

Helodrilus bavaricus, a remarkable new earthworm species from Bavaria, Germany (Crassiclitellata, Lumbricidae)

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Abstract. Here we report on a new *Helodrilus* species found in Roththalmünster, Southern Germany. This unique new species has four pairs of spermathecae and long protruding tubercles. Besides *Lumbricus badensis* Michaelsen, 1907 from Schwarzwald forest, this is the second earthworm species from Germany that appears to be endemic, suggesting that the southern part of present-day Germany may represent the northern limit of the distribution of endemic earthworm species.

Keywords. Annelida, Oligochaeta, Megadrili, endemism, Bayern.

INTRODUCTION

The genus *Helodrilus* Hoffmeister, 1845 is the second oldest valid earthworm genus after *Lumbricus* Linnaeus, 1758. Throughout its history, the genus was treated very differently by different authors (Szederjesi *et al.* 2014) until Perel (1976) recognized that the type species *H. oculus* Hoffmeister, 1845 has no nephridial vesicles and narrowed the genus *Helodrilus* accordingly. Another significant change was made by Zicsi (1985), who separated the genus *Proctodrilus*, which is characterized by an enteric excretory system as opposed to the exocytic system of *Helodrilus*.

Even early molecular phylogenetic studies indicated that the loss of nephridial vesicles could occur in different lineages, and therefore this character, like many other ones in Lumbricidae, may be polyphyletic (Domínguez *et al.* 2015).

Lately, Szederjesi *et al.* (2023) have carried out a detailed molecular phylogenetic study on the genus *Helodrilus* and showed that the genus is polyphyletic, consisting of three unrelated genera *Helodrilus* Hoffmeister, 1845, *Imetescolex* Szederjesi, Marchán & Csuzdi, 2023 and *Coventina* Marchán, Szederjesi & Csuzdi, 2023. The restricted *Helodrilus*, apart from the type species *H. oculus* contains only four other species; *H. cernovitovianus* (Zicsi, 1967), *H. phillipei* Qiu & Bouché, 1998, *H. samniticus* (Cognetti, 1914) and *H. turquini* Qiu & Bouché, 1998.

Recently, colleagues from the Bavarian State Research Center for Agriculture carried out a soil fauna survey on an agriculture field with no-till farming near Roththalmünster, Southern Germany. Together with several widely distributed species (*Lumbricus terrestris* Linnaeus, 1758, *Lumbricus castaneus* (Savigny, 1826), *Lumbricus rubellus* Hoffmeister, 1843, *Aporrectodea caliginosa* (Sa-

vigny, 1826), *Allolobophora chlorotica* (Savigny, 1826), *Aporrectodea rosea* (Savigny, 1826), *Octolasion lacetum* (Örley, 1881), *Proctodrilus tuberculatus* Černosvitov, 1935) an interesting species of *Helodrilus* was observed, which proved to be new to science and is described here.

MATERIAL AND METHODS

Earthworms were collected on 8 randomly distributed samples in an agriculture field near Rotthalmünster, Southern Germany (ca. 48°22'N, 13°12'E) first by an expulsion method with a highly diluted formaldehyde solution (0.2%) and then by hand-sorting of the excavated soil material. The investigated site is located on a slope and has been cultivated with no-till farming since 2021. It is characterized by Haplic Luvisol and loess loam and has a good water holding capacity. The earthworms collected were killed and preserved in 75% ethanol. The holotype of the new species is deposited in the Zoological Collection of the Eszterházy Károly Catholic University (EKCU).

TAXONOMY

Helodrilus bavaricus sp. nov.

Type material. Holotype: EKCU-OLIG-18 Germany, Rotthalmünster, no-tillage agricultural research field, 29.04.2024, leg. R. Walter. Para-

types: EKCU-OLIG-19 2 ex., collection of the Bavarian State Research Center for Agriculture 2 ex., Norbert Höser collection 1 ex.; locality and date same as the Holotype.

Diagnosis. Length 31 mm, diameter 2 mm, setae closely paired. Colour pale. Dorsal pores not visible. Clitellum on ½24, 25–33, tubercles on 1/n27–31. Male pores on 15, surrounded by glandular crescents. Nephridial pores not visible. Two pairs of vesicles in 11, 12. Spermathecae four pairs in 9/10–12/13, open in the mid-dorsal line (M). Calciferous glands without diverticulum. Excretory system exoic, nephridial bladders missing.

Description. External characters. Holotype 31 mm long and 2 mm wide. Number of segments 104. Paratypes: one ex. cut specimen, one ex. 31 mm long and 2 mm wide. Number of segments 106. Secondary annulations present between 10–33 with 2–3 ringlets. Colour pale pink alive, greyish preserved. Prostomium epilobous, 1/3 closed. Dorsal pores not visible. Setae closely paired, setal arrangement just behind clitellum: $aa:ab:bc:cd:dd = 12:1:8.4:1:26$. Male pores on segment 15, surrounded by glandular crescents, protruding into the neighbouring segments. Nephridial pores not visible. Clitellum saddle-shaped on ½24, 25–33. Tubercula pubertatis as protruding glandular ridges on 1/n27–31. Glandular tumescences on 12 *ab* and 13 *cd* (Fig. 1).

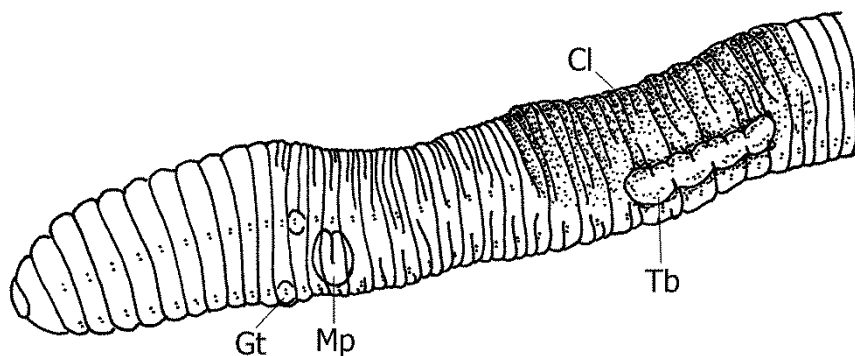


Figure 1. *Helodrilus bavaricus* sp. nov. Gt = genital tumescence, Mp = male pore, Tb = tubercle, Cl = clitellum.

Internal characters. Dissepiments 5/6–8/9 thickened, 9/10–10/11 slightly strengthened. Testes and funnels paired in 10–11, free. Two pairs of seminal vesicles in 11 and 12. Four pairs of spermathecae in 9/10–12/13, small, surrounded by epithelial thickening and external openings near the mid-dorsal line (M). Calciferous glands in 10–11, without distinct diverticula. Last pair of hearts in 11, with a pair of extraoesophageal vessels in 12. Excretory system exoic, nephridial bladders missing. Crop in 15–16, gizzard in 17–18. Typhlosolis T-shaped. Longitudinal musculature fasciculate.

Etymology. The specific epithet refers to the type locality in Bavaria, Germany.

Remarks. The new species is classified in the genus *Helodrilus* on the basis of the absence of nephridial bladders, the position of clitellum and tubercles, the number of vesicles (2 pairs), number of spermathecae (four pairs) and the adiverticulate calciferous glands (Szederjesi *et al.* 2023). Morphologically, the new species is most close to *H. cernosvitovianus* as it has protruding tubercles and dorsally opening spermathecae. However, the position of the clitellum and tubercles and the four pairs of spermathecae distinguish it from all other *Helodrilus* species (Table 1).

DISCUSSION

It is generally accepted that the earthworm fauna in Northern Europe became extinct during the Quaternary due to the thick ice shield present. Areas south of the ice sheet boundary were also affected to some extent by the presence of permafrost, but southern Germany, including southern Bavaria, was ice-free and had continuous and diverse vegetation throughout the Pleistocene (Ellwanger *et al.* 2011, Stebich *et al.* 2020) and might have been suitable for the survival of earthworms. Therefore, this area may fall within the northern limit of the endemic earthworm distributions, as represented by the presence of *Lumbricus badensis* Michaelsen, 1907 in the Black Forest and the newly discovered species *Helodrilus* as well.

According to the last revision (Szederjesi *et al.* 2023), the genus *Helodrilus* has a predominantly Western European distribution, with *H. cernosvitovianus* being the most eastern species recorded from SE Poland (Kostecka & Rozen 1988), W Ukraine (Perel 1976) and NE Hungary (Zicsi 1967, Csuzdi & Zicsi 2003). However, its records from Southern Serbia (Mršić 1991) and Northern Greece (Zicsi & Michalis 1981) are far from the original range and may represent a species close to *Imetescoclex balcanicus* (Černosvitov, 1931).

Table 1. Morphological comparison of the *Helodrilus* species

Taxon	Clitellum	Tubercles	Spermathecae (pairs)	Vesicles	Remarks
<i>H. bavaricus</i> sp. nov.	½24,25–33	1/n27–31	9/10–12/13 M (4)	11, 12	tubercles protruding
<i>H. cernosvitovianus</i> (Zicsi, 1967)	21,22–28,29	½26–½28	9/10–10/11 M (2)	11, 12	tubercles protruding
<i>H. oculatus</i> Hoffmeister, 1845	21,22–31, 1/n32	29–30, 1/n31	9/10–10/11(11/12) <i>cd</i> (2–3)	11, 12	tubercles flat
<i>H. phillipei</i> Qiu & Bouché, 1998	21–32	28–29	9/10–10/11 <i>cd</i> (2)	11, 12	tubercles flat
<i>H. samniticus</i> Cognetti, 1914	21,22–32,33	29–32	9/10–10/11 <i>cd</i> (2)	11, 12	tubercles flat
<i>H. turquini</i> Qiu & Bouché, 1998	24–32	28–30	9/10–10/11 <i>cd</i> (2)	11, 12	tubercles flat

H. bavaricus is similar to *H. cernosvitovianus* in several features, such as the dorsally opening spermathecae or the strongly protruding tubercles, and geographically it is only about 600 km away from the type locality of *H. cernosvitovianus*, so it is assumed that these species may be closely related. However, further DNA studies are needed to determine this using a new 96% ethanol fixed material.

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