

Faunistic study on the earthworms (Annelida: Oligochaeta: Lumbricidae) from the Sarnena Sredna Gora Mts

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Abstract. A total of 381 specimens belonging to 17 earthworm species were collected with 152 pitfall traps in 26 sampling sites during a study of the biodiversity of the Sarnena Sredna Gora Mts. Together with the previous available data this constitutes 42% (21 species) of the lumbricid fauna of Bulgaria. Ten species represent new records for the explored territory. The data on the biotopic distribution and relative abundance of the identified earthworm species were provided for the first time and give valuable information on the species composition of the lumbricids, their specific preferences for environmental conditions, and the conservation value of the studied habitats. The material was collected by a non-traditional method – pitfall traps, a method not applied before for the target group. A comparative analysis of the established earthworms of Sarnena Gora with those from the neighboring regions was done. It showed the importance of the geographical location, relief, climate, soil type and human factor in the formation of the lumbricid fauna.

Key words: lumbricids, Sarnena Gora, check list, new records.

Introduction

Earthworm fauna in Bulgaria includes 50 species, belonging to 15 genera and 2 families (Valchovski 2012). The extent of study in various parts of the country is very different and some mountains have been studied more intensively – Vitosha Mts (Černosvitov 1937), Rila Mts (Valchovski 2016), Pirin Mts (Černosvitov 1934), western parts of the Stara Planina Mts (Šapkarev 1986, Stojanović *et al.* 2012), Sredna Gora Mts (Valchovski & Velizarova 2016), Strandzha Mts (Mihailova 1968), as well as the Sofia Plain (Valchovski 2014) and Upper Thracian Lowland (Michailova 1966, Zicsi & Csuzdi 1986, Valchovski & Szederjesi 2016). The soil mesofauna of large parts from the country have never been a subject of study – especially in the cultivated lands, as well as areas considered to have high anthropogenic impact and areas with low conservation value.

The biodiversity in Sarnena Sredna Gora Mts hasn't been studied on purpose probably due to the prevalence of agricultural lands in the lower regions of the mountain or the absence of Protected Areas. The geographical location, relief, edaphic conditions and specific climatic factors in the mountain are the prerequisite of complex and rich fauna including typical cold-tolerant mountain species and thermophilic xerobiont species, related

to the Transitional Mediterranean Climate, the proximity to the Black Sea and the valleys of the rivers from the Aegean Sea Watershed.

Previous data for the studied territory include a total of 11 earthworm species from different foothill areas (Michailova 1966, Uzunov 2010, Valchovski & Szederjesi 2016). The materials have been collected once or accidentally and don't include the higher parts of the mountain or some specific and characteristic for Sarnena Gora Mts habitats.

The aim of the present paper was to summarize the new data and the previous records on the earthworm fauna in the Sarnena Gora Mts, as well as to study the patterns in their distribution by the habitat types, altitude and seasons. The material was collected with a non-traditional for the earthworms method.

Material and Methods

The species list was completed on the basis of the material collected during field trips and the available bibliographic data. Field work was carried out in the period of 2018 – 2020. Earthworms were collected with 152 pitfall traps. The pitfall traps were of two types: small (made of 500 ml beakers, with salt-vinegar solution as a fixative) and big (cut plastic bottles with 2 l volume and diameter of the enter hole about 12 cm, with 4-10% formaldehyde as a fixative), buried at the level of the substrate. Small traps were used only in 2018 when the material near Zelenikovo vill. was collected from four sampling sites (sites 23, 24, 25, and 26 in Table 1), with 5 traps in each site. Sampling periods were: 19.IV–15.V [1], 15.V–11.VI [2] and 26.VII–25.VIII.2018 [3]. Big traps were used in 2019 – 2020 from the other sampling sites (sites 1-22 in Table 1), with 6 traps in each site. Sampling periods were: III-VII.2019 [1], VII-XI.2019 [2] and XI.2019-IV.2020 [3].

The sampling sites were situated in 3 separate parts of Sarnena Sredna Gora Mts – Svezhen Region, Bratan Region and Chirpan Heights Region (Figure 1, Table 1). The pitfall traps were placed in different habitats with different exposition, altitude and soil type throughout the Sarnena Sredna Gora Mts. The material was collected seasonally, and the three sampling periods were called: [1] – spring-summer, [2] – summer-autumn and [3] – autumn-spring.



Fig. 1. Map of the locations of the main sampling sites. Different colours of the sites reflect the number of collected species. Abbreviations: 1 – 26 are the sampling sites from our research (see Table 1); PM – sampling sites from Mihailova (1966); VS – sampling sites from Valchovski & Szederjesi (2016).

LUMBRICIDAE

Pitfall trapping is one of the oldest and most frequently used methods for faunistic and ecological studies of invertebrates and small terrestrial mammals. Here it was used experimentally in earthworm research for the first time. Disadvantage of the method is that it is missing many of the anecic and large endogeic specimens. The suitability of the method for collecting of earthworms will be analyzed in a future study.

The collected material was rinsed thoroughly with water and transferred into 70% ethanol. Adult specimens were identified at species level, juveniles – at generic level.

For the identification of the material collected, keys and tables made from different authors for other foreign territories (Chekanovskaia 1960, Perel 1979, Vsevolodova-Perel 1997, Mrcic 1991, Csuzdi & Zicsi 2003, Reynolds & Mısırlıoğlu 2018) were used. Main diagnostic characteristics are the prostomium type, body length, arrangement of setae, position of clitellum and tubercula pubertatis, etc.

The ecological groups of the earthworms we used were based on the research of Perel (1979) in which the author describes the position of every species in the soils.

All specimens were deposited in earthworm collection in University of Forestry, Sofia.

During preparation of the compiling list of the region we used generally accepted and up-to-date systematics of the group (Blakemore 2006, Szederjesi 2017, Reynolds & Wetzel 2019), as well as the checklist of earthworms from Bulgaria (Valchovski 2012). For the distribution of the species we used Internet sources such as: Drilobase Project (2013) and Fauna Europaea (Rota 2015).

Table 1. List of the sampling sites from Sarnena Sredna Gora Mts, with their average altitude (a.s.l.), coordinates (GPS) and descriptions of their habitat and soils. WRB – soil type according to World Reference Base for Soil Resources (IUSS Working Group 2015).

No	GPS	a.s.l.	Locality and habitat	Soil description	WRB
1	42°24'46"N 25°05'13"E	344 m	Bratan Region: E Zelenikovo vill. Old mesophile, Scots pine (<i>Pinus sylvestris</i>) and Linden (<i>Tilia sp.</i>) plantation near walnut garden and a river.	Moist to over-moistened, of alluvial type with a lot of rotting organic matter and dry deadwood on the surface.	Chromic Luvisol
2	42°30'31"N 24°59'59"E	860 m	Svezhen Region: W Svezhen vill. on the road to Hadzhi Dimitar's Grave Place. Old mesoxerothermic oak forest (<i>Quercus sp.</i>) near many little meadows.	Well drained and moderately moist, with thick cover of leaf litter and deadwood.	Chromic Cambisol
3	42°29'48"N 25°02'54"E	865 m	Svezhen Region: E Svezhen vill. on the road to Hut Svezhen. Actively grazed ridge pasture with single trees and bushes of oak (<i>Quercus sp.</i>), rosehip (<i>Rosa canina</i>) and birch (<i>Betula pendula</i>).	Clay meadow soil, with characteristic summer droughts.	Chromic Cambisol
4	42°29'50"N 25°02'57"E	863 m	Svezhen Region: E Svezhen vill. on the road to Hut Svezhen. Old coniferous Scots pine and Norway spruce (<i>Picea abies</i>) plantation bordering a pasture.	Thick and moist clay soil, rich in organic matter and dry deadwood on the surface.	Chromic Cambisol
5	42°30'35"N 25°03'51"E	1100 m	Svezhen Region: E Hut Svezhen. Old ridge beech forest (<i>Fagus sp.</i>) with many old trees.	Moderately moist, crumbly, rich in organic matter and dry deadwood on the surface, with a thick leaf litter.	Histic Cambisol

LUMBRICIDAE

6	42°30'36"N 25°04'26"E	975 m	Svezhen Region: E Hut Svezhen. Old ridge beech forest with many old trees.	Silt, crumbly, prone to summer droughts, despite the thick leaf litter and the deadwood on the surface.	Histic Cambisol
7	42°31'03"N 25°02'40"E	1022 m	Svezhen Region: NW Hut Svezhen. Old ridge beech forest on the northern slope with many old trees.	Thick, crumbly, rich in rotting organic matter and dry deadwood on the surface.	Histic Cambisol
8	42°30'60"N 25°02'38"E	1015 m	Svezhen Region: NW Hut Svezhen. Old coniferous plantation of Scots pine, Spruce and Douglas-fir (<i>Pseudotsuga menziensis</i>) on the northern slope, with single trees of beech, overgrown by eagle fern (<i>Pteridium aquilinum</i>).	Sandy, shallow, with a surface organic from rotting dead leaves.	Cambic Leptosol
9	42°31'03"N 25°02'31"E	1008 m	Svezhen Region: NW Hut Svezhen. Actively grazed ridge pasture with single trees and bushes.	Clay soil of pasture-meadow type.	Cambic Umbrisol
10	42°31'59"N 25°02'05"E	898 m	Svezhen Region: NW Hut Svezhen. Mesophile mixed forest of beech, oak and hornbeam (<i>Carpinus orientalis</i>), at the upper limit of the oak and the lower limit of the beech.	Moderately moist, rich in rotting organics, leaf litter and deadwood on the surface.	Histic Cambisol
11	42°32'43"N 25°02'32"E	670 m	Svezhen Region: S Osetenovo vill. River bank near actively used pasture with single old trees and bushes.	Alluvial, with big surface stones and rich in fecal organics from the grazing animals.	Skeletal Fluvisols
12	42°34'12"N 25°01'36"E	633 m	Svezhen Region: S Osetenovo vill. Mesoxerophile oak forest with numbers of large tufts of butcher's-broom (<i>Ruscus aculeatus</i>) near active pasture with single trees.	Crumbly, trampled, with thin leaf litter and rich in fecal organic matter.	Histic Cambisol
13	42°31'35"N 25°11'59"E	583 m	Bratan Region: S Turiya vill. Riverine forest at the lower limit of the beech, with alder (<i>Alnus sp.</i>), hazel (<i>Corylus avellana</i>), hornbeam and meso-hygrophile plants.	Moist or flooded near the river bank, with a thick surface layer of rotting plants and wood.	Skeletal Fluvisols
14	42°21'33"N 25°10'37"E	366 m	Chirpan Heights Region: NW Veren vill. Ridge Black locust (<i>Robinia pseudoacacia</i>) plantation with heliophile plants.	Coarse sandy soil, degraded and well-drained.	Chromic Luvisol
15	42°21'19"N 25°10'47"E	353 m	Chirpan Heights Region: NW Veren vill. Pasture with many bushes and tufts of cactus (<i>Opuntia sp.</i>) bordering with the village.	Silt, thickened by the grazing animals and covered with xerophilous plants.	Chromic Luvisol
16	42°21'01"N 25°17'47"E	386 m	Chirpan Heights Region: S Saedinie vill. Meso-hygrophile rivarine mixed forest with wild vine (<i>Parthenocissus quinquefolia</i>), ivy (<i>Hedera helix</i>) and elm (<i>Ulmus sp.</i>).	Partly flooded (in the gully), rich in rotting organics.	Colluvic Regosol
17	42°20'39"N	487 m	Chirpan Heights Region: S Saedinie	Moderately moist, light, rich in	Chromic

LUMBRICIDAE

	25°17'44"E		vill. Old linden forest on the northern slope with tufts of butcher's-broom.	rotting plant litter and surface organic matter. During the summer, the surface layer dries and hardens.	Luvisol
18	42°20'44"N 25°17'41"E	449 m	Chirpan Heights Region: S Saedinie. Mixed forest of oak, linden, maple (<i>Acer</i> sp.) with butcher's-broom, <i>Viburnum</i> sp. and ivy.	Thick and moist, rich in organic matter, with piles of stones in some places, due to erosion on the steep slope.	Colluvic Regosol
19	42°19'21"N 25°17'39"E	418 m	Chirpan Heights Region: N Sredno Gradishte vill. Xerophile forest of oak and hornbeam with Jerusalem thorn (<i>Parkinsonia aculeata</i>), cornel (<i>Cornus mas</i>), hawthorn (<i>Crataegus</i> sp.) and butcher's-broom.	Shallow and stony.	Skeletal Leptosol
20	42°21'13"N 25°20'46"E	435 m	Chirpan Heights Region: NW Stoyan Zaimovo vill. Abandoned pasture with single bushes and trees – pear (<i>Pyrus</i> sp.), apple (<i>Malus</i> sp.), cherry plum (<i>Prunus cerasifera</i>), oaks, blackthorn and blackberry.	Degraded, coarse sandy soil with many large surface stones.	Skeletal Leptosol
21	42°21'02"N 25°20'40"E	406 m	Chirpan Heights Region: NW Stoyan Zaimovo vill. Alfalfa field bordering with belt of bushes and trees. The pitfall traps are placed on the edge of the ecotone zone.	Degraded, sandy clay, poor in nutrients, due to the condition of the alfalfa field.	Chromic Luvisol
22	42°20'16"N 25°21'28"E	363 m	Chirpan Heights Region: NW Stoyan Zaimovo vill. Wheat field bordering with river bank. Ecotone zone with walnut (<i>Juglans regia</i>) plantation and ruderal plants.	Alluvial, with a thick cover of rotting dead grasses.	Colluvic Regosol
23	42°23'47"N 25°02'57"E	280 m	Bratan Region: W Zelenikovo vill. Rapeseed field. Perennial exploited, severely degraded agricultural land, a consequence of the repeated, annual destruction of the soil structure, the application of mineral fertilizers and plant protection products.	Moderately leached cinnamon, moderately eroded, sandy clay, hardening during droughts.	Chromic Luvisol
24	42°22'45"N 25°04'48"E	288 m	Bratan Region: S Zelenikovo vill. Rapeseed field.	Moderately leached cinnamon, moderately eroded, silty clay.	Chromic Luvisol
25	42°23'49"N 25°03'09"E	290 m	Bratan Region: W Zelenikovo vill. Lightly used pasture located in an agricultural landscape with mainly xerophile plants and tufts of nitrophile ruderal plants.	Moderately leached cinnamon, moderately eroded, sandy clay, with a hard surface layer due to the grazing animals. In summer, the grass dries out and the soil becomes even denser, harder and dustier.	Chromic Luvisol
26	42°22'50"N 25°04'43"E	290 m	Bratan Region: S Zelenikovo vill. Moderately grazed pasture located in an agricultural landscape.	Moderately leached cinnamon, not eroded, light clay.	Chromic Luvisol

Results and Discussion

Material collected during the present study included 381 specimens, and from 264 of them we determined 17 species from 8 genera. Not identified during our study but published for the area (Michailova 1966) were: *Allobophora chlorotica*, *Aporrectodea caliginosa*, *A. trapezoides*, *Eiseniella tetraedra*. A total of 21 earthworm species belonging to 9 genera was found in Sarnena Sredna Gora Mts (Appendix). This represents 42% of all established for Bulgarian lumbricid species and 60% of the genera, respectively. Ten earthworm species were new geographical records of the explored area. They are marked with asterisk (*) in the Species list below.

Species list

1. *Allobophora chlorotica* (Savigny, 1826)

Ecological group: Endogeic.

Distribution: Cosmopolite peregrine species – peregrine type (here and further in the text we use “peregrine“, as initially used by Michaelsen (1903) and Perel (1979). Europe, Western Siberia, Asia Minor, North America, North Africa, South America, New Zealand. Rapidly dispersing hygrophile.

Habitat: Wet, highly organic sites near river banks and in cultivated soils (Michailova 1966).

Distribution in Bulgaria: Iskar River, Sofia Plain (Plisko 1963, Valchovski 2014), Thracian Lowland (Michailova 1966, Šapkarev 1986), SW Bulgaria (Šapkarev 1986, Stojanović *et al.* 2012).

Distribution in Sarnena Sredna Gora: Starozagorski Bani vill., Kazanka vill. (Michailova 1966).

2. **Allobophora leoni* (Michaelsen, 1891)

Ecological group: Endogeic.

Distribution: Central Europe and the eastern shore of the Black Sea.

Habitat: We found it in actively grazed pastures with single bushes and trees.

Distribution in Bulgaria: NW Bulgaria (Michailova 1965).

Distribution in Sarnena Sredna Gora: This is the first record of this species here.

New material: site 3: 1ex. [1].

3. *Aporrectodea caliginosa* (Savigny, 1826)

Ecological group: Endogeic.

Distribution: Cosmopolite – peregrine type.

Habitat: Meadows (Michailova 1966).

Distribution in Bulgaria: Iskar River, Sofia Plain (Plisko 1963, Šapkarev 1986, Valchovski 2014), Thracian Lowland (Michailova 1966, Šapkarev 1986, Valchovski & Szederjesi 2016), SW Bulgaria (Plisko 1963, Stojanović *et al.* 2012), Rila Mts (Valchovski 2016a), Sredna Gora Mts (Valchovski & Velizarova 2016), Vitosha Mts (Stojanović *et al.* 2012) Danube Lowland (Uzunov 2010, Valchovski & Szederjesi 2016).

Distribution in Sarnena Sredna Gora: Kazanka vill., Starozagorski bani vill., Chirpan (Michailova 1966).

4. **Aporrectodea handlirschi* (Rosa, 1897)

Ecological group: Endogeic.

Distribution: Central, Southern and Southeastern Europe, including Crimea and the Northwest Caucasus and European Turkey.

Habitat: We found it in oak forest, pasture and river bank.

LUMBRICIDAE

Distribution in Bulgaria: Vitosha Mts (Černosvitov 1937, Šapkarev 1986), Belasitca Mts (Plisko 1963, Šapkarev 1986), SW Bulgaria (Valchovski 2016b), Sofia Plain (Šapkarev 1986) and Eastern part of Rhodope Mts (Mihailova 1966).

Distribution in Sarnena Sredna Gora: This is the first record of this species here.

New material: site 2: 1ex. [3]; site 9: 2ex. [3]; site 11: 1ex. [1].

5. *Aporrectodea jassyensis* (Michaelsen, 1891)

Ecological group: Endogeic.

Distribution: Widely distributed Western Palaearctic (Trans-Aegean) species.

Habitat: Meadows and cultivated soils (Mihailova 1966). We found it in a pasture.

Distribution in Bulgaria: Sofia Plain (Plisko 1963, Šapkarev 1986, Valchovski 2014), Vitosha Mts (Stojanović et al. 2012), Thracian Lowland (Mihailova 1966, Šapkarev 1986, Valchovski & Szederjesi 2016), SW Bulgaria (Šapkarev 1986), Rila Mts (Valchovski & Misirlioglu 2017) and Rhodope Mts (Mihailova 1966, Szederjesi 2013).

Distribution in Sarnena Sredna Gora: Starozagorski bani vill., Chirpan (Mihailova 1966); beside Striama River near Bania town (Valchovski & Szederjesi 2016)

New material: site 9: 1ex. [2].

6. *Aporrectodea longa* (Ude, 1885)

Ecological group: Anecic.

Distribution: Cosmopolite – peregrine type. Europe, Asia Minor, North America, North Africa, New Zealand synanthropized, invasive outside its natural range.

Habitat: Pastures, cultivated soils, forest (Mihailova 1966). We found it in ridge beech forest with old trees.

Distribution in Bulgaria: Konyavska Mt (Černosvitov 1937), Thracian Lowland, Sredna Gora Mts (Mihailova 1966) and Sofia Plain (Valchovski 2014), SW Bulgaria (Valchovski 2016b).

Distribution in Sarnena Sredna Gora: Kazanka vill., Starozagorski bani vill., Chirpan (Mihailova 1966).

New material: site 5: 7ex. [1].

7. *Aporrectodea rosea* (Savigny, 1826)

Ecological group: Endogeic.

Distribution: Cosmopolite – peregrine type. Europe, Asia, North America, North Africa, South America. Parthenogenetic synanthropic polyploid. Synanthropized, invasive, polymorphic.

Habitat: We found it in mixed forest and river bank.

Distribution in Bulgaria: Sofia Plain (Černosvitov 1937, Plisko 1963, Stojanović et al. 2012, Valchovski 2014), Thracian Lowland (Mihailova 1964, 1966, Šapkarev 1986, Valchovski & Szederjesi 2016), Stara Planina Mts (Rosa 1897, Plisko 1963, Šapkarev 1986), Rila Mts (Šapkarev 1986, Valchovski 2016a), Vitosha Mts (Stojanović et al. 2012), Rhodope Mts (Mihailova 1966), Lyulin Mts (Plisko 1963), Sredna Gora Mts (Valchovski & Velizarova 2016), SW Bulgaria (Černosvitov 1937, Plisko 1963, Šapkarev 1986, Valchovski 2016b), Danubian Plain (Černosvitov 1937, Šapkarev 1986, Uzunov 2010).

Distribution in Sarnena Sredna Gora: Kazanka vill. (Mihailova 1966); beside Striama River near Bania town (Valchovski & Szederjesi 2016).

New material: site 10: 1ex. [1]; site 11: 1ex. [1]. Most common earthworm species in Bulgaria, but low count in the explored area.

8. *Aporrectodea trapezoides* (Dugès, 1828)**Ecological group:** Endogeic.**Distribution:** Cosmopolite – peregrine type. Europe, Asia, North America, Africa, South America and New Zealand.**Habitat:** Wet sites near cultivated soils and river banks (Mihailova 1966).**Distribution in Bulgaria:** Thracian Lowland (Mihailova 1966, Šapkarev 1986), Sofia Plain (Šapkarev 1986, Valchovski 2014), SW Bulgaria (Šapkarev 1986, Stojanović et al. 2012), Vitosha Mts (Stojanović et al. 2012) Danubian Plain, Ludogorie Region, Rila Mts (Šapkarev 1986, Valchovski 2016a).**Distribution in Sarnena Sredna Gora:** Kazanka vill, Chirpan, Starozagorski bani vill. (Mihailova 1966).**9. **Bimastos rubidus* (Savigny, 1826)****Ecological group:** Epigeic.**Distribution:** Cosmopolite – synanthropic type. Distributed in Europe, Asia, Africa, North America, invasive in South America, New Zealand. Synanthropic invasive peregrine species of North American origin.**Habitat:** we found it in ridge beech forest with old trees, coniferous plantation and riverine forest.**Distribution in Bulgaria:** Thracian Lowland (Mihailova 1966, Valchovski & Szederjesi 2016), Western Rhodope Mts (Černosvitov 1934, Mihailova 1966), NW Bulgaria, Eastern Stara Planina Mts (Černosvitov 1934, Šapkarev 1986), Vitosha Mts (Plisko 1963, Šapkarev 1986), Belasitca Mts (Černosvitov 1934), Sredna Groa Mts (Valchovski & Velizarova 2016), Rila Mts (Plisko 1963, Šapkarev 1986, Zicsi & Csuzdi 1986, Valchovski 2016a).**Distribution in Sarnena Sredna Gora:** This is the first record of this species here.**New material:** site 5: 1ex. [3]; site 7: 1ex. [3]; site 1: 2ex. [2]; site 13: 1ex. [1].**10. **Bimastos eiseni* (Levinsen, 1884)****Ecological group:** N/A.**Distribution:** Cosmopolite – peregrine type. Distributed in Europe, Asia, Africa, North America, synanthropic in New Zealand.**Habitat:** We found it in riparian forest, mixed forest, ridge beech forest with old trees and coniferous forest.**Distribution in Bulgaria:** Stara planina Mts (Černosvitov 1937), Vitosha Mts (Plisko 1963), East Rhodope Mts (Mihailova 1966), Rila Mts (Valchovski & Szederjesi 2016).**Distribution in Sarnena Sredna Gora:** This is the first record of this species here.**New material:** site 5: 1ex. [2]; site 8: 1ex. [2]; site 10: 2ex. [1; 3]; site 16: 1ex. [3].**11. **Cernosvitovia rebeli* (Rosa, 1897)****Ecological group:** Endogeic.**Distribution:** Balkan endemic. Romania, Bulgaria, Greece, Albania**Habitat:** We found it in mixed forest (old beech and linden forest), pastures and foot hills.**Distribution in Bulgaria:** Stara Planina Mts (Rosa 1897, Černosvitov 1934, Valchovski 2016c), Strandzha Mts (Černosvitov 1937, Szederjesi 2013), Western Rhodope Mts (Mihailova 1966), Sredna Gora Mts (Valchovski & Velizarova 2016), Gorata Mt (part of Eastern Rhodope Mts) (Szederjesi 2013).**Distribution in Sarnena Sredna Gora:** This is the first record of this species here.**New material:** site 5: 3ex. [1; 3]; site 9: 1ex. [2]; site 10: 1ex. [1]; site 17: 6ex. [1]; site 18: 1ex. [1].

12. **Dendrobaena alpina* (Rosa, 1884)**Ecological group:** Epigeic.**Distribution:** Central, southern and southeastern Europe, Asia Minor, Alpes, the Balkans and the southern Carpathians and the Lesser Caucasus. Mountain species.**Habitat:** We found it in coniferous forest, beech forest, oak forest and pasture (580 – 1000 m).**Distribution in Bulgaria:** Vitosha Mts (Černosvitov 1937, Šapkarev 1986) Western Rhodope Mts (Černosvitov 1937, Mihailova 1966, Szederjesi 2013), Eastern Rhodope Mts (Mihailova 1966), Sredna Gora Mts (Valchovski & Velizarova 2016), Pirin Mts (Uzunov 2010), Rila Mts (Šapkarev 1986, Zicsi & Csuzdi 1986, Uzunov 2010, Valchovski 2016a), Sakar Mts (Mihailova 1966).**Distribution in Sarnena Sredna Gora:** This is the first record of this species here.**New material:** site 2: 1ex. [1]; site 4: 1ex. [3]; site 8: 3ex. [3]; site 6: 4 ex. [1; 3]; site 7: 4ex. [1; 2; 3]; site 9: 4ex. [1; 3]; site 10: 2ex. [1]; site 13: 1ex. [1];.**13. **Dendrobaena balcanica* (Černosvitov, 1937)****Ecological group:** Epigeic.**Distribution:** Balkan endemic. Bulgaria, Greece.**Habitat:** We found it in old beech forest and coniferous forest in mountains (1100m).**Distribution in Bulgaria:** Ali-Botush Mts (Černosvitov 1937) and Pirin Mts (Zicsi & Csuzdi 1986).**Distribution in Sarnena Sredna Gora:** This is the first record of this species here.**New material:** site 5: 3ex. [1]; site 8: 1ex. [1].**14. *Dendrobaena hortensis* (Michaelsen, 1890)****Ecological group:** Epigeic.**Distribution:** Cosmopolite – peregrine type. With a spotted distribution, in many places synanthropized. Palearctic, North and South America, South Africa.**Habitat:** Near river banks (Mihailova 1966). We found it in mixed forest.**Distribution in Bulgaria:** Sredna Gora Mts (Mihailova 1966) and Strandzha Mts (Szederjesi 2013).**Distribution in Sarnena Sredna Gora:** Starozagorski bani vill. (Mihailova 1966).**New material:** site 1: 1ex. [3]; site 10: 3ex. [2]; site 11: 1ex. [3].**15. **Dendrobaena octaedra* (Savigny, 1826)****Ecological group:** Epigeic.**Distribution:** Cosmopolite – peregrine type. Europe, North America, Asia, South America.**Habitat:** We found it in wet sites and beech forest near river.**Distribution in Bulgaria:** Rila Mts (Plisko 1963, Šapkarev 1986, Zicsi & Csuzdi 1986, Uzunov 2010, Stojanović et al. 2012), Stara Planina Mts (Plisko 1963), Lyulin Mts, Vitosha Mts (Plisko 1963, Šapkarev 1986), Sofia Plain, Osogovska Planina Mts (Šapkarev 1986), Central and Eastern part of Rhodope Mts (Uzunov 2010, Szederjesi 2013).**Distribution in Sarnena Sredna Gora:** This is the first record of this species here.**New material:** site 11: 1ex. [2]; site 13: 6ex. [2].**16. **Eisenia fetida* (Savigny, 1826)****Ecological group:** Epigeic.**Distribution:** Cosmopolite peregrine species – synanthropic type. The species has an invasive expansion due to its great ecological flexibility outside its natural range. Distributed in Europe, Asia, North America, North Africa, native to South America and New Zealand.**Habitat:** We found it in agricultural land, mixed forest (beech and oak) and wet sites.

LUMBRICIDAE

Distribution in Bulgaria: Eastern Stara Planina Mts (Rosa 1897), Thracian Lowland (Mihailova 1966, Šapkarev 1986, Valchovski & Szederjesi 2016), Rila Mts (Šapkarev 1986), Sofia Plain (Šapkarev 1986, Valchovski 2014), Pirin Mts (Stojanović et al. 2012).

Distribution in Sarnena Sredna Gora: This is the first record of this species here.

New material: site 5: 2ex. [1; 3]; site 7: 1ex. [3]; site 11: 1ex. [3]; site 12: 1ex. [1]; site 18: 1ex. [1]; site 19: 1ex. [1]; site 22: 1ex. [3].

17. *Eisenia lucens* (Waga, 1857)

Ecological group: Epigeic.

Distribution: From the Pyrenees through the Alps and the Carpathians to Macedonia and Bulgaria (central and southeastern Europe), relocated to Brazil (South America).

Habitat: Under bark of fallen logs near river (Valchovski & Szederjesi 2016). We found it in beech forest near river.

Distribution in Bulgaria: Belasitca Mts (Černosvitov 1934), Osogovo Mts, Rhodope Mts (Černosvitov 1937, Szederjesi 2013), Danubian Plain (Černosvitov 1937, Šapkarev 1986), Western Stara Planina Mts (Černosvitov 1937, Plisko 1963, Szederjesi 2013), Central Stara Planina Mts (Černosvitov 1934, Plisko 1963, Šapkarev 1986), Eastern Stara Planina Mts (Šapkarev 1986, Szederjesi 2013), Sredna Gora Mts (Valchovski & Szederjesi 2016), Rila Mts (Šapkarev 1986), Thracian Lowland (Mihailova 1964), Strandzha Mts (Plisko 1963, Szederjesi 2013), Sofia Plain (Valchovski 2014).

Distribution in Sarnena Sredna Gora: Beside Striama River near Bania town (Valchovski & Szederjesi, 2016).

New material: site 13: 1ex. [1].

18. *Eiseniella tetraedra* (Savigny, 1826)

Ecological group: Amphibiotic epigeic.

Distribution: Cosmopolite – synanthropic type. Europe, Asia, North America, North Africa, invasive in South America and New Zealand). Parthenogenetic, polyploid, amphibiotic and synanthropized invasive species.

Habitat: Lilac forest and near wet sites (Mihailova 1966); river bank (Valchovski & Szederjesi 2016).

Distribution in Bulgaria: Rila Mts (Černosvitov 1934, Zicsi & Csuzdi 1986, Šapkarev 1986), Rhodope Mts (Černosvitov 1934), Vitosha Mts (Černosvitov 1937, Šapkarev 1986, Stojanović et al. 2012), Lyulin Mts, Slavianka Mts, Pirin Mts (Černosvitov 1937), Danubian Plain (Šapkarev 1986, Uzunov 2010), Western and Central Stara Planina Mts, Belasitca Mts (Plisko 1963), Sofia Plain (Plisko 1963, Šapkarev 1986, Valchovski 2014), Sredna Gora Mts, Thracian Lowland (Mihailova 1966, Šapkarev 1986, Uzunov 2010, Valchovski & Szederjesi 2016), Strandzha Mts (Uzunov 2010, Szederjesi 2013).

Distribution in Sarnena Sredna Gora: Kazanka vill. (Mihailova 1966); Sarnena Sredna Gora (Uzunov 2010); beside Striama River near Bania town (Valchovski & Szederjesi 2016).

19. *Lumbricus rubellus* Hoffmeister, 1843

Ecological group: Epi-endogeic.

Distribution: Cosmopolite – peregrine and synanthropic type. Transported to many places around the world and cultivated for the purposes of composting household organic matter, and in other places it has become invasive.

Habitat: Oak forest and near wet sites (Mihailova 1966). We found it in mixed forest (old beech and oak), pasture and near river banks.

Distribution in Bulgaria: Belasitca Mts, Strandzha Mts (Černosvitov 1934), Vitosha Mts, Western Stara Planina Mts (Černosvitov 1937, Plisko 1963), Central Stara Planina Mts (Rosa 1897, Černosvitov 1934, Plisko 1963), Rila Mts (Černosvitov 1937, Šapkarev 1986, Zicsi &

LUMBRICIDAE

Csuzdi 1986, Uzunov 2010), Osogovska Planina Mts, Rhodope Mts (Černosvitov 1937, Mihailova 1966), Sredna Gora Mts (Šapkarev 1986, Uzunov 2010, Valchovski & Velizarova 2016), Danubian Plain (Šapkarev 1986, Uzunov 2010), Ludogorie Region (Šapkarev 1986), Thracian Lowland (Mihailova 1966, Šapkarev 1986, Uzunov 2010), Gorata Mt, Sakar Mts (Mihailova 1966), Pirin Mts (Stojanović et al. 2012), SW Bulgaria (Valchovski 2016b), Sofia Plain (Plisko 1963, Šapkarev 1986, Valchovski 2014).

Distribution in Sarnena Sredna Gora: Starozagorski bani vill., Kazanka vill. (Mihailova 1966).

New material: site 3: 2ex. [1; 3]; site 7: 1ex. [2]; site 9: 2ex. [1; 3]; site 10: 5ex. [1; 2]; site 11: 4ex. [1; 3]; site 12: 1ex. [1]; site 13: 2ex. [1]; site 14: 5ex. [2; 3]; site 15: 8ex. [1]; site 17: 1ex. [3]; site 18: 5ex. [1; 2; 3]; site 19: 5ex. [1]; site 23: 2ex. [2]; site 25: 4ex. [1; 2]; site 26: 17ex. [1; 2].

20. *Lumbricus terrestris* Linnaeus, 1758

Ecological group: Anecic.

Distribution: Cosmopolite – peregrine and synanthropic type. Synanthropized and accidentally introduced in many parts of the world.

Habitats: We found it in pine forest and near river banks.

Distribution in Bulgaria: Sofia Plain (Plisko 1963, Šapkarev 1986, Valchovski 2011, 2014, Stojanović et al. 2012, Valchovski & Szederjesi 2016), Lyulin Mts (Plisko 1963), Eastern (Šapkarev 1986) and Central Stara Planina Mts (Teofilova 2016), Rila Mts (Zicsi & Csuzdi 1986, Szederjesi 2013, Valchovski 2016a), Central Rhodope Mts (Szederjesi 2013), Pirin Mts (Valchovski 2016b), Lower valley of the River of Tundzha (Teofilova 2017), Sredna Gora Mts (Valchovski & Velizarova 2016).

Distribution in Sarnena Sredna Gora: This is the first record of this species here.

New material: site 1: 1ex. [1]; site 11: 1ex. [2].

21. *Octolasion lacteum* (Örley, 1881)

Ecological group: Endogeic.

Distribution: Cosmopolite – peregrine and synanthropic type. Europe, Caucasus, North America, North Africa, invasive in South America and New Zealand. Parthenogenetic, polyploid and invasive.

Habitat: Dughill and near wet sites (Mihailova 1966). We found it in beech forest near river and pine forest.

Distribution in Bulgaria: All over Bulgaria. Rhodope Mts (Černosvitov 1937, Mihailova 1966, Szederjesi 2013), Vitosha Mts (Černosvitov 1937, Šapkarev 1986, Stojanović et al. 2012), Western Stara Planina Mts (Černosvitov 1937, Plisko 1963), Central Stara Planina Mts, Lyulin Mts (Černosvitov 1934, Plisko 1963), Belasitca Mts (Plisko 1963, Šapkarev 1986), Rila Mts (Zicsi & Csuzdi 1986, Šapkarev 1986, Stojanović et al. 2012, Valchovski 2016a), Pirin Mts (Stojanović et al. 2012, Valchovski 2016b), Sofia Plain (Plisko 1963, Šapkarev 1986, Stojanović et al. 2012, Valchovski 2014), Thracian Lowland (Mihailova 1966, Šapkarev 1986); Osogovska Mt (Černosvitov 1937, Šapkarev 1986), Danubian Plain, Ludogorie (Šapkarev 1986), Sredna Gora Mts, Sakar Mts (Mihailova 1966, Valchovski & Velizarova 2016), Strandzha Mts (Valchovski & Misirlioglu 2017).

Distribution in Sarnena Sredna Gora: Kazanka vill. (Mihailova 1966).

New material: site 1: 1ex. [3]; site 13: 1ex. [2].

Fauna analysis – rare, mass, endemic and indicator species

During the investigation we established two rare species (*Allolobophora leoni* and *Dendrobaena hortensis*), two endemic species (*Dendrobaena balcanica* and *Cernosvitovia rebeli*) and one species with limited distribution in the mountains (*Dendrobaena alpina*).

LUMBRICIDAE

Allolobophora leoni has been previously found once in the northwestern part of Bulgaria (Michailova 1965). Our new locality is on the southern slope of an actively grazed pasture at 865 m a.s.l. bordering an old mesophile beech forest (site 3). The territory has thick soil horizon which is the prerequisite for the presence of endogeic earthworms. Only one adult species was collected in the spring-summer sampling period. This finding of *A. leoni* in the area of Sarnena Sredna Gora Mts is the most southeastern locality for the species within its entire range.

According to the available literature data, *D. hortensis* has been reported in two localities from Bulgaria – Starozagorski bani vill. (Michailova 1966), and Strandzha Mts (Szederjesi 2013). Recently it was recovered from Petrohan Pass in the Western Stara Planina Mts (unpublished data from the authors). This species has limited distribution and is present in low numbers (less numerous), and prefers organic and humid coastal soils (Michailova 1966). The new localities represent mesophilic old forests with humid soil horizon in the range of 350-900 m a.s.l. As found by Michailova (1966), all five specimens fell during the summer-autumn period.

Both endemic species (*D. balcanica* and *C. rebeli*) occur in the Balkan Peninsula. *Dendrobaena balcanica* was found during the field work in two new localities for Bulgaria – at 1015 and 1100 m a.s.l. The other known localities of this species are in Slavyanka Mts (Cernosvitov 1937) and Pirin Mts (Zicsi Csuzdi 1986). The species has also been found in the area of Petrohan Pass, Western Stara Planina Mts (unpublished data of the authors from 2017). *Cernosvetovia rebeli* has a wide altitudinal range in the mountains – 450 m to 1100 m a.s.l. We found this species in old mesophilic forests with thick soil horizon in the presence of dead rotting wood. It was collected in all three sampling periods. Common for Sredna Gora and Stara planina Mts.

Dendrobaena alpina is limited to the mountain areas. This epigeic earthworm is found in all Bulgarian mountains from the lower mountain belt to the alpine zone (Valchovski 2012). Apart from typical mountain habitats this species is also registered in old foothill forests. For the region of Sarnena Gora Mts, *D. alpina* can be used as a bioindicator of the middle-mountain microclimate and mountain habitats. On the southern slopes of the Bratan Region of Sarnena Sredna gora Mts this species is registered as low as 850 m a.s.l. (site 2) and on the northern slopes– at 550 m a.s.l. around the village of Turiya (site 13). Such trend in the distribution of mountain species on both sides of the mountain has been registered in other taxonomic groups, e.g. ground beetles (Teofilova & Kodzhabashev 2020) and small mammals (Miteva 2020), pointing their indicativeness concerning the mountain climatic conditions and the lower limit of the middle mountain belt.

Based on the species richness of each sampling site we could classify the habitats of the earthworms from Sarnena Sredna Gora Mts into four groups:

- 1) Degraded habitats, arable lands with destroyed soil structure, suspended soil formation process or eroded soil. Found 1 or 2 species.
- 2) Xerothermic habitats with arid and heavily drained soils. Found 3 species.
- 3) Mesothermal habitats with moderately moist soils. Found 4 or 5 species
- 4) Habitats with moist soils rich of organic matter. Found 6 or 7 species.

The first group includes all arable lands, plain xerothermic pastures with active grazing and tree plantations. The habitats in sampling sites: 3, 4, 6, 14, 15, 20 - 26 (Figure 1, coloured in blue) can be assigned to this group. All they have suffered severe degradation as a result of anthropogenic activities. Depending on their location and altitude the identified species in these areas are mostly ecologically plastic and widespread/common. In Sarnena Gora Mts this is usually *Lumbricus rubellus* which has been found in every degraded habitat.

The second group of habitats includes both natural and partially degraded or secondary habitats, which are in a stage of natural restoration. To this group belong the

LUMBRICIDAE

xerothermic and meso-xerothermic forests in the foothills of the Bratan Region of Sarnena Gora Mts and the Chirpan Heights Region: 2, 12, 16, 17, 18, 19 (Figure 1, coloured in green). The soil in these habitats is rich in organic matter and with thick leaf litter but during the summer months due to high temperatures, drainage and relatively low density it dries out and the worms fall into summer diapause.

The third group includes mesothermal habitats, typical for the low and middle mountain belt with year-round moist and with thick leaf litter covered soil. The main natural woodland vegetation is beech or beech with different mesophilic species. *Dendrobaena alpina* is a typical species here, additionally *D. hortensis*, *D. balcanica* and *C. rebeli* could be mentioned. These localities are coloured in yellow on the map (Figure 1).

The habitats from the fourth group are located near waters (rivers) as well as in old forests with moist and rich soils throughout the year. In our studies habitats 5, 10, 11 and 13 were identified and classified as such (Figure 1, colored in orange). One of the richest in species places is the area around the village of Kazanka where nine earthworm species have been registered (Michailova 1966). Such habitats are indicative for a high diversity of earthworms in Sarnena Sredna Gora Mts and Bulgaria. They can also be included in the list of representative habitats for earthworms and regularly monitored.

Occurrence

The most widespread (found in 15 sites) and numerous species was *L. rubellus* (64 specimens representing 43% of all identified individuals) (Table 2). It occurred in all habitats affected by human activity and was completely absent or has a very low density in the preserved habitats, e.g. old forests and habitats with moist soils.

Other comparatively common species found in 5 to 8 localities (with occurrence between 20 and 30%) were: *D. alpina* (13% abundance and 31% occurrence), *E. fetida* (5% abundance and 27% occurrence) and *C. rebeli* (8% abundance and 19% occurrence). The remaining 13 species were registered with less than eight specimens (abundance below 5%) in less than 5 localities (occurrence below 15%).

Species found in a single locality were *Apporectodea longa* (site 5), *A. jassyensis* (site 9), *Allolobophora leoni* (site 3) and *Eisenia lucens* (site 13), the last three being present by only one specimen each. These species have 4% occurrence (calculated on the basis of 26 localities) and low abundance (less than 1%).

Dendrobaena balcanica, *D. hortensis*, *D. octaedra* and *O. lacteum* have an extrazonal distribution for the region as the last three species have been found in coastal habitats with naturally preserved woodlands having deep soil layer rich in humified and surface rotting organic matter. In total, by the number of individuals collected, the four dominant species compile 70% of all identified earthworm species. *Dendrobaena balcanica* is a relatively rare species and has specific requirements for environmental conditions, as it was also found by Michailova (1966).

Seasonal dynamics of the earthworms

A total of 381 specimens and 17 species of earthworms were found and identified during the recent study. About half of them (198 specimens or 52%), belonging to 13 species (77% of species detected), were determined in the spring-summer [1] period, 64 specimens (17%) belonging to 10 species (59%) were found in the summer-autumn [2] period, and 90 specimens (31%) belonging to 9 species (53%) – in the autumn-spring [3] period (Table 2). *Allolobophora leoni*, *A. rozea*, *A. longa*, *D. balcanica*, *E. lucens* were registered only in the spring-summer period, while *A. jassyensis* and *D. octaedra* were caught only in the summer-autumn season, and *B. rubidus*, *B. eiseni*, *D. alpina* and *L. rubellus* were registered in all three collection periods. The other species were caught in two consecutive seasons or have a pronounced summer diapause, such as *A. handlirschi* and *E. fetida*.

LUMBRICIDAE

Table 2. Distribution among the sampling sites, frequency of occurrence (F), seasonal activity and abundance (number of specimens from the species, and % of all specimens determined to species level, e.g. 150) of the earthworm species from Sarnena Sredna Gora Mts.

Species	Sampling sites	F (%)	Season (sampling period)	Abundance (No/%)
<i>Allolobophora leoni</i>	3	4	1	1 ex/1%
<i>Aporrectodea rosea</i>	10,11	8	1	2 ex/1%
<i>Aporrectodea longa</i>	5	4	1	7 ex/5%
<i>Aporrectodea handlirschi</i>	2,9,11	12	1; 3	4 ex/3%
<i>Aporrectodea jassyensis</i>	9	4	2	1 ex/1%
<i>Bimastos eiseni</i>	5,8,10,16	15	1; 2; 3	5 ex/3%
<i>Bimastos rubidus</i>	1,5,7,13	15	1; 2; 3	5 ex/3%
<i>Cernosvitovia rebeli</i>	5,9,10,17,18	19	1; 2	12 ex/8%
<i>Dendrobaena alpina</i>	2,4,6,7,8,9,10,13	31	1; 2; 3	20 ex/13%
<i>Dendrobaena balcanica</i>	5,8	8	1	4 ex/3%
<i>Dendrobaena hortensis</i>	1,10,11	12	2; 3	5 ex/3%
<i>Dendrobaena octaedra</i>	11,13	8	2	7 ex/5%
<i>Eisenia lucens</i>	13	4	1	1 ex/1%
<i>Eisenia fetida</i>	5,7,11,12,18,19,22	27	1; 3	8 ex/5%
<i>Lumbricus rubellus</i>	3,7,9,10,11,12,13,14,15,17,18 19,23,25,26	58	1; 2; 3	64 ex/43%
<i>Lumbricus terrestris</i>	1,11	8	1; 2	2 ex/1%
<i>Octalasion lacteum</i>	1,13	8	2; 3	2 ex/1%

Comparative analysis of the lumbricid fauna of Sarnena Sredna Gora Mts with its neighboring territories

When comparing the earthworm faunas of the three parts of Sredna Gora Mts (Table 3) (Sarnena, Sashtinska and Ihtimanska) 21 species belonging to nine genera were found in Sarnena Sredna Gora Mts. The published data of the other two parts Valchovski & Velizarova (2016) and Valcovski & Szederjesi (2016) include a total of 13 species, of which 10 species (48% of all for the mountain) for Ihtimanska and 9 species (43%) for Sashtinska Sredna Gora Mts. Six species were common for the three parts of the mountain (29%), and 8 species (38%) were characteristic only for Sarnena Gora Mts.

A total of 26 species were reported for Sarnena Gora Mts and Central Stara Planina Mts (Stojanovic et al. 2013) (Table 3). Eight species of them (31%) were common to both territories (*B. rubidus*, *C. rebeli*, *D. alpina*, *E. lucens*, *E. tetraedra*, *L. rubellus*, *L. terrestris* and *O. lacteum*); five species (19%) were found only in the Central Stara Planina Mts (*Allolobophora robusta robusta*, *Dendrobaena attemsi*, *Dendrobaena rhodopensis*, *Lumbricus polyphemus* and *Proctodrilus opisthoductus*) and 13 species (50%) were found only in Sarnena Gora.

The results of the comparison of the earthworm fauna between Sredna Gora Mts and the Upper Thracian Lowland (Mihailova 1966, Šapkarev 1986) showed 16 species (59%) common to both territories, and 6 species (22%) found only in the Thracian Lowland (*Allolobophora bulgarica*, *Cernosvitovia biserialis*, *Dendrobaena attemsi*, *Octodrilus complanatus*, *Proctodrilus antipai* and *P. tuberculatus*).

Determined only in Sarnena Gora and missing in all neighboring areas were 4 species (19%) (*Allolobophora leoni*, *D. balcanica*, *D. attemsi*, *D. octaedra*).

LUMBRICIDAE

Table 3. Distribution of lubricid species in Sredna Gora Mts, Upper Thracian Lowlands and Central Stara Planina Mts: SGSR – Sarnena Sredna Gora Mts; SGI – Ihtimanska Sredna Gora Mts; SGS – Sashtinska Sredna Gora Mts; TL – Upper Thracian Lowlands; SPC – Central Stara Planina Mts; (+) – our data ; MP – Mihailova (1966); V&V – Valchovski & Velizarova (2016); V&S – Valchovski & Szederjesi (2016); SJ – Sapkarev (1986); TT – Teofilova (2016); SM – Stojanovic et al. (2013).

No	Species	SGSR	SGS	SGI	TL	SPC
1	<i>Allolobophora bulgarica</i>				MP	
2	<i>Allolobophora chlorotica</i>	MP			MP; SJ	
3	<i>Allolobophora leoni</i>	+				
4	<i>Allolobophora robusta robusta</i>					SM e. a.
5	<i>Aporrectodea caliginosa</i>	MP		V&V	MP; SJ	
6	<i>Aporrectodea handlirschi</i>	+			MP; SJ	
7	<i>Aporrectodea jassyensis</i>	+ ; MP; V&S	+		MP	
8	<i>Aporrectodea longa</i>	+; MP			MP	
9	<i>Aporrectodea rosea</i>	+ ; MP; V&S	V&V	V&V; SJ	MP; SJ	
10	<i>Aporrectodea trapezoides</i>	MP		SJ	MP; SJ	
11	<i>Bimastos eiseni</i>	+		V&V	MP	
12	<i>Bimastos rubidus</i>	+	V&S	V&V	MP; SJ	SM e. a.
13	<i>Cernosvitovia biserialis</i>				MP	
14	<i>Cernosvitovia rebeli</i>	+	V&V	V&V	MP	SM e. a.
15	<i>Dendrobaena alpina</i>	+	V&V	V&V	MP	SM e. a.
16	<i>Dendrobaena attemsi</i>				MP	SM e. a.
17	<i>Dendrobaena balcanica</i>	+				
18	<i>Dendrobaena hortensis</i>	+; MP				
19	<i>Dendrobaena octaedra</i>	+				
20	<i>Dendrobaena rhodopensis</i>					SM e. a.
21	<i>Eisenia fetida</i>	+	+; V&S		MP; SJ	
22	<i>Eisenia lucens</i>	+; V&S			MP	SM e. a.
23	<i>Eiseniella tetraedra</i>	MP; V&S	+		MP; SJ	SM e. a.
24	<i>Lumbricus rubellus</i>	+; MP	V&V	V&V	MP; SJ	SM e. a.
25	<i>Lumbricus polyphemus</i>					SM e. a.
26	<i>Lumbricus terrestris</i>	+	V&V	V&V		TT
27	<i>Octodrilus complanatus</i>				MP	
28	<i>Octolasion lacteum</i>	+; MP		V&V	MP; SJ	SM e. a.
29	<i>Proctodrilus antipai</i>				MP	
30	<i>Proctodrilus opisthoductus</i>					SM e. a.
31	<i>Proctodrilus tuberculatus</i>				MP	
	number of species	21	9	10	22	13

During our field work, four species were not identified, but they were reported for the territory of Sarnena Gora Mts by other authors (Mihailova 1966, Uzunov 2010, Valchovski & Szederjesi 2016): *Allolobophora chlorotica*, *Aporrectodea caliginosa*, *Aporrectodea trapezoides* and *Eiseniella tetraedra*. *Allolobophora chlorotica* and *Eiseniella tetraedra* lead an

LUMBRICIDAE

amphibiotic life and are typical for habitats with very high humidity and wet soils. *Aporrectodea caliginosa* and *Aporrectodea trapezoides* are primarily terrestrial but are often found in close proximity to water bodies or swampy areas (Chekanovskaia 1962, Uzunov 2010). According to Uzunov (2010), although being terrestrial, these species have often been established in numerous hydrobiological researches in Bulgaria. A reason for their lack in our collections may be the impossibility to install and expose terrestrial traps in swampy, coastal and aquatic habitats.

Conclusions

Sarnena Sredna Gora has an extremely rich lumbricid fauna (21 species found, 42% of the lumbricid fauna of Bulgaria) which is probably due to the location of the studied area, its relief and contact areas and also sampling efforts.

The distribution of the identified species by localities and habitats shows the dependence of earthworms on the humidity of the environment, the presence of organic matter in the soil and the surface, the microclimatic conditions, the degree of anthropogenic interference and degradation of the habitats. The richest in species areas are with riparian or year-round wet habitats with naturally preserved vegetation and organic matter. The poorest are the degraded agricultural areas where the only species found is *Lumbricus rubellus* or it is also missing.

Four habitats in Sarnena Sredna Gora Mts, where 6 or 7 species were found, namely ridge old beech forest (site 5), mixed forests (sites 10 and 13) and a river bank near pasture with single old trees along with a riparian forest (site 11), can be used as a standard for high earthworms diversity.

The distribution of *Dendrobaena alpina* is indicative for the boundaries of the middle mountain belt in Sarnena Sredna Gora Mts.

The method with pitfall traps used is unique in terms of range and duration of the study, which can be used practically throughout the year. This method is used for the first time in studying the earthworm fauna. Further research and analysis is needed to promote, calibrate and unify it for the purposes of fauna and ecological studies of earthworms.

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LUMBRICIDAE

Appendix. Distribution, number of collected earthworm species from every sampling site and previous literature data for the region of Sarnena Sredna Gora Mts: M - Mihailova (1966); V&S - Valchovski & Szederjesi (2016).

Sampling sites	1	2	3	4	5	6	7	8	9	10	11	12	13
Altitude (m)	344	860	865	863	1100	975	1022	1015	1008	898	670	633	583
<i>Allolobophora chlorotica</i>													
<i>Allolobophora leoni</i>			1										
<i>Aporrectodea caliginosa</i>													
<i>Aporrectodea handlirschi</i>		1							2		1		
<i>Aporrectodea jassyensis</i>									1				
<i>Aporrectodea longa</i>					7								
<i>Aporrectodea rosea</i>										1	1		
<i>Aporrectodea trapezoides</i>													
<i>Aporrectodea</i> sp.	1	6			8				3	4	1	1	
<i>Bimastos eiseni</i>					1			1		2			
<i>Bimastos rubidus</i>	2				1		1						1
<i>Cernosvitovia rebeli</i>					3				1	1			
<i>Dendrobaena alpina</i>		1		1		4	4	3	4	2			1
<i>Dendrobaena balcanica</i>					3			1					
<i>Dendrobaena hortensis</i>	1									3	1		
<i>Dendrobaena octaedra</i>											1		6
<i>Dendrobaena</i> sp.		1		1	3	3	1		2	9	2		5
<i>Eisenia fetida</i>					2		1				1	1	
<i>Eisenia lucens</i>													1
<i>Eisenia</i> sp.											2		
<i>Eiseniella tetraedra</i>													
<i>Lumbricus rubellus</i>			2				1		2	5	4	1	2
<i>Lumbricus terrestris</i>	1										1		
<i>Lumbricus</i> sp.		2		1		5	3	1	4	9	12	1	3
<i>Octalasion lacteum</i>	1												1
Unidentified	1	4	4	2	14	4	7	3	9	22	2	5	16
number of species/specimens	5/6	3/15	2/7	2/5	6/42	2/16	4/18	4/9	5/28	6/58	7/29	3/9	6/36

LUMBRICIDAE

Appendix. Continued

Sampling sites	14	15	16	17	18	19	20	21	22	23	24	25	26		Total
Altitude (m)	366	353	386	487	449	418	435	406	363	280	288	290	290	M/V&S	
<i>Allolobophora chlorotica</i>														M	0
<i>Allolobophora leoni</i>															1
<i>Aporrectodea caliginosa</i>														M	0
<i>Aporrectodea handlirschi</i>															4
<i>Aporrectodea jassyensis</i>														M/ V&S	1
<i>Aporrectodea longa</i>														M	7
<i>Aporrectodea rosea</i>														M/ V&S	2
<i>Aporrectodea trapezoides</i>														M	0
<i>Aporrectodea sp.</i>		1		1					1						27
<i>Bimastos eiseni</i>			1												5
<i>Bimastos rubidus</i>															5
<i>Cernosvitovia rebeli</i>				6	1										12
<i>Dendrobaena alpina</i>															20
<i>Dendrobaena balcanica</i>															4
<i>Dendrobaena hortensis</i>														M	5
<i>Dendrobaena octaedra</i>															7
<i>Dendrobaena sp.</i>						1									0
<i>Eisenia fetida</i>					1	1			1						8
<i>Eisenia lucens</i>														V&S	1
<i>Eisenia sp.</i>			1												3
<i>Eiseniella tetraedra</i>														M/V& S	0
<i>Lumbricus rubellus</i>	5	8		1	5	5				2		4	17	M	64
<i>Lumbricus terrestris</i>															2
<i>Lumbricus sp.</i>		1	1		2	1		2		1	1		6		56
<i>Octalasion lacteum</i>														M	2
Unidentified	3	10	1	0	2	1	1	3	0	0	0	0	0		117
number of species/ specimens	1/8	2/20	3/4	3/8	3/11	3/9	0/1	1/5	2/2	1/3	1/1	1/4	1/23		381