ISBN 978-9940-611-04-0

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INTERNATIONAL CONFERENCE ON ADVANCES IN SCIENCE AND TECHNOLOGY

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COAST 2022

Book title:
Proceedings COAST 2022

Organizer and publisher:
Faculty of Management Herceg Novi

For publisher:
Irena Petrušić, PhD, Dean

Design and Computer processing:
Sanja Samardžić, MSc, Dragana Savić, Spec. Sci

CIP - Каталогизација у публикацији
Национална библиотека Црне Горе, Цетиње

INTERNATIONAL conference on advances in science and technology (I ; 2022 ; Herceg Novi)
Proceedings/International conference on on advances in science and technology, Herceg Novi, May, 26-29, 2022 = Zbornik radova / Međunarodna konferencija o savremenim dostignućima u nauci i tehnologiji, Herceg Novi, 26-29 maj 2022. godine : Fakultet za menadžment, 2022 (Herceg Novi). - 1011 стр. : илустр.

Радови на срп. и енгл. језику. - Текст ћир. и лат. - Напомене и библиографске референце уз текст. - Библиографија уз сваки рад. - Сажеци на енгл. и срп. језику уз радове.

ISBN **978-9940-611-04-0**
COBISS.CG-ID **23232772**

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The authors have full responsibility for the originality and content of their own papers.

OVERVIEW OF THE GEOGRAPHIC DISTRIBUTION ENDEMIC EARTHWORM *HELODRILUS BALKANICUS PLAVENSIS* (KARAMAN, 1972) ON THE BALKAN

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ABSTRACT:
The objective of this paper is to analyze the literature data of records of Helodrilus balcanicus plavensis (Karaman, 1972) in order to present a general overview of its distribution on the Balkan Peninsula. Helodrilus balcanicus plavensis belongs to the broad range Balkan endemic. During the last 50 years, this subspecies has been recorded in localities in Montenegro as well as the western, eastern and southern parts of Serbia, Kosovo and Metohia, while it is sporadically found in Bulgaria. For now, the northernmost limit of the species is in the eastern part of Serbia (Žagubica), while the southernmost limit is in the south part of Kosovo and Metohia (Šar Mountain). Andrijevica (Montenegro) is the westernmost locality reported, while the easternmost limit is in Bulgaria (Pirin Mountain). Further, the habitats of the subspecies are restricted on river banks, near streams and in springs (in roots of aquatic plants), rarely in the mud under stones. Therefore, we classify subspecies H. balcanicus plavensis in the hydrophilic ecological category of earthworms. Overall, this paper summarized the knowledge on the ecology and distribution of a little known Balkan endemic subspecies H. balcanicus plavensis.

Keywords: **Balkan Peninsula, distribution, earthworm, ecology, *Helodrilus balcanicus plavensis***

1. INTRODUCTION

Genus *Helodrilus* Hoffmeister, 1845 includes 20 valid species [1,2]. The naturally distribution of this genus is the Holarctic, from the Iberian Peninsula to Anatolia, Levant, Caucasus and the Balkan Peninsula [2]. The frequent changes in global paleogeographic and climatic ecological conditions throughout the entire geological history of the Balkan Peninsula played a crucial role in the formation of an extremely heterogeneous lumbricid fauna, which is characterized by a high level endemism [3]. Actually, *Helodrilus* is a genus with quite a large number of endemic species in the Balkan Peninsula, respectively out of 16 species, 12 are endemics [4].

Helodrilus balcanicus plavensis is a Balkan endemic species spread in Montenegro [5,6], southwestern and eastern and western part of Serbia [7], in the very southern region of

Kosovo and Metohia [6,8] and sporadically in Bulgaria [9]. Initially, *H. balcanicus plavensis* was described by Karaman (1972) as *Eiseniella balcanica plavensis* from Plave Lake, Montenegro. Mršić and Šapkarev [10] transferred this subspecies in genus *Helodrilus* due to identical taxonomic characteristics as in species within the mentioned genus. On the other hand, by reviewing the scarce literature data, as well as specimens from our old collection, we have presented little known morpho-anatomical characteristics of this subspecies.

Bearing in mind already mentioned, the aim of this paper is to analyze the complete list of records of *H. balcanicus plavensis*, in order to present a general overview of its distribution. At the same time, this paper can serve as a contribution to understanding the ecological characteristics of this little known Balkan endemic subspecies.

2. MATERIAL AND METHODS

We used literature data [5,6,7,8,9] on the subspecies *H. balcanicus plavensis*, also examined in detail the old specimens preserved in the Earthworm Collection of the University of Kragujevac, Serbia, (CEKUS). Based on that, we have presented morpho-anatomic and ecological characteristics as a general overview of distribution on the Balkan Peninsula of this subspecies. The figure with a general overview of the distribution of the *H. balcanicus plavensis* was displayed using Google Maps [10]. We have determined the exact ecological category, based on its ecological behaviours [11,12].

3. RESULTS AND DISCUSSION

Systematics

Phylum Annelida Lamarck, 1802
Class Clitellata Michaelsen, 1919
Family Lumbricidae Rafinesque-Schmaltz, 1815
Genus *Helodrilus* Hoffmeister, 1845

***Helodrilus balcanicus plavensis* (Karaman, 1972)**
Eiseniella balcanica plavensis Karaman, 1972: 321.
Allolobophora (*s.l.*) *balcanica plavensis* Easton, 1983: 476.
Helodrilus balcanicus plavensis Mršić & Šapkarev, 1988: 11; Mršić, 1991: 110; Csuzdi, 2012: 97–99; Stojanović et al., 2018: 143.

Morphological description (according to Karaman and author's data)

External morphology. Body pigmentation whitish-gray in live specimens. White-beige homogeneous color in fixed specimens. The average length from 47 mm to 69 mm (Karaman from 52 to 75 mm) diameter from 2 mm to 2.5 mm. Average number of segments from 119 to 142 (Karaman from 124 to 147). Prostomium is epilobous. First dorsal pore at the intersegmental groove 4/5. The male aperture is in 15, or 14-16 segments. Female pores in 14 over setae b. The setal very small and closely paired, ab = cd; aa = bc; dd=2bc. The setal ab is on the glandular warty protrusions on segments 9-13 and 12 and 13. or 10, 12, 13, 22, 23. and setal cd 21-23 segments. Clitellum in segments from 24, 25 to 30, 31, 32. Tubercula pubertatis in segments from 28, 29 to 29, 30.

Internal anatomy. Septa 5/6–11/12 thickened and muscular. Hearts in segments from 7–11. Calciferous glands in segments 10. Crop in segments 15–16, gizzard in segments 17–18. The typhlosole is simple, oval-shaped. Three pairs of seminal vesicles in segments 9, 11 and 12 and two pairs of spermathecae in 9 and 10 segments on the septa 9/10 to 10/11.

Ecology and distribution. Regarding ecological categories, *H. balcanicus plavensis* belongs to the hydrophilic species, living on river banks, near streams and in springs (in roots of aquatic plants), rarely in the mud under stones [5,7,13].
Based on all available data on the distribution of *H. balcanicus plavensis*, it is clear that this subspecies belongs to the broad range Balkan endemic distributed Montenegro, Serbia, Bulgaria and Kosovo and Metohia. Also, the easternmost limit of the subspecies is in the central part of Bulgaria (Pirin Mountain), while the western part of Montenegro (Andrijevica, Zoriće) is the westernmost limit of distribution. On the other hand, the northmost limit is the eastern part of Serbia (Žagubica), while the south part of Kosovo and Metohia (Šar Mountain) is the southmost limit of distribution for now (Figure 1).

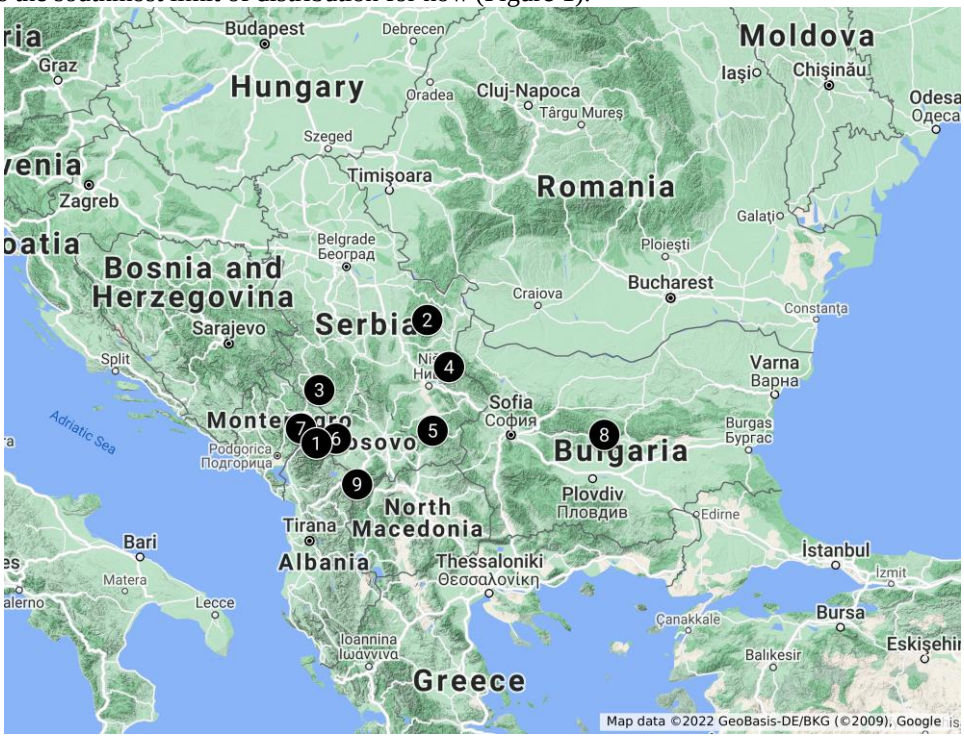

Figure 1. Geographical distribution of the subspecies *Helodrilus balcanicus plavensis* on the Balkan Peninsula (1-Plav Lake, 2-Žagubica, 3-Sjenica, 4-Knjaževac, 5-Kukavica, 6-Peć, 7-Andrijevica, 8-Pirin Mountain, 9-Šar Mountain)

Remarks. Černosvitov [14] found and described the species *Eiseniella balcanica (*now *Helodrilus balcanicus balcanicus)* in Macedonia. The taxonomic characteristics of the subspecies *H. balcanicus balcanicus and H. balcanicus plavensis* are similar, the main difference is that clitellum and tubercula pubertatis covers a less 2-3 segment at *H.*

balcanicus balcanicus (Table 1). Therefore, Stojanović-Petrović et al. [7] suggest that the aforementioned subspecies should be considered species.

Table 1. Taxonomic characteristics of Balkan endemic subspecies *H. balcanicus balcanicus and H. balcanicus plavensis*

Subspecies	Size mm	N. segments	Dorsal pore	Clitellum	T. Pubertatis	Vesicles	Spermathecae
H. balcanicus balcanicus	52-70	80-160	4/5 (5/6)	21-24–32	1/2 26,26,27–28,29	9,11,12	10,11
H. balcanicus plavensis	47-75	119-147	4/5 (5/6)	24,25–30-32	28,29–29,30	9,11,12	10,11

3. CONCLUSION

Interestingly, this subspecies was not found in Macedonia, although the earthworm fauna of Macedonia is well known [15]. Nevertheless, the very fact that *H. balcanicus plavensis* has occurred in south part Kosova and Metohia gives us the right to expect further expansion of this subspecies in Macedonia. Overall, our analysis represents a significant contribution toward the understanding of the distribution and ecology of this endemic subspecies restricted to the Balkan Peninsula.

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