

## Three New Earthworm Species of the Genus *Amyntas* Kinberg, 1867 from Thailand (Clitellata: Megascolecidae)

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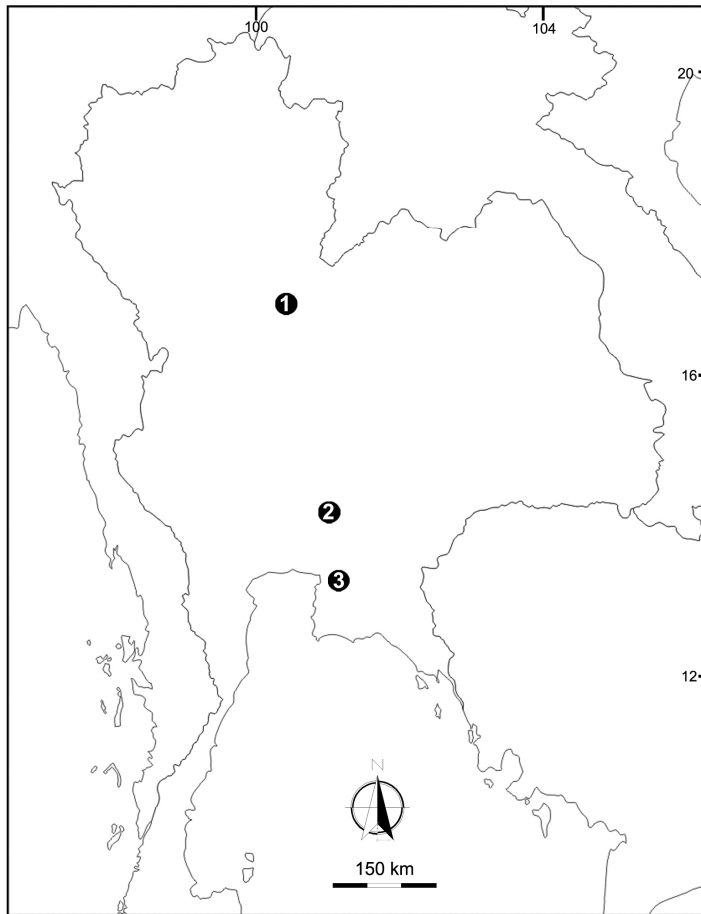
**ABSTRACT.**— This paper describes three new species of earthworms belonging to the genus *Amyntas* (Megascolecidae: Oligochaeta) from Thailand. They are *A. turris* n. sp., *A. nangrongensis* n. sp., and *A. khaohayod* n. sp. which are octothecate, quadrithecate and bithecate, respectively. They were determined to be new after comparing the three new species with the other members of their respective species groups based on their original descriptions and some reference materials from Biozentrum Grindel und Zoologisches Museum, Hamburg, Germany and the Natural History Museum, London. The new species differ from other *Amyntas* in their pattern of genital markings and the appearance of the male field and shape of spermathecae as well. The descriptions with illustrations of three new species are provided.

**KEY WORDS:** *Amyntas*, earthworm, taxonomy, new species, Thailand

### INTRODUCTION

Thailand is located in the tropical area between 5° 37' and 20° 27' north latitudes, and between 97° 22' and 105° 37' east longitudes. It includes an area of approximately 500,000 square kilometers, and lies at the zoogeographical crossroads of South East Asia. Continental Thailand comprises two major biogeographical regions. They are the Indochinese region in the North and the Sundaic region in the South. Apart from the effect of these two regions within the Indomalayan Realm, some elements of Thailand's flora and fauna are also influenced by biogeographical characteristics of the Indian and Palearctic region (Mackinnon & Mackinnon, 1986). Consequently, it supports a variety of tropical ecosystems, forming highly diverse habitats for terrestrial animals including earthworms.

Up to date, forty five species of terrestrial earthworm are already known from Thailand, and mostly they belong to the genera *Amyntas* and *Metaphire* of the family Megascolecidae. Of these 23 species or 50% are *Amyntas*. These species occur in virtually all habitats including natural habitats and agricultural areas, even in mud or sand of banks of the Mekong River, like *A. mekongianus*, and are also found from sea level to high mountains (Gates, 1939; 1972; Blakemore, 2011; Bantaowong et al., 2011a, 2011b; Bantaowong et al., 2014). Here we report one new species from each of the *Amyntas corticis*, *morrissi* and *minimus* species groups, from localities at Phitsanulok, Nakhon Nayok and Chonburi provinces, (Fig. 1).



**FIGURE 1.** Map of type localities of (1) *Aynthas turris* n. sp. from Phitsanulok province; (2) *Aynthas nangrongensis* n. sp. from Nakhon Nayok province; (3) *Aynthas khaohayod* n. sp. from Chonburi province

### MATERIALS AND METHODS

Earthworms collected were killed in 40% (v/v) ethanol, photographed, transferred to 10% (w/v) formalin for fixation, and then transferred to 70% (v/v) ethanol for longer term preservation and subsequent morphological studies. The preserved specimens were examined by external observation of characters and by dorsal dissection.

The descriptions of each species were made during observation under the Olympus SZX7 stereoscopic light microscope. Drawings were made of the external characters and internal organs. In addition, types and other reference materials from the following collections were reinvestigated: the Biozentrum Grindel und Zoologisches Museum, Hamburg, Germany (ZMH), and the Natural History Museum, London (NHMUK). We also compared these

specimens to published descriptions of relevant *Amynthas*.

Specimens are deposited in the Chulalongkorn University, Museum of Zoology, Bangkok, Thailand (CUMZ), the Biozentrum Grindel und Zoologisches Museum, Hamburg, Germany (UHH), and the Natural History Museum, London (NHMUK).

Anatomical abbreviations: fp, female pore; ic, intestinal caeca; mp, male pores; pg, prostate gland; sc, spermathecae; sp, spermathecal pores; sv, seminal vesicles.

## SYSTEMATICS

Genus *Amynthas* Kinberg, 1867

**Type species** *Amynthas aeruginosus* Kinberg, 1867, by monotypy.

*Amynthas turris*

**Bantaowong & Panha, n. sp.**

(Figs. 1, 2)

**Description of Holotype.** — Dimensions; 190 mm by 7.6 mm at segment X, 7.7 mm at segment XX, 7.6 mm at clitellum; body cylindrical with 156 segments. Setae regularly distributed around segmental equators, numbering 48 at VII, 60 at XX, 14 setae between male pores, setae formula AA:AB:ZZ:ZY=1:1:1:1 at XIII. Single female pore at XIV. Prostomium epilobic. First dorsal pore at 12/13. Clitellum annular XIV–XVI with no setae.

Male pores are in XVIII situated close to the lateral border on slightly elevated horizontal triangular area on the setal line. Each male aperture is in a small demarcated tubercle within a distinctly delimited, longitudinally elliptical set of skin folds, whose margin is prominently elevated from the body surface, and separated by 14 setae.

Distance between male pores 7.5 mm, 0.28 circumference apart ventrally. Two pairs of oblong-shaped genital markings in XVII and XIX in line with the male pores. Spermathecal pores paired in 5/6-8/9, 0.30 circumference apart ventral; distance between spermathecal pores 7.5 mm.

Septa 5/6 and 6/7 thick, 7/8 thin, 8/9 and 9/10 absent, 10/11–13/14 thin. Gizzard large behind 7/8, intestinal origin in XV, no lymph glands observed. Typhlosole small from XXVII. Intestinal caecum originated from XXVII extending forward to XXI, simple. Hearts esophageal in X–XIII. Holandric; testes and funnels in ventrally joined sacs in X–XI. Seminal vesicles paired in XI–XII. Prostates in XVI–XX; prostatic ducts long slender, bent into hairpin shape. Sessile genital marking glands present and corresponding to each external genital marking in XVII and XIX.

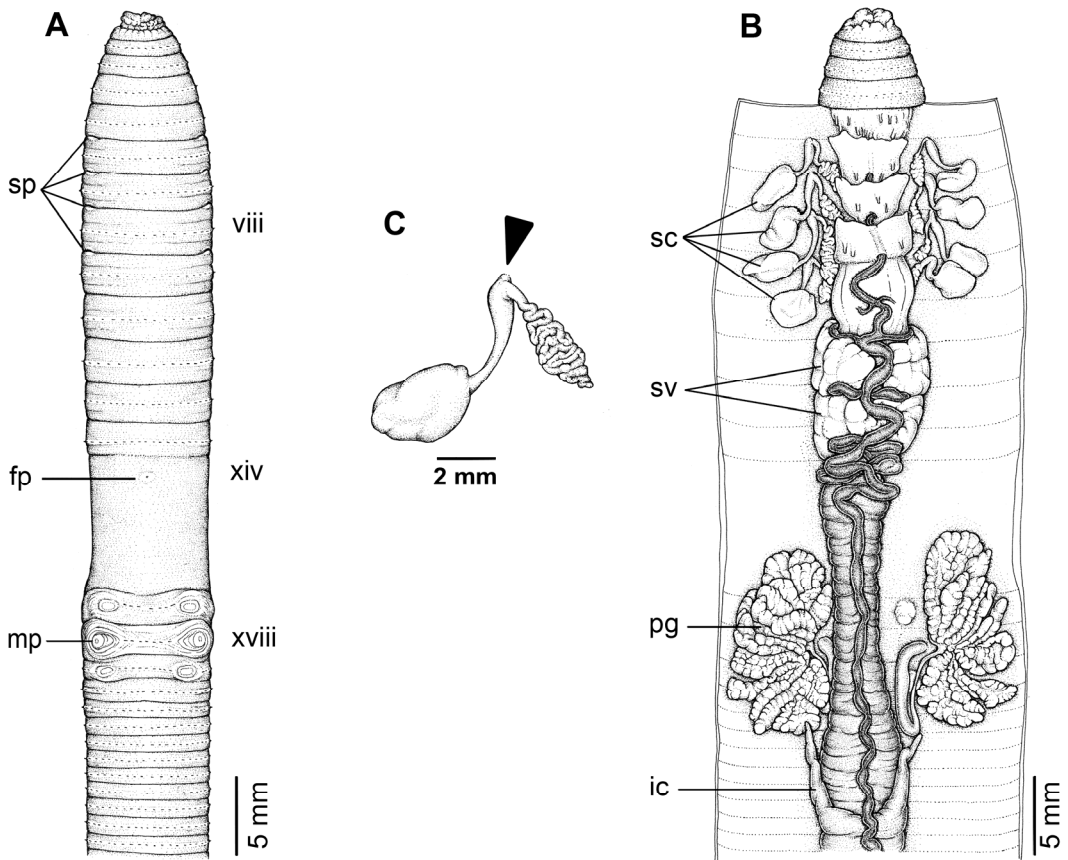
Ovaries in XIII. Spermathecae four pairs in VI–IX; ampulla an elongate sac, distended, with relatively slender duct as long as ampulla. Diverticulum is twisted into a compact mass of coils, stalk attached to duct near body wall.

**Variation.** — The holotype measures 190 mm body length with 156 segments; the eleven paratypes range in size from 160–190 mm (177±10.43 mm) body length with 143–169 segments.

**Type locality.** — Tham Pha Tha Phon non-hunting area, Noen Maprang district, Phitsanulok province, Thailand, 16° 30' 19.4" N, 100° 39' 39.0" E, 110 meters elevation (18 November 2012).

**Etymology.** — The specific epithet “*turris*” in Latin word mean “tower”. This name refers to the ecological characteristics of this species as making tower-like castings.

**Type materials.** — The holotype (CUMZ 3397) and seven paratypes (CUMZ 3398) are deposited in Chulalongkorn University,



**FIGURE 2.** External and internal morphology of holotype (CUMZ 3397) of *Amynthus turris* n. sp. (A) External ventral view; (B) internal dorsal view and (C) spermathecae, and black arrow indicates the connection of the spermathecae and spermathecal pore.

Museum of Zoology. Another two paratypes will be deposited in the Biozentrum Grindel und Zoologisches Museum, Hamburg, Germany (ZMH), and another two paratypes in the Natural History Museum, London (NHMUK).

**Habitat.** — Found in the top soil at about 15 cm depth, the soil surface covered with the leaf litter of a deciduous limestone forest, mostly disturbed. The soil was carefully dug close to the tower-like casts,

which are about 10 cm in height and 3 cm in diameter,

**Diagnosis.** — Length 160–190 mm. Male pores, paired, superficial in segment XVIII, each on a horizontal triangular area, slightly raised areas, two pairs of genital markings on segment XVII and XIX. Spermathecal pores paired in segments 5/6–8/9. Spermathecae elongate sac ampulla, diverticulum twisted into a compact mass of coiled. Holandric, intestinal caeca simple, first dorsal pore in 12/13. Prostate glands

large, ducts long and hairpin shape. Paired sessile genital marking glands on XVII and XIX.

**Remarks.** — *Amyntas turris* n. sp. is one of the medium-sized *Amyntas* and belongs in the *corticis*-group (Sims & Easton, 1972). The characteristic male field with two pairs of genital markings and sessile genital marking glands and simple intestinal caeca are fairly similar to some *corticis* species group members in Indo-Burma. There are three species or species groups which have genital markings at male pore area and has sessile genital marking glands with simple intestinal caeca: *Amyntas rodericensis* (Grube, 1879), *A. suctoria* (Michaelsen, 1907) and *A. andersoni* group (Gates, 1972). The present species can easily be separated from *A. rodericensis* by the position of spermathecal pores in the ventral side while *A. rodericensis* has spermathecal pores in the dorsum. The difference between this species and remaining groups are the locations of genital markings. The present species has two pairs of genital markings in XVII and XIX while *A. suctoria* has only one pair in segment XVIII and the genital markings of *A. andersoni* group are unpaired, or if paired, it will be present in XVIII or behind XVIII.

Comparing with others *corticis* group members in Thailand, mostly they show more than two pairs of genital markings at the male pore lines in *A. longicauliculatus* (Gates, 1931), *A. comptus* (Gates, 1932), *A. phucheeifah* Bantaowong & Panha, 2014 and *A. thakhantho* Bantaowong & Panha, 2014, whereas some species; *A. alexandri* Beddard, 1900 and *A. mekongianus* (Cognetti, 1922) lack genital markings. The remaining members; *A. corticis* (Kinberg, 1867), *A. exiguus* (Gates, 1930) and *A. manicatus* (Gates, 1931) have the genital markings at the male pore area on segment

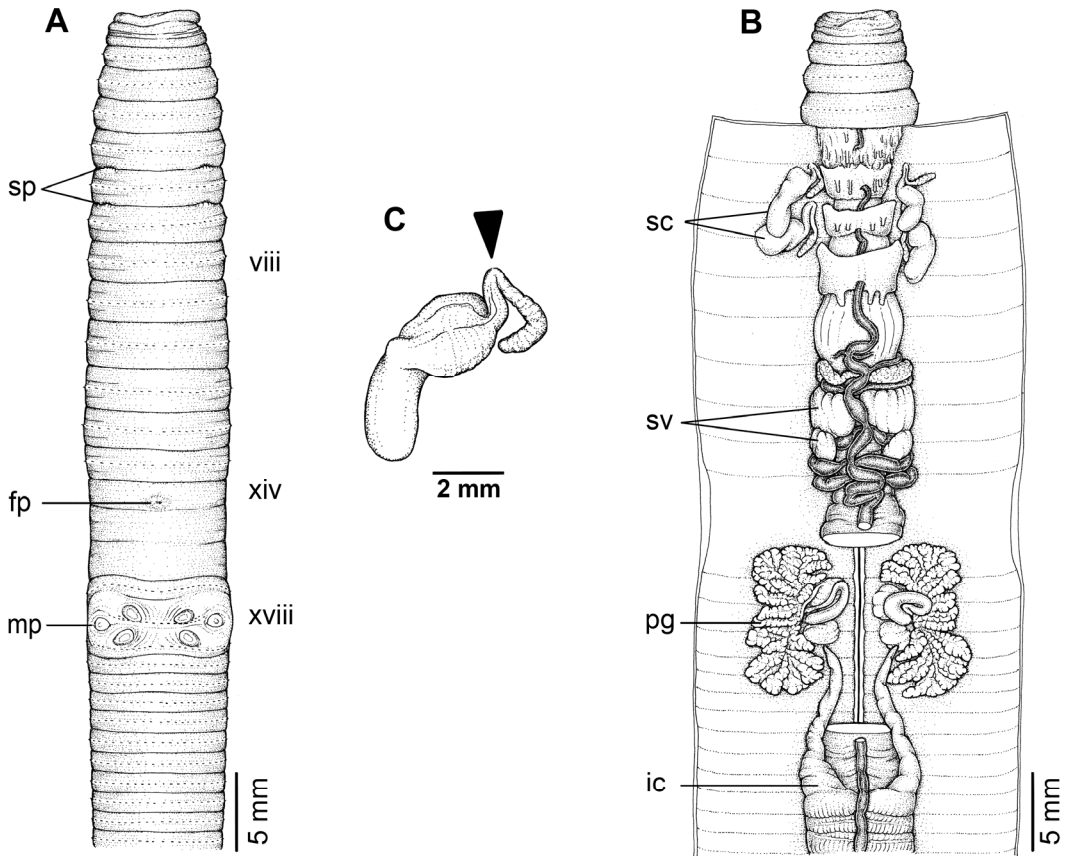
XVIII while the present species has two pairs of genital marking in XVII and XIX.

Although some morphological characters are apparently plastic such as spermathecal pores position, the genital markings at the male pore area, and similar tower-liked cast. These characters are similar to those of *A. thakhantho*. However, the shape of spermathecae in *A. turris* is clearly differ from *A. thakhantho* by the elongated sac ampulla, diverticulum twisted into a compact mass of coils, and spermathecae of *A. thakhantho* is a large sac ampulla with slender, long coiled diverticulum. The male field of *A. turris* is still more convex than in *A. thakhantho* and presenting only two pairs of genital markings in segment XVII and XIX while *A. thakhantho* has four pairs of genital markings in XVII, XIX, XX and XXI. The additional habitat records showed that *A. turris* found in limestone forest at Phitsanulok while *A. thakhantho* found in non-limestone agricultural field which 400 kilometer distance from *A. turris* separated by Phethchabun Mountain range.

***Amyntas nangrongensis* Bantaowong & Panha, n. sp.**  
(Figs. 1, 3)

**Description of Holotype.** — Dimensions; 173 mm by 7.7 mm at segment X, 8.0 mm at segment XX, 7.5 mm at clitellum; body cylindrical with 127 segments. Setae regularly distributed around segmental equators, numbering 44 at VII, 76 at XX, 27 setae between male pores, setae formula AA:AB:ZZ:ZY= 1:1:1:1 at XIII. Single female pore at XIV. Prostomium epilobic. First dorsal pore at 12/13. Clitellum annular XIV–XVI with no setae.

A pair of indistinct rounded male porophores in XVIII, 0.29 circumference apart ventrally; distance between male pores



**FIGURE 3.** External and internal morphology of holotype (CUMZ 3399) of *Amynthes nangrongensis* n. sp. (A) External ventral view; (B) internal dorsal view and (C) spermathecae, and black arrow indicates the connection of the spermathecae and spermathecal pore.

7.5 mm. Genital markings consist of two pairs of elongated oval, diagonally placed markings one pair anterior and one posterior to setae of XVIII, just medial to male pores. Entire male field slightly elevated as a rounded rectangular area. Spermathecal pores paired in 5/6–6/7, each small, with wrinkled margins, about 0.15 circumference apart ventrally; distance between spermathecal pores 3.5 mm.

Septa 5/6 and 6/7 thick, 7/8 thin, 8/9 and 9/10 absent 10/11–13/14 thin. Gizzard large

behind 7/8, intestinal origin in XV, no lymph glands observed. Typhlosole small from XXVII. Intestinal caecum originating in XXVII extending forward to XXI, simple finger-shape. Hearts esophageal in X–XIII. Holandric; testes and funnels in ventrally joined sacs in X–XI. Seminal vesicles paired in XI–XII. Prostates in XVI–XXII; prostatic ducts long slender with hairpin bend. Genital marking glands are sessile and corresponding to each external genital marking in XVIII.

Ovaries in XIII. Spermathecae two pairs in VI–VII; ampulla an elongate sac, twisted, with relatively slender duct as long as ampulla. Diverticulum compact zigzag bound together as a tube shape.

**Variation.** — The holotype measures 173 mm body length with 127 segments; the four paratypes range in size from 170–248 mm (204.3±39.8 mm) body length with 125–138 segments.

**Type locality.** — Nangrong Waterfall, Nakhon Nayok province, Thailand, 14° 19' 45.3" N, 101° 19' 6.8" E, 54 meters elevation (5 October 2013).

**Etymology.** — This species was named after the type locality, Nangrong Waterfall.

**Type materials.** — The holotype (CUMZ 3399) and two paratypes (CUMZ 3400) are deposited in Chulalongkorn University, Museum of Zoology. Another paratype will be deposited in the Biozentrum Grindel und Zoologisches Museum, Hamburg, Germany (ZMH).

**Habitat.** — Found in the top soil at about 10–15 cm depth, the soil surface covered with leaf litter of deciduous forest which originated at the Nangrong Waterfall area.

**Diagnosis.** — Medium size, length 170–248 mm. Male pores paired, superficial in segment XVII, each on a rounded porophore, two pairs of genital markings pre-setal and post-setal in XVIII. Spermathecal pores paired in 5/6–6/7. Spermathecae elongated sac ampulla, diverticulum tubular. Holandric, intestinal caeca simple, first dorsal pore in 12/13. Prostate glands large, ducts long, two pairs of sessile genital marking glands in XVIII.

**Remarks.** — *Amyntas nangrongensis* is a quadrithecate earthworm belonging to the *morrissi* species-group of the genus *Amyntas* (Sims & Easton 1972). This group is from the Oriental region; those having genital markings near the male pore

areas include *A. morrissi* (Beddard, 1892), *A. pallidus* (Michaelson, 1892), *A. insulae* (Beddard, 1896), *A. incongruus* (Chen, 1936), *A. monoserialis* (Chen, 1938) and *A. tripunctus* (Chen, 1946). However, the present species can be easily distinguished from all above related species by having two pairs of genital markings pre-setal and post-setal in XVIII and without genital markings near the spermathecal pores. All the others mentioned above have both pre-clitellar and post-clitellar genital markings, and none has the pattern of *A. nangrongensis*.

The genital markings and their arrangement in this species are somewhat similar to those of *A. fucosus* (Gates, 1933) which has been reported from Nakhon-ratchasima province, in north-eastern Thailand (Bantaowong et al, 2011a) but the latter has three pairs of spermathecal pores in 6/7–8/9 (Gates, 1933) and so belongs to the *aelianus* species-group (Sims & Easton 1972).

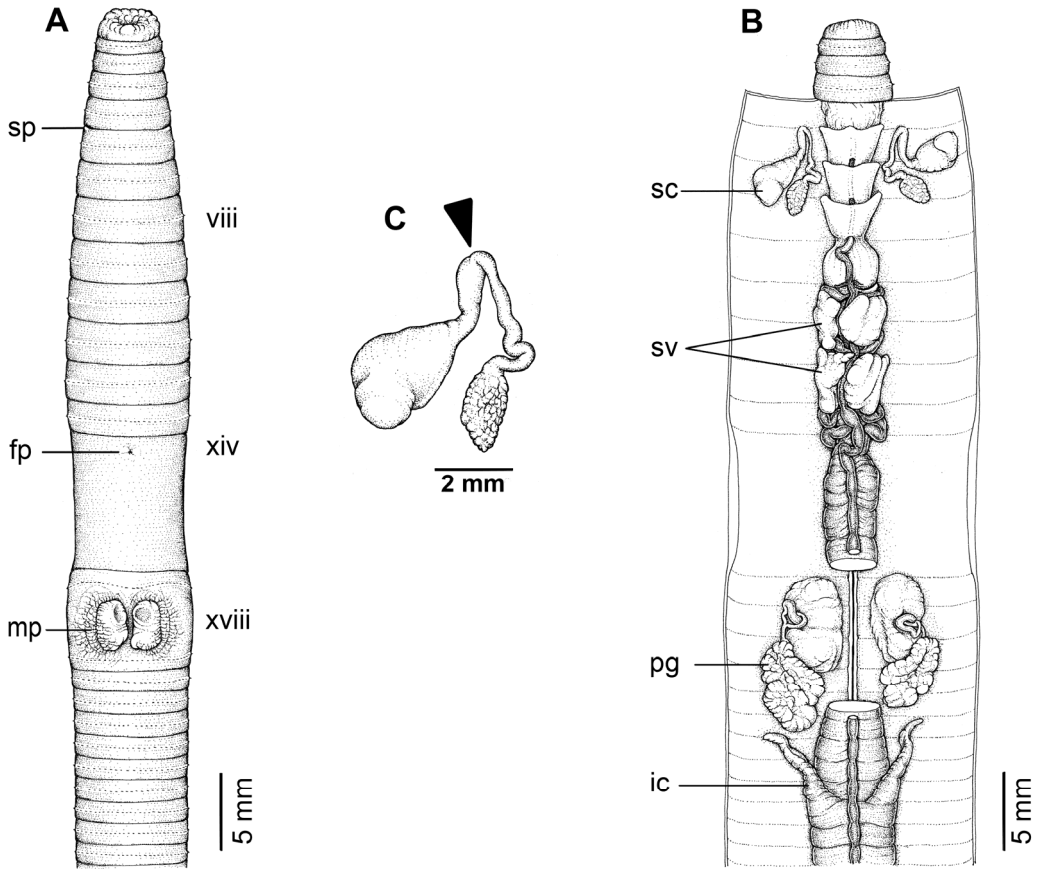
#### *Amyntas khaohayod* Bantaowong &

#### *Panha*, n. sp.

(Figs. 1, 4)

**Description of Holotype.** — Dimensions; 230 mm by 7.5 mm at segment X, 6.8 mm at segment XX, 7.1 mm at clitellum; body cylindrical with 137 segments. Setae regularly distributed around segmental equators, numbering 113 at VII, 105 at XX, no setae between male pores, setae formula AA:AB:ZZ:ZY= 1:1:1:1 at XIII. Single female pore at XIV. Prostomium epilobic. First dorsal pore at 12/13. Clitellum annular XIV–XVI with no setae.

Male pores on the ventro-lateral sides of XVIII, about 0.18 circumference ventrally apart; distance between male pores 4 mm. Each pore on inner wall of a large granular which protrude outside the body wall.



**FIGURE 4.** External and internal morphology of holotype (CUMZ 3401) of *Amynthes khaohayod* n. sp. (A) External ventral view; (B) internal dorsal view and (C) spermathecae, and black arrow indicates the connection of the spermathecae and spermathecal pore.

Spermathecal pores paired in 5/6, 0.40 circumference apart ventrally; distance between spermathecal pores 8 mm.

Septa 5/6 and 6/7 thick, 7/8 thin, 8/9 and 9/10 absent, 10/11–13/14 thin. Gizzard globular behind 7/8, intestinal origin in XV, no lymph glands observed. Typhlosole small from XXVII. Intestinal caecum originates in XXVI extending forward to XXII, long finger-shape. Hearts esophageal in X–XIII. Holandric; testes and funnels in ventrally joined sacs in X–XI. Seminal

vesicles paired in XI–XII. Prostates glands and ducts in XVIII, extending between XVII–XXI; prostatic ducts tightly folded twice, ducts are surrounded by large sessile genital marking glands.

Ovaries in XIII. Spermathecae one pair in VI; ampulla is large and spatulate, with stout duct shorter than ampulla. The diverticulum as long as ampulla, with roughly elliptical terminal chamber.

**Variation.** — The holotype measures 230 mm body length with 137 segments; the

length of nine paratypes varies from 140–190 mm, the number of segments from 100–140. The first dorsal pore is in 12/13 in all of specimens.

**Type locality.** — Khao Hayod temple, Chonburi province, Thailand, 18° 22' 11.1" N, 100° 50' 23.2" E, 607 meters elevation (30<sup>th</sup> September 2010).

**Etymology.** — This species was named after the type locality Khao Hayod.

**Type materials.** — The holotype (CUMZ 3401) and five paratypes (CUMZ 3402) are deposited in Chulalongkorn University, Museum of Zoology. Another two paratypes will be deposited in the Biozentrum Grindel und Zoologisches Museum, Hamburg, Germany (ZMH), and two paratypes in the Natural History Museum, London (NHMUK).

**Habitat.** — Found in the top soil at about 10–15 cm depth in the limestone forest at Khao Hayod temple.

**Diagnosis.** — Length 140–230 mm. Male pores paired in XVIII, each pore on inner wall of the large granular and protruding porophore. Spermathecal pores paired in 5/6, spermathecae spatulate shaped ampulla, diverticulum long and roughly elliptic terminal chamber, intestinal caeca simple, first dorsal pore in 12/13. Holandric. Prostate glands as large as genital marking glands, its duct flanked by large sessile glandular masses on body wall.

**Remarks.** — *Amyntas khaohayod* n. sp. is one of 14 bithecal members of the *minimus* species group (Sims & Easton, 1972). This group has never been recorded in Thailand before, but three species occur in Burma; *A. minimus* (Horst, 1893), *A. nugalis* (Gates, 1931) and *A. papilio* (Gates, 1930). The present species can be separated from first two species by the larger body in 140–230 by 5–7.5 mm while *A. minimus* and *A. nugalis* range in size from 20–56 by 1.5–2.5

mm. The present species appears to be closely related to *A. papilio* (Gates, 1930), but it is separated easily by the aspects of male pore region because male pores of *A. papilio* are on large flat genital markings, but in this species the male pores and genital markings protrude. Moreover, *A. papilio* has slender, small genital marking glands while the present species has large sessile glandular masses.

Another related species of the *minimus*-group is the Indonesian *Amyntas lompoatagensis* (Michaelsen, 1899). The present species can be easily distinguished by having no paired genital papillae at the male pore area and by having the sessile genital marking glands. In contrast *A. lompoatagensis* has two pairs of genital markings on segments XVII and XIX but lacks genital marking glands.

***Amyntas lompoatagensis***  
(Michaelsen, 1899)

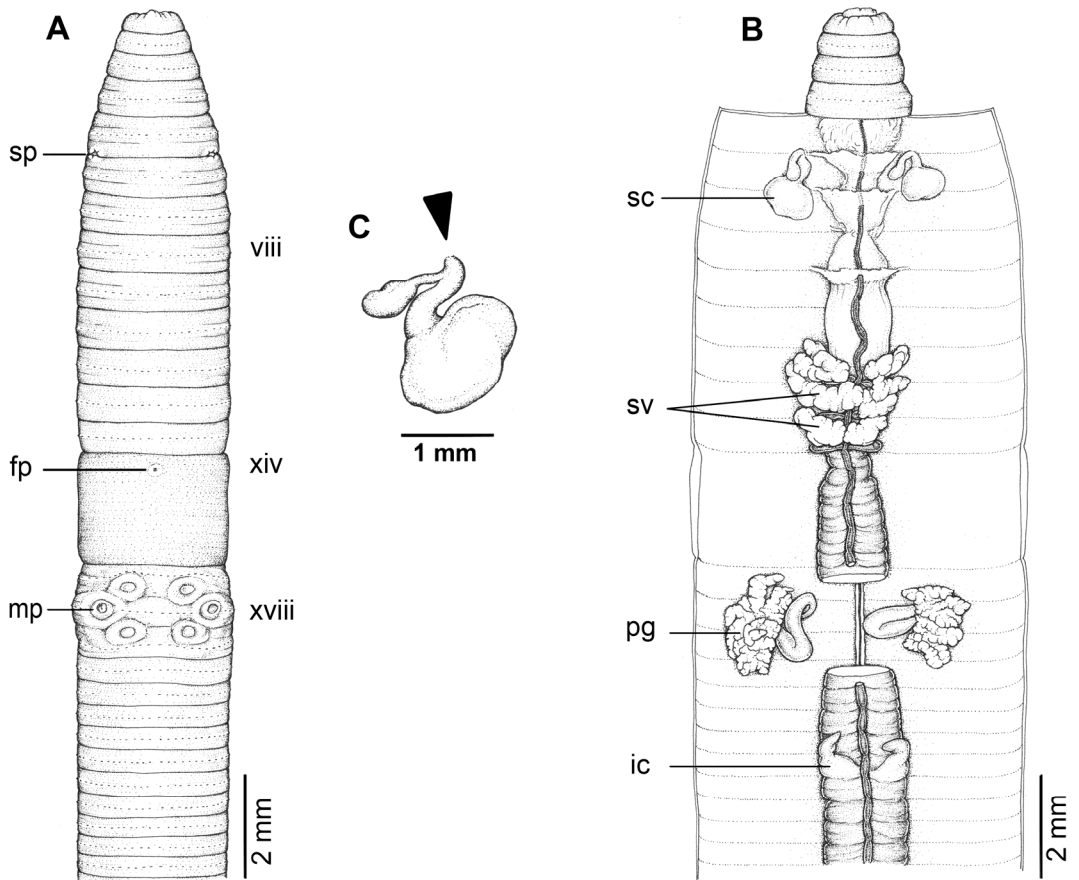
(Fig. 5)

*Pheretima lompoatagensis* Michaelsen,  
1899: 33, fig. 5. Type locality:  
Celebes, Indonesia

*Amyntas lompoatagensis*: Sims &  
Easton, 1972: 236

**Material examined.** — Syntype from ZMH (V 5184, fig. 5): One adult and one sub-adult in 70% ethanol deposited at Biozentrum Grindel Zoologisches Museum, University of Hamburg, Germany.

**Remarkd.** — *Amyntas lompoatagensis* differs from *A. khaohayod* n. sp. by having two pairs of genital papillae present in XVII and XIX, but lacking genital marking glands. The spermathecae have a transversely oval ampulla with a small, short diverticulum.



**FIGURE 5.** External and internal morphology of type (ZMH V 5184) of *Amynthes lompobatangensis*. (A) External ventral view; (B) internal dorsal view and (C) spermathecae, and black arrow indicates the connection of the spermathecae and spermathecal pore.

## DISCUSSION

From the current study, there are a total of approximately 55 species described from Thailand (Bantaowong et al, 2014; 2015). The total land area of Thailand is approximately 500,000 sq.km compare to Burma that is about 657,740 sq. km but has over double the number of described species (129 species), (Gates, 1972; Reynolds, 2009). The terrestrial earthworms of

Thailand are still poorly known, with only a small fraction of the species in this country having been described properly. Many of these species are known only from a single locality or very few localities, so range boundaries can be tentatively outlined in very few cases. These huge gaps in knowledge prevent a proper zoogeographic analysis. Further extensive and detailed taxonomic studies are especially needed to improve the situation.

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