

研究資料 (Research material)

Earthworm fauna (Annelida: Clitellata) of the Main Campus and Chiyoda Experimental Station of Forestry and Forest Products Research Institute

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Abstract

Earthworm fauna of the main campus and Chiyoda Experimental Station of Forestry and Forest Products Research Institute, Ibaraki Prefecture, central Japan were surveyed in the first time. Five species of Family Megascolecidae were recorded. Among them, the taxonomic status of *Amyntas tokioensis* (Beddard, 1892) is discussed on the observation of the holotype.

Key words : earthworm, Megascolecidae, *Amyntas tokioensis*, central Japan

Introduction

Earthworm fauna of the main campus (MC) and Chiyoda Experimental Station (CES) of Forestry and Forest Products Research Institute (FFPRI), Ibaraki Prefecture, central Japan were surveyed for the first time in the course of soil ecotoxicological study conducted by FFPRI (Yamada and Yasuda 2002; Kunisue *et al.* 2006). Five species of family Megascolecidae Rosa, 1891 were identified. Four species of them are well-defined common species from Japan. The other one is a species closely relating to both *Amyntas tokioensis* Beddard, 1892 and *A. irregularis* Goto & Hatai, 1899. The definition and intraspecific variability of *A. irregularis* were well studied by Ohfuchi (1938, 1939). But taxonomic relationship between these two species is still uncertain because of the insufficient description of *A. tokioensis*. We got the opportunity of observing the holotype specimen of *A. tokioensis* deposited in the Natural History Museum in London and studied on the taxonomic status of *A. tokioensis* based on the observation of the holotype.

Materials and Methods

Cite description

MC: Arboreum in the main campus of FFPRI, alt. 25 m a.s.l., 36°0'26"N 140°7'59"E, Matsunosato, Tsukuba-city, Ibaraki Prefecture, central Japan, 2 July 1999, M. Yasuda coll.

CES: Japanese cedar plantation in Chiyoda Experimental Station of FFPRI, near Mt. Tsukuba, alt. 40 m a.s.l., 36°11'7"N 140°12'57"E, Kamishizuku,

Kasumigaura-city, Ibaraki Prefecture, central Japan, 30 June 1999, M. Yasuda coll.

Earthworms were collected by hand from litter and soil. Collected earthworms were carried to the laboratory alive within 3 hours. Worms were anesthetized and killed by ethanol and fixed in formaldehyde within 10 hours. Fixed specimens were then preserved in glass tubes with formaldehyde.

External and internal morphology of the specimen was observed with stereoscopic microscopes (NIKON SMZ-10 and LEICA MZ7) measured with a caliper rule and illustrated with a camera lucida.

Classification system was according to Sims and Easton (1972). Terminology is mainly that of Sims and Easton (1972), but partly based on Ishizuka (1999a).

Taxonomic Account

Five species of Family Megascolecidae were collected from 2 cites (MC and CES) of FFPRI, Ibaraki Pref., central Japan. Specific names and occurrence of these 5 species are summarized in Table 1.

Table 1. List of earthworm species from main campus (MC) and Chiyoda Experiment Station (CES), FFPRI, Ibaraki Pref., central Japan.

	MC	CES
<i>Amyntas agrestis</i> (Goto & Hatai, 1899)	○	○
<i>Amyntas hilgendorfi</i> (Michaelsen, 1892)	○	○
<i>Amyntas hupeiensis</i> (Michaelsen, 1895)	○	—
<i>Amyntas tokioensis</i> (Beddard, 1892)	—	○
<i>Pheretima' aokii</i> Ishizuka, 1999 incertae sedis	○	○

○ : present, — : absent

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Family Megascolecidae Rosa, 1891

***Amyntas agrestis* (Goto & Hatai, 1899)**

[Japanese name: Hatake-mimizu]

Perichaeta agrestis Goto and Hatai, 1899, p. 17, fig. 7.

Pheretima agrestis: Michaelsen, 1900, p. 313; Hatai, 1931, p. 183, fig. 33; Ishizuka, 1999a, p. 57, 2000, p. 11, fig. 16

Amyntas agrestis: Sims and Easton, 1972, p. 235; Easton, 1981, p. 51.

Metaphire agrestis: Blakemore, 2003, p. 243; 2004, p. 160.

Material examined: 8 specimens from MC; 1 specimen from CES.

Diagnosis. Spermathecal pores in furrows 5/6/7/8. Three pairs of spermathecae. Proclitellar external markings of colored patch type in segments 6-8 sometimes absent or varying in their location. Male pores in segment 18. Intestinal caeca manicate.

Remarks. Specimens from MC and CES lack male pores. But they are identified as *A. agrestis* because of having 1) colored patch type external markings in segment 7 without genital gland, 2) 3 pairs of spermathecal pores in furrows 5/6/7/8 and 3) manicate intestinal caeca. Blakemore (2003) reassigned this species to genus *Metaphire* Sims & Easton, 1972 without showing detailed observation of morphology. Ishizuka's (2001) illustration indicates this species has no copulatory pouch. Therefore, it should be attributed to genus *Amyntas*.

***Amyntas hilgendorfi* (Michaelsen, 1892)**

[Japanese name: Hitotsumon-mimizu]

Perichaeta hilgendorfi Michaelsen, 1892, p. 235, fig. 15.

Pheretima hilgendorfi: Michaelsen, 1900, p. 272; Hatai, 1931, p. 187, fig. 38; Ishizuka, 1999a, p. 60, 2001, p. 11, fig. 5

Amyntas hilgendorfi: Sims and Easton, 1972, p. 237; Easton, 1981, p. 51.

Metaphire hilgendorfi: Blakemore, 2003, p. 243; 2004, p. 160.

Material examined: 10 specimens from MC; 4 specimens from CES.

Diagnosis. Two pairs of spermathecal pore in furrows

6/7/8 (sometimes one pair or lacking). Two pairs of normal spermathecae. Proclitellar and postclitellar papillar type genital markings with many small papillae on the oval swelling. Number and location of these markings varying individual to individual. Many pieces of simple duct type small glands gathering and connecting with each papilla of genital markings. Male pores not superficial in segment 18. Intestinal caeca manicate.

Remarks. All specimens from MC and CES have no male pores. But they are identified as *A. hilgendorfi* because of having 1) 2 pairs of spermathecal pores in furrows 6/7/8, 2) proclitellar and postclitellar papillar type genital markings with many small papillae on the oval swelling and 3) manicate intestinal caeca. Blakemore (2003) reassigned this species to genus *Metaphire* Sims & Easton, 1972 without detailed observation. It should be attributed to genus *Amyntas* because of having no copulatory pouch (Ishizuka, 2001) following Easton (1981).

***Amyntas hupeiensis* (Michaelsen, 1895)**

[Japanese name; Kuso-mimizu after Hatai (1931)]

Perichaeta hupeiensis Michaelsen, 1895, p. 35, figs. 11-12.

Pheretima hupeiensis: Michaelsen, 1900, p. 273, Hatai, 1931, p. 188, fig. 39; Ishizuka, 1999a, p. 60; 2001, p. 11, fig. 22.

Amyntas hupeiensis: Sims and Easton, 1972, p. 237; Easton, 1981, p. 53; Blakemore, 2003, p. 243; 2004, p. 159.

Material examined: 1 specimen from MC.

Diagnosis. Colour greenish brown. Three pairs of spermathecal pores in furrows 6/7/8/9. Each paired pores located closely. Three pairs of slender spermathecae in segments 7-9 with no nephridia. Male pores superficial in segment 18. Postclitellar genital markings of sucker-type associated with male pores located in segments 17-19. Grandular mass type genital glands behind the genital markings. Intestinal caeca simple.

Remarks. Only one specimen from MC lacks spermathecae though it has 3 pairs of spermathecal pores. But it is identified as *A. hupeiensis* because of having 1) spermathecal pores in furrows 6/7/8/9, 2) postclitellar genital markings with grandular mass type genital glands in segments 17-19, and 3) simple intestinal caeca.

***Amyntas tokioensis* (Beddard, 1892)**

[Japanese name; Fukisoku-mimizu]

(Figs. 1-2, Table 2)

Perichaeta tokioensis Beddard, 1892, p. 762; 1895, p. 413.

Amyntas tokioensis: Beddard, 1900, p. 633.

Pheretima tokioensis: Michaelsen, 1900, p. 309; Ishizuka, 1999a, p. 66; Nakamura, 1999, p. 28.

Amyntas tokioensis: Sims and Easton, 1972, p. 237; Easton, 1981, p. 51; Blakemore, 2003, p. 243; 2004, p. 160; 2007, p.96, fig. 4.

Perichaeta schizopora Goto and Hatai, 1898, p. 76, fig. 15.

Pheretima schizopora: Michaelsen, 1900, p. 317; Nakamura, p. 23.

Metaphire schizopora: Sims and Easton, 1972, p. 239.

Amyntas schizopora: Easton, 1981, p. 51.

Perichaeta irregularis Goto and Hatai, 1899, p. 13.

Pheretima irregularis: Michaelsen, 1900, p. 276; Ohfuchi, 1938, p. 1, figs. 1-16; 1939, p. 81, figs. 2-4; Ishizuka, 1999, p. 61, 2001, p. 61, fig. 6; Nakamura, 1999, p. 20.

Pheretima jiriensis Song and Paik, 1971, p. 193, figs. 9-17.

Amyntas jiriensis: Easton, 1981, p. 52.

Material examined. 15 specimens from CES (Fig. 2). Holotype (1904.10.5.166) in spirit (Fig. 1); Japan, coll. Mr. Masataka Rokugo, deposited in Department of Zoology, The Natural History Museum, London, UK. The condition of specimen is sufficient for detailed observation. However, septa, intestine and intestinal caeca became very weak and difficult to observe. The type locality 'Tokyo (?)' is only supposed by the specific name '*tokioensis*'. No mention about the type locality in the original description nor the label of holotype.

Diagnosis. Two pairs of spermathecal pores in furrows 6/7/8. Genital markings papillae type, presetal and situated near the spermathecal pores on segment 7-8 with genital glands of simple duct. Male pores in small depressions superficial in segment 18. Some genital markings associated with male pores. Intestinal caeca manicate.

Description of the holotype

Measurements: Body length 65 mm and width 6 mm.

External features: Body color in spirit: grayish brown dorsally and ventrally. The color of clitellum a darker than that of dorsal surface. Number of segments 67. Clitellum segments 14-16. Dorsal pores beginning in

Table 2. Measurements (mm) and intraspecific variety of 15 specimens of *Amyntas tokioensis* (Beddard, 1892) from Chiyoda Experiment Station, Ibaraki Pref., examined in this study and holotype. Specimen numbers correspond to those used in the text and figures.

Specimen	Body length	Body Width	No. of segments	Presence of MP* in segment 18	Presence and location of spermathecae	
					Left	Right
No. 1	98.3	3.3	97	Present in left side	6/7	6/7
No. 2	110.3	3.6	95	-	7/8	-
No. 3	116.0	3.6	95	-	7/8	7/8
No. 4	97.8	3.1	85	-	-	-
No. 5	117.4	4.1	100	-	6/7/8	7/8
No. 6	115.5	3.8	98	-	-	-
No. 7	132.4	4.2	99	-	-	-
No. 8	130.0	4.5	98	-	-	-
No. 9	102.9	4.2	92	-	-	6/7
No. 10	114.7	4.1	100	-	7/8	-
No. 11	115.8	3.8	100	-	-	-
No. 12	108.0	3.1	99	-	-	-
No. 13	91.8	3.1	99	-	-	-
No. 14	115.7	4.1	100	-	-	-
No. 15	138.2	4.1	96	-	6/7	6/7
Holotype	65.0	6.0	67	Present	6/7/8	6/7/8

* MP = Male pores

-: Absent.

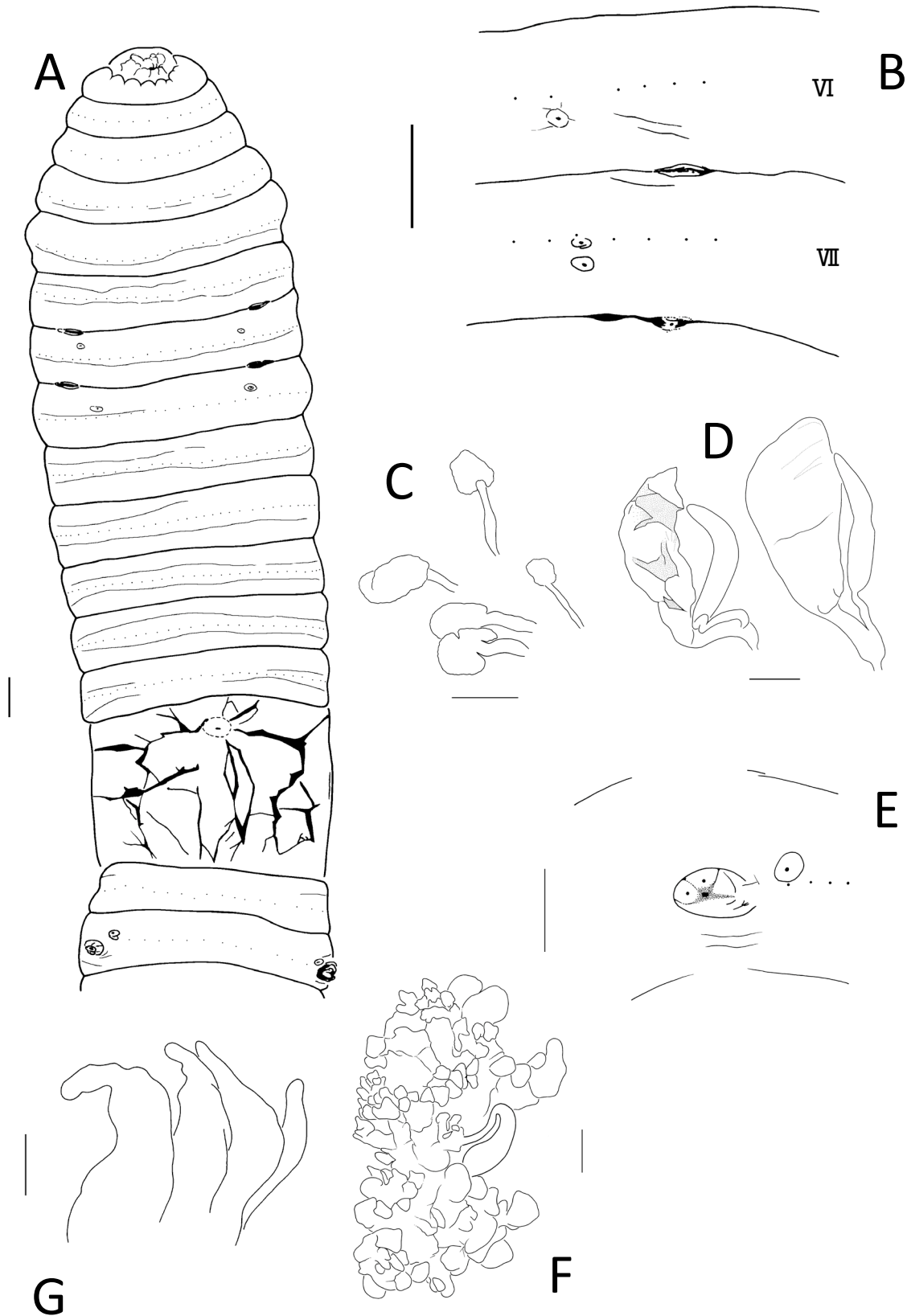


Fig. 1. *Amynthus tokioensis* (Beddard, 1892), holotype. A, habitus; B, spermathecal pores; C, genital glands in segments 6 and 7; D, spermathecae; E, male pore and genital markings in segment 18; F, prostate gland; G, intestinal caeca. All scale bars indicate 1 mm.

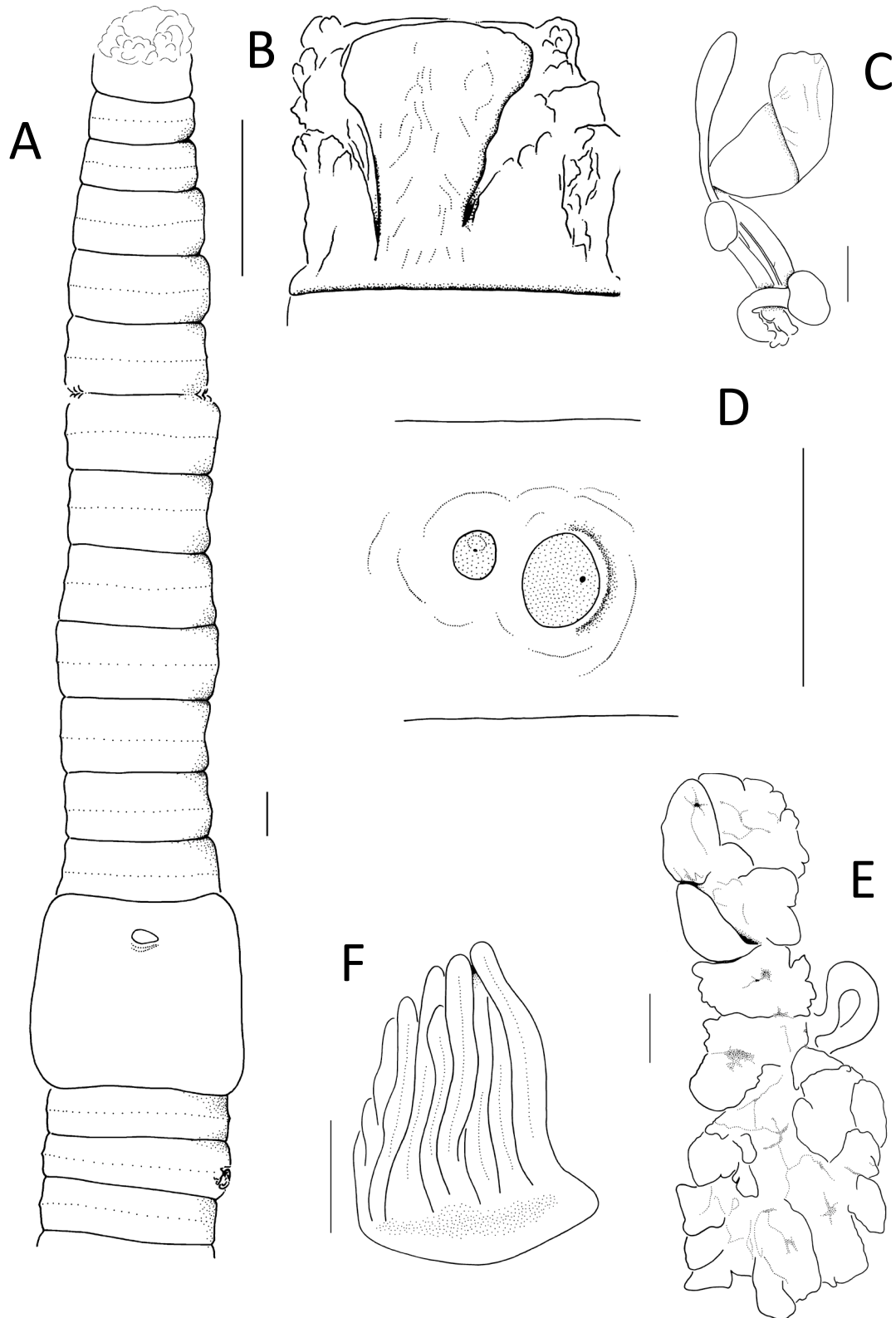


Fig. 2. *Amynthus tokioensis* (Beddard, 1892), specimen No. 1. A, habitus; B, prostomium dorsal; C, spermathecae and genital glands; D, male pore and genital markings in segment 18; E, prostate gland; F, intestinal caeca. Specimen number corresponds to that used in the Table 2, and all scale bars indicate 1 mm.

furrow 12/13. The arrangement of setae perichaetine. Setal number 36 in segment 7, 45 in segment 20. Female pore single, mid-ventrally in segment 14. All 2 pairs of spermathecal pores in furrows 6/7/8 in ventrolateral side, separated by a distance of ca 0.33 of body circumference. Proclitellar genital markings situated prosetal and inside the spermathecal pores in segments 7 and 8, adjacent two markings in segment 7 and single marking in segment 8. Male pores superficial without copulatory pouches on segment 18 in small and shallow concavities which situated on slight circular swellings. Two genital markings situated in the concavities close to male pores. One genital marking situated prosetal and inside the male pores.

Internal anatomy: Septa absent in furrows 8/9/10. Seminal vesicles small extending into segments 11-12. Two pairs of spermathecae in segments 7-8. No nephridia associated with spermathecal ducts. Spermatheca developed as shovel-shaped ampulla with convoluted diverticulum (*sensu* Ishizuka 1999a). The second spermathecae slightly larger than the first. Genital glands of simple duct type associated with the genital markings in segments 7, 8 and 18. Prostates racemose, extending in segments. Intestinal caeca very weak, originating in segment 27, manicate with 4 diverticula.

Discussion.

Historical review

Beddard (1892) described *Perichaeta tokioensis* Beddard, 1892 based on the only holotype from Japan. Michaelsen (1900) assigned it to *Pheretima* Kinberg, 1867. Sims and Easton (1972) made a revision of *Pheretima* group and assigned it to *Amyntas* Kinberg, 1867.

Japanese authors (Ishizuka 1999a; Nakamura 1999) of review papers on the Japanese earthworm fauna dealt the species as a valid species of *Pheretima* s. lat. *sensu* Michaelsen (1900) rejecting the system of Sims and Easton (1972). On the other hand, recent checklists on the Japanese fauna (Blakemore 2003; 2004) followed Sims and Easton, 1972 and assigned it to *Amyntas*.

There has been confused definition of *A. tokioensis*. Easton (1981) attributed it to *A. hilgendorfi*-species complex having manicate intestinal caeca though the original description mentioned the presence of "simple intestinal caeca". Easton's treatment seems to be based on the observation of the holotype because Sims and Easton (1972) nominated

A. tokioensis in the list of specimens observed for their study. But they gave no mention on the detailed morphology of the holotype. On the other hand, Nakamura (1999) assigned it to the group having simple intestinal caeca based on original description. Because of such confusion, it has never recorded from Japan since original description in spite of the existence of holotype.

Difference between the holotype and the original description:

We found some differences of diagnostic characters of nominal species between the holotype and the original description (Beddard 1892) as follows; 1) proclitellar genital markings situated in segments 7 and 8 in holotype, in segments 8 and 9 in the original description, 2) genital glands simple duct type in holotype, no mention in the original description, 3) manicate intestinal caeca originating in segment 27 in holotype, 'usual' two caeca in segment 26 in the original description. The mistake of original description on the type of intestinal caeca sometimes caused taxonomic confusion, for example, Nakamura (1999) treated this species as a member of the species group which has simple intestinal caeca.

Comparison among congeners

***Amyntas irregularis* (Goto & Hatai, 1899):** This species occurs wide-spread in Japan (Ohfuchi 1938; 1939) and Korea (Kobayashi 1938) and show great variability of the numbers of spermathecal and male pores. Typical diagnostic characters of this species are, 1) two spermathecal pores in furrows 6/7/8, 2) pro- and postclitellar genital markings with simple duct type genital glands, 3) male pores superficial, 4) manicate intestinal caeca. These characteristics are according to newly defined diagnosis of *A. tokioensis*. Therefore, *A. irregularis* should be a junior synonym of *A. tokioensis*. *Pheretima schizopora* having one pair of spermathecal pores in furrow 7/8 should be included in the range of intraspecific variability of *irregularis* (Ohfuchi, 1938) and synonym of *A. tokioensis*. Ishizuka (1999a) made *schizopora* to the junior synonym of *irregularis*. We agree this synonymy.

***Amyntas candidus* (Goto & Hatai, 1898) and *A. parvicystis* (Goto & Hatai, 1899):** Both the former described from Taiwan and the latter from Japan were made to junior synonyms of *A. tokioensis* by Beddard (1900). Recently, Ishizuka 1999a also made

A. parvicystis into the junior synonym of *A. tokioensis*. We only know the information of the characters of these two species from the original description because we did not find type series. The description of *A. candidus* suggests that it has simple intestinal caeca. Therefore, we conclude *A. candidus* is a valid species though it resembles *tokioensis* by having two pairs of spermathecal pores in furrows 6/7/8/ and proclitellar genital markings. On the other hand, the original description of *A. parvicystis* mentioned that it has intestinal caeca with frizzled margin like *A. digitatus* (Benham, 1896). We checked Benham's drawing of intestinal caeca in *A. digitatus*. It suggests that *parvicystis* has serrate or multiple type intestinal caeca (*sensu* Ishizuka 1999a) and is not a synonym of *A. tokioensis*.

***Amyntas jiriensis* Song & Paik, 1971:** *Amyntas jiriensis* from Korea is distinguished by having 1) two pairs of spermathecal pores situated in furrows 6/7/8 associated with genital markings, 2) preclitellar genital markings with glands of simple duct inside, 3) male pores superficial, 4) manicate intestinal caeca. These characteristics are according to newly defined diagnosis of *A. tokioensis*. Therefore, *A. jiriensis* should be a junior synonym of *A. tokioensis*.

Remarks. Intraspecific variability of specimens from CER are summarized in Table 2. It does not exceed the range of intraspecific variability of *A. irregularis* reported in Ohfuchi, 1938 and 1939. Therefore they are identified as *A. tokioensis*.

***Pheretima aokii* Ishizuka, 1999, incertae sedis**

[Japanese name: Aoki-mimizu]

Pheretima aokii Ishizuka, 1999b, p. 36, figs. 9-18.
'Metaphire' soulensis: Uchida and Kaneko, 2004, p. 37.

Metaphire soulensis: Blakemore, 2004, p. 161.

Material examined: 4 specimens from MC; 3 specimens from CES.

Diagnosis. Two pairs of spermathecal pores in furrows 6/7/8. Two pairs of spermathecae without diverticulum nor nephridia. Male pores absent. A pair of postclitellar papillar type genital markings with many small papillae on the oval swelling in segment 18. Intestinal caeca manicate.

Remarks. All specimens according to the diagnosis mentioned above. This species should be treated as incertae sedis because of the lack of male pores.

It does not belong to genus *Pheretima* (s. str.) undoubtedly because of no nephridia attached the bottom of spermathecal ducts. It may belong to either *Amyntas* or *Metaphire*.

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森林総合研究所構内および同研究所千代田試験地より得られた 陸生大型ミミズ類（環形動物：環帯類）

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要旨

森林総合研究所構内（茨城県つくば市）および同研究所千代田試験地（茨城県かすみがうら市）において採集された大型陸生ミミズ類の標本の分類学的な整理を行ない、種名を確定した。記録された種はアオキミミズ、クソミミズ、ハタケミミズ、フキソクミミズ、ヒトツモンミミズの5種であった。フキソクミミズの分類学位置について *Amyntas tokioensis* (Beddard, 1892) のタイプ標本の観察に基づいて若干の考察を行なった。

キーワード：ミミズ、フトミミズ科、フキソクミミズ、茨城県

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