

## RECORDS OF TEN FRESHWATER OLIGOCHAETE SPECIES (ANNELIDA, CLITELLATA) FROM SUMATRA, JAVA AND KALIMANTAN, INDONESIA

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### Abstract

Descriptions and taxonomic remarks are provided for ten species of freshwater oligochaetes (Annelida, Clitellata) from Sumatra, Java and Kalimantan, Indonesia. They include six naidines (*Slavina appendiculata*, *Dero pectinata*, *Aulophorus hymanae*, *Branchiodrilus semperi*, *Pristina amphibiotica* and *P. osborni*) and two tubificines (*Limnodrilus claparedianus* and *L. grandisetosus*) new to Indonesia. Enlarged ventral chaetae were described as an infraspecific variation in *Pristina biserrata*.

**Keywords:** Clitellata, Oligochaeta, Naidinae, Tubificinae, taxonomy, new records, Indonesia

### INTRODUCTION

A total of 37 species of freshwater oligochaetes belonging to the families Haplotaxidae, Tubificidae and Enchytraeidae have so far been recorded from Sumatra, Java, Kalimantan, and Bali, Indonesia (Michaelsen, 1932; Michaelsen and Boldt, 1932; Ohtaka and Usman, 1997; Ohtaka et al., 2000; Ohtaka et al., 2003; Sudarso et al., 2003). The fauna was suggested to be characterized by having rich naidines and poor tubificines (Ohtaka et al., 2000). However, faunistic study of aquatic oligochaetes is far from complete in this region, because there remains vast areas and variable habitats that are still unsurveyed, and even

many widespread species are unrecorded.

In the course of the biological and environmental researches carried out by the authors independently, we have collected many oligochaete specimens from lakes, ponds and streams in Sumatra, Java and Kalimantan. They include many taxa so far have never been known from Indonesia. In this article, we record and describe ten species including eight ones new to Indonesia and an aberrant form of *Pristina biserrata* worthy noted.

## MATERIALS AND METHODS

The material was collected by the authors from lakes, ponds and streams in West Sumatra, in Bogor and the adjacent area in Java, and in the peat swamp area of Central Kalimantan, from 1988 to 2004. Specimens collected were immediately fixed in 5-10% formalin solutions, and mounted whole on microscopic slides in Canada Balsam after being dehydrated in a graded series of ethanol and water solutions, and then cleared in methyl salicylate. They were observed and illustrated under a microscope using bright-field and Nomarski illumination. The specimens are deposited in the Museum Zoologicum Bogoriense, Indonesia (MZB), Department of Natural Science, Faculty of Education, Hirosaki University, Japan (AO collection), Research Center for Limnology, Indonesian Institute of Sciences (LIPI), Indonesia (YS collection), and Department of Fisheries, Faculty of Agriculture, University of Palangka Raya, Indonesia (LW collection).

In this paper, former Naididae are regarded as the subfamily Naidinae in the family Tubificidae, and a naidine genus *Pristinella* Brinkhurst is merged into the genus *Pristina* Ehrenberg, according to Erséus and Gustavsson (2002) and Collado and Schmeltz (2000), respectively. In addition, *Dero* and *Aulophorus* are regarded as independent genera.

## TAXONOMIC ACCOUNT

### Family Tubificidae

### Subfamily Naidinae

#### *Slavina appendiculata* (d'Udekem, 1855)

*Nais appendiculata* d'Udekem, 1855; see Brinkhurst and Jamieson (1971) for synonyms and references.

**Material examined.** One immature specimen (MZB ANN.134), a pond in the Bogor Botanical Garden, Bogor, West Java, 2 Mar. 2001. One immature specimen, littoral Saguling Reservoir with aquatic vegetation, Bandung, West Java, Sep. 2001 (YS collection). Two immature specimens, littoral Lake Tonjong with aquatic vegetation, Bogor, West Java, 24 Mar. 2003 (AO collection). One immature specimen, littoral Lake Tundai, Central Kalimantan, 11 Dec. 1998 (LW collection).

**Brief description of material.** Body 4-10 mm long in fixed state. Segments 25-32. Body wall papillate and glandular, foreign matter adhering. Prostomium bluntly conical. Eyes present. Dorsal chaetal bundles from VI, each consisted of one or two hairs and one or two short hair-like needles. Hair chaetae smooth and thick; those in VI much longer (up to 850  $\mu\text{m}$ ) than those in the following segments (280-330  $\mu\text{m}$ ). Dorsal needles thin, 45-53  $\mu\text{m}$  long, tapering distally, with distal end slightly distended. Ventral chaetae 3-5 per bundle with upper tooth thinner and a little longer or almost as long as lower tooth; those in II 93-100  $\mu\text{m}$  long, longer than those in the following segments (72-88  $\mu\text{m}$  long). Chloragogen cells from VI on. Stomach dilatation not prominent. First nephridia in VIII.

**Remarks.** All chaetal characteristics in the present material coincide well with those in the previous descriptions. It is a widespread species (Brinkhurst and Jamieson, 1971). This is the first record of the species from Indonesia.

#### ***Stephensoniana trivandrana* (Aiyer, 1926) (Figs. 1 A-C)**

*Naidium trivandranum* Aiyer, 1926; see Brinkhurst and Jamieson (1971) for synonyms and references.

**Material examined.** One immature specimen (MZB ANN.135), littoral Lake Bojongsari, Bogor, West Java, 3 Mar. 2001. Four immature specimens, a pond in the Bogor Botanical Garden, Bogor, West Java, 3 Mar. 2001, 25 Mar. 2003 (AO collection). One immature specimen, littoral Lake Cikaret, Bogor, West Java, 4 Mar. 2001 (AO collection). One immature specimen, littoral Lake Singkarak, West Sumatra, June 2001 (YS collection). Three immature specimens, profundal Lake Tundai, Central Kalimantan, 14 July 2004 (LW collection). One immature specimen, upper stream in Mt. Wayang, Bandung, West Java, 25 July 2005 (YS collection).

**Brief description of material.** Body 1.5-3.5 mm long in fixed state. Segments 22-35. Body wall papillate and glandular, foreign matter adhering. Prostomium bluntly conical. No eyes. Dorsal chaetal bundles from II, consisted

of 3-6 hairs and 3-5 needles in anterior segments, 1-4 hairs and 1-4 needles in posterior segments (Fig. 1A). Hair chaetae almost smooth, 176-224  $\mu\text{m}$  long. Needle chaetae thin, 40-56  $\mu\text{m}$  long without nodulus, tapering towards the distal end. Ventral chaetae slender, 3-5 per bundle anteriorly, 2-4 per bundle posteriorly; each 77-88  $\mu\text{m}$  long, with proximal nodulus and with upper tooth up to three times longer than lower tooth (Fig. 1 B, C).

**Remarks.** This species has been recorded from South, Southeast, Central and East Asia, Africa, north and South America (Liang, 1958; Brinkhurst and Jamieson, 1971; Harman et al., 1988; Brinkhurst et al., 1990; Kathman and Brinkhurst, 1999; Ohtaka and Nishino, 1999; Sudarso et al., 2003). In Indonesia, Sudarso et al. (2003) first recorded this species from Lake Singkarak, Sumatra.

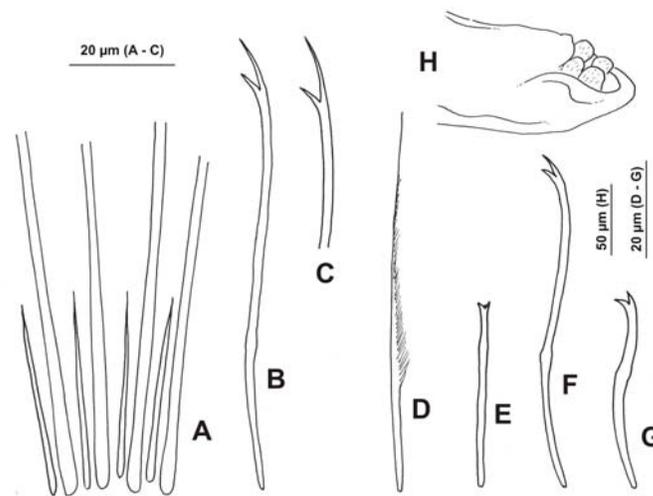


Fig.1. *Stephensoniana trivandrana* and *Dero pectinata* from Indonesia. (A-C) *Stephensoniana trivandrana* from L. Bojongsari, Bogor, Java: (A) dorsal chaetal bundle in a middle segment; (B) ventral chaeta in a middle segment; (C) distal end of ventral chaeta in a posterior segment. (D-H) *Dero pectinata* from Bogor: (D) hair chaeta in VIII; (E) dorsal needle in a middle segment; (F) ventral chaeta in II; (G) ventral chaeta in X; (H) branchial fossa

***Dero pectinata* Aiyer, 1929** (Figs. 1 D-H)

*Dero pectinata* Aiyer, 1929; see Brinkhurst and Jamieson (1971) for synonyms and references.

**Material examined.** One immature specimen (MZB ANN.136), a pond in the Bogor Botanical Garden, West Java, 25 Mar. 2003. Eight immature specimens from the same pond, 2 Mar. 2001, 25 Mar. 2003 (AO, YS, LW collections). One immature specimen, from paddy field in Cibinong, Bogor, West Java, 24 Mar. 2003 (AO collection).

**Brief description of material.** Body 1.5-2.5 mm long in fixed state. Segments 18-29 in single zooids. Prostomium bluntly conical. Eyes absent. Dorsal chaetal bundles from VI, consisted of 1 hair and 1 needle. Hair chaetae 64-82  $\mu\text{m}$  long, straight, unilaterally plumose from 1/4 of proximal end to distal end (Fig. 1D); the lateral feather becoming short distally. Dorsal needles 29-37  $\mu\text{m}$  long, weakly bayonet-shaped, with nodulus situating at 1/4-1/5 from distal end (Fig. 1E). Distal end of dorsal needle shortly bifid, with upper tooth as long as and as thick as or a little thinner than lower tooth, and with 1-3 short and blunt intermediate teeth. Ventral chaetae in II-V 2-4 per bundle, 61-72  $\mu\text{m}$  long, longer and straighter than those in the following segments, with proximal nodulus and with upper tooth 1.5-2 times longer and as thick as or slightly thinner than lower tooth (Fig. F); those from VI on 2-4 per bundle, 40-48  $\mu\text{m}$  long, with distal nodulus and with upper tooth shorter and thinner than lower tooth (Fig. 1 G).

Chloragogen cells surrounding alimentary canal from V. Stomach widening in VIII. Posterior end hardly widen, with small branchial fossa dorsally. Two pairs of knob-shaped gills set in the fossa (Fig. 1H).

**Remarks.** The present species was originally described from south India (Aiyer, 1929), and this is the first recorded occurrence of the species in Indonesia. Every characteristics of the present material were matched with the original description. This species have been recorded from South Asia (Aiyer, 1929), North America (Harman et al., 1979; Kathman and Brinkhurst, 1999), Central and South America (Harman, 1974; Harman, 1982) and Australia (Pinder and Brinkhurst, 1994).

***Aulophorus hymanae* Naidu, 1962** (Figure 2 A-D)

*Aulophorus hymanae* Naidu, 1962, p. 905-908, fig. 22 a-f; see Brinkhurst and Jamieson (1971) for synonyms and references.

**Material examined.** One immature specimen (MZB ANN.137), littoral Lake Cilala, Bogor, West Java, May 2001. Three immature specimens from roots of a macrophyte *Eichhorinia crassipes*, Lake Shingkarak, Sumatra, 3 Aug. 1988 (YS collection). One immature specimen from roots of *E. crassipes*, Lake Lutan, Central Kalimantan, 21 Mar. 2005 (AO collection). One immature

specimen, profundal Lake Tundai, Central Kalimantan, 17, July, 2004 (LW collection).

**Brief description of material.** In fixed state, body 3.5mm long in single zooids, up to 8 mm long in chains. Segments of first zooids 22-25. No eyes. Prostomium bluntly conical. Dorsal chaetal bundles from V, consisted of one smooth hair with 208-262  $\mu\text{m}$  long, and one bayonet-shaped needle with 64-80  $\mu\text{m}$  long. Needle chaetae with nodulus situating at 1/3 from distal end and with straight upper tooth a little longer and thinner than curved lower tooth (Fig. 2A). Ventral chaetae bifurcated; those in II-IV 4-5 per bundle, 96-102  $\mu\text{m}$  long, longer and thinner than those in the followings, with nodulus situating almost medially and with upper tooth up to 1.5 times longer and a little thinner than lower tooth (Fig. 2B); those in V on 2-4 per bundle, 75-88  $\mu\text{m}$  long, with nodulus situating medially to distally and with upper tooth as long as and thinner than lower tooth (Fig. 2C). Nodulus of ventral chaetae becoming distally in posterior segments. Branchial fossa with one pair of non-ciliated long palps and three pairs of digitate gills (Fig. 2D).

**Remarks.** Morphology and size of each sorts of chaetae of the present material well match with those in the original description of this species from southern India (Naidu, 1962). This species has so far been recorded from South Asia and South America (Naidu, 1962; Harman et al., 1988), and is first recorded from Indonesia in the current study.

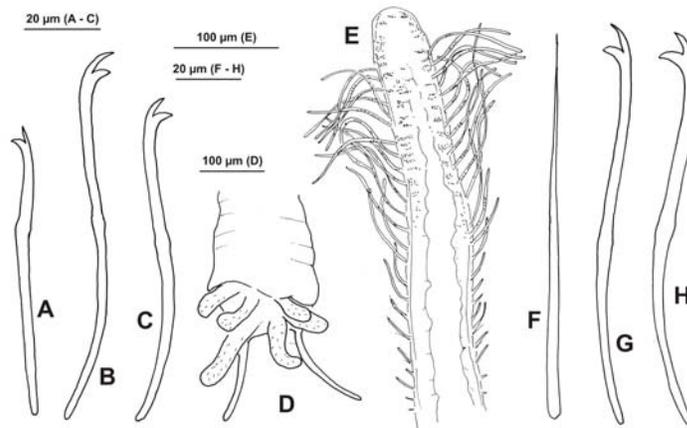


Fig.2. *Aulophorus hymanae* and *Branchiodrilus semperi* from Indonesia. (A-D) *Aulophorus hymanae* from L. Cilala, Bogor, Java: (A) dorsal chaeta in X; (B) ventral chaeta in II; (C) ventral chaeta in XII; (D) branchial fossa. (E-H) *Branchiodrilus semperi* from Lake Lutan, Central Kalimantan: (E) anterior end of body, dorsal view; (F) dorsal needle in XXXII; (G) ventral chaeta in IV; (H) ventral chaeta in a posterior segment

***Branchiodrilus semperi* (Bourne, 1890)** (Figure 2 E-H)

*Chaetobranchus semperi* Bourne, 1890; see Brinkhurst and Jamieson (1971) for synonyms and references.

**Material examined.** One immature specimen (MZB ANN.138) and four immature specimens (AO, LW, YS collections), profundal Lake Tehang, Central Kalimantan, 29 Dec. 2004. Three immature specimens, from a pond in the Bogor Botanical Garden, Bogor, West Java, 25 Mar. 2006 (AO collection).

**Brief description of material.** Body flattened ventro-dorsally, 18-26 mm long in fixed state, 160-210 segments in single zooids. Body surface and gills in anterior segments with brown pigments. Pairs of cylindrical gills distributed in anterior 1/3 - 1/2 of the body (Fig. 2E); gills up to 1300 µm long in anterior segments, becoming shorter posteriorly. Dorsal chaetal bundles with 1-3 smooth hairs and 1-3 straight needles. Hair chaetae in anterior segments up to 1000 µm long, 1.8-2.5 µm thick and, enclosed within gills; those in middle and posterior segments becoming shorter and thicker (3.8-5.1 mm thick) and some or all projecting freely. Hair chaetae sometimes absent in posterior segments. Needles 110-150 µm long, straight and without nodulus, the distal end simple pointed (Fig. 2F). Ventral chaetae 2-5 per bundle, 120-150 µm long. Ventral chaetae in anterior segments a little thinner than the rest, with median to slightly proximal nodulus and with upper tooth longer and thinner than the lower one (Fig. 2G); those in middle and posterior segments with almost median nodulus and with upper tooth as long as but thinner than lower tooth (Fig. 2H).

**Remarks.** This species has so far been recorded from South Asia (Brinkhurst and Jamieson, 1971), and is first recorded from Indonesia in the current study.

***Pristina amphibiotica* Lastockin, 1927** (Figure 3 A-E)

*Pristina amphibiotica* Lastockin, 1927; Sperber, 1948, p. 217, fig. 23a-c; Brinkhurst and Jamieson, 1971, p. 393, fig. 7.22f-h. Ohtaka, 2001, p. 85, figs. 2e-g.

*Pristina jenkiniae* (Stephenson, 1931): Collado and Schmelz, 2001, p.4, figs. 2a-f, 4a, b.

**Material examined.** One immature (MZB ANN.139) and three immature specimens (AO, YS, LW collections), gravelly sand bottoms in the Mas Mountain Stream, Bogor, West Java. 22 Mar. 2003.

**Brief description of material.** Body 1.5-2.6 mm long in fixed state.

Segments 24-27 in single zooids. Prostomium roundish conical, without proboscis. No eyes. Dorsal chaetal bundles from II, consisted of one hair and one, occasionally two needles. Hairs smooth, 112-208  $\mu\text{m}$  long, increasing in length in several anterior segments. Needles stout and bayonet-shaped, 56-69  $\mu\text{m}$  long (Fig. 3A). Distal teeth of needles long and parallel with upper tooth distinctly shorter and much thinner than lower (Fig. 3B, C). Ventral chaetae bifurcated; those in anterior segments 5-8 per bundle, 54-64  $\mu\text{m}$  long, with a little distal nodulus and with upper tooth as long as or a little longer and as thick as or slightly thinner than lower tooth (Fig. 3D); those in posterior segments 3-5 per bundle, 48-56  $\mu\text{m}$  long, with distal nodulus and with upper tooth shorter and thinner than lower tooth (Fig. 3E). Brownish chloragogen cells from V. Stomach gradually widening in VIII or IX.

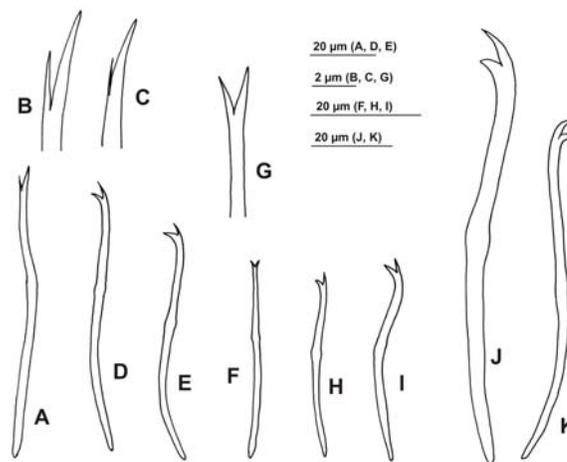


Fig.3. *Pristina amphibiotica* *Pristina osborni*, and *Pristina biserrata* from Indonesia. (A-E) *Pristina amphibiotica* from west Java: (A) dorsal needle in a middle segment; (B, C) variations of distal ends in dorsal needles; (D) ventral chaeta in an anterior segment; (E) ventral chaeta in a posterior segment. (F-I) *Pristina osborni* from Tanjung Puting National Park, Central Kalimantan; (F) dorsal needle in a middle segment; (G) the same, distal end; (H) ventral chaeta in an anterior segment; (I) ventral chaeta in a posterior segment. (J and K) ventral chaetae in right and left bundles in II in *Pristina biserrata* from Palangka Raya, Central Kalimantan

**Remarks.** Taxonomic relationship between *P. amphibiotica* and *P. jenkiniae* remains unclear (Kathman, 1985). In this paper we regard *P. amphibiotica* as a distinct species in that relative length of distal teeth in ventral chaetae is different from *P. jenkiniae* and its synonyms by Kathman (1985). That is, in *P. amphibiotica* upper tooth of ventral chaetae is as long as

or longer than lower tooth in anterior segments, while the upper tooth become distinctly shorter and thinner than lower tooth in posterior segments (Stephenson, 1931; Sperber, 1948; Brinkhurst and Jamieson, 1971; Ohtaka, 2001). On the other hand, in *P. jenkinsae* upper and lower tooth are equally long throughout the segments (Kathman, 1985). On the same point of view, *P. jenkinsae* of Collado and Schmelz (2001), which was described from Amazonian forest soil in Brazil can be assigned to *P. amphibiotica* because the ventral chaetae have longer upper teeth in anteriormost segments and shorter upper teeth in posterior segments. On the other hand, *P. amphibiotica changtuensis* Liang, 1963 from China, has subequal teeth of ventral chaetae throughout the segments, and it should be regarded as *P. jenkinsae* sensu Kathman (1985). Relative lengths of teeth in dorsal needles varied considerably in the present material as in *P. jenkinsae* (Kathman, 1985). This is the first recorded occurrence of the species in Indonesia.

***Pristina osborni* (Walton, 1906)** (Figure 3 F-I)

*Naidium osborni* Walton, 1906. Am. Nat., 40, p. 703, fig. 12.

*Naidium minutum* Stephenson, 1914, p. 327-330, figs. 3-5.

*Pristina minuta* (Stephenson). Sperber, 1948, p. 222-223; Right, 1973, p. 295-298, figs. 3-4.

*Pristina osborni* (Walton). Brinkhurst and Jamieson, 1971, p. 395, fig. 7.22N-P; Harman et al., 1988, p. 2239; Ohtaka and Sato, 2005, p. 4-5, fig. 3.

*Pristinella osborni* (Walton). Grimm, 1990, p. 131-132; Pinder and Brinkhurst, 1994, p. 119-120; Erséus and Grimm, 1998, p. 153-155, figs. 2, 4; Kathman and Brinkhurst, 1999, p. 96-97.

*Pristinella minuta* (Stephenson). Kathman and Brinkhurst, 1999, p. 96.

**Material examined.** One immature specimen (MZB ANN.140) and two immature specimens (AO collection) from a canal in the Tanjung Putting National Park, Central Kalimantan, 24 Feb. 1988. Four immature specimens, littoral Lake Sembuluh, Central Kalimantan, 25 Feb. 1988 (AO, YS collections). One immature specimen, a fish farm pond connected with Kapuas River, Central Kalimantan, 11 Dec. 1998 (AO collection). Two immature specimens, roots of *Eichhornia crassipes* in Lake Tundai, Central Kalimantan, 20 Mar. 2005 (LW collection).

**Brief description of material.** Body 1.5-2.0 mm long, 0.1mm wide. Segments 22-25. No eyes. Prostomium without proboscis. Dorsal chaetal bundles with 1 smooth hair with 96-176 µm long and 1 weakly bayonet-shaped needle

with 26-34  $\mu\text{m}$  long. Needle chaetae with distal nodulus and with long and divergent teeth in which upper tooth as long as or a little longer and as thick as lower tooth (Fig. 3F, G). Ventral chaetae 3-5 per bundle, 29-37  $\mu\text{m}$  long, with nodulus situating a little distally and with upper tooth a little longer and thinner than lower tooth in anterior segments (Fig. 3H), while upper tooth almost as long as and much thinner than lower tooth in posterior segments (Fig. 3I). Stomachal dilatation in VIII.

**Remarks.** There is no distinct difference in the length of dorsal hairs between *P. minuta* and *P. osborni* among literature, and dorsal needles in the present material (96-176  $\mu\text{m}$ ) covered both ranges. Thus, the decisions that both species were synonyms by Brinkhurst and Jamieson (1971), Grimm (1990) and Erséus and Grimm (1998) is reasonable. Intermediate teeth between needle teeth could also vary; they were recorded from African (Grimm, 1990), Australian (Pinder and Brinkhurst, 1994) and North American (Kathman, pres. comm.) materials, while never seen in the present material as in Erséus and Grimm (1998) for Australian specimens. Other chaetal characteristics in the present material match well with the previous descriptions listed above. Chaetal characteristics in *Pristina silvicola* Collado and Schmelz, 2000, described from soils in Brazilian tropical rain forest closely resembles *P. osborni* and the synonyms. However, decision of taxonomic relationships between *P. silvicola* and *P. osborni* should be reserved because many internal characteristics described on living specimens of *P. silvicola* were unclear in *P. osborni*.

*P. osborni* is almost cosmopolitan (Erséus and Grimm, 1998). In Asian region, it has been recorded from Pakistan (Stephenson, 1914), India (Naidu, 1963) and China (Wang, 1995), and is first recorded from Indonesia in the current study. The habitats included some terrestrial environments, Brazilian soil (Right, 1973) and moss in montane rain forest in Costa Rica (Harman, 1982).

***Pristina biserrata* Chen, 1940** (Figure 3 J, K)

*Pristina biserrata* Chen, 1940, p. 49-52, figs. 13-14; Ohtaka et al., 2000, p. 33-34, fig. 2; see Brinkhurst and Jamieson (1971) for other synonyms and references.

**Material examined.** Two immature specimens, littoral Lake Bojongsari, Bogor, West Java, 3 Mar. 2003. One immature specimen, littoral Lake Sabuah, Central Kalimantan, 24 Mar. 2004. Twenty immature specimens, a canal in the campus of University of Palangka Raya, Palangka Raya, Central Kalimantan, 17 Mar. 2005. All material in AO collection.

**Remarks.** In the original description (Chen, 1940) based on Chinese material, ventral chaetae in II-VII were fewer and thinner than those in the following segments, and among II-VII those in II were slightly longer and thicker. On the other hand, Ohtaka et al. (2000) described that ventral chaetae were longer and thicker in II but those from III on hardly differ in size in Central Kalimantan material. The present examination on additional material from Java and Kalimantan reveals that the size of ventral chaetae in *P. biserrata* vary considerably in several anterior segments. The ventral chaetae in II were longer and thicker than those in the following segments in all specimens examined, however extent of the enlargement was variable. In a specimen from the canal in the campus of University of Palangka Raya, Central Kalimantan, the chaetal size was different between left and right bundles in II; one of the pair consisted of four enlarged chaetae with 110-120  $\mu\text{m}$  long (Fig. 3J), while the other bundle consisted of three shorter and thinner chaetae with 80-90  $\mu\text{m}$  long (Fig. 3K). This specimen verifies that the enlarged chaetae in II are nothing but individual variation in this species. Similar variations of chaetal sizes have been known to be induced by water chemistry in other naidine species (Loden and Harman, 1980). In the present material, ventral chaetae in three to four succeeding segments from III also varied in size; usually they were a little shorter and thinner than those in the following segments, however, they were often hardly different from those in succeeding segments.

*Pristina biserrata* has been recorded from East and Southeast Asia (Brinkhurst and Jamieson, 1971; Ohtaka et al., 2000). It is common in Java and Kalimantan, and often predominated among oligochaete assemblages associated with aquatic macrophytes at least in Central Kalimantan (Ohtaka et al., 2003).

#### Subfamily Tubificinae

##### *Limnodrilus claparedianus* Ratzel, 1868 (Figure 4)

*Limnodrilus claparedianus* Ratzel. Ohtaka, 1985, p. 26-28, fig. 7, table 3.

*Limnodrilus claparedeianus* [sic]. Kathman and Brinkhurst, 1999, p. 160-160; see Brinkhurst and Jamieson (1971) for other synonyms and references.

**Material examined.** Fifty mature specimens from a fish diet at the Bogor Agricultural University, Bogor, Java, which were derived from a stream in Jakarta, Java, 2 March 2001. One specimen was deposited as MZB ANN.141, and others were in AO, YS and LW collections.

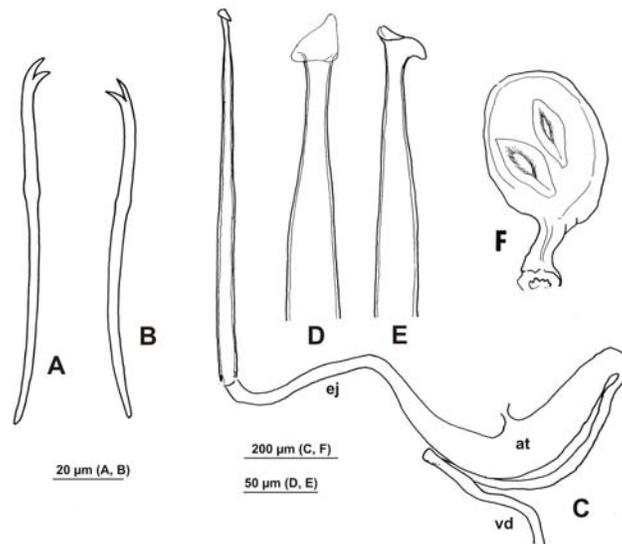


Fig.4. *Limnodrilus claparedianus* from Bogor, Java, Indonesia: (A) ventral chaeta in III; (B) ventral chaeta in a posterior segment; (C) ectal part of male duct; (D and E) distal ends of penis sheaths; (F) spermatheca. Abbreviations: at- atrium; ej- ejaculatory duct; vd- vas deferens

**Description of material.** Body reddish in color, somewhat yellowish posteriorly when living. In fixed state, body 1.0-3.2 mm long, 0.18-1.25 mm wide anteriorly. Segments 110-150. Prostomium bluntly triangular. All chaetae bifurcated, not different in number and shape between dorsal and ventral bundles. In anterior segments, chaetae 3-6 (mostly 4 or 5) per bundle, 104-125 µm long, with nodulus situating 1/4-1/3 from distal end and with upper tooth longer and as thick as lower ones (Fig. 4A). In posterior segments, chaetae 1-2 per bundle, 83-96µm long, with nodulus situating 1/4-1/3 from distal end, and with upper tooth almost as long as and a little thinner than lower tooth (Fig. 4B). Fully mature specimens lacking both ventral and dorsal chaetae in XI.

Clitellum from 1/2X to 1/2XIII, thick. Male funnels set on 10/11. Vasa deferentia in XI, long and winding, 25-30 µm thick. Atria tubular in shape, 550-700 µm long, 130-200 µm thick in maximum (Fig. 4C). Prostate glands almost as large as atria, connected at concave side of middle course of atria through narrow stalks. Ejaculatory ducts as long as or a little shorter than atria, almost as thick as vasa deferentia. Penis sheaths long and tubular (Fig.

4C), surrounded by spiral muscles. In mated specimens, the penis sheaths 600-900  $\mu\text{m}$  long, 32-48  $\mu\text{m}$  in maximum breadths; the length/maximum breadth ratio 15-23 (mean 19.1, sd 2.5, n=10). The wall of penis sheaths one layer and 3.0-4.8  $\mu\text{m}$  thick throughout the length. Distal part of penis sheath becoming narrower into 11-17  $\mu\text{m}$  in breadth (Fig. 4D, E). Thin and triangular hoods set obliquely on distal end of penis sheaths (Fig. 4D, E). Spermathecal pores opening in front of ventral chaetae in X. Spermathecal duct well marked off from ampullae, 130-190  $\mu\text{m}$  long, 90-120  $\mu\text{m}$  thick; spermathecal ampullae ovoid, 390-450  $\mu\text{m}$  long by 260-300  $\mu\text{m}$  (Fig. 4F). Some to several spindle-shaped spermatozeugmates found in spermathecal ampullae. Chloragogen cells begin in V.

**Remarks.** *Limnodrilus claparedianus* is distinguished from other congeners by having one layered long and cylindrical penis sheath with small triangular hood set obliquely, and longer upper tooth of anterior chaetae in both dorsal and ventral bundles. Although the present material match with previous descriptions of *L. claparedianus* in most specific characters, it was different from typical *L. claparedianus* in the length and shape of penis sheath. According to Kathman and Brinkhurst (1999), the penis sheath of North American *L. claparedianus* is most frequently 800-1000  $\mu\text{m}$  long and attained up to 1300  $\mu\text{m}$ , and is up to 50 even 80 times longer than broad. Kennedy (1966) gave 21-42 of length/breadth ratio for European material of the species. Ohtaka (1985) described the penis sheaths as 947-2068  $\mu\text{m}$  in length and 20-44 in length/maximum diameter ratio in Japanese material, and 1004-1668  $\mu\text{m}$  in length and 25-35 in length/maximum diameter ratio in Lake Erie material of *L. claparedianus*. Length of the penis in the present material was shorter (600-900  $\mu\text{m}$ ), and the length/breadth ratio is smaller (15-23) than the above values cited. In addition, distal part of the penis sheath shaft invariably became narrow in the present material, being different from typical *claparedianus* in which width of penis sheath shafts hardly change throughout the length as in the figures of Brinkhurst and Jamieson (1971) and Ohtaka (1985). Nevertheless, wide variations have been known in the length and/or the length/breadth ration in *L. claparedianus* (Kennedy, 1966; Ohtaka, 1985) and a narrow distal shaft in penis sheath which is closely similar to the present material was depicted in North American *L. claparedianus* (Kathman and Brinkhurst, 1999). Therefore, we ascribe the present Javanese material as *L. claparedianus*. *L. claparedianus* is a cosmopolitan species (Brinkhurst and Jamieson, 1971). This is the first recorded occurrence of the species in Indonesia. The present material was found together with a congener, *L. hoffmeisteri* Claparède.

***Limnodrilus grandisetosus* Nomura, 1932** (Figure 5)

*Limnodrilus grandisetosus* Nomura, 1932, p. 511-525, figs. 1-5, pls.13-17; Brinkhurst, 1963, p. 39, fig. 25; Ohtaka, 1985, p. 28-32, figs. 1b, 8-10, table 4; Ohtaka, 1992, p. 35-36, figs. 3e-i.

*Limnodrilus silvani* Eisen: Brinkhurst, 1965, p. 131 (in part); Brinkhurst and Jamieson, 1971, p. 471-472 (in part).

**Material examined.** Four mature specimens, littoral Lake Tehang, Central Kalimantan, mud, 24 Mar. 2003. One specimen was deposited as MZB ANN.142, and other two and one specimens were in AO and LW collections, respectively.

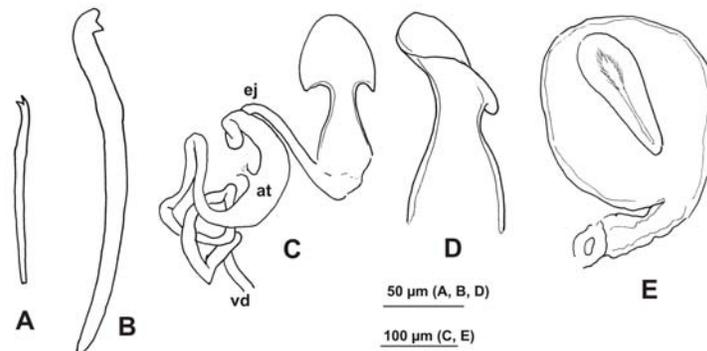


Fig.5. *Limnodrilus grandisetosus* from Lake Tehang, Central Kalimantan, Indonesia: (A) dorsal chaeta in V; (B) ventral chaeta in VIII; (C) ectal part of male duct; (D) penis sheath, lateral view; (E) spermatheca. Abbreviations: at- atrium; ej- ejaculatory duct; vd- vas deferens

**Brief description of material.** All the specimens not intact. Body over 100 mm long, 0.5 mm wide anteriorly. Posterior part of body very slender. Prostomium bluntly conical. Ventral and dorsal chaetae 1-4 per bundle anteriorly, 1-2 per bundle posteriorly; with distal nodulus and with short bifurcated teeth in which upper tooth almost as long as or longer than lower tooth (Fig. 5A). Ventral chaetae from IV to X modified into giant chaetae, up to 220 µm in length in VI or VII or VI, and with short and blunt teeth (Fig. 5B). Ventral chaetae in XI absent. Vasa deferentia long and winding. Atria tubular, 200-300 µm long, 60 µm wide (Fig. 5C). Prostate glands almost as large as atria, connected at concave side of middle course of atria through narrow stalks. Ejaculatory ducts as long as atria and as thick as vasa deferentia. Penis sheaths

short and spade-shaped, 150-200  $\mu\text{m}$  long, 60-80  $\mu\text{m}$  wide at base, thick walled (Fig. 5C). Distal ends of penis sheaths rounded, opening obliquely (Fig. 5D). Spermathecae opening in front of ventral chaetal bundles in X; spermathecal duct 150 $\mu\text{m}$  long, well marked off from ampullae; spermathecal ampullae spherical to ovoid in shape, 270  $\mu\text{m}$  long by 230  $\mu\text{m}$  (Fig. 5E). Spermatozeugmates in spermathecal ampullae spindle-shaped.

**Remarks.** Every characteristics of the present material agrees well with the original and redescrptions of *L. grandisetosus* from Japan (Nomura, 1932; Ohtaka, 1985; 1992). The present examination confirmed that distal part of the penis sheath in this species is expanded to rounded triangular bell and open obliquely (Fig. 5D). *L. grandisetosus* has hitherto been recorded from Japan (Namura, 1932; Ohtaka, 1985, 1992), China (Liang, 1979; Brinkhurst et al., 1990) and Malaya (Ohtaka, 1985). This is the first recorded occurrence of the species in Indonesia, suggesting that this species is widespread in East and Southeast Asia.

On the other hand, there have been described a series of closely related taxa in East and Southeast Asia; *L. amblysetus* Brinkhurst et al., 1990 and *L. paramblysetus* Wang and Liang, 2001 from eastern China, and *L. sp.* of Stephenson (1929) from Myanmar. According to the descriptions, they are different to each other in the forms of chaetae and/or penis sheaths. In addition, *L. grandisetosus* of Yamaguchi (1940) from northeastern China has a simple hood opening right angle to the shaft, and *L. cf. grandisetosus* of Wang and Liang (2001) from eastern China has simple pointed ventral chaetae in the ventral bundles. Both of them are different from typical *L. grandisetosus* which has rounded triangular hood in penis sheaths and no simple pointed chaetae. As Wang and Liang (2001) pointed out, variability of chaetal and genital morphologies should be scrutinized to determine real taxonomic status of these taxa.

## DISCUSSION

Including the present records, forty-five species of microdrile oligochaetes have so far been recorded from Indonesia (Table 1). It is obvious that number of the recorded species surpasses in the subfamily Naidinae, which occupies 76% (34 spp.) of all the recorded oligochaete species in this region. Predominant occurrence of naidines in tropical Asia has been already suggested by Timm (1980). It has been recognized that many naidines show

**Table 1.** A list of freshwater oligochaetes recorded from Indonesia. Only the taxa identified specifically are listed. Valid scientific names are adopted. References: 1, Michaelsen (1932); 2, Michaelsen and Boldt (1932); 3, Ohtaka and Usman (1997); 4, Ohtaka et al. (2000); 5, Ohtaka et al. (2003); 6, Sudarso et al. (2003); 7, present study

Taxon	Sumatra	Kalimantan	Java	Bali
Family Haplotaxidae				
<i>Haplotaxis vermivorus</i> (Michaelsen, 1932)	1			
Family Tubificidae				
Subfamily Naidinae				
<i>Chaetogaster diastrophus</i> (Gruithuisen, 1828)	4			
<i>Chaetogaster diaphanus</i> (Gruithuisen, 1828)	4		5	
<i>Nais pardalis</i> Piguët, 1906	2, 4		2, 5	
<i>Nais bretscheri</i> Michaelsen, 1899	2			
<i>Nais communis</i> Piguët, 1906			2	
<i>Nais raviensis</i> Stephenson, 1914	2			
<i>Slavina appendiculata</i> (d'Udekem, 1855)		7	7	
<i>Allonais pectinata</i> (Stephenson, 1910)	4		5	
<i>Allonais gwaliorensis</i> (Stephenson, 1920)	2			2
<i>Allonais paraguayensis</i> (Michaelsen, 1905)	2		2, 5	
<i>Allonais inaequalis</i> (Stephenson, 1911)	2		2	
<i>Dero digitata</i> (Müller, 1773)	4, 6	4	5	
<i>Dero indica</i> Naidu, 1962	4			
<i>Dero dorsalis</i> Ferronniere, 1899	4			
<i>Dero pectinata</i> Aiyer, 1929			7	
<i>Aulophorus flabelliger</i> Stephenson, 1931	4			
<i>Aulophorus furcatus</i> (Müller, 1773)	2, 4, 6	4, 5	2	
<i>Aulophorus indicus</i> Naidu, 1962		4		
<i>Aulophorus gravelyi</i> Stephenson, 1931	2			2
<i>Aulophorus tonkinensis</i> (Vejdovsky, 1894)	2		2	
<i>Aulophorus hymanae</i> Naidu, 1962	7	7	7	
<i>Branchiodrilus hortensis</i> (Stephenson, 1910)		4	5	
<i>Branchiodrilus semperi</i> (Bourne, 1890)		7	7	
<i>Stephensoniana trivandrana</i> (Aiyer, 1926)	6, 7	7	7	
<i>Pristina breviseta</i> Bourne, 1891	2			
<i>Pristina longiseta</i> Ehrenberg, 1828	2, 4	4, 5	5	
<i>Pristina aequiseta</i> Bourne, 1891	4	4, 5	5	
<i>Pristina synclites</i> Stephenson, 1925		4		
<i>Pristina biserrata</i> Chen, 1940		4, 5, 7	5, 7	
<i>Pristina proboscidea</i> Beddard, 1896	2	5	2	
<i>Pristina rosea</i> (Piguët, 1906)	2		2	2
<i>Pristina amphibiotica</i> Lastockin, 1927			7	
<i>Pristina osborni</i> (Walton, 1906)		7		
<i>Stylaria fossularis</i> Leidy, 1852		4, 5	5	
Subfamily Tubificinae				
<i>Limnodrilus hoffmeisteri</i> Claparede, 1862	3		2, 5	
<i>Limnodrilus claparedianus</i> Ratzel, 1868			7	
<i>Limnodrilus grandisetosus</i> Nomura, 1932		7		
<i>Aulodrilus pluriseta</i> (Piguët, 1906)	2			
<i>Aulodrilus pigueti</i> Kowalewski, 1914	3, 6			
<i>Aulodrilus acutus</i> Ohtaka and Usman, 1997	3	4		
<i>Teneridrilus mastix</i> (Brinkhurst, 1978)	3			
Subfamily Rhyacodrilinae				
<i>Branchiura sowerbyi</i> Beddard, 1892	3, 6		5	
Family Enchytraeidae				
<i>Fridericia bulbosa</i> (Rosa, 1887)			2	
<i>Enchytraeus harurami</i> Stephenson, 1914	2		2	

wide distribution, probably due to their opportunistic strategy of asexual reproduction as the normal case (Erséus and Grimm, 1998), and there is no naidine species restricted in Indonesia. Although the differences in distributional records between islands in Table 1 could depend on research frequency, some faunal differences are found in the naidine composition in Kalimantan. In that, no *Allonais* species and only four species of the genus *Dero* were recorded from Kalimantan, both of which were suggested to have an equatorial bias to their distribution (Pinder and Ohtaka 2004). All the Kalimantan species so far recorded were collected from the peat swamp area of Central Kalimantan, where the water is characterized in having high concentration of humic materials which make the water color brownish, low pH (Iwakuma *et al.*, 2000), and the faunal difference in the Kalimantan records could be related to the peculiar environmental conditions rather than geographically.

Several soil-dwelling *Pristina* species have been known from tropical South America: *Pristina osborni* (Right, 1973), *P. silvicola* Collado and Schmeltz and *P. terrena* Collado and Schmeltz (Collado and Schmeltz, 2000) and *P. marcusii* Collado and Schmeltz, *P. amphibiotica* (as *P. jenkiniae*), *P. notopora* Cernosvitov (Collado and Schmeltz, 2001). It is expected that many of such terrestrial *Pristina* species are distributed also in tropical Asia.

In contrast to the rich variety of naidines, only seven tubificines (three *Limnodrilus*, three *Aulodrilus* and one *Teneridrilus* species) and one rhyacodriline (*Branchiura sowerbyi*) have been recorded from Indonesia. As already pointed out by Ohtaka *et al.* (2000), the paucity of these groups in the tropical regions may be attributable to their evolutionary and physiological trends in that they are thought to originate from the northern temperate zone, and most of the species need hibernation in cold water for successful sexual reproduction (Timm 1980). It is suggested that the eight tubificine and rhyacodriline species recorded from Indonesia adapt to ever high temperature by developing sexual reproduction without hibernation (*Limnodrilus* species and *Branchiura sowerbyi*) or asexual reproduction like naidines (*Aulodrilus* species). It is expected that some different oligochaete diversity is found in montane and alpine waters in this region.

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