New earthworms belonging to the genus of *Amynthas* Kinberg (Megascolecidae: Oligochaeta) and *Drawida* Michaelsen (Moniligastridae: Oligochaeta) from Guangdong, China

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Abstract
This paper describes three new species of earthworm from Guangdong, China: *Amynthas heshanensis* sp. nov., *Amynthas jiangmenensis* sp. nov., and *Drawida cheni* sp. nov. The former two species both have two pairs of spermathecal pores in 6/7–7/8, and simple paired caeca in XXV. Four similar *Amynthas* species are reviewed. *Drawida cheni* sp. nov. has similar characters in external appearance (large body size, no dorsal pore, and no clitellum) with *Drawida sulcata* Zhong, 1986 from Yunnan, China. The species is distinguished from other *Drawida* species by the five gizzards, which are otherwise only found in *D. syringa* Chen, 1933, the smooth body without setae, the superficial male pores, and the female pores in 12/13.

Keywords: *Amynthas*, China, *Drawida*, earthworms, Guangdong, new species, Oligochaeta

Introduction
Spermathecae number and structure are usually species-specific, and have been commonly used as one of the diagnostic characters in the systematics of earthworms (Tsai et al. 2002). Although at least 12 nominal *Amynthas* species which possess two spermathecal pores in 6/7–7/8 have been reported from the Korean peninsula (Hong and James 2001; Hong and Lee 2001; Hong et al. 2001), there are only four such *Amynthas* earthworm species found in China. They are *Amynthas biconcavus* (Quan and Zhong 1989), *Amynthas zhongi* (Qiu et al. 1991), *Amynthas quadrapulvinatus* (Wu and Sun 1997), and *Amynthas acidophila* (Chen 1946). Here we describe two new *Amynthas* species from Guangdong, China.
As for the genus *Drawida* Michaelsen, about 16 nominal earthworm species have been recorded in China. They are *D. gisti* Michaelsen, 1931, *D. gisti nanchanginna* Chen, 1933, *D. gisti anchingiana* Chen, 1933, *D. linhaiensis* Chen, 1933, *D. sinica* Chen, 1933, *D. syringa* Chen, 1933, *D. glabella* Chen, 1938, *D. omeisna* Chen, 1946, *D. sulcata* Zhong, 1986, *D. changbaishanensis* Wu and Sun, 1996, *D. koreana* Kobayashi, 1938, *D. jeholensis* Kobayashi, 1940, *D. nemora* Kobayashi, 1940, *D. japonica* Michaelsen, 1892, *D. japonicus f. siemsseni* Michaelsen, 1910, and *D. grahami* Gates, 1935. However, no species of this genus has been reported from the mainland of Guangdong, except for Hainan Island (in the territory of Guangdong until 1988). For the sake of examining the correlation between earthworm community and vegetation succession, we conducted a survey in the Hilly Land Interdisciplinary Experimental Station of the Chinese Academy of Sciences (22°41′N, 112°54′E) where different pure or mixed tree plantations grow, and Mt. Dinghu (23°09′21″–23°11′30″N, 112°30′39″–112°33′41″E), which has been regarded as an oasis at the Tropic of Cancer in the mid-part of Guangdong Province, with an area of 11.33 km², and elevation ranging from nearly 100 to 700 m.

Earthworms were collected with 0.4% formalin solution, and preserved in 10% formalin solution. All materials were deposited in the Laboratory of Environmental Biology, School of Agriculture and Biology, Shanghai Jiaotong University, China.

*Amynthas heshanensis* sp. nov.  
(Figure 1)

**Type material**

Holotype: a mature specimen (dissected) collected 4 May 2004 from Heshan station (22°41′N, 112°54′E), Guangdong Province, China, coll. Weixin Zhang (coll. no. 2004-003GDHS). Paratype: a mature specimen (coll. no. 2004-013GDHS) collected 4 May 2004 (same collection site as for holotype).

**Other material**

Two immature specimens collected 4 May 2004, same collection as holotype.
**External characters**

Preserved specimens greyish on dorsum, whitish on ventrum. Dimensions 110 mm by 2–2.5 mm at clitellum, segments number 94–108. Annulets conspicuous in segments V–XIII. Prostomium proepilobous. First dorsal pore in 11/12. Setae minute, slightly long, 30 at III, 39–42 at V, 42–51 at VIII, 48–54 at XX, 39–60 at XXV; 13 between male pores, setal formula: $aa=1.1–1.5~ab, zz=1.2~zy$. Clitellum annular, pinkish colour, in XIV–XVI, setae visible externally.

Spermathecal pore: two pairs in 6/7–7/8, ventral, inconspicuous externally. Genital markings not present.

Male pore: one pair in XVIII, 0.4 body circumference ventrally apart from each other, each on the top of a capsule-like porophore surrounded by several circular folds. Genital papillae not present (Figure 1A).

**Internal characters**

Septa 6/7–7/8, 10/11–11/12 comparatively thickened, 8/9–9/10 absent. Gizzard short pachyrhizus-shaped, moderately developed, in VIII–X. Intestine enlarged distinctly from XV. Intestinal caecae paired in XXV, simple, smooth, extending anteriorly to XXII. Oesophageal hearts in X–XIII, whitish.

Spermathecae two pairs in VII–VIII, ampulla oval-shaped, about 2 mm long. The duct is so short as to be inconspicuous. Diverticulum curved, a little longer than the ampulla plus duct, terminal one-quarter dilated into a long chamber (Figure 1B). No accessory glands observed.

Holandry: testis sac two pairs, small, in X–XI, separated from each other. Seminal vesicles paired in XI–XII, well developed, with large conspicuous dorsal lobes. Prostate glands developed, extending from XVII to XXII. Prostatic duct slender, slightly curved at the distal part. No accessory glands present.

**Locality and habitat**

The specimens were collected from vegetable plots near the orchard (elevation 40 m) of Heshan station, one of the core stations of the Chinese Ecological Research Network (CERN) of the Chinese Academy of Sciences, which is located in Heshan County, Guangdong Province, China.

**Remarks**

*Amynthas heshanensis* is somewhat similar to *Amynthas zhongi* (Qiu et al. 1991), *Amynthas sanchongensis* (Hong and James 2001), *Amynthas paiki* (Hong et al. 2001), and *Amynthas taebaekensis* (Hong and James 2001). However, it is easy to distinguish *Amynthas heshanensis* from *A. zhongi* by the larger body size, the much shorter spermathecal duct, and the XXV originating caecae, from *Amynthas sanchongensis, Amynthas paiki, and Amynthas taebaekensis* by the simple structure of male pores, the absent genital markings and papillae, and the simple XXV originating caecae. *Amynthas sanchongensis* has a distinct lateral crescentic groove on the apex of the porophore. *Amynthas paiki* has two pre-setal pairs of genital papillae in XVIII, pre-setal paired sets of two genital markings in segments VII
Amynthas taebaekensis has only one pair of post-setal genital papillae in XVIII.

*Amynthas jiangmenensis* sp. nov.

(Figure 2)

**Type material**

Holotype: a mature specimen (dissected) collected 3 May 2004 from Heshan station (112°54' E, 22°41' N), Guangdong Province, China, coll. Weixin Zhang (coll. no. 2004-005GDHS).

**External characters**

Preserved specimens greyish brown on dorsum, whitish on ventrum, whitish setae line is conspicuous. Dimensions 65 mm by 1.7 mm at clitellum, segments number 110. Annulets inconspicuous. Prostomium proepilobous. First dorsal pore in 11/12. Setae slightly long, thick and comparatively sparse at III–VIII, 27 at III, 33 at V, 48 at VIII, 42 at XX, 39 at XXV; nine between male pores, and 16 between spermathecal pores (VII). Setae formula: aa=1.6 ab, zz=1.5 zy. Clitellum annular, pinkish colour, in XIV–XVI, setae invisible externally.

Spermathecal pore: two pairs in 6/7–7/8, ventral, inconspicuous externally. Genital markings not present.

Male pore: one pair in XVIII, on the centre of a slightly raised, transverse, ellipse-like porophore, 0.3 body circumference apart from each other, surrounded by several circular folds. Genital papillae not present (Figure 2A).

**Internal characters**

Septa 5/6–7/8, 10/11–11/12 comparatively thickened, 8/9–9/10 absent. Gizzard short pot-shaped, moderately developed, in VIII–X. Intestine enlarged distinctly at segment XIV. Intestinal caecae paired in XXV, simple, smooth, with some indentations on one edge, extending anteriorly to XXII. Oesophageal hearts in X–XIII.

Figure 2. External views (ventral) showing male pores (A) and spermathecae (B) of *Amynthas jiangmenensis* sp. nov. mp, male pores.
Spermathecae two pairs in VII–VIII, ampulla long, narrow oval-shaped, whitish, about 1.5 mm long, not marked off from the duct. The duct is slender, about 0.6 mm long. Diverticulum is as long as the duct, with an enlarged chamber. No accessory glands are present (Figure 2B).

Holandry: testis sac two pairs, small, in X–XI, separated from each other. Seminal vesicles paired in XI–XII, small. Prostate gland well developed, the duct much thickened, enlarged at mid-length. No accessory glands present.

Locality and habitat

The holotype was collected at an abandoned nursery near the orchard (elevation 40 m) in Heshan station (112°54′E, 22°41′N), one of the core stations of the Chinese Ecological Research Network (CERN) of the Chinese Academy of Sciences, which is located in Heshan County, Guangdong Province, China.

Remarks

*Amynthas jiangmenensis* is closely related to *Amynthas heshanensis* sp. nov. However, they differ markedly in the structures of the male porophore and spermathecae. In addition, seminal vesicles of *A. jiangmenensis* were smaller than those of *A. heshanensis* sp. n.

*Drawida cheni* sp. nov.

(Figure 3)

Type material

Holotype: a mature specimen (dissected) collected 24 June 2004 from the ravine rain forest (elevation 290 m) in Mt. Dinghu, Guangdong, China, coll. Weixin Zhang (coll. no. 2004-007GDDH). Paratype: a mature specimen (coll. no. 2003-017GDDH) collected 27

![Diagram](image-url)

Figure 3. External views (ventral) showing spermathecal pores, male pores and female pores (A) and spermathecae (B) of *Drawida cheni* sp. nov. fp, female pores; mp, male pores; sep, septum; sp, spermathecal pores.
November 2003, and an immature specimen (coll. no. 2004-027GDDH) collected 7 September 2004 (same collection site as for holotype).

**External characters**

Body large, smooth, with yellowish pigment, slightly sharp at head end and blunt at the caudal part. Dimensions 110–185 mm by 9–11 mm at segment X, segments number 165–174. Annules are conspicuous in IV–XXIX segments. Prostomium prolobous. Clitellum not observed. Dorsal pores absent, and setae are also invisible externally.

Spermathecal pore: one pair in 7/8 intersegmental furrow, ventral, 0.4 body circumference apart from each other, each on the centre of a longitudinally orientated, flat elliptical whitish glandular membrane patch. Genital markings not present.

Male pore: one pair in 10/11 intersegmental furrow, 0.4 body circumference ventrally apart from each other, slightly swollen, each on the centre of a large, longitudinally orientated, flat elliptical whitish glandular membrane patch. Genital papillae not present.

Female pore: one pair in 12/13, 0.4 body circumference ventrally apart from each other. Segment XII is distinctly short (Figure 3A).

**Internal characters**

Septa 5/6–8/9 greatly thickened, muscular. Gizzards five in XII–XXII segments (in XII–XIV, XV–XVI, XVII–XVIII, XIX–XX, and XXI–XXII, respectively), same size, shining on the surface with whitish vertical fibres. Intestine enlarged distinctly at segments XXIV–XXVI, just behind the last gizzard. Oesophageal hearts greatly thickened, black in VI–IX. Meganephridia present, beginning at least from VI, about 20–30 mm long, pairs in each segment close to the anterior septum. There are a few brownish black dots on the surface of segments anterior to VII.

Testis sac: one pair, about 6 mm long, 3.5 mm wide, yellowish, each suspended in middle part of septum 9/10. Ovarian chambers are in XI–XII, about 3.5 mm, vertical long pouch-shaped or palm-like.

Spermathecae one pair in VIII, ampulla oval-shaped, yellowish, about 2.5 mm long, 1.2 mm wide, narrowly attached to the surface of septum 7/8 with a short connective tissue; from its lower side a duct arising, gradually narrowing and making a number of great coils from its median part, about 23 mm in total length, spermathecal atrium inconspicuous or absent (not certain). No accessory glands are present (Figure 3B).

**Remarks**

In appearance *Drawida cheni* sp. nov. is somewhat similar to *Drawida sulcata* Zhong, 1986 from Yunnan, China. They share similar characters of external appearance, large body size, absent dorsal pore, absent clitellum, oval-shaped testis sac and ampulla, and convoluted duct. However, the new species is distinguished from *D. sulcata* and other species by the five gizzards which otherwise can only be found in *D. syringa* Chen, 1933, the absent genital papillae, inconspicuous thumb-shaped spermathecal atrium, as in *Drawida nemorus* Kobayashi, 1936 whose spermathecal duct also terminates without any trace of atrial dilatation. Furthermore, *Drawida cheni* sp. nov is characterised by the smooth body without setae, the intestine origin immediately behind the last gizzard, the female pore in 12/13, and the superficial male pore covered by a glandular membrane patch, with no atrium or penis present.
The name *cheni* is given after Prof. Chen Y., who made great contributions to the earthworm systematics of China.

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