

The millipede genus *Nepalmatoiulus* Mauriès, 1983 (Diplopoda, Julida, Julidae) in Vietnam, with description of a new species

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Abstract

The genus *Nepalmatoiulus* Mauriès, 1983 is represented in Vietnam by eight species. These are included in an identification key and mapped, including *Nepalmatoiulus lamdonginensis* **sp. nov.** Distributional remarks are provided for all of the species.

Key words: taxonomy, distribution, review, key, map

Introduction

The present work continues the study of the collections of the millipede genus *Nepalmatoiulus* Mauriès, 1983. Up to now, all material from China (Mikhaljova 2020a, 2020b, 2023a, 2023b, 2024) and Nepal (Mikhaljova 2025) kept in the Zoological Museum of Moscow State University have been studied. This contribution is devoted to the study of material of *Nepalmatoiulus* from Vietnam, stored in the Zoological Institute of the Russian Academy of Sciences in St. Petersburg, Russia, among which there was one species new to science.

The millipedes of the genus *Nepalmatoiulus* are distributed in Bhutan, China including Taiwan, Northeast India, Japan, Malaysia, Myanmar, Nepal, Thailand and Vietnam. *Nepalmatoiulus* was first described as a subgenus of *Chromatoiulus* Verhoeff, 1894 by Mauriès (1983). Enghoff (1987) raised it to full genus status and reviewed the taxon with the description and re-description of 52 species. At the moment, *Nepalmatoiulus* contains 85 species (including a new species described herein) (Mauriès 1983; Enghoff 1987; Zhang *et al.* 1997; Korsós & Lazányi 2013; Mikhaljova 2020a, 2020b, 2023a, 2023b, 2024, 2025).

Attems (1938) was the first to report a species of this genus from Vietnam, described as a new species, *Fusiulus crassus* Attems, 1938 [Afterwards this species was moved by Golovatch (1983) to the genus *Anaulaciulus* Pocock, 1895 (presumably), and then by Enghoff (1987) to the genus *Nepalmatoiulus*]. Later Vietnamese records of this species by Attems (1953) concern completely different species (particularly *Nepalmatoiulus fan* Enghoff, 1987 and *N. pan* Enghoff, 1987) (Enghoff, 1987). Then Golovatch (1983), in his review of the Vietnamese millipedes, referred only to this species. Some time later, Enghoff (1987) published a revision of the genus *Nepalmatoiulus*, where he described six new species from various territories of Vietnam. In addition, *N. coxahaerens* Enghoff, 1987 originally described from Vietnam (Enghoff 1987), was registered in China (Zhang *et al.* 1997). Note, there are errors in the name of the species: *N. coxahaevens* Enghoff, 1989 on page 520 and *N. coxahaerens* Enghoff, 1989 on page 512. In a subsequent review (Enghoff *et al.* 2004) and the most recent review (Nguyen *et al.* 2025) of Vietnamese millipedes, the same seven aforementioned species of the genus *Nepalmatoiulus* were indicated.

The present paper summarizes the fauna of *Nepalmatoiulus* of Vietnam, providing description of a new species, as well as data on distribution including a map (Fig. 12), and a key to the species of the genus.

Material and methods

The material treated here is kept in the collection of the Zoological Institute of the Russian Academy of Sciences (ZISP) in St. Petersburg, Russia. Specimens were kept in 70–75% ethanol. During study, the gonopods, vulvae and some other body parts were dissected from the male and female and mounted in glycerin as temporary preparations. Specimens were studied using standard stereomicroscopic (MC-2-Zoom Digital) and microscopic (Ergoval) equipment. Scanning electron micrographs (SEM) were made at the Centre for Collective Use “Biotechnology and Gene Engineering” of the Federal Scientific Center of the East Asia Terrestrial Biodiversity, Far Eastern Branch of the Russian Academy of Sciences (FSCB) in Vladivostok, Russia, using a Merlin 62–15 ZEISS scanning electron microscope. Mounts for SEM were made by air-drying after transfer to acetone from 96% alcohol, mounting on stubs, and coating with chromium. After examination, SEM material was removed from the stubs and returned to alcohol. SEM images were edited in Adobe Photoshop Elements 9.

A “body ring formula” indicates the number of podous (including the gonopod ring and collum) and apodous rings before the telson in an individual. This formula is $x(-y)$ where x = sum of podous and apodous body rings excluding telson and y = number of apodous body rings before telson.

The term “nonapical stipital setae of gnathochilarium” means a field of setae at level with, or slightly basal to, the promentum (after Enghoff 1987). The term “limbus” means the hyaline posterior edge of metazona (after Enghoff 1987). The term “coxa 2 with one or two mesapical oral setae” means the setae directed to the body front (after Enghoff 1987).

Figure symbols are explained in the description and in the figure captions.

Taxonomic part

Order **Julida** Brandt, 1833

Family **Julidae** Leach, 1814

Genus ***Nepalmatoiulus*** Mauriès, 1983

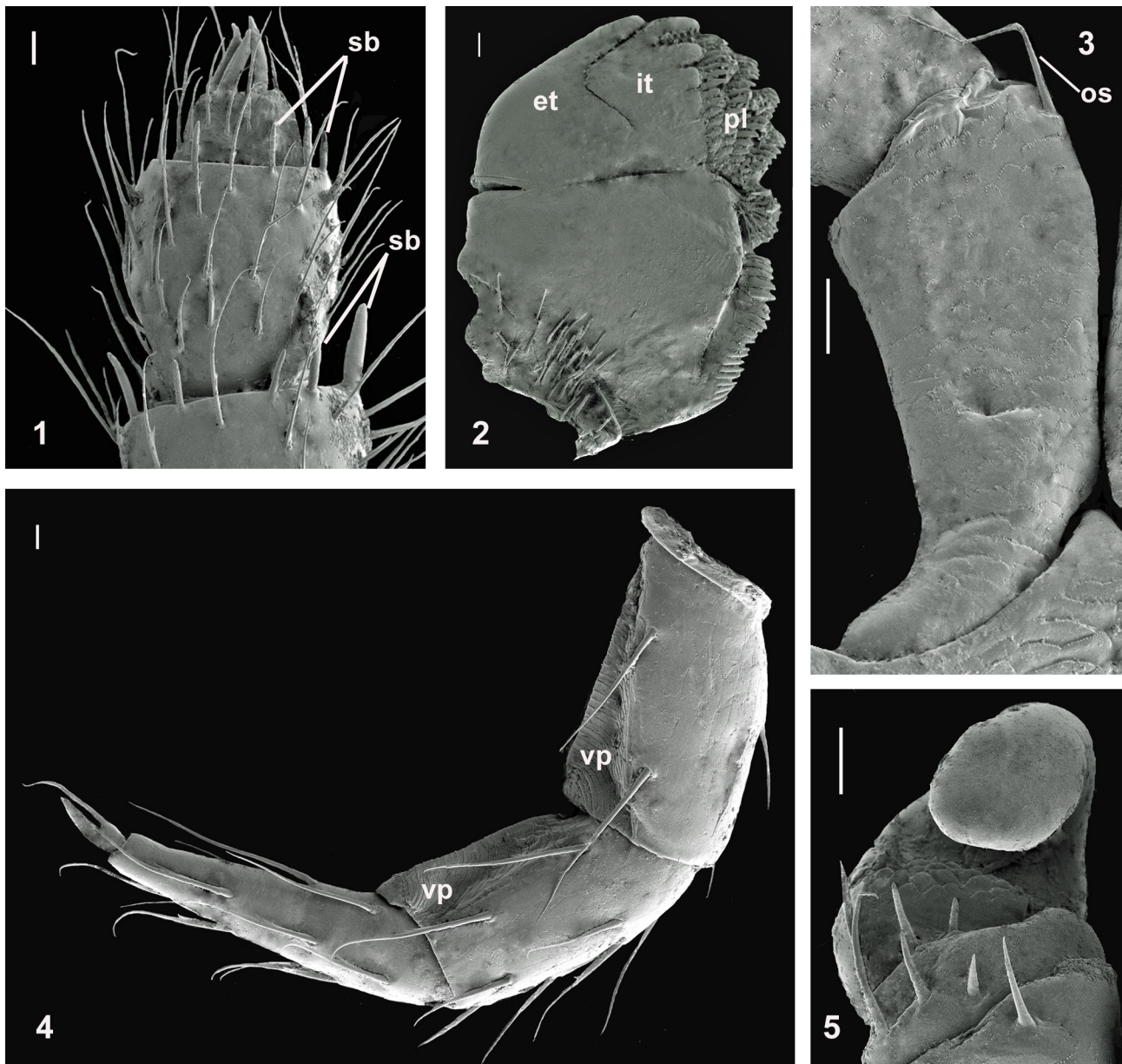
Nepalmatoiulus lamdonginensis sp. nov.

(Figs 1–11)

Material examined. Holotype: male (ZISP), Vietnam, Lam Dong Prov., Lac Durong Distr., Bidoup-Nui Ba National Park, nr meteorological tower, mid-montane mixed tropical forest, 12°11'02.57"N, 108°41'31.68"E, 1510–1520 m a.s.l., pitfall traps & in litter, 26.X–9.XI.2023, leg. D.V. Logunov. Paratype: 1 female (ZISP), same data as for holotype.

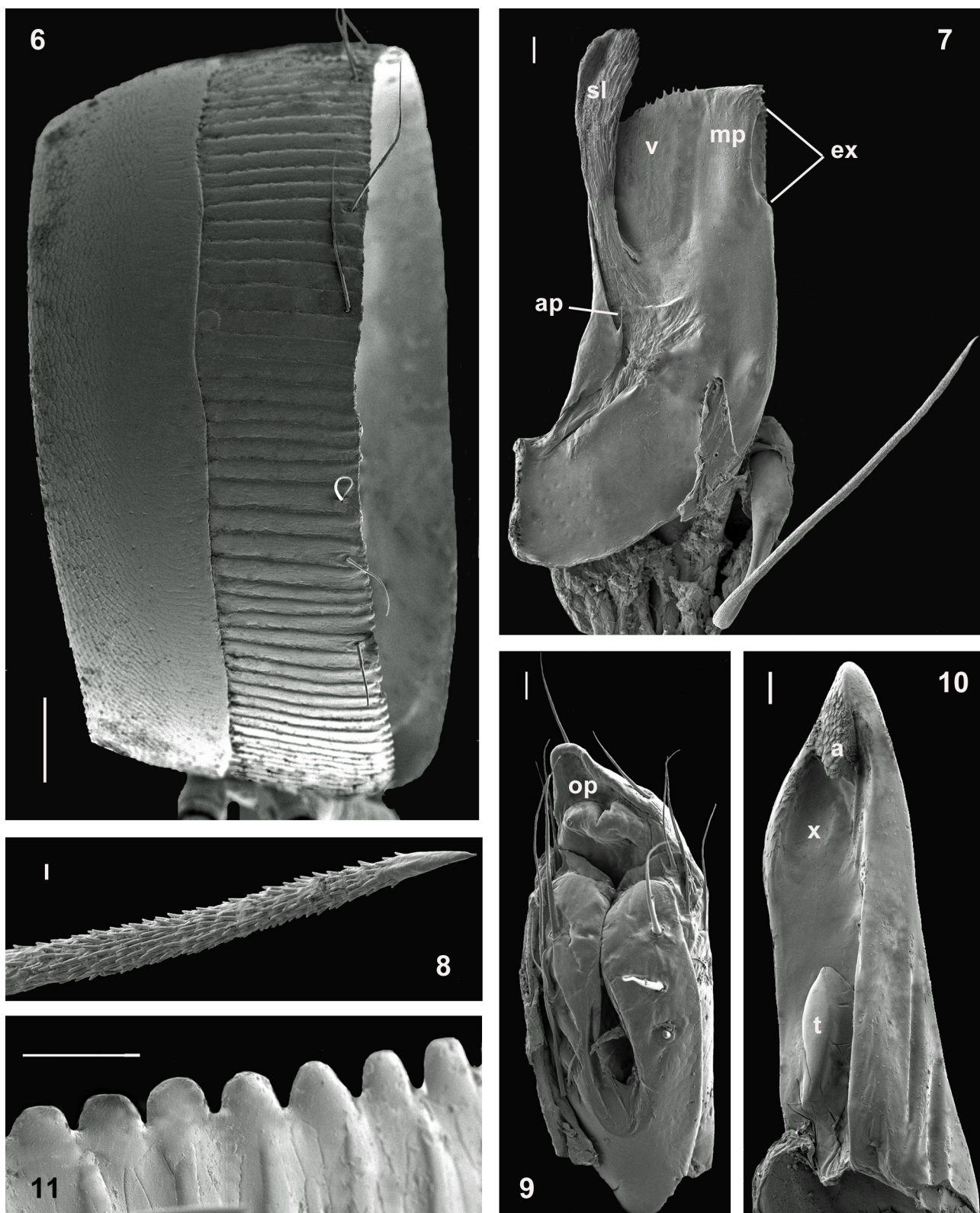
Diagnosis. Differs from congeners mainly by the promere with margins distally very strongly converging (vs not strongly converging in other congeners as in *N. falcatus* Enghoff, 1987), apically quite pointed (vs apically not pointed in other congeners as in *N. operculatus* Enghoff, 1987 or apically rounded as in *N. coxahaerens*), by the apical margin of the promere excavation forming a blunt papillate posterior protrusion (vs not forming a blunt papillate posterior protrusion in other congeners as in *N. operculatus*) coupled with somewhat expanded distal part of the solenomere (vs not somewhat expanded distal part of the solenomere in other Vietnamese congeners).

Description. *Male.* Length in alcohol 18.0 mm, midbody vertical diameter 1.0 mm, with 52(–2) rings, excluding telson. Coloration (in alcohol) transversely striated from marbled dark beige prozona and beige metazona. Anterior part of head beige, vertex and occiput marbled dark beige. Eyes black, antennae dark beige. Collum marbled dark beige, with a brown anterior spot dorsally. Legs light beige. Telson light beige, with a dark beige anterior part; claw-like outgrowth of epiproct bright brown.



FIGURES 1–5. *Nepalmatoiulus lamdonginensis* **sp. nov.**, male holotype (ZISP). 1. Distal part of antenna. 2. Mandibular gnathal lobe, dorsal view. 3. Left coxa 2, anterior view. 4. Distal part of leg 7. 5. Left leg 1, anterior view. **Abbreviations:** **et**, external tooth; **it**, internal tooth; **os**, mesapical oral seta; **pl**, pectinate lamellae; **sb**, sensilla basiconica; **vp**, ventral pads. Scales: 10 μ m (Fig. 4), 20 μ m (Figs 1–3, 5).

Head smooth, 2 epicranial setae, 4 supralabral setae; at least 12 labral setae. Eye patch almost round, with 30 ommatidia. Antennae medium-sized, rather slender and clavate. Antennomeres 5 and 6 with incomplete distodorsal corolla of sensilla basiconica (**sb**) (Fig. 1). Mandibular stipites each with a subrectangular smooth lobe; apical portion of the lobe with well demarcated border. Gnathochilarium with small group of non-apical stipital setae; lamellae linguales each with 5 setae arranged longitudinally. Mandibular gnathal lobe with internal (**it**) and external (**et**) teeth slightly reduced; pectinate lamellae (**pl**) slightly enlarged (Fig. 2). Collum with indistinct striae at posterior margin. A transverse row of relatively long setae at hind edge of collum mainly dorsally.



FIGURES 6–11. *Nepalmatoiulus lamdonginensis* **sp. nov.**, male holotype (Figs 6–8, 10–11) and female paratype (Fig. 9) (ZISP). 6. Pregonopodal ring, lateral view. 7. Right posterior gonopod, mesal view. 8. Distal part of flagellum. 9. Left vulva, posterior view. 10. Right promere, posterior view. 11. Posterior margin of ventral part of metazona of pregonopodal ring. **Abbreviations:** **a**, protrusion; **ap**, acicular process; **ex**, excavation of posterior gonopod; **mp**, mesomeral process; **op**, operculum; **sl**, solenomere; **t**, rudimentary telopodite; **v**, velum; **x**, excavation of promere. Scales: 2 μ m (Fig. 8), 20 μ m (Figs 7, 9–11), 100 μ m (Fig. 6).

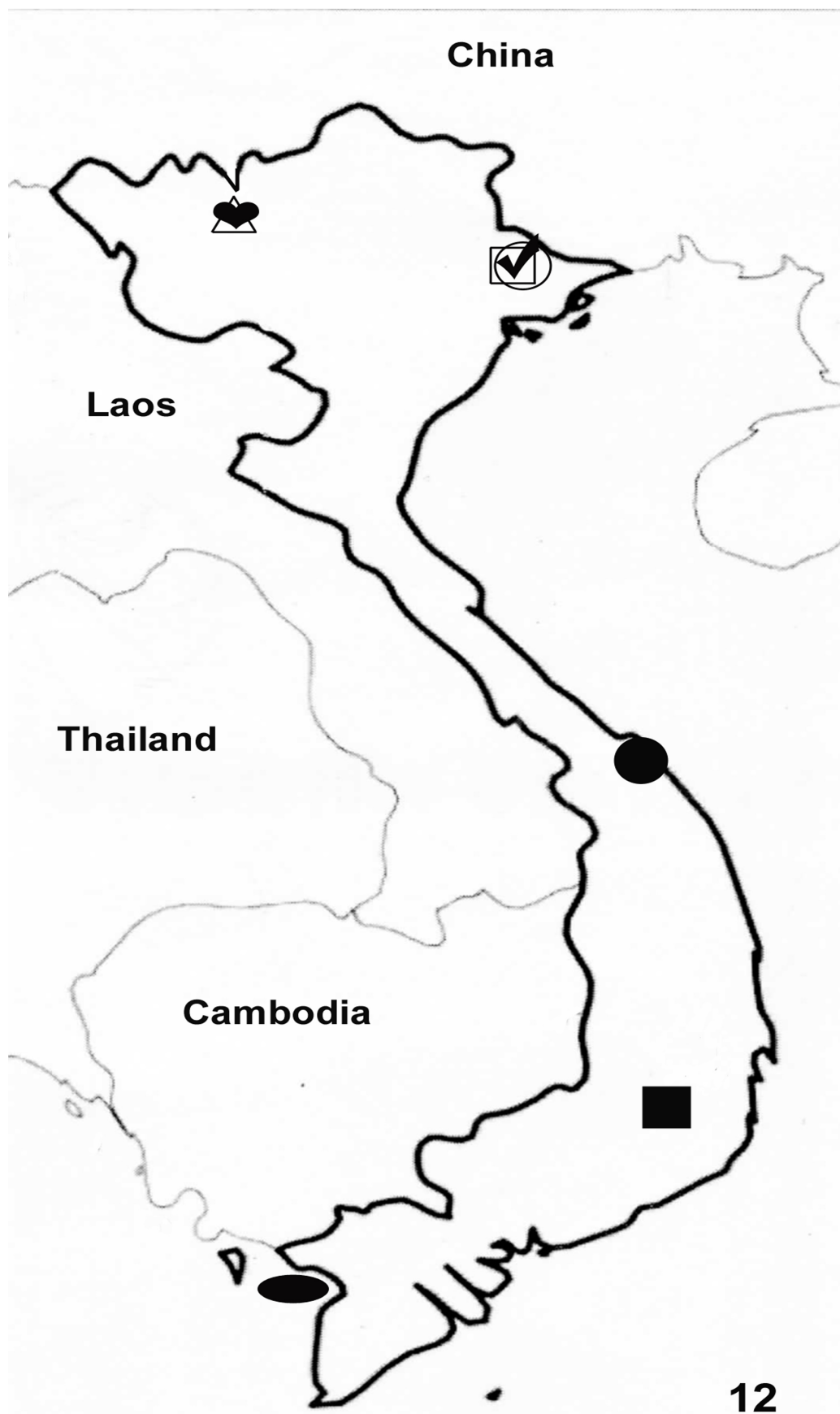


FIGURE 12. Distribution of *Nepalmatoiulus* species in Vietnam. Open square, *N. coxahaerens* Enghoff, 1987; filled circle, *N. crassus* (Attems, 1938); open circle, *N. falcatus* Enghoff, 1987; heart, *N. fan* Enghoff, 1987; filled square, *N. lamdonginensis* sp. nov.; checkmark, *N. operculatus* Enghoff, 1987; open triangle, *N. pan* Enghoff, 1987; ellipse, *N. xenognathos* Enghoff, 1987.

Body rings circular. Prozona smooth. Metazona with dense, regular, longitudinal striae reaching hind margin (10–11 striae in an approximate square with sides equal to metazonal length of a dorsal side of a midbody ring). Limbus (after Enghoff 1987) intermediate between TYPES 1 (in dorsal part, Fig. 6) and 2 (in ventral part, Fig. 11). A transverse row of long setae at hind edge of metazona (Fig. 6), setae gradually growing denser toward telson. Ozopores very small, lying immediately behind suture dividing pro- and metazona. Telson with caudal dorsal projection of moderate length, covered with dense setae and carrying at tip a small claw-shaped process directed posteriad. Preanal ring, anal valves, and subanal scale (hypoproct) densely setose.

Legs slender. Very delicately serrate ventral pads (**vp**) present on tibia and postfemur (Fig. 4), starting from legs 2; the pads gradually diminishing towards posterior body part to totally disappearing on last legs. Claw of all legs at base with a setiform accessory claw ventrally; accessory claw longer than claw (Fig. 4).

Leg pair 1 forming a hook, the distal podomere not coming into close contact with the basal podomeres (“open hook” type in Enghoff 1987), postfemur with inflated scaly-rugose ventral surface, coxa with one seta, distal podomere without tarsal remnant (Fig. 5). Coxa 2 with one mesapical oral seta (**os**), gland opening positioned in basal and axial position (after Enghoff (1987) (Fig. 3).

Ventral margin of ring 7 with rounded lobe (as in Fig. 32 in Enghoff 1987). Gonopods (Figs 7, 8, 10) *in situ* slightly protruding from gonopodal sinus. Anterior gonopod (promere) flattened, with subparallel margins, distally very strongly converging, apically quite pointed, posterior surface subapically excavated for accommodation of the mesomeral process, distal margins of the excavation (**x**) papillate, apical margin of the excavation produced into a blunt papillate posterior protrusion (**a**); posterior surface subcentrally with subovale, flattened, rudimentary telopodite (**t**) (Fig. 10). Flagellum slender, moderately long, densely covered with cuticular spikes for two thirds of its length (Figs 7, 8). Posterior gonopod: mesomeral process (**mp**) hardly demarcated from velum (**v**), with sharp papillae apically and with frontal excavation (**ex**) subapically, lateral margin of the excavation serrated (Fig. 7). Velum not much sloping, its apical margin spinose. Solenomere (**sl**) subcylindrical, spinose throughout, its distal part somewhat expanded; acicular process (**ap**) of the flagellum-guiding flap long (Fig. 7).

Female. Length in alcohol about 20.0 mm, midbody vertical diameter 1.0 mm, with 51(–2) rings, excluding telson. Nonsexual characters as in male except for the absence of non-apical setae on each stipes of gnathochilarium. Vulva: operculum (**op**) higher than bursa; posterior side of the bursa with 6 setae, arranged in two regular rows, apical setae longest (Fig. 9).

Etymology. The specific epithet refers to the type locality, Lam Dong Province. Adjective, masculine.

Conclusion

At present, eight species of *Nepalmatoiulus* (including the new species described above) have been recorded from Vietnam (Table 1). Most of them (except *N. coxahaerens* also recorded in China (Hubei Province) (Zhang *et al.* 1997) and possibly *N. xenognathos* known from a presumed Vietnamese locality (Enghoff 1987)) are endemic to Vietnam. In addition, there are no widespread species among them. All of the species, except *N. coxahaerens*, are known only from their type localities. The localities of the *Nepalmatoiulus* species are distributed in the northern, central and southern regions of Vietnam (Fig. 12). Undoubtedly, this information shows the species diversity of Vietnamese *Nepalmatoiulus* only at the present time. *Nepalmatoiulus* fauna of not only Vietnam, but also of other countries within the range of this genus, is poorly studied.

It is also noteworthy that *Nepalmatoiulus* species in Vietnam are mostly restricted to montane regions. Some of the species (*N. crassus*, *N. lamdonginensis* **sp. nov.**, *N. fan*, *N. pan*) are restricted to the high-montane habitats (up to 1510–2200 m a.s.l.), whereas others (*N. coxahaerens*, *N. falcatus*, *N. operculatus*) prefer to live in localities up to ca. 600–1090 m a.s.l.

Remarks. Enghoff (1987) described *N. xenognathos* based on only one female, presumably from Vietnam. He also reported that according to Attems (1938), this female was collected together with the holotype of *N. crassus*, but clearly did not belong to latter species. Thus, the origin of this female is uncertain. However, Attems (1938) noted that there are some females of a possibly new species of *Fusiulus* from Poulo Dama, which are small islands off the extreme southern Vietnam coast. From this, Enghoff concludes that *N. xenognathos* derives from Poulo Dama (see Enghoff 1987, page 319). Thus, the status of this species is still uncertain. Nevertheless, *N. xenognathos* was described as new; slightly modified mouthparts in combination of large body size and possibly reduced accessory

claws were used as the main diagnostic characters (see Enghoff 1987). However, these characters seem unreliable. Therefore, in the key below, which concerns *N. xenognathos*, I used only its locality, body size as well as the absence of a male in the collected material on this species and the presence of only a female.

TABLE 1. List of *Nepalmatoiulus* species occurring in Vietnam, with data on distributions and basic literature sources.

<i>Nepalmatoiulus</i> species	Distribution	Altitude (m a.s.l.)	Main reference/s
1. <i>N. coxahaerens</i> Enghoff, 1987	Vietnam, Tonkin, Lang Son Province, Mt. Mau-Son. China, Hubei Province, Badong County	ca. 600–900 (Vietnam); average 1089.3 (China)	Enghoff 1987; Zhang <i>et al.</i> 1997; Enghoff <i>et al.</i> 2004; Nguyen <i>et al.</i> 2025
2. <i>N. crassus</i> (Attems, 1938) <i>Fusiulus crassus</i> Attems, 1938 “ <i>Anaulaciulus</i> ” <i>crassus</i> Attems, 1938	Vietnam, Annam, Da Nang Province, Mt. Bana	1500	Attems 1938; Enghoff 1978; Golovatch 1983; Enghoff <i>et al.</i> 2004; Nguyen <i>et al.</i> 2025
3. <i>N. falcatus</i> Enghoff, 1987	Vietnam, Tonkin, Lang Son Province, Mt. Mau-Son	ca. 600–900	Enghoff 1987; Enghoff <i>et al.</i> 2004; Nguyen <i>et al.</i> 2025
4. <i>N. fan</i> Enghoff, 1987 <i>Fusiulus crassus</i> Attems, 1953	Vietnam, Lao Cai Province, Mt. Fansipan	2200	Attems 1953; Enghoff 1987; Enghoff <i>et al.</i> 2004; Nguyen <i>et al.</i> 2025
5. <i>N. lamdonginensis</i> sp. nov.	Vietnam, Lam Dong Province	1510–1520	
6. <i>N. operculatus</i> Enghoff, 1987	Vietnam, Tonkin, Lang Son Province, Mt. Mau-Son	ca. 600–900	Enghoff 1987; Enghoff <i>et al.</i> 2004; Nguyen <i>et al.</i> 2025
7. <i>N. pan</i> Enghoff, 1987 <i>Fusiulus crassus</i> Attems, 1953	Vietnam, Lao Cai Province, Mt. Fansipan	2200	Attems 1953; Enghoff 1987; Enghoff <i>et al.</i> 2004; Nguyen <i>et al.</i> 2025
8. <i>N. xenognathos</i> Enghoff, 1987	Presumably Vietnam, Kien Giang Province, “Poulo Dama” (small islands off extreme south of Vietnam) (after Enghoff 1987)	?	Enghoff 1987; Enghoff <i>et al.</i> 2004; Nguyen <i>et al.</i> 2025

Key to *Nepalmatoiulus* species occurring in Vietnam

1. Distribution: Kien Giang Province, “Poulo Dama”. Male unknown. Length of female 41 mm. *N. xenognathos*
- 1a. Distribution: different. Male known. Length of female different. 2
2. Solenomere deeply bifid. *N. coxahaerens*
- 2a. Solenomere not bifid. 3
3. Solenomere long, its distal part rises far above the edge of velum and apex of mesomeral process. 4
- 3a. Solenomere shorter, its distal part not rises far rises or slightly rises above the edge of velum and apex of mesomeral process. 6
4. Promere with margins distally strongly converging, apically quite pointed, rugose margin of apical excavation with blunt caudal protrusion. Solenomere distally expanded. *N. lamdonginensis* **sp. nov.**
- 4a. Promere different. Solenomere distally more or less tapering. 5
5. Leg pair 1 without postfemoral rugosities; tibial apophyses only slightly converging, forming slender arched hooks. *N. falcatus*
- 5a. Leg pair 1 with postfemoral rugosities; tibial apophyses converging, forming thicker, acute hooks with main axes of legs. *N. fan*
6. Solenomere subapically with spinose posterior protrusion, apically with a strong spine; velum steeply sloping *N. operculatus*
- 6a. Solenomere different; velum not steeply sloping. 7
7. Apical edge of velum smooth, without protrusion. Male body size small, approximately 8 mm in length. *N. pan*
- 7a. Apical edge of velum with protrusion. Male body size larger, more than 8 mm in length. *N. crassus*

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