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Three New Earthworms of the Genus *Amynthas* (Clitellata: Megascolecidae) from Nam Ha NPA, Laos

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ABSTRACT

Three new species of *Amynthas* (Clitellata: Megascolecidae) were discovered in the Nam Ha National Protected Area (NPA) of Laos. These are *Amynthas namhaensis* sp. nov., *Amynthas vanhi* sp. nov., and *Amynthas angtanensis* sp. nov. *Amynthas namhaensis* sp. nov. and *Amynthas vanhi* sp. nov. are athecal, with male pores 0.14−0.17 and 0.17−0.19 circumference apart ventrally, respectively. *Amynthas angtanensis* sp. nov. has four pairs of spermathecal pores on 4/5−7/8, with male pores very closely set at 0.07−0.1 circumference apart. Descriptions of the new species are provided, including illustrations of the ventral view, intestinal caeca, and spermathecae.

Keywords: earthworms, *Amynthas*, Megascolecidae, Clitellata, Nam Ha NPA, Laos, new species, taxonomy

INTRODUCTION

Southeast Asia is particularly interesting because the dominant elements of the East Asian earthworm fauna are Australasian in origin (Sims and Easton, 1972). Southeast Asia is the most likely avenue for the colonization of East Asia by earthworms of the *Pheretima* complex, which includes *Amynthas*.

The earthworm fauna of Laos is little-studied. Previous study of the earthworms of Laos can be found in Thai and Samphon (1988, 1989, 1990a, 1990b, 1991a, 1991b), Hong (2008), Hong et al. (2008), and Hong (2010).

This paper reports species of *Amynthas* discovered in the core of the Nam Ha National Protected Area (NPA) in the Laung Namtha Province of northern Laos. The core is designated an Important Bird Area (IBA), which consists of a mountainous ridge, between 1,000 and 2,094 m elevation, which runs south-west from the international border with China. The natural vegetation of the IBA is dry evergreen forest with the upper forest at higher elevations. Large areas of forest have, however, been cleared for shifting cultivation. Nam Ha NPA is an important biological resource, and is also an essential resource to the local people who live in and near the area.

In this paper, three species that are new to science are reported from Nam Ha, northern Laos: *Amynthas namhaensis* sp. nov., *Amynthas vanhi* sp. nov., and *Amynthas angtanensis* sp. nov.

MATERIALS AND METHODS

The specimens were found in soils and litter layers in forests. Illustrations are of anatomical views containing important characters, prepared with a camera lucida. Descriptions are based on the external examination and dorsal dissection under the microscope. Measurements are in millimeters. The holotype and paratypes are deposited in the Biology Department, Faculty of Science, National University of Laos, Vientiane (BDNUL).

SYSTEMATIC ACCOUNTS

Order Haplotaxida Grube, 1850
Family Megascolecidae Rosa, 1891

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Genus *Amynthas* Kinberg, 1867

***Amynthas namhaensis* Hong and James sp. nov. (Fig. 1)**

Material examined. Holotype: clitellate (BDNUL 0023): Laos, Laung Namtha Province, Nam Ha NPA, Keua Lome Mountain (21°08.161′N, 101°17.025′E), 1,177 m, soil and litter layers, good forest condition with grass understorey, sandy soil, 6 Sep 2006, K. Inkhavilay, Vanh, and Tear colls. Paratypes: 2 clitellates (BDNUL 0026, BDNUL 0027); same data as for holotype. Non-type material: 3 clitellates, 1 aclitellate, same data as for holotype.

Diagnosis. Spermathecal pores absent; male porophores transverse oval pads meeting mid-ventrally in elevated area 2.2–2.4 mm, surrounded by outer rings; pores 0.14–0.17 circumference apart ventrally, intestinal caeca simple, genital markings lacking.

Description. Unpigmented. Dimensions 70–80 mm, by 3.2–3.5 mm at segment X, 3.1–3.7 mm at segment XXX, 2.9–3.0 mm at clitellum; segments 75–100. Setae slightly more crowded ventrally, numbering 43–47 at VII, 43–53 at XX, 0 between male pores, setal formula AA:AB:ZZ:YZ =2:1:3:2 at XIII. Female pore single in XIV, on 0.3–0.5 mm oval porophore. Prostomium epilobic with tongue open, clitellum coffee color, formalin preservation. First dorsal pores at 10/11. Clitellum annular XIV-XVI; setae invisible externally.

Male field bound by transverse rectangular-oval furrow spanning 20 intersetal intervals between 17/18 and 18/19; grooves within paired circular pads almost meeting mid-ventrally; pores 0.14–0.17 circumference apart ventrally. No spermathecal pores. Genital markings absent.

Septa 5/6–7/8 thick, 8/9 thin, 9/10 absent, 10/11–12/13 thin. Gizzard globular in VIII. Intestine begins in XV, lymph glands not found. Typhlosole medium sized found from XXVI. Intestinal caeca simple, originating in XXVII, and extending anteriorly about to XXV, small and flattened oval sac. Esophageal hearts four pairs in X–XIII. Male sexual system holandric, testes and funnels in ventrally joined sacs in X–XI. Seminal vesicles small, two pairs in XI–XII. Prostates confined to XVIII; one or both glands absent in some specimens; prostate ducts muscular, vasa deferentia terminate in XVIII. Genital papilla glands absent.

Ovaries in XIII. Spermathecae absent. Genital marking glands not found.

Etymology. The species is named for its type locality, Nam Ha NPA.

Distribution. Laos.

Remarks. *Amynthas namhaensis* sp. nov. has no spermathecal pores, rendering it difficult to compare to other species in the genus. *Amynthas* spp. lacking spermathecae may be derived from any known spermathecal battery by simple deletion. Other than the known athecal morphs of species with spermathecae (Gates, 1972), we can compare this species to other athecal species. First we will compare it to five athecal species, *A. hohuanmontis* Tsai et al, 2002, *A. chilanensis* Tsai et Tsai, 2007, *A. bilineatus* Tsai et Shen, 2007, *A. irregularis* (Goto et Hatai, 1899), and *A. dageletensis* Hong et Kim, 2005. *Amynthas irregularis* and *A. dageletensis* are Korean, and have manicate cecum unlike the present species, which has simple caeca. The first three are known only from Taiwan and have simple intestinal caeca, like *A. namhaensis* sp. nov. However, all have genital markings in some location, usually near the male pores, but in *A. bilineatus* there are also several pairs in the pre-clitellar segments. Tsai et al. (2007) determined that these three species are in the *sheni* subgroup of the *illotus*-group, all of which are athecal. They also argue against the necessity of determining the sexual morphs (H morphs, as in Gates, 1972) related to these species, for describing and naming new parthenogenetic lineages. *Amynthas illotus* (Gates, 1932) has male pores on small oval porophores, has many more setae and lacks septa 8/9/10 (Gates, 1972). The very common *A. corticis* Kinberg, 1867,

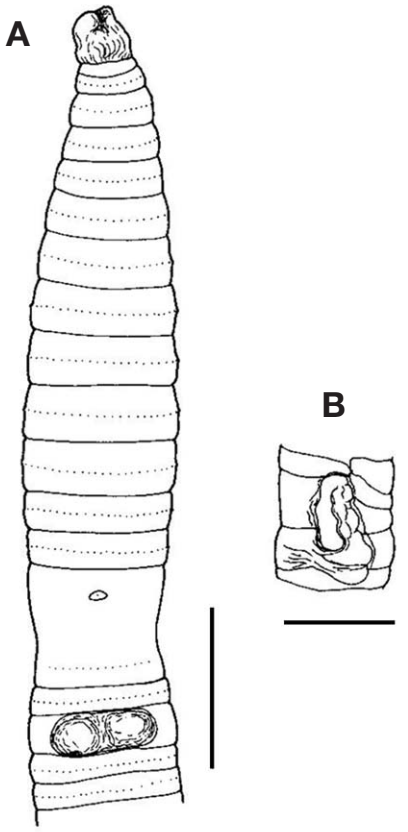

Fig. 1. *Amynthas namhaensis* sp. nov. A, Ventral view; B, Intestinal caeca. Scale bars: A=2.5 mm, B=1 mm.

typically has one to three genital markings associated with each small male porophore, so even if all spermathecae were deleted it would still be distinct from *A. namhaensis* sp. nov.

Amynthas namhaensis sp. nov. is similar to *A. vanhi* sp. nov., but differs in the shape of the male pore region, the absence of genital papillae in XVII, the presence of septum 9/10, and by having fewer setae on VII than *A. vanhi* sp. nov. *Amynthas vanhi* sp. nov. has approximately normal male organs, whereas *A. namhaensis* sp. nov. shows significant reductions of the prostates and other male organs. A possible near relative could be *A. angtanensis* sp. nov., an octothecal species with which it shares the general features of the male field. However, the spacing of the male pores is much narrower in *A. angtanensis* sp. nov., which also lacks septum 8/9. After subtraction of spermathecae the two would still be different. Thai and Samphone (1988, 1989, 1990b) has published many new Laotian species, each of which have 2–4 pairs of spermathecae.

Amynthas vanhi Hong and James sp. nov. (Fig. 2)

Material examined. Holotype: clitellate (BDNUL 0024): Laos, Laung Namtha Province, Nam Ha NPA, Keua Lome Mountain (21°08.161′N, 101°17.025′E), 1,177 m, soil and litter layers, good forest condition with grass understorey, sandy soil, 6 Sep 2006, K. Inkhavilay, Vanh, and Tear colls. Paratype: 1 clitellate (BDNUL 0028); same data as for holotype.

Diagnosis. Spermathecal pores lacking; male porophore pads human foot print-shaped, set longitudinally; pores 0.17–0.19 circumference apart; paired genital papillae in XVII in line with male porophores, larger numbers of setae in head than in post-clitellar segments, cupped zig-zag folded typhlosole, intestinal caeca simple.

Description. Unpigmented. Dimensions 58–65 mm, by 3.5–3.8 mm at segment X, 3.0–3.5 mm at segment XXX, 3.2–3.5 mm at clitellum; segments 112. Setae regularly distributed around segmental equators numbering 65–66 at VII, 43–52 at XX, 2–3 between male pore, setal formula AA:AB:ZZ:YZ = 2:2:1:1 at XIII. Female pore single in XIV, on 0.3–0.4 mm circular porophore. Prostomium epilobic with tongue open, clitellum light brown, formalin preservation. First dorsal pores at 9/10. Clitellum annular XIV–XVI; setae invisible externally.

Male porophores human foot print-shaped, set longitudinally, concave laterally, extending to segment XX; 0.9–1.0 mm wide; male pores equatorial on segment XVIII at anterior ends of seminal grooves, extending posteriorly to equator of XX, near lateral margins of pads 0.17–0.19 circumference apart ventrally. Spermathecal pores absent. Epidermal thickenings paired, postsetal in XVII close to male porophores.

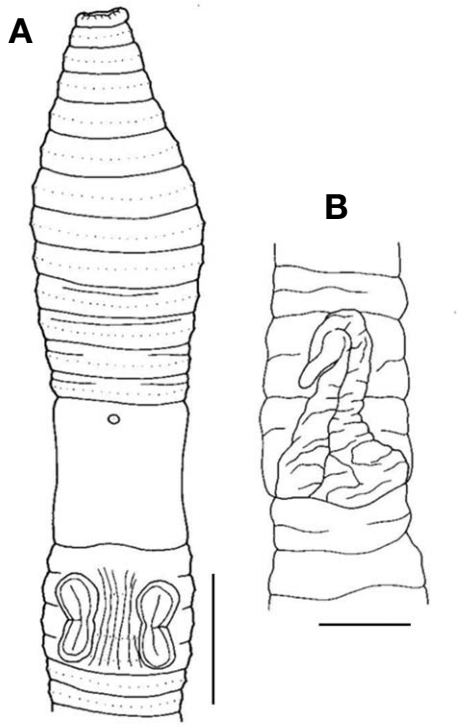

Fig. 2. *Amynthas vanhi* sp. nov. A, Ventral view; B, Intestinal caeca. Scale bars: A=2.5 mm, B=1 mm.

Septa 5/6–7/8 thick, 8/9–10/11 absent, 11/12 muscular, 12/13 thin. Gizzard globular in VIII–X. Intestine begins in XV, lymph glands not found. Typhlosole simple fold XXII–XXV, from XXVI–XXVII deep zig-zag folds with lateral edges curved posteriorly as cupped folds, ventral edges join continuous straight mid-ventral ridge. Simple digitate intestinal caeca, originating in XXVII, extending about to XXIII. Esophageal hearts four pairs in X–XIII; those of XIII largest. Male sexual system holandric, testes and funnels in ventrally paired sacs in X, dorsally united sacs in XI. Testes sac of XI encloses hearts, seminal vesicles. Seminal vesicles two pairs in XI–XII well developed with dorsal lobes. Prostates in XVIII, extending over XVI–XXIII; short bent fusiform muscular ducts, glands large, thick, each divided into several lobes. Genital papilla glands lacking.

Ovaries in XIII. No spermathecae. Genital marking glands absent.

Etymology. The species is named for Mr. Vanh, one of the collectors.

Distribution. Laos.

Remarks. The present species is similar to *A. namhaensis* sp. nov. with respect to lack of spermathecal pores, but *A. vanhi* sp. nov. has 2–3 setae between male pores and has many more setae in the anterior segments, more anterior first

dorsal pores (9/10 vs.10/11). *Amynthas vanhi* sp. nov. has a human foot print-shaped male porophores extending to segment XX and paired genital markings in XVII. The same characters of Taiwan, Korean and peregrine *Amynthas* species mentioned in the remarks under *A. namhaensis* sp. nov. also serves to distinguish *A. vanhi* sp. nov. from those species. The typhlosole of *A. vanhi* sp. nov. is unique among known *Amynthas*, though we have seen others similar to it in some undescribed Laotian species. The structure is nearly identical to that of many *Glossoscolex* spp. in southern Brazil (Righi, 1971).

Amynthas angtanensis Hong and James sp. nov. (Fig. 3)

Material examined. Holotype: clitellate (BDNUL 0025): Laos, Laung Namtha Province, Nam Ha NPA, Angtan Mountain (21°08.590′N, 101°16.417′E), 1,351 m, soil and litter layers, good forest condition, thick surface litter layer over black soil, 7 Sep 2006, K. Inkhavilay, Vanh, and Tear colls. Paratypes: 2 clitellates (BDNUL 0029, BDNUL 0030); same data as for holotype.

Diagnosis. Spermathecae four pairs V–VIII; male field a transverse oval between eq. XVII, eq. XIX; spanning 10 intersetal intervals, bound by a furrow; male pores superficial on small round porophores at lateral ends of oval area, within furrow boundary.

Description. Unpigmented. Dimensions 35–46 mm, by 2.8–3.0 mm at segment X, 2.0–2.6 mm at segment XXX, 2.2–2.7 mm at clitellum; body very small, segments 66–94. Setae slightly more crowded ventrally, numbering 34–37 at VII, 32–37 at XX, 0 between male pore, setal formula AA: AB:ZZ:YZ=2:1:3:2 at XIII. Female pore single in XIV, on 0.2–0.3 mm circular porophore. Prostomium epilobic with tongue open, clitellum coffee color, formalin preservation. First dorsal pores at 12/13. Clitellum annular XIV–XVI; setae invisible externally.

Male field a transverse oval between eq. XVII, eq. XIX; spanning 10 intersetal intervals, bounded by a furrow; male pores superficial on small round porophores at lateral ends of oval area, within furrow boundary, 0.07–0.1 circumference apart ventrally. Spermathecal pores four pairs in 4/5–7/8, 0.06–0.08 circumference apart ventrally. Genital markings lacking.

Septa 5/6–7/8 thick, 8/9/10 absent, 10/11–13/14 thin. Gizzard large in VIII–X. Intestine begins in XV, lymph glands not found. Typhlosole low simple fold from XVIII. Intestinal caeca simple, originating in XXVII, and extending anteriorly to about XXIII, simple broad triangular sac. Esophageal hearts four pairs in X–XIII. Male sexual system holandric, testes and funnels in ventrally joined sacs in X, XI. Seminal vesicles paired, well developed in XI–XII with dorsal lobes. Prostates in XVII, extending between XVI–XXI; glands divided into 3–4 small lobes, ducts short with one sharp curve, large fusiform and muscular.

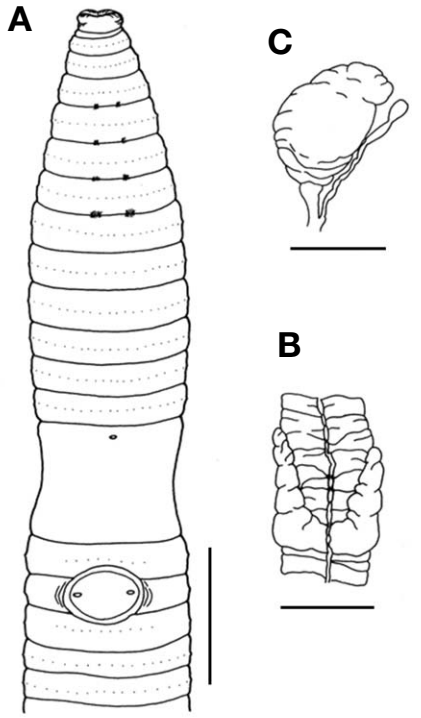

Fig. 3. *Amynthas angtanensis* sp. nov. A, Ventral view; B, Intestinal caeca; C, Spermathecae. Scale bars: A=2.5 mm, B=1 mm, C=2 mm.

Ovaries in XIII. Spermathecae four pairs in V–VIII; ampulla irregular-ovate, stout ducts shorter than ampulla, iridescent diverticulum chamber egg-shaped, with stalk, longer than ampulla, no nephridia on spermathecal ducts.

Etymology. The species is named for its type locality, Angtan Mountain.

Distribution. Laos.

Remarks. *Amynthas angtanensis* sp. nov. has four pairs of spermathecae in the novel location of V–VIII. There are some additional *Amynthas* with the first spermathecae in V and VI: *A. swanus* (Tsai, 1964, part); V–VII: *pauxillulus*-group containing *A. dignus* (Chen, 1946), *A. pauxillulus* (Gates, 1936), *A. swanus* (Tsai, 1964, part); 4/5–8/9: *hexathecus*-group containing *A. albobrunneus* (Beddard, 1912), *A. brevicinctus* (Gates, 1958), *A. flustrellus* (Gates, 1949), *A. hexathecus* (Benham, 1896), *A. orientalis* (Beddard, 1912), *A. pauaiensis* (Beddard, 1912), *A. polytoreutus* (Michaelsen, 1928), *A. scholasticus* (Goto et Hatai, 1898), *A. sodalis* (Beddard, 1912), *A. solomonis* (Beddard, 1899). Beddard's 1912 species just listed are very probably referable to *Pithemera*, considering their short clitella, last hearts in XII and their five pairs of spermathecae, all of which match many *Pithemera* spe-

cies so numerous in northern Luzon, Philippines (e.g. Hong and James, 2008). These four species were placed in *Amynthas* by Sims and Easton (1972) because there were no data on the location of the caeca. The possession of four pairs of spermathecae in V−VIII is unique in the genus. Other Laotian *Amynthas* with four pairs of spermathecal pores have been recorded by Thai and Samphon (1988), but all are in the *corticis* group with spermathecae in V−VIII.

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