

## An unusual new species of the millipede genus *Glyphiulus* Gervais, 1847 from Borneo (Diplopoda: Spirostreptida: Cambalopsidae)

### Необычный новый вид двупарноногих многоножек рода *Glyphiulus* Gervais, 1847 с Борнео (Diplopoda: Spirostreptida: Cambalopsidae)

S.I. Golovatch<sup>1</sup>, J.-J. Geoffroy<sup>2</sup>, J.-P. Mauriès<sup>3</sup> & D. VandenSpiegel<sup>4</sup>  
С.И. Головач<sup>1</sup>, Ж.-Ж. Жоффруа<sup>2</sup>,  
Ж.-П. Морьес<sup>3</sup>, Д. ВанденШпигель<sup>4</sup>

<sup>1</sup> Институт проблем экологии и эволюции РАН, Ленинский пр. 33, Москва 119071 Россия.

<sup>1</sup> Institute for Problems of Ecology and Evolution, Russian Academy of Sciences, Leninsky pr. 33, Moscow 119071, Russia.

<sup>2</sup> Muséum national d'Histoire naturelle, Département Ecologie & Gestion de la Biodiversité, UMR 7204 CERSP du CNRS, Equipe EVOLTRAIT, 4, avenue du Petit Château, F-91800 Brunoy, France.

<sup>3</sup> Muséum national d'Histoire naturelle, Département Systématique et Evolution, Section Arthropodes, Case Postale n°53, 61 rue Buffon F-75231 Paris Cedex 05, France.

<sup>4</sup> Musée Royal de l'Afrique centrale, B-3080 Tervuren, Belgium.

KEY WORDS: Diplopoda, *Glyphiulus*, taxonomy, new species, cave, Borneo.

КЛЮЧЕВЫЕ СЛОВА: Diplopoda, *Glyphiulus*, таксономия, новый вид, пещера, Борнео.

**ABSTRACT.** The large, basically Southeast Asian genus *Glyphiulus* appears to be represented in the fauna of Borneo (Kalimantan, Indonesia) by a new, quite aberrant species, *G. striganovae* sp.n., which fails to readily fit into either of the two species groups currently delimited in the genus, i.e. the *granulatus*- or the *javanicus*-group. This new species tentatively remains ungrouped pending the discovery of further congeners south of Malay Peninsula, including Borneo.

**РЕЗЮМЕ.** Большой, главным образом юговосточноазиатский род *Glyphiulus* представлен в фауне Борнео (Калимантан, Индонезия) новым, весьма уклоняющимся видом, *G. striganovae* sp.n., который невозможно четко отнести ни к одной из двух групп видов, пока выделенных в составе данного рода, т.е. ни к группе *granulatus*, ни к группе *javanicus*. Этот новый вид временно остается вне группы, пока к югу от Малайского полуострова, включая Борнео, не будут найдены другие виды этого рода.

#### Introduction

Formally, Borneo has hitherto been known to support only one genus of the basically Australasian millipede family Cambalopsidae: *Plusioglyphiulus* Silvestri, 1923. Six species of altogether 27, nearly all cavernicoles, are currently considered as being endemic to that island; none shows a pantropical distribution, whereas the bulk of species diversity is observed in Thailand and Malaysia [Golovatch et al., 2009, 2011a].

*Hypocambala* Silvestri, 1897 is the next genus to potentially be present in Borneo as well, because a couple of its 13 described species are widespread pantropical anthropochores, whereas another few congeners have been described both west and east of Borneo [Jeekel, 2004; Golovatch et al., 2011d].

The basically Southeast Asian genus *Glyphiulus* Gervais, 1847 is by far the largest in the family. Based on the structure of ♂ legs 1, the genus is divided into two well delimited, obviously natural species groups, the *granulatus*-group, which currently encompasses 22 species, including the pantropical *G. granulatus* (Gervais, 1847), and the *javanicus*-group, which includes 33 species [Golovatch et al., 2007a, b, 2011b, c]. Combined, both groups range from the central-southern parts of China and the Ryukyus in the north, through Vietnam, Laos and Cambodia, to south-central Thailand (excluding Malay Peninsula) in the south [Golovatch et al., 2011b, c]. The geographically closest record of a *Glyphiulus* to Borneo is that of *G. javanicus* Carl, 1911 from north-central Java, Indonesia [Carl, 1911]. However, because that species was found in a sugar cane plantation, while all other congeners occur north of the Malay Peninsula, we can soundly suggest that *G. javanicus* in Java actually represents an introduction from a still unknown locality somewhere in Indochina or China [Golovatch et al., 2007b].

All the more interesting is a recent discovery in a cave in Borneo of an obviously local species of *Glyphiulus*. It appears to show a number of aberrant traits that do not allow us to assign it with certainty to either of the accepted species groups. In addition, this new

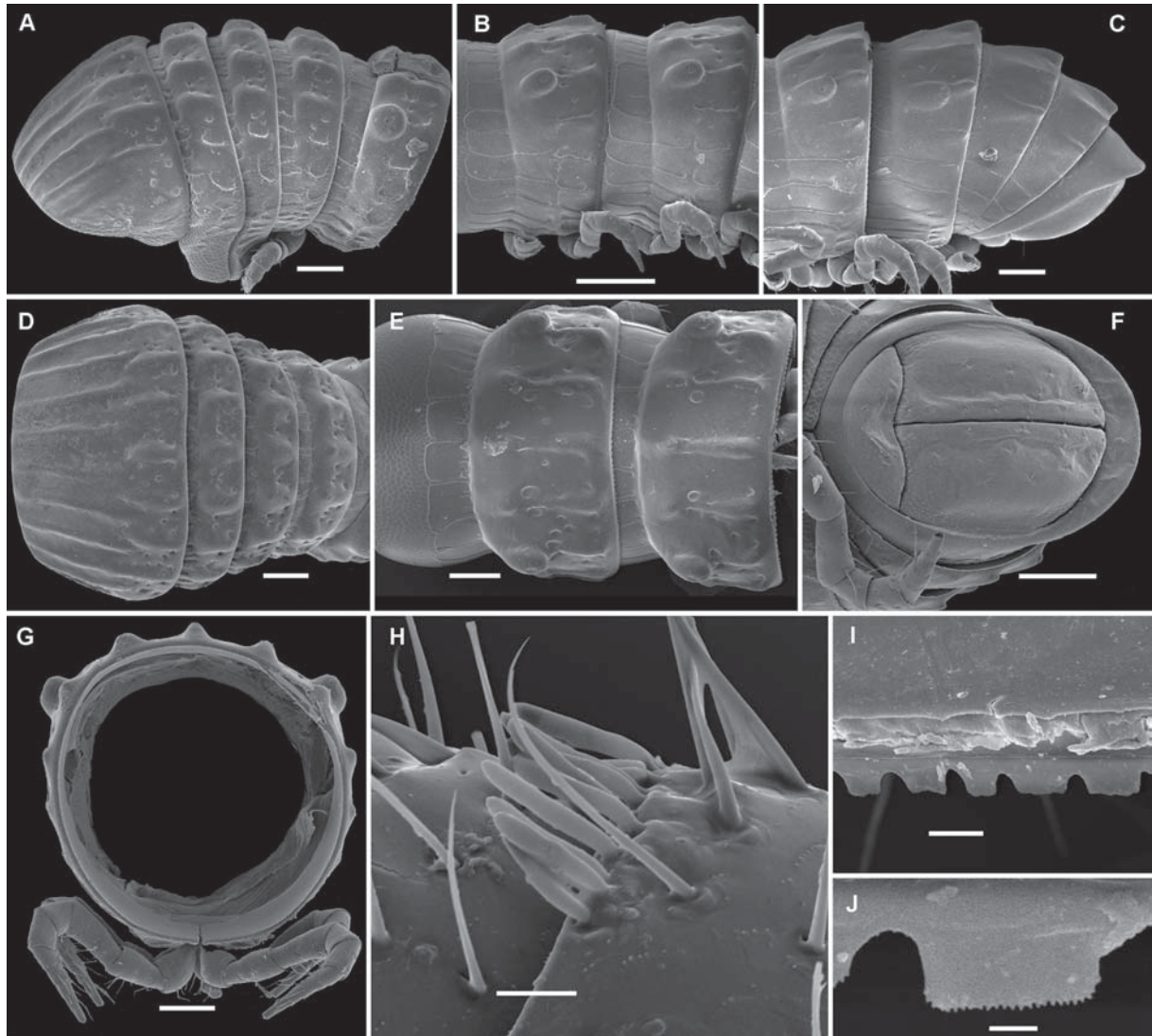


Fig. 1. *Glyphiulus striganovae* sp.n., ♂ paratype. A & D — collum and segments 2–5, lateral and dorsal views, respectively; B & E — midbody segments, lateral and dorsal views, respectively; C & F — posterior body portion, lateral and ventral views, respectively; G — cross-section of a midbody segment, caudal view; H — sensilla on antennomeres 5 and 6, lateral view; I & J — limbus. Scale bars: 0.2 (B), 0.1 (A, C–G), 0.01 (H & I) & 0.002 mm (J).

Рис. 1. *Glyphiulus striganovae* sp.n., паратип ♂. А, D — коллум и сегменты 2–5, соответственно сбоку и сверху; В, Е — среднетуловищные сегменты, соответственно сбоку и сверху; С, F — задняя часть тела, соответственно сбоку и снизу; G — поперечный разрез через среднетуловищный сегмент, сзади; H — сенсиллы на члениках антенн 5 и 6, сбоку; I, J — лимбус. Масштаб: 0,2 (B), 0,1 (A, C–G), 0,01 (H & I) и 0,002 мм (J).

species is among the smallest congeners known to date. A brief introduction to the karst region where the new species comes from can be found in Salas et al. [2005].

The present paper provides a description of the first *Glyphiulus* encountered in Borneo. It remains yet ungrouped pending the discovery of further congeners south of Malay Peninsula, in particular in Borneo.

#### Abbreviations used:

MNHN — Muséum national d'Histoire naturelle, Paris, France;

MZB — Museum Zoologicum Bogoriense, Cibinong, Indonesia;

ZMUM — Zoological Museum, State University of Moscow, Moscow, Russia;

SEM — Scanning electron microscopy.

#### Material and methods

The material serving as the basis for the present contribution derives from the subterranean collections made in Indonesia by Anne Bedos and Louis Deharveng (both MNHN). Most of this material, including the holotype, has been deposited in MZB, with several paratypes shared between the collections of MNHN and ZMUM, as indicated hereafter.

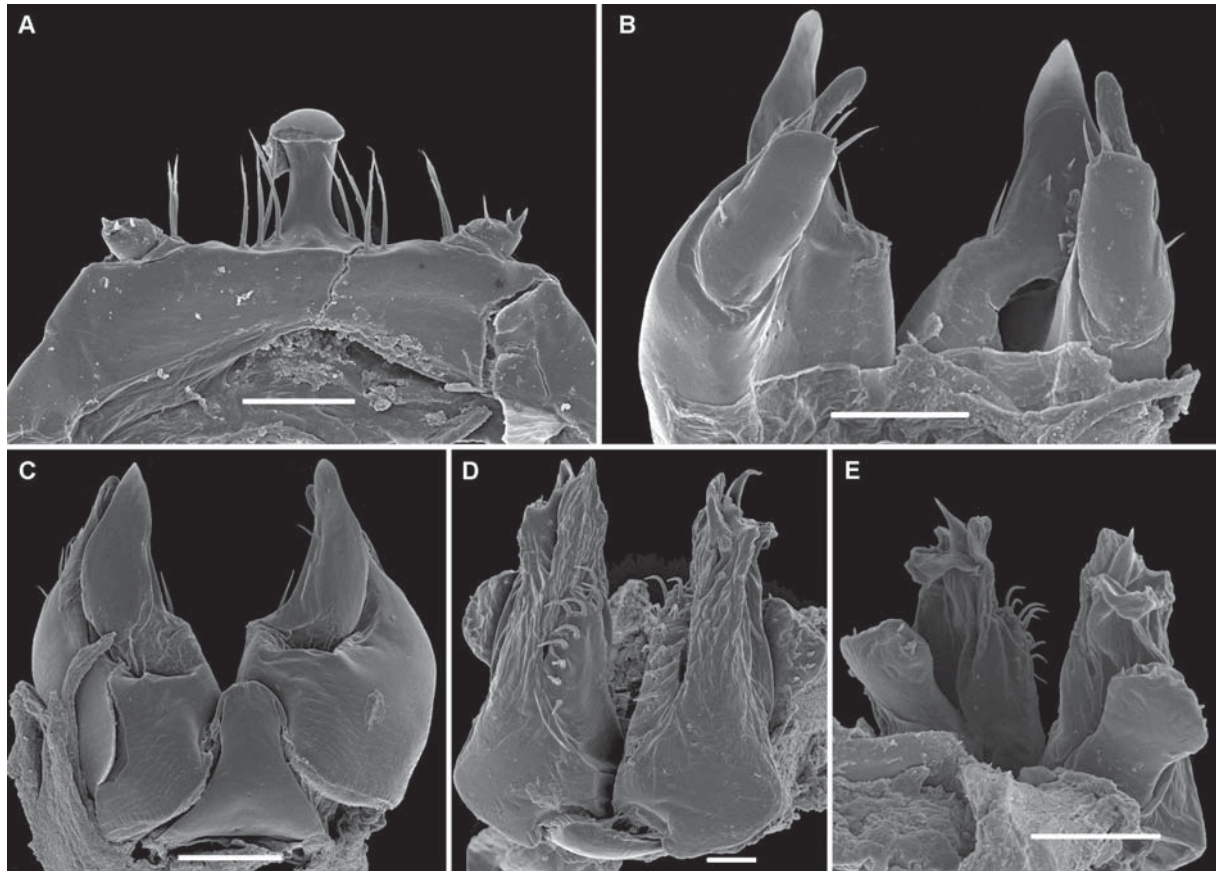


Fig. 2. *Glyphiulus striganovae* sp.n., ♂ paratype. A — legs 1, front view; B & C — anterior gonopods, caudal and front views, respectively; D & E — posterior gonopods, front and caudal views, respectively. Scale bars: 0.05 mm.

Рис. 2. *Glyphiulus striganovae* sp.n., паратип ♂. А — ноги 1, спереди; В, С — передние гоноподы, соответственно сзади и спереди; D, E — задние гоноподы, соответственно спереди и сзади. Масштаб 0,05 мм.

SEM micrographs were taken using a JEOL JSM-6480LV scanning electron microscope. After examination, SEM material was removed from stubs and returned to alcohol, all such samples being kept at MNHN.

Carinotaxy formulae are those developed by Golovatch et al. [2007a, b, 2011b, c].

### Taxonomic part

#### *Glyphiulus striganovae* sp.n.

Figs 1–3.

HOLOTYPE ♂ (MZB), Indonesia, Borneo, Kalimantan Timur, Pengadan, Cave Gua Mardua, 19.08.2004, leg. L. Deharveng, A. Bedos, Y. Suhardjono & C. Rahmadi (KAL-119).

PARATYPES. 1 ♂, 2 ♀♀ (MZB), 1 ♂, 1 ♀ (MNHN GA 099), 1 ♂ (ZMUM), 1 ♂ (SEM), same locality, together with holotype.

NAME. Honours Bella R. Striganova, a renowned Russian soil biologist and ecologist, on the occasion of her 80<sup>th</sup> birthday.

DIAGNOSIS. Differs readily from congeners in its very small size, the peculiar carinotaxy formulae (especially of the midbody segments, in which the front row of crests below ozoporiferous tubercles is fully obliterated), coupled with the evidently bipartite ante-

rior gonopods and the prominent telopodite vestiges of the posterior gonopods.

DESCRIPTION. Length of both sexes 8–13 mm, width 0.6–0.7 mm. Coloration pallid, only repugnatorial glands and ocelli sometimes showing red-brown. Body with 30–37p+3–2a+T in both sexes. Holotype ca 10 mm long, 0.7 mm wide, with 31a+3p+T segments.

Usually 4–7+4–7 ocelli, often nearly unpigmented and thus very poorly visible, arranged in 2–3 loose vertical rows (2+2 to 3+3+1, counting from frons). Antennae short and stout (Fig. 3A), antennomere 5 largest, together with 6<sup>th</sup> with a distodorsal group of minute bacilliform sensilla (Fig. 1H). Gnathochilarium oligotrichous, mentum divided. Collum (Fig. 1A & D) evidently crested, most of crests being incomplete; carinotaxy formula, 1c+II+3c+4a+pc+ma. Segments 2–4 each with only one row of high, simple, rounded crests (Fig. 1A & D), following metaterga with two transverse rows only dorsally and one (caudal) row laterally; carinotaxy pattern of midbody segments, 0/3(4)+I/i+p/p+m/m (Fig. 1A–E & G).

Ozopores starting from segment 5, ozoporiferous cones stump-shaped, rather low, broader than high (Fig. 1A–C, E & G). Metatergal surface very sparsely and

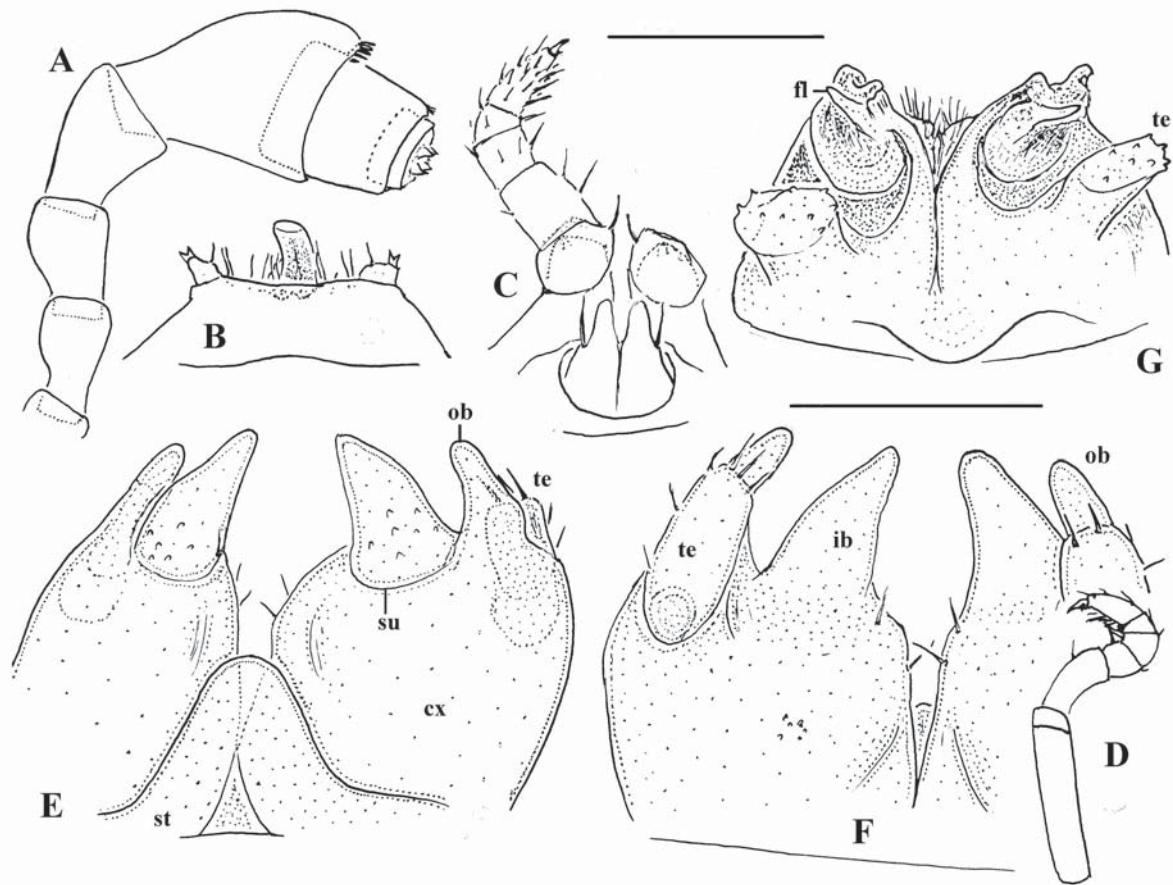


Fig. 3. *Glyphiulus striganovae* sp.n., ♂ paratype. A — antenna, lateral view; B — legs 1, front view; C — leg 2, caudal view; D — leg 3, caudal view; E & F — anterior gonopods, front and caudal views, respectively; G — posterior gonopods, caudal view. Scale bars: 0.2 (A–D) & 0.1 mm (E–G).

Рис. 3. *Glyphiulus striganovae* sp.n., паратип ♂. А — антенна, сбоку; В — ноги 1, спереди; С — нога 2, сзади; D — нога 3, сзади; E, F — передние гоноподы, соответственно спереди и сзади; G — задние гоноподы, сзади. Масштаб: 0,2 (А–D) и 0,1 мм (E–G).

finely lunulate (Fig. 1A–E). Postcollum constriction evident, but not particularly strong (Fig. 1A & D). Telson (Fig. 1C & F) bare and smooth, paraprocts only poorly setose, hypoproct bean-shaped. Limbus very finely microdentate (Figs 1I & J).

Legs short, nearly as long as midbody height (Fig. 1A–C & G). A long filament/spine at base of claw over half the length of claw itself.

♂ legs 1–3 (Figs 2A, 3B–D) same as is numerous species of the *Glyphiulus javanicus*-group [Golovatch et al. 2007b, 2011c]; legs 1 with a short, doubled, unciform, central process flanked by shorter, setose, tuberculiform telopodite vestiges.

Anterior gonopods (Figs 2B, C, 3E & F) placed on a well-developed central sternum (**st**). Coxites (**cx**) evidently two-branched: inner branch (**ib**) roundly subtriangular, separated basally from base of coxite by a sulcus (**su**) on front face, somewhat higher than a narrower, finger-shaped, similarly simple outer branch (**ob**) carrying a shorter, subcylindrical, poorly setose, 1-segmented telopodite (**te**) at base on caudal face. Pos-

terior gonopods (Figs 2D, E, 3G) rather short, distally membranous, folded, with a short, but evident flagellum (**fl**), at base with a pair of unusually high, stump-shaped telopodites (**te**) on caudal face.

REMARKS. Based on the conformation of ♂ legs 1, the new species clearly belongs to the *javanicus*-group of *Glyphiulus*. However, such unusual, likely primitive traits as the evidently bipartite anterior gonopods and the prominent telopodite vestiges of the posterior gonopods prevent us from unequivocally assigning it to either of the species groups, even though its affinities to the *javanicus*-group are much better expressed than to the *granulatus*-group. Instead we prefer to leave *G. striganovae* sp.n. ungrouped pending the discovery of further congeners south of Malay Peninsula, including Borneo. Indeed, *G. striganovae* sp.n. is the southeasternmost indigenous species of *Glyphiulus* encountered to date.

Its unpigmented and very small body, short legs and antennae, as well as only partly pigmented ocelli seem to testify against *G. striganovae* sp.n. being a true

cavernicole. Instead, the MSS or even soil can be more readily suggested as its typical habitat.

**Acknowledgements.** We are most grateful to Yayuk Suhardjono and Cahyo Rahmadi (MZB), as well as to Louis Deharveng and Anne Bedos (both MNHN), who have entrusted us their valuable material for study in the framework of the Sangkulirang karst expedition organized by The Nature Conservancy under the auspices of LIPI. The first author's stay in Paris in March and April 2012 was supported by the MNHN.

## References

- Carl J. 1911. Drei neue Diplopoden des Genfer Museums // *Revue suisse de Zoologie*. T.19. P.397–407.
- Golovatch S.I., Geoffroy J.-J., Mauriès J.-P., VandenSpiegel D. 2007a. Review of the millipede genus *Glyphiulus* Gervais, 1847, with descriptions of new species from Southeast Asia (Diplopoda, Spirostreptida, Cambalopsidae). Part 1. The *granulatus*-group // *Zoosystema*. Vol.29. Fasc.1. P.7–49.
- Golovatch S.I., Geoffroy J.-J., Mauriès J.-P., VandenSpiegel D. 2007b. Review of the millipede genus *Glyphiulus* Gervais, 1847, with descriptions of new species from Southeast Asia (Diplopoda, Spirostreptida, Cambalopsidae). Part 2. The *javanicus*-group // *Zoosystema*. Vol.29. Fasc.3. P.417–456.
- Golovatch S.I., Geoffroy J.-J., Mauriès J.-P., VandenSpiegel D. 2009. Review of the millipede genus *Plusioglyphiulus* Silvestri, 1923, with descriptions of new species from Southeast Asia (Diplopoda, Spirostreptida, Cambalopsidae) // *Zoosystema*. Vol.31. Fasc.1. P.71–116.
- Golovatch S.I., Geoffroy J.-J., Mauriès J.-P., VandenSpiegel D. 2011a. The millipede genus *Plusioglyphiulus* Silvestri, 1923 in Thailand (Diplopoda, Spirostreptida, Cambalopsidae) // *Zootaxa*. No.2840. P.1–63.
- Golovatch S.I., Geoffroy J.-J., Mauriès J.-P., VandenSpiegel D. 2011b. New species of the millipede genus *Glyphiulus* Gervais, 1847 from the *granulatus*-group (Diplopoda: Spirostreptida: Cambalopsidae) // *Arthropoda Selecta*. Vol.20. No.2. P.65–114.
- Golovatch S.I., Geoffroy J.-J., Mauriès J.-P., VandenSpiegel D. 2011c. New species of the millipede genus *Glyphiulus* Gervais, 1847 from the *javanicus*-group (Diplopoda: Spirostreptida: Cambalopsidae) // *Arthropoda Selecta*. Vol.20. No.3. P.149–165.
- Golovatch S.I., Geoffroy J.-J., Mauriès J.-P., VandenSpiegel D. 2011d. Two new species of the millipede genus *Hypocambala* Silvestri, 1895 from China and Vietnam (Diplopoda: Spirostreptida: Cambalopsidae) // *Arthropoda Selecta*. Vol.20. No.3. P.167–174.
- Jeekel C.A.W. 2004. A bibliographic catalogue of the “Cambaloidea” (Diplopoda, Spirostreptida) // *Myriapod Memoranda*. Vol.7. P.43–109.
- Salas L.A., Bedos A., Deharveng L., Fryer S., Hadiaty R., Heryanto, Munandar, Nardiyono, Noerdjito M., Noerdjito W., Rahmadi C., Riyanto A., Rofik, Ruskamdi A., Struebig M.J., Suhardjono Y., Suyanto A., Vermeulen J.J., Walck C., Wiriadinata H., Meijaard, Stanley E., Stanley S. 2005. Biodiversity, endemism and the conservation of limestone karsts in the Sangkulirang Peninsula, Borneo // *Biodiversity*. Vol.6. No.2. P.15–23.