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ICCBIKG 2021



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# BOOK OF PROCEEDINGS

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## DIVERSITY OF EARTHWORMS (CLITELLATA: OLIGOCHAETA) FROM SERBIAN SIDE OF ŠAR MOUNTAIN

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### Abstract:

This paper presents the currently known records on the diversity of earthworm fauna on Šar Mountain. The Šar Mt. is located in the south part of Serbia and is a part of the Šar-Pindus Mountain system. The complete list of present taxa of the family Lumbricidae in the researches area was formed by reviewing data from old collections, relevant literary sources and by its own field research in the period from 2019 to 2020. The list comprises 24 taxa, belonging to 10 genera of the family Lumbricidae. The genera with the largest number of the registered taxa are *Dendrobaena* (7) and *Aporrectodea* (5), while the genera *Bimastos*, *Eiseniella*, *Helodrilus*, *Octodrilus* and *Octolasion* are represented by one taxon. With respect to the zoogeographical analysis, the majority of the recorded taxa belong to the group of peregrine species (12). The endemic species are represented by two taxa and belong to the genera *Dendrobaena* and *Helodrilus*. The Balkan endemic subspecies *Helodrilus balcanicus plavensis* (Karaman, 1972) and illyric *Dendrobaena illyrica* (Cognetti, 1906), were recorded on new sites from the Šar Mt., that represent the southernmost limits of the geographical range of these species at the moment.

**Key words:** earthworms, Šar Mountain, zoogeography distribution

### 1. Introduction

The Šar Mountain is situated in the central part of the Balkan Peninsula, with the main ridgeline that is 85 km long, making the natural border line between Serbia in the North and North Macedonia in the South, partially between Serbia and Albania in the West. From the main plateau of Šar Mountain, having an average altitude of 2.000 to 2.100 m, 25 peaks are rising, reaching an altitude of more than 2.500 m. The highest peaks are Titov vrh (2.747 m) and Bistra (2.651 m). Šar Mountain marks the beginning of a separate morphotectonic massif of the Dinaric Alps, known in classical geological and geomorphological literature as the Šar-Pindus Mountain system. This mountain is distinguished the complex paleo-geographical changes in the past, refugial character during the Ice Age, very complex floristic composition, as well as a combination of various ecological conditions changing in a small area [1]. In biogeographical terms, Šar Mt. belongs to Mediterranean Central European, boreal and Central-South-European mountain region [2]. The earthworm fauna of Serbia is quite well-known. Stojanović et al. [3] recorded the presence of 77 lumbricid taxa in the country. It is worth mentioning that most of the earlier researches focused mainly on northern, western central and eastern Serbia [4-8], while only a few collecting expeditions were led to the areas of this mountain range.



The aim of this paper is to present the results of the recent collectings as well as the unpublished and literature data on the earthworm fauna in order to document the lumbricid diversity of the Šar Mt. and zoogeographical distribution of the taxa.

## 2. Material and Methodes

Our researches were carried out in 2019-2020 on the Šar Mountain (42°05' N; 20°50'E). Earthworms were collected using the diluted formaldehyde method complemented with digging (0.4 x 0.4 m<sup>2</sup>) and hand sorting as well as turning over rocks, debris and logs. Species identification was made according to the complex features provided in Mršić [9], Csuzdi & Zicsi [10] and Blakemore [11]. For each species in the list below, we represents distribution from literature data, unpublished data (name of collection/number in the collection, number of species, locality, habitat, date of sampling), author's data (number of species, locality, habitat, date of sampling) and zoogeographical distribution type as proposed by Csuzdi et al. [12].

## 3. Results and Discussion

The present research resulted in reporting altogether 24 earthworm taxa from different parts of the Šar Mt. The genera *Dendrobaena* and *Aporrectodea*, represented by seven and five taxa respectively are the dominant faunal component of the earthworms from Šar Mt. The remaining registered taxa belong to the genera which shown in Table 1. Chronologically these species can be allocated to eight different types of zoogeographical distribution (Table 1). The earthworm fauna of the Šar Mt., is highly peregrine (12 taxa). In this area, the endemic taxa were represented by two taxa belonging to the genera *Dendrobaena* and *Helodrilus*.

Table 1. List of the earthworm taxa from the Šar Mountain classified to zoogeographical distribution types

| Taxa  | Distribution          | Localities (Literature data, unpublished data from collection, author's data)   |
|---|-----------------------|---|
| <i>Allolobophora chlorotica</i> (Savigny, 1826)           | Peregrine             | Uroševac (Šapkarev, 1975); CEKUS/214 2 exp., Dragaš (42°03'N,20°39'E), meadow, 01.05.1990;  |
| <i>Allolobophora leoni</i> Michaelsen, 1891               | Trans-Aegean          | Uroševac (Šapkarev, 1975);  |
| <i>Aporrectodea caliginosa caliginosa</i> (Savigny, 1826) | Peregrine             | Uroševac (Šapkarev, 1972); Prizren, Uroševac (Šapkarev, 1975); CEKUS/209 3 exp., Dragaš, meadow 01.05.1990; CEKUS/210 2 exp., Ljubovište, meadow 07.01.1992; CEKUS/211 3 exp., Dragaš, meadow 01.05.1992; CEKUS/212 1 exp., Dragaš, arable land 01.05.1992;   |
| <i>Aporrectodea caliginosa trapezoides</i> (Duges, 1828)  | Peregrine             | CEKUS/213 1 exp., Ljubovište (42°03'N,20°45'E), 01.05.1990; 1 exp., Dublice (42°23'N,21°01'E), 05.05.2019;  |
| <i>Aporrectodea georgii</i> (Michaelsen, 1890)            | Atlanto-Mediterranean | Uroševac (Šapkarev, 1972); CEKUS/208 1 exp., Dragaš, 01.05.1990;  |
| <i>Aporrectodea jassyensis</i> Michaelsen, 1891           | Trans-Aegean          | Uroševac (Šapkarev 1972); Prizren (1975);   |
| <i>Aporrectodea rosea</i> (Savigny, 1826)                 | Peregrine             | Uroševac (Šapkarev 1975); CEKUS/201 5 exp., Dragaš, 01.05.1990; CEKUS/202 1 exp., Dragaš, 07.07.1990; CEKUS/203 2 exp., Dragaš, 08.07.1990; CEKUS/204 3 exp., Dragaš, 22.02.1992; CEKUS/205 1 vexp., Dragaš, 01.05.1990; CEKUS/206 2 exp., Dragaš, 22.02.1992; CEKUS/207 6 exp., Dragaš, 22.02.1992; 1 exp., Viča (42°15'N,21°04'E), 12.03.2019; 3 exp., Popovce (43°04'N,20°47'E), 05.05.2019; 2 exp., Berevce, (42°14'N,20°01'E), 05.05.2019; 2 exp., Štrpce (42°14'N,21°01'E), 05.05.2019; 2 exp., Štrpce, 06.06.2020; |
| <i>Bimastos rubidus</i> (Savigny, 1826)                   | Peregrine             | Brezovica (Zicsi, 1972); Uroševac (Szederjesi, 2019); CEKUS/200 1 exp., Dragaš, anthropogenic biotope, 22.02.1992;  |
| <i>Dendrobaena alpina alpina</i> (Rosa, 1884)             | Balkan-Alpine         | Brezovica (Zicsi, 1972);  |
| <i>Dendrobaena attemsi</i> (Michaelsen, 1902)             | Balkan-Alpine         | Šar Mt. (Černosvitov, 1931);  |
| <i>Dendrobaena byblica byblica</i> (Rosa, 1893)           | Circum-Mediterranean  | Šar Mt. (Černosvitov, 1931); Šar Mt. (Karaman, 1969, 1971); Ljuboten (Šapkarev, 1972); Ljuboten (Šapkarev, 1975);   |
| <i>Dendrobaena illyrica</i> (Cognetti, 1906)              | Illyric               | 2 exp., Viča, 12.03.2019;   |
| <i>Dendrobaena jahorensis</i> Mršić, 1991                 | Endemic               | Uroševac (Szederjesi, 2019).  |
| <i>Dendrobaena octaedra</i> (Savigny, 1826)               | Peregrine             | Šar Mt. (Karaman, 1971); Ljuboten (Šapkarev, 1972); 3 exp., Viča, 12.03.2019;   |

|  |                  |  |
|--|------------------|--|
| <i>Dendrobaena platyura</i> (Fitzinger, 1833)          | Central European | CEKUS/218 2 exp., Ljubovište, 07.05.1992;  |
| <i>Eisenia fetida</i> (Savigny, 1826)                  | Peregrine        | CEKUS/216 1 exp., Ljubovište, 01.05.1990;  |
| <i>Eisenia lucens</i> (Waga, 1857)                     | Central European | Ljuboten (Šapkarev, 1971, Šapkarev, 1972);   |
| <i>Eiseniella tetraedra tetraedra</i> (Savigny, 1826)  | Peregrine        | CEKUS/217 1 exp., Ljubovište, 05.05.1990;  |
| <i>Helodrilus balcanicus plavensis</i> (Karaman, 1972) | Endemic          | CEKUS/218 2 exp., Dragaš, 08.07.1990;  |
| <i>Lumbricus castaneus</i> (Savigny, 1826)             | Peregrine        | Ljuboten (Šapkarev, 1972);   |
| <i>Lumbricus rubellus</i> Hoffmeister, 1843            | Peregrine        | Prizren (Szederjesi, 2019); CEKUS/219 2 exp., Ljubovište, 08.05.1990; CEKUS/220 1 exp., Dragaš, 22.02.1992; CEKUS/221 3 exp., Dragaš, 22.02.1992; CEKUS/222 4 exp., Dragaš, 08.04.1992; 5 exp., Viča, meadow 12.03.2019; 2 exp., Štrpce meadow 06.06.2020; |
| <i>Lumbricus terrestris</i> Linnaeus, 1758             | Peregrine        | 12 exp., Viča, 13.10.2019;   |
| <i>Octodrilus transpadanus</i> (Rosa, 1884)            | Trans-Aegean     | Ljuboten (Šapkarev, 1972); CEKUS/223 3 exp., Dragaš, 08.07.1990; CEKUS/224 2 exp., Dragaš, 22.02.1992;   |
| <i>Octolasion lacteum</i> (Örley, 1881)                | Peregrine        | Prizren (Šapkarev, 1975); CEKUS/225 1 exp., Ljubovište, 08.07.1990; CEKUS/226 2 exp., Dragaš, 22.02.1992; CEKUS/1228 1 exp., Berevce, 05.05.2019; CEKUS/1333 2 exp., Štrpce, 06.06.2020;   |

According to Szederjesi [8], the Balkan endemic *D. jahorensis* has been found for the first time in Kosovo and Metohija. Hence, the number of earthworm taxa present in Serbia is now 78. So far, Mršić [9] has found this species only at one locality in Bosnia and Herzegovina (Jahorina Mountain). According to Trakić et al. [13], *D. jahorensis* has a narrow geographical range in the Balkans. However, research conducted by Szederjesi [8] has shown that this species belongs to the group of broad-ranged Balkans taxa. *Helodrilus balcanicus plavensis*, is a broad-ranged Balkan endemic taxon, present in the western part of Montenegro as well as in the broader area of Serbia [3]. The new locality from the Šar Mt., represents the southernmost limit of the geographical range of this species at the moment. *D. illyrica* belongs to the Illyrian zoogeographical type. It is mostly represented in the north-western part of the Balkans. It is only sporadically registered in Montenegro and in the southwestern parts of Serbia. Namely, our findings extended its area of distribution to the south and currently represent the southernmost limit of the geographical range of this species (Fig. 1).

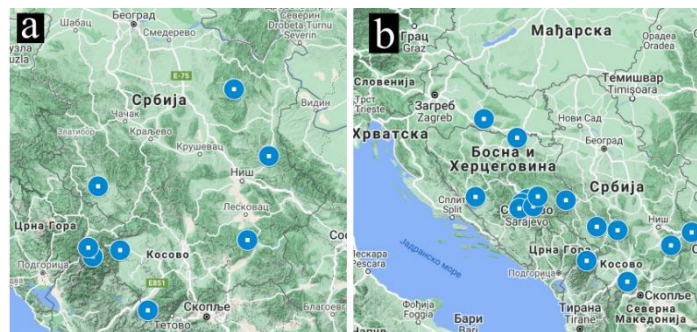


Fig. 1. Distribution map of **a.** *Helodrilus balcanicus plavensis* and **b.** *Dendrobaena illyrica* in the Balkan Peninsula as well as the southernmost limits of the geographical range of these species in the south part of Serbia

#### 4. Conclusion

Overall, the first list of known earthworm taxa in the area of Šar Mt. comprises 24 taxa with only two endemic taxa which are much lower in comparison to 28 endemic taxa distributed in Serbia. Even though our knowledge of the distribution of earthworm taxa in the Šar Mt., is far from complete, our study noted significant faunistic observations. So, we have found an extension of the known distribution of taxa *H. balcanicus plavensis* and *D. illyrica* to the south, in Serbia. If we consider the fact that the territory of the Šar Mt. represents glacial refugia in the Balkan Peninsula, we expect more species, particularly endemic taxa, in further research on this mountain.

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## RESEARCH ON THE FAUNA OF EARTHWORMS (OLIGOCHAETA, LUMBRICIDAE) IN ĐERDAP NATIONAL PARK

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### Abstract:

Đerdap National Park is located in the southeastern part of Europe, in the northeastern part of Serbia, on the border with Romania. This paper presents the currently known records on the diversity of earthworm fauna in Đerdap National Park. The number of species from family Lumbricidae known to be occurring in the studied region is 29 species from 11 genera. The genera with the largest number of the registered taxa are *Dendrobaena* (8) and *Aporrectodea* (7). A third of all species are peregrines (37.93%). Trans-Aegean species take part with 13.8%, followed by endemic, Central European, Balkanic-Alpine (10.34%). Then follow Illyric (6.90%) and slightly less Moesian, Circum-Mediterranean, and Southern-Alpine (3.45%). Endemic species take a part with three taxa. Only one species (*Allolobophora mehadiensis boscaiui* (Pop, 1948)) is Dacian endemic. The obtained results indicate a diverse Lumbricidae fauna. It is certainly necessary to continue with intensive research in order to preserve the biological diversity of this area.

**Key words:** earthworms, Đerdap National Park, Serbia, diversity, zoogeography

### 1. Introduction

It is known that Serbia as a hot spot of biodiversity in the Balkans is well studied [1]. This is confirmed by a large number of endemic and relict species, especially among invertebrates, including earthworms. However, there are still no data on these organisms of National parks in Serbia. Đerdap National Park is located in the southeastern part of Europe, in the northeastern part of Serbia, on the border with Romania. First data on earthworms in this area date from the end of the last century [1]. Further research in this territory was sporadic and conducted as part of the earthworm research of the former Yugoslavia [2] or in frame research of Serbia [3].

National parks represent the highest level of protection of the natural area in our country. Đerdap National Park is habitat for over 150 birds' species. The mammal fauna is also diverse and numerous, as are insects, especially diurnal butterflies. However, earthworms were neglected, for no reason. So we explored the area of Đerdap National Park. This paper presents the currently known records on the diversity of earthworm fauna, including literature data and new data from the field.



## 2. Material and Methodes

Đerdap National Park represent natural border between Serbia and Romania. The landforms are closely related to the geological composition and tectonic structure, which caused the heterogeneity of the landscape [4]. The largest part of the national park is the Đerdap Gorge, the morphological features of which show that it was formed by the successive incision of the Danube into the Carpathian Mountain massif. Watercourses belong to the Danube river basin. The climate is continental. Earthworms were collected using the diluted formaldehyde method complemented with digging (0.4 m x 0.4 m) and hand sorting as well as turning over rocks, debris and logs. Species identification and zoogeographic analysis were made according to the literature data [1, 5, 6, 7].

## 3. Results and Discussion

The number of species from family Lumbricidae known to be occurring in the studied region is 29 species from 11 genera. The genera with the largest number of the registered taxa are *Dendrobaena* (8) and *Aporrectodea* (7). According to our zoogeographic analysis, a third of all species are peregrines (37.93%), followed by Trans-Aegean (13.8 %), endemic, Central European, Balkanic-Alpine (10.34%), Illyric (6.90%) and Moesian, Circum-Mediterranean, and Southern-Alpine (3.45%) (Table 1).

Table 1. Classification of ecological categories and zoogeographic distribution type

| Species   | Habitat   | Ecological category | Zoogeographic type |
|---|---|---------------------|--------------------|
| <i>Allolobophora leoni</i> Michaelsen, 1891           | mesophil meadow (authors' data)   | endogeic            | Trans-Aegean       |
| <i>Allolobophora mehadiensis boscaiui</i> (Pop, 1948) | oak forest, meadow with a nut tree, orchard (Szederjesi, 2012)  | anecic              | Dacian endemic     |
| <i>Allolobophora robusta</i> Rosa, 1895               | cave, beech, mixed and oak forests, orchard, fragment on a pasture (Mršić, 1991; Szederjesi, 2012)  | anecic              | Moesian            |
| <i>Allolobophora sturanyi sturanyi</i> Rosa, 1895     | dry oak forest (Szederjesi, 2012)   | endogeic            | Illyric            |
| <i>Aporrectodea caliginosa</i> (Savigny, 1826)        | mesophil meadow (authors' data)   | endogeic            | Peregrine          |
| <i>Aporrectodea cemernicensis</i> Mršić, 1991         | stream valley with young forest (Szederjesi, 2012)  | endogeic            | Balkan endemic     |
| <i>Aporrectodea handlirschi</i> (Rosa, 1897)          | limestone rocks and secondary forest, (Szederjesi, 2012)  | endogeic            | Trans-Aegean       |
| <i>Aporrectodea jassyensis</i> Michaelsen, 1891       | valley meadow, mixed forest (authors' data)   | endogeic            | Trans-Aegean       |
| <i>Aporrectodea rosea</i> (Savigny, 1826)             | cave, mesophil meadow, bech and oak forests (Mršić, 1991; authors' data)  | endogeic            | Peregrine          |
| <i>Aporrectodea sineporis</i> (Omodeo, 1952)          | stream valley with oak forest at the edge of the village, beech forest (Szederjesi, 2012)   | epigeic             | Balkanic-Alpine    |
| <i>Aporrectodea trapezoides</i> (Duges, 1828)         | mesophil meadow, beech forest (authors' data)   | endogeic            | Peregrine          |
| <i>Bimastos eiseni</i> (Levinsen, 1884)               | old beech forest, alder forest along a stream, (Szederjesi, 2012)   | epigeic             | Peregrine          |
| <i>Bimastos rubidus</i> (Savigny, 1826)               | stream valley, beech forest, alder forest along a stream (Szederjesi, 2012); beech and oak forests, mesophil meadow, cave (authors' data) | epigeic             | Peregrine          |

|   |   |          |                      |
|---|---|----------|----------------------|
| <i>Cernosvitovia getica</i> (Pop, 1947)         | banks of streams, cave (Mršić & Šapkarev, 1987; Mršić, 1991)  | epigeic  | Balkan endemic       |
| <i>Dendrobaena alpina alpina</i> (Rosa, 1884)   | oak and beech forests, alder forest along a stream (Szederjesi, 2012)                                     | epigeic  | Balkan-Alpine        |
| <i>Dendrobaena attemsi</i> (Michaelsen, 1902)   | beech forest (Szederjesi, 2012)   | epigeic  | Balkan-Alpine        |
| <i>Dendrobaena byblica byblica</i> (Rosa, 1893) | stream valley with oak forest at the edge of the village (Szederjesi, 2012); beech forest (authors' data) | epigeic  | Circum-Mediterranean |
| <i>Dendrobaena depressa</i> (Rosa, 1893)        | stream valley with oak forest at the edge of the village, beech forest (Szederjesi, 2012)                 | anecic   | Central European     |
| <i>Dendrobaena hortensis</i> (Michaelsen, 1890) | quarry (Szederjesi, 2012)   | epigeic  | Peregrine            |
| <i>Dendrobaena illyrica</i> (Cognetti, 1906)    | beech forest (authors' data)  | epigeic  | Illyric              |
| <i>Dendrobaena octaedra</i> (Savigny, 1826)     | beech forest (Szederjesi, 2012); beech and oak forests, cave (authors' data)                              | epigeic  | Peregrine            |
| <i>Dendrobaena veneta</i> (Rosa, 1886)          | quarry (Szederjesi, 2012)   | epigeic  | Peregrine            |
| <i>Eisenia lucens</i> (Waga, 1857)              | beech forest (Szederjesi, 2012); beech forest (authors' data)   | epigeic  | Central European     |
| <i>Eiseniella tetraedra</i> (Savigny, 1826)     | mesophil meadow, beech and oak forests (authors' data)  | epigeic  | Peregrine            |
| <i>Lumbricus polyphemus</i> (Fitzinger, 1833)   | cave, mixed beech forest (Mršić, 1991; Szederjesi, 2012)  | anecic   | Central European     |
| <i>Lumbricus rubellus</i> Hoffmeister, 1843     | cave, mesophil meadow, beech and oak forests (Mršić, 1991; authors' data)                                 | epigeic  | Peregrine            |
| <i>Octolasion lacteum</i> (Örley, 1881)         | cave, beech forest, beech-alder forest with stream (Mršić, 1991; Szederjesi, 2012)                        | endogeic | Peregrine            |
| <i>Perelia gestroi</i> (Cognetti, 1905)         | mesophil meadow (authors' data)   | anecic   | Southern-Alpine      |
| <i>Proctodrilus opisthoductus</i> Zicsi, 1985   | meadow with a nut tree (Szederjesi, 2012)   | endogeic | ?                    |

Out of the three endemic species, two are endemics of the Balkans (*Ap.cemernicensis* Mršić, 1991 and *C. getica* (Pop, 1947)) and one is Dacian endemic (*All. mehadiensis boscaiui* (Pop, 1948)). Species *Ap. cemernicensis* is an endemic of the central part of the Balkans peninsula. According to Szederjesi [2], *Ap.cemernicensis* has been found for the first time in Serbia, right in the National Park Đerdap. Another locality in Serbia is known, Prnjavor [8]. Species *C. getica* is an endemic, more widespread in the east Serbia and the southwestern part of Romania [9]. Dacian endemics are the most representative element in endemic earthworm fauna of the Romanian Carpathians [7]. Spreading widespread Dacian endemics occupy lower altitudes [8] and inhabit the Pannonian Plain between the Carpathians and the Danube, therefore, it is not surprising that *All. mehadiensis boscaiui* is present in this national park. Also, this species registered in east Vojvodina [11]. Species *All. sturanyi sturanyi* belongs to the Illyrian zoogeographical type. The first time found in Đerdap 2013 [2]. This species occupies the northern part of the Western Balkans [1, 2, 11, 12]. Also, *D. illyrica* belongs to the same type, and it's sporadic registered in Montenegro and in the southern parts of Serbia [3]. In the Đerdap National Park, it was registered for the first time in our research.

## 5. Conclusion

The first list of known earthworm taxa in the research area comprises 29 taxa with only three endemic taxa. But, we cannot ignore the appearance of species with other types of distribution (Balkan-Alpine, Illyric, Moesian) that indicate the autochthonous character of the earthworm fauna.

Based on our results, it is necessary to continue the intensive research in order to preserve the biological diversity of the area.

### Acknowledgments

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## DISTRIBUTION OF ENDEMIC SPECIES *CERNOSVITOVIA DUDICHI* IN SERBIA

Tanja B. Trakić<sup>1</sup>, Mirjana M. Stojanović<sup>1</sup>, Filip J. Popović<sup>1</sup>, Slobodanka B. Radosavljević<sup>1</sup> and Jovana M. Sekulić<sup>2</sup>

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### Abstract:

The genus *Cernosvitovia* consists of nine species in the whole world. Out of the nine species, eight species are with primary distribution in the eastern part of the Balkan Peninsula (except *Cernosvitovia schweigeri*). In the Lumbricidae fauna of Serbia, seven species from this genus have been registered. Among them, 6 taxa are endemic. The aim of this paper is to present new data of the endemic species *Cernosvitovia dudichi* Zicsi & Šapkarev, 1982, based on the current taxonomic status of species, literature data, and our unpublished data. In this paper, we have summarized the knowledge on the geographic distribution, biology, and habitat *C. dudichi* in Serbia. Our recent investigations have revealed new records for *C. dudichi* in Central Serbia. After 30 years, this species was found in another place in this area, in Goč Mt. New locality suggests that *C. dudichi* possess a wider range than it was previously thought.

**Key words:** earthworm; endemic species; *Cernosvitovia dudichi*; Serbia

### 1. Introduction

The species from genus *Cernosvitovia* are distributed on the Balkan Peninsula, in the Southern Carpathians and Asia Minor [1, 2]. Genus *Cernosvitovia* is a typical endemic genus with a total of nine species that have been described so far (eight are from the Balkans and one species from the Marmara region of Asia Minor). According to the literature Stojanović et al. [3], it seems that the species diversity from genus *Cernosvitovia* is the highest in Serbia. Out of the seven species, six are endemic, most widespread along with the Serbo-Macedonian tectonic plate. It spreads primarily throughout the Rhodope (Balkan) tectonic plate. The high number endemic of *Cernosvitovia* species in Serbia is obvious even in comparison with neighboring zones, where recent studies serve as a comparison [3].

*Cernosvitovia dudichi* Zicsi & Šapkarev, 1982 was the first described in Serbia, Jastrebac Mt. [4] and, has not been reported another place so far. *C. dudichi* belongs to the endemic species [5], distributed in a southeast part of the Balkan Peninsula. Until now, the southernmost limit of the species is the central part of Serbia [4-7]. Our recent investigations have revealed new records for *C. dudichi* in Serbia. After 30 years, this species was found in another place in central Serbia. A new investigated locality (Goč) could contribute to better insight into the spread of this species.

The objective of this paper is to analyze the whole list of records of *C. dudichi* to present a general overview of its distribution on the Balkan Peninsula. Additionally, our study records an extension of the known distribution of *C. dudichi* to the northwest.



## 2. Material and methods

We used data on species obtained from the old Institute's collection (from Faculty of Science, Kragujevac, Serbia) that relate to undetermined material collected in the central part of Serbia. All published and unpublished data currently known were included. Earthworms were collected by the formalin method, digging (0.4 x 0.4 m) and hand sorting (as well as by turning over rocks, debris, and logs). The earthworms were killed in 70% ethanol, immediately fixed in 4% formalin solution, and later stored in 90% ethanol. The collected species were identified in the laboratory of the Faculty of Science in Kragujevac, Serbia. Species identification was made according to the complex features provided in Šapkarev [8], Zicsi [9] Mršić [6], Csuzdi & Zicsi [1] and, Blakemore [10].

## 3. Results and Discussion

### *Cernosvitovia dudichi* Zicsi & Šapkarev, 1982

*Cernosvitovia dudichi* Zicsi & Šapkarev, 1982: 181.

*Cernosvitovia dudichi*: Karaman 1987: 71; Trakić *et al.* 2016: 259; Stojanović *et al.* 2018: 135.

*Cernosvitovia (Zicsiona) dudichi*: Mršić & Šapkarev 1987: 71; Mršić & Šapkarev 1988: 13; Mršić 1991: 149; Csuzdi 2012: 97–99.

#### *Description of the species*

Body cylindrical, the length of body 82-132 mm, and consisting of 173-191 body segments. The prostomium is epilobous. The first dorsal pore is in intersegmental groove 8/9. The male aperture openings on the 26th segment. The distance between the hetae in the preclitral part is  $2bc = aa$ ;  $bc = 3ab$  and in the postclitral part  $ab = 1.5bc$ ;  $ab = cd$ . Glandular papillae surround setae  $ab$  on 12th, 15th, 17th or 12th, 15th, 18th, 20th and 34th or 13th, 15th, 17th, 22nd and, 23rd segments. The clitellum extends from the 23-32 segment. The *tubercula pubertatis* is located on the 24-31 segment (Fig. 1). The septa are thickened from 5/6 to 8/9. Four pairs of seminal vesicles in the 9th to the 12th segment. Lateral hearts 6-11. The crop occupies segments 15-16 and the gizzard is in 17-19. Testes and sperm funnels in 10 and 11 segments, free. Two pairs of spermathecae in the 11th and 12th segments. The calciferous glands have lateral tubercles in the 9-12 segment.

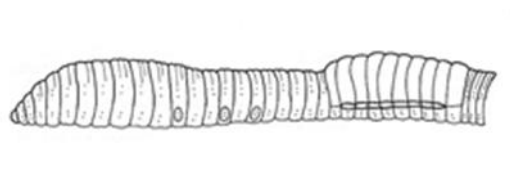


Fig. 1. Anterior part of the body of species *Cernosvitovia dudichi*  
source [6]

**Ecology:** *Cernosvitovia dudichi* inhabits meadows and oak forests [5,11]. It belongs to the endogeic species.

**Distribution in Serbia:** Jastrebac, 1 exp., oak forest, 25.11.1979. [4-7].

**Old Institute collection:** Goč, 3 exp., oak forest, 13.04.2009.; 1 exp., meadows, 18.04.2009. (Fig. 2).

**General distribution:** *Cernosvitovia dudichi* is an endemic species, recorded in the central part of Serbia [3].

**Remarks:** Analysis of a very old Institute collection has shown that *C. dudichi* is also present at one place in the central part of Serbia.

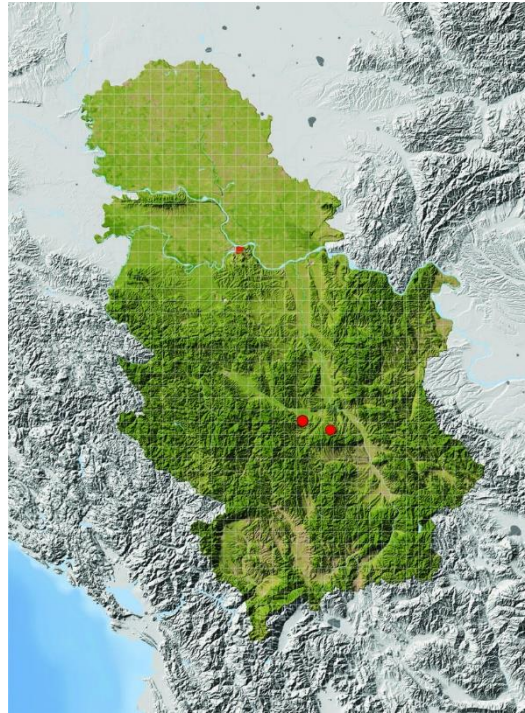


Fig. 2. Distribution of *Cernosvitovia dudichi* in Serbia (UTM 10 x 10 km)

The geomorphology of the Balkan Peninsula, a somewhat warmer climate, and its position in relation to most of Europe have enabled the Balkan Peninsula, including the territory of Serbia, to become one of the most important refuge centers of European fauna, which is the reason for great biodiversity. The largest number of endemic species, in Europe, is represented in the Balkan and Iberian Peninsula and to a lesser extent in the Carpathians and Caucasus [12,13]. The cause of this wealth lies in the specific geographic location of Serbia, on the border between two biogeographical regions (Pannonian and Balkan). So far, recorded 77 taxa from 13 genera [3], with as many as 25 endemic taxa. Among the endemics, there are several typical ones that exclusively occur in the Balkan Peninsula. Such are the endemics from the genus *Cernosvitovia*, which is classified in the archaic group. These are archaic (old) species that, with their adaptability to specific conditions, have survived to this day. Archaic species are now present in the Balkans, the Pyrenees and the Apennine Peninsula, the northwestern part of Africa (Maghreb), the southern part of France, Sardinia, Corsica, the southern parts of Switzerland and the Czech Republic, Turkey, and the central parts of Asia. Today, these archaic species are relics or endemic forms that possess more of certain adaptive properties than the relic elements (*Cernosvitovia biserialis*, *C. crainensis*, *C. dudichi*, *C. getica*). Based on the number of endemic *Cernosvitovia* species in the Balkans, it is clear these areas are the most important centers of diversity of this genus. So far, *C. dudichi* has been found at high altitudes from 1000 to 1,500 m a.s.l. These data together with our results indicate that the habitat of *C. dudichi* is mainly in the high mountains. Considering an extension of the distribution of *C. dudichi* to the northwest, it is possible to assume that the species of this genus are mostly spread along with the Serbo-Macedonian tectonic plate.

#### 4. Conclusion

Despite our intensive search, *C. dudichi* has not been found in other regions of the central parts of the Balkans. Nevertheless, the very fact that *C. dudichi* has occurred in the new locality, gives us the right to expect further expansion of a greater number of individuals into Serbia. Our knowledge of the distribution and abundance of *C. dudichi*, is still imperfect. However, new findings greatly expand the known range of the species and genus. Therefore, our study serves as a guideline and stimulus for further work on its improvement and revision.

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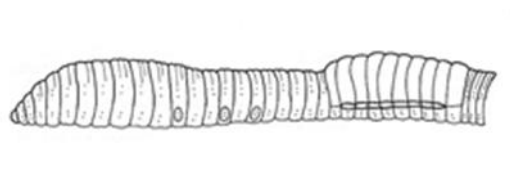


Fig. 1. Anterior part of the body of species *Cernosvitovia dudichi*  
source [6]

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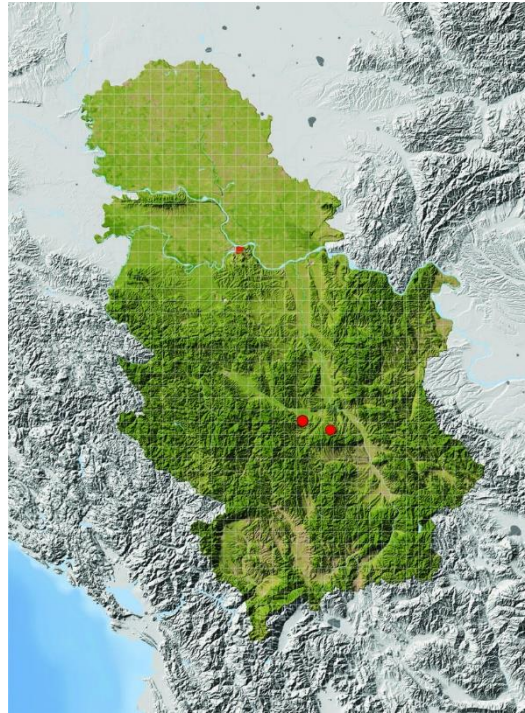


Fig. 2. Distribution of *Cernosvitovia dudichi* in Serbia (UTM 10 x 10 km)

The geomorphology of the Balkan Peninsula, a somewhat warmer climate, and its position in relation to most of Europe have enabled the Balkan Peninsula, including the territory of Serbia, to become one of the most important refuge centers of European fauna, which is the reason for great biodiversity. The largest number of endemic species, in Europe, is represented in the Balkan and Iberian Peninsula and to a lesser extent in the Carpathians and Caucasus [12,13]. The cause of this wealth lies in the specific geographic location of Serbia, on the border between two biogeographical regions (Pannonian and Balkan). So far, recorded 77 taxa from 13 genera [3], with as many as 25 endemic taxa. Among the endemics, there are several typical ones that exclusively occur in the Balkan Peninsula. Such are the endemics from the genus *Cernosvitovia*, which is classified in the archaic group. These are archaic (old) species that, with their adaptability to specific conditions, have survived to this day. Archaic species are now present in the Balkans, the Pyrenees and the Apennine Peninsula, the northwestern part of Africa (Maghreb), the southern part of France, Sardinia, Corsica, the southern parts of Switzerland and the Czech Republic, Turkey, and the central parts of Asia. Today, these archaic species are relics or endemic forms that possess more of certain adaptive properties than the relic elements (*Cernosvitovia biserialis*, *C. crainensis*, *C. dudichi*, *C. getica*). Based on the number of endemic *Cernosvitovia* species in the Balkans, it is clear these areas are the most important centers of diversity of this genus. So far, *C. dudichi* has been found at high altitudes from 1000 to 1,500 m a.s.l. These data together with our results indicate that the habitat of *C. dudichi* is mainly in the high mountains. Considering an extension of the distribution of *C. dudichi* to the northwest, it is possible to assume that the species of this genus are mostly spread along with the Serbo-Macedonian tectonic plate.

#### 4. Conclusion

Despite our intensive search, *C. dudichi* has not been found in other regions of the central parts of the Balkans. Nevertheless, the very fact that *C. dudichi* has occurred in the new locality, gives us the right to expect further expansion of a greater number of individuals into Serbia. Our knowledge of the distribution and abundance of *C. dudichi*, is still imperfect. However, new findings greatly expand the known range of the species and genus. Therefore, our study serves as a guideline and stimulus for further work on its improvement and revision.

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