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Review of the millipede family Diplomaragnidae of Japan, with description of a new species and the restoration of the combination *Diplomaragna hokkaidensis* (Verhoeff, 1939) (Diplopoda, Chordeumatida, Diplomaragnidae)

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Abstract

Diplomaragnidae are currently represented in Japan by ten species in three genera. One species is described here as new to science: *Tokyosoma flexuosum* sp. n. *Maritimosoma hokkaidense* (Verhoeff, 1939) is returned to *Diplomaragna*: *Diplomaragna hokkaidensis* (Verhoeff, 1939). The distributions of the Japanese species of Diplomaragnidae are mapped.

Key words: Millipede, diplomaragnid, new species, description, transfer, map, Japan

Introduction

The first data on diplomaragnids of Japan derive from the paper by Verhoeff (1914) where the new genus *Syntelopodeuma* Verhoeff, 1914 and the new species *S. gracilipes* Verhoeff, 1914 were described, and the subfamily Diplomaragninae obtained full family status. Later Verhoeff described another new species of this genus (*S. hokkaidense* Verhoeff, 1939) (Verhoeff 1939), and erected a new monotypic genus *Niponiothauma* Verhoeff, 1942 with the type species *N. inflatum* Verhoeff, 1942 (Verhoeff 1942). Shear (1990) reillustrated this species and expressed his doubts about its type locality.

Verhoeff (1929), in a key, introduced a new subfamily Tokyosominae (recte: Tokyosomatinae) with type genus *Tokyosoma* gen. n. and its type species *Tokyosoma takakuwai* sp. n. However, he only gave an ample diagnosis of the subfamily and a very short description ("♂, ♀, 20 mm lg") of the type species. A more complete description of the type species was only published three years later (Verhoeff 1932). However, according to the rules of the International Code of Zoological Nomenclature (Arts. 12.1, 12.2.6 and 13.5) a valid name should be accompanied by a description or diagnosis; so all the three taxa were proposed validly, and the valid publication date of the type species is *Tokyosoma takakuwai* Verhoeff, 1929. Mistakes in Verhoeff's description and localities were corrected by Takakuwa (1954) and Miyosi (1958, 1959). Murakami (1971) also redescribed *Tokyosoma takakuwai*.

In addition, several cave-dwelling diplomaragnids have been discovered: Miyosi (1958) described the new genus *Pterygostegia* Miyosi, 1958 with the type species *P. kuroiwadensis* Miyosi, 1958. Murakami & Kawasaki (1975, 1976) added three more species to this genus from caves of two prefectures (*P. obliqua*, *P. anops*, and *P. grandilobata*). Later, a description of *Diplomaragna tsurusakii* Shear, 1990, from Hokkaido Island, appeared.

It should be noted that the taxonomic history of the family Diplomaragnidae is dramatic considering the creation of new families and genera and their subsequent synonymization and transfer, as well as new combinations of species. Information on this progress can be obtained from the publications by Golovatch (1977, 1979), Shear (1979, 1990), and Mikhaljova (2000). In addition, a new, in-depth study of the gonopod structure of Japanese Diplomaragnidae is required, especially on the species of the genera *Tokyosoma* and *Pterygostegia* (Mikhaljova *et al.* 2010).

The present paper provides a description of a new species as well as a list of Diplomaragnidae occurring in

Japan. *Diplomaragna hokkaidensis* (Verhoeff, 1939) is returned from *Maritimosoma* to *Diplomaragna*. In addition, the distributions of the Japanese diplomaragnids are mapped (Map). As most of the Japanese species belonging to this family require a revision, we refrain from giving a key to them based solely on published accounts.

Material and methods

Material treated here has been deposited in the collection of the Hungarian Natural History Museum, Budapest, Hungary (HNHM). Specimens were collected in 70–75% ethanol. During the study, the gonopods and some other parts were dissected from a male and mounted in glycerin as temporary micropreparations. Specimens were studied and illustrated using standard stereomicroscopic, photographic and drawing equipments.

Catalogue sections include the literature references for Japan only.

Taxonomy

Diplomaragna gracilipes (Verhoeff, 1914)

Syntelopodeuma gracilipes Verhoeff 1914: 360–369, figs 10–14.

Syntelopodeuma gracilipes—Takakuwa 1954: 125–126, figs 142–144; Miyosi 1959: 53, 126, 219, pl. 12: figs 173, 173'.

Diplomaragna gracilipes—Shear 1990: 31–32, figs 83–87; 1999: 12; Mikhaljova 2000: 174.

Distribution. Japan (Hokkaido Island), ?Korea, ?Taiwan.

Remarks. The species was originally described in *Syntelopodeuma* from Hokkaido Island, Japan (Verhoeff 1914), and later transferred to the genus *Diplomaragna* (Shear 1990). The records of this species in Korea (Takakuwa & Takashima 1944, Takakuwa 1954) and in Taiwan (Wang 1958) seem dubious because of the geographic distances between the type locality and these records. More information on this can be found in the publication by Shear (1999).

Diplomaragna hokkaidensis (Verhoeff, 1939)

Syntelopodeuma hokkaidense Verhoeff 1939: 113–116, figs 1–4.

Syntelopodeuma hokkaidense—Takakuwa 1954: 127–128, fig. 145; Miyosi 1959: 53, 126, 219, pl. 12: figs 174, 174'.

Diplomaragna hokkaidensis—Shear 1990: 32.

Maritimosoma hokkaidense—Mikhaljova 2000: 177.

Distribution. Japan (Hokkaido Island: Rumoi Sub-prefecture).

Remarks. The species was originally described in *Syntelopodeuma* from Hokkaido Island (Rumoi), Japan (Verhoeff 1939), and later transferred to the genus *Diplomaragna* (Shear 1990). Mikhaljova (2000) put it in her newly erected genus *Maritimosoma* Mikhaljova, 2000. However, taking into account the structure of gonopods of this species (especially the lack of posterior gonopod mesal processes, the presence of which is one of the main distinguishing characters of species of *Maritimosoma*), morphological similarities with other Hokkaido species of *Diplomaragna* and the geographical evidence, here we refer to it again as belonging to *Diplomaragna*.

Diplomaragna tsurusakii Shear, 1990

Diplomaragna tsurusakii Shear 1990: 30–32, figs 79–82.

Diplomaragna tsurusakii—Mikhaljova 2000: 175.

Distribution. Japan (Hokkaido Island: Ishikari Sub-prefecture).

Remarks. The species is only known from the original description from Hokkaido Island (Sapporo), Japan.

***Pterygostegia anops* Murakami & Kawasawa, 1976**

Pterygostegia anops Murakami & Kawasawa 1976: 115–118, fig. 3.

Diplomaragna anops—Shear 1990: 38.

Pterygostegia anops—Mikhailjova 2000: 176.

Distribution. Japan (Shikoku Island: Ehimé Prefecture, the boundary between Ehimé and Kôchi prefectures).

Remarks. The species was originally described in *Pterygostegia* (Murakami & Kawasawa 1976), later transferred first to the genus *Diplomaragna* (Shear 1990), then it was returned to *Pterygostegia* (Mikhailjova 2000). This species is only known from its *terra typica*, i.e. Ehimé Prefecture and the boundary between Ehimé and Kôchi prefectures, Japan. This cave inhabitant is the only species of the genus devoid of eyes.

***Pterygostegia grandilobata* Murakami & Kawasawa, 1976**

Pterygostegia grandilobata Murakami & Kawasawa 1976: 118–120, fig. 4.

Diplomaragna grandilobata—Shear 1990: 38.

Pterygostegia grandilobata—Mikhailjova 2000: 176.

Distribution. Japan (Shikoku Island: Kôchi Prefecture).

Remarks. The species was originally described in *Pterygostegia* from caves of Kôchi Prefecture, Shikoku Island, Japan (Murakami & Kawasawa 1976), later transferred to the genus *Diplomaragna* (Shear 1990), and then it was returned to *Pterygostegia* (Mikhailjova 2000). This cave inhabitant is only known from its *terra typica*.

***Pterygostegia kuroiwadensis* Miyosi, 1958**

Pterygostegia kuroiwadensis Miyosi 1958: 180–183, fig. I–II.

Pterygostegia kuroiwadensis—Miyosi 1959: 53, 126, 219, pl. 13: figs 177, 177; Murakami & Kawasawa 1976: 112–115, fig. 2; Mikhailjova 2000: 175–176, figs. 58–63.

Diplomaragna kuroiwadensis—Shear 1990: 38; Nishikawa & Murakami 1991: 300.

Distribution. Japan (Shikoku Island: Ehimé, Kôchi prefectures).

Remarks. The species was originally described in *Pterygostegia* from Kuroiwa-dô Cave, Ehimé Prefecture, Shikoku Island, Japan, (Miyosi 1958), later transferred to the genus *Diplomaragna* (Shear 1990), and then it was returned to *Pterygostegia* (Mikhailjova 2000). This species appears to be widespread in limestone caves at the southwestern part of Ehimé Prefecture and at the eastern and western parts of Kôchi Prefecture.

***Pterygostegia obliqua* Murakami & Kawasawa, 1975**

Pterygostegia obliqua Murakami & Kawasawa 1975: 192–195, fig. 1.

Pterygostegia obliqua—Murakami & Kawasawa 1976: 115; Mikhailjova 2000: 176.

Diplomaragna obliqua—Shear 1990: 38.

Distribution. Japan (Shikoku Island: Kôchi Prefecture).

Remarks. The species was originally described in *Pterygostegia* from caves of Kôchi Prefecture, Shikoku Island, Japan (Murakami & Kawasawa 1975), later transferred to the genus *Diplomaragna* (Shear 1990), and then it was returned to *Pterygostegia* (Mikhailjova 2000). This cave inhabitant is only known from its *terra typica*.

***Tokyosoma flexuosum* sp. n.**

Figs 1–4, Map.

Material examined. *Holotype*: 1 male (HNHM), Japan, Central Ryukyus, Okinawa Island, Katsuren Peninsula, next to White Beach, secondary forest, 26°18'43" N, 127°53'59" E, 60 m, 22 October 2010, leg. Z. Korsós.

Diagnosis. Differs from congeners mainly by the sinuous shape of the lateral coxal branch of the posterior gonopod, by the form of the posterior gonopod colpocoxite, which carries a lateral large spinous process, as well as in a flattened, concave, setose process of the coxa of male leg 10.

Description. Male (Fig. 1). Length about 15 mm, width with paraterga about 1.5 mm. Coloration in alcohol pale grayish, with broad dark brown band along axial line. Paraterga light brown ventrally. Venter and lower portion of pleura pale. Collum, genae pale. Anterior portion of head light brown. Legs with marbled brown distal parts. Ocellaria black. Antennae dark brown.



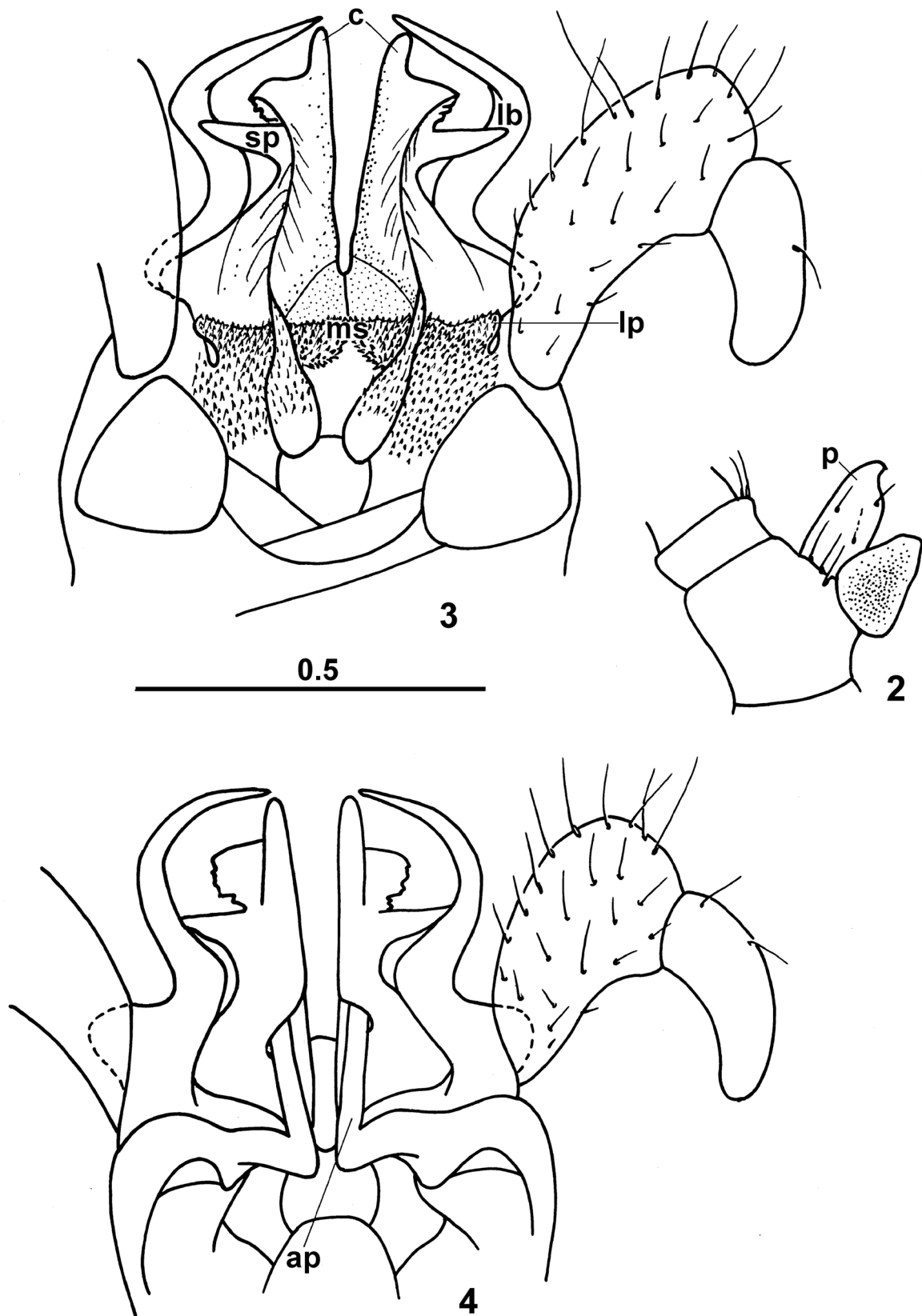
FIGURE 1. *Tokyosoma flexuosum* sp. n., male holotype (photograph by Z. Korsós, not to scale).

Body with 31 or 32 segments. The specimen is broken, thus it is impossible to accurately count the number of body segments, but it is most likely the true number is 32. Head covered with both relatively long and short setae. Eye patches composed of at least 24–26 ocelli. Collum semi-circular. Body width gradually increasing until somite 7, parallel-sided on somites 8–20(21), thereafter gradually tapering. Beginning from somite 2, paraterga normally developed, rounded, increasingly less distinct towards hind part of body, strongly reduced on somite 27, absent from somites 28–31. Metazonal macrochaetae in a transverse row on somites 30–31, like an elongate (to different degrees) triangle on preceding somites. Macrochaetae in anterior and hindmost parts of body relatively long, pointed apically, but in middle and posterior parts of body short (excluding caudolateral macrochaetae) and blunt. Anterolateral macrochaetae in posterior part of body clubbed. Metazonites with two very low longitudinal projections placed along axial suture on each side and with a diagonally positioned projection on each paratergite.

Leg pairs 3–7 not enlarged. Legs 3–5 without tarsal papillae. Legs 6–7 with a small group of funnel-shaped tarsal papillae apically near claw. Claws of pregonopodal legs at base dorsally with two small additional claws, and ventrally with a filament. Postgonopodal legs (including leg pairs 10 and 11) without tarsal papillae. Claws of postgonopodal legs (including leg pairs 10 and 11) at base dorsally with two small additional claws and ventrally with a long filament.

Legs 10 and 11 with coxal glands. Coxa 10 caudoventrally with a flattened concave setose process (**p**) with an anteriorly curved apex (Fig. 2). Trochanter 10 with a tiny ventral outgrowth setose apically. Coxa 11 with low ventral prominence. Trochanter 11 with a caudal setose process rounded apically.

Anterior gonopod telopodite 1-segmented, flagelliform, beset with cuticular spinules, its distal part positioned inside sheaths with elevated edges (Fig. 3). Telopodite base and distal part of coxosternum tightly attached to adjacent mesal portion of posterior gonopod. Posterior gonopod colpocoxites fused sub-basally. Colpocoxites distally with short processes (**c**) and, laterally, with large flat spinous processes (**sp**). Mesal sheath processes of posterior gonopod colpocoxites fused medially into a single cup-shaped low structure (**ms**) covered with pointed spinules. Lateral sheath processes of colpocoxites (**lp**) cup-shaped, low, carrying pointed spinules caudally.



FIGURES 2–4. *Tokyosoma flexuosum* sp. n., male holotype. 2, coxa and trochanter 10, coxal secret protruded, front view; 3, gonopods, caudal view; 4, gonopods, front view; **p**, coxal process; **c**, distal processes of colpocoxites; **ms**, mesal sheath processes of posterior gonopod colpocoxites; **lp**, lateral sheath process of posterior gonopod colpocoxite; **lb**, posterior gonopod lateral coxal branch; **sp**, lateral spinous process of colpocoxite; **ap**, anterior process of posterior gonopod angiocoxite. Scale in mm.

Posterior gonopod angiocoxite with a subconical globule, but without process in posterior view. Posterior gonopod coxal part with a long lateral flat branch (**lb**) curved mesally, laterally and mesally. Basal part of this branch fused with both colpocoxite and anterior angiocoxite. Angiocoxite depressed centrally in anterior view (Fig. 4), supplied with a long process (**ap**); distal portion of this process penetrating colpocoxite. Posterior gonopod telopodite 2-segmented; femur short and thin.

Female unknown.

Name. The specific epithet refers to the sinuous lateral coxal branch of the posterior gonopod.

Remarks. *Tokyosoma flexuosum* **sp. n.** is the first record of the family Diplomaragnidae on the entire Ryukyu Archipelago. Up to now, only one chordeumatid species, *Nipponothrix yuwandake* Shear & Tanabe, 1994, belonging to the family Metopidiotrichidae, was known from Amami-o-shima Island, Central Ryukyus (Nakamura & Korsós 2010).

***Tokyosoma inflatum* (Verhoeff, 1942)**

Niponiothauma inflatum Verhoeff 1942: 205–206, figs 1–6.

Niponiothauma inflatum—Miyosi 1959: 53, 128, pl. 12: figs 176–176".

Diplomaragna inflata—Shear 1990: 36.

Tokyosoma inflatum—Mikhaljova 2000: 178.

Distribution. Japan (Kuringawa; Kyushu Island: Kumamoto Prefecture).

Remarks. The species was originally described in *Niponiothauma* (Verhoeff 1942), later transferred to the genus *Diplomaragna* (Shear 1990), then to the genus *Tokyosoma* (Mikhaljova 2000). This species was described from Kuringawa, Japan. Shear (1990), however, suggested that this type locality is incorrect because it is impossible to find any information on that location on maps, and that *T. inflatum* originates from Kyushu Island where (in Kumamoto Prefecture) the additional specimens have been found.

***Tokyosoma takakuwai* Verhoeff, 1929**

Tokyosoma takakuwai Verhoeff 1929: 1481; Verhoeff 1932: 515, pl. 6: figs 41–44.

Tokyosoma takakuwai—Takakuwa 1954: 129: figs 147–148; Miyosi 1958: 181; Miyosi 1959: 32, 53, 127, pl. 12: figs 175–175';

Murakami 1971: 323–326, 325: fig. 6; Shinohara 1979: 33; Mikhaljova 2000: 178: figs 67–73.

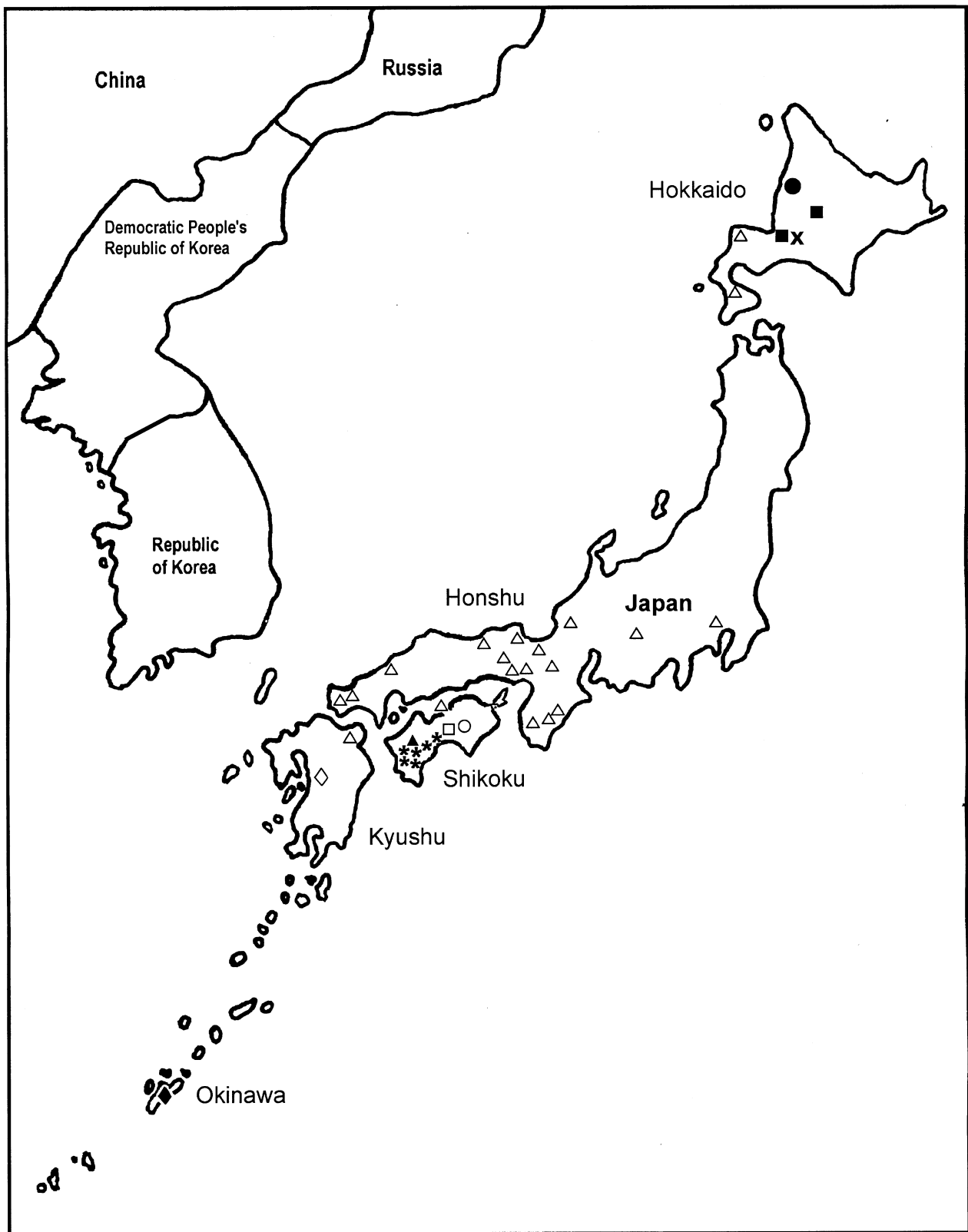
Diplomaragna takakuwai—Shear 1990: 36; Nishikawa & Murakami 1991: 300.

Distribution. Japan (islands: **Shikoku:** Ehimé Prefecture; **Honshu:** Shimané, Yamaguchi, Hyogo, Osaka, Kyoto, Shiga, Wakayama, Nara, Mie, Fukui, Nagano, Tokyo prefectures; **Kyushu:** Oita Prefecture; **Hokkaido:** Hiyama Sub-prefecture, Shiribeshi Sub-prefecture).

Remarks. The species was originally described in *Tokyosoma* (Verhoeff 1929), later transferred to the genus *Diplomaragna* (Shear 1990), and then it was returned to *Tokyosoma* again (Mikhaljova 2000). Type locality of the species is in the vicinity of Imabari, Ehimé Prefecture, Japan (see Murakami 1971).

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Map. Distribution of Diplomaragnidae millipedes in Japan. (Cross: *Diplomaragna gracilipes*; filled circle: *Diplomaragna hokkaidensis*; filled square: *Diplomaragna tsurusakii*; filled triangle: *Pterygostegia anops*; open square: *Pterygostegia grandilobata*; asterisk: *Pterygostegia kuroiwadensis*; open circle: *Pterygostegia obliqua*; filled diamond: *Tokyosoma flexuosum* sp. n.; open diamond: *Tokyosoma inflatum*; open triangle: *Tokyosoma takakuwai*).

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