

Freshwater Oligochaetes (Oligochaeta, Tubificida, Naididae) from Several Swamps in Kyungsangnam-do, Korea

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ABSTRACT

Seven freshwater naidid oligochaetes are recorded on the basis of the materials collected from four lowland swamps, Upo-neup, Oisong-neup, Chilnal-neup, and Chunam-ji, in Kyungsnagnam-do, Korea during the period from February 1988 to September 1991: *Chaetogaster diastrophus* (Gruithuisen), *C. diaphanus* (Gruithuisen), *Amphichaeta asiatica* Liang, *Pristina longiseta* Ehrenberg, *P. biserrata* Chen, *Stylaria fossularis* Leidy, *Slavina appendiculata* (d'Udekem). These species are redescribed and illustrated with a key to the species and genera of the family Naididae in Korea. This is the first taxonomic record on the freshwater naidid oligochaetes in Korea.

Key words: taxonomy, Oligochaeta, Naididae, freshwater, Korea

INTRODUCTION

Naididae is one of the largest and most common oligochaete families occurring in freshwater. Naidid worms occur mostly among aquatic vegetations or similar objects in freshwater but occur rarely in marine or estuarine environments. Though the ecological importance of naids have not been known well, naids occur frequently and abundantly in various freshwater ecosystems. For example,

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the total number of North American freshwater species in all oligochaetes families is about 150 and about half of them is naidid worms (Brinkhurst, 1986). Presently, about 150 species of naids are recorded in the world (Brinkhurst and Jamieson, 1971; Brinkhurst and Wetzel, 1984).

In East Asia, approximately 30 species of naids have been reported from Japan (Yamaguchi, 1954; Ohtaka, 1985), and about 50 species from China (Chen, 1940; Brinkhurst *et al.*, 1990), respectively. However, any taxonomic study on naidid worms have not been performed yet in Korea.

In Korea, many lowland swamps are scattered near the Nakdong River in Kyungsangnam-do. They get inundated in rainy season and dried to reveal the bottom in dry season showing severe fluctuations in the amount of water in a year. These natural swamps were formed very long years ago and much organic materials have been accumulated so that various aquatic plants, diatoms, and desmids are to constitute characteristic ecosystem. This area is paid much attention with visiting of various migrant birds. Some swamps are used for supplying water for agriculture and fishing to the people. Unfortunately, however, most of these lowland swamps are getting changed to farm lands, and in danger of destruction of natural environment by the inflow of agricultural chemicals and many other refuges from their surroundings.

The present study was performed to elucidate the oligochaete fauna of the lowland swamps in South Korea. We conformed seven species belonging to family Naididae. This report deals with the redescrptions and illustrations of them, in addition to a key to the species and genera of family Naididae in Korea.

MATERIALS AND METHODS

The materials of naids were collected from 10 stations of four lowland swamps, Upo-neup, Oisong-neup, Chilnal-neup, and Chunam-ji, in Kyungsnagnam-do, South Korea during the period from February 1988 to September 1991 (Fig. 1). Collections were made with a conical plankton net or a dip-net (both 155 μ m in mesh size) after shaking the water severely. The samples were fixed with 5-10% formalin, histological fixatives such as Bouin, or 20-30% alcohol, and preserved in 70% alcohol. For the observation of living specimens, the samples were rapidly carried to laboratory and gradually replaced with new freshwater in the wide surface containers. The observations were usually made with fixed specimens. In some cases, living specimens cultured in the laboratory were also observed for examining movements, habit, internal anatomy, and chaetotaxy.

The samples were inventoried to determine the presence and the reproductive state of the species under a Olympus stereomicroscope. Each specimen was removed to a drop of glycerol in a reversed slide for subsequent study. Temporary mounts of whole specimens in glycerol were used for the measurements and the drawings of intact animals and their parts. For the detail observation of chaetae, the specimens were mounted in polyvinyl lactophenol (Jones, 1946) or Amman's lactophenol (Brinkhurst, 1963) on the glass slides and compressed with the cover slips. Drawing and measuring were made with a Olympus compound microscope with a drawing tube system. All specimens examined are deposited in the first author's collection.

The 'Material examined' section includes the sampling station and other informations. Collectors

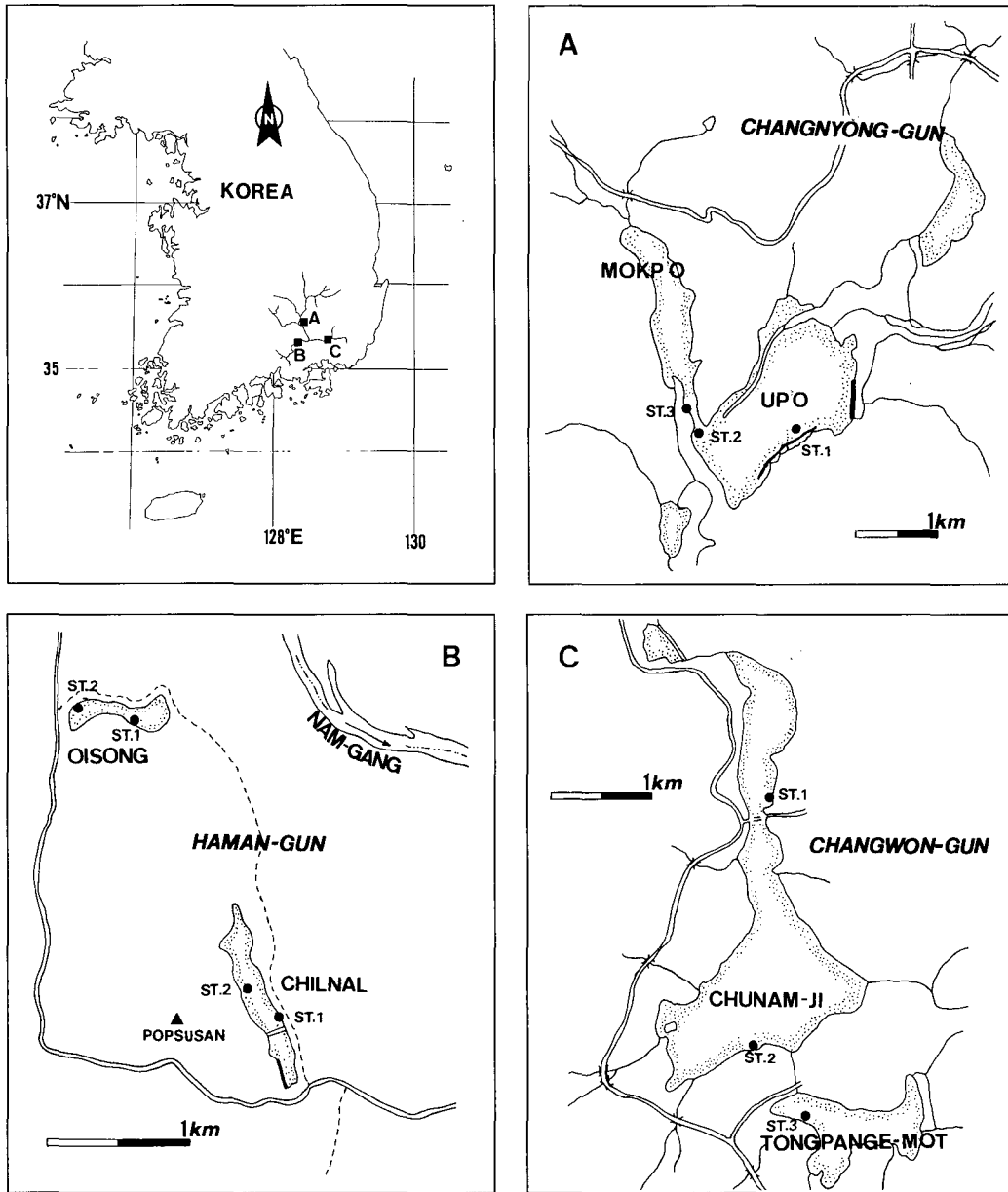


Fig. 1. Maps showing the sampling stations. A, Upo-neup; B, Oisong-neup and Chilnal-neup; C, Chunam-ji.

are not referred because all the specimens were collected by the authors themselves. The terminology and the classification are mainly after Nemeč and Brinkhurst (1987). The following abbreviations are used in text: l = body length, w = body width, s = number of segments of single zooid, n = number of segments of first zooid in chain, Roman numeral = segmental number (Ohtaka, 1985; Brinkhurst, 1986).

TAXONOMIC ACCOUNTS

Order Tubificida 실지렁이목

Suborder Tubificina 실지렁이아목

Superfamily Tubificidea 실지렁이상과

Family Naididae 풀지렁이과

Subfamily Naidinae Lastockin, 1924 물지렁이아과 (신칭)

Genus *Chaetogaster* von Baer, 1827 털배물지렁이속 (신칭)

1. *Chaetogaster diastrophus* (Gruithuisen, 1828) 파배기털배물지렁이 (신칭) (Fig. 2)

Nais diastrophus Gruithuisen, 1828, p. 416.

Chaetogaster gulosus Leidy, 1852a, p. 124.

Chaetogaster annandalei Stephenson, 1917, p. 88.

Chaetogaster diastrophus: Ude, 1929, p. 22; Chen, 1940, p. 31; Sperber, 1948, p. 59, figs. 3C, 6, 7A, 7B, 7G, Pl. 1, fig. 1; Brinkhurst, 1964, p. 201, fig. 1A; Brinkhurst and Jamieson, 1971, p. 307, fig. 7, 1A-E; Liang, 1979, p. 274; Harman *et al.*, 1979, p. 519; Harman, 1982, p. 288; Brinkhurst, 1986, p. 51; Grimm, 1987, p. 75, figs. 1-3, Fig. 4; Harman *et al.*, 1988, p. 2233.

Chaetogaster sp. Yamaguchi, 1940, p. 384, fig. 2.

Material examined. 1 ind., Oisong-neup (St. 1), 15 Apr. 1988; 3 inds., Oisong-neup (St. 1), 15 Jan. 1989; 2 inds., Oisong-neup (St. 2), 22 Feb. 1988; 3 inds., Oisong-neup (St. 2), 15 Apr. 1988; 6 inds., Oisong-neup (St. 2), 15 Jan. 1989; 3 inds., Chilnal-neup (St. 1), 4 Apr. 1989; 2 inds., Chilnal-neup (St. 2), 4 Apr. 1989; 6 inds., Chunam-ji (St. 2), 14 Apr. 1988; 9 inds., Chunam-ji (St. 3), 14 Apr. 1988; 3 inds., Chunam-ji (St. 3), 2 Oct. 1988; 13 inds., Chunam-ji (St. 3), 4 Apr. 1989.

Description. Body transparent and very flexible. Prostomium well developed and pointed with fine sensory hairs; mouth open at extreme anteroventral end. Without proboscis and eye. $l = 0.5\text{--}1$ mm (preserved) up to 3 mm (4 chains in living). $w = 85\text{--}110\ \mu\text{m}$ at II. $n = 8\text{--}10$ (usually 9).

Dorsal chaetae absent.

Ventral chaetae in II straight with faintly curved at both proximal and distal ends; chaetae 4-8 in number per bundle and 83-127 μm in length, longer than any chaetae in other segments; nodulus proximal (about five-eighths from tip); upper tooth twice as long as lower. Chaetae absent in III-V. In rest segments, chaetae 4-8 in number per bundle, 55-68 μm long; nodulus middle or slightly proximal (about five-ninths from tip); upper tooth longer and thinner than lower.

Pharynx in II-III. Oesophagus in IV, short and narrow. Stomach in V-VI. Usually 2-4 budding regions found.

Remarks. This species is one of the smallest naidid worms and tends to be overlooked without careful observation. It is also one of the most widely distributed species over the world. The worms are commonly living in bottom. When fixed, they are very constricted. They can be easily sustained in laboratory by adding only some drops of freshwater. The prostomium of the species is rather conspicuous than those of other species in genus *Chaetogaster*, so it can be easily distinguished by the developed prostomium from its congeners, especially from *C. diaphanus* (Gruithuisen, 1828)

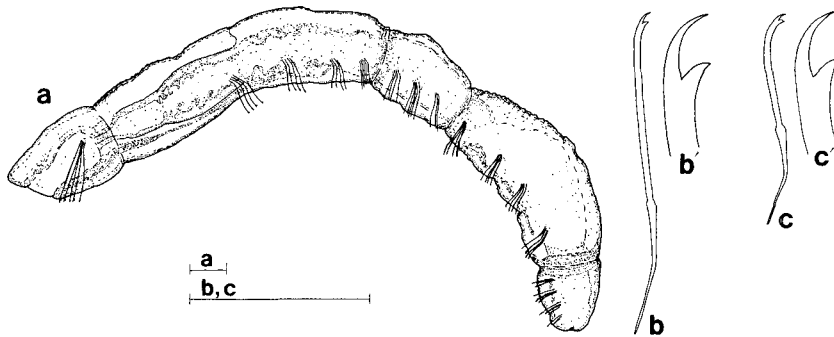


Fig. 2. *Chaetogaster diastrophus* (Gruithuisen). a, habitus in lateral view; b, b', ventral chaeta in II; c, c', posterior ventral chaeta. Scales: 50 μ m.

which has inconspicuous one. The morphology of sexual organs was studied in detail by Sperber (1948). According to Sperber (1948), the characteristic features of *C. diastrophus* are that the spermathecal ampulla is elongated, the vas deferens is long, and the atrial ampulla is fairly large.

This species was reported from Japan (Stephenson, 1917; Yamaguchi, 1940) and China (Chen, 1940; Liang, 1979). In Japan, it was first recorded as *C. annandalei* by Stephenson (1917). This Japanese species was reduced to a synonym with *C. diastrophus* (Gruithuisen) by Chen (1940). Yamaguchi (1940) described *Chaetogaster* sp. from Japan. Although the shape of prostomium was not referred in his description (Yamaguchi, 1940), *Chaetogaster* sp. is the same species as *C. diastrophus* in the following points (Yamaguchi, 1940): (1) body length is 0.6 mm, (2) number of segments is 10, (3) chaetae are 4-7 in number per bundle, (4) chaetae are 83 μ m long in II and 58 μ m long in VI in length, and (5) chaetae are bifid with longer upper tooth.

Distribution. Korea, East and South Asia, Europe, North and South America, Africa.

2. *Chaetogaster diaphanus* (Gruithuisen, 1828) 수정털배물지렁이 (신칭) (Fig. 3)

Nais diaphana Gruithuisen, 1828, p. 409.

Chaetogaster diaphanus: Ude, 1929, p. 24, fig. 19; Chen, 1940, p. 29; Sperber, 1948, p. 66, figs. 5, 7D, I, Pl. 1, figs. 5, 6; Brinkhurst, 1964, p. 202, fig. 1C; Brinkhurst and Jamieson, 1971, p. 310, fig. 7, 1I-K; Liang, 1979, p. 274; Brinkhurst, 1986, p. 51; Grimm, 1987, p. 71, Pl. 1, figs. 2, 3, Fig. 2.

Material examined. 3 inds., Chilnal-neup (St. 1), 2 Oct. 1988; 2 inds., Chilnal-neup (St. 2), 4 Apr. 1989; 2 inds., Chunam-ji (St. 2), 2 Oct. 1988.

Description. Body transparent. Prostomium inconspicuous; mouth open at anteroventral end. Without proboscis and eye. l = 2-3.5 mm (preserved). w = 130-320 μ m at II. n = 9-14 (usually 9).

Dorsal chaetae absent.

Ventral chaetae in II nearly straight, 6-8 in number per bundle, 173-190 μ m in length and 4-5 μ m in thickness; nodulus proximal (about three-fifths from tip); upper tooth twice as long as lower. Chaetae absent in III-V. In rest segments, chaetae straight with curved proximal end, 4-6 (mainly 5) in number per bundle, and 124-138 μ m long; nodulus middle or very slightly proximal; upper tooth twice as long as lower.

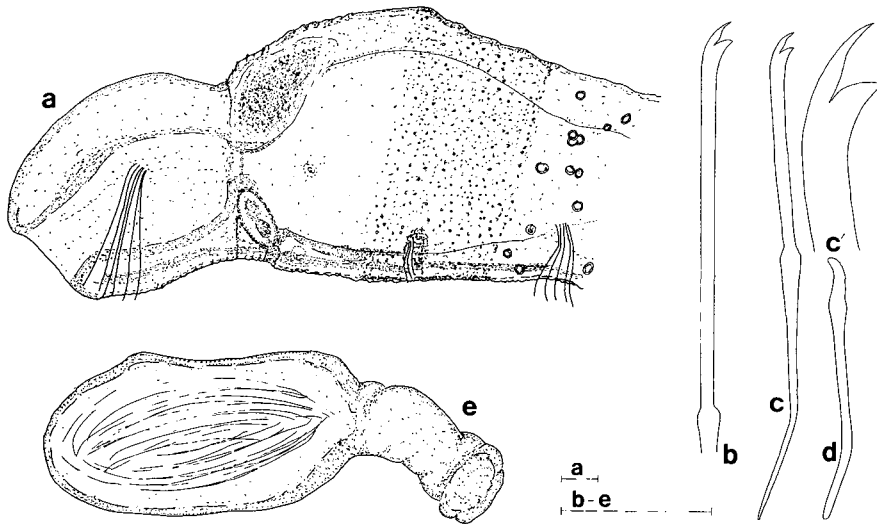


Fig. 3. *Chaetogaster diaphanus* (Gruithuisen). a, anterior segments in lateral view; b, ventral chaeta in II; c, c', posterior ventral chaeta; d, genital chaeta in V; e, spermatheca. Scales: 50 μ m.

Genital chaetae (penial chaetae), when present, in V, fairly straight with proximal and distal bends, 3 in number per bundle, 65-72 μ m in length and about 3.5 μ m in thickness, and with nodular swelling at one-sixth from tip; distal end simple or with rudimentary teeth.

Stomach stretched to VI. Clitellum in V, granulated; small granules of about 34 μ m in diameter scattered in posterior segments. Pair of spermathecae present in V(?), each bag-like, and narrowing towards duct. Spermathecal ampulla about 110 μ m long and about 60 μ m in diameter.

Remarks. This species is the largest worm in the genus *Chaetogaster*. It can be easily distinguished from other species of the genus by the large size. The chaetae of this species are also much longer and stronger than those of others. *C. diaphanus* especially differs by the size of chaetae and the body width at II from both *C. diastrophus* (Gruithuisen, 1828) and *C. limnaei* von Baer, 1827. *C. limnaei* has the characteristic smaller chaetae with the teeth of about equal length. The worms usually occur in freshwater, but they also can be found in brackish water (Brinkhurst and Jamieson, 1971). Sexually matured ones were found on October in this study.

Distribution. Korea, Asia, Europe, North America, Africa.

Genus *Amphichaeta* Tauber, 1879 양털물지렁이속 (신칭)

3. *Amphichaeta asiatica* Liang, 1958 아시아양털물지렁이 (신칭) (Fig. 4)

Amphichaeta asiatica Liang, 1958, p. 41, Pl. 1, figs. 1-6.

Material examined. 1 ind., Upo-neup (St. 1), 6 Apr. 1991; 1 ind., Chilnal-neup (St. 1), 4 Apr. 1989; 1 ind., Chilnal-neup (St. 2), 4 Apr. 1989; 53 inds., Chilnal-neup (St. 3), 22 Feb. 1988; 3 inds., Chunam-ji (St. 1), 4 Apr. 1989; 28 inds., Chunam-ji (St. 1), 14 Feb. 1991; 6 inds., Chunam-ji (St. 2), 14 Apr. 1988; 5 inds., Chunam-ji (St. 3), 14 Apr. 1988; 3 inds., Chunam-ji (St. 3), 4 Apr. 1989.

Description. Eye absent. Body transparent, broader at anterior end. Prostomium conspicuous

with pointed apex, but often not conspicuous in preserved specimens. Length of III, VII and VIII about twice or more than that of IV. $l = 0.7-2$ mm (preserved). $w = 0.10-0.14$ mm at III. $s = 13-15$. $n = 8$.

Dorsal chaetae beginning from III; all double-pronged crotchets, straight without or with faint nodulus. Chaetae in III 4 in number per bundle and $76-82$ μm long; nodulus proximal (about four-sevenths from tip); upper tooth equal or slightly longer than lower. Chaetae in both IV and V shorter and fewer than those in rest segments, 2-3 in number per bundle, $53-59$ μm long. Chaetae in rest segments 2-3 (usually 3) in number per bundle, $62-89$ μm long; upper tooth about twice as long as lower in posterior segments. Hair chaetae absent.

Ventral chaetae nearly same as dorsal. Chaetae in II-III 3 in number per bundle and $69-81$ μm in length; upper tooth equal or slightly longer than lower; usually, chaetae in III slightly longer than those in II. Chaetae in both IV and V 2-3 in number per bundle, $52-62$ μm long. Chaetae in rest segments 2-3 (usually 3) in number per bundle, $81-84$ (mainly about 80) μm long; upper tooth about twice as long as lower. Genital chaetae not found.

Pharynx in II-III. Oesophagus in IV, narrow and short. Stomach present in V-VI. Intestine beginning from VII. Clitellum present in 1/2V-VI, granulated and opaque. Pair of spermathecae present in V; ampulla ovoid and about 52 μm in diameter, with wall of about 4 μm thick. Egg sac in VI. Male atrium in VI, globular or slightly ovoid, and about 52 μm in diameter.

Remarks. This species was first recorded from China by Liang (1958). It has the closest resemblances with an European species, *A. sannio* Kallstenius, 1892. However, *A. sannio* can be easily distinguished from *A. asiatica* by the points as follows (Liang, 1958): (1) size is smaller, 1-1.5 mm long, (2) $n = 9$, (3) crotchets are shorter and thinner, without nodulus, and their teeth are short and equally long, (4) usually found in brackish water while *A. asiatica* is purely a freshwater form.

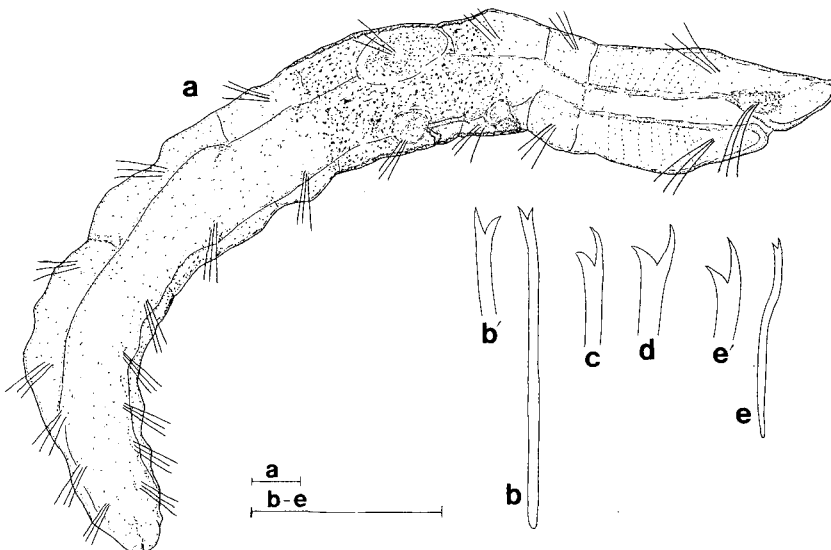


Fig. 4. *Amphichaeta asiatica* Liang. a, habitus in lateral view; b, b', ventral chaeta in II; c, posterior ventral chaeta; d, dorsal chaeta in III; e, e', posterior dorsal chaeta. Scales: 50 μm .

Korean specimens of the present study are nearly same as Chinese except that the cheatal lengths of the latter are more or less longer than those of the former.

Distribution. Korea, China.

Genus *Pristina* Ehrenberg, 1828 주둥이물지렁이속(신칭)

4. *Pristina longiseta* Ehrenberg, 1828 긴털주둥이물지렁이(신칭) (Fig. 5)

Pristina longiseta Ehrenberg, 1828, p. 112; Ude, 1929, p. 29, figs. 25-26; Chen, 1940, p. 46, fig. 12A, a; Yamaguchi, 1953, p. 285, fig. 5, Pl. 7, fig. 1; Liang, 1979, p. 276; Rodriguez, 1987, p. 39, figs. 2-3; Grimm, 1990, p. 126, Fig. 2.

Pristina longiseta longiseta: Sperber, 1948, p. 236, Pl. 21, figs. 2, 6; Brinkhurst and Jamieson, 1971, p. 402, fig. 7, 21J, 25E-I.

Pristina longiseta sinensis: Sperber, 1948, p. 237; Ercolini, 1969, p. 33, figs. 48-50.

Material examined. 4 inds., Upo-neup (St. 1), 1 Oct. 1988; 1 ind., Upo-neup (St. 2), 1 Oct. 1988; 6 inds., Chilmal-neup (St. 2), 4 Apr. 1989; 9 inds., Oisong-neup (St. 2), 15 Apr. 1988; 3 inds., Chunam-ji (St. 2), 14 Apr. 1988; 45 inds., Chunam-ji (St. 3), 2 Oct. 1988.

Description. No eyes. Prostomium with conspicuous proboscis; anterior and posterior ends ciliated. Proboscis 112-130 μ m long and 10 μ m thick. l = 1-2 mm (preserved), up to about 5 mm in living. n = 13-19 (usually 14 or 18).

Dorsal chaetae beginning from II. Hairs in III usually 3 in number per bundle, thicker and extremely longer than rest, 0.4-0.7 mm long, and not serrated. Rest hairs 1-4 (usually 3) in number per bundle, often with 1 short hair (length up to 136 μ m), 175-340 μ m long, and very finely serrated except those in II. Needles nearly straight and simple-pointed, 2-4 (usually 4) in number per bundle, and 44-61 μ m long.

Ventral chaetae in both II and III more or less different from those in rest segment, longer and thicker than rest, with upper tooth about 3 times as long as lower. Chaetae in II 5-6 in number per bundle, longer and slightly thicker than rest, 56-72 μ m long and thickness up to about 3 μ m; nodulus slightly proximal (five-ninths from tip). Chaetae in III 3-5 in number per bundle, 62-69 μ m long, and nodulus very slightly distal (9/20 from tip). In specimens from Chunam-ji (2 Oct. 1988) of this study, chaetae in III much thicker than those in II and posterior ones, but in specimens from Oisong-neup (15 Apr. 1988), chaetae in III as thick as those in II, and more or less thicker than posterior ones. Rest posterior chaetae 5-9 (usually 6-7) in number per bundle, 45-57 μ m long; nodulus slightly distal, and upper tooth about twice as long as lower. Sometimes, extra incomplete chaeta (only anterior chaetal part) found in II, III and some segment of rest.

Stomach dilatation beginning from 1/3 VII. No swimming.

Remarks. This species is known as one of the most common species occurring in various types of aquatic habitats in the world (Sperber, 1940; Rodriguez, 1987). Because of this, there have been many different descriptions from each other on *Pristina longiseta* Ehrenberg, 1828. Among these descriptions, that of Chinese specimens made by Chen (1940) are mostly consistent with Korean specimens of this study.

There had been many confusions in acknowledging so called *P. longiseta* complex. In 1905, Michaelson initiated the trinomial concept by recognizing it as conspecific *P. longiseta* forma *typica* from Europe and Zanzibar *P. longiseta* var. *leidyi* from North America and Paraguay

(Harman and McMahan, 1975). This concept was changed by Chen (1940) who considered *P. longiseta* var. *leidyi* from North America as species rank *P. leidyi*. But later Sperber (1948) recognized four subspecies in *P. longiseta*, *P. l. longiseta* Ehrenberg, 1828, *sinensis* Sperber, 1848, *leidyi* Smith, 1896, and *bidentata* Cernosvitov, 1942. According to Sperber (1948), four subspecies are differentiated from each other by the different features of needle, hair serration, and

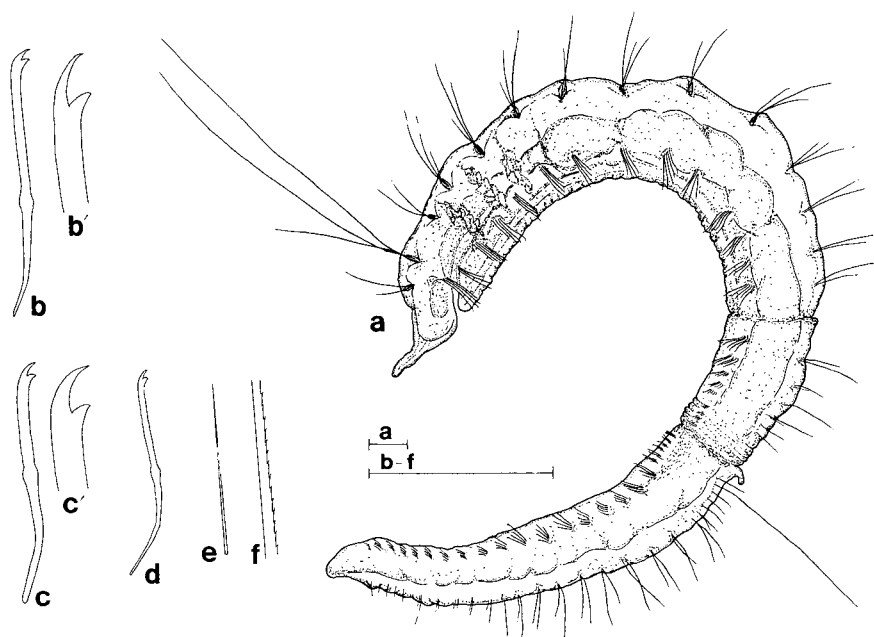


Fig. 5. *Pristina longiseta* Ehrenberg. a, habitus in lateral view; b, b', ventral chaeta in II; c, c', ventral chaeta in III; d, posterior ventral chaeta; e, needle chaeta; f, hair serrations. Scales: 50 μ m.

Table 1. Comparisons of the four subspecies in *Pristina longiseta* Ehrenberg, 1828 designated by Sperber (1948).

Subspecies	<i>P. l. longiseta</i> Ehrenberg	<i>P. l. sinensis</i> Sperber	<i>P. l. leidyi</i> Smith	<i>P. l. bidentata</i> Cernosvitov
Needle	simple-pointed	simple-pointed	simple-pointed	finely bifid
Hair serration	fine	fine	far apart	fine
Ventral chaetae in II	slightly longer and thicker	slightly thicker	slightly stouter	considerably longer and thicker
Ventral chaetae in III	slightly longer and thicker	much thicker	slightly stouter	slightly longer and thicker
Distal tooth/ proximal tooth	twice	fewer	not fewer	·
n	13-18	14-16	14-25	13-23
Distribution	Europ, India, Australia	China, Africa	North America	South America

ventral chaetae in II and III, and distribution (Table 1). Among them *P. l. sinensis* was synonymized into *P. l. longiseta* by Brinkhurst and Jamieson (1971). Subsequently Harman and McMahan (1975) abolished the subspecies concept and presented two new species combination, *P. longiseta* Ehrenberg from Europe, Asia and Africa and *P. leidyi* Smith from North and South America and Hawaii. However, Rodriguez (1987) recently discussed the taxonomic status of *P. leidyi* and the polytypic character of *P. longiseta*, and pointed out the possibility of hybridization and "forms" in *P. longiseta*.

Though some problems are still existed in the recognition of *P. longiseta* as mentioned above, the species can be easily distinguished from other species by conspicuous proboscis and very elongated hair chaetae in III. *P. longiseta* is especially differentiated from *P. biserrata* Chen, 1940 by that the body size is relatively small and the elongated hairs are found only in III not in all segments.

Distribution. Korea, Asia, Europe, Africa.

5. *Pristina biserrata* Chen, 1940 톱니털주둥이물지렁이 (신칭) (Fig. 6)

Pristina biserrata Chen, 1940, p. 49. figs. 13-14; Sperber, 1948, p. 238; Brinkhurst and Jamieson, 1971, p. 405, fig. 7, 25N-P; Liang, 1979, p. 276.

Material examined. 12 inds., Upo-neup (St. 1), 1 Oct. 1988; 15 inds., Upo-neup (St. 2), 1 Oct. 1988; 18 inds., Chilnal-neup (St. 1), 2 Oct. 1988; 18 inds., Oisong-neup (St. 1), 2 Oct. 1988; 52 inds., Chunam-ji (St. 3), 2 Oct. 1988.

Description. No eyes. Prostomium well developed, with proboscis of 340-440 μm in length. $l = 2-3$ (usually about 2) mm (preserved). $w = 0.14-0.25$ mm. $s = 28-34$ (excluding 5-6 usually degenerated posterior segments). $n = 17-18$.

Dorsal chaetae beginning from II, 2-4 (usually 3, 2 long and 1 short) in number per bundle, up to 3.5 μm in thickness, and all very distinctly serrated; serrations about 8 μm apart, but less apart in tip of hair. Most hairs serrated from proximal end to tip, but longest hair in some bundle not serrated in proximal part. Hairs in II-VII relatively shorter than rest hairs in younger specimens, but in most adult specimens, hairs in II-VII slightly shorter or as long as rest. In certain specimen from Upo-neup (St. 2), hairs in II-VII 286-340 μm long, about 2-3 times as long as body width (= 0.14 mm) while rest hairs 598-640 μm long, about 4 times longer than body width. But in another specimen (seemingly adult) body width 0.21 mm, hairs in II-VII 408-570 μm long (length of 408 μm observed in II), not shorter than posterior ones (length up to 585 μm). Needles 3-5 in number per bundle, simple-pointed, straight without nodule, with distal part effiliated, and about 1.5-2 μm thick.

Ventral chaetae in II 5-6 (in young) or 9 (in adult) in number per bundle, 98-107 μm long; length longer than any other ones except genital chaetae; nodule very slightly distal (about 13-14/30 from tip); upper tooth thinner and about 2 times longer than lower. Chaetae in III-VII more or less fewer than rest, 5-11 in number per bundle, 72-92 μm long, and nodule distal (about 12/27 from tip). Chaetae in rest posterior segments, 5-12 (usually 9-11) in number per bundle, 65-79 μm long, and nodule distal (about 9/22 from tip). Genital chaetae in VI, enlarged and modified, 2 in number per bundle, up to 114 μm long and about 4 μm thick; nodule slightly proximal (about four-sevenths from tip); upper tooth more robust and longer than lower.

Clitellum in VII-IX, opaque, and granulated both dorsally and ventrally. Stomach dilatation beginning from VIII.

Remarks. After the first report from China by Chen (1940), there has been no records of the species from other regions. In the original description, Chen (1940) did not mention about exact needles, but he seemed to regard needles as “2-6 very short ones (hairs)”. Korean specimens in this study are generally well accorded with Chinese ones of the original description, but some differences are found between the two. In Korean specimens, the genital chaetae are 2 in number per bundle not 3 as in Chinese specimens (Chen, 1940). In addition to this, the hairs in II-VII are not always shorter than those in the rest segments in Korean specimens. That is, the lengths of hairs in Korean specimens are more or less shorter than those in Chinese, up to about 0.6 mm while 0.5-1.1 mm in the latter (Chen, 1940). These differences between the two seem to be the variations within the species which can be often found from other naidid species. So the length of chaetae in II-VII may not be a good character of *P. biserrata* which was previously noticed by Brinkhurst and Jamieson (1971).

This species can be easily distinguished from *P. longiseta* Ehrenberg by its longer size, elongated hairs arranged through all segments not in particular segments, and very distinctly serrated hairs which can be easily seen under the low magnification (about $\times 100$).

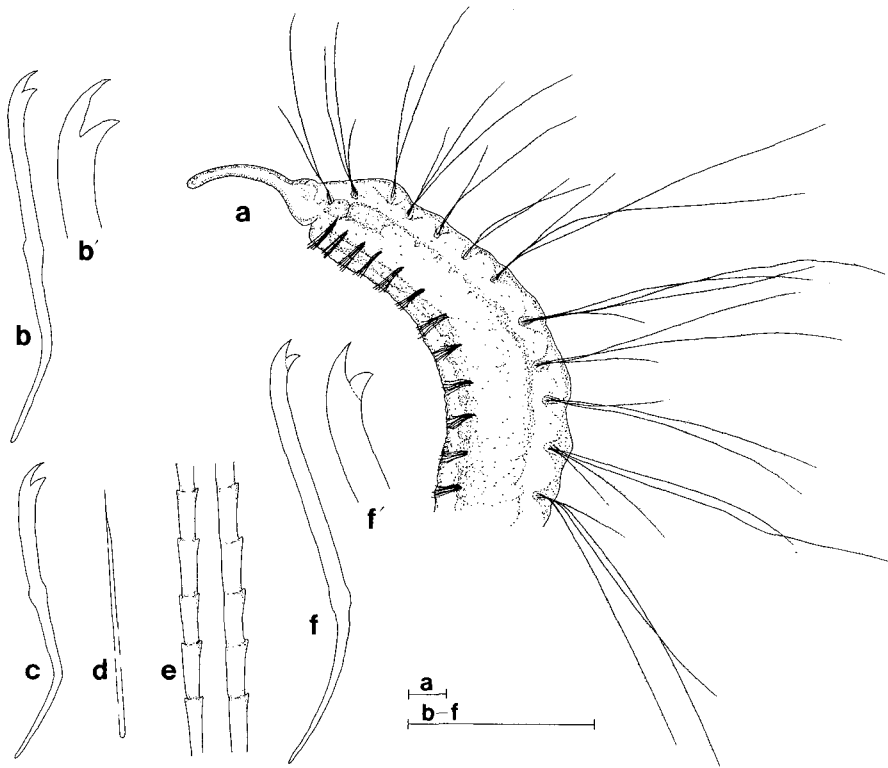


Fig. 6. *Pristina biserrata* Chen. a, anterior segments in lateral view; b, b', ventral chaeta in II; c, posterior ventral chaeta; d, needle chaeta; e, hair serrations; f, f', genital chaeta in VI. Scales: 50 μm .

Distribution. Korea, China.

Subfamily Stylarinae Nemeč and Brinkhurst, 1987 기둥물지렁이아과(신칭)

Genus *Stylaria* Lamarck, 1816 기둥물지렁이속(신칭)

6. *Stylaria fossularis* Leidy, 1852 긴주둥이기둥물지렁이(신칭) (**Fig. 7**)

Stylaria fossularis Leidy, 1852b, p. 287; Chen, 1940, p. 44, fig. 11; Sperber, 1948, p. 149; Brinkhurst and Jamieson, 1971, p. 354, fig. 7, 11B; Liang, 1979, p. 274; Grimm, 1990, p. 140, Fig. 11.

Stylaria lacustris: Yoshizawa, 1928, p. 587, figs. 1-28; Kondo, 1936, p. 384, Pl. 23, fig. 9 (not *Stylaria lacustris* Linnaeus, 1767).

Material examined. 2 inds., Upo-neup (St. 2), 1 Oct. 1988; 5 inds., Chunam-ji (St. 1), 2 Oct. 1988; 12 inds., Chunam-ji (St. 1), 21 Sep. 1991; 5 inds., Chunam-ji (St. 2), 2 Oct. 1988; 8 inds., Chunam-ji (St. 2), 4 Apr. 1989; 30 inds., Chunam-ji (St. 2), 21 Sep. 1991; 15 inds., Chunam-ji (St. 3), 14 Apr. 1988; 21 inds., Chunam-ji (St. 3), 2 Oct. 1988; 4 inds., Chunam-ji (St. 3), 21 Sep. 1991.

Description. Large naeidid worm. Body more or less flattened dorsoventrally. Eyes usually present at ventrolateral margin of mouth part. Proboscis conspicuous and projecting anterodorsally from tip of pointed prostomium, not from notch between two lateral lobes; length 0.65-1.0 mm; width 45-65 μ m in basal part, more slender toward distal end. In some cases, incomplete proboscis found in middle part of worm before completely separating from daughter zooid(s). $l = 2-7$ (usually 2-5) mm (preserved). $w = 0.19-0.30$ mm (preserved). $s = 22-37$. $n = 17-14$ (mainly 20-22).

Dorsal chaetae beginning in VI. Hairs 2-3 (usually 2, 1 long and 1 short) in number per bundle, 2.5-3.4 μ m thick, and not serrated; short hair 86-286 μ m long, thinner than long one. Needles 3-5 (usually 3 or 4) in number per bundle, simple-pointed without nodulus, and most parts embedded in chaetal sac; length 70-85 μ m and thickness about 1/2 times as that of hairs.

Ventral chaetae bifurcate, all similar to each other, 4-11 (usually 6-8) in number per bundle, 100-138 (usually 127 ± 5) μ m long and about 3.5 μ m thick; nodulus proximal (about four-sevenths from tip); upper tooth thinner and 3-3.5 times longer than lower; posterior chaetae generally shorter than middle and anterior ones.

Nephridia beginning in VII, paired per segment. Nephrostome finely ciliated, penetrating anterior septum and forming nephropore of small pore in other end; nephropore open outward ventrally. Stomach dilatation usually observed in most specimens, beginning from VII and stretching to VIII, but not observed in post-zooid. Intestine from IX. Spermatheca in V.

Remarks. The worms are commonly found on the leaves of plants and the debris in the brinks of water. The asexual reproduction by fragmentation was frequently observed from the materials collected in April, September and October in the present study. This species was confused for a while with *S. lacustris* (L. 1767) in the past (Yoshizawa, 1928; Kondo, 1936). According to Sperber (1948), it was much indebted to Michaelson who united *S. fossularis* with *S. lacustris* in 1900. Chen (1940) separated again them by their different shape of prostomium with proboscis. *S. lacustris* is well distinguished with *S. fossularis* by having a notch, from which the proboscis is projecting, between two lateral lobes in prostomium.

Distribution. East and South Asia (Korea; China, Japan, India), North America, Africa, Europe

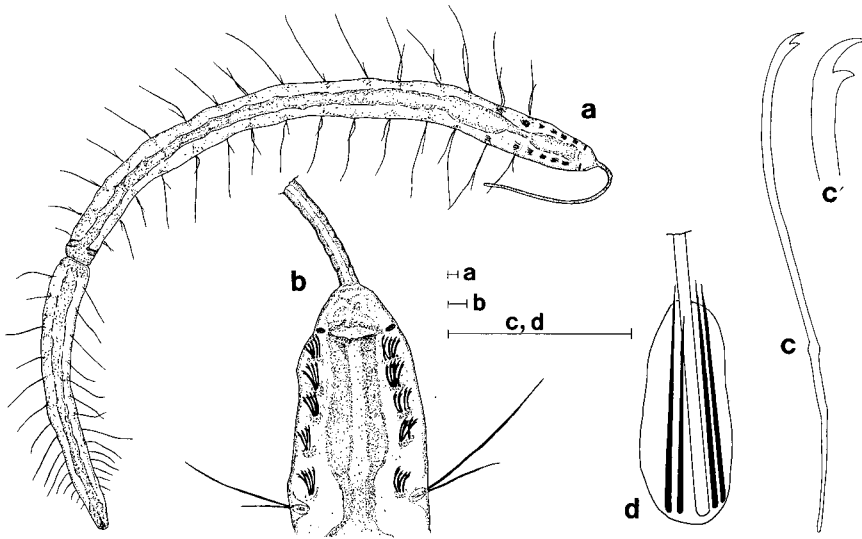


Fig. 7. *Stylaria fossularis* Leidy. a, habitus in lateral view; b, anterior segments in ventral view; c, c', ventral chaeta in II; d, dorsal chaetal sac with needles. Scales: 50 μ m.

(Britain).

Genus *Slavina* Vejdovsky, 1883 꺾질물지렁이속 (신칭)

7. *Slavina appendiculata* (d' Udeken, 1855) 긴털꺾질물지렁이 (신칭) (Fig. 8)

Nais appendiculata d'Udekem, 1855, p. 552.

Slavina appendiculata: Ude, 1929, p. 42, figs. 51-52; Chen, 1940, p. 43, fig. 10; Sperber, 1948, p. 133, figs. 15A-B, 26B; Yamaguchi, 1953, p. 293, fig. 11; Brinkhurst, 1964, p. 209, fig. 3C; Brinkhurst and Jamieson, 1971, p. 344, fig. 7, 8R-S, 9A-C; Liang, 1979, p. 274; Harman *et al.*, 1979, p. 523; Harman, 1982, p. 297; Brinkhurst, 1986, p. 87; Grimm, 1990, p. 141, Fig. 11.

Material examined. 25 inds., Upo-neup (St. 1), 21 Jan. 1988; 2 inds., Upo-neup (St. 1), 24 Feb. 1988; 10 inds., Upo-neup (St. 1), 3 Apr. 1988; 15 inds., Oisong-neup (St. 1), 15 Apr. 1988; 1 ind., Oisong-neup (St. 2), 15 Apr. 1988; 1 ind., Oisong-neup (St. 2), 2 Oct. 1988; 8 inds., Chilnal-neup (St. 1), 4 Apr. 1989; 1 ind., Chilnal-neup (St. 1), 5 Apr. 1991; 9 inds., Chunam-ji (St. 1), 14 Jan. 1989; 13 inds., Chunam-ji (St. 1), 14 Feb. 1991; 2 inds., Chunam-ji (St. 2), 14 Apr. 1988; 1 ind., Chunam-ji (St. 3), 14 Apr. 1988.

Description. Eye usually present (sometimes absent). Prostomium round or smoothly triangular. Body encrusted with foreign materials, possessing non-retractile papillae with 2-3 sensory hairs; papillae scattered ventrally and dorsally, up to 40 μ m in height and about 16 μ m in width. When fixed, anterior few segments (up to VI) severely contracted. $l = 2.0-4.5$ mm (preserved). $w =$ about 0.15-0.25 mm (preserved). $s = 15-34$. $n = 19-21$.

Dorsal chaetae beginning in VI, consisting of 1-3 hairs and 2-3 needles. Hair chaetae in VI strongly elongated, smooth, and up to about 0.7 mm long. Rest chaetae 160-330 μ m long, about

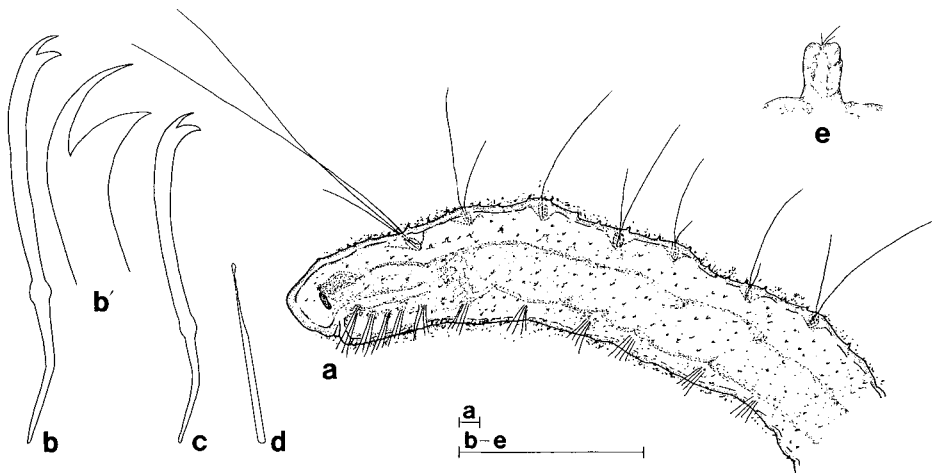


Fig. 8. *Slavina appendiculata* (d'Udekem). a, anterior segments in lateral view; b, b', ventral chaeta in II; c, posterior ventral chaeta; d, needle chaeta; e, papilla. Scales: 50 μ m.

1-2 times as long as body width. Needles straight, about 58 μ m long; distal part effilated and tip distended.

Ventral chaetae consisting of 3-5 (usually 4) per bundle, all similar to each other; bifurcate crotchets with proximal nodulus (three-fifths from tip), having angular proximal bend. Teeth nearly equal in length while upper tooth about 2-3 times as thin as lower. Chaetae in II-V more or less longer than rest; chaetae in II especially longer than any others, up to 143 μ m long while those in middle and posterior segments about 90 μ m long.

Remarks. This species is only *Slavina* species reported in Asia. *S. appendiculata* has close resemblances with *S. evelinae* (Marcus, 1942), but the former can be easily distinguishable from the latter by having non-elongated hair chaetae in VI and by the smaller number of hair chaetae and needles per bundle.

Distribution. Korea, East and South Asia, Europe, North and South America, Africa, New Zealand.

A key to the species and genera of the family Naididae in Korea

- 1. Dorsal chaetae absent 2 (genus *Chaetogaster*)
- Dorsal chaetae present 3
- 2. Prostomium conspicuous; ventral chaetae in II less than 140 μ m; body width in II about 0.1 mm *C. diastrophus* (Gruithuisen)
- Prostomium inconspicuous; ventral chaetae in II more than 145 μ m, usually about 180 μ m; body width in II more than 0.2 mm *C. diaphanus* (Gruithuisen)
- 3. Hair chaetae absent (genus *Amphichaeta*); only needles present; dorsal chaetae beginning from III; prostomium conspicuous with pointed apex; all chaetae double-pronged crotches; ventral chaetae usually 3 per bundle; purely freshwater form *A. asiatica* Liang
- Hair chaetae present 4

4. Hair chaetae beginning from II 5 (genus *Pristina*)
 Hair chaetae beginning behind II 6
5. Hair chaetae in III very elongated; all hair chaetae except in II and III finely serrated; prostomium with distinct proboscis *P. longiseta* Ehrenberg
 Hair chaetae elongated in all segments; all hair chaetae distinctly serrated; prostomium with proboscis *P. biserrata* Chen
6. Proboscis projecting from tip of prostomium; dorsal setae of all bundles less than 10 per bundle (genus *Stylaria*); hair chaetae in VI not elongated *S. fossularis* Leidy
 Proboscis absent; hair chaetae in VI very elongated (genus *Slavina*); dorsal chaetae consisting of 1-3 hairs and 2-3 needles *S. appendiculata* (d'Udekem)

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요 약

1988년 2월부터 1991년 9월까지 경상남도 우포늪, 외송늪, 질날늪 및 주남지에 서 채집된 표본들을 동정하여 7종의 물지렁이류를 보고한다: *Chaetogaster diastrophus* (Gruithuisen), *C. diaphanus* (Gruithuisen), *Amphichaeta asiatica* Liang, *Pristina longiseta* Ehrenberg, *P. biserrata* Chen, *Stylaria fossularis* Leidy, *Slavina appendiculata* (d'Udekem). 저자들은 7종에 대하여 재기재하였고 도판을 작성하였으며, 한국산 물지렁이과 종들에 대한 검색표를 제시하였다. 본 연구는 한국 담수산 물지렁이류에 관한 최초의 분류학적 기록이다.