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New descriptions of enchytraeid species (Clitellata: Enchytraeidae) from Korea

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The following seven species of soil enchytraeids belonging to five genera were collected from Korea: *Enchytraeus buchholzi* Vejdovský, 1878, *Enchytraeus irregularis* Nielsen & Christensen, 1961, *Fridericia bulboides* Nielsen & Christensen, 1959, *Hemifridericia parva* Nielsen & Christensen, 1959, *Henlea perpusilla* Friend, 1911, *Henlea ventriculosa* (Udekem, 1854), and *Marionina argentea* Michaelsen, 1889 *sensu lato*. Species were found in soil and litter layers of sites investigated in 2007, 2008 and 2014. Diagnoses or descriptions for these species are provided here with new micrographs or drawings.

Keywords: Clitellata, Enchytraeidae, Korea, Taxonomy

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Introduction

Terrestrial enchytraeids have diverse habitats in soil environments worldwide. There are 33 genera and 709 valid species in the family Enchytraeidae (Schmelz and Collado, 2015). Members in the family Enchytraeidae are also diverse and abundant in litter layers and soils in the forests of Korea (Dózsa-Farkas and Hong, 2010; Dózsa-Farkas *et al*., 2015).

These miniscule worms are generally smaller than other terrestrial Clitellata species. They typically have a soft body, pale body color, single-pointed chaetae, clitellum stretching over XII-XIII segments, testes attached to septum 10/11, sperm funnels in XI, male pores in XII, ovaries attached to septum 11/12 and extending as female pores at the posterior margin of segment XII. The spermathecae are open to the exterior at the intersegmental furrow of 4/5. Spermathecae are free or connected with the oesophagus. Enchytraeidae differs from other Clitellata based on these traits.

The taxonomy of the Enchytraeidae has been studied in several areas of the Korean peninsula (Dózsa-Farkas and Hong, 2010; Christensen and Dózsa-Farkas, 2012; Dózsa-Farkas *et al*., 2015). Dózsa-Farkas and Hong (2010) recorded three new species in the genus *Hemienchytraeus*: *Hemienchytraeus koreanus*, *H. jeonjuensis*, and *H. quadratus*, including two terrestrial polychaetes, *Hrabeiella* sp. and *Parergodrilus heideri* from South Korea and North Korea, respectively. Christensen and Dózsa-Farkas (2012) described three new species (*Globulidrilus helgei*, *Fridericia seoraksani*, and *Mesenchytraeus longiductus*) within a new genus, *Globulidrilus,* from forest areas on Mt. Seoraksan, South Korea. Recently, Dózsa-Farkas *et al*. (2015) recorded five new enchytraeids: *Henlea magnaampullacea*, *Fridericia sphaerica, F. cusanicaformis, F. granulocyta, Mesenchytraeus calyx* together with three unrecorded species, *Enchytraeus christenseni* Dózsa-Farkas, 1992, *Enchytraeus dichaetus* Schmelz and Collado, 2010, and *Achaeta cf. brevivasa* Graefe, 1980 from soil and litter layers in agricultural farm regions and mountain forests. In the same paper, Dózsa-Farkas *et al*. (2015) provided a detailed description of *Fridericia peregrinabunda* Michaelsen, 1913, a species that has been mentioned as a test organism for soil toxicity trials in Korea (An and Yang, 2009). Dózsa-Farkas *et al*. (2015) also described some traits of *F. peregrinabunda* not mentioned in previous studies. Here, we record seven species belonging to five genera: *Enchytraeus buchholzi* Vejdovský, 1878 *sensu lato*, *Enchytraeus irregularis* Nielsen and Christensen, 1961, *Fridericia bulboides* Nielsen and Christensen, 1959, *Hemifridericia parva* Nielsen and Christensen, 1959, *Henlea perpusilla* Friend, 1911, *Henlea ventriculosa* (Udekem, 1854), and *Marionina argentea* Michaelsen, 1889 which have not been previously described in Korea. We also provide some characteristic traits and new

micrographs of these species.

While Korean terrestrial enchytraeids have been studied considerably, the fauna-list is not yet complete since many areas have never been investigated. Many new species are expected to be discovered in the future.

Materials and Methods

Samples were extracted from soil samples collected in 2007-2008 and 2014 from experimental areas of Chonbuk National University, including an experimental farm at the University, maple tree cultivation area, earthworm experimental box, and deciduous mountain forest in Mt. Jiri, Mt. Cheontae, Yeongdong-gun, Mt. Hwangaksan, Gimcheon-si and Dongjin-myeon, Buan-gun from cultivation areas of agronomical fields.

Enchytraeids were extracted from the soil samples by wet funnel method (O'Connor, 1962). Worms were first observed and measured alive. They were then anaesthetized in 15-20% ethanol and preserved in 70% ethanol. Some of the specimens were stained with borax-carmine, and then passed through ethanol dehydration series (from 70% to 100%), mounted temporarily in clove oil, then permanently in Euparal between two coverslips so that these worms could be observed from both sides (Schmelz, 2003). Important morphological characters were recorded *in vivo* and photographed (Axio Imager, A2 microscope with differential interference contrast illumination, AxioCam MRc 5 Zeiss digital camera, Axiovision software). These whole-mounted specimens were reinvestigated and photographed as well. Specimens of juveniles were kept in culture in a petri-dish at 10-12°C (Dózsa-Farkas *et al*., 2015).

Systematic Accounts

Class Clitellata Linnaeus, 1740
Order Enchytraeida Timm, 2013
Family Enchytraeidae Vejdovský, 1879
Genus *Enchytraeus* Henle, 1837
New Korean name: Gasi-ae-jireongi-sok (가시애지렁이속)

1. *Enchytraeus buchholzi* Vejdovský, 1879 *sensu lato* (Fig. 1)

Enchytraeus buchholzi Vejdovský, 1879; Schmelz and Collado, 2010: 88, Figs 32H, 33J, K; Dózsa-Farkas, Felföldi and Hong 2015: 173, Table 1, for complete synonym assign: Rota (1994).
New Korean name: Gasi-ae-jireongi (가시애지렁이)

Material examined. Korea, Jeollabuk-do, Jeonju-si, Chonbuk National University, College of Agriculture & Life Science, soil and litter layers in mountain forest near experimental farm (35°50′59.0″N, 127°07′56.4″E, 55 m asl.), 3 April 2014 and 19 May 2014, Y. Hong coll.; Jeollabuk-do, Jeonju-si, Chonbuk National University (35°50′50.2″N, 127°08′01.8″E, 60 m asl.), 3 April 2014, Y. Hong coll.; Jeollabuk-do, Buan-gun, Dongjin-myeon, soil and leaves in Mulberry tree cultivation area of agronomical fields (35°46′07.3″N, 126°43′16.1″E, 16 m asl.), 3 April 2014, Y. Hong coll.; Jeollabuk-do, Buan-gun, Dongjin-myeon, soil in a cabbage plot (field) of agronomical fields (35°46′05.6″N, 126°43′15.6″E, 18 m. asl.), 3 April 2014, Y. Hong coll.; Cheungcheongbuk-do, Yeongdong-gun, Mt. Cheontae, soil and litter layers of a forest (36°06′57.8″N, 128°00′30.4″E, 201 m. asl.), 19 May 2014, Y. Hong coll.; Gyeungsannbuk-do, Gimcheon-si, Mt. Hwangaksan, Jikjisa temple, soil and litter layers of a forest (36°06′00.6″N, 127°58′55.4″E, 304 m. asl.), 19 May 2014, Y. Hong coll.; Jeollabuk-do, Muju-gun, Sulchon-myeon, soil and litter layers of a mixed forest (35°59′28.7″N, 127°50′46.8″E, 544 m. asl.), 19 May 2014, Y. Hong coll.

Diagnosis. Smaller worm, 5-9 mm long with 24-34 segments. Chetae straight with ental hook, formula of 2,3-2,3 : 3-3. Hyalin and granular cells more or less in dense transversal rows (Fig. 1A), Clitellum saddle-shaped (Fig. 1B). Four pairs of preclitellar nephridia from 6/7. Oesophageal appendage (Fig. 1C) with a pair of unbranched tubes and with much coiled canal, the common opening dorsally into oesophagus behind pharyngeal pad. Coelomocytes mostly without refractile granule (Fig. 1D). Sperm funnels (Fig. 1E-G) and male copulatory organs (Fig. 1H) small. Ectal ducts of spermathecae shorter than ampullae, glands on distal part of ectal ducts (Fig. 1I). Ental ducts mostly long, open separately into oesophagus.

Remarks. The genus *Enchytraeus* Vejdovský, 1879 is currently composed of 49 valid species (Schmelz and Collado, 2012). *E. buchholzi* is one of the largest dominant species in the soil with a cosmopolitan distribution. This species and other smaller *Enchytraeus* species are cultured by aquarists as fish food. They are ideal for most rainbow fishes (adults and larger fries).

Habitat and distribution. Terrestrial, except strongly acidic soils. Widespread, cosmopolitan (Schmelz and Collado, 2010).

Deposition. NIBRIV0000544610.

2. *Enchytraeus irregularis* Nielsen and Christensen, 1961 (Figs. 2-4)

Enchytraeus irregularis Nielsen & Christensen, 1961: 13-14, Figs. 7-10; Dózsa-Farkas and Hong, 2010: 173, Table 1.
New Korean name: Yangsik-ae-jireongi (양식애지렁이)

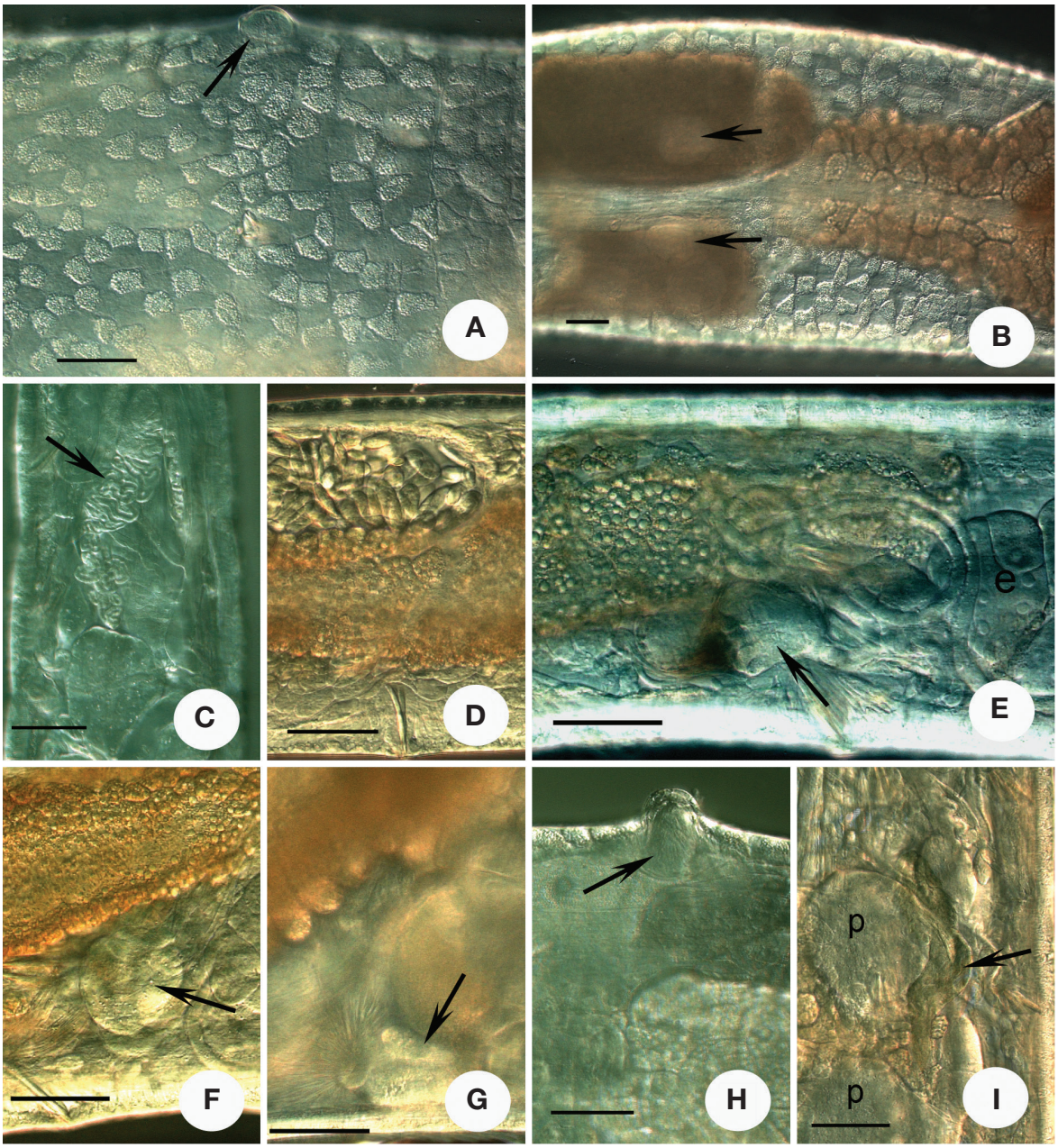


Fig. 1. Micrographs of *Enchytraeus buchholzi*. A. Clitellar glands lateral view (male copulations organ marked with arrow); B. Clitellar glands ventral view (male copulations organ marked with arrows); C. Oesophageal appendage (marked with arrow); D. Coelomocytes; E. Sperm funnel (marked with arrow, e. submature oocytes); F, G. Sperm funnels (marked with arrows); H. Everted bursa lateral view (marked with arrow); I. Spermatheca lateral view (marked with arrow). All micrograph *in vivo*. Scale bars: 50 μm.

Material examined. Korea, Jeollabuk-do, Jeonju-si, Songcheon-dong, Earthworm breeding box in house (food-waste), 3 September 2007, Y. Hong coll.

Schmelz and Collado (2010) synonymized this species with *E. capitatus* v. Bülow, 1957, however there are some differences between the two species and unfortunately the type specimens are lost. We give a more detailed description of *E. irregularis* on the basis of the specimens from Korea illustrated with micrographs.

Description. Medium-sized whitish worms, 14-20 mm long, width 400-500 μm at VIII and 550-650 μm at clitellum (*in vivo*), length of fixed specimens 10-13 mm, width 400-440 (600) μm at VIII, 550-680 (800) μm at clitellum, segments 47-66 (segments 41-49 in Nielsen & Christensen, 1961). Chaetae straight or slightly curved, formula of 3-2,3 : 3-2,3,(4). Many small epider-

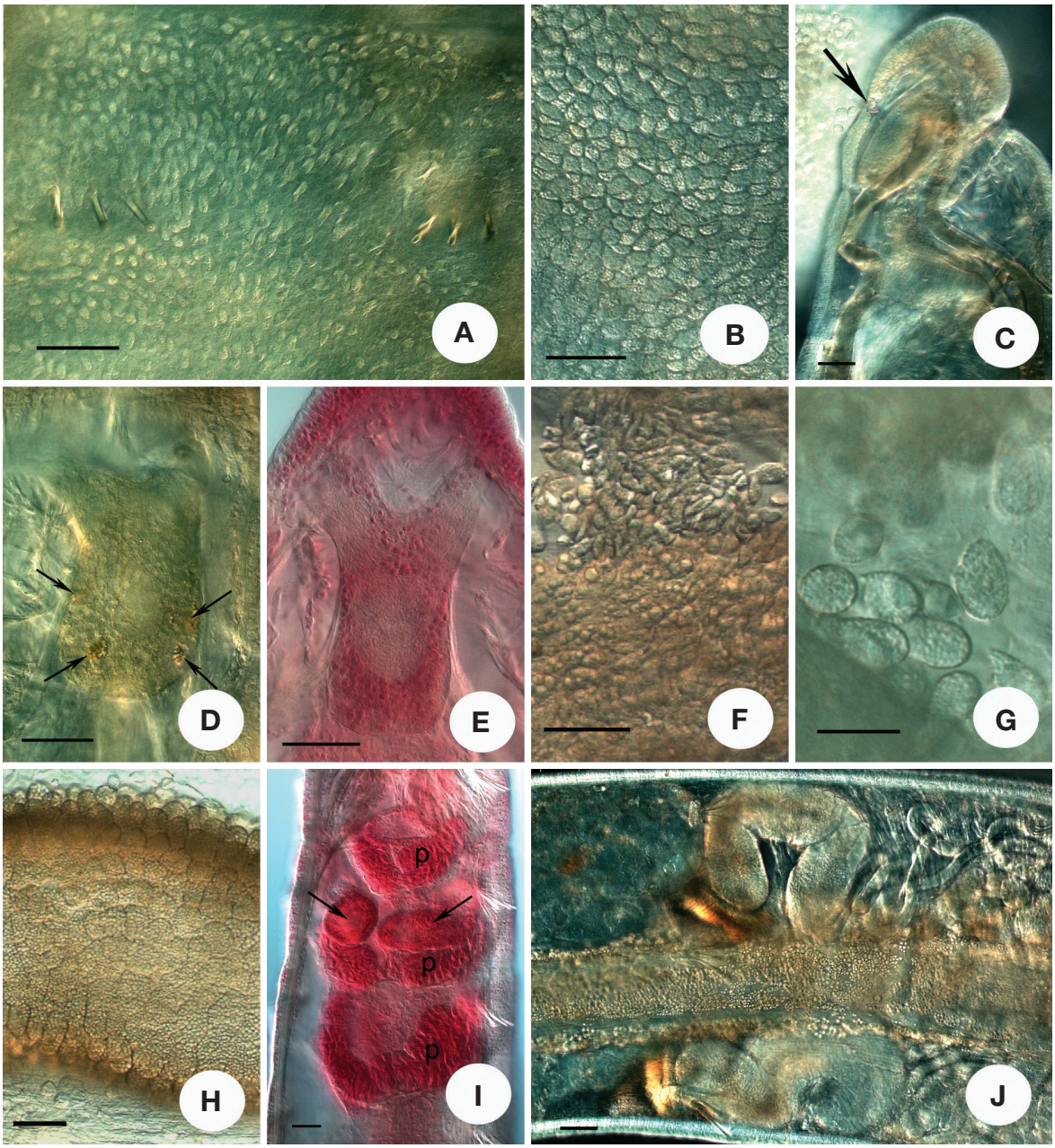


Fig. 2. Micrographs of *Enchytraeus irregularis*. A. Many small epidermal glands in segment III, ventral view; B. Clitellar glands dorsal view; C. Head pore lateral view (marked with arrow) and the anterior dorsal blood vessel (the blood is faintly red); D. Brain (the four aggregation of refractile globules marked with arrows); E. Brain of a fixed and stained specimen; F. Coelomocytes; G. Coelomocytes in 100× magnification; H. Chloragogen cells; I. Pharyngeal glands (p), spermathecal diverticula marked with arrows; J. Sperm funnels. All micrographs *in vivo* except E and I. Scale bars: 50 µm except G (20 µm).

mal glands irregularly in first five segments ventrally (Fig. 2A). Clitellum saddle-shaped, extending mostly over XII- XIII, sometimes longer for XII-XIV, gland cells small (22-28 by 14-23 µm) with darker or lighter granules, irregularly scattered (Fig. 2B). Oesophageal appendages short, irregular outline, thin-walled with a single central lumen, communicate with oesophagus dorsally, immediately behind pharynx. Three pairs of pharyngeal glands all with a connection dorsally and ventral lobes, especially for posterior pair (Fig. 2I). Brain (Fig. 2D, E) about 145 µm long, about 1.7 times as long as width (*in vivo*), straight posteriorly, both postero-lateral region usually with two or one pairs of aggregation of refractile globules (Fig. 2D). Head pore at 0/1

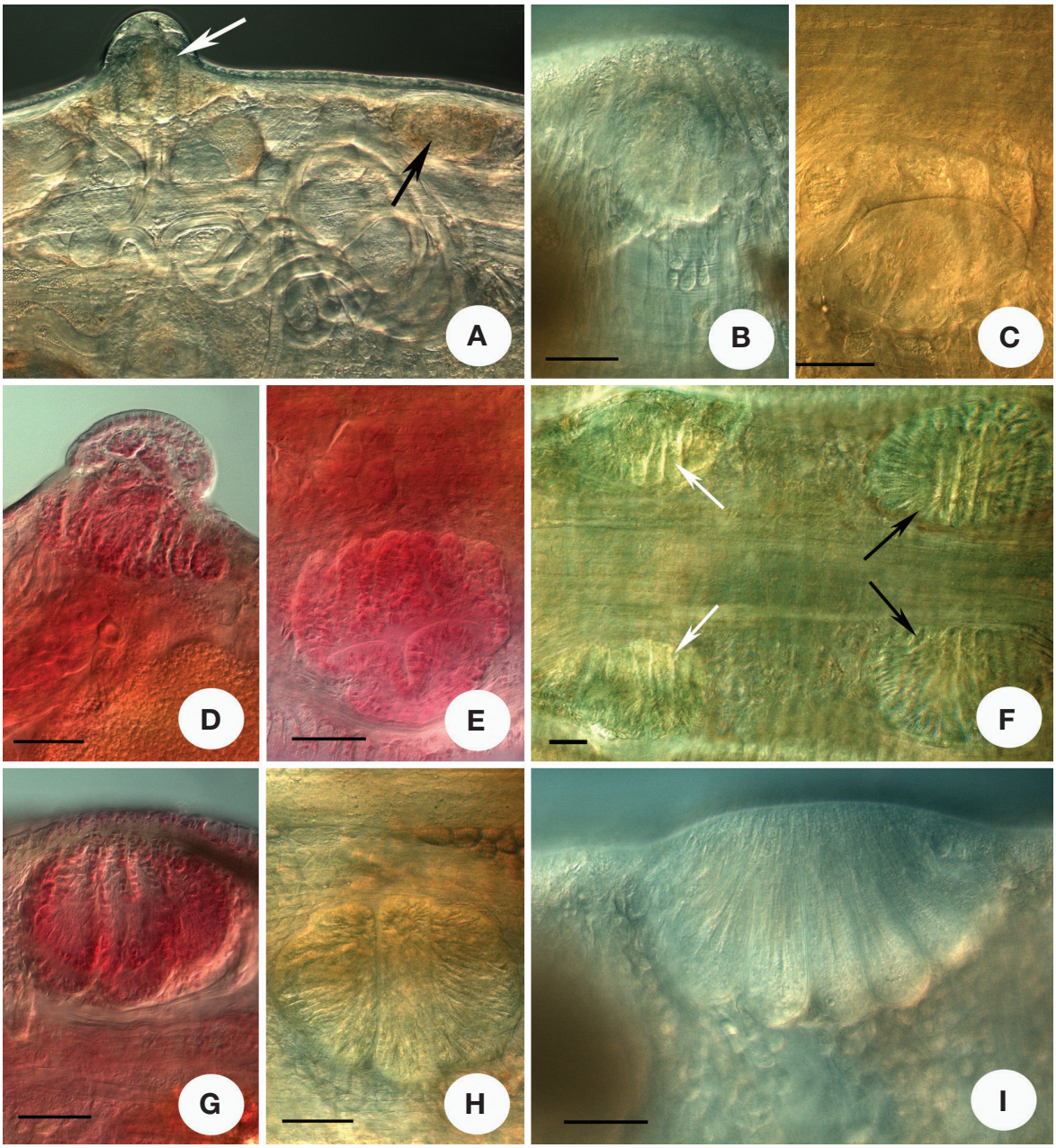


Fig. 3. Micrographs of *Enchytraeus irregularis*. A. Everted bursa of male copulations organ (marked with white arrow) vas deferens and extra copulations gland (marked with black arrow) lateral view; B. Male copulations organ with a glandular bulb and more glandular bodies; C. Bursal slit; D, E. Male copulations organs of fixed and stained specimens lateral and ventral views; F. Clitellum ventral view (male copulations organ marked with white arrows) and extra copulations glands (marked with black arrows); G. Accessory sexual gland exceptionally in segment XV; H, I. Accessory sexual glands in XIII ventral view, and lateral view respectively. A-C, F, H, I, *in vivo;* D, E, G, fixed and stained. Scale bars: 50 µm.

(Fig. 2C). Four pairs of nephridia, anteseptale consisting of funnel only, postseptale oval, efferent duct originating postero-ventrally. Coelomocytes one type, only mucocytes, small, oval or olongate pear-shaped, about 20-29 µm long (*in vivo*), filled with light granules (Fig. 2F, G). Chloragogen cells (20-39 µm long *in vivo*) from VII containing brownish globules (Fig. 2H). Dorsal vessel originates in XV-XVI, blood faintly red (Fig. 2C). Paired testis sacs (seminal vesicles), well developed and lobed in IX-XI. Sperm funnels (Fig. 2J) 400-600 µm long, 5-8 times longer than width, longer than body diameter, collars slightly wider than funnel. Spermatozoa about 85-100 µm long, heads about 30 µm, sperm ducts about 20 µm wide *in vivo* and irregularly coiled in XII (Fig. 3A).

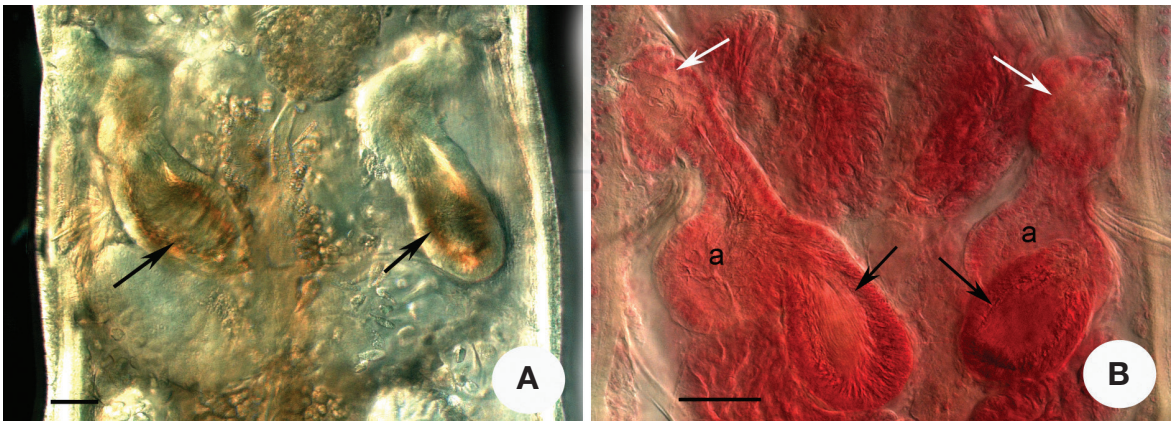


Fig. 4. Micrographs of *Enchytraeus irregularis*. A, B. Spermathecae (spermathecal diverticula marked with black arrows, ectal glands marked with white arrows, (a), ampullae. A, *in vivo*; B, fixed and stained. Scale bars: 50 µm.

Male copulatory organs (Fig. 3B) with a glandular bulb and 6-8 narrower long glandular bodies around male pores (Fig. 3A-F). Laterally bent bursal slits longitudinal (Fig. 3C). Whole male copulatory organ 130-150 µm long and 120-130 µm wide *in vivo*. After male copulatory organs, a pair of oval or square glandular structure with subdivision ('accessory sexual glands') (130-260 µm long, 90-180 µm wide, about 100 µm high) (Fig. 3F, H, I) without external orifice. These organs mostly larger than male copulations organ. In Nielsen & Christensen (1961), these glands ventrally in XII in front of male copulatory organs. These glands in collected specimens from Korea always only in XIII. In one case (slide No. 573), clitellum extended over XII-XV and accessory sexual gland found in XIV, but one side only (Fig. 3G).

Spermathecae (Fig. 4A, B) with have medial length of ectal ducts (ca. 100 µm long with distinct canals and a ring of glands around ectal orifices). Length of glands about 50-60 µm (fixed). Ducts widen into ampullae proximally (diameter of ampullae about 90 µm), which again gradually tapers into short ental ducts, communicating separately with oesophagus. From ampullae anteriorly or laterally arises one large diverticula filled with spermatozoa, 2-8 eggs mature at a time.

Remarks. *E. irregularis* differs from *E. capitatus* by accessory sexual glands which are absent in *E. capitatus*. In the brain of *E. capitatus* there are no refractile dropples in the postero-lateral region (Nielsen & Christensen, 1961). There are 4 chaetae in bundles praeclitellarly of *E. capitatus*, whereas there are maximum of 3 chaetae in these bundles and postclitellarly of *E. irregularis* (very rarely 4 chaetae). In addition, there is no enlarged posterior chaetae as in *E. irregularis* (Schmelz and Collado, 2010).

Habitat and distribution. Compost of botanical gardens in Denmark. Vermicompost in Hungary (1987) and Korea (2007). Possibly an introduced species.

Deposition. NIBRIV0000544611.

Genus *Fridericia* Michaelsen, 1889

New Korean name: Cham-ae-jireongi-sok (참애지렁이속)

3. *Fridericia bulboides* Nielsen and Christensen, 1959 (Fig. 5)

Fridericia bulboides Nielsen and Christensen, 1959: 72-75; Dózsa-Farkas & Hong, 2010: 31, Table 1; Dózsa-Farkas, Felföldi and Hong, 2015: 173, Table 1, for complete synonym assign: Schmelz (2003).

New Korean name: Myohyang-cham-ae-jireongi (묘향참애지렁이)

Material examined. Korea, Jeollabuk-do, Buan-gun, Dongjin-myeon, soil in a rice paddy field of agronomical fields (35°46′05.7″N, 126°43′14.7″E, 17 m asl.), 3 April 2014, Y. Hong coll.; North Korea, Pyunganbuk-do, Mt. Myohyang, Hyangsan at the branch of Chongchon river, litter layers in deciduous forest, 7 July 1988, Csuzdi coll.; North Korea, Pyunganbuk-do, Mt. Myohyang, litter layers in deciduous forest, Isonnam near to a waterfall, 8 July 1988, Csuzdi coll.

Diagnosis. White worms, 5-9 (12) mm long, 0.25 mm wide with 29-38 segments, chaetae straight and distinctly hooked entally, maximum length ca. 40-50 µm preclitellarly, 60-75 µm postclitellarly, inner chaetae in a bundle shorter than outer chaetae, formula: (1,3)4-4,2 : 4,(5)-4,2. Clitellum girdle-shaped, cells mostly reticulate. Oesophageal appendage unbranched very long, much coiled in IV-V, extending to VII (type b) (Fig. 5A). Five pairs of preclitellar nephridia from 6/7 to 10/11. Coelomo-mucocytes (Fig. 5C) with hyaline matrix at periphery refractile vesicles, type b (according to Möller, 1971). Chylus cells between XI-XV, occupying 2 seg-

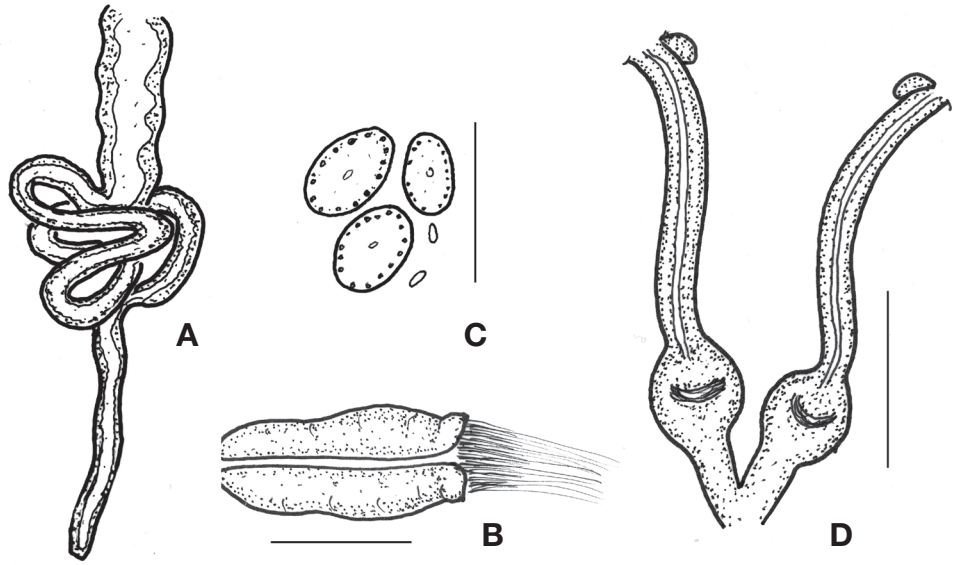


Fig. 5. *Fridericia bulboides*. A. Oesophageal appendage; B. Sperm funnel; C. Coelomocytes; D. Spermathecae. Scale bars: 50 μm.

ments. Dorsal blood vessel originating in XIII-XVII, blood colorless. Seminal vesicle absent or small. Sperm funnels (Fig. 5B) about 1.5-2 times longer than wide, bursal slits longitudinal. Male copulatory organ small, often flat. Subneural glands absent. Spermathecal ectal glands globular and sessile, ectal duct long, ampullae onion-shaped without diverticula. Typically proximal ducts of spermathaecae fused at entrance into oesophagus (Fig. 5D). 1-2 eggs mature at a time.

Remarks. Genus *Fridericia* Michaelsen, 1889 is currently composed of more than 100 valid species. *F. bulboides* differs from other small *Fridericia* species with onion-shaped spermathecal ampullae fused one common opening into oesophagus, 4 chaetae in preclitellar bundles, type b coelomo-mucocytes, and characteristic b type oesophageal appendages (Cech and Dózsa-Farkas, 2005).

Habitat and distribution. *Fridericia bulboides* is one of the most common species in soil with, a cosmopolitan distribution. Found in limy to sandy, dry and moist, nutrient-rich and nutrient-poor soils. Also found in aquatic, salt marshes, and freshwater habitats (Schmelz, 2003).

Deposition. NIBRIV0000544612.

Genus *Hemifridericia* Nielsen and Christensen, 1949
New Korean name: Aegi-ae-jireongi-sok (애기애지렁이속)

4. *Hemifridericia parva* Nielsen and Christensen, 1959 (Fig. 6)

Hemifridericia parva Nielsen and Christensen, 1959: 68, Figs. 68-70; Dózsa-Farkas & Hong, 2010: 31, Table 1. Dózsa-Farkas & Felföldi, 2015: 185-192, Table 1, Fig. 1A, C, E, G, H, Fig. 2C, D, G, Fig. 3B-D, F, Fig. 4A.
New Korean name: Aegi-ae-jireongi (애기애지렁이)

Material examined. Korea, Jeollabuk-do, Namwon-gun, Unbong-myeon, Mt. Jiri, Bamsagol Valley, litter layers in deciduous forest (35°46′05.7″N, 126°43′14.7″ E), 18 September 2008 and 6 October 2008, Y. Hong coll.

Diagnosis. 2-3 mm long and 150-200 μm wide worms *in vivo* with 15-21 segments. Chaetae straight without nodulus, proximally bent, gradually increasing in size from anterior to caudal segments, formula: 2-2 : 2,3,(1)-2. Three pairs of pharyngeal glands, all with ventral lobes, two anterior pairs with dorsal connection or separated, posterior pair in VI elongate, never united dorsally. Brain deeply incised posteriorly (Fig. 6A). In ventral bundles, preclitellarly 3 chaetae except in II and XI (with two chaetae) (Fig. 6D). Two chaetae present in XII in lateral bundles, also ventrally near penial bulbs (Fig. 6C), a rare character in enchytraeids. Clitellum over XII-1/2 XIII, saddle-shaped, large square hyalocytes and granulocytes in transverse rows dorsally. No oesophageal appendages. Coelomo-mucocytes scarce, oval with weakly granular texture, length of 13-20 μm, lenticytes very numerous, 5-10 μm long (*in vivo*). Chloragogen cells forming a prominent layer of large cells about 20-37 μm in diameter with refractile globules. Three pairs of nephridia (Fig. 6B) in preclitellar region at 6/7, 7/8, and 9/10. Dorsal blood vessel originating in XII, blood colorless, anterior bifurcation of dorsal blood vessel in I. Seminal vesicle absent. Sperm funnel (Fig. 6E) small, pear-shaped, about 40 μm long, collar slightly narrower

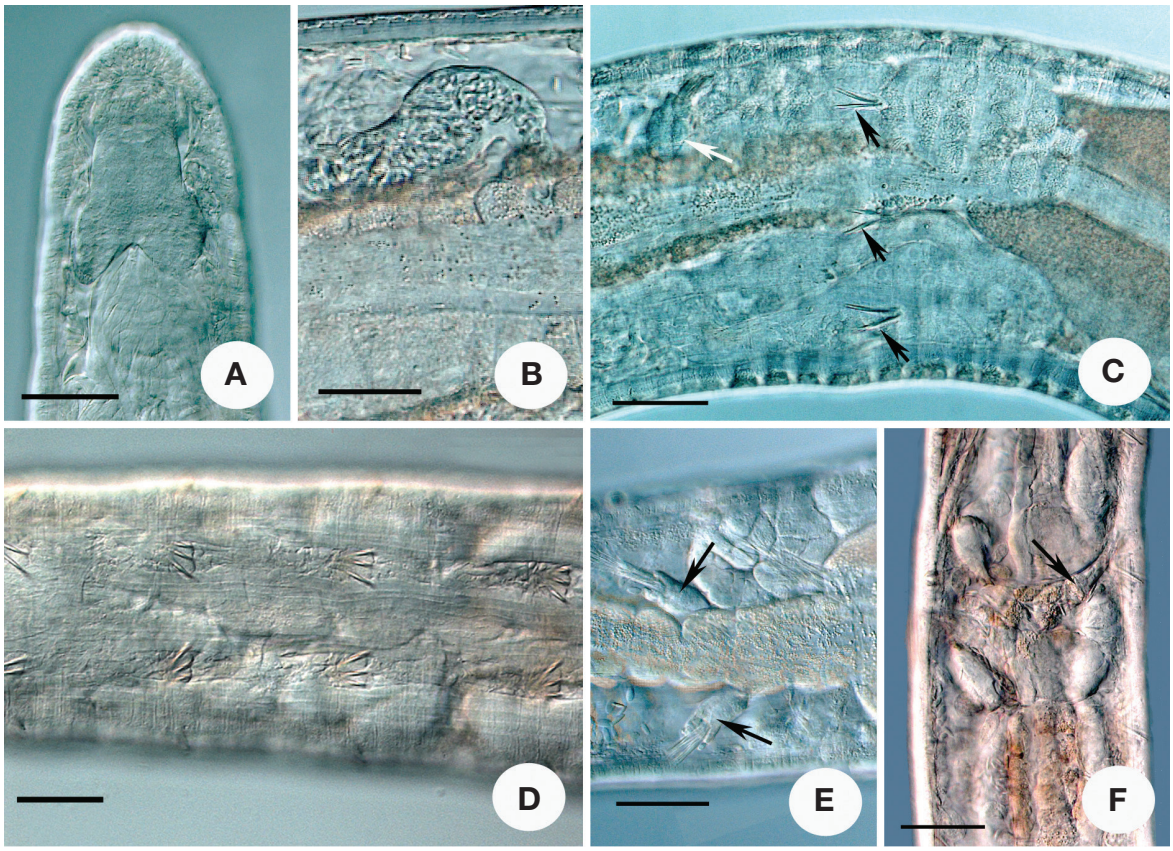


Fig. 6. Micrographs of *Hemifridericia parva*. A. Brain; B. Nephridium preclitellarly; C. Clitellar area ventral view (clitellar chaetae marked with black arrows, sperm funnel marked with white arrow); D. Ventral chaetae from II (only 2 chaetae), III-V segments (3 chaetae in a bundle) ventral view; E. Sperm funnels (marked with arrows); F. Spermathecae (only one of the pair is visible). All micrograph *in vivo*. Scale bars: 50 µm.

than funnel body. Spermatozoa about 45-50 µm long, heads about 18-20 µm long (*in vivo*). Male copulatory organs small and compact, 47-56 µm long. Spermathecae (Fig. 6F) with long ectal ducts devoid of glands, ampullae spherical, 15-20 µm in diameter *in vivo*, ental ducts fused, one common opening into oesophagus. One or two mature eggs present at a time (Dózsa-Farkas and Felföldi, 2015).

Remarks. Genus *Hemifridericia* Nielsen and Christensen, 1959 is currently composed of two valid species.

Habitat and distribution. Wet soils and widespread (Schmelz and Collado, 2010).

Deposition. NIBRIV0000544613.

Genus *Henlea* Michaelsen, 1889

New Korean name: Kkoma-ae-jireongi-sok (꼬마애지렁이속)

5. *Henlea perpusilla* Friend, 1911 (Fig. 7)

Henlea perpusilla Friend, 1911: 466; Friend, 1912: 585; Dózsa-Farkas and Hong, 2010: 31, Table 1; Dózsa-Farkas, Felföldi and Hong, 2015: 173, Table 1, for complete synonym assign: Rota (1994).

New Korean name: Kkoma-ae-jireongi (꼬마애지렁이)

Material examined. Korea, Jeollabuk-do, Buan-gun, Dongjin-myeon, soil in a rice paddy field of agronomical fields (35°46′05.7″N, 126°43′14.7″E, 17 m asl.), 3 April 2014, Y. Hong coll.; Jeollabuk-do, Jeonju-si, Chonbuk National University, College of Agriculture & Life Science, soil and litter layers in mountain forest nearby experimental farm (35°50′50.2″N, 127°08′01.8″E), 3 September 2007 and 6 October 2008, Y. Hong coll.; North Korea, Pyunganbuk-do, Mt. Myohyang, Hyangsan at the branch of Chongchon river, litter layers in deciduous forest, 7 July 1988, Csuzdi coll.; North Korea, Pyunganbuk-do, Mt. Myohyang, litter layers in deciduous forest, Isonnam near to a waterfall, 8 July 1988, Csuzdi coll.

Diagnosis. 4-10 mm long and 280-310 µm wide worms *in vivo*, with 25-36 segments. Chaetae straight or slightly bent, up to 5-9 chaetae in ventral bundles. Epidermal gland cells form several rows on prostomium and segments (Fig. 7A). Head pore at 0/I, a transverse slit (Fig. 7A). Pharyngeal glands free dorsally (Fig. 7B, E), occa-

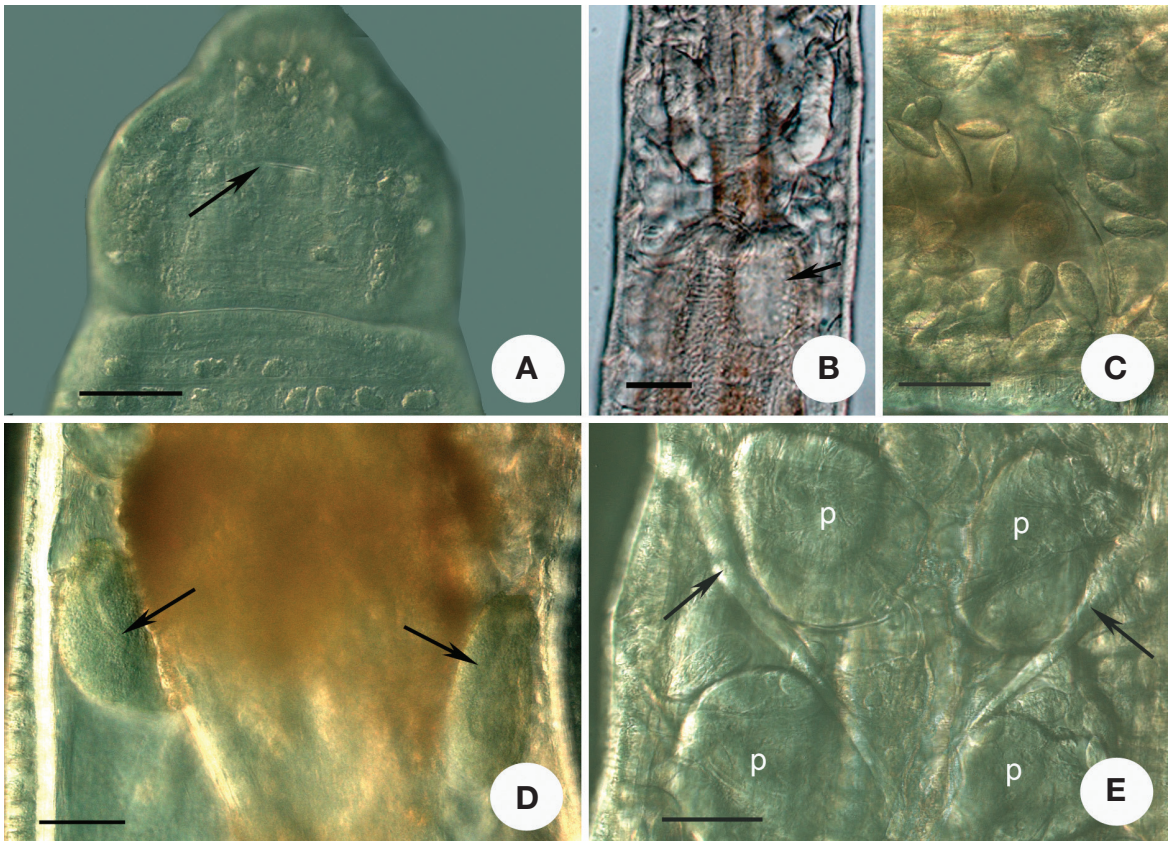


Fig. 7. Micrographs of *Henlea perpusilla*. A. Head pore (marked with arrow) and epidermal glands; B. Gut widening abruptly in segment VIII (dorsal blood vessel marked with arrow); C. Coelomocytes; D. Sperm funnels (marked with arrows); E. Spermathecae (marked with arrows), first and secondary pharyngeal glands (p). All micrograph *in vivo*. Scale bars: 50 μm.

sionally connected in VI. Clitellar gland cells in reticulate pattern or in dense rows. Brain posteriorly straight or slightly concave. Five pairs of preclitellar nephridia from 6/7 to 10/11. Coelomocytes only mucocytes, oval, transparent, finely granulated (Fig. 7C). Intestine abruptly widened at 7/8 (Fig. 7B), occasionally with slight diverticula-like lateral protrusion in VIII. Dorsal vessel from VIII, blood colorless (Fig. 7B). Sperm funnel small, about 1.5 times longer than width (Fig. 7D). Spermathecal ectal glands absent or present but small, ectal duct short, ampulla almost as narrow as ectal duct or slightly dilated with gradual transition into common ental ducts, communicate with oesophagus, often form a common spermcontaining chamber (Fig. 7E). Surely a complex species with various cytotypes (Nielsen and Christensen, 1959; Schmelz and Collado, 2010).

Remarks. Genus *Henlea* Michaelsen, 1889 is currently composed of 35 valid species.

Habitat and distribution. Often at wet soils or almost aquatic sites. Very common and widespread species (Schmelz and Collado, 2010).

Deposition. NIBRIV0000324914.

6. *Henlea ventriculosa* (Udekem, 1854) (Fig. 8)

Henlea ventriculosa (Udekem, 1854): 853, Figs. 1, 4, 6-9; Dózsa-Farkas & Hong, 2010: 31, Table 1, for complete synonym assign: Rota (1994).

New Korean name: Yusa-kkoma-ae-jireongi (유사꼬마애지렁이)

Material examined. Korea, Jeollabuk-do, Jeonju-si, Chonbuk National University, College of Agriculture & Life Science, soil and litter layers in maple trees cultivation of experimental farm (35°50′51.1″N, 127°08′00.3″E), 3 September 2007 and 6 October 2008, Y. Hong coll.; Jeollabuk-do, Jeonju-si, Chonbuk National University, College of Agriculture & Life Science, Earthworm experimental organic-type box (35°50′43.3″N, 127°08′02.5″E), 3 September 2007, Y. Hong coll.; North Korea, Pyunganbuk-do, Mt. Myohyang, Hyangsan at the branch of Chongchon river, litter layers in deciduous forest, 7 July 1988, Csuzdi coll.; North Korea, Pyunganbuk-do, Mt. Myohyang, litter layers in deciduous forest, Isonnam near to a waterfall, 8 July 1988, Csuzdi coll.

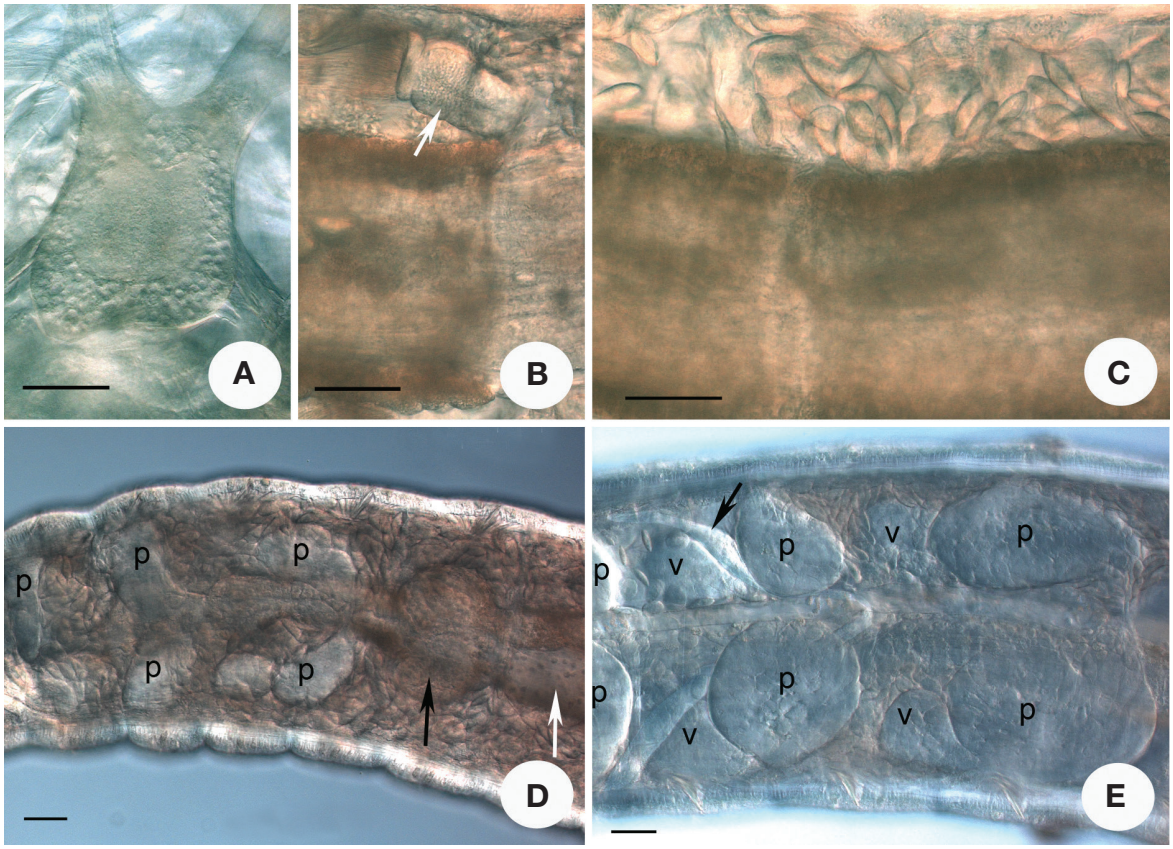


Fig. 8. Micrographs of *Henlea ventriculosa*. A. Brain; B. Sperm funnel (marked with arrow); C. Coelomocytes; D. Segments IV-IX: intestinal diverticula in VIII (marked with black arrow), origin of dorsal blood vessel in IX (marked with white arrow), pharyngeal glands (p); E. Spermathecae (marked with arrows), pharyngeal glands dorsally (p), ventral lobes of pharyngeal glands (v). All micrograph *in vivo*. Scale bars 50 μm.

Diagnosis. 9-15 mm long, color yellowish. Segment number 40-50-(60). Brain slightly longer than width and slightly incised posteriorly (Fig. 8A). Three pairs of free pharyngeal glands (Fig. 8D, E). Up to 6-9 chaetae in ventral bundles; chaetae in caudal segments as numerous as in anterior segments. Coelomocytes oval finely granulated not brownish (Fig. 8C). Seven pairs of preclitellar nephridia from 4/5 to 10/11. Gut widening abrupt at 8/9 and in VIII, four intestinal diverticula, closely applied to one another, outline spherical (Fig. 8D). Dorsal vessel from IX, blood colorless (Fig. 8D). Spermathecal ectal duct longer than ampulla without ectal glands. Ampullae not or slightly wider than ectal ducts. Ental ducts united before attachment to oesophagus (Fig. 8E). Nielsen and Christensen, 1959, Schmelz and Collado, 2010).

Remarks. Species complex. The specimens investigated in this study are very similar to *H. ventriculosa* in the following: size (8-12 mm, 40-44 segments), intestinal diverticula in VIII, with large cavity inside; dorsal vessel origin in IX, 7 pairs of preclitellar nephridia. It was identified as *H. ventriculosa* in our first publication (Dózsa-Farkas and Hong, 2010). However, we founded some morphological differences later in our new collections. The maximum number of chaetae in a bundle is only 6-7 (often a maxium of 8-9 chaetae in *H. ventriculosa*). The coelomocytes are slightly rounder than those usually in *H. ventriculosa* and light brown. The main differences of these *H. ventriculosa* collected from South Korea from *H. ventriculosa* described in Europe are shorter spermathecal ectal ducts and wider spermathecal ampullae. Molecular analysis also shows that these Korean specimens resemble *H. ventriculosa* collected from Europe. However, they are not identical. Therefore, it was named *Henlea* sp. (Dózsa-Farkas, Felföldi and Hong, 2015). Further investigation should be conducted for these *H. ventriculosa* found in Korea.

Habitat and distribution. Moist and dry soils, cosmopolitan (Schmelz and Collado, 2010).

Deposition. NIBRIV0000544614.

Genus *Marionina* Michaelsen, 1890

New Korean name: Dol-ae-jireongi-sok (돌애지렁이속)

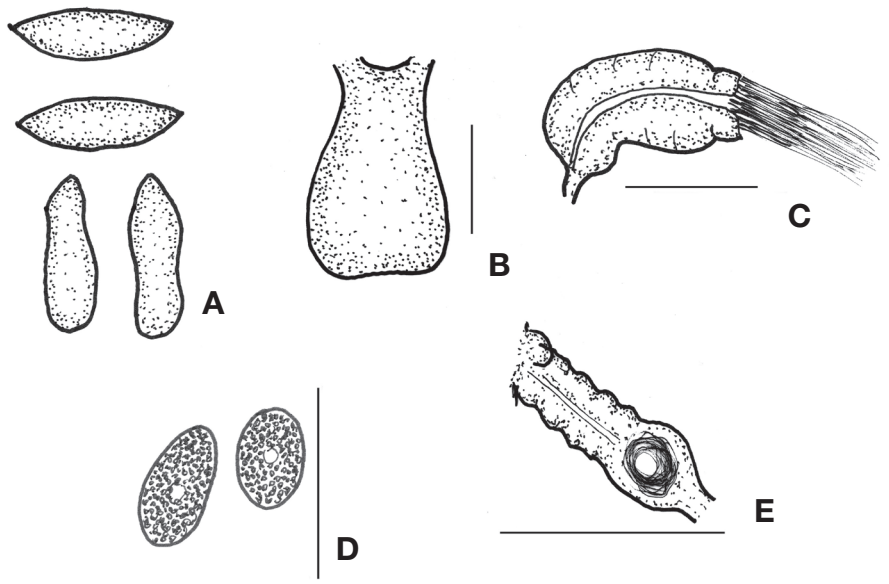


Fig. 9. *Marionina argentea*. A. Pharyngeal glands (schematic); B. Brain; C. Sperm funnel; D. Coelomocytes; E. Spermathecae. Scale bars: 50 μm.

7. *Marionina argentea* Michaelsen, 1889 *sensu lato* (Fig. 9)

Marionina argentea Michaelsen, 1889: 15-17: fig. 6a, b; Dózsa-Farkas and Hong, 2010: Table 1, for complete synonymy Rota: 2013.

New Korean name: Dol-ae-jireongi (돌애지렁이)

Material examined. Korea, Jeollabuk-do, Namwon-gun, Unbong-myeon, Mt. Jiri, Bamsagol Valley, Litter layers in deciduous forest (35°20′56.4″N, 127°33′03.9″E, 569 m asl.), 18 September 2008 and 6 October 2008, Y. Hong coll.

Diagnosis. 3-7 mm long and about 180 μm wide worms *in vivo*, with 19-26 segments. Color intensely white due to aggregations of colomocytes. Chaetae thin, straight, sharply pointed ectally, distinctly hooked entally. Two chaetae in bundles throughout, absent laterally in II. Pharyngeal glands broadly united dorsally in IV and V, separate and elongate in VI (Fig. 9A) Dorsal vessel from XIII, blood colorless. Preclitellar nephridia in one or two positions of 7/8, 8/9, or 9/10. Coelomocytes filled with coarse refractile granula, dark-black in transmittent light (Fig. 9D). Clitellum saddle-shaped, gland cells in separate rows. Seminal vesicle absent or small. Sperm funnel (Fig. 9C) small, ca 1.5 times as long as width, male glandular bulb small. No subneural gland. Spermathecal ectal duct with slight glandular swellings and one or two slightly larger glands at orifice, ampullae oval or pear-shaped, lumens contain spermathozoa. Ental ducts short, and communicate separately with oesophagus (Fig. 9E). Mostly one large mature egg present at a time (Nielsen and Christensen, 1959, Schmelz and Collado, 2010).

Remarks. The genus *Marionina* Michaelsen, 1890 is a polyphyletic enchytraeid genus represented by about 100 nominal species (Rota *et al*., 2008). This genus was originally described in 1889. It was initially named *Marionia*, but was corrected to *Marionina* one year later by Michaelsen himself. According to ICZN (1999), a new replacement name has its own author and date. Thus, the correct nomenclature of the genus should be *Marionina* Michaelsen, 1890 (Rota *et al*., 2008). *Marionina argentea* species is a complex. Rota (2013) has carried out a revision of this complex, described 3 new species, and separated *M. argentea sensu stricto* from this group. We were unable to take this complicated segregation in these Korean specimens into consideration. Therefore, we named our specimens '*M. argentea sensu lato*'.

Habitat and distribution. In wet sites, also aquatic. In soils, often in deeper strata with groundwater contact. Slightly salt-tolerant. Not at acidic sites. Very common and cosmopolitan (Schmelz and Collado, 2010).

Deposition. NIBRIV0000544615.

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