

Two New Species of Polydesmoid Millipedes from Western Java, Indonesia (Diplopoda: Polydesmida: Cryptodesmidae, Haplodesmidae)

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ABSTRACT.— Two new species of the millipede order Polydesmida are described from primary rainforest litter on the slope of Mount Salak, an active volcano in western Java, Indonesia. *Circulocyptus javanicus* n. sp. differs from *C. faillei* Golovatch, 2016, the sole, and type, species of the genus *Circulocyptus* Golovatch, 2016, family Cryptodesmidae, known from several places in central and southern Vietnam, by the much larger body (ca 20 vs. 11–16 mm long), more numerous radii at the anterior margin of the collum (29 vs. 25), more abundant metatergal tubercles (usually 6 vs. 4 rows), the shape of the lateral margin of paraterga (anterolateral corner mostly broadly rounded vs. squarish), and minor details of gonopodal structure. The diagnosis of *Circulocyptus* is refined since this genus seems to be unique not only within the family, but also amongst the entire Polydesmida in showing an accessory seminal chamber located not at the end of a solenomere, which is a typical situation, but on a separate gonopodal branch and lying just opposite the solenomere tip. *Cylindrodesmus telnovorum* n. sp. is only a third species to be recognized in *Cylindrodesmus* Pocock, 1889, family Haplodesmidae, a genus which presently encompasses the type species *C. hirsutus* Pocock, 1889, nearly ubiquitous, mostly pantropical and partly parthenogenetic, and *C. villosus* Pocock, 1898, from Rotuma Island, Fiji, southwestern Pacific. The new species differs from both primarily by the peculiar colour pattern (mainly blackish contrasting with pinkish) and uniramous gonopod (much like in *C. hirsutus*, but gradually attenuating in distal half until a blunt tip).

KEY WORDS: Polydesmida, *Circulocyptus*, *Cylindrodesmus*, taxonomy, new species, distribution

INTRODUCTION

Whereas the Oriental, or Indo-Malayan, realm is the globe's only biogeographical region that supports all 16 extant orders of the class Diplopoda (Shelley and Golovatch, 2011), the order Polydesmida is by far the most speciose among millipedes (Minelli, 2015). The diplopod fauna of Java, like those of the entire Sunda Archipelago and Indo-Australia, is also dominated by polydesmidans, especially representatives of the family Paradoxosomatidae. In contrast, species and genera from the families Cryptodesmidae and Haplodesmidae are quite few. The former group contains in Java only five species of *Ophrydesmus*

Cook, 1896 (Golovatch, 2015), while the latter family comprises six species in four genera: the endemic *Helodesmus porosus* Cook, 1896, *Doratodesmus armatus* (Pocock, 1894), *D. muralis* Cook, 1896 and *D. vestitus* Cook, 1896, as well as both largely pantropical *Prosopodesmus jacobsoni* Silvestri, 1910 and *Cylindrodesmus hirsutus* Pocock, 1889 (Golovatch et al., 2009; Stoev et al., 2010).

All the more interesting seems to be the discovery of two new polydesmoid species in western Java, one each in Cryptodesmidae and Haplodesmidae. Both are described below and both allow for the diagnoses of their respective genera to be refined.

MATERIAL AND METHODS

The material treated below has been taken in a mid-montane primary rainforest in western Java on the slope of an active volcano by Dmitry and Edwin Telnov (The Entomological Society of Latvia, Riga). All type material is in the collection of the Zoological Museum of the Moscow University, Russia.

Pictures in the field were taken by D. Telnov, while focus stacking photographs by Kirill V. Makarov, of the Teachers' Training University of Moscow, Russia.

DESCRIPTIONS

Family Cryptodesmidae

Genus *Circulocryptus* Golovatch, 2016

Type species: *C. faillei* Golovatch, 2016

Circulocryptus javanicus n. sp. (Figs 1-4)

Holotype.— ♂, Indonesia, western Java, Halimun-Salak National Park, Mount Salak, north of Kawa Ratu Crater, 6°42'12"S, 106°42'10"E, primary lower montane tropical rainforest near spring (Fig. 1), 1225 m a.s.l., thin wet litter soon after a heavy rain, 30.VIII.2017, leg. D. & E. Telnov.

Name.— To emphasize the provenance from Java; adjective.

Diagnosis.— Differs clearly from *C. faillei* Golovatch, 2016, known only from several localities in central and southern Vietnam (Golovatch, 2016; Golovatch and VandenSpiegel, 2017), by a much larger body (ca 20 vs. 11-16 mm long), more numerous radii at the anterior margin of the collum (29 vs. 25), more abundant metatergal tubercles (usually 6 vs. 4 rows), the shape of the lateral margin of paraterga (anterolateral corner mostly broadly rounded vs. squarish), and minor details of gonopodal structure (e.g. the presence of a lateral outgrowth **k** on solenophore **sph**).



FIGURE 1. The habitat that supports both new species. Picture by D. Telnov.



FIGURE 2. Live coloration of *Circulocryptus javanicus* n. sp., ♂ holotype, dorsal view. Picture by D. Telnov.

Description.— Length ca 20 mm, width ca 2.0 and 4.6 mm on midbody pro- and metazonae, respectively. Live coloration blackish brown with contrasting orange antennae (Fig. 2), in alcohol apparently a little faded, dark brown to brown, antennae yellowish, venter, gonopods and basal podomeres light yellowish brown, distal podomeres red-brown (Fig. 3)

Body with 20 segments. In width, head \ll collum $<$ segment 2 $<$ 3 $<$ 4=15; thereafter body rapidly tapering towards telson. Head mostly very densely pilose, pilosity being very short; vertigial region delicately microgranulate (Fig. 3B). Antennae short and clavate; in length, antennomere 3 = 5 = 6 $>$ 2 = 4 = 7; both antennomeres 5 and 6 highest, each with a tight dorso-apical group of bacilliform sensilla; interantennal isthmus about twice as large as diameter of antennal socket.

Tegument generally dull, mostly very delicately microgranulate, prozonae finely shagreened. Collum flabellate, regularly rounded, but considerably impressed at fore margin, fully concealing the head from above (Figs 2-3). Paraterga very strongly developed, only slightly declined, largely held subhorizontal and leaving the dorsum only moderately convex, wing-shaped, set high (at about upper 1/4 to 1/3 of midbody

height), starting with collum, laterally and caudally more or less clearly lobulate (Figs 1-2). Anterior margin of collum entire, with 29 long radii, sometimes quite vague, dividing it into 15+15 lobulations, these being setigerous apically and likewise largely obscure (Fig. 3). Dorsal surface of collum and following metaterga beset with very short, often abraded, whitish tergal setae, each latter normally surmounting a small, flat tergal tubercle or boss. Caudal margin of collum with neither traceable radii nor lobulations, mid-caudal part moderately elevated, densely and irregularly tuberculate. Postcollum metaterga each with 5-6 (usually six), mostly regular (especially regular the first and last rows), transverse rows of rather flat, sometimes clearly obliterated, setigerous, largely roundish tubercles or bosses, 2-3 rows extending laterally onto paraterga. Anterior edge/shoulder of paraterga always entire, mostly nearly straight and slightly bordered, increasingly, but faintly curved caudad towards telson; anterolateral edge regularly and broadly rounded, caudolateral corner always acutangular and narrowly rounded, drawn increasingly caudad, but clearly projecting behind rear tergal margin only on paraterga 15-19; paraterga 19 produced behind as far as tip of epiproct. Lateral

margin of paraterga with five small, but distinct lobulations, caudal margin on each side until base of paraterga with additional

7-8 larger lobulations, these gradually reduced in size mesad and further on turning into another 7-8 rounded, subequally small



FIGURE 3. Habitus of *Circulocryptus javanicus* n. sp. in alcohol, ♂ holotype, dorsal (A) and ventral (B) views, respectively. Pictures by K. V. Makarov, taken not to scale.

lobules (Fig. 2). Neither axial line nor pleurosternal carinae. Limbus microspinulate. Ozopores barely visible, small, round, located at anterior margin at the very base of paraterga, traceable at least on segment 7 (after breaking the body), pore formula untraceable. Stricture dividing pro- and metazonae thin, shallow, shining and polished unlike adjacent parts. Epiproct (Figs 2-3) short, conical, truncate at apex. Hypoproct (Fig. 3B) subtrapeziform, 1+1 caudal setae clearly separated, borne on small knobs.

Sternites sparsely setose, mostly narrow, moderately impressed, strongly separated only just in front of and behind gonopods, i.e. between coxae 7 and 9 (Fig. 3B). Legs densely setose, unmodified, long, but

relatively stout, ca 1.4–1.5 times as long as paratergal width (♂); in length, tarsi > femora > prefemora and tibiae > coxae and postfemora; gonapophyses on coxae 2 small cones; neither adenostyles nor tarsal brushes. Gonopod aperture subcordiform, caudal and lateral margins slightly elevated.

Gonopods (Fig. 4) very complex, in situ both held parallel to each other (Fig. 3B). Coxites small and stout, fused medially, each with a single, strong, apicodorsal seta; cannulae long and slender. Telopodite subcircular, very strongly curved caudad, vaguely bipartite. Basal part (**b**) retrorse apically, extended near midway into a long, solid, spiniform, curved, bare, lateral solenomere (**sl**), the latter at its base on mesal side bearing a fringed membranous

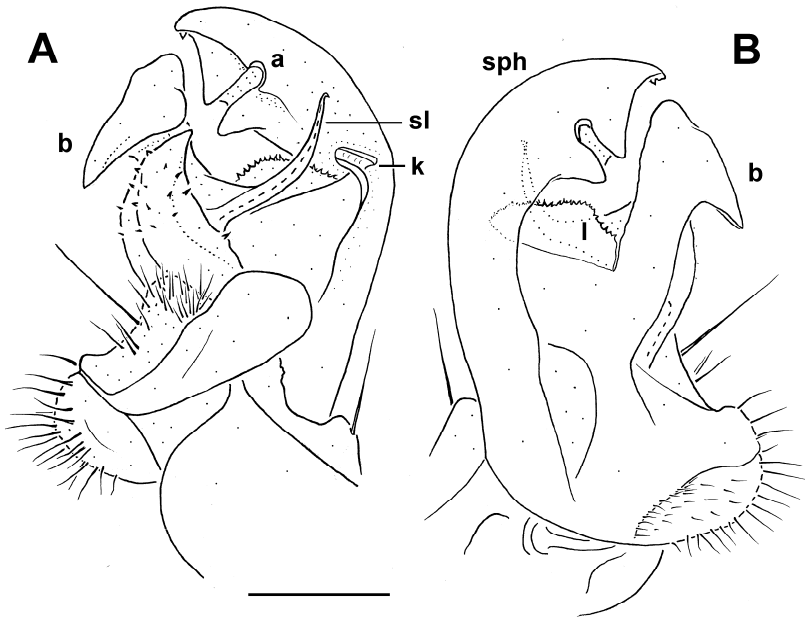


FIGURE 4. Left gonopod of *Circulocryptus javanicus* n. sp., ♂ holotype, lateral (A) and mesal (B) views, respectively. Scale bar: 0.2 mm.

Designations: b – basal part, l – hyaline lobe, sl – solenomere, sph – solenophore branch, a – accessory seminal chamber with short duct.

hyaline lobe (**l**). A distinct accessory seminal chamber (**a**) and a short duct devoid of a hairy pulvillus lying in distal part of solenophore branch (**sph**) just opposite **sl**.

Remarks.— The genus *Circulocryptus* has originally been diagnosed by the particularly complex and subcircular gonopods showing a small finger-shaped prefemoral process (Golovatch, 2016). However, since additional samples of *C. faillei* from central and southern Vietnam failed to reveal such a process in the remaining populations (Golovatch and VandenSpiegel, 2017), a new diagnosis of the genus is warranted. With the discovery of *C. javanicus* n. sp., which is unequivocally very similar to *C. faillei* both in somatic (e.g. an increased number of radii at the anterior margin of the collum) and gonopodal traits (a subcircular biramous telopodite, a shorter basal branch (**b**) equipped near midway with a long and spiniform solenomere (**sl**) ending up just opposite an obvious accessory seminal chamber (**a**) and a short duct, both latter located inside the second, longer gonopodal branch (**sph**) etc.), *Circulocryptus* can be rediagnosed as a genus outstanding not only within Cryptodesmidae, but also among all Polydesmida.

Indeed, the presence of an accessory seminal chamber in numerous Polydesmidea, often together with a hairpad, is always associated with the terminal part of the seminal groove. When a solenomere is developed, i.e. the branch or process that supports at least the end portion of the seminal groove, the accessory seminal chamber, when present, is always located inside or near the solenomere. *Circulocryptus* is thus unique in the solenomere and accessory seminal chamber being widely separated and lying on two opposite gonopodal branches. The tip of the solenomere can be supposed to fit in both

the duct and accessory seminal chamber for sperm transfer. Even a rudimentary hairpad is traceable near the duct in some *C. faillei* populations (Golovatch and VandenSpiegel, 2017). All this also implies multiple origins of an accessory seminal chamber, a duct and a hairpad not only within Polydesmida, but even among genera of Cryptodesmidae.

Family Haplodesmidae

Genus *Cylindrodesmus* Pocock, 1889

Type species: *C. hirsutus* Pocock, 1889

Cylindrodesmus telnovororum n. sp.

(Figs 1, 5-6)

Holotype.— ♂, Indonesia, western Java, Halimun-Salak National Park, Mount Salak, north of Kawa Ratu Crater, 6°42'12"S, 106°42'10"E, primary lower montane tropical rainforest near spring (Fig. 1), 1225 m a.s.l., thin wet litter soon after a heavy rain, 30.VIII.2017, leg. D. & E. Telnov.

Paratypes.— 1 ♂, 1 ♀, same data, together with holotype.

Name.— Honours Dmitry and Edwin Telnov, the collectors.

Diagnosis.— Differs clearly from both *C. hirsutus* Pocock, 1889 and *C. villosus* Pocock, 1898 by the remarkable colour pattern, from *C. villosus* by the uniramous gonopodal telopodite, from *C. hirsutus* by the shape of the gonopodal telopodite, including its blunt tip.

Description.— Length ca 5 (♂) or 6.5 mm (♀), width on midbody pro- and metazonae 0.5 and 0.6 (♂) or 0.7 and 0.8 mm (♀), respectively. General coloration largely dark (grey) brown, but remaining body with a remarkable pattern of strongly contrasting lighter collum, segment 2 and telson (in nature likely red, but in alcohol faded from light pinkish to nearly pallid); head mostly grey-brown, anterior halves of prozonae partly red-brown; three distal podomeres of



FIGURE 5. Habitus of *Cylindrodesmus telnovorum* n. sp. in alcohol, ♀ (left) and ♂ (right) paratypes, lateral views. Pictures by K. V. Makarov, taken not to scale.

walking legs lighter grey; venter and basal podomeres light yellow-brown; antennae largely dark castaneous brown, only their tips pallid; metatergal setation pallid (Fig. 5).

Body subcylindrical, with 19 (♂) or 20 segments (♀), not capable of volvation. Head very densely pubescent. Collum and following metaterga clothed with a dense, dull, microvillose cerategument crust. Antennae very short and clavate, in situ basal part of each placed inside a deep, transverse, nearly C-shaped groove (Fig. 5); antennomere 6 clearly largest, remaining ones subequal in length; both antennomeres 5 and, especially, 6 with a tight dorso-apical

group of bacilliform sensilla (Fig. 6A). In width, head < collum < segment 3=4 < 2=5=15 (♂) or 16 (♀), thereafter body gradually tapering towards telson (Fig. 5). Collum hood-shaped, regularly rounded at anterior and lateral margins, far from concealing the head from above (Fig. 5). Paraterga nearly absent, only on segment 2 slightly enlarged, lobe-shaped at anterolateral margin and subtending the head on both sides; following paraterga like rounded bulges, set at about half of midbody height, virtually absent from penultimate segment.

Collum and metatergal tegument rough and dull, very densely and irregularly



FIGURE 6. *Cylindrodesmus telnovorum* n. sp., ♂ paratype. Antenna, lateral view (A), leg 9, lateral view (B), and left gonopod, mesal view (C). Scale bars: 0.2 mm (A, B) and 0.1 mm (C).

Designation: sl – solenomere.

setose; stricture between pro- and metaterga thin, deep and clearly ribbed; prozonae finely micro-alveolate and shagreened. Dorsum very convex, segments subcircular in cross-section; setation consisting of extremely dense and simple setae and considerably more sparse, but much longer, likewise irregular, bisegmented, filiform hairs, the latter up to 1/3-1/2 as long as metaterga (Fig. 5). Ozopores borne on very short, round, stump-shaped, rather disc-like porosteles, pore formula normal: 5, 7, 9, 10, 12, 13, 15-18(19) (Fig. 5). Limbus microcrenulate. Epiproct short, curved ventrocaudally, subtruncate caudally, but tip located ventrally, invisible from above (Fig. 5). Hypoproct trapeziform, 1+1 apical setae well-separated, borne on small knobs.

Sterna narrow, sparsely setose, coxae medially nearly contiguous, only between ♂ coxae 7 and 9 distinctly separated. Legs subequal in both sexes, slightly incrassate (Fig. 6B), densely setose, short and stout, ca 1.3 (♂) or 1.2 (♀) times as long as body height, devoid of micropapillae (Figs 5, 6B).

Gonopods (Fig. 6C) with large, subcylindrical, mediobasally fused coxae; cannulae long and slender. Telopodite slender, uniramous, blade-shaped, elongated, only slightly longer than coxa, faintly and regularly curved caudad, poorly broadened near midlength, very gradually tapering in distal half; prefemoral (= setose) portion nearly half as long as a blunt acropodite (= solenomere, **sl**). Neither an accessory seminal chamber nor a hairy pulvillus.

Remarks.— According to the latest review (Golovatch et al., 2001), the genus *Cylindrodesmus* contains only two species. One is the pantropical *C. hirsutus* which often shows parthenogenetic populations, including all those encountered in European hothouses. The other is *C. villosus* from Rotuma Island, Fiji, Polynesia, distinguished by its distally branching gonopods. Neither shows any colour pattern, being monochrome, nearly pallid to brick reddish. As noted by Bergholz (2005), shifts from a parthenogenetic to a bisexual state and back seem to occur regularly in *C. hirsutus*, depending on environmental conditions: harsher habitats tend to support the thelytokous (male-free) form, while more favourable places tend to be populated by the bisexual form.

The above new species is the first in *Cylindrodesmus* to demonstrate a particularly bright colour pattern. This allows for the generic diagnosis as formulated by Golovatch et al. (2001) to be refined in this respect. Similar, yet far from that vividly coloured cases seem to be rare in the entire family Haplodesmidae, for instance like those observed in certain *Doratodesmus* spp. (Cook, 1896). Except for the few diagnostic features, including the coloration and the shape of the gonopodal telopodite, the above account of *C. telnovorum* n. sp. matches virtually in every detail the extensive SEM iconographies and descriptions available for the unequivocally most similar *C. hirsutus* (e.g. Golovatch et al., 2001, 2017). With the new evidence at hand, the origin centre of *Cylindrodesmus* seems to have lain in the Sunda area.

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