

New earthworms of the genus *Drawida* Michaelsen, 1900 (Oligochaeta: Moniligastridae) from Korea

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New earthworms of the genus *Drawida* Michaelsen, 1900 (Oligochaeta: Moniligastridae) from Korea. - Three new species of the genus *Drawida*, *Drawida songae* sp. n., *Drawida jirisanensis* sp. n., *Drawida guryeensis* sp. n. are described from material collected in Mt. Palgong and Mt. Jiri in South Korea. *Drawida songae* sp. n. has no spermathecal atrium, no prostates, and genital markings in vii-xi. *Drawida jirisanensis* sp. n. has a spermathecal atrium and unpaired mid-ventral genital markings in viii-xi. *Drawida guryeensis* sp. n. has a spermathecal atrium and paired genital markings in viii-x between *B* and *C*. Descriptions of the new species are provided, including illustrations of the ventral view and spermathecae.

Key-words: Earthworms - *Drawida* - Moniligastridae - Oligochaeta - Korea - taxonomy.

INTRODUCTION

The *Drawida* were collected from many locations, but they were restricted to small areas or microhabitats within the collection locations. They were also much less abundant than *Amyntas* in the same sites. Moniligastridae were believed to need 'moister conditions than any other family of earthworms', due to their lack of dorsal pores (Stephenson, 1930). Some other earthworm families with many members typically found in wet habitats also lack dorsal pores. At this point it is not clear if a lack of dorsal pores is favorable to life in wet conditions, or if a lack of dorsal pores is an ancient condition retained by families with predominantly semi-aquatic and mud-dwelling species. It is also possible that dorsal pores serve a function that is not required in wet habitats. However, there are worms with dorsal pores living in wet places, and worms without them living in mesic soils. The present three new species lack dorsal pores, and they all come from wet locations. Typical *Drawida* sites are mud, under stones in water, or in saturated soil. Mt. Jiri and Mt. Palgong are long time natural forests. Specimens were collected just after rainy seasons.

The reported Korean Moniligastridae includes the descriptions of 6 species belonging to the genus *Drawida*. These species are *D. nemora* Kobayashi, 1936, *D. an-*

chingiana Chen, 1933, *D. keikiensis* Kobayashi, 1938, *D. koreana* Kobayashi, 1938, *D. gisti* Michaelsen, 1931, and *D. japonica* (Michaelsen, 1892).

In this study, three new species of *Drawida* are described based on material collected from 1996 to 1998 from the litter layer in forests, and on material from Ms. Song Min-Ja, a former Korean oligochaetologist, whose collections were made from 1965 to 1971. Thus a total of nine species of the genus *Drawida* have thus far been recorded in Korea.

The characters of taxonomic importance in this genus are 'pigmentation; position of the male, female and spermathecal pores; genital markings; number and position of the gizzards shape and position of testis sacs; shape of prostate and condition of the ovarian chamber; and the size and shape of the spermathecae (Stephenson, 1923). In this paper, spermathecal pores, genital markings, and description of the atria are seen to provide a set of taxonomically useful characters in Korean *Drawida*. The holotypes and paratypes of the new species are deposited in the collection of the Jeonbuk National University; some paratypes are deposited at the Museum of Natural History of Geneva.

DESCRIPTIONS

MONILIGASTRIDAE Claus, 1880

Drawida Michaelsen, 1900

Drawida songae sp. n.

Figs 1A-B

Material: Holotype and 2 paratypes: Daegu-si, Mt. Palgong, 10 July 1969, A. Gu coll. Other material: Daegu-si, Mt. Palgong, Page-sa, 3 clitellate specimens, 1 acitellate specimen, 26 August 1965, M. J. Song coll.

Etymology: Named after Ms. Min-Ja Song, who has made great contributions to the taxonomy of Korean earthworms.

Diagnosis: Spermathecae in viii, attached to face of septum 7/8 without atrium; ampulla large pouch, round ball shape, ducts very long and thin. Genital markings present in vii-xi, one or two, rarely three markings per segment; paired in some or all of vii-x in *CD*, paired in one or both of xi, xii in *AB*.

Description: Dimensions 70-93 by 2.8-3.0 mm at segment vii, 3.7-3.9 mm at xxx, 3.7-4.0 mm at clitellum (xii); body cylindrical in cross section; preclitellar rather conical shape, segments 149-172. Setae small closely paired, preclitellar $AB=CD$, $AA=BC$, postclitellar $AB=CD$, $AA>BC$. Setae not pointed, slightly curved at ends. Prostomium prolobous separated from groove. Color pinkish throughout, clitellum reddish, formalin preservation. Clitellum annular thick swollen x-xiv, sometimes extends on ix and xv; interrupted 1/2 of x-xi, between *D* and *D* ventrally.

Secondary male pores, one pair transverse slits at *AB* on 10/11, protuberant tubercle without penis externally, pores slightly wider than *AB* size. Spermathecal pores conspicuous longitudinal openings in 7/8 at *AB* line. Nephropores visible on *D*. Genital markings present in vii-xi, numbers irregular, one or two, rarely three markings per segment; paired in some or all of vii-x in *CD*, paired in one or both of xi, xii in *AB*. Each genital marking distinct, large, darkish circular slightly protuberant tubercle. Female pores paired, presetal of xii near *B*, transverse or longitudinal slits, minute, but easily visible. Dorsal pores absent.

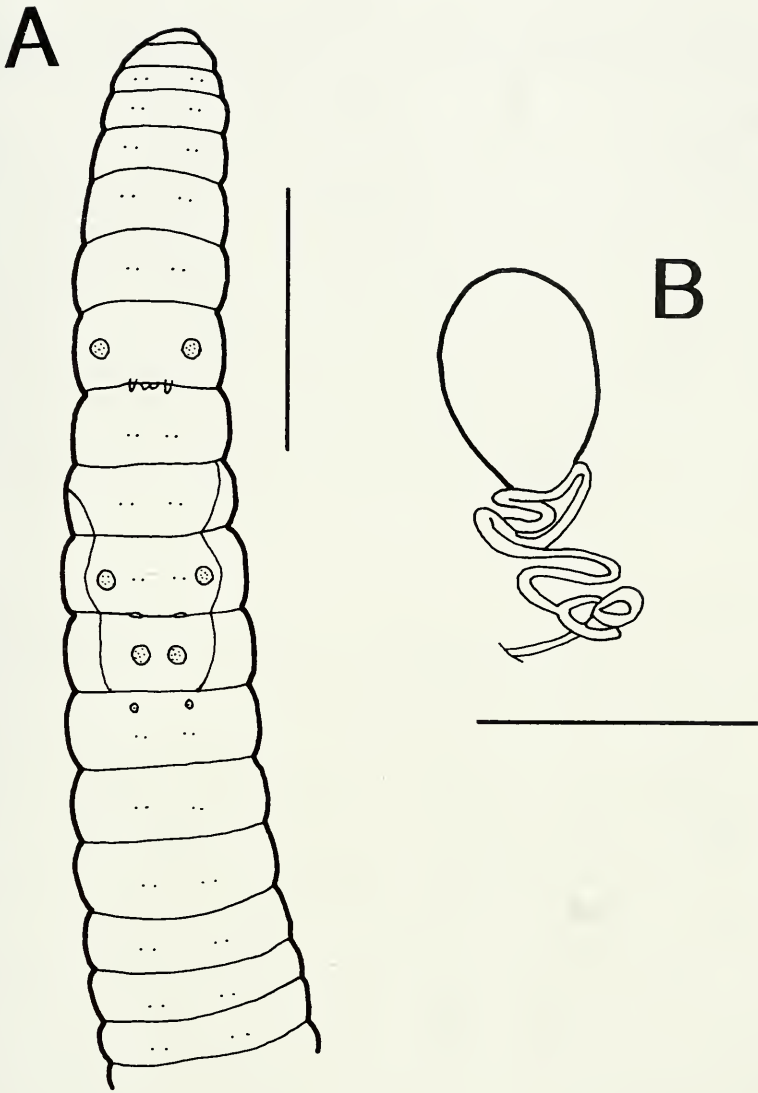


FIG. 1

Drawida songae sp. n. A: ventral view; B: spermathecae. Scale bars = 5 mm (A), 2 mm (B).

Septa 5/6-8/9 thick, muscular, 9/10-12/13 thin. Gizzards four xiv-xvii, brownish, smooth on the surface. Dorsal vessel large in calibre, four pairs lateral hearts vi-ix. Nephridia usually present, nephridial vesicle long, extending to dorsal vessel. One pair of testis sacs suspended in septum 9/10, mostly in x; vas deferens long, coiled, joining body wall. Prostates absent. Ovarian chamber in xi, formed by septa 10/11 and 11/12, brittle. Ovisacs in xii large, flattened, extending to xiii or xiv, almost completely covering gizzards.

Spermathecae in viii, attached to face of septum 7/8 without atrium; ampulla large pouch, round ball shape, ducts very long, thin, irregularly twisted, muscular. Genital markings have muscular areas corresponding to the externally visible circular tubercles.

Remarks: The present species appears to be closely related to *Drawida nemora* Kobayashi, 1936, in body shape and spermathecae but it can be distinguished easily by the position of male pores and genital markings. *Drawida songae* sp. n. has the male pores on *AB* on 10/11, while *D. nemora* has the male pores between *B* and *C*. Genital markings of *D. nemora* are indistinct, small and whitish or pale, but *Drawida songae* sp. n. has large, dark circular markings. Also, the new species has no prostate glands, but *D. nemora* has the disk-like prostates in x, xi. Kobayashi described a conical penis usually not visible externally, but *Drawida songae* sp. n. has no penis at all. Gates (1962) pointed out that a beautiful red color of the clitellum in many *Drawida* “develops” after preservation by formalin. This present species has the same red coloration after 30 years of preservation. *Drawida songae* sp. n. has two characters of systematic importance, absence of both spermathecal atria and prostates. Most *Drawida* species have these two internal organs.

***Drawida jirisanensis* sp. n.**

Figs 2A-C

Material: Holotype and 3 paratypes: Gyung-sangnam-do, Hamyang-gun, Mt. Jiri, Baikmudong (35° 15'-18'N, 127° 33'-35'E), 17 July 1996, Y. Hong coll. Other material: Same data as for holotype, 6 clitellate, 3 acitellate specimens.

Etymology: The species is named after the type locality.

Diagnosis: Spermathecal ducts in viii, attached to face of septum 7/8; atrium in vii, ampulla round, ducts long and thin. Genital markings unpaired mid-ventral in viii-xi, sometimes vii and xii, within *A A* viii, when in xii usually paired.

Description: Dimensions 48-73 by 2.0-2.8 mm at segment vii, 3.3-3.6 mm at xxx, 2.5-3.7 mm at clitellum (xii); body cylindrical in cross section; preclitellar rather conical shape, segments 81-127. Setae small closely paired, $AA < BC$, $AB = CD$ almost equal. Setae blunt, slightly curved at ends. Prostomium probolous separated from groove. Color light pinkish, or bluish throughout, clitellum light reddish, formalin preservation. Clitellum annular, slightly swollen ix-xii, sometimes extends on xiii.

Secondary male pores, paired relatively large slits in intersegmental furrow between *B* and *C* on 10/11, from each slit, short, stout, blade shape penis, as large as 1.0 mm long, 0.5 mm wide at base. Spermathecal pores in 7/8 at *CD* line, sometimes with genital marking. Nephropores minute on *C*. Genital markings unpaired mid-ventral in viii-xi, sometimes vii and xii, within *A A* on viii, when in xii usually paired. Each genital marking distinct, medium, darkish circular tubercle, clearly protuberant, surroundings elevated. Female pores paired in 11/12 close to *B*, minute, but easily visible. Dorsal pores absent.

Septa 5/6-8/9 thick, 9/10-12/13 thin. Gizzard five xii-xvi, smooth on the surface. Dorsal vessel large in calibre, four pairs lateral hearts in vi-ix. Nephridia usually present, nephridial vesicle long, extend to dorsal vessel. One pair of testis sacs suspended in 9/10; vas deferens long thin, coiled, going to ental end of prostate. Prostates ix-x moderately thick, smooth yellowish surface, connected to ventral body wall; lying

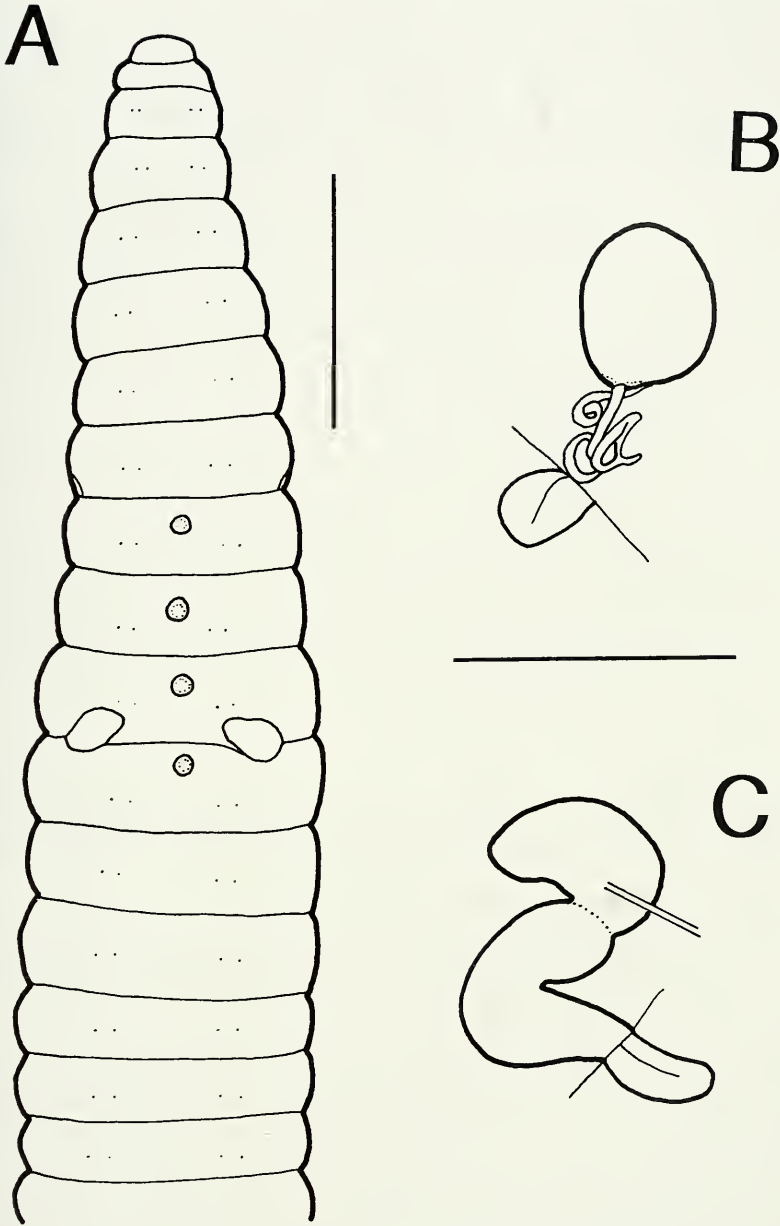


FIG. 2

Drawida jirisanensis sp. n. A: ventral view; B: spermathecae; C: secondary male pores. Scale bars = 3 mm (A), 2 mm (B, C).

curved in ventral part of segment. Ovarian chamber in xi-xii, right, left sides connected. Ovisacs in xii-xiv, sometimes extending to xvi.

Spermathecae, ducts in viii, attached to face of septum 7/8; atrium in vii, ampulla round, ducts long, thin, irregularly twisted, muscular; connected to spermathecal pores through small C-shaped atrium. Genital markings with interior hardened muscular domes corresponding to the externally visible circular tubercles.

Remarks: This species is similar to *Drawida keikiensis* Kobayashi, 1938 and *D. syringa* Chen, 1933, on the shape of spermathecae and male genitalia. It can be distinguished by the genital markings, which *D. keikiensis* and *D. syringa* always lack. Kobayashi described *D. keikiensis* using two semi-mature specimens which lacked genital markings. However, all 3 acitellate *Drawida jirisanensis* sp. n. examined here had genital markings present in A A like mature individuals. The new species also has a different shape of prostate gland than *D. keikiensis*.

Spermathecal atria may be subject to considerable intraspecific modification (Gates, 1962). In this case *Drawida jirisanensis* sp. n. has the atria in vii, spermathecae and ducts in viii, but in *D. keikiensis* all are wholly lying upon the posterior surface of 7/8. The function of the spermathecal atria is unknown but is unlikely to be the same as that of spermathecal diverticula in other megadriles which are used storage of the sperm received in copulation (Gates, 1962). The previous new species *Drawida songae* sp. n. has no spermathecal atria, so *Drawida jirisanensis* sp. n. species differs from it in this important character. *Drawida jirisanensis* sp. n. has different shaped atria from next species, *Drawida guryeensis* sp. n.

Drawida guryeensis sp. n.

Figs 3A-C

Material: Holotype and 3 paratypes: Jeollanam-do, Gurye-gun, Mt. Jiri, Piagol, 26 July 1996, Y. Hong coll. Other material: Same data as for holotype, 3 clitellate, 5 acitellate specimens.

Etymology: The species is named after the type locality.

Diagnosis: Spermathecae in viii, attached to face of septum 7/8; short, round-shaped atrium; ampulla middle-sized pouch, round ball shape and ducts long. Genital markings paired in viii-x, between B and C, circular protuberant with elevated surrounding ring; presetal on vii-ix, postsetal on x.

Description: Dimensions 62-83 by 2.3-2.5 mm at segment vii, 2.8-3.7 mm at xxx, 2.6-3.3 mm at clitellum (xii); body cylindrical in cross section; preclitellar rather conical shape, segments 121-128. Setae small closely paired, preclitellar $AB=CD$, $AA=BC$, postclitellar $AB=CD$, $AA<BC$. Setae not sharp, slightly curved at ends. Prostomium prolobous separated from groove. Color light pinkish or bluish throughout, clitellum pinkish, formalin preservation. Clitellum annular, thick, swollen x-xiii.

Secondary male pores, one pair transverse slits from between B and C, close to B on 10/11, short, blade-shape penis, as large as 1.0 mm long, 0.4 mm wide at base. Spermathecal pores conspicuous longitudinal openings in 7/8 at CD line. Nephropores visible on D. Genital markings paired in viii-x, between B and C, circular protuberant with elevated surrounding ring; presetal on vii-ix, postsetal on x. Female pores paired, anterior of xii or 11/12 or near B on 11/12, unrecognizable. Dorsal pores absent.

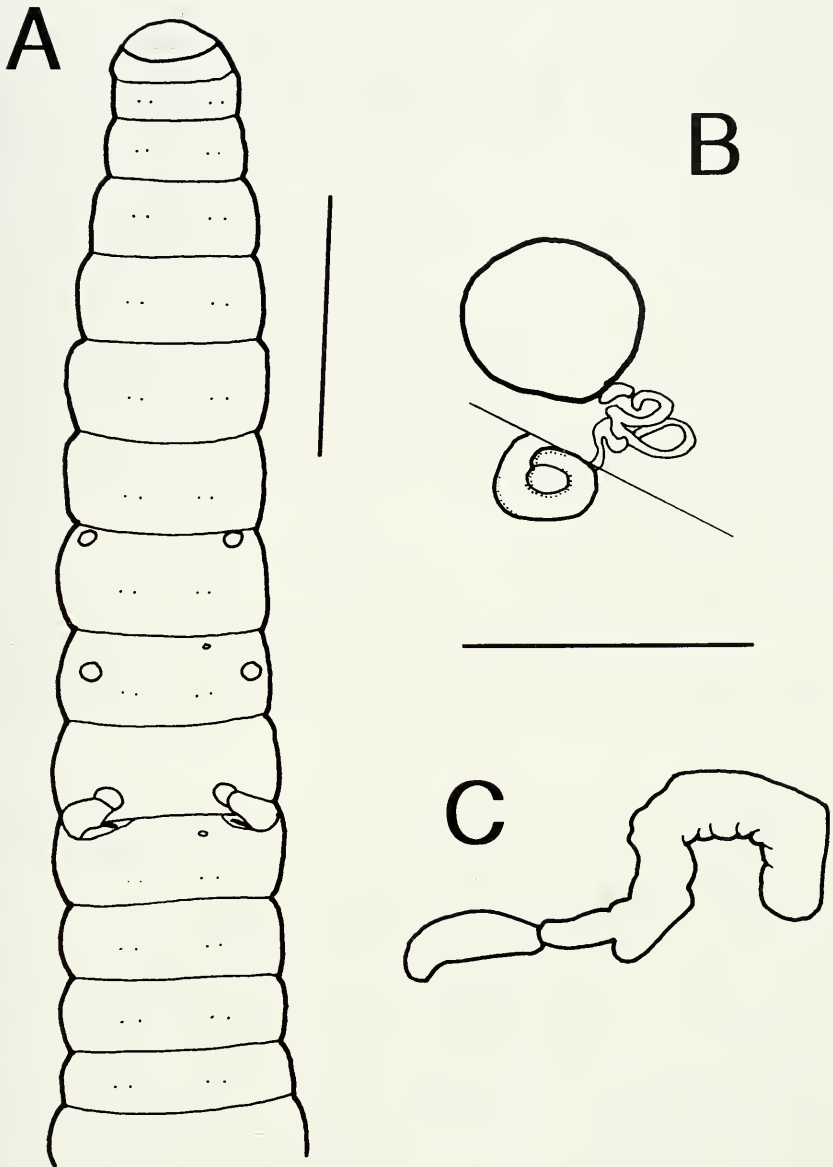


FIG. 3

Drawida guryeensis sp. n. A: ventral view; B: spermathecae; C: secondary male pores. Scale bars = 3 mm (A), 2 mm (B, C).

Septa 5/6, 8/9 thin, 6/7, 7/8 thick, 9/10 very thin. Gizzards four xiii-xvi, brownish, smooth on the surface. Dorsal vessel large in calibre, four pairs lateral hearts vi-ix. Nephridia usually present, nephridial vesicle long, extending to dorsal vessel. One pair of testis sacs suspended in septum 9/10, sperm duct very thin, coiled in large

mass. Prostates one pair, embedded in septum 9/10, Ovarian chamber in xi, formed by septa 10/11 and 11/12, brittle. Ovisacs in xii large, thick, extending to xvi, almost completely covering gizzards.

Spermathecae in viii, attached to face of septum 7/8; short, round-shaped atrium; ampulla middle-sized pouch, round ball shape, ducts long, irregularly twisted, muscular. Genital markings with muscular areas corresponding to the externally visible circular tubercle.

Remarks: The present species appears to be closely related to *Drawida jirisanensis* sp. n., with similar body shape, spermathecal atrium, and shape of prostate, but it is separated easily by the position of genital markings. *Drawida guryeensis* sp. n. has genital markings paired between B and C, which *Drawida jirisanensis* sp. n. has unpaired between A A. Also this species is similar to *D. tairaensis* Ohfuchi, 1938 from Japan, with respect to shape of penis, but it is different in genital markings and spermatheca atrium, since *D. tairaensis* always lacks genital markings. Genital markings are not found as frequently in Indian or Burmese species but are of taxonomic importance (Gates, 1945). Most Korean *Drawida* species have genital markings except for *D. keikensis*.

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