



## Marine Phallodrilinae (Oligochaeta, Tubificidae) of Hainan Island in southern China

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### Abstract

Six species of Phallodrilinae are reported from Hainan Island in southern China. The mesopsammic *Akteredrilus yiboi* sp. nov. is new to science. It is characterized by a combination of (1) small, straight, conical, strongly cuticularized penis sheaths, (2) posterior prostate glands being associated with the most ectal parts of the atria, and (3) small spermathecal ampulla. *Bathydriulus ampliductus* Erséus, 1997 is recorded for the first time since it was originally described from Australia's Northern Territory.

### Introduction

To date, a total of 75 species of marine oligochaetes, representing 25 genera and 4 families, have been recorded from the coasts of mainland China, around Hong Kong (Erséus, 1984, 1990a, 1992a, 1997a; Erséus & Diaz, 1997) and Qingdao (Erséus et al., 1990). A few brackish-water species have also been reported from Taiwan (Erséus & Hsieh, 1997). A vast majority of all these taxa were described from Hong Kong, and although the sampling efforts were less extensive in Qingdao and Taiwan, this is probably a reflection of that marine oligochaetes are more species-rich in southern (i.e. tropical) China than in the north. At the same time, however, Hong Kong is one of the most populous metropolitan areas in the world, with heavily impacted marine habitats, which may only contain a part of all species occurring in the South China Sea. Therefore, a collecting trip to Hainan Island was made by the authors during March, 2000. Hainan is the second largest island in the country and situated 800–900 km southwest of Hong Kong. The sampling was concentrated on the oligochaete fauna of estuarine and other inshore habitats (including mangrove forests),

which proved to be suitable for tubificids belonging to the subfamilies Limnodriloidinae and Rhyacodrilinae. In this paper, however, we report on a few members of the subfamily Phallodrilinae collected at some intertidal and shallow subtidal sites near Sanya in southern Hainan. This includes one new species of *Akteredrilus* Knöllner, 1935 and the second species record of *Bathydriulus* Cook, 1970 for China. The limnodriloidines and rhyacodrilines will be described elsewhere (Wang & Erséus, in preparation).

### Materials and methods

Collected manually from intertidal and shallow subtidal sediments, the samples were repeatedly stirred with habitat water, and the organic suspensions decanted into a fine-mesh sieve (250–300 µm). Live, sexually mature oligochaetes were sorted under dissecting microscopes and then fixed in Bouin's fluid. After about 1 day in the fixative, they were transferred into 70% ethanol. The worms were later stained with paracarmine, cleared in xylene and mounted whole in Canada balsam. All measurements and drawings

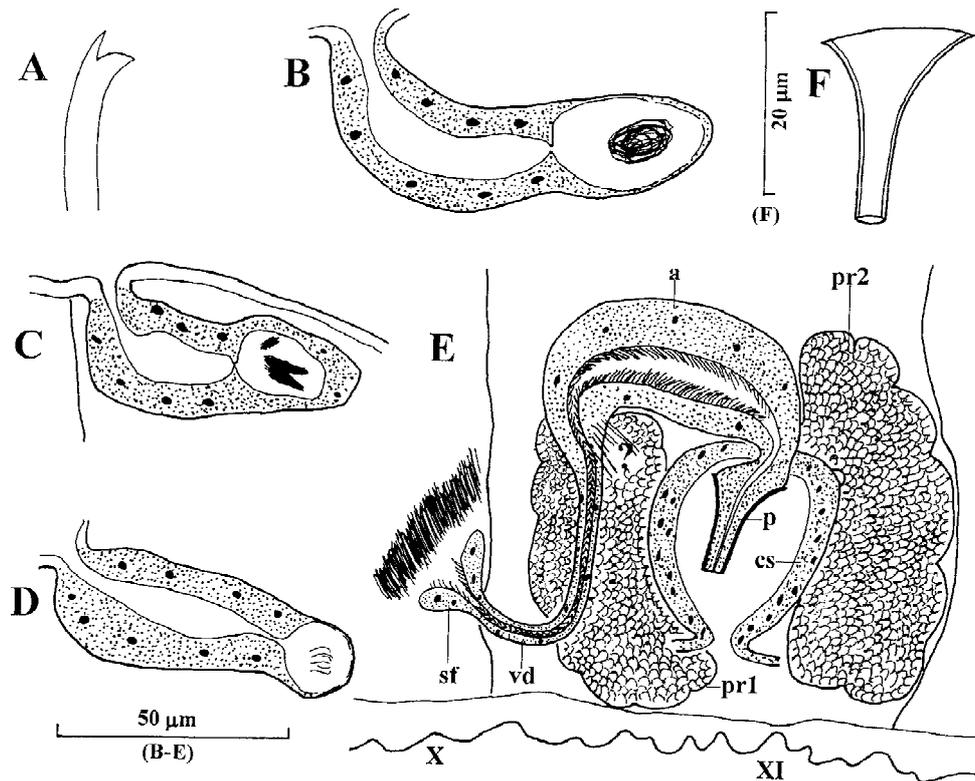


Figure 1. *Aktedrilus yiboi* sp. nov. (A) free-hand drawing of chaeta, (B–D) spermathecae of three different specimens, (E) male duct, (F) penis sheath. Abbreviations: a – atrium; cs – copulatory sac; p – penis; pr1 – anterior prostate; pr2 – posterior prostate; sf – sperm funnel; vd – vas deferens; ? – probable entrance of pr1 into atrium.

in this paper refer to these fixed, whole-mounted and slightly compressed specimens. Holotype, some paratypes and other reference specimens are deposited in the Institute of Hydrobiology (IHB), Chinese Academy of Sciences (CAS), in Wuhan, China; the remaining material is lodged in the Swedish Museum of Natural History (SMNH), in Stockholm.

### Systematic account

#### *Aktedrilus yiboi* sp. nov. (Fig. 1)

*Holotype*: IHB HANA2000016a, whole-mounted specimen.

*Type locality*: China, southern Hainan, lower end of estuary of a stream, SE of Teng Qiao Town (NE of Sanya City), 18° 23.13' N, 109° 45.67' E, lower intertidal, medium to coarse sand, 18 March 2000 (Station SY00-9A).

*Paratypes*: IHB HANA2000016b-h, 7 specimens, and SMNH Type Coll. 5344-5350, 7 specimens, all from type locality.

*Etymology*: This species is named for the late Prof. Yibo Cui, former head of Department of Freshwater Ecology, Institute of Hydrobiology, CAS, Wuhan. He was a great man who devoted his young life to science and is now truly missed.

*Description*: Four complete specimens 2.3–2.6 mm long (holotype: 2.6 mm), 32–39 segments (holotype: 34). Diameter at XI 0.1–0.2 mm. Prostomium obtusely conical, about as long as wide. Secondary annuli present in pre-clitellar segments. Epidermal adhesive glands not observed. Clitellum more or less developed over 3/4X–XII. Chaetae bifid, with upper teeth thinner and shorter than lower (Fig. 1A). Bifids 29–34  $\mu\text{m}$  long, 1.4–1.9  $\mu\text{m}$  thick; (0) 3–5 per bundle anteriorly, (1) 2–4 per bundle in post-clitellar segments. Ventral chaetae absent in XI. Male pores paired in ventral chaetal lines in mid-XI. Spermathecal pore mid-dorsal, anteriorly in X.

Pharyngeal glands in IV–VI. Chloragogen cells from V onwards. Male genitalia (Fig. 1E) paired. Vas deferens slightly shorter than atrium, about 50  $\mu\text{m}$  long, 5  $\mu\text{m}$  wide, entering atrium apically. Atrium

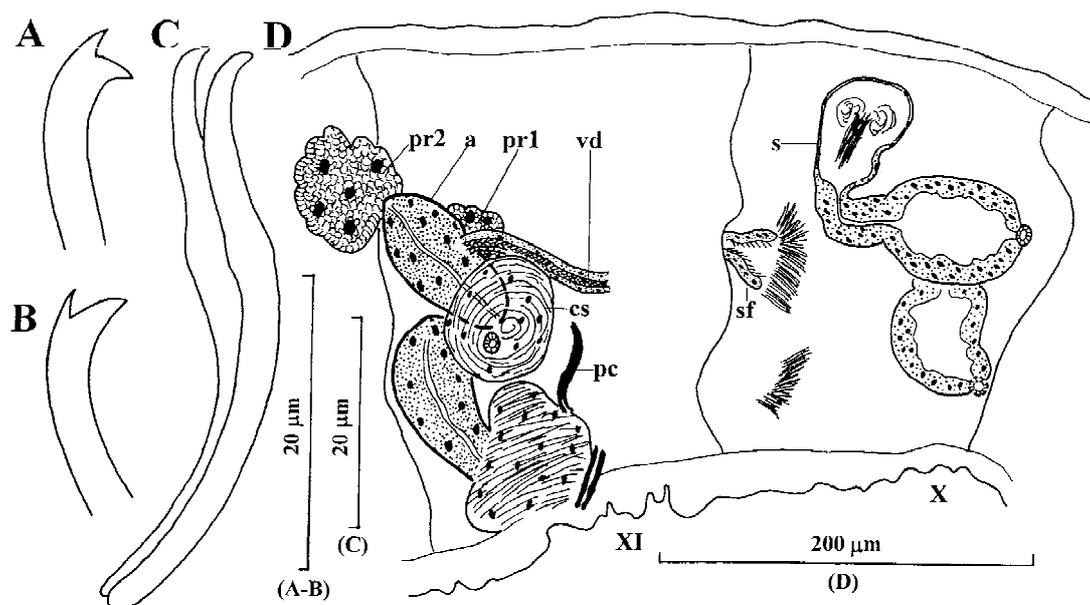


Figure 2. *Bathydrilus ampliductus*. (A, B) somatic chaetae showing variation in teeth morphology, (C) penial chaetae, (D) somewhat lateral view of genitalia in segments X–XI. Abbreviations: pc – penial chaetae; s – spermatheca; others as for Fig. 1.

somewhat spindle-shaped, 55–70  $\mu\text{m}$  long, maximally 25  $\mu\text{m}$  wide, with thin outer muscular layer and thick inner ciliated epithelium. Atrium terminating into straight, funnel-shaped, strongly cuticular penis, 19–24  $\mu\text{m}$  long, basally 9.5–14.5  $\mu\text{m}$  wide, ectally 3.0–4.8  $\mu\text{m}$  wide (Fig. 1E, F). Penis enclosed in copulatory sac, 50–60  $\mu\text{m}$  long, maximally 34–38  $\mu\text{m}$  wide. Anterior prostate gland surrounding vas deferens and probably entering most ental part of atrium, posterior prostate attached to junction between atrium and copulatory sac (Fig. 1E). Sperm sac well developed, generally extending through 4–5 segments in IX–XIII. Egg sac extending through 1–2 segments, usually in XIII–XIV. Spermathecal duct 29–53  $\mu\text{m}$  long, 17–28  $\mu\text{m}$  wide; ampulla small, spherical to oval, 12–36  $\mu\text{m}$  long, maximally 17–19  $\mu\text{m}$  wide, with thin or thick walls (Fig. 1B–D). Spermatozoa scattered, or bundled, or in compact mass, in spermathecal ampulla.

**Remarks:** The small, straight, conical, strongly cuticularized penis sheaths of this new species resemble those of *Akteredilus argatxae* Giani & Rodriguez (1988) known from spring habitats in northern Spain, and which is the only known freshwater member of this genus (Giani & Rodriguez, 1988). In *A. argatxae*, however, the spermatheca has a much larger ampulla and a shorter duct than in *A. yiboi* sp. nov., and the posterior prostate glands are associated with the copu-

latory sacs, i.e. not with the most ectal parts of the atria as in *A. yiboi*. With regard to atria, prostate arrangement and spermathecae, it therefore seems likely that *A. yiboi* is more closely related to *Akteredilus floridensis* Erséus (1980), originally described from Florida, U.S.A., and Barbados in the Caribbean (Erséus, 1980), but subsequently recorded also from Hong Kong (Erséus, 1997a). The new species, however, differs from *A. floridensis* in its smaller, less curved and more tapered penis sheaths.

**Distribution and habitat:** Known only from the type locality in Hainan (southern China). Lower intertidal sand.

#### ***Akteredilus parvithecatus* (Erséus, 1978)**

*Bacescuella parvithecata* Erséus, 1978: 264–265, Fig. 2, Ta. 1; Erséus, 1980: 106–107, Fig. 10B.

*Bacescuella pilicrepus* Erséus, 1984: 153–154.

*Akteredilus parvithecatus*: Erséus, 1987: 117–119, Fig. 6; Erséus, 1990a: 281.

**Material examined:** IHB HANA2000016i-j, 2 specimens, and SMNH Main Coll. 38552, 1 specimen, all from Wuzhi Island, an islet about 20 km E of Sanya City, rocky beach immediately E of sandy beach on northern side of islet, 18° 18.97' N, 109° 45.85' E, high intertidal, heterogeneous sand under boulders, 19 March 2000 (Station SY00-12).

**Remarks:** The new specimens conform well with the

descriptions of, in particular, original and Saudi Arabian material (Erséus, 1978, 1987). The penial sacs of the Hainan material are deeper than the corresponding organs in the Hong Kong form of *A. parvithecatus*, first regarded as a separate species, *Bacescuella pili-crepus* (see Erséus, 1984, 1990a), but this falls within the variation noted by Erséus (1987).

*Distribution and habitat*: Circumtropical: Southern China [Hainan (new record), Hong Kong,], Pacific coast of Mexico, Galapagos Islands, Caribbean area (including Bermuda), Atlantic coast of France, and Saudi Arabia. Intertidal and barely subtidal sand.

***Jamiesoniella athecata* Erséus, 1981**

*Jamiesoniella athecata* Erséus, 1981: 28–29, Figs 27–29; Erséus, 1990b: 265–266, Fig. 17; Erséus, 1992a: 168–169, Fig. 7.

*Material examined*: IHB HANA2000016k-1, 2 specimens, and SMNH Main Coll. 38553–38554, 2 specimens, all from Station SY00-12 (for details, see *A. parvithecatus* above).

*Remarks*: The new specimens conform with the previous descriptions, with the exception that the clitellum of the Hainanese worms extends over X–XII instead of 1/2X–XII that characterized material from other localities, including Hong Kong.

*Distribution and habitat*: Southern China [Hainan (new record), Hong Kong], Northern Territory and Queensland (Australia), and Belize. Intertidal, largely coarse sand.

***Jamiesoniella enigmatica* Erséus, 1990**

*Jamiesoniella enigmatica* Erséus, 1990a: 283–285, Fig. 9.

*Material examined*: IHB HANA2000016 m-ad, 18 specimens, and SMNH Main Coll. 38555–38572, 18 specimens, all from Station SY00-12 (for details, see *A. parvithecatus* above).

*Brief description of new material*: Ten complete specimens 1.9–2.9 mm long, 27–34 segments. Width at XI 0.1–0.2 mm. Clitellum over 3/4X–XII. Chaetae (2) 3–4 (6) per bundle anteriorly, (2) 3–4 (5) per bundle in post-clitellar segments. Ventral chaetae occasionally present on XI. Pharyngeal glands in IV–VI. Male ducts rudimentary, with visible sperm funnel. Small sperm masses (in sperm sac?) present, in X. Egg sac extending through 2–3 segments in XI–XIII. Spermathecae absent.

*Remarks*: This species was previously known only from Hong Kong, in a habitat similar to that of the present material (Erséus, 1990a). The new and the

old specimens are almost identical. The sperm funnels were not observed in any material from Hong Kong, but they are visible in a number of the present individuals.

*Distribution and habitat*: Known only from southern China [Hainan (new record), Hong Kong]. Intertidal sand and gravel.

***Pectinodrilus molestus* (Erséus, 1988)**

*Phallodrilus molestus* Erséus, 1988: 787–789, Figs 1B–D and 2D–F; Erséus, 1990b: 261.

*Pectinodrilus molestus* Erséus, 1992b: 36; Erséus, 1992a: 162–163, Fig. 3.

*Material examined*: IHB HANA2000006a, specimen from E end of bay near Teng Hai, E of Sanya City, 18° 16.29' N, 109° 43.66' E, lower intertidal, coarse sand, partly under boulders, 16 March 2000 (Station SY00-5A).

*Remarks*: This precopulatory specimen is 3.2 mm long, with 37 segments. The subdental ligaments stated to be present on the chaetae of the Hong Kong material (Erséus, 1992a), as well as on those of other localities (Erséus, 1988), are inconspicuous in the new worm. Otherwise, the Hainanese form fits previous descriptions.

*Distribution and habitat*: Southern China [Hainan (new record), Hong Kong], Northern Territory and Queensland (Australia), Fiji, Hawaii, Florida, Belize, Bermuda, Barbados. Intertidal and subtidal sands, to at least 70 m depth.

***Bathydriilus ampliductus* Erséus, 1997 (Fig. 2)**

*Bathydriilus ampliductus* Erséus, 1997b: 116–117, Fig. 8.

*Material examined*: IHB HANA2000012c, specimen from the West Coral Islet (Ximaozhou) (W of Sanya City), reef flat at NW side of island close to tourist resort, 18° 14.56' N, 109° 21.97' E, barely subtidal, poorly oxygenated coarse sand with smell of H<sub>2</sub>S, 17 March 2000 (Station SY00-8A).

*Description of new material*: Specimen incomplete, more than 7 mm long and with more than 53 segments. Width at XI 0.3 mm. Prostomium equilaterally triangular. Clitellum over X–1/3XIII, with thickest part in XII. Somatic chaetae bifid, with upper teeth thinner and shorter than lower; these chaetae 41–48 μm long, 1.9–2.4 μm thick, 2–3 (4) per bundle anteriorly, 2 per bundle in post-clitellar segments (Fig. 2A, B). Penial chaetae sigmoid, nodulated and simple-pointed, about 50 μm long, 2.5 μm thick at middle, 2 per bundle (Fig. 2C). Male pores paired in line with ventral chaetae

in posterior part of XI. Spermathecal pores paired in lateral lines in most anterior part of X.

Pharyngeal glands in IV–VIII. Male genitalia (Fig. 2D) paired. Vas deferens about 10  $\mu\text{m}$  wide, and appears to be longer than atrium, entering latter somewhat ectal to middle. Atrium somewhat spindle-shaped, about 90  $\mu\text{m}$  long, maximally 45  $\mu\text{m}$  wide, with conspicuous outer muscular layer and thick inner epithelium, but internal ciliation inconspicuous. Anterior prostate gland dorsal to and near entrance of vas deferens into atrium, posterior one attached to apex of atrium. Copulatory sac much folded, with conspicuous musculature, but details unclear. Sperm sac in X. Egg sac extending through XI–XIII. Spermathecal ducts totally about 95  $\mu\text{m}$  long, bipartite, with 30  $\mu\text{m}$  wide tubular, ental, parts and 58  $\mu\text{m}$  wide oval, ectal, vestibules; ampullae somewhat pear-shaped, about 70  $\mu\text{m}$  long, 35–40  $\mu\text{m}$  wide, with loose sperm bundles in lumina (Fig. 2D).

**Remarks:** This species was originally described from northern Australia on the basis of only two specimens (Erséus, 1997b). The new individual conforms with them in most aspects, including measurements. In the Hainanese form, however, the upper teeth of the chaetae are more reduced, the penial chaetae are more sigmoid, and the atria are smaller (only 90  $\mu\text{m}$  long as opposed to 140  $\mu\text{m}$  for the holotype).

**Distribution and habitat:** Southern China (new record), Northern Territory (Australia). Intertidal coarse sediment.

## Discussion

It is not surprising that four of the six species reported here were previously known from Hong Kong, considering that Erséus (1984, 1990a, 1992a, 1997a) spent a total time of about 2 months in the latter area, collecting in various habitats at over 200 sites. It is more noteworthy that the other 2 phallo-drilines (*Akteredrilus yiboi* and *Bathydrilus ampliductus*) were not found in Hong Kong, where totally 21 species representing 8 genera of Phallo-drilinae were recorded. This demonstrates how little we still know about the oligochaetes of the South China Sea despite a massive effort in one selected area. Considering the tropical location and more pristine conditions in Hainan, a continued scrutiny around this island will probably yield a substantial number of additional taxa of Phallo-drilinae, the most

diverse of all marine groups of Tubificidae (see Erséus, 1992b), as well as of the other subfamilies.

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