

Remarks on the *Dendrobaena kozuensis* (Šapkarev, 1971) species group (Oligochaeta, Lumbricidae)

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Abstract. New material of the earthworm species *Dendrobaena kozuensis* were collected from a cave in the Lovćen Mts. in Montenegro. In this study, a detailed morphological description of the specimens is given and the relationships of this species are discussed from a morphological point of view.

Keywords. Earthworms, Oligochaeta, Montenegro, Cave fauna.

INTRODUCTION

The earthworm species *Dendrobaena kozuensis* (Šapkarev, 1971) was described as *Allolobophora kozuensis* from Kožuf Planina, North Macedonia. As it showed several peculiar morphological characteristics (e.g. the pinkish clitellum on 22–29, 30, tubercles on 23–27, 28, remarkably widely standing setae), Šapkarev (1971) could not really relate it to any other earthworm species.

Meanwhile, Karaman (1972) described *Dendrobaena montenigrina* from the cave Nerodova Pećina, Elaso Do, Montenegro. He thought this new species being closest morphologically to the Central Asian *D. fedtschenkoi* (Michaelsen, 1910) due to their greyish yellow pigmentation, first dorsal pore in 10/11, gizzard in 17–18 and the lack of calciferous diverticula.

However, instead of a Central Asian relationship, this species shows significant similarities with *D. kozuensis* regarding its clitellum (22–29), tubercles (24–27), the two pairs of vesicles, the small male pore and the lack of calciferous diverticula. Consequently, Šapkarev (1975) synonymized *D. montenigrina* with *D. kozuensis*.

Some remarkable, morphologically close species are also known from the Balkan Peninsula. They share many characteristics, including similar positions of the clitellum and tubercles, very small male pores, and the absence of calciferous diverticula. These are *D. bokakotorensis* Šapkarev, 1975 described from Perast, Montenegro, and the Albanian endemics, *D. feheri* Szederjesi & Csuzdi, 2017 and *D. skipetarica* Szederjesi & Csuzdi, 2017. According to the molecular phylogenetic analysis of Szederjesi *et al.* (2017) the latter two species showed relationship with the *D. byblica* (Rosa, 1893) group and joined that clade basally, together with *D. loebli* (Zicsi, 1985) distributed in the western part of Turkey and Eastern Greece. However, a recent phylogenetic study including a large number of *Dendrobaena* species refuted this result, showing that the Albanian *D. skipetarica* and the *D. byblica* species group are far from each other (Szederjesi *et al.* 2025).

The present study aims to provide a detailed morphological description of the new *D. kozuensis* material and evaluate its relationships.

MATERIAL AND METHODS

Earthworms were collected by hand-sorting. The specimens were killed and fixed in 96%

ethanol. The samples were placed in the earth-worm collection of the Eszterházy Károly Catholic University (EKCU-OLIG).

RESULTS

Dendrobaena kozuensis (Šapkarev, 1971)

Allolobophora kozuensis Šapkarev, 1971: 155.
Dendrobaena montenigrina Karaman, 1972: 96.
Dendrobaena kozuensis: Šapkarev 1975: 31.
Dendrobaena (Dendrobaena) kozuensis: Šapkarev 1978: 295.
Dendrobaena kozuensis: Mršić 1991: 564, Csuzdi 2012, Stojanović *et al.* 2018: 138, Popović *et al.* 2025: 221.

Material examined. EKCU-OLIG-34 2 ex., Montenegro, Lovćen Mts, Poda, cave, N42°22'50.17" E18°48'44.9", 150 m, from mud and wall, 02.08.2025, leg. S. Gyarmati, L. Dányi.

External characters. 26–27 mm long and 4 mm wide. Number of segments 61–62. Colour pale. Prostomium epilobous 1/3 closed. First dorsal pore invisible. Setae widely paired. Setal arrangement behind clitellum: *aa:ab:bc:cd:dd* = 1.67:1:1.13:1.33:4.46. Male pores very small on segment 15, hardly seen. Nephridial pores aligned

in setal line *b*. Clitellum on segments ½ 22, 23–27, ½ 28, yellow coloured. Tubercula pubertatis on segments 24–26. Glandular tumescences not seen (Figure 1).

Internal characters. All septa membranous. Testes and funnels paired in segments 10–11. Two pairs of seminal vesicles in 11 and 12. Spermathecae two pairs in 9/10, 10/11 with external openings near setal line *d*. Calciferous glands without diverticula. Last pair of hearts in 11, with extraoesophageal vessels in 12. Nephridial bladders simple, sausage-shaped. Crop in segments 15–16, and gizzard in segments 17–18. Typhlosolis unilobous. Longitudinal musculature of pinnate type.

Remarks. From a morphological point of view, our specimens show a transitional state between *D. kozuensis* and *D. montenigrina* regarding its clitellar organs (cl. ½ 22, 23–27, 28, tb. 24–26 vs. *D. kozuensis* cl. 22–29, 30, tb. 23–27, 28; *D. montenigrina* cl. 22–29, tb. 24–27), which can validate the synonymy by Šapkarev (1975). In any other characters, they are highly similar with the original description of *D. kozuensis*.

The main characteristics of *D. kozuensis* and the similar species are shown in Table 1.

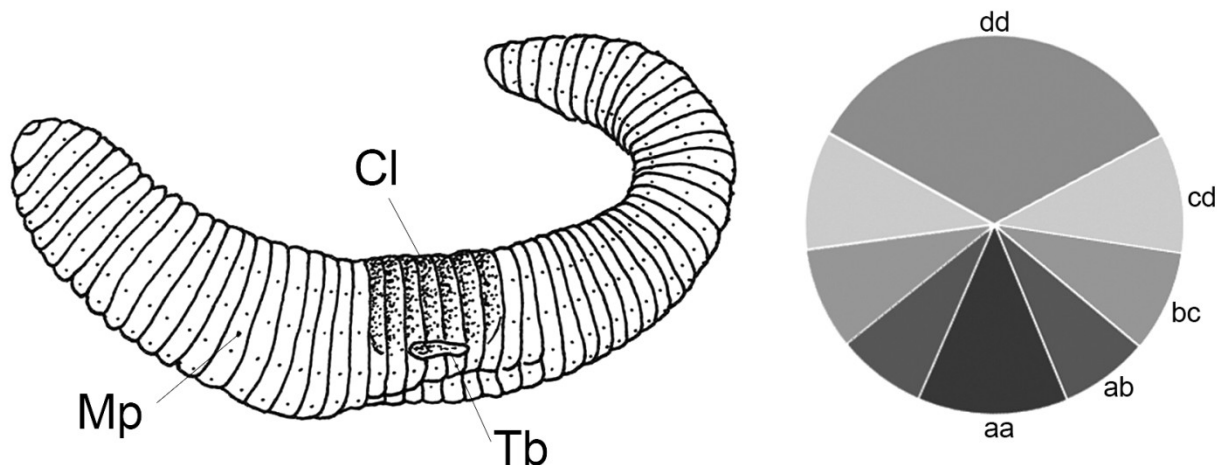


Figure 1. Ventrolateral view of *D. kozuensis* (Šapkarev, 1971) and the setal arrangement. Cl = clitellum, Tb = tubercles, Mp = male pore.

Table 1. Main characteristics of the *D. kozuensis* (Šapkarev, 1971) species group.

Species	Colour	Clitellum	Tubercles	Vesicles	Spermathecae	Male pore
<i>D. kozuensis</i> (Šapkarev, 1971)	yellowish, pale	22, ½ 22, 23–27, 28, 29, 30	23, 24– 26, 27, 28	11, 12	9/10, 10/11 <i>d</i>	small on 15
<i>D. bokakotorensis</i> Šapkarev, 1975	greyish, yellowish	½ 23, 24– ½ 29, 29	24–27, 28	9–12	9/10, 10/11 <i>d</i>	small on 15
<i>D. feheri</i> Szederjesi & Csuzdi, 2017	slight pinkish on the head	23–29	25–27	9, 11, 12	9/10, 10/11 <i>d</i>	small on 15
<i>D. skipetarica</i> Szederjesi & Csuzdi, 2017	dark red- violet	24–28	25–27	9–12	9/10, 10/11 <i>d</i>	small on 15
<i>D. loebli</i> (Zicsi, 1985)	slight pinkish on the head	24–½ 29, 29	25–27, ½ 28	9, 11, 12	9/10, 10/11 <i>d</i>	small on 25 or 26

DISCUSSION

The *D. kozuensis* species group includes some Balkanic (*D. bokakotorensis*, *D. feheri*, *D. skipetarica*) and West Anatolian (*D. loebli*) taxa, which are characterized by similar positions of the clitellar organs, a lack of calciferous diverticula and very small male pores. Morphologically, these features could relate these species to the *D. byblica* group, as did it several researchers (Karaman 1972, Šapkarev 1975, Mršić 1991, Szederjesi *et al.* 2017). Nevertheless, recent molecular phylogenetic results (Szederjesi *et al.* 2025) suggest that *D. skipetarica* stands apart from *D. byblica* and its associated species. This could mean that these seemingly similar characteristics might have evolved independently of each other. and these two groups are also distinguished by their distribution: the *D. byblica* group includes Middle Asian and Middle Eastern species, and one species is widespread in the Mediterranean (*D. byblica*). However, further studies, including phylogenetic analyses are needed to reveal the exact relationships of the *D. kozuensis* species group, and to clarify whether it belongs to the genus *Dendrobaena* or not.

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