

A NEW DRAGON MILLIPEDE (POLYDESMIDA: PARADOXOSOMATIDAE: PARADOXOSOMATINAE: ORTHOMORPHINI) FROM THE PHILIPPINES

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ABSTRACT. – A new dragon millipede species, *Desmoxytes philippina*, from the Philippines is described. This first Philippine dragon millipede species expands the previously known distribution of the group, from Southeast Asia (*Desmoxytes* Chamberlin, 1923) and Australia (*Desmoxytoides* Mesibov, 2006).

KEYWORDS. – Polydesmida, Paradoxosomatidae, dragon millipedes, Philippines.

INTRODUCTION

The term “dragon millipedes” refers to millipede species of two genera *Desmoxytes* Chamberlin, 1923, and *Desmoxytoides* Mesibov, 2006 (Family Paradoxosomatidae Daday, 1889, Order Polydesmida Pocock, 1897). The dragon millipedes can be distinguished from other paradoxosomatid genera by the conspicuous form of the paraterga, which are dorsally and laterally expanded, and shaped like antlers, spines or wings with pointed lateral tips. This group is also characterized by the metatergal sculpture and the somewhat simple gonopod telopodite, featuring an unprotected solenomere.

The genus *Desmoxytes* currently consists of 26 species distributed in South East Asia (from south-eastern China to Vietnam, Thailand and Myanmar) (Table 1). So far, it appears that most species are endemic and have relatively small distributional ranges. However, collecting has been sparse in the entire region and the actual distributional range for each species is not yet well known.

The other genus of the group, *Desmoxytoides*, containing the species *D. hasenpuschorum* Mesibov, 2006, was described from Australia. The discovery of a dragon millipede in the Australian tropics raised the question of the phylogeny and biogeography of the lineage and how *Desmoxytes* should be circumscribed (Mesibov, 2006). The new Philippine species partly closes the distributional gap between Southeast Asia and Australia.

MATERIALS AND METHODS

The male type specimen was collected during the Field Museum Philippine Zoological Expedition (1946–1947), conducted by H. Hoogstraal to collect mammals. Dr. Floyed G. Werner collected the millipede specimen. The specimen is preserved in 75% ethanol. The catalog number prefix FMNH-INS identifies the holotype as a Field Museum of Natural History specimen in the insect collections. The line illustrations were made with the help of a Leica dissection scope and a camera lucida attached to the scope. The photographic images were taken with Olympus SZH10 microscope and an Olympus Qcolor3 digital camera. All measurements are in millimeters. Type specimen is deposited at the Field Museum of Natural History (FMNH).

TAXONOMY

Paradoxosomatidae Daday, 1889

Paradoxosomatinae Daday, 1889

Orthomorphini Brölemann, 1916

***Desmoxytes* Chamberlin, 1923**

***Desmoxytes philippina*, new species**
(Figs. 1–11)

Material examined. – Holotype: male (FMNH-INS 856), South Slope, Mt. Balabag, Mantalingajan Range, southern Palawan Island, Pandanus, 4,500 ft (~1,370 m), coll. E. G. Werner, 10 May 1947.

Table 1. Known dragon millipede species of genus *Desmoxytes* Chamberlin, 1923 (Golovatch & Enghoff, 1994; Nguyen et al., 2006; Enghoff et al., 2007; Golovatch et al., 2010).

No.	Species	Distribution
1	<i>Desmoxytes cornutus</i> (Zhang & Li, 1982)	Guangxi Province, Southern China
2	<i>Desmoxytes draco</i> (Cook & Loomis, 1924)	Jiangxi Province, Southern China
3	<i>Desmoxytes minutuberculata</i> (Zhang, 1986)	Southern China
4	<i>Desmoxytes longispina</i> (Loksa, 1960)	China
5	<i>Desmoxytes scutigeroideus</i> Golovatch, Geoffroy & Mauriès, 2010	Guangxi Province, Southern China
6	<i>Desmoxytes scolopendroides</i> Golovatch, Geoffroy & Mauriès, 2010	Guangxi Province, Southern China
7	<i>Desmoxytes aspera</i> (Attems, 1937)	South Center of Vietnam
8	<i>Desmoxytes cattienensis</i> Nguyen, Golovatch & Anichkin, 2006	Dongnai Province, Southern Vietnam
9	<i>Desmoxytes cervaria</i> (Attems, 1953)	Laocai Province, Northern Vietnam
10	<i>Desmoxytes enghoffi</i> Nguyen, Golovatch & Anichkin, 2006	Quangbinh Province, Center of Vietnam
11	<i>Desmoxytes hostilis</i> Golovatch & Enghoff, 1994	Vinhphuc Province, Northern Vietnam
12	<i>Desmoxytes pilosa</i> (Attems, 1937)	Southern Vietnam
13	<i>Desmoxytes proxima</i> Nguyen, Golovatch & Anichkin, 2006	Laocai Province, Northern Vietnam
14	<i>Desmoxytes specialis</i> Nguyen, Golovatch & Anichkin, 2006	Kontum Province, South Center of Vietnam
15	<i>Desmoxytes spectabilis</i> (Attems, 1937)	South Center of Vietnam
16	<i>Desmoxytes acantherpestes</i> Golovatch & Enghoff, 1994	Western coast of Siam Gulf, Thailand
17	<i>Desmoxytes gigas</i> Golovatch & Enghoff, 1994	Southern Thailand
18	<i>Desmoxytes rubra</i> Golovatch & Enghoff, 1994	Southern Thailand
19	<i>Desmoxytes delfae</i> (Jeekel, 1964)	Southern Thailand
20	<i>Desmoxytes jeekeli</i> Golovatch & Enghoff, 1994	Northern Thailand
21	<i>Desmoxytes pterygota</i> Golovatch & Enghoff, 1994	Western coast, Southern Thailand
22	<i>Desmoxytes purpurrosea</i> Enghoff, Sutcharit & Panha, 2007	Southern Thailand
23	<i>Desmoxytes taurina</i> (Pocock, 1895)	Southern Myanmar
24	<i>Desmoxytes cervina</i> (Pocock, 1895)	Southeastern Myanmar
25	<i>Desmoxytes terae</i> (Jeekel, 1964)	Northern Malaysia and Southern Thailand
26	<i>Desmoxytes planata</i> (Pocock, 1895)	Nearly pantropically

Diagnosis. – This new species can be distinguished from all other dragon millipedes by such unique characters as the very simple gonopod featuring only a single branch: the solenomere curves down and forms a full circle; the seminal groove runs on the lateral side of femorite. The second branch, the solenophore, as present in other *Desmoxytes* species, is absent.

Etymology. – The name “*philippina*” is an adjective, referring to the type locality, the Philippines.

Description. – Size: length ca. 26.3; width of midbody, pro- and metazona, 1.3 and 1.7, respectively. Distance between two paratergal tips on midbody bodyrings ca. 3.1.

Colouration: generally chestnut-brown, some parts darker.

Head: somewhat smaller than collum and other bodyrings; epicranial suture thin but obvious and distinct; frons sparsely setose along the epicranial suture.

Antenna: slender but extremely long, ca. extending back to bodyring 7. Antennomeres subequal: 3, 4, 5 > 2, 6 > 1, 7 (Fig. 1).

Collum: sub-trapezoidal with evident transverse sulcus at 2/3 length; surface shagreened with 2+2 setae near front margin, and 2+2 small granulations near rear margin. Paraterga sub-triangular, wing-shaped with a pointed tip, anteriorly with two lateral incisions.

Body: collum=2<=3<=4-17, thereafter gradually tapering. Prozona, metazona and even pleura shagreened, shiny without any trace of microgranulation. Transverse sulcus present from metaterga 2, deep and distinctly evident, extending to paratergal base. Metaterga with 2+2, and 2+2 traces of setae in front of and behind the transverse sulcus. Constriction dividing pro- and metazona narrow and thin, with neither striations nor granules (Figs. 2-4).

Paraterga well-developed, spiniform, only slightly elevated above dorsum on bodyrings 2–3, thereafter well-elevated. Paraterga on pore-less bodyrings relatively smaller with two

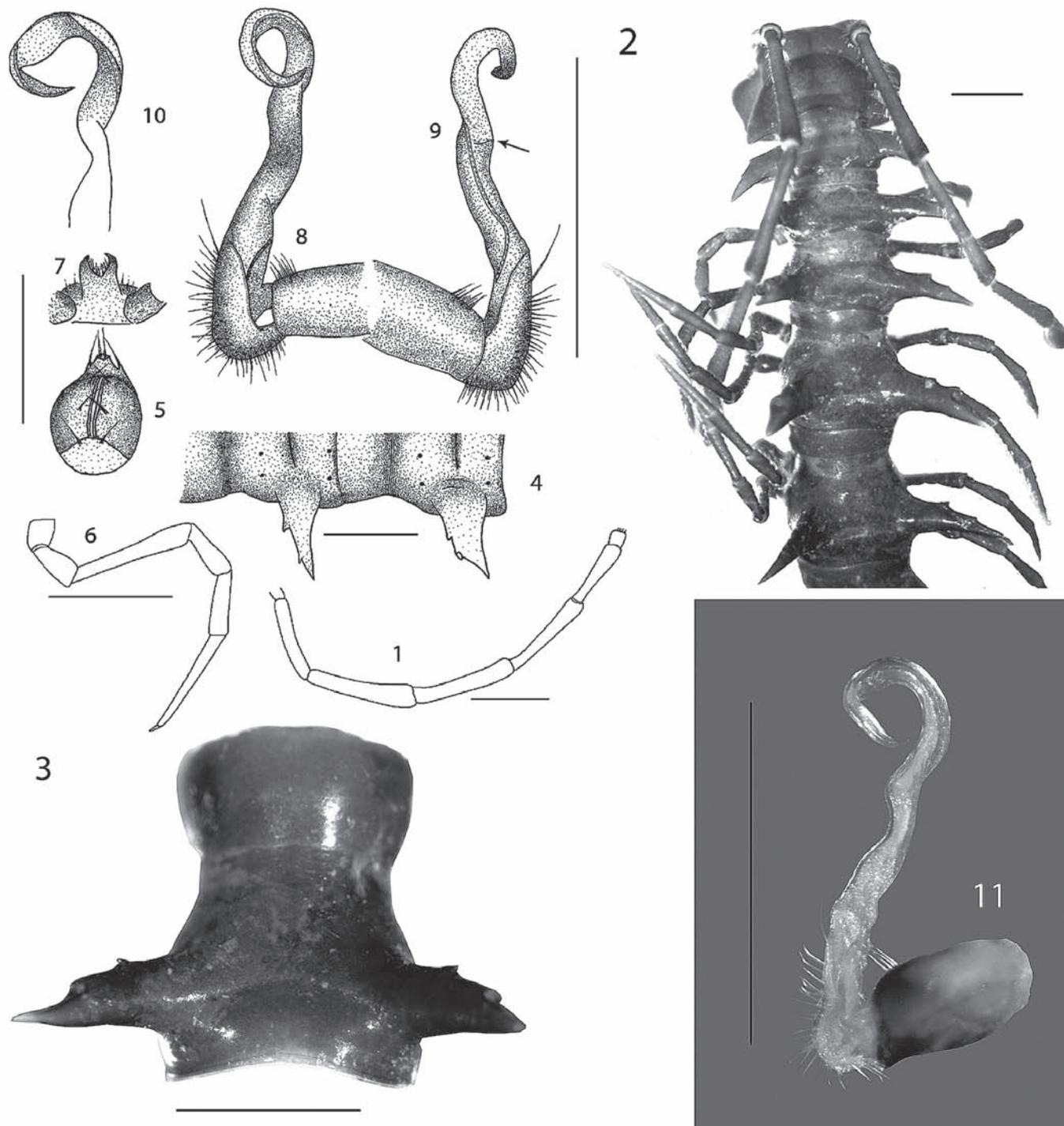
small teeth at 1/3 and 2/3 lateral length, while on pore-bearing bodyrings larger with only one small tooth at 1/3 of its length, and the ozopore at 2/3 lateral length. Latero-distal corner of paraterga usually strongly pointed, paler than body colour. Paraterga on bodyring 19 very small. Axial line completely absent. Pleurosternal carinae absent.

Telson: Epiproct with one lateral setiferous tubercle on each side, tip broadly truncated. Hypoproct trapezoid with laterodistal setiferous knobs. Paraprocts semi-circular (Fig. 5).

Legs: slender and extremely long, ca. 3 times longer than midbody height. Tibia and tarsi of legs 1–4 with ventral brushes. Femur very long, without any modifications (Fig. 6).

Sterna: sparsely setose, cross impression evidently deep, with an antierad bi-tubercled lamina between coxae 4 originating on sternite 5 (Fig. 7).

Gonopod (Figs. 8–11): simple; coxa subcylindrical with a densely setose ventrodistal part. Prefemorite rather



Figs. 1–11. *Desmoxytes philippina* new species, male holotype: 1, Antenna; 2, anterior part of body, dorsal view; 3, segment 10, dorsal view; 4, segments 11–12, dorsal view; 5, leg 10; 6, telson, ventral view; 7, sternum 5, posteroventral view; 8–11, gonopod, mesal view (8, 11), lateral view (9), dorsal view (10), arrow indicates postfemoral cingulum. Scale bar = 1 mm.

Table 2. Comparison of five characters for *Desmoxytes*, *Desmoxytoides* and *Desmoxytes philippina*, new species.

Other <i>Desmoxytes</i> species	<i>Desmoxytes philippina</i> new species	<i>Desmoxytoides hasenpuschorum</i> Mesibov, 2006
Metatergal surface mostly with various microgranulations	Metatergal surface shagreened, without any granulates or tubercles	Metatergal surface with minute tubercles
Paraterga: wing or antler-shaped, or spiniform as in <i>D. longispina</i> (Loksa, 1960)	Paraterga spiniform	Paraterga antler-form
Solenophore (=second process) present, but usually condensed and short, sometimes complex in shape	Solenophore absent	Solenophore (=second process) present, spiniform, and smaller than solenomere
Seminal groove running mesally on femorite	Seminal groove running laterally on femorite	Seminal groove running mesally on femorite
Acropodite with a postfemoral cingulum	Acropodite with a postfemoral cingulum	Acropodite without a distinct cingulum

long, densely setose, separated from femorite by oblique demarcation. Femorite long, slender and slightly curved mesad; demarcation between femorite and postfemoral region present laterally (Fig. 9). The postfemoral region simple, with only one branch, the solenomere curving down to form the complete circle; tibiotarsus (=solenophore) missing.

Seminal groove running mesally until end of prefemur, turning onto lateral side and running laterally along femur and entering the solenomere.

DISCUSSION

The tribal and subfamilial classification of the species-rich polydesmid family Paradoxosomatidae (177 genera, 878 species) lacks a clearly defined phylogenetic framework. Whether the three subfamilies, 22 tribes and numerous genera are monophyletic, is uncertain. A case in point is the so-called dragon millipedes. It has been a widespread practice within millipede taxonomy to describe a large number of monotypic genera whenever morphologically divergent species are encountered. The same route could be taken in the case of *Desmoxytes philippina*, new species. However, the description of a new monotypic genus in the absence of a complete phylogenetic analysis of the dragon millipedes and its sister taxa would obscure the only phylogenetic signal currently available, the modified paraterga. The gonopods of *D. philippina* are distinguished by the absence of the solenophore. The absence of this character, however, does not support any relationships with other genera, because the solenophore may simply be lost in this particular species. For this reason, we refrain from erecting yet another monotypic genus in the family Paradoxosomatidae.

Golovatch & Enghoff (1994) based the potential monophyly of the genus *Desmoxytes* on features of the paraterga as a single putative synapomorphy; no gonopodal or other somatic characters were advanced in support. Despite the lack of putative gonopodal and other somatic synapomorphies, they synonymized several genera under *Desmoxytes* and thus accepted the spiniform and wing-shaped paratergal modifications as an apomorphy of the group. Many of the 26 species currently placed into the genus *Desmoxytes*

Chamberlin, 1923, share a varying number of characters such as surface of metaterga often more or less roughly granulate and with at least two rows of tubercles/knobs in front of or behind the transverse sulcus. Legs and antennae often long and slender (as in *D. philippina*), femora of legs 5, 6, 9 and/or 9 in males usually inflated to humped ventrally; gonopod with postfemoral region strongly demarcated by a sulcus or cingulum, telopodite with two branches, solenomere and solenophore as in other members of the tribe Orthomorphi. In all species previously assigned to *Desmoxytes*, these two branches are usually strongly reduced in size and condensed, with solenomere and solenophore closely aligned. While the recently described monotypic genus *Desmoxytoides* Mesibov, 2006, shares the special spine- or antler-shaped paraterga with *Desmoxytes*, the second gonopod process (=solenophore?) is spiniform and smaller than the solenomere and both are not closely aligned. However, both these genera also share the following characteristics: paraterga and metatergal surface more or less covered by micro-granulation or minute tubercles, and with at least two rows of tubercles/knobs in front or behind the transverse sulcus.

With its spine-shaped paraterga, this new Philippine species of the genus, *Desmoxytes philippina*, new species, certainly belongs to the dragon millipedes. However, its metatergal surface sculpture is shagreened and lacks granules and tubercles. The gonopods are unique within this group, since the telopodite consists of only a single branch, the solenomere, while a second branch (a solenophore) is completely absent. Furthermore, the trajectory of the seminal groove is unique, running mostly laterally on the femorite.

The comparison between this new species, and other *Desmoxytes* species as well as *Desmoxytoides hasenpuschorum* Mesibov, 2006, is given in Table 2 below.

The genus *Desmoxytes* seems to be restricted to the continental Southeast Asia (southern China, Myanmar, Thailand, Vietnam and peninsular Malaysia) while *Desmoxytoides* has been hitherto found in Australia. The discovery of *Desmoxytes philippina*, new species, expands the range of the genus both southwards and eastwards. The relationships among *Desmoxytes* species and their relationship to *Desmoxytoides* are not well understood, as the gonopod structures are diverse.

A phylogenetic analysis, possibly incorporating molecular data, would test the monophyly of *Desmoxytes* and its relationship to *Desmoxytoides*, and would shed light on the origin of the biogeographic pattern observed in this groups, as well as gonopodal character evolution.

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