.** In the current study the diversity, zoogeographical position and distribution of earthworms from Sredna Gora Mountain (Bulgaria) is presented. During the present investigation, altogether ten earthworm species belonging to seven genera were collected. Among them, seven taxa are reported for the first time from the Sredna Gora Mt.: *Cernosvitovia rebeli*, *Dendrobaena alpina*, *Allolobophoridella eiseni*, *Dendrodrilus rubidus rubidus*, *Aporrectodea caliginosa*, *Aporrectodea rosea* and *Lumbricus terrestris*. On the basis of the new and literature data here we provide the first list of lumbricid earthworms from Sredna Gora Mountain.

**Keywords.** Soil fauna, Clitellata, earthworms, zoogeography, distribution

### INTRODUCTION

The Sredna Gora Mountain is situated in the central part of Bulgaria, bounded on the north by the Sub-Balkan plains and on the south the Thracian valley. The mountain is bordered by the Iskar River to the west and Tundzha River to the east. The Sredna Gora Mountain is some 285 km long and about 50 km wide with highest peak Goliam Bogdan 1603 m a.s.l. The mountain's land area covers 5950 km<sup>2</sup> and the average height is 608 m a.s.l. The Mountain is divided to three parts: Ihtimanska Sredna Gora (western part), Sashtinska Sredna Gora (central part) and Surnena Sredna Gora (eastern part) (Michev *et al.* 1980).

Earthworm biodiversity in Sredna Gora Mountain is almost unexplored. Its lumbricid fauna hasn't been studied so far; there are only sporadic data from this area. Previous data from Sredna Gora Mountain of Mihailova (1966), Šapkarev (1986) and Valchovski & Szederjesi (2016) altogether recorded 8 earthworm species and sub-species: *Aporrectodea longa* (Ude, 1885), *Aporrectodea jassyensis* (Michaelsen, 1891), *Dendro-*

*baena hortensis* (Michaelsen, 1890), *Dendrodrilus rubidus subrubicundus* (Eisen, 1874), *Eisenia fetida* (Savigny, 1826), *Eiseniella tetraedra* (Savigny, 1826), *Lumbricus rubellus* Hoffmeister, 1843 and *Octolasion lacteum* (Örley, 1881).

The aim of this paper is to summarize the new data as well as the literature records on the earthworm fauna to present the lumbricid diversity of the Sredna Gora Mountain.

### MATERIALS AND METHODS

The field investigations were carried out during the spring of 2016. 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. All the specimens were killed in 96% ethanol, fixed in 4% formalin solution and in 96% ethanol, and then transferred into 75% ethanol. The material is deposited in the Institute of Soil

Science, Agrotechnologies and Plant Protection “N. Poushkarov”, Sofia, Bulgaria in private earthworm collection of Hristo Valchovski (PC HV). Identification of species was done in accordance to Mršić (1991).

The collecting sites are as follows:

1. Bunovo – Ihtimanska Sredna Gora Mt., Mirkovo County, mixed forest roadside east of the village, 907m.

2. Dolno Kamartsi – Ihtimanska Sredna Gora Mt., Gorna Malina County, mixed forest south of the village, 839m.

3. Koprivshitsa – Sashtinska Sredna Gora Mt., coniferous forest north of the village, 980m.

4. Miromir – Sashtinska Sredna Gora Mt., Hisarya County, pine forest, 365m.

5. Miromir – Sashtinska Sredna Gora Mt., Hisarya County, oak forest, 345m.

6. Dolna Banya - Ihtimanska Sredna Gora Mt., north of the village, brook near Maritsa River, 613m.

7. Dolna Banya - Ihtimanska Sredna Gora Mt., north of the village, oak forest, 677m.

8. Dolna Banya - Ihtimanska Sredna Gora Mt., north of the village in burned coniferous forest, 679m.

## RESULTS

### Family Lumbricidae Rafinesque-Schmaltz, 1815

#### Genus *Allolobophoridella* Mršić, 1990

##### *Allolobophoridella eiseni* (Levinsen, 1884)

*Lumbricus eiseni* Levinsen, 1884: 241.

*Eisenia eiseni*: Zicsi & Csuzdi 1986: 114.

*Allolobophoridella eiseni*: Mršić 1991: 255.

*Material examined.* PCHV/64 one ex., Mirkovo County, Bunovo, under bark of fallen birch, mixed forest roadside east of the village, 907m, N 42° 42' 17", E 23° 54' 33", leg. H. Valchovski, 03.04.2016.

#### Genus *Aporrectodea* Örley, 1885

##### *Aporrectodea caliginosa caliginosa* (Savigny, 1826)

*Enterion caliginosum* Savigny, 1826: 180.

*Allolobophora nocturna* Evans, 1946: Mihailova 1966: 189 (misidentification).

*Allolobophora caliginosa f. typica*: Mihailova 1966: 187.

*Allolobophora caliginosa*: Plisko 1963: 429.

*Allolobophora caliginosa caliginosa*: Šapkarev 1986: 82.

*Aporrectodea caliginosa caliginosa*: Stojanović *et al.*

2012: 11; Valchovski 2012: 88.

*Aporrectodea caliginosa*: Stojanović *et al.* 2013: 637.

*Material examined.* PCHV/69 5 ex., Dolna Banya, brook near Maritsa River, 613m, N 42° 19' 13", E 23° 46' 28", leg. H. Valchovski and E. Velizarova, 13.04.2016.

##### *Aporrectodea jassyensis jassyensis* (Michaelsen, 1891)

*Allolobophora jassyensis* Michaelsen, 1891: 15; Mihailova 1966: 188; Šapkarev 1986: 83.

*Aporrectodea jassyensis jassyensis*: Valchovski 2014: 3.

*Aporrectodea jassyensis*: Szederjesi 2013: 77.

*Material examined.* PHCV/66 2 ex., Hisarya Miromir district, pine forest, 365m, N 42° 28' 47", E 24° 43' 46", leg. H. Valchovski, 09.04.2016.

##### *Aporrectodea rosea rosea* (Savigny, 1826)

*Enterion roseum* Savigny, 1826: 182.

*Allolobophora prashadi* (Stephenson, 1922): Mihailova 1964: 167.

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

*Eisenia rosea* var. *macedonica* (Rosa, 1893): Mihailova 1966: 186.

*Eisenia rosea* var. *bimastoides* (Cognetti, 1901): Mihailova 1966: 186.

*Allolobophora rosea*: Plisko 1963: 428.

*Allolobophora rosea rosea*: Šapkarev 1986: 81.

*Aporrectodea rosea rosea*: Valchovski 2014: 3

*Aporrectodea rosea*: Stojanović *et al.* 2012: 9.

*Material examined.* PHCV/66 eight ex., Hisarya Miromir district, pine forest, 365m, N 42° 28' 47", E 24° 43' 46", leg. H. Valchovski, 09.04.2016; PCHV/67 three ex., Dolna Banya, north of the village in burned coniferous forest, 679m, N 42° 19' 30", E 23° 46' 41", leg. H. Valchovski & E. Velizarova, 13.04.2016; PCHV/68 one ex., Dolna Banya, oak forest, 677m, N 42° 19' 13", E 53° 46' 43", leg. H. Valchovski & E. Velizarova, 13.04.2016.

**Genus *Cernosvitovia* Omodeo 1956**

***Cernosvitovia rebeli* (Rosa, 1897)**

(Figure 1)

*Allolobophora rebeli* Rosa, 1897: 2.

*Octolasion rebeli*: Černosvitov 1934: 77; 1937: 89; Mihailova 1966: 194.

*Cernosvitovia rebeli*: Valchovski 2012: 91; Szederjesi 2013: 78.

*Material examined.* PCHV/64 one ex., Mirkovo County, Bunovo, mixed forest roadside east of the village, 907m, N 42° 42' 17", E 23° 54' 33", leg. H. Valchovski, 03.04.2016; PHCV/66 two ex., Hisarya Miromir district, oak forest, 345m, N 42° 28' 55", E 24° 43' 43", leg. H. Valchovski, 09.04.2016.

**Genus *Dendrobaena* Eisen, 1873**

***Dendrobaena alpina* (Rosa, 1884)**

*Allolobophora alpina* Rosa, 1884: 28.

*Eisenia alpina* f. *typica*: Černosvitov 1937: 80; Mihailova 1966: 185.

*Dendrobaena alpina*: Plisko 1963: 437; Zicsi & Csuzdi 1986: 118; Valchovski 2012: 91.

*Material examined.* PCHV/64 one ex., Mirkovo County, Bunovo, mixed forest roadside east of the village, 907m, N 42° 42' 17", E 23° 54' 33", leg. H. Valchovski, 03.04.2016; PCHV/63 four ex., Gorna Malina county, Dolno Kamartsi, mixed forest south of the village, 839m, N 42° 42' 47", E 23° 52' 55", leg. H. Valchovski, 03.04.2016; PCHV/65, three ex., Koprivshitsa, coniferous forest north of the village, 980m, N 42° 40' 00", E 24° 20' 34", leg. H. Valchovski, 03.04.2016; PCHV/67 three ex., Dolna Banya, north of the village in burned coniferous forest, 679m, N 42° 19' 30", E 23° 46' 41", leg. H. Valchovski & E. Velizarova, 13.04.2016; PCHV/68 one ex., Dolna Banya, oak forest, 677m, N 42° 19' 13", E 53° 46' 43", leg. H. Valchovski & E. Velizarova, 13.04.2016.

**Genus *Dendrodrilus* Omodeo, 1956**

***Dendrodrilus rubidus rubidus* (Savigny, 1826)**

*Enterion rubidum* Savigny, 1826: 182.

*Dendrodrilus rubidus*: Perel 1979: 200.

*Dendrobaena rubida*: Plisko 1963: 434.

*Bimastus tenuis*: Mihailova 1966: 192.

*Dendrobaena rubida tenuis*: Zicsi & Csuzdi 1986: 119.

*Dendrodrilus rubidus rubidus*: Šapkarev 1986: 79.

*Material examined.* PCHV/64 three ex., Mirkovo County, Bunovo, under bark of fallen birch, mixed forest roadside east of the village, 907m, N 42° 42' 17", E 23° 54' 33", leg. H. Valchovski, 03.04.2016.

**Genus *Lumbricus* Linnaeus, 1758**

***Lumbricus rubellus* Hoffmeister, 1843**

*Lumbricus rubellus* Hoffmeister, 1843: 187; Plisko 1963: 438; Mihailova 1966: 194; Zicsi & Csuzdi 1986: 120; Šapkarev 1986: 85; Stojanović *et al.* 2012: 9; Valchovski 2014: 5.

*Material examined.* PHCV/66 one ex., Hisarya Miromir district, pine forest, 365m, N 42° 28' 47" E 24° 43' 46", leg. H. Valchovski, 09.04.2016; PCHV/68 four ex., Dolna Banya, oak forest, 677m, N 42° 19' 13" E 53° 46' 43", leg. H. Valchovski & E. Velizarova, 13.04.2016.

***Lumbricus terrestris* Linnaeus, 1758**

*Lumbricus terrestris* Linnaeus, 1758: 647; Černosvitov 1937: 90; Plisko 1963: 438; Šapkarev 1986: 85; Zicsi & Csuzdi 1986: 120; Stojanović *et al.* 2012: 9; Szederjesi 2013: 80; Valchovski 2014: 5.

*Material examined.* PCHV/65 two ex., Koprivshitsa, coniferous forest north of the village, 980m, N 42° 40' 00", E 24° 20' 34", leg. H. Valchovski, 03.04.2016; PCHV/69 seven ex., Dolna Banya, brook near Maritsa River, 613m, N 42° 19' 13", E 23° 46' 28", leg. H. Valchovski & E. Velizarova, 13.04.2016.

**Genus *Octolasion* Örley, 1885**

***Octolasion lacteum* (Örley, 1881)**

*Lumbricus terrestris* var. *lacteum* 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; Szederjesi 2013: 81; Stojanović *et al.* 2012: 9; Valchovski 2014: 6.

*Material examined.* PCHV/63 one ex., large form, Gorna Malina county, Dolno Kamartsi, mixed forest south of the village, 839m, N 42° 42' 47", E 23° 52' 55", leg. H. Valchovski, 03.04. 2016.

## DISCUSSION

The list of earthworm species and subspecies recorded for Sredna Gora Mountain contains 15 taxa (Table 1). Out of the 10 earthworm species found in the present survey 7 proved to be new to the fauna of the explored area; these are *Cernosvitovia rebeli*, *Dendrobaena alpina*, *Allolobophridella eiseni*, *Dendrodrilus rubidus rubidus*, *Aporrectodea caliginosa*, *Aporrectodea rosea* and *Lumbricus terrestris*.

The Balkan endemic species *Cernosvitovia rebeli* has not been registered previously from this region. In Bulgaria rare *Cernosvitovia rebeli* was

recorded only from a few localities so far: Balkan Mts. (Rosa 1897, Černosvitov 1934), Strandja Mt. (Černosvitov 1937, Szederjesi 2013) and Rhodope Mts. (Mihailova 1966, Szederjesi 2013). Sredna Gora Mountain is situated between the Rhodope Mts. and Balkan Mts. representing the southern and northern localities of *Cernosvitovia rebeli* respectively (Fig. 1).

According to the zoogeographical composition, the earthworm fauna of the Sredna Gora Mountain is highly peregrine. From the 15 lumbricid species recorded 11 (73.3%) belong to this chorological group. From the four autochthonous species (26.7%) *C. rebeli* is a Balkanic endemism, *D. alpina* possesses a Balkanic-Alpine distribution, *Ap. jassyensis* is Trans-Aegean and *Ai. eiseni* has a larger Holarctic range.

It is to be expected that in the future further new lumbricid species will be found in the region, because large areas have not been explored yet including the territory of the wildlife sanctuary of the Sredna Gora Mountain.



**Figure 1.** Distribution of *Cernosvitovia rebeli* (Rosa, 1897) on the Balkan Peninsula. Black dots = new records, black squares = literature data.

**Table 1.** List of earthworm species from Sredna Gora Mountain

Earthworm species	Zoogeographical position	Distribution in Sredna Gora Mt.
<i>Allolobophoridella eiseni</i>	Holarctic	Ihtimanska Sredna Gora
<i>Aporrectodea caliginosa</i>	Peregrine	Ihtimanska Sredna Gora
<i>Aporrectodea jassyensis</i>	Trans-Aegean	Sashtinska Sredna Gora
<i>Aporrectodea longa</i>	Peregrine	Surnena Sredna Gora
<i>Aporrectodea rosea</i>	Peregrine	Sashtinska and Ihtimanska Sredna Gora
<i>Cernosvitovia rebeli</i>	Endemic	Sashtinska and Ihtimanska Sredna Gora
<i>Dendrobaena alpina</i>	Balkanico-Alpine	Sashtinska and Ihtimanska Sredna Gora
<i>Dendrobaena hortensis</i>	Peregrine	Surnena Sredna Gora
<i>Dendrodrilus rubidus rubidus</i>	Peregrine	Ihtimanska Sredna Gora
<i>Dendrodrilus rubidus subrubicundus</i>	Peregrine	Surnena Sredna Gora
<i>Eisenia fetida</i>	Peregrine	Sashtinska Sredna Gora
<i>Eiseniella tetraedra</i>	Peregrine	Surnena and Sushtinska Sredna Gora
<i>Lumbricus rubellus</i>	Peregrine	Sashtinska and Ihtimanska Sredna Gora
<i>Lumbricus terrestris</i>	Peregrine	Sashtinska and Ihtimanska Sredna Gora
<i>Octolasion lacteum</i>	Peregrine	Ihtimanska and Surnena Sredna Gora

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