

First record of *Orthomorpha zehntneri* Carl, 1902 (Diplopoda: Polydesmida: Paradoxosomatidae) from India

Первая находка *Orthomorpha zehntneri* Carl, 1902 (Diplopoda: Polydesmida: Paradoxosomatidae) в Индии

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KEY WORDS: gonopod, new record, Northeast India, *Orthomorpha*, taxonomy.

КЛЮЧЕВЫЕ СЛОВА: гонопод, новая находка, Северо-восточная Индия, *Orthomorpha*, таксономия.

ABSTRACT. The diplopod species *Orthomorpha zehntneri* Carl, 1902 is recorded for the first time from India. Previously, it was known only from Java, Indonesia. In India, the genus *Orthomorpha* Bollman, 1893 has hitherto been known by two species, viz. the pantropical *Orthomorpha coarctata* (de Saussure, 1860) and the endemic *Orthomorpha almorensis* Turk, 1947. This new record represents the third species of the genus from the country. A brief morphological description, illustrations and notes on variations from the original population are presented and discussed.

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РЕЗЮМЕ. Диплоподы вида *Orthomorpha zehntneri* Carl, 1902 впервые отмечены в Индии. Прежде этот вид был известен только с острова Ява (Индонезия). В Индии род *Orthomorpha* Bollman, 1893 до сих пор был представлен двумя видами, а именно пантропическим *Orthomorpha coarctata* (de Saussure, 1860) и эндемичным *Orthomorpha almorensis* Turk, 1947. Новая находка представляет собой третий вид рода в стране. Представлены и обсуждаются краткое морфологическое описание, иллюстрации и заметки по отличиям от исходной популяции.

Introduction

The family Paradoxosomatidae Daday, 1889 is the largest within the class Diplopoda de Blainville, 1844, presently comprising more than 1,000 species that belong

to about 200 genera. The family shows a nearly global distribution, occurring on all continents except Antarctica and also being conspicuously absent from the Nearctic [Ng *et al.*, 2025]. In India, the family is represented by about 55 species belonging to 23 genera. The Southeast Asian genus *Orthomorpha* Bollman, 1893 is one of the largest in the family Paradoxosomatidae. It is widely distributed across Southeast Asia, ranging from northern Myanmar and Thailand in the northwest to Lombok Island, Indonesia in the southeast [Likhitrakarn *et al.*, 2025]. To date, species of *Orthomorpha* have been recorded from numerous countries across Southeast Asia, highlighting its broad geographic distribution, with highest diversity recorded from Thailand (24 species) followed by Indonesia (13 species), Laos (9 species), Vietnam (8 species), Malaysia (7 species), Cambodia (6 species), Myanmar (4 species), China (1 species) and Singapore (1 species) [Chen *et al.*, 2023; Likhitrakarn *et al.*, 2025].

Species of this genus are categorized into six species groups, namely the Sunda *weberi*-group, the *sericata*-group, the *coarctata*-group, the *hydrobiologica*-group, the *bipunctata*-group, and the *karschi*-group [Golovatch, 1998; Likhitrakarn *et al.*, 2010]. At present, the genus comprises a total of 60 accepted species [Chen *et al.*, 2023; Likhitrakarn *et al.*, 2025]. The Indian millipede fauna comprises more than 270 species belong to 90 genera, 25 families and 11 orders [Golovatch, Wesener, 2016]. The genus *Orthomorpha* Bollman, 1893 has hitherto been known to occur in India by only two species: *O. almorensis* Turk, 1947 and the pantropical anthrophore, *O. coarctata* (de Saussure, 1860) [Golovatch, Wesener, 2016]. This paper documents the addition of *Orthomorpha zehntneri* Carl, 1902 to the Indian fauna, based on material from Arunachal Pradesh in northeastern India (Fig. 1). Previously this species was known only from Java, Indonesia (Fig. 2).

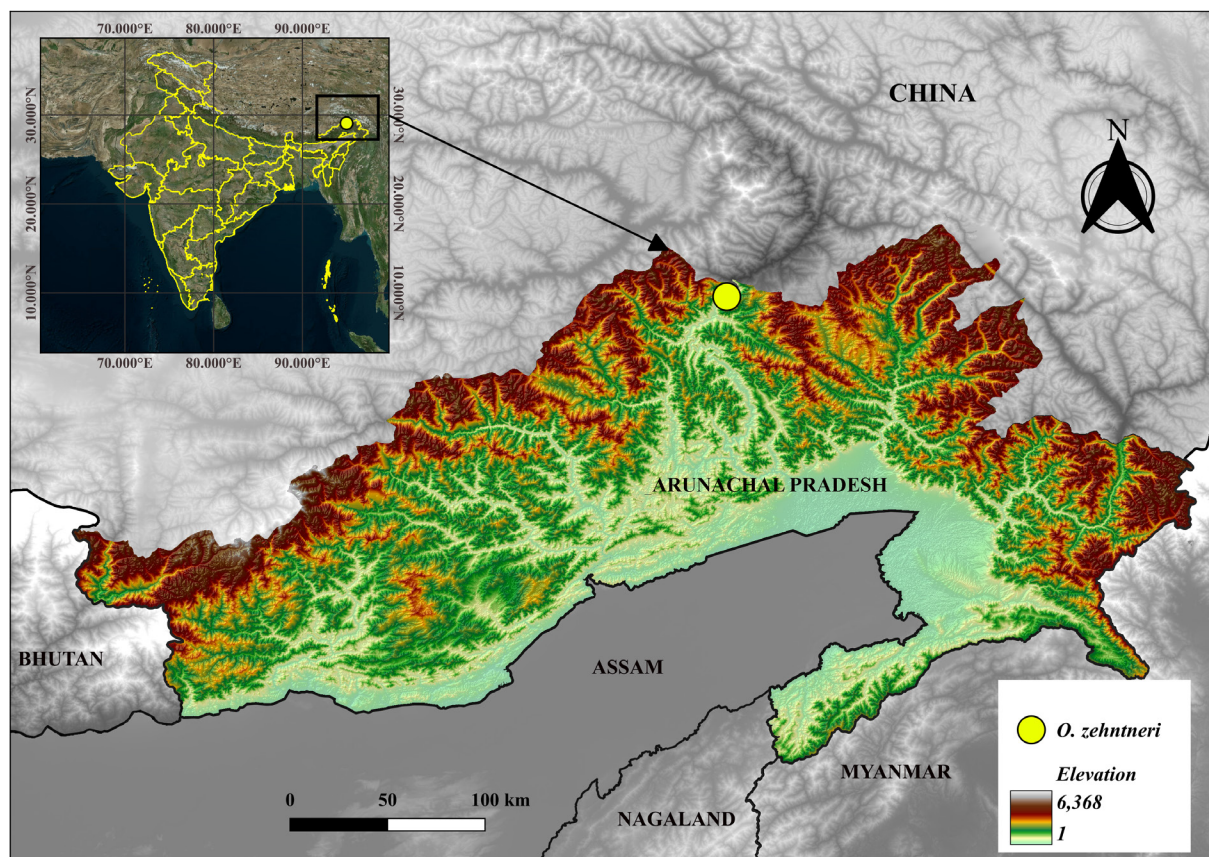


Fig. 1. Map showing the new record of *Orthomorpha zehntneri* Carl, 1902 in Arunachal Pradesh, India.

Рис. 1. Карта, показывающая новую находку *Orthomorpha zehntneri* Carl, 1902 в штате Аруначал-Прадеш (Индия).

Material and Methods

The millipede specimens were collected from leaf litter in Arunachal Pradesh using hand-picking and subsequently preserved in 90% ethanol. The preserved specimens were examined using a Leica EZ4 stereo microscope. Multifocal images were obtained using a Leica DMC 4500 digital camera mounted on a Leica M205A stereo microscope. Photographs were stacked with Leica Application Suite (LAS) version 4.12 software and final images were processed with Adobe Photoshop 7.0. The distribution map was prepared using QGIS 3.40 Bratislava. The specimens are deposited in the Museum and Taxidermy Section, Zoological Survey of India, Kolkata.

Taxonomy

Class Diplopoda
Order Polydesmida
Family Paradoxosomatidae Daday, 1889
Genus *Orthomorpha* Bollman, 1893

Type species: *Polydesmus beaumontii* LeGuilou, 1841, by subsequent designation.

Orthomorpha zehntneri Carl, 1902
Figs 3–4.

Orthomorpha Zehntneri Carl, 1902: 584.

Orthomorpha zehntneri — Jeekel, 1980: 325; Likhitrakarn *et al.*, 2011: 75.

MATERIAL. 1 ♂ (ZSIK-TM147), India, Arunachal Pradesh, Upper Siang, Gelling check post, 29°08'31.96" N, 94°58'44.83" E, 1308 m a.s.l., 06.x.2025, leg. S.D. Gurumayum & Party.

DESCRIPTIVE NOTES. Male (♂). Body with 20 segments; length ca. 26 mm; width of midbody pro- and metazona, 1.8–1.9 mm and 2.8–3.0 mm, respectively (vs. 19–22 mm in length, and 1.4–1.5 and 2.1–2.4 mm in width on midbody pro- and metazona, respectively, in ♂ as mentioned in the available redescrptions by Likhitrakarn *et al.* [2011] or 2.8 mm in width, as given in the original description by Carl [1902]). Coloration in alcohol dark castaneous brown, paraterga contrasting light red-brown to pallid. Clypeolabral region sparsely setose (Fig. 3d) (vs. densely setose [Likhitrakarn *et al.*, 2011]). Epicranial sulcus deeply impressed, reaching slightly below the upper level of antennal sockets (Fig. 3d). Antennae moderately long, ca. 3.7–3.8 mm, clavate; relative antennomere lengths: 1st < 2nd > 3rd > 4th < 5th < 6th; antennomere 6 apically widest and antennomere 7 brownish black, both densely setose, whereas antennomeres 4 and 5 sparsely setose (Fig. 3e). Collum subsemi-circular, wider than head (Fig. 3g); second ring wider than collum, ring 3 likewise wider than ring 2. Surface of collum smooth and polished (Fig. 3g), devoid of setae (vs. three transverse rows of setae stated in Likhitrakarn *et al.* [2011]). Tegument smooth and shining; prozona very finely shagreened, metaterga leathery and densely rugose (Figs 3a, b); below paraterga microgranular, faintly rugulose (Fig. 3h). Metaterga 2–19 devoid of setae. Ozopores evident. Transverse sulcus complete on metaterga 3–18, incomplete on ring 19, narrow and shallow, reaching the bases of paraterga.

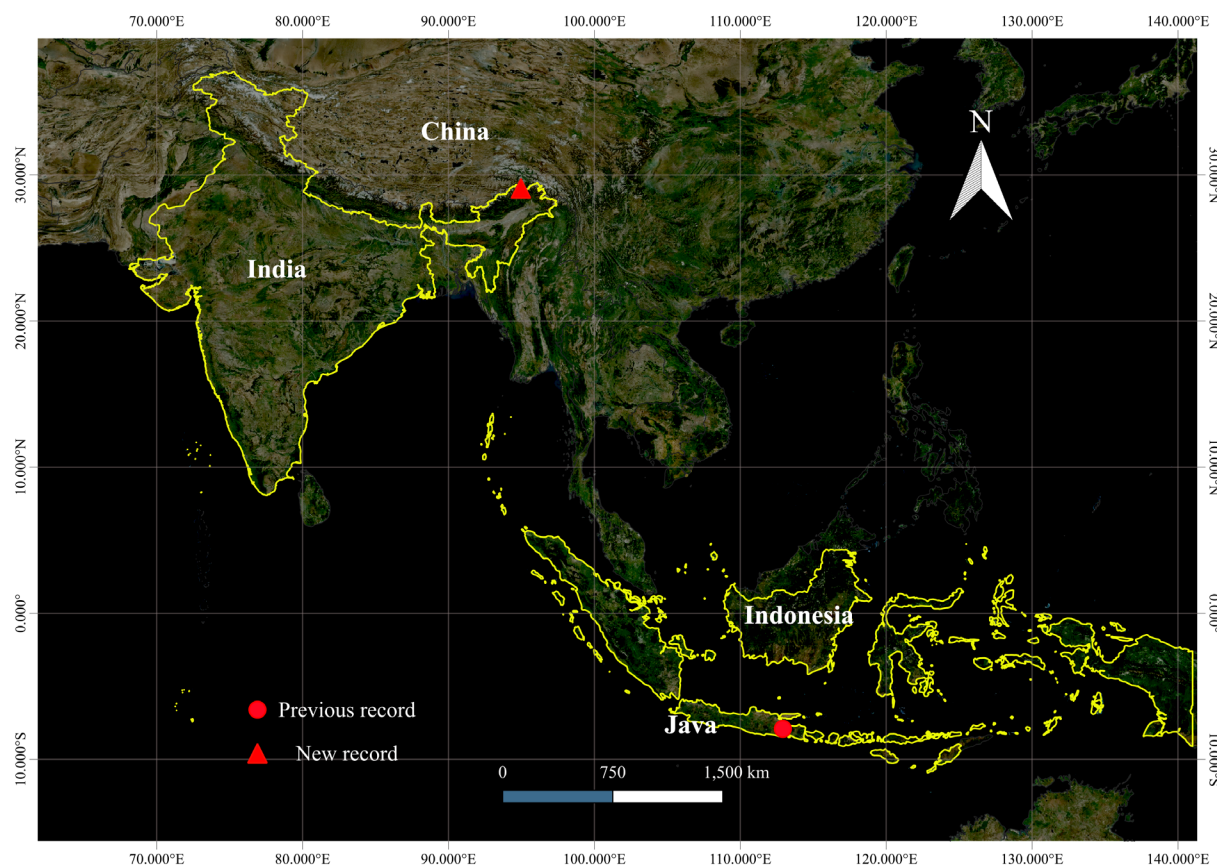


Fig. 2. Map of the distribution of *Orthomorpha zehntneri* Carl, 1902 from Arunachal Pradesh, India and Java, Indonesia.

Рис. 2. Карта с распространением *Orthomorpha zehntneri* Carl, 1902 в штате Аруначал-Прадеш (Индия) и на острове Ява (Индонезия).

Paraterga very well developed, extending slightly beyond the posterior tergal margin and bearing two marginal teeth; caudal corner slightly pointed (Figs 3a, b). Epiproct conical, inflated dorsoventrally, subtruncate apically, bearing two distinct apical papillae directed ventrocaudally (Fig. 3f); pre-apical papillae evident, lying close to apex. Hypoproct trapezoidal (Fig. 3f). Legs long and slender; midbody leg length ca. 3.0–3.5 mm (♂) (Fig. 4f) (vs. 1.3–1.5 mm long [Likhitrakarn *et al.*, 2011]). Relative podomere lengths: femur > tarsus > tibia = prefemur > postfemur. Prefemora without modifications. Sterna sparsely setose. Between ♂ coxae 4, a very distinct paramedian pair of anteroventrally directed lobes, both setose apically and slightly split into two (Fig. 4e) (vs. deeply, but incompletely split, as indicated in Likhitrakarn *et al.* [2011]). A paramedian pair of small tubercles located anterior to gonopod aperture (Fig. 4b).

Gonopods simple. Coxite long and slender, bearing strong setae distodorsally. Cannula subcylindrical. Prefemur densely setose. Femorite slender, very slightly curved and distinctly enlarged distally, with a postfemoral part demarcated by an oblique lateral sulcus. Solenophore curved mesally, with a tridentate tip: lamina lateralis slightly helical in shape, narrower than lamina medialis. In the right gonopod, tip of solenophore with subequal terminal and subterminal denticles, median denticle slightly longer; left gonopod with terminal, subterminal and median denticles subequal. Solenomere long and flagelliform (Figs 4a–d).

REMARKS. The fresh specimen examined shows minor variations compared to the previously redescribed material. These include a sparsely setose clypeolabral region, the absence of setae from the collum, a slightly larger body size, and

relatively longer legs than those reported for the redescribed syntypes. Such differences can be regarded as intraspecific variations and may also reflect differences in preservation, population-level variability or geographic separation of the present material from the type locality.

DISTRIBUTION. Java, Indonesia [Jeekel, 1980; Golovatch, 1998; Likhitrakarn *et al.*, 2011], Arunachal Pradesh, India (new record).

Discussion

The present study reports *Orthomorpha zehntneri* Carl, 1902 for the first time in the Indian subcontinent, based on a specimen collected from Arunachal Pradesh, northeastern India, at the eastern end of the Himalayan range, thus extending its known distribution. The new Indian locality lies approximately 4,550 air-km away from the nearest previously known locality in Java, Indonesia. *Orthomorpha zehntneri* belongs to the *bipunctata*-group, one of the six species groups proposed by Golovatch [1998], which is characterized by the presence of a single median process between male coxae 4 and a gonopod tip that is either bifid or trifid. So far, this is the only member of the species group recorded from the Indian subcontinent. Previously, only two species of the genus *Orthomorpha* have been reported from India, namely, *Orthomorpha coarctata* (de Saussure, 1860) and *O. almoresis* Turk, 1947. Of these, the pantropi-

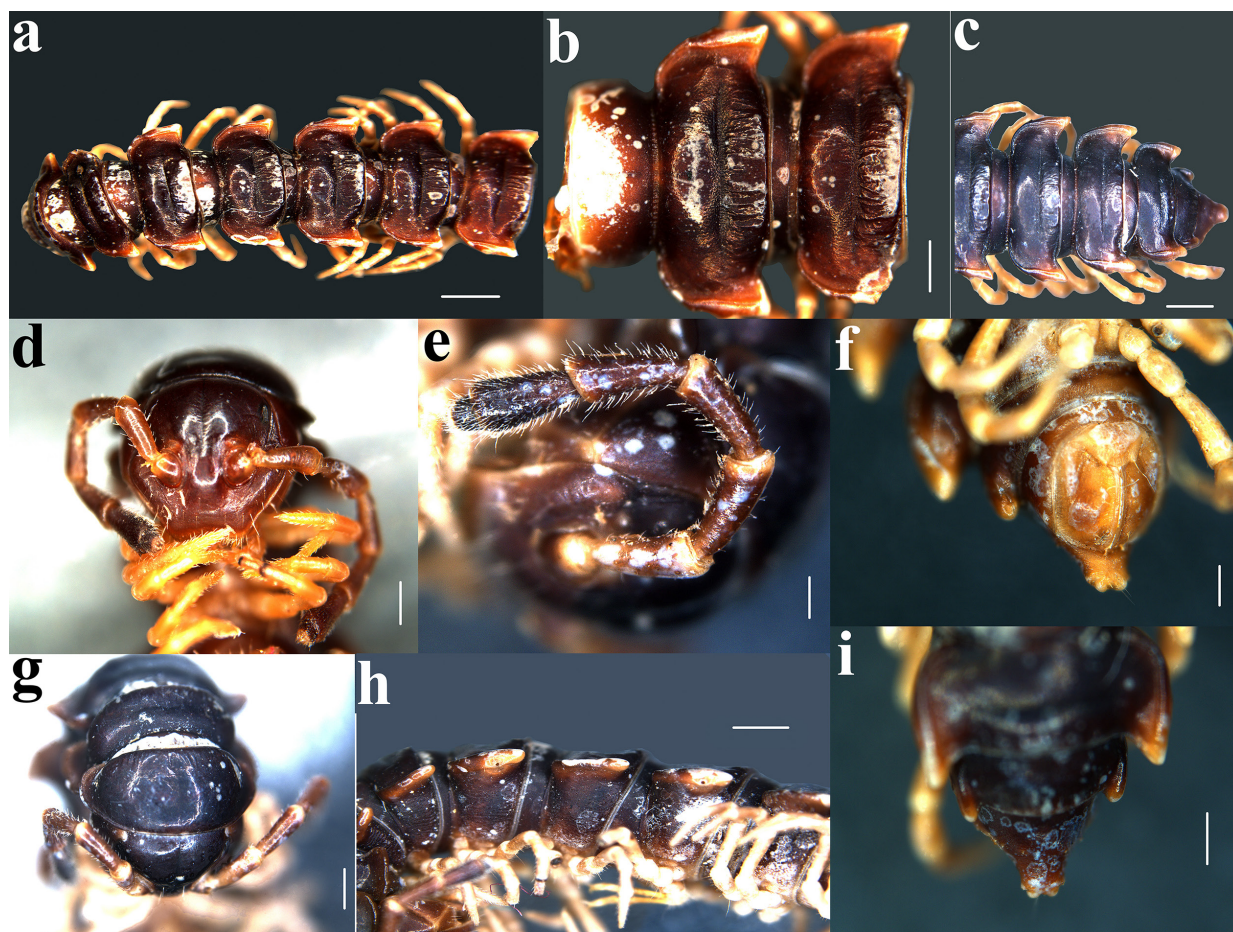


Fig. 3. *Orthomorpha zehntneri* Carl, 1902, ♂: **a** — anterior body part, dorsal view; **b** — 10 and 11 body segments, dorsal view; **c** — posterior body part, dorsal view; **d** — head, frontal view; **e** — antennae, dorsolateral view; **f** & **i** — telson, ventral and dorsal views, respectively; **g** — collum, dorsal view; **h** — anterior body part, lateral view. Scale bars: **a**, **c**, **h** — 2 mm; **b**, **d**, **e**, **g** — 1 mm; **f**, **i** — 0.5 mm.

Рис. 3. *Orthomorpha zehntneri* Carl, 1902, ♂: **a** — передняя часть тела, сверху; **b** — туловищные сегменты 10 и 11, сверху; **c** — задняя часть тела, сверху; **d** — голова, спереди; **e** — антенны, одновременно сверху и сбоку; **f** и **i** — тельсон, соответственно снизу и сверху; **g** — коллум, сверху; **h** — передняя часть тела, сбоку. Масштаб: **a**, **c**, **h** — 2 мм; **b**, **d**, **e**, **g** — 1 мм; **f**, **i** — 0,5 мм.

cal *O. coarctata* belongs to the *coarctata*-group, which is characterized by the absence of sternal modification between male coxae 4 and the gonopod tip with a single and rounded lappet [Golovatch, 1998]. *Orthomorpha coarctata* is often assigned to the genus *Asiomorpha* Verhoeff, 1939. However, following the comprehensive revision of *Orthomorpha* by Likhitrakarn *et al.* [2011], the species is retained within *Orthomorpha*. The species shows a pantropical distribution due to anthropochory [Likhitrakarn *et al.*, 2025].

Orthomorpha coarctata has been reported from various parts of India [Golovatch, Wesener, 2016]. From Arunachal Pradesh, it was recorded as *Asiomorpha coarctata* (de Saussure, 1860) by Temjenmongla, Mayi [2025]. In contrast, *Orthomorpha almoresis* Turk, 1947 was originally described from Almora, Uttarakhand, India [Turk, 1947; Golovatch, Wesener, 2016; Golovatch, Martens, 2018]. This species was treated as *incertae sedis* by Golovatch, Wesener [2016]. Based on the inadequate original description and poorly illustrated gonopods, it is considered dubious. It seems to belong to the genus *Kronopolites* Attems, 1914, as the gonopodal postfemo-

ral process appears to be double, forming a distinct fork [Golovatch, Wesener, 2016; Golovatch, 2019].

With the present record of *O. zehntneri*, the genus is now represented in India by three species, including one dubious. The species closely resembles the widespread *O. coarctata* in overall habitus, which may result in superficial misidentification. However, the two species can be readily distinguished by male characters: *O. zehntneri* possesses a single median sternal process between male coxae 4 and a bifid or trifid gonopod tip, whereas *O. coarctata* lacks sternal modification and has a simple gonopod apex with a single rounded lappet [Jeekel, 1980]. Following the original description by Carl [1902], the species was subsequently re-examined and redescribed first by Jeekel [1980] and later by Likhitrakarn *et al.* [2011], based solely on syntypes. Since the original collection made by Dr. L. Zehntner, no additional material of this species has been reported. Consequently, all subsequent taxonomic accounts relied solely on syntypes. In this context, the present collection represents an indicative rediscovery of the species after 120+ years. Its occurrence in India after such a

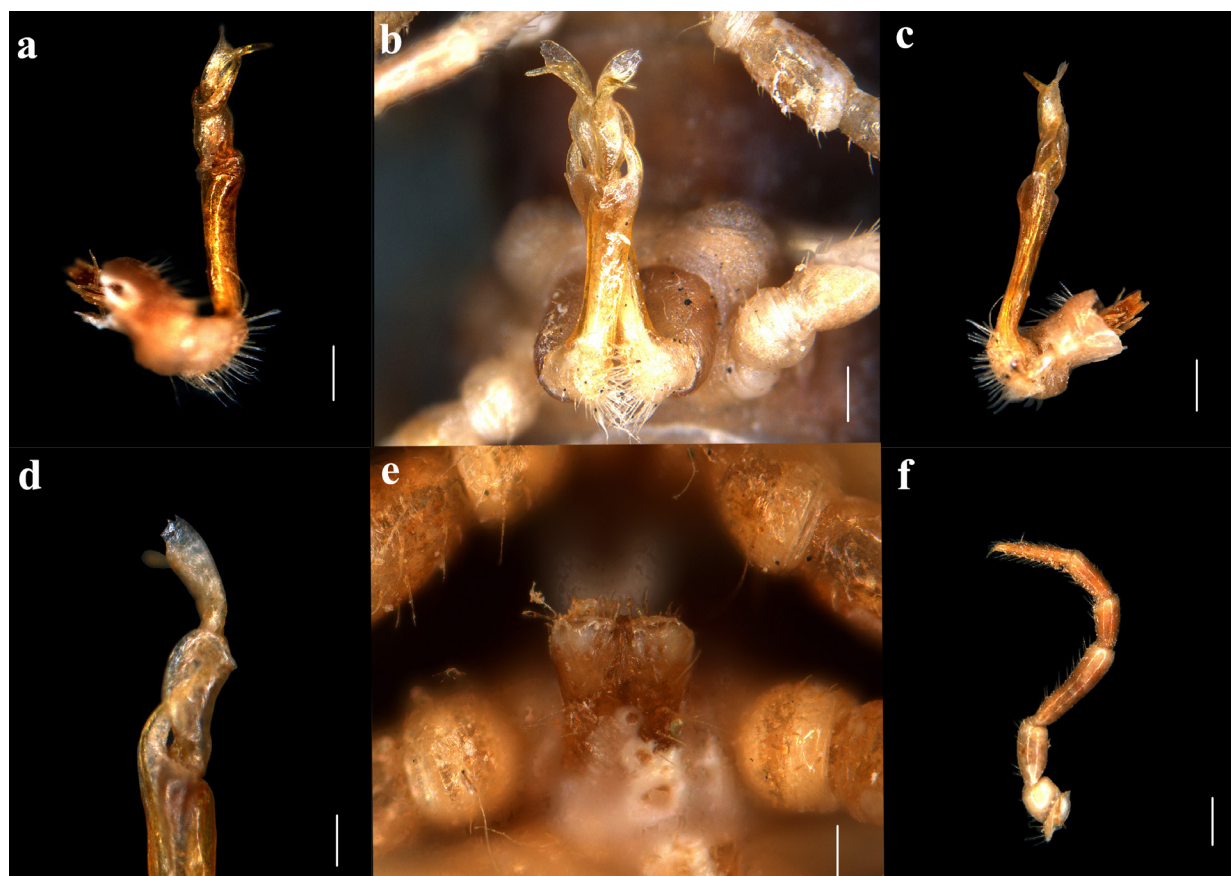


Fig. 4. *Orthomorpha zehntneri* Carl, 1902, ♂: **a** — right gonopod, lateral view; **b** — gonopod with prominent paramedian pair of small tubercles anterior to gonopod aperture, ventral view; **c** — right gonopod, mesal view; **d** — right gonopod, subcaudal view; **e** — sternal lamella between coxae 4, subcaudal view; **f** — right leg of middle body segment. Scale bars: **a, b, c, f** — 0.5 mm; **d, e** — 0.2 mm.

Рис. 4. *Orthomorpha zehntneri* Carl, 1902, ♂: **a** — правый гонопод, сбоку; **b** — гонопод с мощной парамедиальной парой маленьких бугорков впереди отверстия гоноподов, снизу; **c** — правый гонопод, изнутри; **d** — правый гонопод, почти сзади; **e** — стеральная пластинка между тазиками 4, почти сзади; **f** — правая нога среднетуловищного сегмента. Масштаб: **a, b, c, f** — 0,5 мм; **d, e** — 0,2 мм.

long interval suggests that the species may have had a broader distribution in the past.

Conclusion

This study provides a taxonomic account of the millipede genus *Orthomorpha* in India with the addition of one species, *Orthomorpha zehntneri* Carl, 1902. With this inclusion, the genus is represented in India by three species, one of which is considered dubious, while the genus currently comprises 59 recognized species globally. India harbours a rich yet incompletely documented diplopod fauna. Several new species and distributional records have been reported in recent years, indicating that the millipede diversity of the country remains far from fully explored. These discoveries underscore the need for comprehensive faunal surveys to document cryptic millipede diversity in India, especially in the understudied north-eastern region.

CONFLICT OF INTEREST: The authors declare that they have no conflict of interest.

Ethical approval: No ethical issues were raised during our research.

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