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Earthworms of the 'acaecate' *Pheretima* group in Vietnam (Oligochaeta: Megascolecidae), with description of a new species from the Mekong delta

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Abstract

The 'acaecate' *Pheretima* group from Vietnam is revised, with description of a new species, *Polypheretima mekongmontis* sp. nov. A total of 18 species of three genera, *Metapheretima* Michaelsen, 1928, *Planapheretima* Michaelsen, 1934, and *Polypheretima* Michaelsen, 1934 has been recorded from Vietnam. Caecate species of *Planapheretima* are included here as well. *Planapheretima arboricola* (Rosa, 1890), *Pl. lacertina* (Chen, 1946), *Pl. tenebrica* (Chen, 1946), *Polypheretima elongata* (Perrier, 1872), and *Po. taprobanae* (Beddard, 1892) are originally recorded from other countries; all remaining species are native to Vietnam. The species *Polypheretima tani* (Thai, 1996) and *Po. tiencanhensis* (Pham, 1995) are transferred to the genus *Metapheretima*. A key to species and distribution maps are also presented.

Key words: Acaecate earthworms, Clitellata, new species, Vietnam

Introduction

The 'acaecate' *Pheretima* group comprises pheretimoid species without intestinal caeca. The group was carefully revised by Easton (1979) and consists of more than 100 species in five genera: *Archipheretima* Michaelsen, 1928, *Polypheretima* Michaelsen, 1934, *Planapheretima* Michaelsen, 1934, *Metapheretima* Michaelsen, 1928, and *Pleionogaster* Michaelsen, 1892. The group is known to have a restricted distribution in the Indo-Australian archipelago except for several species found in Asian mainland (Easton 1979).

To date, 17 species of the 'acaecate' *Pheretima* group have been recorded from Vietnam, five species of *Planapheretima*, three of *Metapheretima*, and nine of *Polypheretima* (Stephenson, 1931; Michaelsen, 1934a; Thai, 1982, 1984, 1996, 1997; Nguyen, 1993). The genus *Planapheretima* includes species with and without caeca but is considered here, for reasons of convenience, as belonging to the 'acaecate' group of pheretimoid species (Easton 1979). *Planapheretima arboricola* (Rosa, 1890), *Pl. lacertina* (Chen, 1946), *Pl. tenebrica* (Chen, 1946), *Polypheretima elongata* (Perrier, 1872), and *Po. taprobanae* (Beddard, 1892) are exotic or distributed also outside Vietnam (Gates 1972; Thai 1983; Chen 1946). Most of the remaining native species are restrictedly distributed in Central Vietnam or Northern Vietnam, except for *Polypheretima colonensis* and *Polypheretima grandisetosa*, recorded only from the Con Lon Islands (Southern Vietnam), and a new species described here, *Polypheretima mekongmontis* sp. nov., found in the mountain region of the Mekong Delta. The paper provides a review of the 'acaecate' *Pheretima* group recorded in Vietnam, and the description of a new species, *Polypheretima mekongmontis* sp. nov. It gives distribution maps of the listed species and new illustrations of *Po. elongata* (Perrier, 1872) and *Po. taprobanae* (Beddard, 1892). Species descriptions originally published in Vietnamese are paraphrased in the taxonomic section.

Methods and material

The checklist was compiled from reviewing existing literature and examining available specimens housed in the Soil Organism Research Centre (Hanoi National University of Education = HNUE), the Laboratory of Zoology (Cantho University = CTU), and in the Hue University of Education (HUE), Vietnam. The earthworm classification follows Sims & Easton (1972) and Easton (1979). Genera and species are listed alphabetically. Appropriate citations for each species are given if they provide original records for Vietnam and/or affect the taxonomy of the species. Remarks on species taxonomy are being discussed. Distribution maps were created using the software Diva-GIS ver. 7.5.

Fresh specimens were collected from all over Vietnam. The worms were killed in formalin 2%, transferred to formalin 4% for fixation for approximately 24 hours, and then transferred to new 4% formalin for long-term preservation and morphological studies. Holotype and paratypes of the new species described are deposited in the Laboratory of Zoology, CTU, Cantho City, Vietnam. Other specimens are housed in the Soil Organism Research Centre (SORC), HNUE, Hanoi, Vietnam.

Abbreviations: C = Clitellate specimen/specimens; A = Aclitellate specimen/specimens (e.g., "5C" = 5 clitellate specimens).

Taxonomic part

Family Megascolecidae Michaelsen, 1900

Genus *Metapheretima* Michaelsen, 1928

Pheretima (*Metapheretima*) (partim) Michaelsen, 1928: 8.

Metapheretima—Sims & Easton 1972: 205, 233; Easton 1979: 79.

Type species. *Perichaeta neoguinensis* Michaelsen, 1892, by original designation.

Diagnosis. "Megascolecidae with an oesophageal gizzard in VIII, intestinal caeca and gizzards absent. Body cylindrical, setae never excessively crowded ventrally, creeping sole absent. Male pores lacking porophores, occasionally on slim penes which may be within copulatory pouches. Crescentic genital markings associated with the male pores on mature individuals of most species. Spermathecal pores small or large, spermathecal diverticula variable in structure and origin" (Easton 1979: 79).

Distribution. North and southeast New Guinea, New Britain, Lombok, Carolines, Solomon Islands and New Hebrides (Easton 1979).

Metapheretima tani (Thai, 1996), comb. nov.

(Fig. 1)

Pheretima tani Thai, 1996: 4, Fig. 3A.

Polypheretima tani—Nakamura 1999: 7; Blakemore 2007: 53.

Type material. Holotype: 1A (SORC-HV.227) Vietnam, Phu Yen province, Tuy Hoa city, Hoa Binh co-operative, 15 November 1989, coll. Nguyen Duc Tan. Paratype: 1A (SORC-HV.227) same date as holotype (Thai 1996).

Description. Body cylindrical, unpigmented. Prostomium epilobous. First dorsal pore in 12/13. Setae numerous, regularly distributed on pre- and postclitellar segments, 104 in V, 110 in VIII, 104 in XIII, 66+18 in XVIII and 70 in XXV, aa=1.5ab, zz=zy. Numerous spermathecal pores in paired batteries in furrow 4/5. Crescentic genital markings associated with the porophores in XVIII. Genital markings paired, presetal on XIX–XXI, and presetal on VIII, IX and postsetal on VII, VIII. Spermathecae 15 pairs in 4/5. Ampulla somewhat enlarged distad, diverticula shorter. Holandric. Testes sacs ventral. Seminal vesicles developed in XI, less developed in XII. Ovisacs developing in XIII. Last hearts in XII. Intestine beginning at XV, and intestinal caeca absent. Typhlosole simple, lamelliform, T=0.21. Septa 8/9/10 absent, 5/6/7/8 thickened, 10/11/12 slightly thickened. Pharyngeal micronephridia in 7/8. (Data from Thai 1996: 4.)

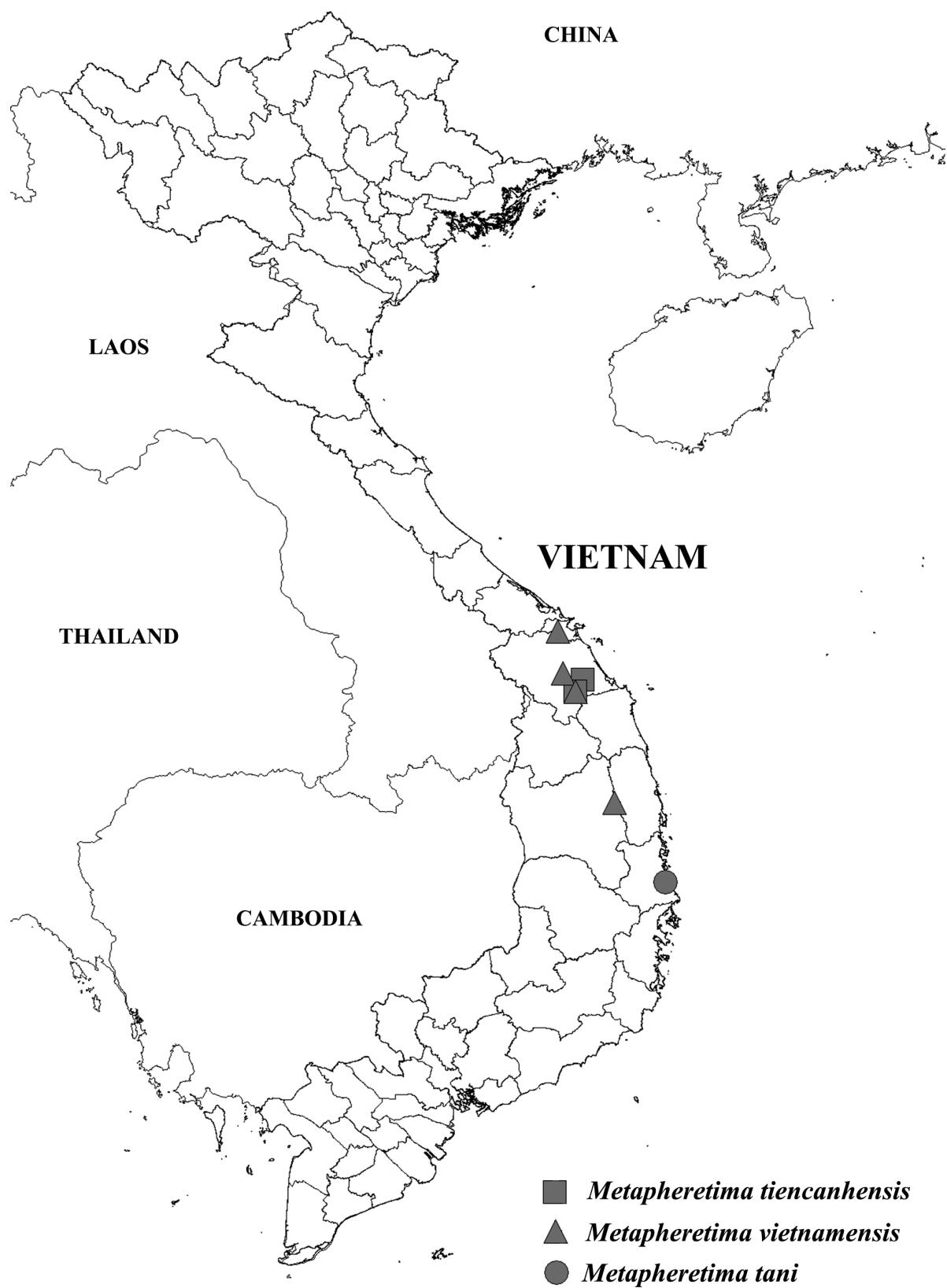


FIGURE 1. Distribution of species of the genus *Metapheretima* in Vietnam.

Records from Vietnam. Phu Yen Province (Tuy Hoa).

Distribution. Only known from Vietnam.

Remarks. The species is fairly similar to *Polypheretima elongata* (Perrier, 1872), but it is polythecal (about 15 spermathecae in V), with external markings in front of the clitellum and two pairs of crescentic genital markings in the male region. The species was transferred to *Polypheretima* by Nakamura (1999) and Blakemore (2007), but with the presence of two pairs of crescentic genital markings in XVIII (Thai 1996), the species fits better in *Metapheretima*. Blakemore (2007) considered it as "*species inquirenda*", but did not give arguments. Types were rechecked for this study and the species diagnosis is confirmed here.

***Metapheretima tiencanhensis* (Pham, 1995), comb. nov.**

(Fig. 1)

Pheretima tiencanhensis Pham, 1995b: 24, Fig. 1C.

Polypheretima tiencanhensis—Nakamura 1999: 7.

Type material. Holotype: 1C (SORC-HV.228) Quang Nam province, Tien Phuoc, Tien Canh, village No.1, 27 January 1988, coll. Pham Thi Hong Ha; Paratype: 1C (SORC-PV.228.1) Quang Nam province, Tra My town, group No.3, garden, 4 March 1989, coll. Pham Thi Hong Ha (Pham 1995).

Description. Body length 197mm, diameter 6 mm, segments 190, weight 2.3 gr. Medium size, colour ash. Clitellum 1/2XIII-3/4XVI. Prostomium epilobous. First dorsal pore in 11/12. Setae numerous, regularly distributed on segments, 87(43) in IV, 110(44) in V, 126 in VIII, 118 in XIII, 87+23 in XVIII, 82 in XIX, aa>ab, zz>zy. Crescentic genital markings associated with male porophores. Two pairs of genital markings on XVII and XIX. Spermathecal pores paired in 4/5–6/7. A pair of genital markings round on VII. Ampulla subequal to ducts in length, diverticula shorter. Testes sacs ventral, not separated. Prostate glands in XVII–XIX, strongly lobuled. Last heart in XIII. Intestine beginning at XV, without coeca. Typhlosole lamelliform, T=0.24. Septa 8/9/10 absent. Pharyngeal micronephridia in 7/8. (Data from Pham 1995: 24.)

Records from Vietnam. Quang Nam Province (Tien Phuoc; Tra My).

Distribution. Only known from Vietnam.

Remarks. The species is particularly similar to *Metapheretima vietnamensis* Thai, 1984, but differs in body size, position, number and morphology of spermathecal pores. The species was transferred to *Polypheretima* by Nakamura (1999) and Blakemore (2007), but with the presence of two pairs of crescentic genital markings in XVIII (Thai 1996), the species fits better in *Metapheretima*. Blakemore (2007) considered it as "*species inquirenda*", but did not give arguments. Types were rechecked for this study and the species diagnosis is confirmed here.

***Metapheretima vietnamensis* Thai, 1984**

(Fig. 1)

Metapheretima vietnamensis Thai, 1984: 614, Fig. 1B; Blakemore 2007: 104.

Type material. 1C (W.270, Zoological Museum of M. V. Lomonosov Moscow State University, Russia) (Thai, 1984)

Records from Vietnam. Gia Lai Province (An Khe town); Da Nang City (Hoa Vang); Quang Nam Province (Hiep Duc; Tra My) (Thai 1984; Pham 1995a).

Distribution. Only known from Vietnam.

Remarks. The species is relatively similar to *Metapheretima speiseri* (Michaelsen, 1913) and *Metapheretima apunae* Lee, 1981, but differs from both in having two pairs of spermathecal pores in 5/6 and the spermathecal diverticulum originating from the spermathecal duct (Thai 1984).

Genus *Planapheretima* Michaelsen, 1934

Pheretima (*Planapheretima*) Michaelsen, 1934: 15.
Planapheretima—Sims & Easton 1972: 209, 233; Easton 1979: 64.

Type species. *Pheretima moultoni* Michaelsen, 1913, by original designation.

Diagnosis. "Megascolecidae with an oesophageal gizzard in VIII. Intestinal caeca sometimes present, intestinal walls often with glandular areas, intestinal gizzards absent. Body mainly flattened dorsoventrally, setae usually crowded ventrally, creeping sole often present. Male pores simple, never within copulatory pouches. Spermathecal diverticula simple, usually ectal in origin" (Easton 1979: 64).

Distribution. China (Szechuan), Myanmar, Vietnam, Indonesia (Sumatra, Borneo), Celebes and New Guinea (Easton 1979).

Remarks. Easton (1979) commented that both acaecate and caecate species of the genus *Planapheretima* formed a single phenetic group different from other acaecate genera, but he still considered them as belonging to the 'acaecate' *Pheretima* group. No analysis on the genus has been made to confirm its taxonomic status. Thus, all *Planapheretima* species in this study are temporally placed in the 'acaecate' group.

***Planapheretima arboricola* (Rosa, 1890)**

(Fig. 2)

Perionyx arboricola Rosa, 1890: 119; Beddard 1895: 438; Michaelsen 1900: 209; Michaelsen 1903: 89; Gates 1936: 465; Gates 1972: 141.

Pheretima arboricola—Gates 1936: 399; Gates 1972: 169; Thai 1997: 5, Fig. 3B.

Planapheretima arboricola—Sims & Easton 1972: 233; Easton 1979: 76, Figs 27j, 30a.; Nakamura 1999: 5; Blakemore 2007: 8.

Type locality. Myanmar (Mt Carin).

Type material. Genoa 44017, Museo Civico di Storia Naturale "Giacomo Doria", Italy. (Rosa 1890)

Material examined. 12A (SORC-V.206.1) Vinh Phuc province, Tam Dao National Park, on the way to the Rung Rinh peak, 20 June 1995.

Records from Vietnam. Vinh Phuc Province (Tam Dao National Park) (Thai 1997).

Distribution. Myanmar; Vietnam.

Remarks. The populations in Vietnam differ from the description of Gates (1936) in having spermathecal pores paired in VI, VII, additional genital markings in VI, and more setae (Thai 1997).

***Planapheretima lacertina* (Chen, 1946)**

(Fig. 2)

Pheretima lacertina Chen, 1946: 109, Plate IV Fig. A; Thai, 1997: 4, Fig. 2C.

Planapheretima lacertina—Sims & Easton 1972: 233; Easton 1979: 78, Figs 27k, 30d; Nakamura 1999: 5; Blakemore 2007: 57.

Type locality. China (Szechuan).

Material examined. 2C (HNUE) Son La Province, Ta Sua Natural Reserve, forest, 30 December 2012, coll. Tran T.T. Binh.

Records from Vietnam. Lao Cai Province (Sapa)—(Thai, 1997); Son La Province (Ta Sua).

Distribution. China; Vietnam.

Remarks. The population in Vietnam differs from the original description of the species (Chen 1946) in smaller body size, fewer setae and in having spermathecal pores paired in 5/6/7/8 (Thai 1997).

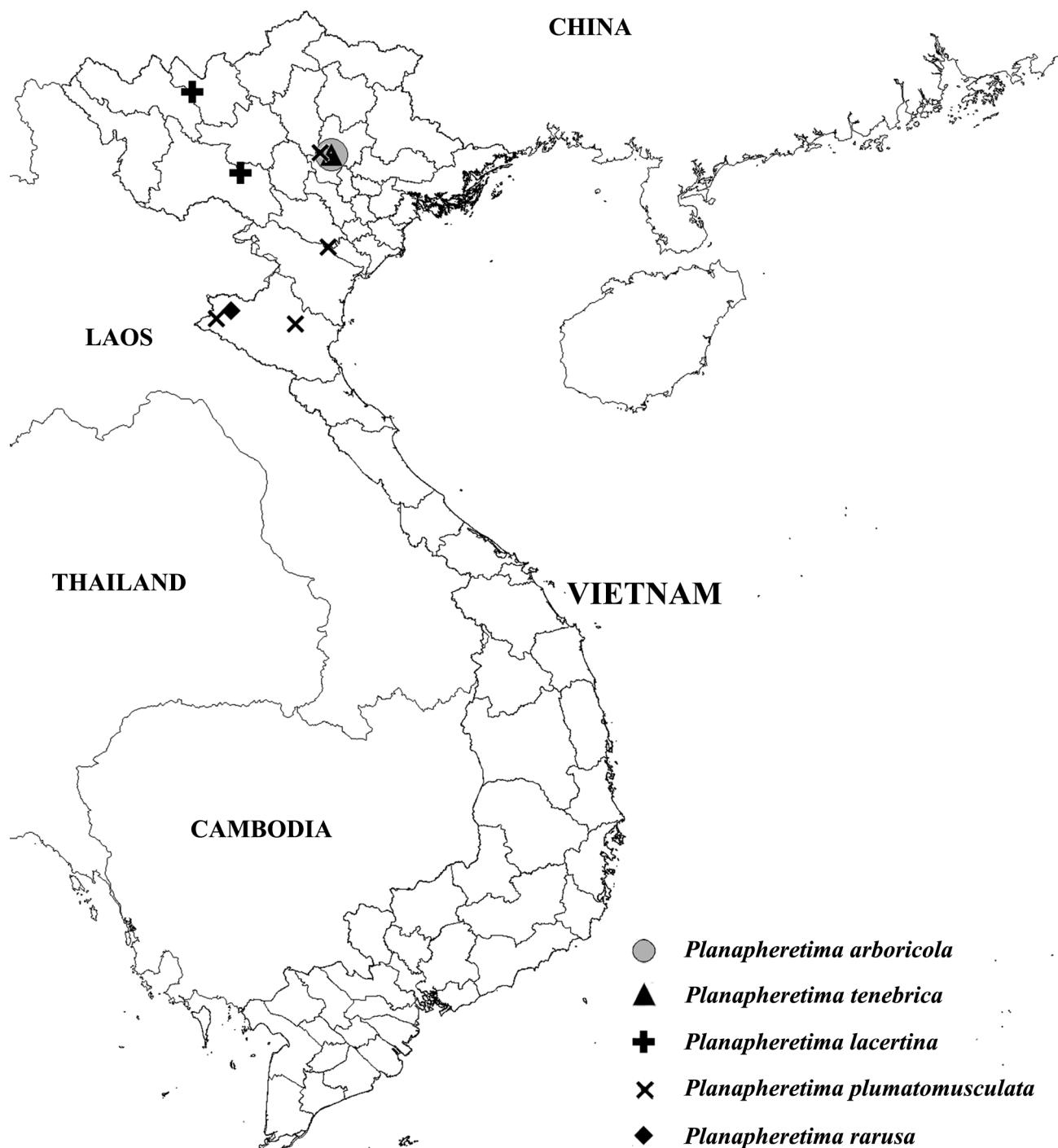


FIGURE 2. Distribution of species of the genus *Planapheretima* in Vietnam.

***Planapheretima plumatomusculata* (Thai, 1982)**
(Fig. 2)

Pheretima plumatomusculata Thai, 1982: 829, Fig. 3g; Thai 1997: 2, Fig. 2B.
Planapheretima plumatomusculata—Blakemore 2007: 81.

Type locality. Vietnam (Ninh Binh).

Type material. In the collection of Zoological Museum of M. V. Lomonosov Moscow State University, Russia.

Material examined. 8C, 7A (CTU) Vinh Phuc Province, Tam Dao National Park, on the way to the observation tower, 25 July 1998, coll. Tran T.T.Binh.

Records from Vietnam. Nghe An Province (Ky Son; Quy Hop); Ninh Binh Province (Cuc Phuong); Vinh Phuc Province (Tam Dao) (Thai 1997; Do 1994; Le 1995).

Distribution. Only known from Vietnam.

Remarks. The species is fairly similar to *Planapheretima lacertina* (Chen, 1946), but differs in having spermathecal pores paired in 5/6/7 dorsally and pigments dorsally (Thai 1997).

***Planapheretima rarusa* (Thai, 1997)**

(Fig. 2)

Pheretima rarusa Thai, 1997: 1, Fig. 2A.

Planapheretima rarusa—Blakemore 2007: 85.

Type material. Holotype: 1C (SORC-V.202) Nghe An province, Ky Son District, Muong Long commune, Tham Lang village, forest, 21 June 1986, coll. Tran Minh Khoi. Paratypes: 1C, 1A, same data as holotype; 1C, Nghe An province, Ky Son District, Chau Son, primary forest (Thai 1997).

Description. Body length 75mm, diameter 3.5–4mm, segments 92. Body flattened ventrally with creeping sole. Prostomium epilobous. First dorsal pore in 9/10. Clitellum in XIV–XVI. Setae numerous, more distributed ventrad, 65(57) in V, 81(71) in VIII, 27–30 in XVIII, 68 in XXV, $yz=7ab$, $zz=11aa$. Porophores in shallow pouches of parietal invagination. Genital markings small, oval papillae, ranged in transversal presetal and postsetal lines, 2 on XVII, 3+2 on XVIII and 2 on XIX. Spermathecal pores three pairs, dorsolateral in 5/6/7/8. Ampulla more or less heart-shaped, diverticula as long as or longer than ampulla, attaching to ducts. Testes sacs ventral, not separated. Seminal vesicles well developed in XI–XVI. Prostate glands well-developed, strongly lobulated. Ovisacs well developed. Last hearts in XIII. Intestine beginning at XV. Intestinal caeca in XXVI–XXVII. Septa 8/9/10 present, other septa thinned. Pharyngeal micronephridia in 6/7. (Data from Thai 1997: 1–2.)

Records from Vietnam. Nghe An Province (Ky Son: Muong Long) (Thai 1997).

Distribution. Only known from Vietnam.

Remarks. The species is very close to *Planapheretima plumatomusculata* (Thai, 1982) but differs in violet color dorsally, having copulatory pouch, genital markings in male regions, and accessory glands with long duct (Thai 1997). Types were rechecked for this study.

***Planapheretima tenebrica* (Chen, 1946)**

(Fig. 2)

Pheretima tenebrica Chen, 1946: 93, Plate III Fig. A; Thai 1997: 4, Fig. 3A.

Planapheretima tenebrica—Sims & Easton 1972: 233; Easton 1979: 77, Figs 27l, 30e; Nakamura 1999: 5; Blakemore 2007: 97.

Type locality. China (Szechuan).

Records from Vietnam. Vinh Phuc Province (Tam Dao) (Thai 1997).

Distribution. China; Vietnam.

Remarks. The population in Vietnam differs from the original description (Chen 1946) in bigger size, more setae and having simple intestinal caeca (Thai 1997).

Genus *Polypheretima* Michaelsen, 1934

Pheretima (*Polypheretima*) Michaelsen, 1934a: 25.

Metapheretima (part)—Sims & Easton 1972: 205, 233.

Polypheretima—Easton 1979: 28.

Type species. *Perichaeta stelleri* Michaelsen, 1892, by original designation.

Diagnosis. "Megascolecidae with an oesophageal gizzard in VIII, intestinal caeca and gizzards absent. Body cylindrical, setae never excessively crowded ventrally, creeping sole absent. Male pores on circular porophores which may be within copulatory pouches. Crescentic genital markings absent. Spermathecal pores small, spermathecal diverticula simple and usually ectal in origin" (Easton 1979: 28).

Distribution. Philippines, Indonesian archipelago, Papua New Guinea, Malaya peninsula and Vietnam (Easton 1979).

***Polypheretima annamensis* (Stephenson, 1931)**

(Fig. 3)

Pheretima annamensis Stephenson, 1931: 60, text-fig. 13.

Metapheretima annamensis—Sims & Easton 1972: 233.

Polypheretima annamensis—Easton 1979: 56; Nakamura 1999: 7; Blakemore 2007: 7.

Type locality. Vietnam (Lam Dong).

Type material. BMNH1930.2.7.10-11, British Museum of Natural History, London, UK. (Stephenson, 1931)

Records from Vietnam. Lam Dong Province (Lang Bian Peaks) (Stephenson 1931).

Distribution. Only known from Vietnam.

Remarks. There are no other records from Vietnam since its description.

***Polypheretima colonensis* (Thai, 1996)**

(Fig. 3)

Pheretima colonensis Thai, 1996: 1, fig. 2A.

Polypheretima colonensis—Nakamura 1999: 7; Blakemore 2007: 24.

Type material. 7A (SORC-HV.222) Ba Ria-Vung Tau province, Conlon Island, Nha Bang slope, 6200m asl, 24–26 June 1989, coll. Thai Tran Bai (Thai 1996).

Description. Body cylindrical, unpigmented. Prostomium prolobous. First dorsal pore in 11/12. Setae all fine and regularly distributed on pre- and postclitellar segments, 97(22) in V, 89 in VIII, 72 in XIII, 50+4 in XVIII, 80(16) in XIX, 74 in XXV, aa=2ab, zz=2zy. Male porophore superficial, on an eyelike circular plate. Crescentic genital markings present in association with male porophores. No other genital markings in spermathecal and male regions. Spermathecal pores 2 pairs, ventral in furrows 5/6/7, about 0.25 body circumference apart. Ampulla heart-shaped, diverticula short, attaching to duct. Metandric. Testes sacs ventral in XI, not separated. Seminal vesicles in XII. Ovaries and ovisacs well developed in XIII. Last hearts in XIII. Intestine beginning at XVII, without caeca. Typhlosole simple, lamelliform, T=0.12. Septa 8/9 and 10/11 absent, 5/6/7/8 and 9/10 thickened, 11/12/13 slightly thickened. Pharyngeal micronephridia in 7/8. (Data from Thai 1996: 1–2.)

Records from Vietnam. Ba Ria—Vung Tau Province (Conlon Island).

Distribution. Only known from Vietnam.

Remarks. The species is fairly similar to *Polypheretima sepikensis* Ude, 1924, but it is metandric, genital markings and accessory glands are absent, and the first dorsal pore is in 11/12. There are crescentic markings in front of and behind the male pores, but they differ from the crescentic genital markings of *Metapheretima* sensu Easton (1979). Types were rechecked for this study.

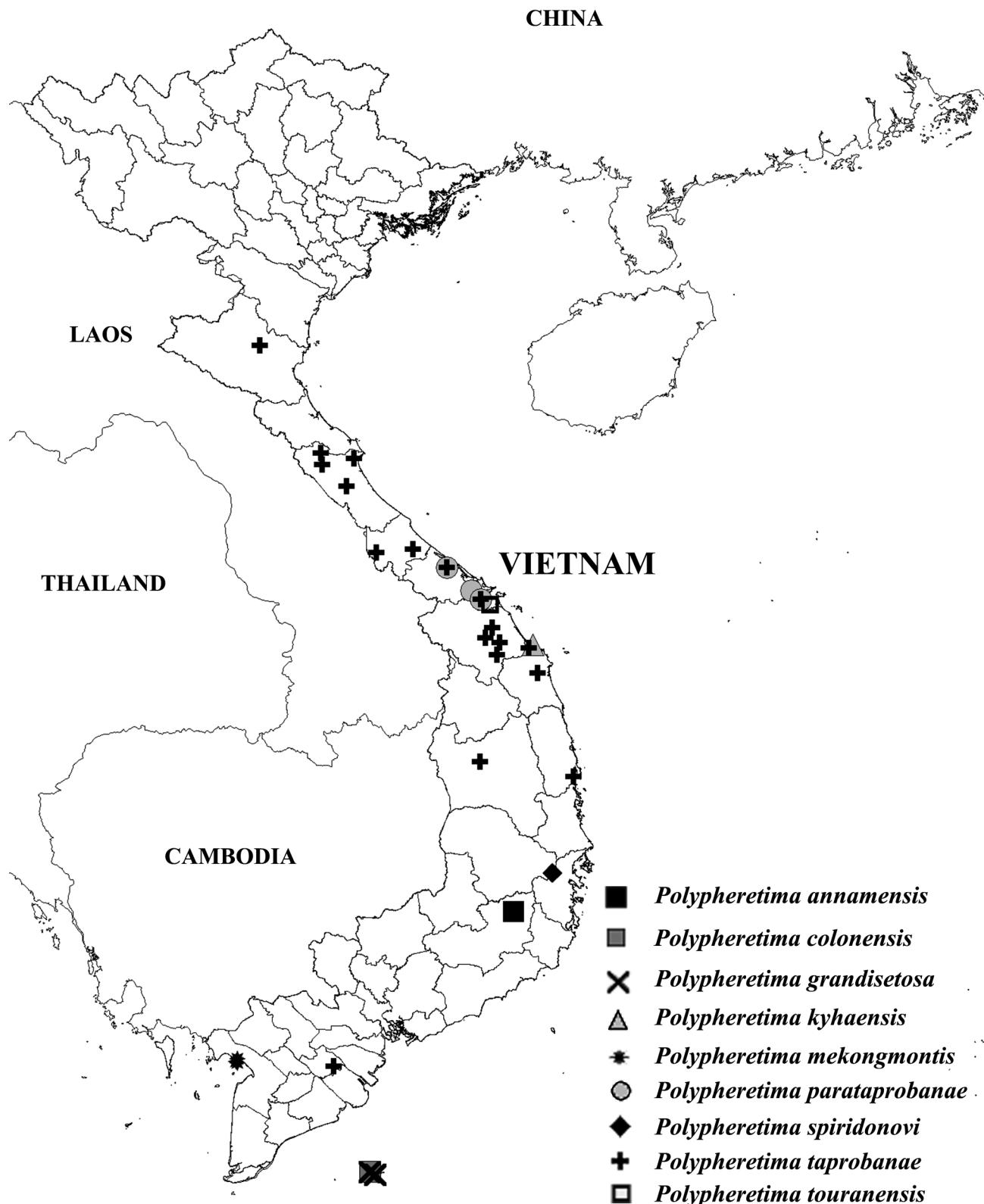


FIGURE 3. Distribution of species of the genus *Polypheretima* in Vietnam. The exotic *Po. elongata* with many records all over the country is omitted.

***Polypheretima elongata* (Perrier, 1872)**

(Fig. 4)

Perichaeta elongata Perrier, 1872: 124, Plate IV Fig. 69; Beddard 1895: 431.

Metapheretima elongata—Sims & Easton 1972: 233.

Polypheretima elongata—Easton 1979: 53, Fig. 22a; Nakamura 1999: 7; Blakemore 2002: 231, Fig. 2.19; 2007: 32.

Perichaeta biserialis Perrier, 1875: 1044.

Perichaeta acystis Beddard, 1895: 423.

See Easton (1976: 40–41) and Blakemore (2002) for more synonyms.

Type locality. Peru.

Type material. AE 633-646, Museum of National History, Paris, France.

Material examined. 45C (HNUE) Thai Binh province, Quynh Phu District, rice field, July 2013 coll. Nguyen Thi Bich; 5C (HNUE) Kon Tum province, Kon Klor village, garden, October 2013, coll. Nguyen Thi Lan; 3C (HNUE) Phu Tho province, Thanh Ba District, May 2009, coll. Nguyen Thi Thuy Phuong; 63C (HNUE) Nam Dinh province, Hai Hau District, garden, May 2012, coll. Nguyen Thi Ha; 15C (HUE) Tien Giang province, Cai Lay District, Tan Hoi commune, garden, 28 October 2008, coll. Nguyen Huy Nam; 25C+30A (HUE) Tien Giang province, Cho Gao District, long-term tree garden, 25 August 2008, coll. Nguyen Van Nam; 7C+11A (HUE) Lam Dong province, Dam Rong District, Da Tong Commune, short-term tree growing land near Da Nhim forest, <600m asl, 14 April 2013 coll. Nguyen Van Nam; 15C (CTU-EW027) Vinh Long province, Vung Liem District, 9 November 2008, coll. Nguyen Thi Nhi.

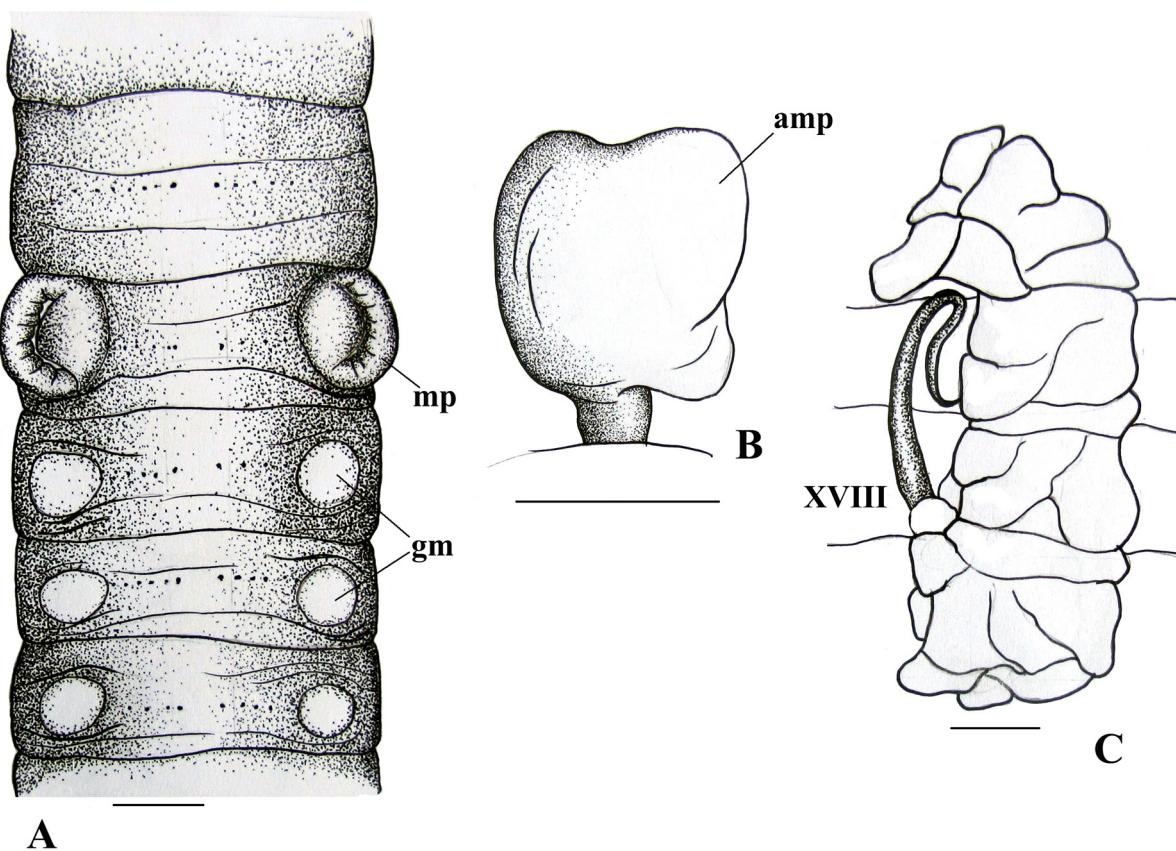


FIGURE 4. *Polypheretima elongata* (Perrier, 1872) from Vung Liem, Vinh Long Province. **A.** Male pore region (mp = male pore, gm: genital marking). **B.** Spermathecae (amp= ampulla). **C.** Prostate gland. Scale = 1mm.

Records from Vietnam. Bac Giang Province (Tan Yen); Lang Son Province (Dong Mo, Chi Lang); Quang Ninh Province (Tien Yen); Hai Phong Province (Cat Ba and Cat Hai Islands); Dien Bien Province (Dien Bien city); Son La Province (Song Ma); Nghe An Province (Ky Son); Ha Noi city; Hai Duong Province; Hung Yen Province; Ha Nam Province; Nam Dinh Province; Ninh Binh Province; Quang Binh Province (Quang Trach; Dong Hoi);

Quang Tri Province (Dong Ha; Quang Tri); Thua Thien Hue Province (Hue; Phu Loc); Binh Dinh Province; Ninh Thuan Province (Phan Rang; Ninh Son; Song Pha; Ninh Hai); Binh Thuan Province (Bac Binh; Tuy Phong; Phan Ri); Ben Tre Province (Binh Dai; Thanh Phu; Cho Lach; Ba Tri); Can Tho city (Can Tho); Vinh Long Province; Dong Thap Province; Tien Giang Province; An Giang Province; Tra Vinh Province; Soc Trang Province; Ca Mau Province (Do & Le 1992; Le 1995; Do 1994; Tran 1985; Nguyen 1994; Huynh 1996; Thai 1987; Nguyen & Tran 2008).

Distribution. A cosmopolitan species (Blakemore 2002, 2007).

Remarks. *Polypheretima elongata* is an exotic species originating from the Indonesian region (Easton 1976), and commonly found in the Indochinese region (Thai 1983). A new illustration of *Po. elongata* is provided in this study (Fig. 4) because there are no available figures of this species from Vietnamese samples.

***Polypheretima grandisetosa* (Thai, 1996)**

(Fig. 3)

Pheretima grandisetosa Thai, 1996: 3, Fig. 2B.

Polypheretima grandisetosa—Nakamura 1999: 7; Blakemore 2007: 45.

Type material. Holotype: 1A (SORC-HV.223) Ba Ria-Vung Tau province, Conlon Island, slope near Datdoc Bay, 10m asl, 25 June 1989, coll. Thai Tran Bai. Paratype: 1A, same data as holotype (Thai 1996).

Further material. 5A (SORC), Ba Ria-Vung Tau province, Baycanh Island, 210m asl, 20 June 1989, coll. Thai Tran Bai (Thai 1996).

Description. Body cylindrical, small size, unpigmented. Prostomium prolobous. First dorsal pore in 11/12. Setae all fine and regularly distributed on pre- and postclitellar segments, 60(16) in V, 54 in VI, 50 in VIII, 40+4 in XVIII, 44 in XXV, aa=1.52ab, zz=zy; segment VI with 4–6 enlarged setae on the dorsal side. Male pores on transversely oval porophores. No genital markings in both spermathecal and male regions. Spermathecal pores 2 pairs, ventral in furrows 5/6/7, about 0.25 body circumference apart. Metandric. Seminal vesicles in XII. Ovaries small in XIII. Last hearts in XIII. Intestine beginning at XVII, without caeca. Typhlosole simple, lamelliform, T=0.15. Septa 8/9/10 absent, 5/6/7/8 thickened. Pharyngeal micronephridia in 7/8. (Data from Thai 1996: 3–4.)

Records from Vietnam. Ba Ria-Vung Tau Province (Conlon Island; Baycanh Island).

Distribution. Only known from Vietnam.

Remarks. The species is relatively close to *Polypheretima colonensis* Thai, 1996, but differs in smaller size and the presence of big setae in VI. Types were rechecked for this study.

***Polypheretima kyhaensis* (Thai, 1996)**

(Fig. 3)

Pheretima kyhaensis Thai, 1996: 4, Fig. 3B.

Polypheretima kyhaensis—Nakamura 1999: 7; Blakemore 2007: 61.

Type material. Holotype: 1A (SORC-HV.224) QUANG NAM, Nui Thanh District, Ky Ha commune, 24 November 1989, coll. Pham Thi Hong Ha. Paratype: 1A, same data as holotype (Thai 1996).

Description. Body cylindrical, colour pale. Prostomium epilobous. First dorsal pore in 11/12. Setae numerous, regularly distributed on segments, 160(40) in V, 126(50) in VIII, 32+16 in XVIII, 60(20) in XIX, 62 in XXV, aa>ab, zz>zy. Male porophores superficial. Spermathecal pores 4 pairs, ventral in 5/6-8/9. Genital markings presetal, paired, one pair each on VIII and IX, two pairs on XVIII and XIX, and one pair on XVII, XX and XXI. Ampulla heart-shaped, diverticula small, attaching to duct. Holandric. Testes sacs extending to the lateral line. The first seminal vesicles more developed and larger than the other seminal vesicles. Ovaries large on septum 12/13. Prostate glands in XVII-XIX. Intestine beginning at XV, without caeca. Typhlosole simple, lamelliform, T=0.35. Last hearts in XII. Septa 8/9/10 absent, 4/5–7/8 thickened. Pharyngeal micronephridia in 5/6/7/8. Lymph glands not developed (Data from Thai 1996: 4–5.).

Records from Vietnam. Quang Nam Province (Nui Thanh, Ky Ha).

Distribution. Only known from Vietnam.

Remarks. The species is fairly similar to *Polypheretima monticola* (Beddard, 1912), but differs in the absence of septa 8/9/10, more complicated arrangement of genital markings in the male pore region. Types were rechecked for this study.

***Polypheretima parataprobanae* (Thai & Nguyen, 1993)**

(Fig. 3)

Pheretima parataprobanae Thai & Nguyen, 1993: 7, Fig. 1C.

Polypheretima parataprobanae—Blakemore 2007: 77.

Type material. Holotype: 1C (SORC-HV.225) Thua Thien Hue province, Hue city, Nguyet Bieu, sandy garden, 13 January 1985, coll. Nguyen Van Thuan. Paratypes: 1C, 1A, same data as holotype (Nguyen 1993).

Description. Medium size, body cylindrical, colour pale. Prostomium prolobous. First dorsal pore in 12/13. Setae numerous, regularly distributed on segments, 104–126 in V, 124–134 in VIII, (64–78) + (18–22) in XVIII, 104–120 in XIX, 96–110 in XXV, aa \geq ab, zz=1–1.5zy. Porophores raising strongly with small slits around the foot. No genital markings in male region. Spermathecal pores 1 pair ventral in 7/8. Genital markings oval-shaped, one pair, presetal on VIII. Ampulla heart-shaped, ducts short and small, diverticula short, attaching to ducts. Testes sacs ventral, not separated. Protate glands slightly lobuled. Typhlosole lamelliform, T=0.03. Intestine beginning at XVI, without caeca. Septa 5/6/7/8 thickened, 8/9/10 absent. (Data from Nguyen 1993: 7.)

Records from Vietnam. Thua Thien Hue Province (Hue city, Bach Ma National Park); Da Nang city (Hoa Vang) (Nguyen 1993) (Pham 1995a).

Distribution. Only known from Vietnam.

Remarks. The species is fairly similar to *Polypheretima taprobanae* (Beddard, 1892), but differs in absence of genital markings in the male region, and having a pair of genital markings near the spermathecal pores. Types were rechecked for this study.

***Polypheretima spiridonovi* (Thai, 1996)**

(Fig. 3)

Pheretima spiridonovi Thai, 1996: 3, Fig. 2C.

Polypheretima spiridonovi—Nakamura 1999: 7; Blakemore 2007: 93.

Type material. Holotype: 1C (SORC-HV.226) Khanh Hoa Province, Duc Mu pass, 9 January 1989, coll. Spiridonov S.E. Paratype: 1C (SORC-PV.226), same data as sample SORC-HV.226 (Thai 1996).

Description. Body cylindrical. Colour light brown. Prostomium epilobous. Clitellum XIV–XVI. First dorsal pore in 12/13. Setae numerous, regularly distributed on segments, 113 in IV, 136 in XIII, 120 in XXV, aa=1.5–2ab, zz=2–5zy. Male porophore on the bottom of a cone-like depression, about 0.25 body circumference apart. No genital markings in spermathecal and male regions. Numerous spermathecal pores in paired batteries, 6 pairs in 4/5, 6 pairs in 6/7 and 7 pairs and a single battery in 5/6. Ampulla heart-shaped, diverticula simple, attaching to duct. Holandric. Testes sacs ventral. Lymph glands absent. Ovaries large on septum 12/13. Intestine beginning at XV, without caeca. Last hearts in XII. Typhlosole simple, lamelliform, T=0.22. Septa 8/9/10 absent, 5/6/7/8 thickened. Pharyngeal micronephridia in 6/7. (Data from Thai 1996: 3–4.)

Records from Vietnam. Khanh Hoa Province (Duc Mu pass).

Distribution. Only known from Vietnam.

Remarks. The species is fairly similar to *Polypheretima polytheca* (Beddard, 1900) but differs in having spermathecal pores in 4/5–6/7, testes sacs in ventral position, absence of a copulatory pouch, and absence of genital markings. Types were rechecked for this study.

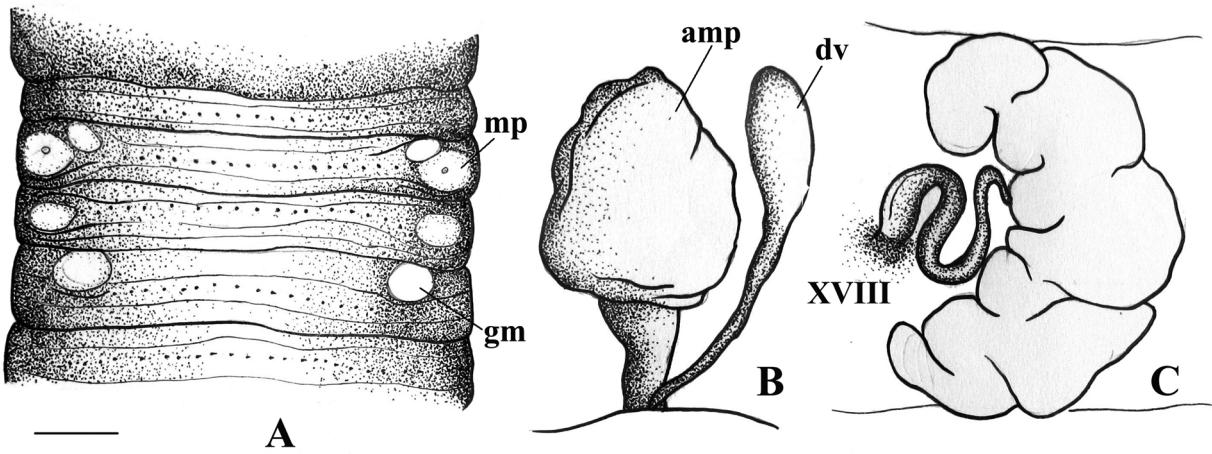


FIGURE 5. *Polypheretima taprobanae* (Beddard, 1892) from Vung Liem, Vinh Long Province. **A.** Male pore region (mp=male pore, gm=genital marking). **B.** Spermathecae (amp=ampulla, dv=diverticula); **C.** Prostate gland. Scale = 1mm.

Polypheretima taprobanae (Beddard, 1892)

(Figs 3, 5)

Perichaeta taprobanae Beddard, 1892: 163; Beddard 1895: 411; Michaelsen 1900: 308.

Metapheretima taprobanae—Sims & Easton 1972: 181, 233.

Polypheretima taprobanae—Easton 1979: 45, Fig. 20c; Nakamura 1999: 8; Blakemore 2002: 234, Fig. 2.20; 2007: 97.

Perichaeta pauli Michaelsen 1897: 243, Fig. 26.

Pheretima taprobanae var. *pauli*—Michaelsen 1900: 309.

Metapheretima pauli—Sims & Easton 1972: 233.

Pheretima taprobanae—Gates, 1972: 220.

Type locality. Sri Lanka.

Type material. In the collection of the Oxford University Museum, U.K.

Material examined. 6C (SORC-V.241.2) Quang Binh province, Bo Trach District, Tan Trach commune, 18 May 1991, coll. Nguyen Van Thuan; 1C (SORC-V.241.6) Quang Binh province, Tuyen Hoa district, Mai Hoa commune, tea planted hill, 20 August 1991, coll. Nguyen Duc Tan; 1C (SORC-V.241.3) Quang Nam province, Nui Thanh district, Ky Ha, 24 January 1989, coll. Pham Thi Hong Ha; 1C, 1A (SORC-V.241.6) Quang Ngai province, garden, 30 November 1994, coll. Cao Van Sung; 3C (HUE) Lam Dong province, Dam Rong District, Da Tong Commune, short-term tree growing land near Da Nhim forest, <600m asl, 14 April 2013 coll. Nguyen Van Nam; 3C + 3A (HUE) Lam Dong province, Dam Rong District, Da Rsal commune, bare hill, 600-800m asl, 14 April 2013, coll. Nguyen Van Nam; 5C (CTU-EW027) Vinh Long province, Vung Liem District, Trung Thanh commune, 9 November 2008, coll. Nguyen Thi Nhi.

Records from Vietnam. Nghe An Province (Quy Hop); Quang Binh Province (Tuyen Hoa; Minh Hoa; Quang Trach; Bo Trach); Quang Tri Province (Quang Tri; Huong Hoa); Thua Thien Hue Province (Huong Dien; Hue city); Da Nang city (Hoa Vang); Quang Nam Province (Que Son; Hiep Duc; Nui Thanh; Tien Phuoc; Tra My); Quang Ngai Province (Tu Nghia); Gia Lai Province (Pleiku city); Binh Dinh Province; Vinh Long Province (Vung Liem) (Do 1994; Nguyen 1994; Pham 1995a; Huynh 1996; Nguyen & Tran 2008).

Distribution. A cosmopolitan species (Blakemore 2002, 2007).

Remarks. The species has been recorded from various parts of the world (India, Sri Lanka, Seychelles, Brazil, Hawaii, Madagascar, Fiji, Australia, Southeast Asia, Papua New Guinea) (Blakemore 2002). However, its homeland is still unknown exactly. The species possibly originated in Southeast Asia (Easton 1979) or in Papua New Guinea (Gates 1972). A new illustration of *Po. taprobanae* is provided in this study (Fig. 5) because there are no available figures of this species from Vietnamese samples.

***Polypheretima touranensis* (Michaelsen, 1934)**

(Fig. 3)

Pheretima touranensis Michaelsen, 1934b: 499.

Pheretima touranensis—Sims & Easton 1972: 225, "incertae sedis".

'*Pheretima*' *turanensis*—Easton 1979: 118.

Amyntas? *turanensis*—Blakemore 2007: 100.

Type locality. Vietnam (Tourane = Da Nang).

Type material. AE688 (A730), Museum of Natural History, Paris, France.

Records from Vietnam. Da Nang City (Vu Gia pass) (Michaelsen 1934b).

Distribution. Only known from Vietnam.

Remarks. The intestine of the type material was so damaged that presence or absence of caeca could not be identified. However, Easton (1979) still placed the species into the 'acaecate' *Pheretima* group. There are no other records from Vietnam since its original description.

***Polypheretima mekongmontis* sp. nov.**

(Figs 3, 6)

Type material. Holotype: 1C (CTU. EW028—h01) Kien Giang Province, Hon Dat District, Hon Me Mt. (10°06'12.3N; 104°52'43.5E), mango garden, 13 November 2010, coll. Nguyen Thanh Tung. Paratypes: 10C (CTU. EW028—p02), same data as holotype.

Further material. 3C, Kien Giang Provinve, Hon Dat District, Mt. Hon Soc (10°09'48.1N; 104°54'23.2E); 3C, Kien Giang Provinve, Hon Dat District, Mt. Hon Dat (10°06'37.6N; 104°53'06.2E), 13 November 2010, all coll. Nguyen Thanh Tung.

Diagnosis. Small to medium body size, prostomium prolobous, first dorsal pore in 12/13, polythecal, spermathecal pores in 4/5/6/7, male pores paired in XVIII, each in a copulatory pouch with a large opening, genital markings large, paired in XVII and XIX, anterior pair in XVII directing towards the mid-ventral part, clitellum annular, XIV–XVI, intestinal caeca absent, testes paired, ventral, holandric, septa 8/9/10 absent.

Etymology. Named after its location, which is the mountain region of the Mekong Delta, Vietnam.

Description. Body length 65–101 mm, diameter 1.58–3.36 mm, fresh weight 0.3–1.1 gr, segment number 122–160. Colour similar on dorsum and ventrum, brownish in front of clitellum, brown around clitellum, with a greyish black tail. Prostomium prolobous. First dorsal pore in 12/13. Setae 37–49 in VIII, 40–53 in XXX, 4–7 between male pores, aa = 1.2–1.5 ab, zz = 1.3–2 zy. Clitellum annular, XIV–XVI, smooth, setae and dorsal pores absent. Polythecal, spermathecal pores ventrolateral in 4/5/6/7, not more than 4 pairs per segment, number of spermathecal pores gradually increasing from anterior to posterior segments, distance between paired spermathecal pores about 0.3 body circumference ventrally. Female pore single, mid-ventral in XIV. Male pores paired in XVIII, ventro-lateral, distance between pores about 0.30 body circumference ventrally, each in a copulatory pouch with a large opening. Genital markings large, paired in XVII and XIX, anterior pair in XVII directing towards the mid-ventral part.

Septa 5/6/7/8 thick, 8/9/10 absent, 10/11/12/13 thin. Gizzard round in IX–X. Intestine enlarged from XV or XVI. Intestinal caeca absent. Last lateral hearts in XII. Pharyngeal micronephridia in 5/6/7. Lymph glands absent. Overall number of spermathecae in V–VII 13 to 18. Ampulla oval, spermathecal diverticula present, stalk coiled, shorter than ampulla, originating from spermathecal duct. Accessory glands absent in spermathecal region. Typhlosole simple, lamelliform. Holandric, testes sacs paired in X and XI, small, separated, ventral, yellowish. Seminal vesicles paired in XI and XII, divided into several small lobes. Ovaries paired in ventral XIII, ovisacs developing in XIII, less so in XIV. Prostate glands paired in XVIII, extending anteriorly to XVII and posteriorly to XIX. Prostatic duct C-shaped. Accessory glands (Fig. 6E) hidden under parieties.

Locality and habitat. Examined specimens were collected from sandy soil in the mango garden in Kien Giang Provinve (Hon Dat, Hon Soc and Hon Me Mountain—Hon Dat District, Den Mountain—Ha Tien Town); An Giang Province (To Mountain—Tri Ton District). All mature specimens were collected in November, 2010. A lot of their castings could be seen on the surface of the soil where they live (Fig. 6F).

Remarks. The new species is fairly similar to *Polypheretima spiridonovi* (Thai, 1996) in the following characters: first dorsal pore in 12/13, polythecal with spermathecal pores in 4/5/6/7, last lateral hearts in XII, septa 5/6/7/8 thick, lymph gland absent, ovisacs in XIII. It differs from *Po. spiridonovi* in the following: copulatory pouches in XVIII, paired genital markings in XVII and XIX, lower number of spermathecae.

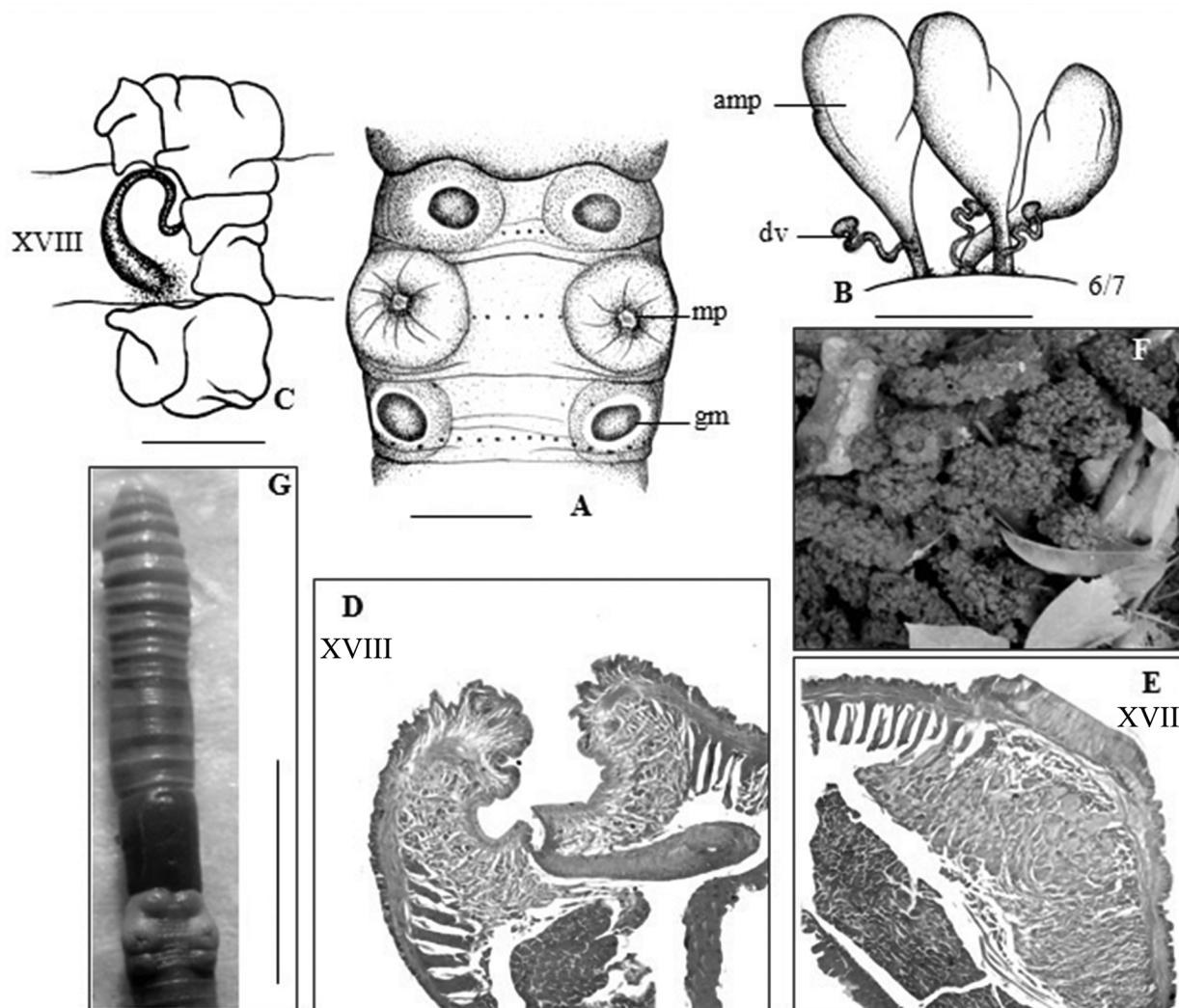


FIGURE 6. *Polypheretima mekongmontis* sp. nov., holotype (A–E, G). A. Male pore region (mp=male pore, gm=genital marking). B. Spermathecae (amp=ampulla, dv=diverticula). C. Prostate gland. D. Copulatory pouch, transverse body section E. Accessory gland, transverse body section. F. Casts. G. Ventral view of clitellum and male pore region. Scale bar = 1mm (for A, B, C), = 10mm (for G).

Key to species of the 'acaecate' *Pheretima* group in Vietnam

- | | | |
|---|--|---------------------------------|
| 1 | Body cylindrical; creeping sole absent | 2 |
| - | Body more or less flattened ventrally; creeping sole present | 10, genus <i>Planapheretima</i> |
| 2 | Crescentic genital markings present in XVIII | 3, genus <i>Metapheretima</i> |
| - | Crescentic genital markings absent | 4, genus <i>Polypheretima</i> |
| 3 | Spermathecal pores numerous in 4/5; last heart in XII | <i>M. tani</i> |
| - | Spermathecal pores three pairs in 4/5/6/7; last heart in XIII | <i>tiencanhensis</i> |
| - | Spermathecal pores two pairs in 5/6 and three pairs in 6/7/8/9 | <i>M. vietnamensis</i> |
| 4 | Genital markings absent in both male and spermathecal region | 5 |
| - | Genital markings present in both male and spermathecal region | 7 |
| - | Genital markings present in male region only | 8 |
| 5 | Two pairs of spermathecal pores in 5/6/7; metandric | 6 |
| - | One pair of spermathecal pores in 6/7; holandric | <i>Po. annamensis</i> |

-	Polythecal in 4/5/6/7; holandric	<i>Po. spiridonovi</i>
6	Four to six large setae on the dorsum of VI; male pores simple	<i>Po. grandisetosa</i>
-	Large setae in VI absent; male pores on an eyelike circular plate	<i>Po. colonensis</i>
7	Four pairs of spermathecal pores in 5/6-8/9	<i>Po. kyhaensis</i>
-	One pair of spermathecal pores in 7/8	<i>Po. taprobanae</i>
8	Bithecal	<i>Po. parataprobanae</i>
-	Polythecal	9
9	Genital markings paired in XVII and XIX	<i>Po. mekongmontis sp. nov.</i>
-	Genital markings paired in XIX and successive segments	<i>Po. elongata</i>
10	Spermathecal pores on dorsum	11
-	Spermathecal pores on ventrum	12
11	Copulatory pouch absent; genital markings absent	<i>Pl. plumatomusculata</i>
-	Copulatory pouch present; small, genital markings small in male region	<i>Pl. rarusa</i>
12	Intestinal caeca multiple; genital markings unpaired, large in XVII	<i>Pl. arboricola</i>
-	Intestinal caeca simple or absent; no genital markings	13
13	Intestinal caeca small, simple	<i>Pl. tenebrica</i>
-	Intestinal caeca absent	<i>Pl. lacertina</i>

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