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# A preliminary study of oligochaetes in Poyang Lake, the largest freshwater lake of China, and its vicinity, with description of a new species of *Limnodrilus*

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*Key words:* Tubificidae, Naididae, freshwater oligochaetes, taxonomy, new species, Poyang Lake

**Abstract**

The oligochaete fauna of the largest freshwater lake of China, Poyang Lake, has never been investigated before. On the basis of a preliminary survey in the lake and its vicinity in 1997–1999, 25 species belonging to 20 genera and 5 families are recorded. Among them, one genus, *Cernosvitoviella* (Enchytraeidae), and two species, *Bratislavia unidentata* (Naididae), *Potamothrix bedoti* (Tubificidae), are recorded from China for the first time. Another tubificid, *Limnodrilus paramblysetus* sp. nov., is new to science. It is similar to *L. amblysetus* Brinkhurst et al., 1990 in chaetal shape but differs in having short hooded penis sheaths.

## Introduction

Located in the northern Jiangxi Province at the junction of the middle and lower reaches of Changjiang (Yangtze) River, Poyang Lake (28° 25′–29° 45′ N, 115° 48′–116° 44′ E) covers an area of 3283 km$^2$ at a water-level of 21.7 m ASL, with a maximum length of 173 km, a maximum width of 73 km and a shore development ($D_L$) of 5.9. It is a fluvial lake formed about 6000 years ago, and receives flows from five rivers, undergoing a great change of water level within a year (Zhu & Zhang, 1997). Being the largest freshwater, shallow lake in the country and one of the two large lakes still connecting the main river course of Changjiang, Poyang Lake plays an important role in maintaining aquatic biodiversity. However, no faunistic work on oligochaetes has been carried out in this water body. During the limnological investigation of Poyang Lake and its vicinity in 1997–1999, oligochaete specimens were collected mainly from the quantitative samples and reported below. This includes a new species of *Limnodrilus* and two new records for China. One additional new record, *Potamothrix bedoti* from Houhu Lake of Wuhan, is also given herein.

## Materials and methods

Quantitative bottom samples were collected with a weighted Petersen grab (1/16 m$^2$) and sieved with a 420 μm sieve, and then worms were sorted manually in a white porcelain dish and preserved in 10% formalin. For some qualitative samples, live oligochaetes were sorted under dissecting microscope, or extracted by the wet-funnel method and fixed in 10% formalin. Specimens were prepared by two methods, i.e. glycerine mounts and Canada balsam mounts. For the former, oligochaetes were saturated with glycerine under cover slips sealed with asphalt around their edges. For the latter, worms were stained in borax carmine and mounted in Canada balsam. Measurements of chaetae and internal organs refer to glycerine and balsam mounts, respectively, and drawings were made using a camera lucida. The types and other specimens are deposited in the Specimen Room of Invertebrates, Institute of Hydrobiology (IHB), Chinese Academy of Sciences (CAS), in Wuhan.

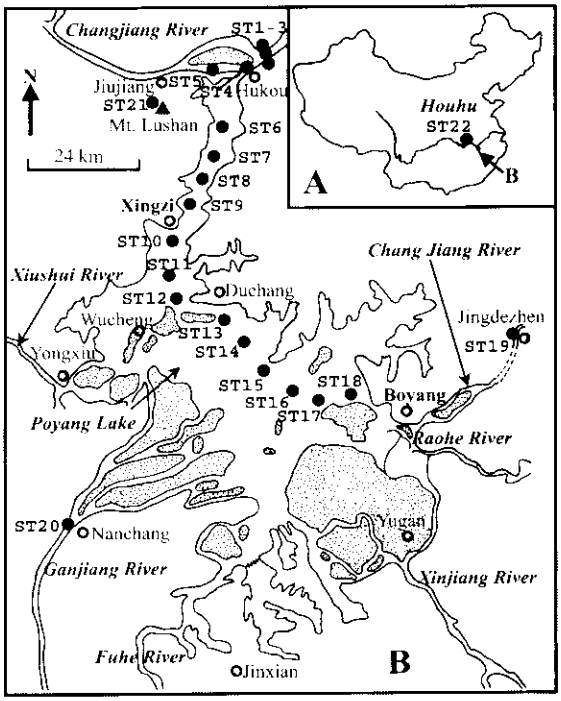


*Figure 1.* Sampling stations in Poyang Lake and its vicinity. (A) China, (B) Poyang Lake.

## Description of study sites

The stations (Fig. 1, ST1–19) in Poyang Lake and adjacent Changjiang were sampled by the authors at five times, in October, 1997, April and November, 1998, and May and July, 1999. Station 2 is omitted, as no sample was collected due to the rapid current. Environmental factors associated with these stations are given for the different times when oligochaetes were collected. The specimens from Chang Jiang River, Ganjiang River (tributaries of Changjiang) and Mt. Lushan (Fig. 1, ST19–21) were collected by the authors in June, 1999. In Houhu Lake (Fig. 1, ST22), Wuhan, the sample was taken by Dr Z. Gong in April, 1999. Macrophytes were not found at any stations.

*ST1.* Changjiang River, N of Balijiang transect, 29° 47.90′ N, 116° 16.49′ E, mainly silt, 17 Apr 1998: 6.0 m depth, 0.3 m $s^{-1}$ flow; 7 May 1999: 6.0 m depth, 0.9 m $s^{-1}$ flow.

*ST3.* S of the above transect, 29° 47.71′ N, 116° 17.77′ E, 28 Oct 1997: clay, 5.0 m depth, 0.2 m $s^{-1}$ flow; 14 Nov 1998: mainly sand, 2.0 m depth, 0.8 m $s^{-1}$ flow.

*ST4.* N of S branch of Changjiang near Shizhongshan in Hukou, 29° 45.12′ N, 116° 13.11′ E, mainly silt, 14 Nov 1998: 9.0 m depth, 0.3 m $s^{-1}$ flow; 7 May 1999: 7.2 m depth; 12 Jul 1990: 17.3 m depth, 0.3 m $s^{-1}$ flow.

*ST5.* S of S branch of Changjiang, W of Hukou, 29° 46.32′ N, 116° 09.96′ E, sand, 16.0 m depth, 0.5 m $s^{-1}$ flow, 12 Jul 1999.

*ST6.* Outlet of Poyang lake, W of Xieshan, 29° 39.87′ N, 116° 09.97′ E, clay, 16 Apr 1998: 2.5 m depth, 0.4 m $s^{-1}$ flow; 13 Nov 1998: 11.0 m depth, 0.3 m $s^{-1}$ flow.

*ST7.* Lake outlet, between Hamashi and Xieshan, 29° 37.03′ N, 116° 08.26′ E, mainly sand, 10.0 m depth, 0.2 m $s^{-1}$ flow, 11 Jul 1999.

*ST8.* Lake outlet, SE of Hamashi, 29° 32.26′ N, 116° 06.73′ E, mainly clay, 1.5 m depth, 29 Oct 1997.

*ST9.* Lake outlet, NE of Xingzi, 29° 28.25′ N, 116° 05.57′ E, mainly sand, 13 Nov 1998: 2.5 m depth, 0.4 m $s^{-1}$ flow; 9 Jul 1997: 13.4 m depth, 0.2 m $s^{-1}$ flow.

*ST10.* Lake outlet, S of Xingzi, 29° 24.27′ N, 116° 03.78′ E, 29 Oct 1997: 3 m depth, 0.3 m $s^{-1}$ flow; 16 Apr 1998: mainly sand, 4.3 m depth, 0.2 m $s^{-1}$ flow; 6 May 1999: clay, 5.8 m depth, 0.5 m $s^{-1}$ flow.

*ST11.* S end of lake outlet, 29° 19.92′ N, 116° 04.33′ E, mainly clay, 16 Apr 1998: 4.2 m depth, 0.2 m $s^{-1}$ flow; 13 Nov 1998: 5.0 m depth, 0.6 m $s^{-1}$ flow; 6 May 1999: 4.5 m depth, 0.4 m $s^{-1}$ flow.

*ST12.* Lake proper, W of Duchang, 29° 16.32′ N, 116° 06.23′ E, mainly silt, 13 Nov 1998: 11.0 m depth, 0.6 m $s^{-1}$ flow; 6 May 1999: 11.0 m depth, 0.6 m $s^{-1}$ flow; 11 Jul 1999: 8.5 m depth, 0.2 m $s^{-1}$ flow.

*ST13.* Lake proper, E of Wugongshan, 29° 14.45′ N, 116° 11.73′ E, 30 Oct 1997: 4.8 m depth, 0.3 m $s^{-1}$ flow; 15 Apr 1998: sand with clay, 2.8 m depth, 0.2 m $s^{-1}$ flow; 5 May 1999: silt, 8.9 m depth, 0.2 m $s^{-1}$ flow.

*ST14.* Lake proper, NW of Huangjinzui, 29° 14.27′ N, 116° 14.32′ E, 30 Oct 1997: 3.5 m depth, 0.2 m $s^{-1}$ flow; 12 Nov 1998: mainly silt, 2.8 m depth, 0.5 m $s^{-1}$ flow; 5 May 1999: mainly silt, 3.5 m depth, 0.2 m $s^{-1}$ flow; 9 Jul 1999: clay, 8.1 m depth, 0.1 m $s^{-1}$ flow.

*ST15.* Lake proper, SW of Huangjinzui, 29° 11.80′ N, 116° 16.08′ E, 15 Apr 1998: clay, 1.9 m depth, 0.1 m $s^{-1}$ flow; 15 Nov 1998: mainly sand, 5.0 m depth, 0.6 m $s^{-1}$ flow; 9 Jul 1999: clay, 7.9 m depth, 0.1 m $s^{-1}$ flow.

*ST16.* Lake proper, SW of Zhupaoshan, 29° 09.22′ N, 116° 18.34′ E, 15 Apr 1998: mainly sand, 5.3 m depth, 0.3 m $s^{-1}$ flow; 9 Jul 1999: clay, 7.6 m depth, 0.1 m $s^{-1}$ flow.

*ST17.* Lake proper, NW of Nanshancaozhou, 29° 06.34′ N, 116° 20.15′ E, mainly clay. 15 Apr 1998: 4.8 m depth, 0.5 m $s^{-1}$ flow; 12 Nov 1998: 4.0 m depth, 0.6 m $s^{-1}$ flow; 5 May 1999: 7.3 m depth, 0.5 m $s^{-1}$ flow.

*ST18.* Lake proper, N of Nanshancaozhou, 29° 04.59′ N, 116° 22.29′ E. 12 Nov 1998: silt, 3.5 m depth, 0.7 m $s^{-1}$ flow; 5 May 1999: clay, 5.6 m depth.

*ST19.* Chang Jiang River inside Jingdezhen City, 29.3° N, 117.2° E, shallow area close to bank, cleft-stone with attached algae, 11 Nov 1998.

*ST20.* Ganjiang River near Nanchang City, 28.6° N, 115.9° E, shallow area close to bank, clay, 14 Jun 1999.

*ST21.* Various localities in Mt. Lushan, 29.5° N, 115.9° E, mainly brooks, 15–17 Jun 1999.

*ST22.* Houhu Lake, Wuhan, 30° 33′ N, 114° 23′ E, lentic waters, silt, 2.2 m depth, Apr 1999.

## Results

### *Species composition*

A total of 25 species, representing 20 genera of 5 families, have been identified from Poyang Lake and its vicinity (Table 1). Among them, *Limnodrilus paramblysetus* is new to science. One genus, *Cernosvitoviella*, and two species, *Bratislavia unidentata*, *Potamothrix bedoti* are recorded from China for the first time. *Nais elinguis* has never been recorded from eastern China before, although it is a cosmopolitan species (Sperber, 1948) and was known from northwestern China, i.e. Xinjiang (Sinkiang) Uygure Autonomous Region (Liang, 1964).

### *Systematic account*

In this part, we describe new species, new records, and rare and other taxa with some taxonomic significance. Enchytraeid species are excluded, considering that these specimens are either immature, or not sufficient for the determination of details.

HAPLOTAXIDAE

***Haplotaxis* sp.** (Fig. 2 A,B)

*Material examined:* 1 balsam mount from ST15.

*Brief description:* Specimen incomplete and immature, length > 60 mm, width 0.3 mm, segments > 190. Prostomium cylindrical, separated from peristomium by a transverse groove (Fig. 2 A). Segments V–XXIX conspicuously 2-ringed (Fig. 2 A); XXX–XLII inconspicuously 3–4(5)-ringed. No dorsal chaetae. Ventral chaetae 1 per bundle, absent in the right of III, occasionally with 1 short replacement chaeta anteriorly; sigmoid, simple-pointed, with nodulus (Fig. 2 B); chaetae in II and III smaller, 97–104 μm long, 6–8 μm thick; from IV onwards 194–206 μm long, 10–12 μm thick. Chromophilous masses in X–XI.

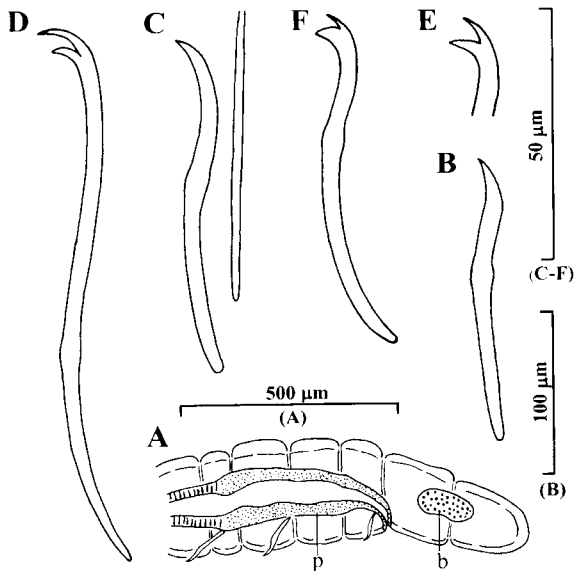


*Figure 2. Haplotaxis* sp.: (A) lateral view of anterior segments, (B) chaeta (VII). *Bratislavia unidentata*: (C) hair and needle (VII), (D–F) ventral chaetae (III, VI, VII, respectively). Abbreviations: b – brain; p – pharynx.

*Remarks*: Previously, the family Haplotaxidae has only been described from subterranean waters or rivers in China (Brinkhurst et al., 1990; Wang, 1995). The occurrence of *Haplotaxis* in Poyang Lake is the first record of this family in a Chinese shallow lake.

NAIDIDAE

***Bratislavia unidentata*** (Harman, 1973) (Fig. 2 C–F)

*Pristina unidentata* Harman, 1973: 161–163, Figure 2; Harman, 1974: 17.

*Bratislavia unidentata* (Harman). Harman & Loden, 1978: 541–544, Figure 1; Kathman & Brinkhurst, 1998: 92–93; Brinkhurst & Marchese, 1989: 114–115.

*Material examined*: 3 glycerine and 5 balsam mounts from ST19.

*Brief description of new material*: Specimens immature, length 4–9 mm, segments 40–80 plus undifferentiated tails. No stomach. Pharyngeal glands in III-VI. Hairs (0) 1 (2) per bundle, 80–120 μm long,

*Table 1.* Species composition of oligochaetes in Poyang Lake and its vicinity. 1, presence; 0, absence; #, new record of the genus for China; *, new record of the species for China

| Stations | 1 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HAPLOTAXIDAE | | | | | | | | | | | | | | | | | | | | | |
| *Haplotaxis* sp. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| LUMBRICULIDAE | | | | | | | | | | | | | | | | | | | | | |
| *Lumbriculus variegatus* (Müller, 1774) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| ENCHYTRAEIDAE | | | | | | | | | | | | | | | | | | | | | |
| #*Cernosvitoviella* sp. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| *Mesenchytraeus* sp. | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NAIDIDAE | | | | | | | | | | | | | | | | | | | | | |
| *Paranais frici* Hrabě, 1941 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Nais elinguis* Müller, 1773 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| *Slavina appendiculata* d'Udekem, 1855) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 |
| *Dero digitata* (Müller, 1773) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| *Aulophorus furcatus* (Müller, 1773) | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Bratislavia unidentata* (Harman, 1973) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| *Pristinella jenkinae* (Stephenson, 1931) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| *Pristina longiseta* Ehrenberg, 1828 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| TUBIFICIDAE | | | | | | | | | | | | | | | | | | | | | |
| *Tubifex* sp. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| *Limnodrilus hoffmeisteri* Claparède, 1862 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| *Limnodrilus* cf. *grandisetosus* Nomura, 1932 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| *Limnodrilus paramblysetus* sp. nov. | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| #**Potamothrix bedoti* (Piguet, 1913) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| *Teneridrilus mastix* (Brinkhurst, 1978) | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 |
| *Spirosperma nikolskyi* (Lastockin, 1953) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| *Aulodrilus limnobius* Bretscher, 1899 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Aulodrilus pluriseta* (Piguet, 1906) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| *Aulodrilus pigueti* Kowalevski, 1914 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Aulodrilus pectinatus* Aiyer, 1928 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Bothrioneurum* sp. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| *Branchiura sowerbyi* Beddard, 1901 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| Species number | 3 | 4 | 3 | 1 | 1 | 1 | 1 | 2 | 3 | 5 | 2 | 3 | 6 | 5 | 1 | 3 | 5 | 3 | 3 | 8 | 4 |

maximally 1.8 $\mu$m thick, without serration. Needles 1 (2) per bundle, simple-pointed and sigmoid, with nodulus distal (Fig. 2 C). Ventral chaetae in II–V 4–5 per bundle, longer and slightly thinner than the rest, with nodulus proximal and upper teeth about twice as long as lower (Fig. 2 D); those following 3–4 per bundle, with nodulus distal and upper teeth thinner, as long as (Fig. 2 E) or shorter than lower (Fig. 2 F).

*Remarks*: This species was originally described as *Pristina unidentata* from Oklahoma and Texas (Harman, 1973), and later reassigned to *Bratislavia* on the basis of genital organs (Harman & Loden, 1978). The new specimens, which were numerous at the locality, coincide well with the descriptions of original and Surinamese material (Harman, 1973, 1974), but there are some minor differences. The Chinese worms have thicker hair chaetae (1.8 $\mu$m *versus* 1 $\mu$m), and more chaetae in the anteriormost segments (4–5 *versus* 3–4 per bundle).

*Distribution*: Central China (new record), Eastern USA, Surinam, Argentina.

TUBIFICIDAE

***Limnodrilus*** cf. ***grandisetosus*** Nomura, 1932

*Limnodrilus grandisetosus* Nomura, 1932: 511, Figures 1–5, Pls. XIII–XVII; Yamaguchi, 1940: Figure 6; Liang, 1979: 277; Ohtaka, 1985: Figure 8 A–E, I; Brinkhurst et al., 1990: Figure C.

*Material examined*: 2 glycerine mounts from ST1 and ST4, respectively.

*Brief description*: Specimens immature, slender and coiled, length 9–24 mm, segments 44 up to more than 100. Prostomium conical. Dorsal chaetae 2–4 per bundle anteriorly, with upper teeth reduced or absent; 1–2 per bundle posteriorly, with upper teeth about twice as long as lower. Ventral chaetae 1–2 per bundle. Anterior ventral chaetae bifid, or sometimes simple-pointed, usually longer and thicker than dorsal; giant chaetae in V–VIII (IX), with blunt teeth. Posterior ventral chaetae similar to dorsal.

*Remarks*: Although simple-pointed chaetae have never been observed in *L. grandisetosus*, the presence of giant chaetae suggests that the present specimens could be tentatively identified as this species.

In terms of the ectal ends of the penis sheaths, there are two different descriptions of *L. grandisetosus* in Chinese material. Yamaguchi (1940) recorded this species from northeastern China and stated that the penis sheaths are hooded, and Liang (1979) later noted the same for the specimens from Huama Lake along middle Changjiang. However, Brinkhurst et al. (1990) reported that the penis sheaths in this species have rounded triangular plate-like heads, an observation based upon three Chinese specimens and one Japanese worm. This fits the descriptions of Japanese material including type specimens (Nomura, 1932; Ohtaka, 1985). For the time being, we do not know whether the penis sheaths were similar or not in the Chinese and Japanese material of Brinkhurst's study. Obviously, a further study is needed to determine whether this variation is interspecific or intraspecific, or just due to an observational problem.

*Distribution*: Japan, China, Malaysia.

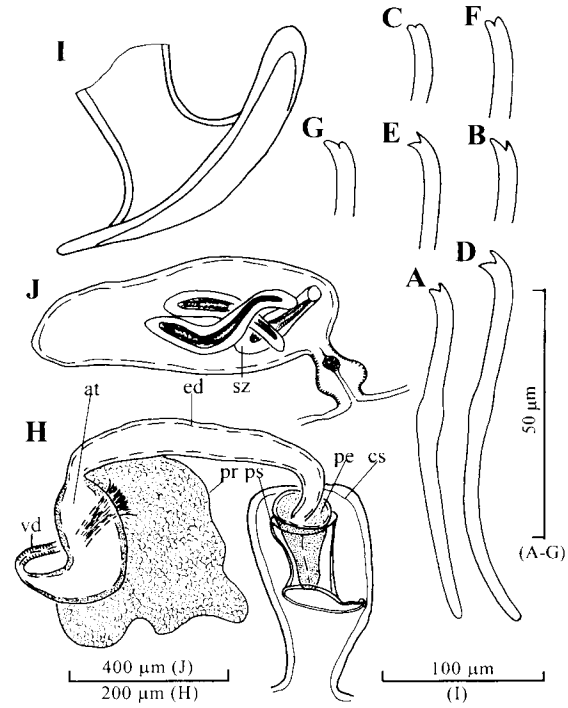


*Figure 3. Limnodrilus paramblysetus* sp. nov. (A–E) dorsal chaetae (III, IV, V, XIII, XL, respectively), (F, G) ventral chaetae (VI), (H) male duct, (I) penis sheath, (J) spermatheca. Abbreviations: at – atrium; cs – copulatory sac; ed – ejaculatory duct; pe – penis; pr – prostate; ps – penis sheath; sz – spermatozeugmata; vd – vas deferens.

***Limnodrilus paramblysetus*** sp. nov. (Fig. 3)

*Holotype*: IHB AHA1998001a, mature specimen in balsam mount.

*Type locality*: China, Changjiang River, N of Balijiang, 17 Apr 1998 (ST1).

*Paratypes*: 7 mature specimens: IHB AHA 1998001b-d, 3 balsam mounts (2 dissected), and IHB AHA1999001a, 4 specimens in 10% formalin,

all from type locality on 17 Apr 1998 and 7 May 1999, respectively.

*Etymology*: Named *paramblysetus* for the resemblance with *amblysetus* with regard to chaetae.

*Description*: Dimensions of the formalin fixed individuals: length 15–23 mm (holotype: 18 mm), width 0.6–0.8 mm anteriorly, 0.4–0.6 mm posteriorly; segments 54–97 (holotype: 54). Prostomium conical. Clitellum over 1/2X–XII. Chaetae bifid, 66–80 μm long, 2.4–2.9 μm thick, with distal nodulus. Bifids 5–7 per bundle anteriorly, with blunt teeth, and subequal teeth or upper teeth reduced (Fig. 3 A–C, F–G); 3–5 per bundle posteriorly, usually with upper teeth thinner than and as long as lower (Fig. 3 D–E). Ventral chaetae absent from XI. Male pores paired in line with ventral chaetae in mid-XI. Spermathecal pores paired in line with ventral chaetae, anterior to middle of X.

Male genitalia paired. Vas deferens long and irregularly coiled, 27–39 μm wide, entering atrium apically. Atrium somewhat oblong, straight or curved (Fig. 3 H), 140–200 μm long, maximally 66–125 μm wide. Prostate gland large, entering atrium medially. Ejaculatory duct 320–820 μm long, 45–70 μm wide. Penis conical, enclosed in copulatory sac; cuticularized penis sheath cylindrical and hooded, 97–109 μm long, minimally 47–58 μm wide, maximally 66–79 μm wide and 183–214 μm wide at hood (Fig. 3 I); spiral muscles appear to be absent. Spermathecal ducts spindle-shaped, 145–195 μm long, 80–160 μm wide, with vestibules; ampullae oblong, 440–730 μm long, 200–300 μm wide, with spermatozeugmata in lumina (Fig. 3 J).

*Remarks*: This species was initially identified as *Limnodrilus amblysetus* Brinkhurst et al., 1990, because of the bluntness of the teeth in some chaetae (Wang et al., 1999), but a careful examination later revealed distinct differences between the two taxa. In *L. paramblysetus* sp. nov., all chaetae are bifid, but in *L. amblysetus*, some simple-pointed chaetae are also present (Brinkhurst et al., 1990; Ohtaka & Nishino, 1999). Moreover, the penis sheaths of the former are hooded with a cylindrical shaft, whereas those of the latter are spade-shaped with a flared shaft. Referring to measurements of the penis sheaths, the new species has the shortest sheaths and the lowest length–width ratio in comparison with *L. amblysetus*, as well as with *L. grandisetosus* Nomura, 1932 and *L. silvani* Eisen, 1879 (Table 2). In the latter two species, the penis sheaths are also spade-shaped as in *L. amblysetus*.

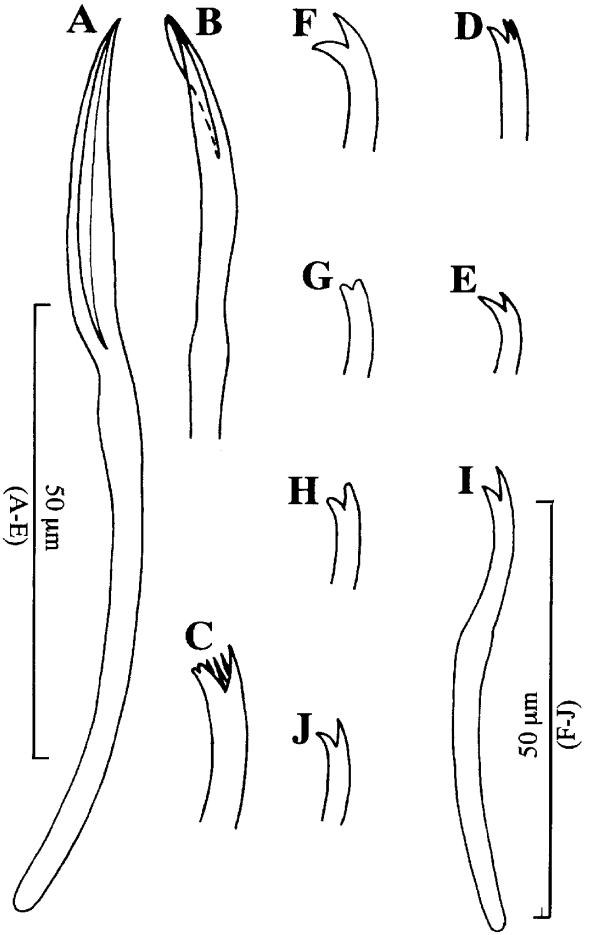


*Figure 4. Potamothrix bedoti*: (A, B) spermathecal chaetae (VIII), (C) dorsal bifid (XIII). *Aulodrilus pluriseta*: (D) dorsal bifid (VI), (E) ventral chaeta (XII). *Teneridrilus mastix*: (F–I) dorsal bifids (II, II, VII, XV, respectively), (J) ventral chaeta (XXIV).

*Distribution*: Known only from type locality in mid-lower Changjiang, China.

***Potamothrix bedoti*** (Piguet, 1913) (Fig. 4 A–C)

*Tubifex* (*Ilyodrilus*) *bedoti* Piguet, 1913: 124–126, Figure 4 c–e.

*Euilyodrilus bedoti* (Piguet). Timm, 1970: 65, Figure 12.

*Potamothrix bedoti* (Piguet). Timm, 1999: 98–99.

*Material examined*: 1 balsam mount from ST22.

*Brief description of new material*: Specimen partially mature, length 8 mm, segments 60. Prostomium slightly conical. Hairs 0–4 per bundle, without serration. Dorsal bifids 2–3 per bundle, 80–108 μm long, nodulus distal, usually with 2–3 intermediate teeth;

*Table 2.* Comparison of penis sheaths of *Limnodrilus paramblysetus* sp. nov. and some allied species. *L* – length; $W_{max}$ – maximum width in shaft; $W_{min}$ – minimum width. For the measurements, means and ranges (in parentheses) are given

| | *L. paramblysetus* sp. nov. | *L. amblysetus* Brinkhurst et al. | *L. grandisetosus* Nomura | *L. silvani* Eisen |
|---|---|---|---|---|
| *L* (μm) | 103(97–109) | 328(320–335) | 227(185–277) | 306(303–307) |
| $W_{max}$ (μm) | 72(66–79) | 180(170–190) | 114(88–158) | 69(66–72) |
| $W_{min}$ (μm) | 52(47–58) | 60(55–65) | 43(36–62) | 46(44–48) |
| $L/W_{max}$ | 1.4 | 1.8 | 2.1 | 4.5 |
| $L/W_{min}$ | 2.0 | 5.5 | 5.5 | 6.7 |
| $W_{max}/W_{min}$ | 1.4 | 3.0 | 2.7 | 1.5 |
| Reference | The present paper | Measured from Brinkhurst et al., 1990 | Ohtaka, 1985 | Ohtaka, 1985 |

upper teeth slightly longer than lower, and lower teeth thicker and truncated posteriorly, sometimes secondarily branched (Fig. 4 C). Ventral chaetae 2–5 per bundle, with nodulus distal and upper teeth as long as but thinner than lower. Two spermathecal chaetae modified in the right of VIII, one developed, the other developing (Fig. 4 A–B); those on the left side unmodified, 3 per bundle. Chromophilous masses in VIII–IX.

*Remarks*: The identification was mainly based upon spermathecal chaetae and its unusual position (Timm, 1970, 1999). Many specimens from Houhu Lake have similar chaetal morphology, and may be juveniles of *P. bedoti*. The abnormal position of the spermathecal chaetae and the presence of numerous immature worms probably indicate that the fragmentation is a prevalent means of reproduction of this species in Houhu. *P. bedoti* may be widespread in China, but easily overlooked owing to the rarity of maturation.

*Distribution*: Europe, North America and Asia (Changjiang Basin and northwards).

***Teneridrilus mastix*** (Brinkhurst, 1978) (Fig. 4 F–J)

*Ilyodrilus mastix* Brinkhurst, 1978: 2171–2173, Figure 3; Erséus & Qi, 1985: 193–194, Figure 1.

*Teneridrilus mastix* (Brinkhurst). Holmquist, 1985: 332–334, 336–341, 357–360, Figures 18, 21 D–E, 22E, 23 K–L, 24 P–R and 31A; Erséus et al., 1990: 840–841; Ohtaka & Nishino, 1999: 38–40, Figures 5–6.

*Material examined*: 5 balsam mounts and 3 glycerine mounts from ST16, ST8-12, ST14 and ST20.

*Brief description of new material*: Specimens partially mature, length 7.5–9.5 mm, segments 41–61. Prostomium reduced. Hairs short and bayonet-shaped, usually absent in the first two or three anterior segments and 1–3 per bundle in the following. Dorsal and ventral bifids usually with upper teeth longer than (Fig. 4 I), or as long as (Fig. 4 F, J), lower, but sometimes teeth short and blunt anteriorly (Fig. 4 G–H). Bifids in II, (1) 2 per bundle, somewhat stout or normal, with sharp or blunt teeth (Fig. 4 F–G); those in III (0) 2 (3) per bundle. From IV onwards, dorsal bifids 1–4 per bundle, ventral chaetae 2–5 per bundle. Eggs present. Ovaries one pair in XI. Male ducts undeveloped.

*Remarks*: This species is widespread in Zhujiang (Pearl) River and the lakes along Changjiang (Erséus & Qi, 1985; Liang, et al., 1995). The new material fits the recent revision of *T. mastix* by Ohtaka & Nishino (1999), but the blunt teeth of some anterior chaetae are reported for the first time in this species. In the material from Zhujiang, the bifid chaetae of segment II were stated to be stout with upper teeth shorter than lower (Erséus & Qi, 1985; Ohtaka & Nishino, 1999), but the corresponding chaetae of the present specimens are hardly thicker than those of other segments, and their teeth are either modified or unmodified.

*Distribution*: North America, Japan, China, Indonesia.

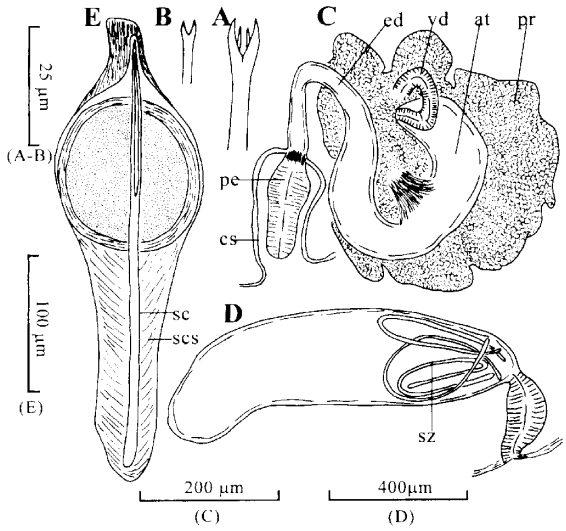


*Figure 5. Spirosperma nikolskyi.* (A, B) chaetae (anterior, posterior, respectively), (C) male duct, (D) spermatheca, (E) spermathecal chaeta. Abbreviations: sc – spermathecal chaeta; scs – sac of spermathecal chaeta; others as for Figure 3.

***Spirosperma nikolskyi*** (Lastockin, 1953) (Fig. 5)

*Peloscolex nikolskyi* Lastockin. Chekanovskaya, 1962: 353–354, Figure 180; Brinkhurst & Jamieson, 1971: 507–508, Figure 8.20 K–M; Liang, 1979: 277, Figure 2.

*Orientodrilus nikolskyi* (Lastockin). Holmquist, 1978: 189, 195, 197, 200–206, Figure 3, Figure 9 I; Holmquist, 1979: 49, Figure 15.

*Spirosperma nikolskyi* (Lastockin). Brinkhurst, 1981: 1058, Figure 3.

*Material examined*: 2 mature specimens in balsam mounts (dissected) and 5 immature specimens in glycerine mounts, all from ST15.

*Brief description of new material*: Length 30–45 mm, segments 85–115. Cuticular papillae numerous. Sensory papillae 2 rows per segment anteriorly, with one row along with chaetal bundle and the other between bundles; 3–4 rows per segment in middle part and 2 rows per segment posteriorly. Hairs not serrated, (3) 4 (6) per bundle anteriorly, 1–4 per bundle posteriorly. Dorsal bifids up to 5 per bundle anteriorly, prongs equal, with few intermediate teeth and without nodulus; 2–3 per bundle posteriorly, thinner and shorter than anterior dorsals, and usually without intermediate teeth and also without nodulus. Ventral chaetae with 1–2 simple-pointed chaetae and 1 bifid chata per bundle in II–IV, and with 1–2 bifids per bundle in following segments. Ventral bifids with upper teeth longer than and as thick as lower in II to about VII, and with upper teeth much shorter and thinner than lower in following segments. Spermathecal chaetae 1 per bundle, straight and simple-pointed, entirely enclosed in chaetal sacs. Vasa deferentia long, entering horse-shore shaped atria apically; prostate glands large, attached to median parts of atria; ejaculatory ducts distinct; penes cylindrical, with copulatory sacs. Spermathecae one pair in X, with long duct and long spermatozeugmata.

*Remarks*: Since Liang (1979) recorded this species from China for the first time, it has been found to be common in the Changjiang and Zhujiang Basins, but to be rarely mature. The present specimens coincide well with Liang's description except for some intraspecific variation. First, the ejaculatory ducts are longer than those described by Liang. Second, the spermathecal ducts were very short according to Liang, which could be due to the loss of the ectal parts in his dissection. Third, Liang counted two spermathecal chaetae per bundle, as opposed to one per bundle in the new material. Fourth, the glandular sacs of the spermathecal chaetae, which were previously reported only from the Japanese form (Brinkhurst, 1981), were not noted by Liang.

*Distribution*: Europe, North America and Asia (Zhujiang Basin and northwards).

***Aulodrilus pluriseta*** (Piguet, 1906) (Fig. 4 D–E)

*Aulodrilus pluriseta* (Piguet). Brinkhurst & Jamieson, 1971 (*partim*): 525–526, Figure 8.23 E; Kathman & Brinkhurst, 1998: 184–185; Timm, 1999: 90–91.

*Material examined:* 1 glycerine mount from ST14.

*Brief description of new material*: Specimen immature, length 10 mm, segments 60. Hairs 2–5 per bundle, bayonet-shaped. Dorsal bifids 2–7 per bundle, usually with upper teeth duplicated and shorter than, or as long as, lower (Fig. 4 D). Ventral chaetae 3–9 per bundle, with upper teeth about half as long as lower (Fig. 4 E).

*Remarks*: This species is common in China, but was formerly overlooked (Liang, 1979). In Chinese material, the upper teeth of dorsal bifids have been found to be variable, i.e. they are either bifurcate as mentioned above, or normal with similar shape and size as the lower teeth (Wang, 1995).

*Distribution*: Cosmopolitan (not recorded in South America).

## Discussion

Historically, all the lakes along Changjiang were connected to the mainstream of the river, and a complex potamo-lacustrine ecosystem was thus formed. However, during 1950–1970s, most of them were separated from the river trunk by damming. This has probably resulted in the loss of habitat and species diversity. As one of the two large lakes maintaining a connection with the mainstream, Poyang Lake has more natural conditions, and could be a shelter for species that have disappeared from other waters. Although the material of this study was largely from quantitative samples in the lake center, it is still shown by the occurrences of rare taxa, such as *Haplotaxis*, *Bratislavia* and *Limnodrilus paramblysetus* sp. nov., that Poyang Lake region is an invaluable pool of aquatic oligochaetes. Therefore, to increase our faunistic knowledge about Chinese oligochaetes, a continued scrutiny in Poyang Lake seems well justified.

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## References

Brinkhurst, R. O., 1978. Freshwater Oligochaeta in Canada. Can. J. Zool. 56: 2166–2175.

Brinkhurst, R. O., 1981. A contribution to the taxonomy of the Tubificinae (Oligochaeta: Tubificidae). Proc. biol. Soc. Wash. 94: 1048–1067.

Brinkhurst R. O. & B. G. M. Jamieson, 1971. The Aquatic Oligochaeta of the World. Oliver & Boyd, Edinburgh: 860 pp.

Brinkhurst, R. O. & M. R. Marchese, 1989. Guide to the freshwater aquatic Oligochaeta of South and Central America. Climax 6: 1–179.

Brinkhurst, R. O., S. Qi & Y. L. Liang, 1990. The aquatic Oligochaeta from the People's Republic of China. Can. J. Zool. 68: 901–916.

Chekanovskaya, O. V., 1962. Aquatic Oligochaeta of the USSR. Opred Faune SSSR 78(3): 1–513 (English translation 1981 by Amerind Publishing Co. Pvt. Ltd., New Delhi).

Erséus, C. & S. Qi, 1985. Two aberrant Tubificidae (Oligochaeta) from Pearl River in the People's Republic of China. Hydrobiologia 127: 193–196.

Erséus, C., J. K. Hiltunen, R. O. Brinkhurst & D. W. Schloesser, 1990. Redefinition of *Teneridrilus* Holmquist (Oligochaeta: Tubificidae), with description of two new species from North America. Proc. biol. Soc. Wash. 103: 839–846.

Harman, W. J., 1973. New species of Oligochaeta (Naididae) with additional distributional records from Oklahoma and Texas. Southwest. Nat. 18: 151–164.

Harman, W. J., 1974. The Naididae (Oligochaeta) of Surinam. Zool. Verhandl. 133: 1–36.

Harman, W. J. & M. S. Loden, 1978. *Bratislavia unidentata* (Oligochaeta: Naididae), a re-description. Southwest. Nat. 23: 541–544.

Holmquist, C., 1978. Revision of the Genus *Peloscolex* (Oligochaeta, Tubificidae). 1. Morphological and anatomical scrutiny, with discussion on the generic level. Zool. Scr. 7: 187–208.

Holmquist, C., 1979. Revision of the genus *Peloscolex* (Oligochaeta, Tubificidae) 2. Scrutiny of the species. Zool. Scr. 8: 37–60.

Holmquist, C., 1985. A revision of the genera *Tubifex* Lamarck, *Ilyodrilus* Eisen, and *Potamothrix* Vejdovsky & Mràzek (Oligochaeta, Tubificidae), with extensions to some connected genera. Zool. Jb. Syst. 112: 311–366.

Liang, Y. L., 1964. Studies on the aquatic Oligochaeta of China. II. On some species of Naididae from Sinkiang with description of a new species *Allodero prosetosa*. Acta Zool. Sin. 16: 643–652 (in Chinese with English abstract).

Liang, Y. L., 1979. Studies on the aquatic Oligochaeta of China. III. Aquatic Oligochaeta of the Huama Lake. Oceanol. Limnol. Sin. 10: 273–281 (in Chinese with English abstract).

Liang, Y. L., T. H. Wu & Z. C. Xie, 1995. On the current conditions of zoobenthos in Baoan Lake with an assessment of its potential fishery production capacity. In Liang, Y. L. & H. Q. Liu (eds), Resources, Environment and Fishery Ecological Management of Macrophytic Lake (No. 1). Science Press, Beijing: 178–192 (in Chinese with English abstract).

Kathman, R. D. & R. O. Brinkhurst, 1998. Guide to the freshwater oligochaetes of North America. Aquatic Resources Center, College Grove, Tennessee: 264 pp.

Nomura, E., 1932. *Limnodrilus grandisetosus* nov. sp., a freshwater oligochaete. Scient. Rep. Tohoku imp. Univ. (Ser. IV) 7: 511–527.

Ohtaka, A., 1985. Taxonomical revision of three Japanese *Limnodrilus* species (Oligochaeta). Proc. jap. Soc. Syst. Zool. 30: 18–35.

Ohtaka, A. & M. Nishino, 1999. Studies on the aquatic oligochaete fauna in Lake Biwa, central Japan. II. Records and taxonomic remarks of nine species. Hydrobiologia 406: 33–47.

Piguet, E., 1913. Notes sur les Oligochètes. Rev. suisse Zool. 21: 111–146.

Sperber, C., 1948. A taxonomical study of the Naididae. Zool. Bidr. Upps. 28: 1–296.

Timm, T., 1970. On the fauna of the Estonian Oligochaeta. Pedobiologia 10: 52–78.

Timm, T., 1999. A guide to the Estonian Annelida. Estonian Academy Publishers, Tallinn: 208 pp.

Wang, H. Z., 1995. Studies on taxonomy, distribution and ecology of microdrile oligochaetes of China, with descriptions of

two new species from the vicinities of the Great Wall Station of China, Antarctica. D.Sc. Thesis, Institute of Hydrobiology, Chinese Academy of Sciences, Wuhan, China: 184 pp (in Chinese with English summary).

Wang, H. Z., Z. C. Xie, X. P. Wu & Y. L. Liang, 1999. A preliminary study of zoobenthos in the Poyang Lake, the largest freshwater lake of China, and its adjoining reaches of Changjiang River. Acta Hydrobiol. Sin. 23 (supplement): 132–138.

Yamaguchi, H., 1940. Oligochaeta of Manchoukuo. In Kawamura, T. (ed.), Report of the Limnobiological Survey of Kwantung and Manchoukuo. Kwantung Kyoku: 382–394 (in Japanese).

Zhu, H. H. & B. Zhang, 1997. The Poyang Lake. Press of University of Science & Technology of China. Hefei: 349 pp (in Chinese).