



## The millipede family Metopidiotrichidae new to the fauna of Taiwan: the description of a new species; a review of and a key to the Chordeumatida occurring in Taiwan (Diplopoda)

ELENA V. MIKHALJOVA<sup>1</sup>, SERGEI I. GOLOVATCH<sup>2</sup> & HSUEH-WEN CHANG<sup>3,4</sup>

<sup>1</sup>Institute of Biology and Soil Science, Far Eastern Branch, Russian Academy of Sciences, prospekt Stoletiya Vladivostoka 159, Vladivostok 690022, Russia. E-mail: mikhailjova@biosoil.ru

<sup>2</sup>Institute for Problems of Ecology and Evolution, Russian Academy of Sciences, Leninsky prospekt 33, Moscow 119071, Russia. E-mail: sgolovatch@yandex.ru

<sup>3</sup>Department of Biological Sciences, National Sun Yat-Sen University, 70 Lien-Hai Road, Kaohsiung 804, Taiwan, ROC. E-mail: hwchang@mail.nsysu.edu.tw

<sup>4</sup>Corresponding author

### Abstract

The family Metopidiotrichidae and the genus *Metopidiothrix* Attems, 1907 are formally new to the fauna of Taiwan, due to the discovery of *Metopidiothrix taiwanensis* sp. nov. The fauna of Chordeumatida of Taiwan is reviewed and keyed, at present containing 13 unquestioned species from three genera and three families. Three further species, one genus and one family are dubious either as taxa or as elements of the Taiwanese fauna, or both. Palaeartic elements, such as Diplomaragnidae and Niponiosomatidae, appear to strongly dominate over austral/tropical ones (Metopidiotrichidae).

**Key words:** Millipede, chordeumatidans, new record, new species, taxonomy, key, distribution, Taiwan

### Introduction

The millipede family Metopidiotrichidae (earlier sometimes misspelled as Metopidiothricidae) is one of the few in the large, mainly boreal order Chordeumatida which are entirely or nearly entirely tropical. This family is mainly confined to the Indo-Australian realm and present only marginally also in Japan. At the moment, it contains seven genera, among which *Metopidiothrix* Attems, 1907 is the largest, comprising 37 species ranging from Papua New Guinea in the southeast, through Indonesia, Malaysia and the Philippines, to Thailand and Vietnam in the north (Shear 2002).

All the more interesting is the recent discovery in Taiwan of still another new species of *Metopidiothrix*, currently the northernmost congener. Hence, both the family Metopidiotrichidae and the genus *Metopidiothrix* are new to the Taiwanese list. The opportunity is also taken to review and key the entire fauna of Chordeumatida of Taiwan.

### Material and methods

Material treated here has been shared between the collections of the National Museum of Natural Sciences, Taichung, Taiwan (NMNS) and Department of Biological Sciences, National Sun Yat-Sen University, Kaohsiung, Taiwan (NSYSUB). The samples were kept in 70–75% ethanol. During the study, the gonopods and some other parts were dissected from the male and mounted in glycerin as temporary micropreparations. Specimens were studied and illustrated using standard stereomicroscopic and drawing equipment.

## Taxonomic part

### *Metopidothrix taiwanensis* sp. nov.

Figs 1–9

**Material examined.** *Holotype*: male (NMNS, 6708–001), Taiwan, Pingtung County, Manzhou Township, Lan-Jen Stream, 50 m a.s.l., 23.III.2002, leg. C.N. Wu *et al.* *Paratype*: 1 female (NSYSUB), same locality, 23.III.2002, leg. C.C. Chen.

**Diagnosis.** Differs from other congeners mainly by the shape of the posterior gonopod coxite which shows two simple branches of different length, by the somewhat flattened, mesally curved distal part of the anterior gonopod, by the strongly enlarged male legs 3, as well as by the denticulate margins of the spermatophoral cavity of the female syncyphium.

**Description.** Male. Length ca 4.3 mm, width about 0.5 mm. Coloration grey-brown with a green tinge (the latter likely due to staining the gonopod block in intense blue-green). Front body portion infusate. Head generally dark grey-brown, clypeolabral region lighter, labrum whitish. Ocellaria dark grey-brown. Antennae grey-brown, their distal parts lighter.

Body with 32 segments. Head strongly modified, characteristic of male *Metopidothrix*, with an enlarged clypeolabral region set off from a strongly narrowed labrum by a distinct sulcus with a deep flexure backwards in clypeolabral region, creasing head across just below antennal sockets, forming a sharp angular projection on each side below and in front of antennae, and making it swollen and strongly sclerotized. Below crease, labrum strongly narrowed and flat. Clypeal knob acute, labral knobs tiny, with setae at base. Genae strongly convex, subquadrate. Ocellaria subtriangular, each composed of at least 12 ocelli. Antennae slightly clavate, long, extending behind until end of segment 5 when stretched laterally; antennomeres 1 and 2 each with a distodorsal knob supporting one (antennomere 1) or two (antennomere 2) thick dendroid setae (Fig. 1). Collum semi-circular. Body with very small, rounded paraterga growing increasingly reduced towards telson. Each metatergum with 3+3 long macrochaetae, all subequal in length and pointed.

Walking legs each with a claw supplied with a strong filament ventrally at base. Tarsal papillae absent. Leg pair 3 very strongly enlarged, 4–5 times thicker, but not much longer than normal legs; tarsus rather short and pyriform, bearing special, strong setae; prefemur strongly swollen and setose ventrally (Fig. 2). Leg pair 10 with telopodites reduced to one small button-shaped segment and evident gland sacks (Fig. 3). Leg pair 11 with coxae setose both subapically and, especially, ventro-parabasally, supplied with strong mesal hooks rounded at tip (Fig. 4).

Anterior gonopods (Figs 5–7) with a large shelf extending well mesad, carrying short setae on tips; a rod-shaped process wanting; both median coxosternal angles well-developed. Posterior gonopods (Figs 6–8) with prominent branched coxites; anterior branch shorter and stout, carrying a gland channel; posterior branch longer and slender, pointed apically.

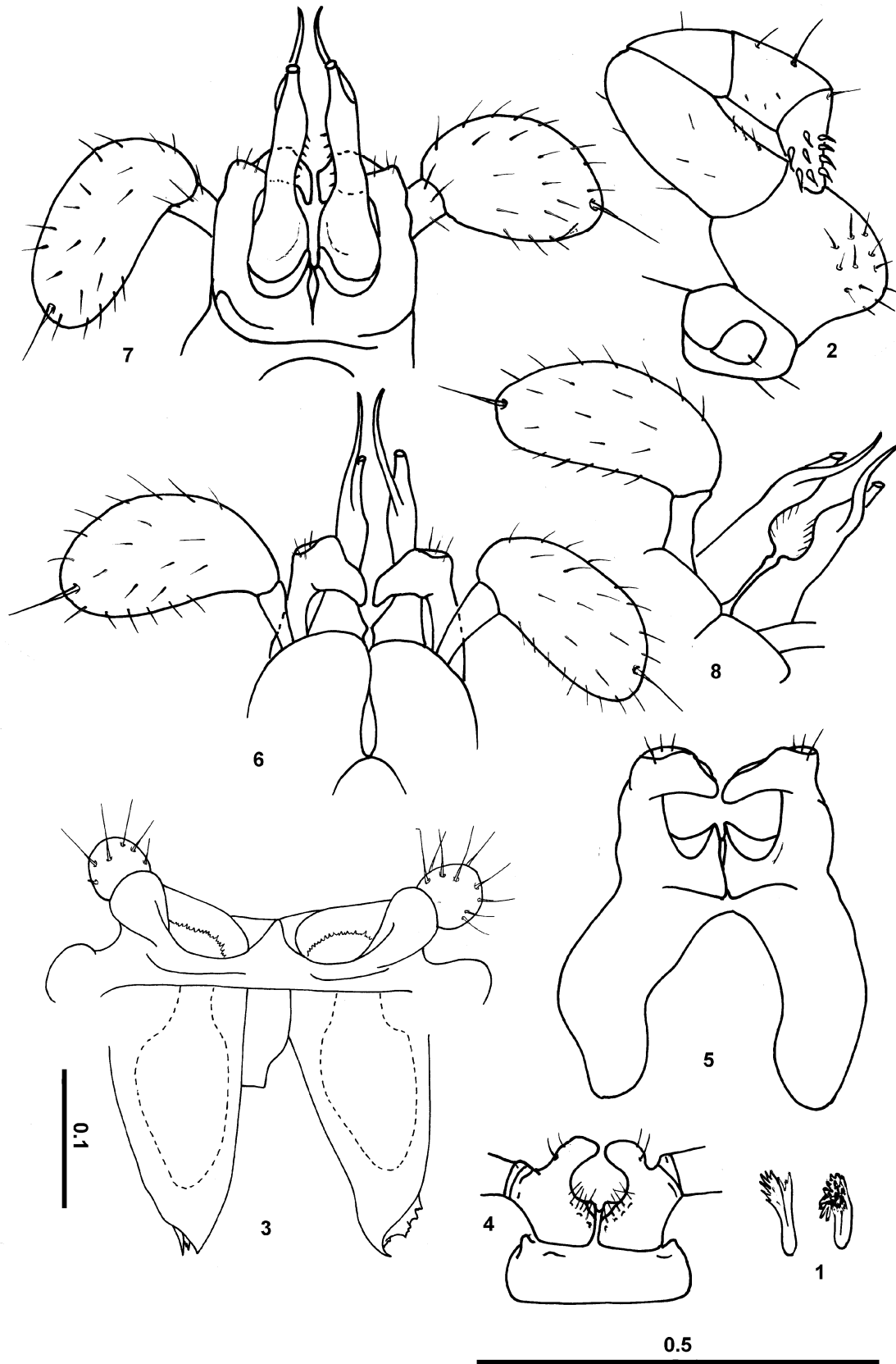
Female. Length about 5.5 mm, width about 0.5 mm. Coloration generally light brown with brown prozona. Venter beige. Front part of body infusate, castaneous brown. Clypeolabral region light brown, other parts except labrum brown, labrum and telson whitish. Antennae brownish, distally lighter. Ocellaria black. Body with 32 segments. Ocellaria composed of at least 13 ocelli.

Fused cyphopods, or vulvae, termed a syncyphium (Shear 2002), with two dentiform outgrowths, one on each side of a large cavity (= fossa) designed for accommodation of spermatophores; central plate also bearing two dentiform processes (Fig. 9).

**Name.** The specific epithet refers to Taiwan, the *terra typica*.

## A review of the Chordeumatida occurring in Taiwan

Until recently, the chordeumatidan fauna of Taiwan consisted of only three species in the family Diplomaragnidae (Verhoeff 1936; Wang 1958; Shear 1999), of which two still remain dubious (Mikhaljova *et al.* 2010), as well as one species of Speophilosomatidae (Wang 1958), the presence of which in Taiwan seems unlikely (Mikhaljova *et al.* 2011). At present, however, considering only unquestioned records, Taiwan supports 13 species, three genera and three families of Chordeumatida.



**FIGURES 1–8.** *Metopidiotrix taiwanensis* sp. nov., male holotype. 1, distinctive setae of antennomere 2 (not drawn to scale); 2, leg 3, caudal view; 3, leg pair 10, caudal view; 4, coxae 11, caudal view; 5, anterior gonopods, caudal view; 6, gonopods, caudal view; 7, gonopods, front view; 8, posterior gonopods, caudal view. Scales in mm.

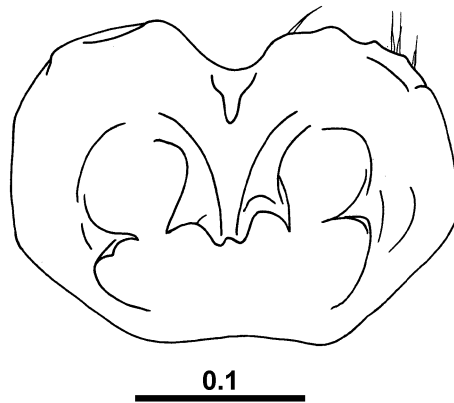


FIGURE 9. *Metopidothrix taiwanensis* sp. nov., female paratype. Syncyphium, ventral view. Scale in mm.

The Palaearctic family Diplomaragnidae is represented in Taiwan by ten unquestioned species, all in the Japanese-Korean-Taiwanese genus *Tokyosoma* Verhoeff, 1932, and virtually all high-montane; yet two further diplomaragnids, both in the genus *Diplomaragna* Attems, 1907, remain dubious (Mikhailjova *et al.* 2010). In any event, Taiwan supports the southernmost species of Diplomaragnidae.

This large family dominates the millipede fauna of Russia's Asian part, being especially diverse in the mountains at its border with Mongolia, as well as in the south of the Russian Far East (Mikhailjova 2004). Shear (1990) believes that south-central Siberia together with the adjacent areas of Mongolia might have served as the origin centre for Diplomaragnidae, whence spread of certain members could have occurred to the east and west together with forest.

The family Niponiosomatidae, with two species in a single genus, *Niponiosoma* Verhoeff, 1941, from Japan, is still another unquestioned Palaearctic element in the millipede fauna of Taiwan. It is represented there by the endemic genus *Taiwaneuma* Mikhailjova, Golovatch & Chang, 2011, also with two high-montane species (Mikhailjova *et al.* 2011). Shear (1988) sees the Niponiosomatidae as being especially close to, if not a synonym of, the diverse Nearctic family Tingupidae.

In contrast, the family Metopidiotrichidae is quite diverse and common in Australia, New Zealand, Indonesia, the Philippines and Southeast Asia. Its sole Taiwanese species of *Metopidothrix* is definitely a tropical element in the fauna of the island, *M. taiwanensis* sp. nov. apparently representing the northernmost congener. Its occurrence in the southern, low-montane part of Taiwan agrees well with the above zoogeographical evidence. Shear (2002) considers this family as an austral group of Gondwanan origin.

The rate of endemism of Chordeumatida in Taiwan amounts to 100% at the species level (discarding the few dubious species), one genus (*Taiwaneuma*, 33%) seems to be confined to the island, but there are no endemic families there. The fauna is mixed in composition, comprising elements of various origins, both Palaearctic and austral. Yet the Palaearctic influence is predominant.

For the sake of completeness, however, the following key considers all 16 species, four genera and four families of Chordeumatida hitherto formally recorded in Taiwan, including both dubious species of *Diplomaragna* and a questionable record of a Japanese species of *Speophilosoma* Takakuwa, 1949.

#### A key to families, genera and species of Chordeumatida occurring in Taiwan

- |       |   |   |
|-------|---|---|
| 1(30) | Adult body with more than 26 segments. Leg pair 7 of male normal . . . . .  | 2 |
| 2(5)  | Body with 28 segments. Tegument of metatergites densely alveolate, short and low ridges running longitudinally and scattered over metatergal surface. . . . . family Niponiosomatidae, genus <i>Taiwaneuma</i>                      |   |
| 3(4)  | Three pairs of short, subequal flagella on colpocoxite of anterior gonopods, these flagella not concealed inside a groove formed by excavated postgonopodal coxae. Collum with spots resembling eyes. . . . . <i>T. ramuligerum</i> |   |
| 4(3)  | Two pairs of very long flagella on colpocoxite of anterior gonopods concealed inside a groove formed by excavated postgonopodal coxae. Collum without spots resembling eyes. . . . . <i>T. crinitum</i>                             |   |
| 5(2)  | Body with 29 or 32 segments. Tegument of metatergites different. . . . .  | 6 |
| 6(7)  | Male clypeolabrum enlarged and elongated, set off from behind by a strong sulcus . . . . .  |   |

	.....family Metopidiotrichidae, genus <i>Metopidiothrix</i> , <i>M. taiwanensis</i> <b>sp. nov.</b>	
7(6)	Male clypeolabrum normal .....	family Diplomaragnidae
8(11)	Posterior gonopods without long lateral coxal branches .....	genus <i>Diplomaragna</i>
9(10)	Anterior angiocoxal process of posterior gonopod without apical ridge. Lateral angle of anterior angiocoxite rounded .....	<i>D. gracilipes</i>
10(9)	Anterior angiocoxal process of posterior gonopod with an apical ridge. Lateral angle of anterior angiocoxite distinct .....	<i>D. formosana</i>
11(8)	Posterior gonopods with long lateral coxal branches .....	genus <i>Tokyosoma</i>
12(13)	Posterior gonopod colpocoxite with a lateral horn-shaped process .....	<i>T. distinctum</i>
13(12)	Posterior gonopod colpocoxite without lateral horn-shaped process .....	14
14(15)	Lateral coxal branch of posterior gonopod with neither any processes nor blades .....	<i>T. australe</i>
15(14)	Lateral coxal branch of posterior gonopod with some processes and blades .....	16
16(23)	Posterior gonopod colpocoxite with a distal outgrowth .....	17
17(18)	Distal outgrowth of posterior gonopod colpocoxite short .....	<i>T. breviprocesum</i>
18(17)	Distal outgrowth of posterior gonopod colpocoxite long .....	19
19(20)	Lateral coxal branch of posterior gonopod bifurcated into long and slender branches .....	<i>T. bifurcatum</i>
20(19)	Lateral coxal branch of posterior gonopod not bifurcated into long and slender branches .....	21
21(22)	Posterior gonopod lateral coxal branch with a dentiform process subapically .....	<i>T. fanfan</i>
22(21)	Posterior gonopod lateral coxal branch without any processes subapically .....	<i>T. spinifer</i>
23(16)	Posterior gonopod colpocoxite without distal outgrowth .....	24
24(25)	Posterior gonopod telopodite femur very small, knob-shaped .....	<i>T. serratum</i>
25(24)	Posterior gonopod telopodite femur normal, not knob-shaped .....	26
26(27)	Posterior gonopod lateral coxal branch divided into three processes distally .....	<i>T. cornutum</i>
27(26)	Posterior gonopod lateral coxal branch without three processes distally .....	28
28(29)	Middle portion of posterior gonopod coxal branch microtuberculate laterally, distal portion of the branch blade-shaped .....	<i>T. lobatum</i>
29(28)	Middle portion of posterior gonopod coxal branch with a lateral, thin, serrate blade, distal portion of the branch beak-shaped .....	<i>T. taroko</i>
30(1)	Adult body with 26 segments. Leg pair 7 of male strongly reduced and modified. ....	.....family Speophilosomatidae, genus <i>Speophilosoma</i> , <i>S. montanum</i>

## Acknowledgements

We are most grateful to the National Science Council (NSC), Taiwan, Republic of China, and to the Russian Academy of Sciences, Moscow, Russian Federation, for the support rendered to the Taiwanese and Russian teams, headed by H. W. Chang and S. I. Golovatch, respectively, to actively collaborate in our joint ecofaunistic studies on the Myriapoda of Taiwan (NSC grant No. 98-2923-B-110-002-MY2, Russian Foundation for Fundamental Investigations grant No. 09-04-92005-HHC\_a). We are deeply obliged to the collectors whose samples have been treated in this paper, and to Mrs G. A. Sinelnikova (IBSS, Vladivostok, Russia) for helpfully inking the line drawings.

## References

- Mikhaljova, E.V. (2004) *The millipedes (Diplopoda) of the Asian part of Russia*. Pensoft, Sofia–Moscow, 292 pp.
- Mikhaljova, E.V., Golovatch, S.I., Chang, H.W. (2010) The millipede family Diplomaragnidae in Taiwan, with descriptions of nine new species (Diplopoda, Chordeumatida). *Zootaxa*, 2615, 23–46.
- Mikhaljova, E.V., Golovatch, S.I., Chang, H.W. (2011) The millipede family Niponiosomatidae new to the fauna of Taiwan, with descriptions of a new genus and two new species (Diplopoda, Chordeumatida). *Zootaxa*, 2980, 49–60.
- Shear, W.A. (1988) Systematic position of the millipede family Niponiosomatidae (Diplopoda, Chordeumatida, Brannerioidea). *Myriapodologica*, 2(6), 37–43.
- Shear, W.A. (1990) On the Central and East Asian millipede family Diplomaragnidae (Diplopoda, Chordeumatida, Diplomaragnoidea). *American Museum Novitates*, 2977, 1–40.
- Shear, W.A. (1999) The millipede genus *Diplomaragna* confirmed for Taiwan, with the description of a new species (Diplopoda, Chordeumatida, Diplomaragnidae). *Myriapodologica*, 6(2), 11–18.
- Shear, W.A. (2002) The millipede genus *Metopidiothrix* Attems (Diplopoda: Chordeumatida: Metopidiotrichidae). *Invertebrate Systematics*, 16, 849–892.
- Verhoeff, K.W. (1936) Ueber Diplopoden aus Japan, gesammelt von Herrn Y. Takakuwa. *Transactions of the Sapporo Natural History Society*, 14, 148–172.
- Wang, Y.H.M. (1958) Serica 1i: On Diplopoda from Taiwan with a new strongylosomids (sic!). *Quarterly Journal of the Taiwan Museum*, 11(3–4), 340–344.