

**Diplocardia patuxentis sp. n., a new earthworm species from Maryland, North America (Oligochaeta: Acanthodrilidae)**

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**Abstract** – A new earthworm species *Diplocardia patuxentis* sp. n. is described from Jug Bay Wetlands Sanctuary, Maryland, USA. In addition, new data on the distribution of *Diplocardia caroliniana* EISEN, 1899 and *Diplocardia texensis* SMITH, 1924 are presented. With 6 figures.

**Key words** – North America, Oligochaeta, earthworms, *Diplocardia*, new species.

## INTRODUCTION

*Diplocardia* is an indigenous earthworm genus in North America. Its species are distributed along the eastern part of United States and smaller, discontinuous ranges could be found in California and Mexico (JAMES 1995). Although this is the most species rich genus in North America with some fifty species, different authors agree, that a lot of species are still to be described (GATES 1977, JAMES 1995, REYNOLDS 1998). In his review on diplocardian earthworms GATES (1977) already discussed that numerous morphs and variants could not be fitted into his key, and possibly warrant specific status.

In the framework of the Baltimore Ecosystem Study (BES) we have been surveying the soil fauna of the Greater Baltimore Metropolitan Area, Maryland. Earthworms collected in different urban and rural localities were dominated by introduced lumbricid species, but in more remote, protected places we have collected some *Diplocardia* species, one of which proved to be new to the science.

## MATERIALS AND METHODS

Sampling primarily took place in mixed deciduous forests, forest edges and riparian zones. The most common trees in this area include several species of oak (*Quercus nigra*, *Q. velutina*, *Q. alba*, *Q. rubra*), tulip poplar (*Liliodendron tulipifera*), red maple (*Acer rubrum*), and sweetgum (*Liquidambar styraciflua*)

Earthworms were collected by formalin extraction, digging and handsorting. Animals were killed in 75% ethanol, fixed in 4% formalin for several days and preserved in 75% ethanol.

Parallel collections of specimens are deposited in the earthworm collection of the Johns Hopkins University, Baltimore, MD, USA and in the soil zoology collection of the Hungarian Natural History Museum, Budapest, Hungary.

## TAXONOMY

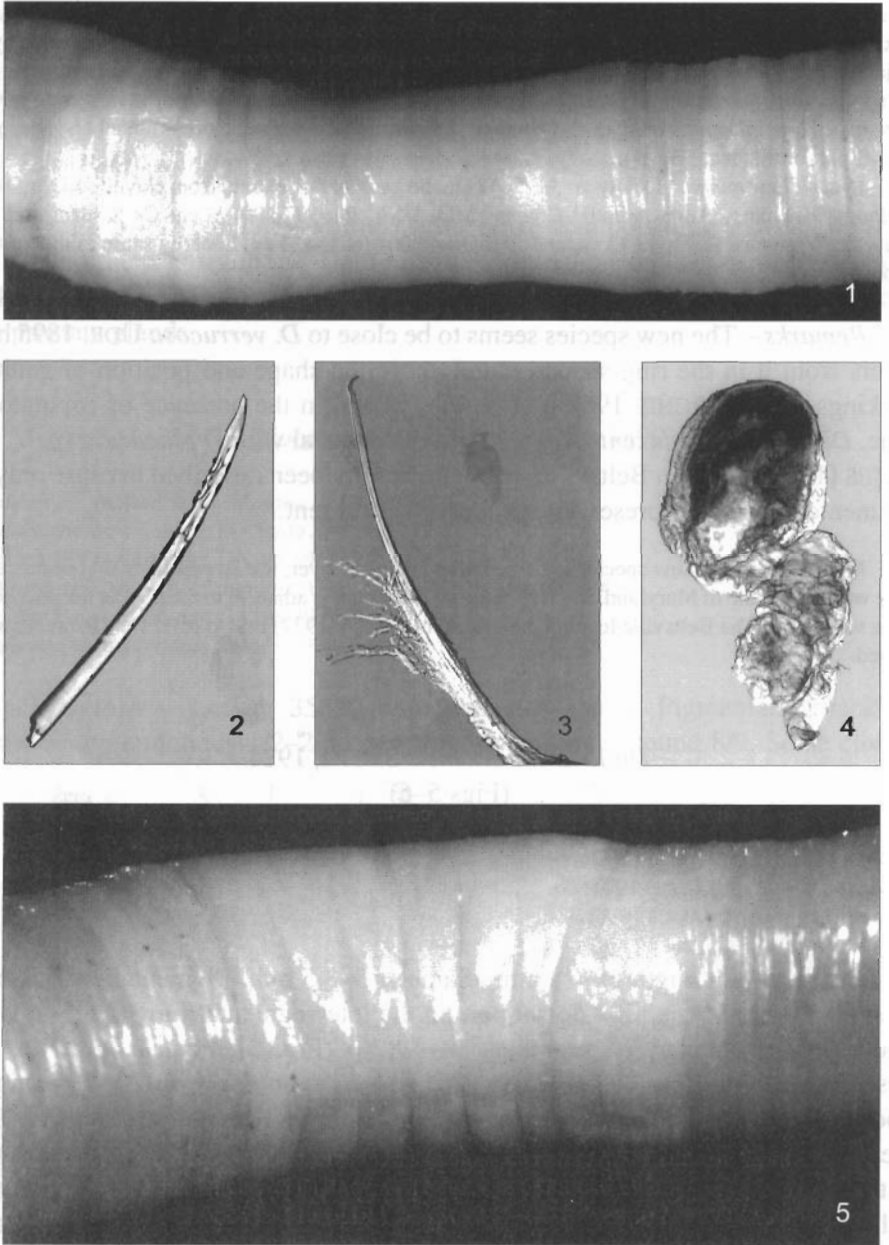
**Diplocardia patuxentis** sp. n.

(Figs 1–4)

**Diagnosis** – Length 40–63 mm, diameter 2.5–3.5 mm. Pigmentation lacking. Prostomium epilobous, first dorsal pore in the intersegmental furrow 10/11. Clitellum annular, on segments 13–18. Female pores in 14 presetal. Prostate pores on 19, 21 in setal line *b*. Male pores on 20, in seminal grooves. Penial setae and copulatory setae present. Unpaired pad-like genital markings in 8, 9, 11, 22, 23, between setae *b*. Spermathecal pores in intersegmental furrow 7/8, 8/9. Muscular gizzards united in 5–6. Testes paired in 10, 11 enclosed in perioesophageale testis sac. Seminal vesicles in 9, 12. Last hearts in 12. Dorsal blood vessel **single throughout**. Oesophagus widened in 15–16, with low but dense **longitudinal folds**. **Intestinal** origin at 17/18.

**Description** – Holotype 55 mm in length and 3 mm in diameter, segments 110. Paratypes 40–63 mm long and 2.5–3.5 mm wide. Body cylindrical throughout, 71–113 segments. Setae paired, setal formula at segment 25; aa:ab:bc:cd:dd=3.3:1:2:1:13.3. **Prostomium** epilobous, 1/2 open. Segments 11, 12 triannulate, after the clitellum slightly bi- or triannulate. **Color** pale, **pigmentation** lacking. First dorsal pore in 9/10 closed, in 10/11 open. Nephridial pores on the leading edges of segments in the setal line *d*. Spermathecal pores minutes, intersegmental in 7/8, 8/9 open in setal line *a*. Female pores paired presetal on 14, somewhat median to setae *a*. Clitellum 13–18, annular. Prostate pores at the end of seminal grooves on 19, 21 in setal line *b* (Fig. 1). **Male pores on 20**. Unpaired pad-like genital markings between setae *b* on 8, 9, 11, 22, 23. Setae *a-b* on 8 and 9 frequently missing, if present modified. Copulatory setae small, straight, about 0.2 mm in length with several scale-like ornamentation (Fig. 2).

First septum visible 5/6. Septa 6/7, 7/8, 8/9 slightly muscular. Two oesophageal gizzards fused in 5–6. No obvious calciferous glands, but the oesophagus widened in segments 15–16 with densely arranged, low to middle high longitudinal folds. Intestine begins in segment 18. Thyphlosole about one third in diameter of the intestine, gradually decreasing and ends at the segment 47. Dorsal blood



**Figs 1-5.** *Diplocardia patuxentis* sp. n.: 1 = ventro-lateral view of the clitellar region, 2 = copulatory seta from segment 9, 3 = penial seta, 4 = spermatheca; *D. texensis* SMITH, 1924: 5 = ventro-lateral view of the clitellar region

vessel single throughout last hearts in 12. Male sexual system holoandric, with testes in 10 and 11, enclosed in perioesophageale testis sac. Seminal vesicles in 9, 12. Male ducts separate, run in close proximity until segment 20. Prostates small each confined into own segment and accompanied by a penial setal sac. Penial setae 0.5 mm in length and 0.01 mm wide, somewhat bowed with irregular tip and serrated ornamentation (Fig. 3). Ovaries and funnels in 13, free. Spermathecae in 8 and 9, with pear-shaped ampulla and a small duct. Diverticulum multilocular with numerous chambers, attached to ental part of the duct (Fig. 4).

*Material examined* – Holotype: AF/5047 On the bank of a streamlet from clayey soil, Jug Bay Wetlands Sanctuary, Anne Arundel County, MD, USA. 04. 27. 2001. Leg. Cs. Csuzdi and K. Szlávecz. Paratypes: AF/5048 13 ex. and J.H.-Olig. 2001.04.1–4. 4 ex. Locality same as that of the holotype.

*Remarks* – The new species seems to be close to *D. verrucosa* UDE, 1895 but differs from it in the ring-shaped clitellum, in the shape and position of genital markings (see MURCHIE 1962 p. 189, Fig. 2) and in the presence of copulatory setae. *Diplocardia patuxentis* sp. n. might be identical with *Diplocardia* sp. V. of GATES (1977) found in Beltsville, MD, and has not been described because only a fragmented and badly preserved specimen was present.

*Etymology* – The new species is named after Patuxent river, the largest river that occurs entirely within the state of Maryland. Jug Bay Wetland Sanctuary is adjacent to the river at the midpoint of the watershed. The Beltsville locality mentioned in GATES (1977) is also part of the Patuxent watershed.

*Diplocardia texensis* SMITH, 1924  
(Figs 5–6)

*Diplocardia keyesi* var. *texensis* SMITH, 1924: 2.

*Diplocardia texensis*: GATES 1977: 26.

*Diplocardia texensis*: JAMES 1990: 384.

*Diagnosis* – Length 60–78 mm, diameter 3–3.5 mm. Pigmentation lacking. Prostomium epilobous, first dorsal pore in the intersegmental furrow 11/12. Clitellum almost annular, on segments 14–19(20) (Fig. 5). Female pores in 14 presetal. Prostate pores on 20, 22 in setal line *b*. male pores on 20, in seminal grooves. Penial and copulatory setae lacking. Unpaired genital markings on 14. Spermathecal pores at the leading edges of segments 8 and 9. Muscular gizzards united in 5–6. Testes paired in 10, 11 enclosed in perioesophageale testis sac. Seminal vesicles in 9, 12. Last hearts in 12. Dorsal blood vessel single throughout. Calciferous glands lacking. Intestinal origin at 18/19. Typhlosole present as a low undulated ridge. Prostates long, coiled, encircle the intestine, reaching 4–5 segments

backwards. Spermathecae simple with moderately large ampulla and short duct. Diverticulum arises at the junction.

*Material examined* – AF/5050 4 ex, AF/5051 13 praead. ex. and J.H.-Olig. 2001.04.5. 1 ex., J.H.-Olig. 2001.04.6–8. 3 praead. ex. At the junction of Otter Point Trail and Railroad Bed Trail, wet sandy soil, Jug Bay Wetlands Sanctuary, Anne Arundel County, MD, USA. 04. 27. 2001. Leg. Cs. Csuzdi and K. Szilávecz.

*Remarks* – *Diplocardia texensis* has a north-south disjunct distribution (Fig. 6). The northern population differs from the original one in the position of the clitellum (14–19 (20) instead of 13–20), and according to our specimens in the size of the prostate glands.

### *Diplocardia caroliniana* EISEN, 1899

*Diplocardia singularis caroliniana* EISEN, 1899: 172.

*Diplocardia caroliniana*: MICHAELSEN 1900: 327.

*Diplocardia caroliniana*: GATES 1942: 93.

? *Diplocardia singularis* complex, UDE, 1893: REYNOLDS 1974: 4.

*Diplocardia caroliniana*: GATES 1977: 6.

*Diplocardia caroliniana*: JAMES 1990: 385.

*Diagnosis* – Length 35–50 mm, diameter 2 mm. Pigmentation lacking. Prostomium epilobous 1/2–2/3 open, first dorsal pore around 8/9. Setae closely

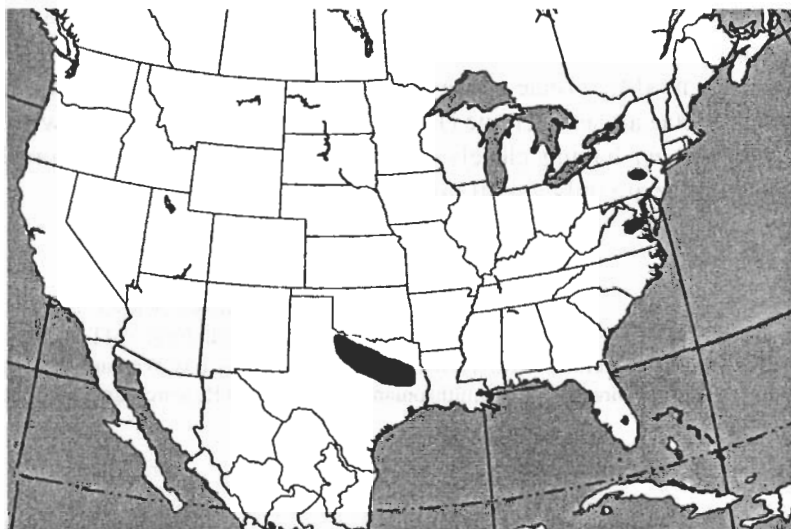


Fig. 6. Distribution of *Diplocardia texensis* SMITH, 1924

paired setal arrangement at the middle of the body: aa:ab:bc:cd=5:1:4:1.5. Clitellum annular, on segments 13–17, 1/2 18. Female pores presetal on 14, slightly medial to setae *a*. Prostate pores on 18, 20, male pores on 19 in seminal grooves. Penial setae present. Setae on 9 with nodulus but slightly modified. Tips with dense serrated ornamentation. Paired genital markings on 17 and sometimes on 21 *ab*. Spermathecal pores on minute protuberances in 6/7, 7/8, 8/9. Muscular gizzards in 5–6. Testes paired in 10, 11, seminal vesicles in 9, 12. Last hearts in 12. Dorsal blood vessel single throughout. Calciferous glands lacking but low inner folds in 13–15. Intestinal origin at 17. Typhlosole present as a low undulated ridge. Prostates normal, occupying 1–2 segments. Spermathecae simple with longer ampulla and shorter duct. An unstalked diverticulum attached to the ental part of the duct.

*Material examined* – AF/4068 1 ex. Smithsonian Environmental Research Center, Edgewater, MD, USA, mixed deciduous forest edge. 07. 21. 1999. Leg. K. Szlávecz. AF/5052 30 ex., J.H.-Olig. 2001.04.9–16. Smithsonian Environmental Research Center, Edgewater, MD, USA. 06. 12. 1999. Leg. K. Szlávecz. AF/5053 1 ex. Smithsonian Environmental Research Center, Edgewater, MD, USA, forest edge at Beaver Pond. 04. 28. 2001. Leg. Cs. Csuzdi and K. Szlávecz. AF/5054 2 ex. Smithsonian Environmental Research Center, Edgewater, MD, USA, mixed deciduous forests. 04. 28. 2001. Leg. Cs. Csuzdi and K. Szlávecz. AF/5055 18 ex, J.H.-Olig. 2001.04.17–20. 4 ex., mixed deciduous forest in Cross Keys, Baltimore, MD, USA. 04. 24. 2001. Leg. Cs. Csuzdi and K. Szlávecz.

*Remarks* – REYNOLDS (1974) reported *D. singularis* complex from Maryland, but due to the taxonomic difficulties of this species group he **did not give more data**. The differences between *D. singularis* and *D. caroliniana* are thought to be the presence of pigmentation at the former species (GATES 1977) **furthermore the presence of modified setae in the region of spermathecal pores, and the more closely paired setae at the latter one** (JAMES 1990). Our specimens show similarity with *D. caroliniana* **having closely paired setae and no pigmentation, but the spermathecal setae are only slightly modified**.

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