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COMMUNICATION

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A checklist of earthworms (Annelida: Oligochaeta) in southeastern Vietnam

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Abstract: The earthworms of southeastern Vietnam are reported based on literature and samples collected during the period of 2012–2019. A total of 41 earthworm species of 12 genera in six families are recorded in the southeastern part of Vietnam. Of these, *Polyphheretima elongata* and *Dichogaster affinis* are recorded for the first time in the region. The dominant family is Megascolecidae with 35 species of seven genera while each of the other families is represented by only one species, except for Octochaetidae which has one genus and two species. The comprehensive checklist also provides data of each species including examined specimens, distributions and remarks. An identification key to species is compiled for southeastern Vietnam.

Keywords: Identification key, survey, Ho Chi Minh, humid, subtropical, data

Abbreviation: A—Aclitellate specimens | C—Clitellate specimens | CTU—Can Tho University | IEBR—Institute of Ecology and Biological Resources—Vietnam Academy of Science and Technology | SORC—Soil Organism Research Center—Hanoi National University of Education | NP—National Park | NR—Natural Reserve | Mts—Mountain | ag—accessory gland | amp—ampulla | atr—atrium | cl—clitellum | dv—diverticulum | fp—female pore | gm—genital markings | mp—male pore | np—nephridial pore | sg—seminal groove | os—penial seta | sp—spermathecal pore | st—seta.

Khu hệ giun đất vùng Đông Nam Bộ Việt Nam được tổng kết dựa trên các tài liệu nghiên cứu trước đây và các mẫu vật thu thập trong giai đoạn 2012–2019. Tổng số có 41 loài đất thuộc 12 giống, 6 họ được ghi nhận cho khu vực này. Trong đó, hai loài *Polyphheretima elongata* và *Dichogaster affinis* được ghi nhận lần đầu tiên ở khu vực Đông Nam Bộ. Họ Megascolecidae là họ chiếm ưu thế với 35 loài, 7 giống, trong khi các họ giun đất khác chỉ gặp 1 loài, 1 giống, và họ Octochaetidae gặp 2 loài, 1 giống. Các thông tin về số lượng cá thể phân tích, phân bố và nhận xét cho từng loài cũng được trình bày chi tiết. Khoá phân loại các loài giun đất cho khu vực cũng được xây dựng.

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Author contribution: All authors equally contribute to the current paper, including sample collecting, analyzing, photographing and manuscript writing.

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INTRODUCTION

Southeastern Vietnam has an area of 23,607.8km², located between 10.316–12.283°N & 105.800–107.583°E. This region is the territory of six provinces and city: Ho Chi Minh, Ba Ria – Vung Tau, Dong Nai, Binh Duong, Binh Phuoc, and Tay Ninh. The terrain changes from mountainous areas and midlands to coastal deltas. The region is located in a humid subtropical climate zone featured by the rainy season, which starts in May and lasts till October (average rainfall counted for 90% of the whole year), and the dry season from November to April. The region has different soil types, but mainly dominated by ferralsols and acrisols (Sterling et al. 2008).

The earthworms of Vietnam in general and of the southeastern part in particular was first reported by Perrier (1872, 1875) with descriptions of four new species. There were no reports for the southeastern part of Vietnam until 1956 when Omodeo (1956) described six new species. After that, there were no reports on earthworms in the region for approximate 60 years. Recently, Nguyen (2014) and Nguyen et al. (2015) reported list of earthworms recorded in small parts of Binh Duong Province. Nguyen et al. (2015a,b) also described four new species from Dong Nai Province. All data were synthesized into a comprehensive checklist of earthworms in Vietnam by Nguyen et al. (2016). After 2016, the earthworms of southeastern Vietnam have been intensively studied, and 14 new species were described from this region (Nguyen & Lam 2017; Nguyen et al. 2018, 2019, 2020a,b). Together with discoveries of new species, taxonomic acts have also been undertaken. Nguyen et al. (2017) and Nguyen (2020) corrected *Metaphire magophila* (Nguyen, 2011) as a senior synonym of *M. easupana* (Thai & Huynh, 1993). Samples of *M. neoexilis* (Thai & Samphon, 1988) found in Binh Duong province were misidentified as *Amyntas modigliani* (Rosa, 1896).

This work aims to provide comprehensive information on the earthworms of southeastern Vietnam. An identification key is also provided to facilitate further studies on earthworms in this region.

MATERIAL AND METHODS

The species list was created based on literature, e.g., Perrier (1872, 1875), Omodeo (1956), Nguyen (2014), Nguyen et al. (2015), Nguyen et al. (2015a,b, 2016, 2017, 2018, 2020a,b), Nguyen & Lam (2017), and Nguyen et al. (2019, 2020). The species was also

confirmed by identifying samples collected from 263 sites (Figure 1) during the rainy season (early September to late October) in 2012–2019.

Earthworms were collected by digging and hand-sorting method following Górný & Grum (1993). After collecting, specimens were cleaned by tap water, killed in 2% formalin, temporally fixed in formalin 4% for 12 hours, then transferred to new formalin 4% for long-term preservation. All specimens were deposited in the Laboratory of Zoology, Department of Biology, Can Tho University.

The specimens were examined under a motic digital microscope (Model: DM143-FBGG-C) and dissected from the dorsal side for internal observation. Colour images were taken using a camera attached directly to the microscope, then improved and grouped into plates using Photoshop CS6.

RESULTS

Until date, a total of 41 earthworm species of 12 genera in six families (Almidae, Megascolecidae, Moniligastridae, Octochaetidae, Ocnerodrilidae, and Rhinodrilidae) have been recorded in southeastern Vietnam. All information of each species is presented in the checklist. *Polypheretima elongata* and *Dichogaster affinis* are reported for the first time in the region. Megascolecidae was the dominant family in terms of the number of species and genera (35 species of seven genera). It also corresponded to the earthworm distribution in the Oriental region (Hendrix & Bohlen 2002). Other families had only one species each except Octochaetidae which had two species in one genus. Particularly, the genus *Metaphire* had 20 species while *Amyntas* was poorly known with only seven species. Thai (2000) also indicated that *Metaphire* was the most diverse genus in the south of Vietnam.

In addition, 16 species were described from the southeastern part of Vietnam since 2016. Therefore, the total earthworm species of Vietnam has increased to 240 in 25 genera and eight families.

Family ALMIDAE Duboscq, 1902

Genus *Glyphidrilus* Horst, 1889

1. *Glyphidrilus papillatus* (Rosa, 1890)

(Image 1 a1, Table 1)

Examined material: 2C (CTU-EW.030.02) and 3C (CTU-EW.030.04); data for samples shown in Table 1.

Distribution: Ba Ria-Vung Tau (Dat Do); Binh Duong (Tan Uyen, Dau Tieng, Phu Giao); Ho Chi Minh City (Nha

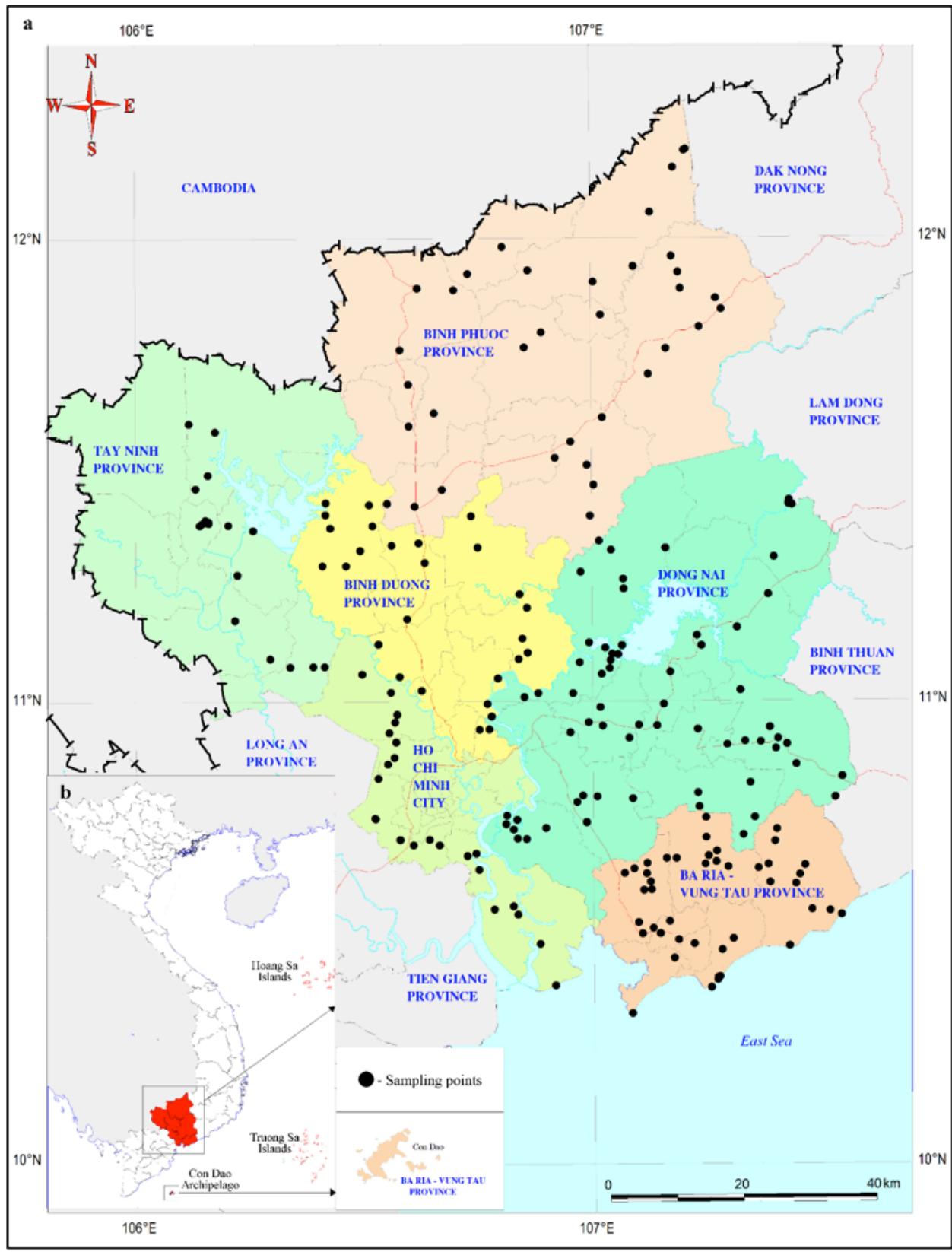


Figure 1. Collecting sites in southeastern Vietnam: a—southeastern Vietnam (mainland) | b—Vietnam map.

Be); Tay Ninh (Trang Bang).

Remarks: It was found in edges of water ponds or paddy fields.

Family MEGASCOLECIDAE Rosa, 1891

Genus *Lampito* Kinberg, 1867

2. *Lampito mauritii* Kinberg, 1867

(Image 2 a1–a2, Table 1)

Examined material: 27C (CTU-EW.002.01), 13C (CTU-EW.002.07), 6C (CTU-EW.002.11), 9C (CTU-EW.002.13), 18C (CTU-EW.002.22), 46C (CTU-EW.002.27), and 21C (CTU-EW.002.32); data for samples were shown in Table 1.

Distribution: Dong Nai (Xuan Loc; Nhon Trach; Long Thanh); Ba Ria-Vung Tau (Vung Tau, Ba Ria, Xuyen Moc, Tan Thanh, Dat Do, Long Dien); Binh Duong (Di An, Dau Tieng, Bau Bang, Thu Dau Mot); Binh Phuoc (Chon Thanh); Ho Chi Minh City (Nha Be, Binh Chanh, Hoc Mon, Cu Chi); Tay Ninh (Trang Bang, Go Dau, Duong Minh Chau, Tan Chau, Tay Ninh).

Remarks: The species was found aggregated in high density in sandy soil and decomposed cow dung.

Genus *Perionyx* Perrier, 1872

3. *Perionyx excavatus* Perrier, 1872

(Image 2 b1–b2, Table 1)

Examined material: 1C (CTU-EW.003.02) and 1C (CTU-EW.003.03); data for samples in Table 1.

Distribution: Dong Nai (Nhon Trach); Binh Duong (Di An, Dau Tieng, Bau Bang, Thu Dau Mot, Phu Giao); Ho Chi Minh City (Binh Chanh); Ba Ria-Vung Tau.

Remarks: The species has been bred commonly in local earthworm farms, but rarely found in the wild.

Genus *Pontodrilus* Perrier, 1874

4. *Pontodrilus litoralis* (Grube, 1855)

Examined material: No specimen available

Distribution: Ba Ria-Vung Tau (Omodeo 1956)

Remarks: Omodeo (1956) collected samples of the species from mangrove soils (Ba Ria-Vung Tau Province), but there were no other further records in the study area recently.

Genus *Amyntas* Kinberg, 1867

5. *Amyntas dorsomorrioides* Nguyen & Nguyen, 2020

(Image 2 f1–f2, Table 1)

Examined material: 1C (CTU-EW.174.h01), 2C (CTU-EW.174.p02), and 2C (IEBR-EW.174.p02); data in Table 1.

Distribution: Ba Ria–Vung Tau (Ba Ria City, Minh Dam Mts).

Remarks: The species is closely similar to *A. dorsomorriisi* (Do & Tran, 1995), however, distinguished by having spermathecal pores laterally, a pair of genital markings in xvii, first dorsal pore in 12/13, 6–7 setae between two male porophores, intestine swelling at xv, and lobuled typhlosole (Nguyen et al. 2020a).

6. *Amyntas exiguum austrinus* (Gates, 1932)

(Image 2 d1–d2, Table 1)

Examined material: 4C (CTU-EW.057.01), 5C (CTU-EW.057.02), 14C (CTU-EW.057.03), 8C (CTU-EW.057.04), 8C (CTU-EW.057.05), and 11C (CTU-EW.057.11); data in Table 1.

Distribution: Dong Nai (Vinh Cuu, Thong Nhut, Long Khanh); Binh Phuoc (Bu Dang, Bu Gia Map, Dong Phu, Phuc Long); Ba Ria-Vung Tau (Dat Do); Tay Ninh (Tay Ninh City).

7. *Amyntas juliani* (Perrier, 1875)

Examined material: No specimen available.

Distribution: Ho Chi Minh City (Perrier 1875).

Remarks: There were no further reports in the study area since Perrier (1875).

8. *Amyntas longiprostaticus* Nguyen & Lam, 2020

(Image 2 g1–g2, Table 1)

Examined material: 1C (CTU-EW.088.h01), 5C (CTU-EW.088.p02), 4C (IEBR-EW.088.p02), 30C (CTU-EW.088.03), and 17C (IEBR-EW.088.03); data in Table 1.

Distribution: Dong Nai (Cam My, Cat Tien NP).

Remarks: The species is somewhat similar to *A. papilio* (Gates, 1930) and *A. khaohayod* Bantaowong & Panha, 2015. It is, however, characterized by having the distance between male pores wider, presence of genital markings in the spermathecal region, first dorsal pore in 11/12, and smaller size (Nguyen et al. 2020a).

9. *Amyntas minhdam* Nguyen & Tran, 2020

(Image 2 h1–h2, Table 1)

Examined material: 1C (CTU-EW.168.h01), 1C (CTU-EW.168.p02), 3C (CTU-EW.168.p03), and 2C (IEBR-EW.168.p03); data in Table 1.

Distribution: Ba Ria-Vung Tau (Minh Dam Mts).

Remarks: The species is fairly similar to *A. sapinianus* (Chen, 1946) and *A. morrisi* (Beddard, 1892). It is, however, distinguished by having a pair of genital markings in the male region, chain-shaped seminal chamber, and first dorsal pore in 12/13 (Nguyen et al. 2020a).

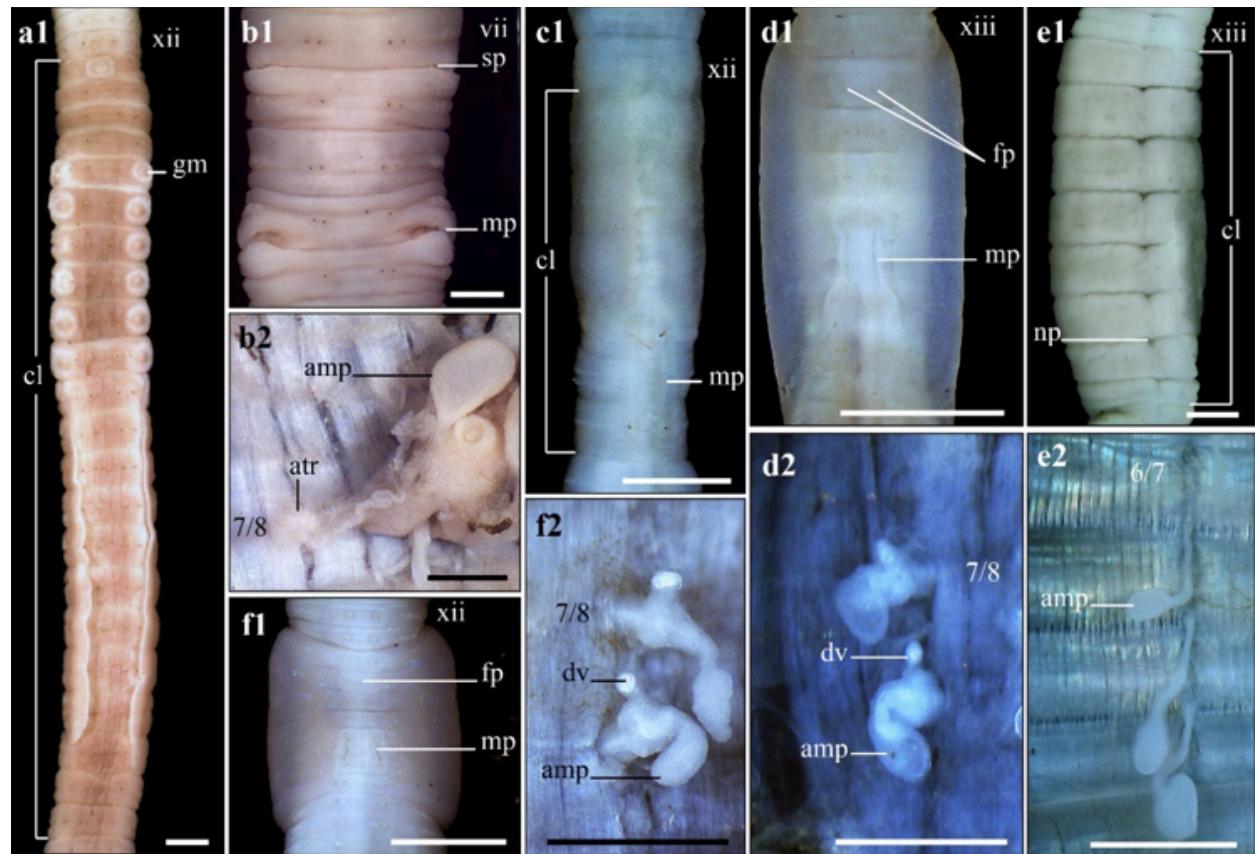


Image 1. Male region (1) and spermathecae (2) of non-megascolecid species in southeastern Vietnam: a—*Glyphidrilus papillatus* | b—*Drawida beddardi* | c—*Eukerria saltensis* | d—*Dichogaster affinis* | e—*Dichogaster bolaui* | f—*Pontoscolex corethrurus*. Scale bar= 1mm. © D.H. Lam.

10. *Amyntas ocularius* Nguyen & Lam, 2020

(Image 2 i1–i2, Table 1)

Examined material: 1C (CTU-EW.167.h01), 2C (CTU-EW.167.p02), 3C (CTU-EW.167.p03), and 2C (IEBR-EW.167.p03); data in Table 1.

Distribution: Ba Ria-Vung Tau (Binh Chau-Phuoc Buu NR).

Remarks: The species is somewhat similar to *A. compositus* (Gates, 1932) and *A. papulosus* (Rosa, 1896). It is, however, distinctly different from those congeners in having numerous genital markings being arranged in transverse lines in both of the spermathecal and male regions, and being agglomerated into two groups in 19/20, and first dorsal pore in 13/14 (Nguyen et al. 2020a).

11. *Amyntas polychaetiferus* (Thai, 1984)

(Image 2 e1–e2, Table 1)

Examined material: 29C (CTU-EW.008.01), 10C (CTU-EW.008.04), 11C (CTU-EW.008.07), 20C (CTU-EW.008.10), 10C (CTU-EW.008.18), 6C (CTU-EW.008.21), and 2C (CTU-EW.008.24); data in Table 1.

Distribution: Widely distributed in the study area, but more gathered in Dong Nai and Ba Ria-Vung Tau, little known in Binh Duong and Binh Phuoc, and rarely found in Ho Chi Minh City and Tay Ninh.

Remarks: The species have setae crowded ventrally in xix, varied in numbers or sometimes in usual position. The species was reported from the study area with the highest frequency and species abundance compared to other places.

Genus *Metaphire* Sims & Easton, 1972

12. *Metaphire anomala* (Michaelsen, 1907)

(Image 3 k1–k2, Table 1)

Examined material: 11C (CTU-EW.020.06), 7C (CTU-EW.020.07), 10C (CTU-EW.020.13), 8C (CTU-EW.020.14), and 20C (CTU-EW.020.21); data in Table 1.

Distribution: Dong Nai (Vinh Cuu, Xuan Loc, Dinh Quan, Trang Bom, Cam My, Long Thanh); Ba Ria-Vung Tau (Chau Duc, Xuyen Moc, Tan Thanh, Ba Ria City); Binh Duong (Tan Uyen; Binh Phuoc: Phu Rieng); Tay Ninh (Duong Minh Chau, Tay Ninh City).

Remarks: The species is morphologically different

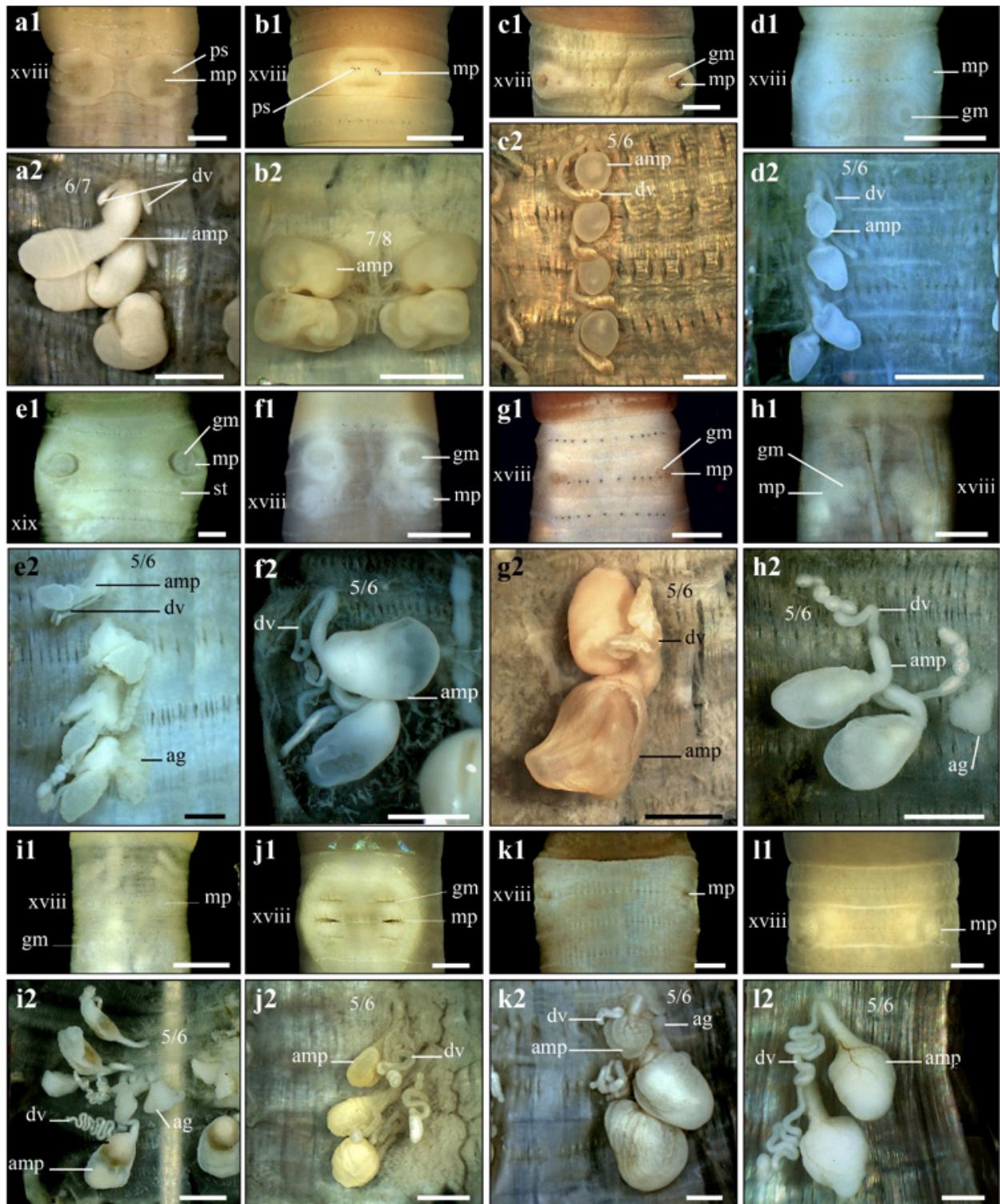


Image 2. Male region (1) and Spermathecae (2) of megascolecid species in southeastern Vietnam: a—*Lampito mauritii* | b—*Perionyx excavatus* | c—*Amyntas corticis* | d—*Amyntas exiguis austrinus* | e—*Amyntas polychaetiferus* | f—*Amyntas dorsomorrioides* | g—*Amyntas longiprostaticus* | h—*Amyntas minhdam* | i—*Amyntas ocularius* | j—*Metaphire bahli* | k—*Metaphire cf. campanulata* | l—*Metaphire easupana*. Scale bar=1mm. © D.H. Lam.



from the original description of Michaelsen (1907) by having male pore in xix, four pairs of spermathecal pore in 5/6/7/8/9, no genital markings, and bigger size.

13. *Metaphire bahli* (Gates, 1945)

(Image 2 j1–j2, Table 1)

Examined material: 30C (CTU-EW.004.01), 30 (CTU-EW.004.02), 22 (CTU-EW.004.03), 16 (CTU-EW.004.04), 28C (CTU-EW.004.19), 19C (CTU-EW.004.24), 20C (CTU-EW.004.25), 39C (CTU-EW.004.54), and 30C (CTU-EW.004.62); data in Table 1.

Distribution: Widely distributed in southern Vietnam.

14. *Metaphire bariaensis* Nguyen, Nguyen, Lam & Nguyen, 2020

(Image 3 l1–l2, Table 1)

Examined material: 1C (CTU-EW.169.h01), 2C (CTU-EW.169.p02), 3C (CTU-EW.169.p03), and 15C (CTU-EW.169.04); data in Table 1.

Distribution: Ba Ria-Vung Tau (Ba Ria, Bao Quang Mts).

Remarks: The species is somewhat similar to *M. truongsonensis* (Thai, 1984); however, it is characterized by having spermathecal pores located laterally and separated intestinal caeca (Nguyen et al. 2020b).

15. *Metaphire cf. campanulata* (Rosa, 1890)

(Image 2 k1–k2, Table 1)

Examined material: 17C (CTU-EW.018.01), 14C (CTU-EW.018.09), 14C (CTU-EW.018.11), 25C (CTU-EW.018.20), 4C (CTU-EW.018.34), and 8C (CTU-EW.018.36); data in Table 1.

Distribution: Commonly found in the study area.

Remarks: The species is closely similar to *M. houleti* (Perrier, 1872) but it is characterized by mushroom-shaped spermathecae, first dorsal pore in 11/12, and bigger size.

16. *Metaphire easupana* (Thai & Huynh, 1993)

(Image 2 l1–l2, Table 1)

Examined material: 5C (CTU-EW.012.04), 35C (CTU-EW.012.05), 10C (CTU-EW.012.10), 25C (CTU-EW.012.17), and 23C (CTU-EW.012.26); data in Table 1.

Distribution: Dong Nai (Vinh Cuu, Xuan Loc, Dinh Quan); Ba Ria-Vung Tau (Tan Thanh, Ba Ria City, Long Dien; Minh Dam Mts); Tay Ninh (Ba Den Mts).

Remarks: The species was known as *M. magophila* (Nguyen, 2011), but it was synonymized by Nguyen et al. (2017).

17. *Metaphire grandiverticulata* Nguyen & Lam, 2017

(Image 3 a1–a2, Table 1)

Examined material: 1C (CTU-EW.089.h01), 9C (CTU-EW.089.p02), 13C (CTU-EW.089.03), and 24C (CTU-EW.089.04); data in Table 1.

Distribution: Dong Nai (Long Khanh); Ho Chi Minh City (Hoc Mon).

Remarks: The species is similar to *M. neoexilis* (Thai & Samphon, 1988), but it is characterized by having large and stout spermathecal diverticula and ventrally connected testes sacs (Nguyen & Lam 2017).

18. *Metaphire haui* Nguyen, Nguyen, Lam & Nguyen, 2020

(Image 4 a1–a2, Table 1)

Examined material: 1C (CTU-EW.172.h01), 4C (CTU-EW.172.p02), 2C (CTU-EW.172.p03), and 4A (CTU-EW.172.p04); data in Table 1.

Distribution: Ba Ria-Vung Tau (Dinh Mts, Tan Thanh).

Remarks: The species is fairly similar to *M. peguana* (Rosa, 1890), but it is distinguished by having spermathecal pores located laterally, first dorsal pore in 7/8, and genital markings in xvii and xix (Nguyen et al. 2020b).

19. *Metaphire houleti* (Perrier, 1872)

(Image 3 b1–b2, Table 1)

Examined material: 49C (CTU-EW.006.01), 25C (CTU-EW.006.06), 26C (CTU-EW.006.11), 10C (CTU-EW.006.19), 3C (CTU-EW.006.27), 9C (CTU-EW.006.45), and 11C (CTU-EW.006.48).

Distribution: Widely distributed in southern Vietnam.

20. *Metaphire houletteoides* Nguyen, Nguyen, Lam & Nguyen, 2020

(Image 4 b1–b2, Table 1)

Examined material: 1C (CTU-EW.180.h01) and 3C (CTU-EW.180.p02); data in Table 1.

Distribution: Binh Phuoc (Loc Ninh, Dong Phu, Bu Gia Map NP, Bu Dang).

Remarks: The species is fairly similar to *M. houleti* (Perrier, 1872), however, it is characterized by having two pairs of spermathecal pores in 7/8/9 and smaller size (Nguyen et al. 2020b).

21. *Metaphire malayanoides* Nguyen & Lam, 2017

(Image 3 c1–c2, Table 1)

Examined material: 1C (CTU-EW.084.h01), 8C (CTU-EW.084.p02), 5C (CTU-EW.084.p03), 16C (CTU-EW.084.04), 31C (CTU-EW.084.05), 14C (CTU-EW.084.06), and 34C (CTU-EW.084.07); data in Table 1.

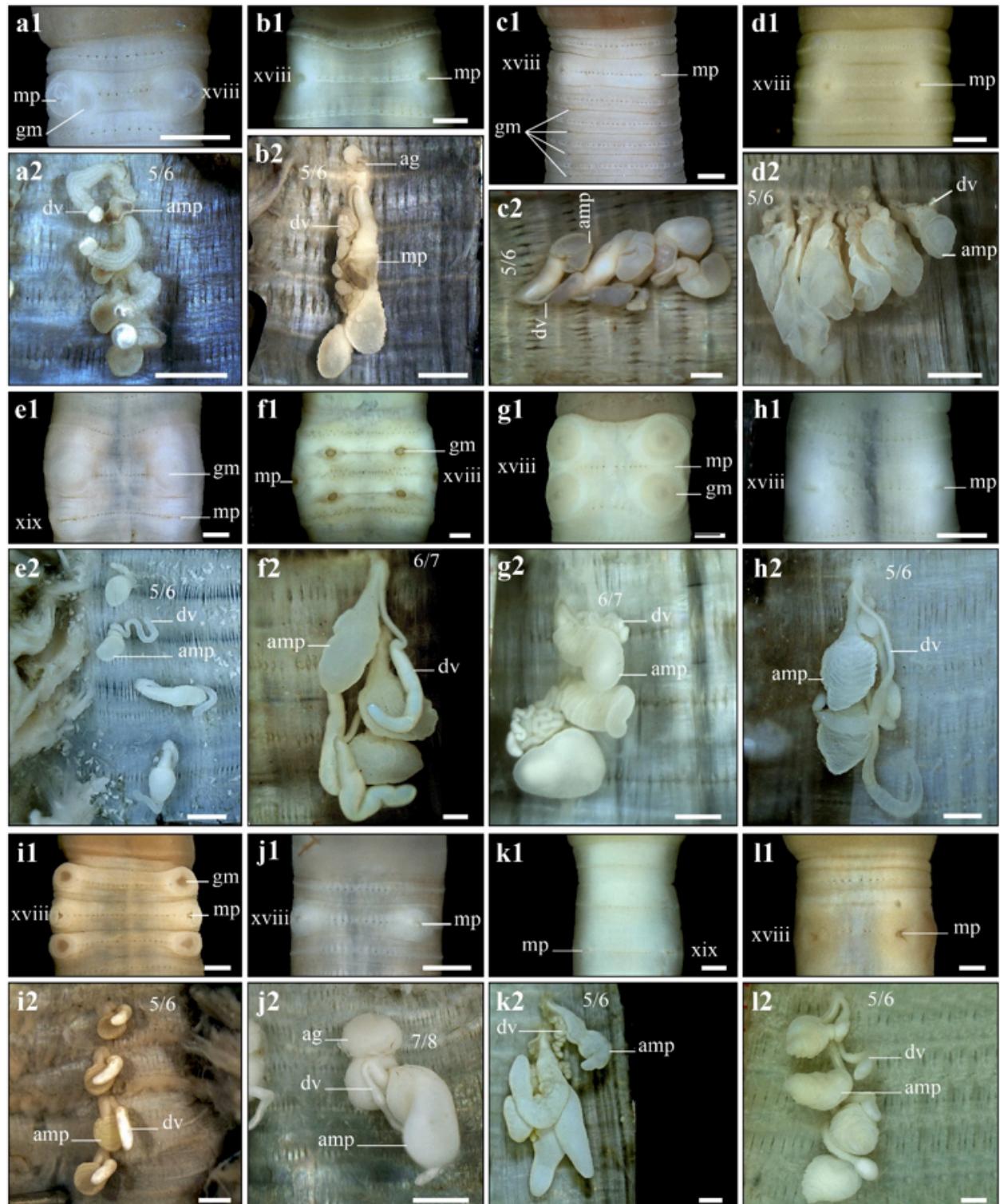


Image 3. Male region (1) and Spermatheca (2) of megascolecid species in southeastern Vietnam (continued): a—*Metaphire grandiverticulata* | b—*Metaphire houleti* | c—*Metaphire malayanoides* | d—*Metaphire mangophiloides* | e—*Metaphire neoexilis* | f—*Metaphire pacseana* | g—*Metaphire peguana peguana* | h—*Metaphire planata* | i—*Metaphire posthuma* | j—*Metaphire xuanlocensis* | k—*Metaphire anomala* | l—*Metaphire bariaensis*. Scale bar= 1mm. © D.H. Lam.

Distribution: Dong Nai (Vinh Cuu, Dinh Quan, Thong Nhat, Trang Bom).

Remarks: The species is closely similar to *M. malayana* (Beddard, 1900), however, it is recognized by having presence of genital markings in intersegmental furrows (from 19/20 to 26/27), first dorsal pore in 12/13, and separated testes sacs (Nguyen & Lam 2017).

22. *Metaphire mangophilooides* Nguyen & Le, 2015

(Image 3 d1–d2, Table 1)

Examined material: 1C (CTU-EW.082.h01) and 1C (CTU-EW.082.p02); data in Table 1.

Distribution: Dong Nai (Vinh Cuu).

Remarks: The species is fairly similar to *M. easupana* (Thai & Huynh, 1993) but it is characterized by having spermathecal pores in 5/6 and polythecate (Nguyen et al. 2015a).

23. *Metaphire neoexilis* (Thai & Samphon, 1988)

(Image 3 e1–e2, Table 1)

Examined material: 32A (CTU-EW.085.01), 13A (CTU-EW.085.02), 3A (CTU-EW.085.03), and 3A (CTU-EW.085.04); data in Table 1.

Distribution: Dong Nai (Long Thanh, Cam My); Binh Duong (Dau Tieng, Phu Giao).

Remarks: The present population has slight difference from the original description of Thai & Samphon (1988) in genital markings in xviii and male pores in xix.

24. *Metaphire pacseana* (Thai & Samphon, 1988)

(Image 3 f1–f2, Table 1)

Examined material: 6C (CTU-EW.083.01), 4C (CTU-EW.083.03), 3C (CTU-EW.083.07), and 6C (CTU-EW.083.14); data in Table 1.

Distribution: Dong Nai (Long Thanh, Nhon Trach); Binh Duong (Bac Tan Uyen, Ben Cat, Dau Tieng, Bau Bang); Binh Phuoc (Hon Quan); Ho Chi Minh City (Cu Chi); Tay Ninh (Go Dau, Duong Minh Chau, Ba Den Mts.).

Remarks: The populations collected in Ba Den Mountain (Tay Ninh province) and Phu Giao (Binh Duong province) lack genital markings while others have two pairs in 17/18 and 18/19 as in the original description.

25. *Metaphire peguana peguana* (Rosa, 1890)

(Image 3 g1–g2, Table 1)

Examined material: 5C (CTU-EW.009.02), 15C (CTU-EW.009.03), 3C (CTU-EW.009.05), 13C (CTU-EW.009.07), and 16C (CTU-EW.009.14); data in Table 1.

Distribution: Dong Nai (Vinh Cuu, Xuan Loc, Nhon Trach, Long Thanh); Ba Ria-Vung Tau (Tan Thanh); Binh Duong (Bac Tan Uyen, Phu Giao, Ben Cat); Binh Phuoc

(Chon Thanh); Ho Chi Minh City (Can Gio, Nha Be, Binh Chanh, Hoc Mon, Cu Chi).

Remarks: The species is somewhat similar to *M. bahli* (Gates, 1945), but is characterized by having large disc-shaped genital markings and unconcave male region.

26. *Metaphire planata* (Gates, 1926)

(Image 3 h1–h2, Table 1)

Examined material: 9C (CTU-EW.016.04), 11C (CTU-EW.016.05), 11C (CTU-EW.016.10), 8C (CTU-EW.016.15), 31C (CTU-EW.016.20), 12C (CTU-EW.016.36), and 9C (CTU-EW.016.39); data in Table 1.

Distribution: Widely distributed in southern Vietnam, but more commonly found in grey soils of deltas.

Remarks: The species was erroneously identified as *M. californica* (Kinberg, 1867), but corrected by Nguyen et al. (2020). *M. planata* differs from *M. californica* in having spermathecal pores in 5/6/7, genital marking present in the spermathecal region associated with saccular accessory glands internally, simple intestinal caeca, separated testes sacs, and smaller size. It is noted that the preservation code CTU-EW.005 (for *M. californica*) would be changed to CTU-EW.016 (for *M. planata*).

27. *Metaphire planatoides* Nguyen, Nguyen, Lam & Nguyen, 2020

(Image 4 c1–c2, Table 1)

Examined material: 1C (CTU-EW.171.h01) and 2C (CTU-EW.171.p02); data in Table 1.

Distribution: Ba Ria-Vung Tau (Minh Dam Mts.).

Remarks: The species is closely similar to *M. planata* (Gates, 1926), but it is distinguished by lacking of genital markings and accessory glands, having waved diverticula, connecting testes sacs, and smaller size (Nguyen et al. 2020b).

28. *Metaphire posthuma* (Vaillant, 1868)

(Image 3 i1–i2, Table 1)

Examined material: 10C (CTU-EW.011.01) and 19C (CTU-EW.011.03); data in Table 1.

Distribution: Dong Nai (Xuan Loc); Binh Duong (Dau Tieng, Phu Giao); Ho Chi Minh City (Can Gio, Hoc Mon, Cu Chi); Tay Ninh (Tan Chau).

29. *Metaphire setosa* Nguyen, Nguyen, Lam & Nguyen, 2020

(Image 4 d1–d2, Table 1)

Examined material: 1C (CTU-EW.179.h01), and 6C (CTU-EW.179.p02); data in Table 1.

Distribution: Binh Phuoc (Hon Quan, Chon Thanh).



Image 4. Male region (1) and Spermathecae (2) of megascolecid species in southeastern Vietnam (continued): a—*Metaphire* sp. | b—*Metaphire haui* | c—*Metaphire houletteoides* | d—*Metaphire planatooides* | e—*Metaphire setosa* | f—*Metaphire songbeensis* | g—*Polypheretima cattienensis* | h—*Polypheretima colonensis* | i—*Polypheretima cordata* | j—*Polypheretima elongata* | k—*Polypheretima grandisetosa* | l—*Polypheretima militum* | m—*Pheretima vungtauensis*. Scale bar= 1mm. © D.H. Lam.

Table 1. The collection of earthworm samples from southeastern Vietnam.

No.	Species names and label codes	Number of Specimen	GPS Coordinates		Location	Date	Collector
			Latitude (North)	Longitude (East)			
1 <i>Glyphidrilus papillatus</i> (Rosa, 1890)							
CTU-EW.030.02	2C	10.487778	107.251111	Dat Do, Ba Ria Vung Tau	x.2016	Nam Q. Nguyen	
CTU-EW.030.04	3C	10.913889	106.566111	Hoc Mon, Ho Chi Minh City	ix.2019	Nam Q. Nguyen	
2 <i>Lampito mauritii</i> Kinberg, 1867							
CTU-EW.002.01	27C	10.792778	107.525556	Xuan Loc, Dong Nai	x.2012	Thang V. Nguyen	
CTU-EW.002.07	13C	10.464167	107.276944	Dat Do, Ba Ria Vung Tau	x.2016	Nam Q. Nguyen	
CTU-EW.002.11	6C	11.429167	106.548333	Chon Thanh, Binh Phuoc	x.2017	Nam Q. Nguyen	
CTU-EW.002.13	9C	11.412500	106.412778	Dau Tieng, Binh Duong	x.2017	Nam Q. Nguyen	
CTU-EW.002.27	46C	10.691667	106.603056	Binh Chanh, Ho Chi Minh City	ix.2019	Nam Q. Nguyen	
CTU-EW.002.32	21C	11.077500	106.402222	Trang Bang, Tay Ninh	ix.2019	Nam Q. Nguyen	
3 <i>Perionyx excavatus</i> Perrier, 1872							
CTU-EW.003.02	1C	10.727222	106.827222	Nhon Trach, Dong Nai	x.2016	Nam Q. Nguyen	
CTU-EW.003.03	1C	11.333611	106.746389	Phu Giao, Binh Duong	x.2017	Nam Q. Nguyen	
4 <i>Amynthas dorsomorrioides</i> Nguyen & Nguyen, 2020							
CTU-EW.174.h01	1C	10.511111	107.126944	Dinh Mts., Ba Ria Vung Tau	x.2016	Hau P. Nguyen	
CTU-EW.174.p02	2C	10.405833	107.271667	Minh Dam Mts., Ba Ria Vung Tau	x.2016	Hau P. Nguyen	
IEBR-EW.174.p02	2C	10.405833	107.271667	Minh Dam Mts., Ba Ria Vung Tau	x.2016	Hau P. Nguyen	
5 <i>Amynthas exiguum austrinus</i> (Gates, 1932)							
CTU-EW.057.01	4C	11.142778	107.225556	Dinh Quan, Dong Nai	x.2013	Nhan V. Le	
CTU-EW.057.02	5C	10.994444	107.151389	Thong Nhat, Dong Nai	x.2013	Nhan V. Le	
CTU-EW.057.03	14C	11.258889	107.065833	Vinh Cuu, Dong Nai	x.2013	Trong C. Duong	
CTU-EW.057.04	8C	11.809444	107.067500	Bu Dang, Binh Phuoc	x.2017	Nam Q. Nguyen	
CTU-EW.057.05	8C	12.192778	107.206944	Bu Gia Map NP, Binh Phuoc	x.2017	Nam Q. Nguyen	
CTU-EW.057.11	11C	11.390556	106.155278	Ba Den Mts., Tay Ninh	ix.2019	Nam Q. Nguyen	
6 <i>Amynthas longiprostaticus</i> Nguyen & Lam, 2020							
CTU-EW.088.h01	1C	11.425000	107.428333	Cat Tien NP, Dong Nai	x.2013	Nhan V. Le	
CTU-EW.088.p02	5C	11.425000	107.428333	Cat Tien NP, Dong Nai	x.2013	Nhan V. Le	
IEBR-EW.088.p02	4C	11.425000	107.428333	Cat Tien NP, Dong Nai	x.2013	Nhan V. Le	
CTU-EW.088.03	30C	11.425000	107.428333	Cat Tien NP, Dong Nai	x.2013	Nhan V. Le	
IEBR-EW.088.03	17C	11.425000	107.428333	Cat Tien NP, Dong Nai	x.2013	Nhan V. Le	
7 <i>Amynthas minhdam</i> Nguyen & Tran, 2020							
CTU-EW.168.h01	1C	10.405556	107.271667	Minh Dam Mts., Ba Ria Vung Tau	x.2016	Hau P. Nguyen	
CTU-EW.168.p02	1C	10.405556	107.271667	Minh Dam Mts., Ba Ria Vung Tau	x.2016	Hau P. Nguyen	
CTU-EW.168.p03	3C	10.405556	107.271667	Minh Dam Mts., Ba Ria Vung Tau	x.2019	Dang H. Lam	
IEBR-EW.168.p03	2C	10.405556	107.271667	Minh Dam Mts., Ba Ria Vung Tau	x.2019	Dang H. Lam	
8 <i>Amynthas ocularius</i> Nguyen & Lam, 2020							
CTU-EW.167.h01	1C	10.547500	107.512778	Binh Chau Phuoc Buu NR, Ba Ria Vung Tau	x.2016	Ai T. Truong	
CTU-EW.167.p02	2C	10.547500	107.512778	Binh Chau Phuoc Buu NR, Ba Ria Vung Tau	x.2016	Ai T. Truong	
CTU-EW.167.p03	3C	10.547500	107.512778	Binh Chau Phuoc Buu NR, Ba Ria Vung Tau	x.2019	Dang H. Lam	
IEBR-EW.167.p03	2C	10.547500	107.512778	Binh Chau Phuoc Buu NR, Ba Ria Vung Tau	x.2019	Dang H. Lam	
9 <i>Amynthas polychaetiferus</i> (Thai, 1984)							
CTU-EW.008.01	29C	11.331944	107.157778	Vinh Cuu, Dong Nai	x.2012	Trong C. Duong	

No.	Species names and label codes	Number of Specimen	GPS Coordinates		Location	Date	Collector
			Latitude (North)	Longitude (East)			
	CTU-EW.008.04	10C	10.898611	107.021667	Trang Bom, Dong Nai	x.2013	Nhan V. Le
	CTU-EW.008.07	11C	10.803056	107.225833	Cam My, Dong Nai	x.2014	Nhan V. Le
	CTU-EW.008.10	20C	10.646111	107.458333	Xuyen Moc, Ba Ria Vung Tau	x.2016	Nam Q. Nguyen
	CTU-EW.008.18	10C	11.798056	106.933889	Phu Rieng, Binh Phuoc	x.2017	Nam Q. Nguyen
	CTU-EW.008.21	6C	11.050000	106.788889	Tan Uyen, Binh Duong	x.2017	Nam Q. Nguyen
	CTU-EW.008.24	2C	11.077500	106.400000	Go Dau, Tay Ninh	ix.2019	Nam Q. Nguyen
10	<i>Metaphire anomala</i> (Michaelsen, 1907)						
	CTU-EW.020.06	11C	10.921667	107.076111	Trang Bom, Dong Nai	x.2013	Nhan V. Le
	CTU-EW.020.07	7C	11.434444	107.428889	Tan Phu, Dong Nai	x.2013	Nhan V. Le
	CTU-EW.020.13	10C	10.525833	107.162222	Ba Ria City, Ba Ria Vung Tau	x.2016	Nam Q. Nguyen
	CTU-EW.020.14	8C	11.798056	106.933889	Phu Rieng, Binh Phuoc	x.2017	Nam Q. Nguyen
	CTU-EW.020.21	20C	11.386944	106.143056	Tay Ninh City, Tay Ninh	ix.2019	Nam Q. Nguyen
11	<i>Metaphire bahli</i> (Gates, 1945)						
	CTU-EW.004.01	30C	11.231389	107.381944	Dinh Quan, Dong Nai	x.2013	Nhan V. Le
	CTU-EW.004.02	30C	10.837500	107.541111	Xuan Loc, Dong Nai	x.2012	Thang V. Nguyen
	CTU-EW.004.03	22C	11.312222	107.394722	Tan Phu, Dong Nai	x.2013	Nhan V. Le
	CTU-EW.004.04	16C	11.018333	106.953889	Vinh Cuu, Dong Nai	ix.2012	Trong C. Duong
	CTU-EW.004.19	28C	10.639167	107.085556	Tan Thanh, Ba Ria Vung Tau	x.2016	Nam Q. Nguyen
	CTU-EW.004.24	19C	11.429167	106.548333	Chon Thanh, Binh Phuoc	x.2017	Nam Q. Nguyen
	CTU-EW.004.25	20C	10.942778	106.772500	Di An, Binh Duong	x.2017	Nam Q. Nguyen
	CTU-EW.004.54	39C	10.387500	106.912500	Can Gio, Ho Chi Minh City	ix.2019	Nam Q. Nguyen
	CTU-EW.004.62	30C	11.382778	106.200000	Duong Minh Chau, Tay Ninh	ix.2019	Nam Q. Nguyen
12	<i>Metaphire bariaensis</i> Nguyen, Nguyen, Lam & Nguyen, 2020						
	CTU-EW.169.h01	1C	10.593333	107.113889	Bao Quang Mts., Ba Ria Vung Tau	x.2016	Hau P. Nguyen
	CTU-EW.169.p02	2C	10.593333	107.113889	Bao Quang Mts., Ba Ria Vung Tau	x.2016	Hau P. Nguyen
	CTU-EW.169.p03	3C	10.639167	107.085556	Ba Ria City, Ba Ria Vung Tau	x.2016	Hau P. Nguyen
	CTU-EW.169.04	15C	10.525833	107.162222	Tan Thanh, Ba Ria Vung Tau	x.2019	Nam Q. Nguyen
13	<i>Metaphire cf. campanulata</i> (Rosa, 1890)						
	CTU-EW.018.01	17C	11.425278	107.428611	Tan Phu, Dong Nai	x.2013	Nhan V. Le
	CTU-EW.018.09	14C	10.666667	107.248333	Chau Duc, Ba Ria Vung Tau	x.2016	Nam Q. Nguyen
	CTU-EW.018.11	14C	11.527778	106.916667	Dong Xoai, Binh Phuoc	x.2017	Nam Q. Nguyen
	CTU-EW.018.20	25C	11.050000	106.789167	Tan Uyen, Binh Duong	x.2017	Nam Q. Nguyen
	CTU-EW.018.34	4C	11.021389	106.555000	Cu Chi, Ho Chi Minh City	ix.2019	Nam Q. Nguyen
	CTU-EW.018.36	8C	11.382778	106.200000	Duong Minh Chau, Tay Ninh	ix.2019	Nam Q. Nguyen
14	<i>Metaphire easupana</i> (Thai & Huynh, 1993)						
	CTU-EW.012.04	5C	11.160000	107.314444	Dinh Quan, Dong Nai	x.2013	Nhan V. Le
	CTU-EW.012.05	35C	10.944167	107.383611	Xuan Loc, Dong Nai	x.2012	Thang V. Nguyen
	CTU-EW.012.10	10C	11.018889	106.877500	Vinh Cuu, Dong Nai	ix.2012	Trong C. Duong
	CTU-EW.012.17	25C	10.404167	107.267778	Minh Dam Mts., Ba Ria Vung Tau	x.2016	Nam Q. Nguyen
	CTU-EW.012.26	23C	11.390556	106.155278	Ba Den Mts., Tay Ninh	x.2019	Nam Q. Nguyen
15	<i>Metaphire grandiverticulata</i> Nguyen & Lam, 2017						
	CTU-EW.089.h01	1C	10.741389	106.975278	Long Thanh, Dong Nai	x.2014	Nhan V. Le
	CTU-EW.089.p02	9C	10.741389	106.975278	Long Thanh, Dong Nai	x.2014	Nhan V. Le

No.	Species names and label codes	Number of Specimen	GPS Coordinates		Location	Date	Collector
			Latitude (North)	Longitude (East)			
	CTU-EW.089.03	13C	10.741389	106.975278	Long Thanh, Dong Nai	x.2014	Nhan V. Le
	CTU-EW.089.04	24C	10.913889	106.566111	Hoc Mon, Ho Chi Minh City	ix.2019	Nam Q. Nguyen
16	<i>Metaphire hau Nguyen, Nguyen, Lam & Nguyen, 2020</i>						
	CTU-EW.172.h01	1C	10.525833	107.162222	Ba Ria City, Ba Ria Vung Tau	x.2016	Hau P. Nguyen
	CTU-EW.172.p02	4C	10.525833	107.162222	Ba Ria City, Ba Ria Vung Tau	x.2016	Hau P. Nguyen
	CTU-EW.172.p03	2C	10.499444	107.141944	Ba Ria City, Ba Ria Vung Tau	x.2016	Hau P. Nguyen
	CTU-EW.172.p04	4A	10.525833	107.162222	Tan Thanh, Ba Ria Vung Tau	x.2016	Hau P. Nguyen
17	<i>Metaphire houletti</i> (Perrier, 1872)						
	CTU-EW.006.01	49C	11.089722	107.035833	Vinh Cuu, Dong Nai	x.2012	Trong C. Duong
	CTU-EW.006.06	25C	11.425278	107.428611	Tan Phu, Dong Nai	x.2013	Nhan V. Le
	CTU-EW.006.11	26C	10.651667	107.240833	Chau Duc, Ba Ria Vung Tau	x.2016	Nam Q. Nguyen
	CTU-EW.006.19	10C	12.057222	107.127500	Bu Gia Map, Binh Phuoc	x.2017	Nam Q. Nguyen
	CTU-EW.006.27	3C	11.333611	106.746389	Phu Giao, Binh Duong	x.2017	Nam Q. Nguyen
	CTU-EW.006.45	9C	10.868333	106.548889	Hoc Mon, Ho Chi Minh City	ix.2019	Nam Q. Nguyen
	CTU-EW.006.48	11C	11.382778	106.200000	Duong Minh Chau, Tay Ninh	ix.2019	Nam Q. Nguyen
18	<i>Metaphire houletteoides</i> Nguyen, Nguyen, Lam & Nguyen, 2020						
	CTU-EW.180.h01	1C	11.468611	107.000833	Dong Phu, Binh Phuoc	x.2017	Tien T. H. Luong
	CTU-EW.180.p02	3C	11.468611	107.000833	Dong Phu, Binh Phuoc	x.2017	Tien T. H. Luong
19	<i>Metaphire malayanoides</i> Nguyen & Lam, 2017						
	CTU-EW.084.h01	1C	11.142778	107.225556	Dinh Quan, Dong Nai	x.2013	Nhan V. Le
	CTU-EW.084.p02	8C	11.142778	107.225556	Dinh Quan, Dong Nai	x.2013	Nhan V. Le
	CTU-EW.084.p03	5C	10.994444	107.152222	Thong Nhat, Dong Nai	x.2013	Nhan V. Le
	CTU-EW.084.04	16C	11.142778	107.225556	Dinh Quan, Dong Nai	x.2013	Nhan V. Le
	CTU-EW.084.05	31C	10.994444	107.152222	Thong Nhat, Dong Nai	x.2013	Nhan V. Le
	CTU-EW.084.06	14C	11.111111	107.053333	Vinh Cuu, Dong Nai	x.2012	Trong C. Duong
	CTU-EW.084.07	34C	11.231389	107.381944	Dinh Quan, Dong Nai	x.2013	Nhan V. Le
20	<i>Metaphire mangophiloides</i> Nguyen & Le, 2015						
	CTU-EW.082.h01	1C	11.265000	107.064444	Vinh Cuu, Dong Nai	xi.2012	Trong C. Duong
	CTU-EW.082.p02	1C	11.265000	107.064444	Vinh Cuu, Dong Nai	xi.2012	Trong C. Duong
21	<i>Metaphire neoexilis</i> (Thai & Samphon, 1988)						
	CTU-EW.085.01	32A	10.705833	106.825000	Nhon Trach, Dong Nai	x.2014	Nhan V. Le
	CTU-EW.085.02	13A	10.705833	106.825000	Nhon Trach, Dong Nai	x.2014	Nhan V. Le
	CTU-EW.085.03	3A	10.973889	106.568333	Cu Chi, Ho Chi Minh City	ix.2019	Nam Q. Nguyen
	CTU-EW.085.04	3A	11.077500	106.400000	Go Dau, Tay Ninh	ix.2019	Nam Q. Nguyen
22	<i>Metaphire pacseana</i> (Thai & Samphon, 1988)						
	CTU-EW.083.01	6C	10.790278	107.036389	Long Thanh, Dong Nai	x.2014	Nhan V. Le
	CTU-EW.083.03	4C	11.624444	106.651667	Hon Quan, Binh Phuoc	x.2017	Nam Q. Nguyen
	CTU-EW.083.07	3C	11.294722	106.406111	Dau Tieng, Binh Duong	x.2017	Nam Q. Nguyen
	CTU-EW.083.14	6C	11.077500	106.400000	Go Dau, Tay Ninh	ix.2019	Nam Q. Nguyen
23	<i>Metaphire peguana peguana</i> (Rosa, 1890)						
	CTU-EW.009.02	5C	10.944167	107.383611	Xuan Loc, Dong Nai	ix.2012	Thang V. Nguyen
	CTU-EW.009.03	15C	11.089722	107.035833	Vinh Cuu, Dong Nai	x.2012	Trong C. Duong
	CTU-EW.009.05	3C	10.499167	107.102778	Tan Thanh, Ba Ria Vung Tau	x.2016	Nam Q. Nguyen
	CTU-EW.009.07	13C	11.094722	106.841111	Bac Tan Uyen, Binh Duong	x.2017	Nam Q. Nguyen

No.	Species names and label codes	Number of Specimen	GPS Coordinates		Location	Date	Collector
			Latitude (North)	Longitude (East)			
	CTU-EW.009.14	16C	11.021389	106.555000	Cu Chi, Ho Chi Minh City	ix.2019	Nam Q. Nguyen
24	<i>Metaphire planata</i> (Gates, 1926)						
	CTU-EW.005.04	9C	11.010278	106.846944	Vinh Cuu, Dong Nai	ix.2012	Trong C. Duong
	CTU-EW.005.05	11C	10.727500	106.892778	Nhon Trach, Dong Nai	x.2014	Nhan V. Le
	CTU-EW.005.10	11C	10.643889	107.113889	Tan Thanh, Ba Ria Vung Tau	x.2016	Nam Q. Nguyen
	CTU-EW.005.15	8C	11.429167	106.548333	Chon Thanh, Binh Phuoc	x.2017	Nam Q. Nguyen
	CTU-EW.005.20	31C	11.419167	106.413611	Dau Tieng, Binh Duong	x.2017	Nam Q. Nguyen
	CTU-EW.005.36	12C	10.558889	106.821111	Can Gio, Ho Chi Minh City	ix.2019	Nam Q. Nguyen
	CTU-EW.005.39	9C	11.077500	106.400000	Trang Bang, Tay Ninh	ix.2019	Nam Q. Nguyen
25	<i>Metaphire planatoides</i> Nguyen, Nguyen, Lam & Nguyen, 2020						
	CTU-EW.171.h01	1C	10.405833	107.271667	Minh Dam Mts., Ba Ria Vung Tau	x.2016	Hau P. Nguyen
	CTU-EW.171.p02	2C	10.405833	107.271667	Minh Dam Mts., Ba Ria Vung Tau	x.2016	Hau P. Nguyen
26	<i>Metaphire posthuma</i> (Vaillant, 1868)						
	CTU-EW.011.01	10C	10.780000	107.495278	Xuan Loc, Dong Nai	x.2012	Thang V. Nguyen
	CTU-EW.011.03	19C	10.387500	106.912500	Can Gio, Ho Chi Minh City	ix.2019	Nam Q. Nguyen
27	<i>Metaphire setosa</i> Nguyen, Nguyen, Lam & Nguyen, 2020						
	CTU-EW.179.h01	1C	11.567222	106.596111	Hon Quan, Binh Phuoc	x.2017	Tien T. H. Luong
	CTU-EW.179.p02	6C	11.567222	106.596111	Hon Quan, Binh Phuoc	x.2017	Tien T. H. Luong
28	<i>Metaphire songbeensis</i> Nguyen, Nguyen, Lam & Nguyen, 2020						
	CTU-EW.176.h01	1C	11.760833	106.577222	Loc Ninh, Binh Phuoc	x.2017	Tien T. H. Luong
	CTU-EW.176.p02	9C	11.760833	106.577222	Loc Ninh, Binh Phuoc	x.2017	Tien T. H. Luong
	CTU-EW.176.03	13C	11.760833	106.577222	Loc Ninh, Binh Phuoc	x.2017	Tien T. H. Luong
	CTU-EW.176.04	8C	11.294722	106.406111	Dau Tieng, Binh Duong	x.2017	Na S. Dinh
29	<i>Metaphire xuanlocensis</i> Nguyen & Lam, 2017						
	CTU-EW.086.h01	1C	10.815833	107.542222	Xuan Loc, Dong Nai	ix.2012	Thang V. Nguyen
	CTU-EW.086.p02	9C	10.815833	107.542222	Xuan Loc, Dong Nai	ix.2012	Thang V. Nguyen
	CTU-EW.086.03	17C	10.712500	107.324722	Cam My, Dong Nai	x.2013	Nhan V. Le
	CTU-EW.086.04	6C	10.654444	107.264722	Chau Duc, Ba Ria Vung Tau	x.2016	Nam Q. Nguyen
	CTU-EW.086.05	12C	10.606111	107.438611	Xuyen Moc, Ba Ria Vung Tau	x.2016	Nam Q. Nguyen
	CTU-EW.086.06	6C	10.646111	107.458333	Chau Duc, Ba Ria Vung Tau	x.2016	Nam Q. Nguyen
30	<i>Pheretima vungtauensis</i> Nguyen, Nguyen & Nguyen, 2018						
	CTU-EW.166.h01	1C	10.749167	107.243056	Chau Duc, Ba Ria Vung Tau	x.2016	Ai T. Truong
	CTU-EW.166.p02	2C	10.749167	107.243056	Chau Duc, Ba Ria Vung Tau	x.2016	Ai T. Truong
	CTU-EW.166.p03	1C	10.661667	107.156389	Chau Duc, Ba Ria Vung Tau	x.2016	Ai T. Truong
	CTU-EW.166.p04	1C	10.640278	107.350000	Chau Duc, Ba Ria Vung Tau	x.2016	Ai T. Truong
	CTU-EW.166.p05	2C	10.643889	107.113889	Tan Thanh, Ba Ria Vung Tau	x.2016	Hau P. Nguyen
	CTU-EW.166.p06	1C	10.485833	107.181667	Tan Thanh, Ba Ria Vung Tau	x.2016	Hau P. Nguyen
	CTU-EW.166.p07	1C	10.594167	107.123333	Tan Thanh, Ba Ria Vung Tau	x.2016	Hau P. Nguyen
31	<i>Polypheretima cattienensis</i> Nguyen, Tran & Nguyen, 2015						
	CTU-EW.040.h01	1C	11.425000	107.428333	Tan Phu, Dong Nai	x.2013	Nhan V. Le
	CTU-EW.040.p02	6C	11.425000	107.428333	Tan Phu, Dong Nai	x.2013	Nhan V. Le
	CTU-EW.040.03	6C	11.425278	107.428611	Tan Phu, Dong Nai	xi.2019	Dang H. Lam

No.	Species names and label codes	Number of Specimen	GPS Coordinates		Location	Date	Collector
			Latitude (North)	Longitude (East)			
32 <i>Polypheretima cordata</i> Nguyen, Tran & Nguyen, 2015							
	CTU-EW.042.h01	1C	11.113611	107.052778	Vinh Cuu, Dong Nai	x.2013	Trong C. Duong
	CTU-EW.042.p02	7C	11.113611	107.052778	Vinh Cuu, Dong Nai	x.2013	Trong C. Duong
	CTU-EW.042.03	4C	11.428333	107.427222	Tan Phu, Dong Nai	x.2013	Nhan V. Le
	CTU-EW.042.04	7C	11.113611	107.052778	Vinh Cuu, Dong Nai	x.2013	Trong C. Duong
	CTU-EW.042.05	4C	10.947778	107.018333	Dinh Quan, Dong Nai	x.2013	Nhan V. Le
	CTU-EW.042.06	4C	11.511667	106.986667	Dong Phu, Binh Phuoc	x.2013.	Nhan V. Le
	CTU-EW.042.07	4C	12.191111	107.203333	Bu Gia Map, Binh Phuoc	x.2017	Nam Q. Nguyen
	CTU-EW.042.08	4C	11.527778	106.916667	Dong Xoai, Binh Phuoc	x.2017	Nam Q. Nguyen
33 <i>Polypheretima elongata</i> (Perrier, 1872)							
	CTU-EW.026.02	4C	10.835278	106.526944	Binh Chanh, Ho Chi Minh City	ix.2019	Nam Q. Nguyen
34 <i>Polypheretima militium</i> Nguyen, Tran & Nguyen, 2015							
	CTU-EW.041.h01	1C	11.142500	107.014444	Vinh Cuu, Dong Nai	x.2013	Trong C. Duong
	CTU-EW.041.p02	6C	11.142500	107.014444	Vinh Cuu, Dong Nai	x.2013	Trong C. Duong
	CTU-EW.041.03	3C	11.142500	107.014444	Vinh Cuu, Dong Nai	x.2013	Trong C. Duong
	CTU-EW.041.04	5C	11.113611	107.053333	Vinh Cuu, Dong Nai	x.2019	Nam Q. Nguyen
35 <i>Drawida beddardi</i> (Rosa, 1890)							
	CTU-EW.031.02	4C	11.925000	106.726944	Bu Dop, Binh Phuoc	x.2017	Nam Q. Nguyen
	CTU-EW.031.04	7C	11.433056	106.385278	Dau Tieng, Binh Duong	x.2014	Nhi T. N. Nguyen
36 <i>Eukerria saltensis</i> (Beddard, 1895)							
	CTU-EW.182.01	8C	12.057222	107.127500	Bu Gia Map, Binh Phuoc	x.2017	Nam Q. Nguyen
	CTU-EW.182.02	7C	11.024722	106.621944	Thu Dau Mot, Binh Duong	x.2017	Nam Q. Nguyen
	CTU-EW.182.03	7C	10.387500	106.912500	Can Gio, Ho Chi Minh City	ix.2019	Nam Q. Nguyen
	CTU-EW.182.04	8C	10.691389	106.660000	Binh Chanh, Ho Chi Minh City	ix.2019	Nam Q. Nguyen
	CTU-EW.182.05	29C	10.702778	106.573889	Binh Chanh, Ho Chi Minh City	ix.2019	Nam Q. Nguyen
	CTU-EW.182.06	16C	11.390556	106.155278	Tay Ninh City, Tay Ninh	ix.2019	Nam Q. Nguyen
	CTU-EW.182.07	20C	11.382778	106.137778	Tay Ninh City, Tay Ninh	ix.2019	Nam Q. Nguyen
37 <i>Dichogaster affinis</i> (Michaelsen, 1890)							
	CTU-EW.033.01	16C	10.551944	106.779722	Can Gio, Ho Chi Minh City	ix.2019	Nam Q. Nguyen
	CTU-EW.033.02	3C	11.077500	106.400000	Trang Bang, Tay Ninh	ix.2019	Nam Q. Nguyen
38 <i>Dichogaster bolai</i> (Michaelsen, 1891)							
	CTU-EW.035.03	5C	10.639167	107.085556	Tan Thanh, Ba Ria Vung Tau	x.2016	Nam Q. Nguyen
	CTU-EW.035.04	20C	12.191111	107.203333	Bu Gia Map, Binh Phuoc	x.2017	Nam Q. Nguyen
	CTU-EW.035.08	20C	10.749722	107.349722	Cam My, Dong Nai	x.2013	Nhan V. Le
	CTU-EW.035.09	11C	10.477222	106.879444	Can Gio, Ho Chi Minh City	ix.2019	Nam Q. Nguyen
	CTU-EW.035.11	5C	11.390556	106.155278	Tay Ninh City, Tay Ninh	ix.2019	Nam Q. Nguyen
39 <i>Pontoscolex corethrurus</i> (Müller, 1857)							
	CTU-EW.001.01	31C	11.424444	107.435278	Tan Phu, Dong Nai	x.2013	Nhan V. Le
	CTU-EW.001.11	5C	10.628889	107.112500	Tan Thanh, Ba Ria Vung Tau	x.2016	Nam Q. Nguyen
	CTU-EW.001.22	69C	11.861111	107.025556	Bu Dang, Binh Phuoc	x.2017	Nam Q. Nguyen
	CTU-EW.001.29	19C	11.050000	106.788889	Tan Uyen, Binh Duong	x.2017	Nam Q. Nguyen
	CTU-EW.001.44	27C	10.702778	106.573889	Binh Chanh, Ho Chi Minh City	ix.2019	Nam Q. Nguyen
	CTU-EW.001.45	21C	11.371389	106.254722	Duong Minh Chau, Tay Ninh	ix.2019	Nam Q. Nguyen

Remarks: The species has very unique morphology characters among known *Metaphire* species, with regard to its saddle-shaped clitellum and setal arrangement in two rings (Nguyen et al. 2020b).

30. *Metaphire songbeensis* Nguyen, Lam & Nguyen, 2020

(Image 4 e1–e2, Table 1)

Examined material: 1C (CTU-EW.176.h01), 9C (CTU-EW.176.p02), 13C (CTU-EW.176.03), and 8C (CTU-EW.176.04); data in Table 1.

Distribution: Binh Duong (Dau Tieng, Di An, Ben Cat, Bau Bang); Binh Phuoc (Loc Ninh, Chon Thanh, Dong Xoai, Dong Phu, Phu Rieng, Bu Dang, Phuc Long, Bu Gia Map, Bu Dop).

Remarks: The species is fairly similar to *M. posthuma* (Vaillant, 1868), but it is recognized by having spermathecal pores in the dorsum, first dorsal pore in 9/10, and ventrally connected testes sacs. There are two morphological forms. The first form found in Binh Duong Province has spermathecal pores located closely to the mid-dorsal line and four pairs of genital markings in the male region. The other form has spermathecal pores located laterodorsally and more than four pairs of genital markings (Nguyen et al. 2020b).

31. *Metaphire xuanlocensis* Nguyen & Lam, 2017

(Image 3 j1–j2, Table 1)

Examined material: 1C (CTU-EW.086.h01), 9C (CTU-EW.086.p02), 17C (CTU-EW.086.03), 6C (CTU-EW.086.04), 12C (CTU-EW.086.05), and 6C (CTU-EW.086.06); data in Table 1.

Distribution: Dong Nai (Xuan Loc, Cam My); Ba Ria-Vung Tau (Ba Ria City, Xuyen Moc, Chau Duc).

Remarks: The species is fairly similar to *M. phaluongana* (Do & Huynh, 1992), but it is distinguished by having a pair of genital markings in xviii, separated testes sacs, and presence of penial seta (Nguyen & Lam 2017).

Genus *Pheretima* Kinberg, 1867

32. *Pheretima vungtauensis* Nguyen, Nguyen & Nguyen, 2018

(Image 4 i1–i2, Table 1)

Examined material: 1C (CTU-EW.166.h01), 2C (CTU-EW.166.p02), 1C (CTU-EW.166.p03), 1C (CTU-EW.166.p04), 2C (CTU-EW.166.p05), 1C (CTU-EW.166.p06), and 1C (CTU-EW.166.p07); data in Table 1.

Distribution: Ba Ria-Vung Tau (Chau Duc, Tan Thanh).

Remarks: The species is closely related to *M. houlettei* (Perrier, 1872), it is but specialized by the presence of

micronephridia attached onto the spermathecal ducts (Nguyen et al. 2018). Currently, *Pheretima vungtauensis* is known as the only species of genus *Pheretima* sensu stricto found in Vietnam.

Genus *Polypheretima* Michaelsen, 1934

33. *Polypheretima cattienensis* Nguyen, Tran & Nguyen, 2015

(Image 4 f1–f2, Table 1)

Examined material: 1C (CTU-EW.040.h01), 6C (CTU-EW.040.p02), and 6C (CTU-EW.040.03); data in Table 1.

Distribution: Dong Nai (Cat Tien NP).

Remarks: The species is similar to *Po. aringeana* (Beddard, 1900), but it is distinguished by lacking of genital markings, presence of seminal chambers, and the strongly coelomic copulatory pouches (Nguyen et al. 2015b).

34. *Polypheretima cordata* Nguyen, Tran & Nguyen, 2015

(Image 4 h1–h2, Table 1)

Examined material: 1C (CTU-EW.042.h01), 7C (CTU-EW.042.p02), 4C (CTU-EW.042.03), 7C (CTU-EW.042.04), 4C (CTU-EW.042.05), 4C (CTU-EW.042.06), 4C (CTU-EW.042.07), and 4C (CTU-EW.042.08); data in Table 1.

Distribution: Dong Nai (Vinh Cuu, Tan Phu, Trang Bom, Dinh Quan); Binh Phuoc (Dong Phu, Bu Dang, Bu Gia Map, Loc Ninh).

Remarks: The species is closely similar to *Po. grandisetosa* (Thai, 1996), but it is specialized by number of spermathecal pores (one pair in 5/6, 2 pairs in 6/7 or a pair per segment (found in Binh Phuoc Province)), holandry, presence of copulatory pouches, and absence of stout setae in the dorsum (Nguyen et al. 2015b).

35. *Polypheretima elongata* (Perrier, 1872)

(Image 4 j1, Table 1)

Examined material: 4C (CTU-EW.026.02); data in Table 1.

Distribution: Ho Chi Minh City (Binh Chanh).

Remarks: This is the first record of the species in the southeastern part of Vietnam, although it is widely distributed in the Mekong Delta (Nguyen 2014).

36. *Polypheretima militium* Nguyen, Tran & Nguyen, 2015

(Image 4 i1–i2, Table 1)

Examined material: 1C (CTU-EW.041.h01), 6C (CTU-EW.041.p02), 3C (CTU-EW.041.03), and 5C (CTU-EW.041.04); data in Table 1.

Distribution: Dong Nai (Vinh Cuu).



Key to the earthworm species in southeastern Vietnam

1. – Setae Lumbricine 2
- Setae Perichaetine 8
2. – Clitellum formed from more than one layer of cells 3
- Clitellum formed from a single layer of cells *Drawida beddardi*
3. – Clitellum annular *Eukerria saltensis*
- Clitellum saddle-shaped 4
4. – Clitellum within 5 segments xiii–xviii *Pontodrilus litoralis*
- Clitellum within more than 5 segments 5
5. – Clitellum within 7 segment xiii–xx. Male pores in xviii 6
- Clitellum within more than 7 segments. Male pore invisible 7
6. – Female pore single. Genital markings absent *Dichogaster bolai*
- Female pore paired. Genital marking single in mid-ventral of 8/9 *Dichogaster affinis*
7. – Clitellum within 9 segments xiv–xxii *Pontoscolex corethrurus*
- Clitellum within 22 segments xiii–xxxvi *Glyphidrilus papillatus*
8. – Clitellum within 4 segments xiv–xvii 9
- Clitellum within 3 segments xiv–xvi 10
9. – Three pairs of spermathecal pores in 6/7/8/9. Bidiverticulate *Lampito mauritii*
- Two pairs of spermathecal pores in 7/8/9. Adiverticulate *Perionyx excavatus*
10. – Intestine with a pair of caeca 11
- Intestine without caeca 38
11. – Copulatory pouches present 12
- Copulatory pouches absent 32
12. – Nephridia attached onto the spermathecal ducts *Pheretima vungtauensis*
- Spermathecal ducts without nephridia 13
13. – Male pore in xix 14
- Male pore in xviii 16
14. – Four pairs of spermathecal pores in lateroventral 5/6/7/8/9. Clitellum annular 15
- Three pairs of spermathecal pores in 6/7/8/9 dorsally. Clitellum saddle-shaped *Metaphire setosa*
15. – One pair of genital markings in xviii. First dorsal pore in 8/9 *Metaphire neoxenilis*
- Genital markings absent sin the male region. First dorsal pore in 12/13 *Metaphire anomala*
16. – Multiple spermathecae per segment *Metaphire mangophilooides*
- One pair of spermathecae per segment 17
17. – Four pairs of spermathecal pores in 5/6/7/8/9 18
- Less than four pairs of spermathecal pores 22
18. – Spermathecal pores dorsally *Metaphire songbeensis*
- Spermathecal pores not in dorsum 19
19. – Caeca complex. Genital markings absent in the male region *Metaphire bariaensis*
- Caeca simple Genital markings present in the male region 20
20. – Genital markings intersegmental in the male region *Metaphire malayanooides*
- Genital markings segmental in the male region 21
21. – Two pairs of genital markings in xvii and xix. Septum 8/9 thickened *Metaphire posthuma*
- One pairs of genital markings in xviii *Metaphire grandiverticulata*
22. – Three pairs of spermathecal pores 6/7/8/9 23
- Less than three pairs of spermathecal pores 28
23. – Spermathecal pores dorsally *Metaphire hau*
- Spermathecal pores not in dorsum 24
24. – Spermathecal pores laterally. Caeca manicate *Metaphire pacseana*
- Spermathecal pores lateroventrally. Caeca simple 25
25. – Genital markings two pairs in 17/18 and 18/19 26
- Genital markings absent in the male region 27
26. – Genital markings slit-like. Male region strongly concave *Metaphire bahli*
- Genital markings disc-shaped. Male region not concave *Metaphire peguana peguana*
27. – First dorsal pore in 11/12. Spermatheca mushroom-shaped *Metaphire cf. campanulata*
- First dorsal pore in 9/10. Spermatheca ovoid *Metaphire houleti*
28. – Two thecal segments. Penial setae absent 29
- One thecal segments in 7/8. Penial setae present *Metaphire xuanlocensis*
29. – Spermathecal pores in 5/6/7. Caeca manicate *Metaphire easupana*
- Spermathecal pores in 6/7/8 or 7/8/9. Caeca simple 30

30. – Spermathecal pores in 6/7/8..... 31
 – Spermathecal pores in 7/8/9..... *Metaphire houletteoides*
31. – Genital markings surrounded, next to spermathecal pores. Accessory glands present..... *Metaphire planata*
 – Genital markings absent in both the male and spermatheca regions. Accessory glands absent..... *Metaphire planatoides*
32. – Four pairs of spermathecal pores in 5/6/7/8/9..... 33
 – Less than four pairs of spermathecal pores..... 35
33. – Setae crowded in ventrad in xix..... *Amyntas polychaetiferus*
 – Setae in usual position..... 34
34. – Two to three pairs of genital markings in xviii and 18/19;.....
 – One pair of genital markings in 18/19. Genital markings single in vii or ix..... *Amyntas exiguum austrius*
 – Three to four pairs of genital markings in xvii, xix and onwards. Genital markings absent in the spermathecal region *Amyntas juliani*
35. – Three pairs of spermathecal pores in 5/6/7/8 *Amyntas ocularius*
 – Less than three pairs of spermathecal 36
36. – Two pairs of spermathecal pores in 5/6/7 37
 – Only one pair of spermathecal pores in 5/6..... *Amyntas longiprostaticus*
37. – Spermathecal pores laterodorsally. One pair of genital markings in xvii. Markings absent in the spermathecal region
 *Amyntas dorsomorrioides*
 – Spermathecal pores lateroventrally. One pair of genital markings in xviii. One to five genital markings in vi-vii *Amyntas mindam*
38. – Three to four pairs of genital markings in xix afterwards..... *Polypheretima elongata*
 – Genital markings absent in the male region..... 39
39. – Multiple spermathecae per segment in vi and vii. Testes sacs connected ventrally 40
 – One pair of spermatheca in vi and two pairs in vii. Testes sacs separated..... *Polypheretima cordata*
40. – Seminal chamber present. Male pores crescentic-shaped..... *Polypheretima cattienensis*
 – Seminal chamber absent. Male pores round-shaped..... *Polypheretima militium*

Remarks: The species is somewhat similar to *Po. colonensis* (Thai, 1996), but it is identified by holandry, polythecate, first dorsal pore in 12/13 or 13/14, and intestinal swelling at xv (Nguyen et al. 2015b).

Family MONILIGASTRIDAE Claus, 1880

Genus *Drawida* Michaelsen, 1900

37. *Drawida beddardi* (Rosa, 1890)

(Image 1 b1–n2, Table 1)

Examined material: 4C (CTU-EW.031.02) and 7C (CTU-EW.131.04); data for samples were shown in table 1.

Distribution: Binh Phuoc (Tan Thanh, Bu Dang); Binh Duong (Phu Giao, Dau Tieng) (Nguyen 2014; Nguyen et al. 2015).

Family OCNERODRILIDAE Beddard, 1891

Genus *Eukerria* Michaelsen, 1935

38. *Eukerria saltensis* (Beddard, 1895)

(Image 1 c1, Table 1)

Examined material: 8C (CTU-EW.182.01), 7C (CTU-EW.182.02), 7C (CTU-EW.182.03), 8C (CTU-EW.182.04), 29C (CTU-EW.182.05), 16C (CTU-EW.182.06), and 20C (CTU-EW.182.07); data in Table 1.

Distribution: Binh Duong (Thu Dau Mot); Binh Phuoc (Chon Thanh, Bu Dang, Bu Gia Map); Ho Chi Minh City (Can Gio, Nha Be, Binh Chanh); Tay Ninh (Tay Ninh City).

Family OCTOCHAETIDAE Gates, 1959

Genus *Dichogaster* Beddard, 1888

39. *Dichogaster affinis* Michaelsen, 1890

(Image 1 d1–d2, Table 1)

Examined material: 16C (CTU-EW.033.01) and 3C (CTU-EW.033.02); data in Table 1.

Distribution: Ho Chi Minh City (Can Gio); Tay Ninh (Ba Den Mts, Trang Bang).

Remarks: The species was recorded for the first time in southeastern Vietnam. It was usually found along with *Dichogaster bolaui* in soils of roadside or fallow lands.

40. *Dichogaster bolaui* (Michaelsen, 1891)

(Image 1 f1–f2, Table 1)

Examined material: 5C (CTU-EW.035.03), 20C (CTU-EW.035.04), 20C (CTU-EW.035.08), 11C (CTU-EW.035.09), and 5C (CTU-EW.035.11); data in Table 1.

Distribution: Ba Ria-Vung Tau (Ba Ria City, Tan Thanh); Dong Nai (Cam My); Binh Phuoc (Bu Gia Map NP); Ho Chi Minh City (Can Gio, Hoc Mon, Binh Chanh).

Remarks: It was very common in southeastern Vietnam, especially in moist soils.

Family RHINODRILIDAE Benham, 1890

Genus *Pontoscolex* Schmarda, 1861

41. *Pontoscolex corethrurus* (Müller, 1857)

(Image 1 e1–e2, Table 1)

Examined material: 31C (CTU-EW.001.01), 5C (CTU-EW.001.11), 69C (CTU-EW.001.22), 19C (CTU-EW.001.29), 27C (CTU-EW.001.44), and 21C (CTU-EW.001.45); data in Table 1.

Distribution: Very commonly distributed in Vietnam.

Remarks: The species was known to be native to the South America region, but wide spread over the world (Brown et al. 2006). In Vietnam, this species has been known widely in all habitats except natural forests in high mountains.

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