




## Taxonomy of Japanese *Gonatopus* (Hymenoptera: Dryinidae), with description of a new species

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### Abstract

A new species of *Gonatopus*, *G. tagoi* **sp. nov.**, is described from Japan. Previously uncertain species, *Agonatopus gracilis* Esaki & Hashimoto, 1932 is redescribed based on newly collected females. Currently *A. gracilis* is included in *Gonatopus*, however, the name *Gonatopus gracilis* is preoccupied by Kieffer, 1905. Therefore, *Gonatopus gigantestratiotes* **nom. nov.** is provided as a replacement name. An updated key to the females of Japanese *Gonatopus* is given.

**Key words:** Chrysoidea, key, new replacement name, parasitic wasp, redescription

### Introduction

Members of the pincer wasp genus *Gonatopus* Ljungh, 1810 (Hymenoptera, Dryinidae, Gonatopodinae) are parasitoids and predators of Auchenorrhyncha (Hemiptera) (Guglielmino *et al.* 2013). In Japan, 16 species are known (Mita & Olmi 2013; Mita *et al.* 2017, 2021; Olmi & Xu 2015; Xu *et al.* 2013). Most species in Japan have a body size ranging from 2.0–4.5 mm long, but I recently found a series of large females exceeding 4.5 mm from Honshu and Kyushu. Their characteristics, particularly those of the mesosoma and proleg, suggest they belong to the *Gonatopus* species groups 4 and 7, respectively (Olmi & Xu 2015). The former species is apparently undescribed. The latter species was found to be *Agonatopus gracilis* Esaki & Hashimoto, 1932. It is the largest species of apterous Gonatopodinae in Japan. According to the original description, the total body length of the holotype female reaches 5.8 mm. However, its taxonomic status has been uncertain for a long time, because the holotype female is considered lost and no additional specimen is known (Mita *et al.* 2021).

### Material & Methods

Morphological terms and the definition of species groups were followed Xu *et al.* (2015), Mita *et al.* (2017). Terms were also referred from Lanes *et al.* (2020) and Martins & Melo (2024). Following abbreviations were used in descriptions: POL, the minimum distance between the inner edges of the lateral ocelli; OL, the minimum distance between the inner edges of a lateral ocellus and the median ocellus; OOL, the distance from the outer edge of a lateral ocellus to the compound eye; OPL, the minimum distance from the posterior edge of a lateral ocellus to the occipital carina. Examined specimens are deposited in the Entomological Laboratory, Faculty of Agriculture, Kyushu University, Fukuoka, Japan (ELKU). Photo images of dried specimens were taken by a Canon EOS M200 mounted on an Olympus SZX10 (for body) or an Olympus BX43 (for chela) and processed using Zerene Stacker (Zerene Systems, LLC, Richland, WA, USA). A chela and a tarsus were removed from right proleg and they were mounted on a small slide after KOH treatment. A field photograph was taken using a digital camera, Panasonic Lumix FZ150 with a macro conversion lens, Raynox DCR-250.

## Results

### Genus *Gonatopus* Ljungh, 1810

#### Group 4, *Gonatopus tagoi*, new species

(Figs 1–4, 10)



**FIGURES 1–4.** *Gonatopus tagoi* sp. nov. (holotype female). 1, habitus; 2, head; 3, mesosoma, dorsal view; 4, mesosoma, lateral view. Scales = 0.5 mm (head), 1.0 mm (others).

**Description.** *Holotype female.* Apterous. Head (Fig. 2) excavated, 0.47× longer than wide; frons smooth with ocellar triangle sculptured; inner orbit of eye and vertex granulated; frontal line complete; malar space smooth; gena smooth; OL = 3.5; POL = 1.5; OOL = 9.0; maximum diameter of anterior ocellus 1.0; occipital carina absent; antennae distally thickened; each antennomere showing following ratio: 9.5: 6.5: 21.0: 13.0: 10.0: 9.0: 7.5: 7.5: 6.5; 10.0. Palpal formula 6/3. Pronotum (Figs 1, 3, 4) 1.1× longer than wide, smooth; anterior transverse groove and strong transverse impression present. Mesoscutum rugose, not granulated; lateral pointed apophyses absent; mesoscutellum smooth, almost flat in lateral view; mesopleuron transversely striate and granules; sides of mesopleuron almost flat (Fig. 3); meso-metapleural suture absent, but indicated among keels. Metanotal region roughly sculptured, flat in lateral view; metapectal-propodeal complex striate, partly granulate except anterodorsal surface smooth. Protarsomeres showing following ratio: 92: 18: 24: 104: 150: T1 0.88× T4; T3 producing into one hook; chela (Fig. 10) with T5 bearing two rows of 17 + 18 lamellae, one separated lamellae; apex of T5 bearing approximately 25 lamellae; enlarged claw with one large subapical tooth and one row of 12 lamellae. Tibial spurs 1/0/1.

*Color.* Head black except anterior part of frons, malar spaces, and clypeus testaceous, genae brown; mandibles testaceous with reddish brown teeth; antenna brownish black excluding scape, pedicel, basal margin of F1 testaceous, apex of F8 brown; pronotum light brown, with surface around transverse impression darkened; propleuron dorsally black, ventrally dark brown; mesoscutum testaceous; mesoscutellum, mesopleuron, metapectal-propodeal complex black; legs mostly yellowish brown but profemur, protibia and basitarsus brownish; metasoma brown except petiole black.

*Measurements (in mm).* Head 0.57 long, 1.22 wide; antenna 2.72; mesosoma 2.43; procoxa 0.90; protochanter 0.67; profemora 1.38; protibia; 1.27; T5 0.75; total body length 4.70.

*Male.* Unknown.

**Specimens examined.** Holotype: ♀, “JPN, Saitama Pref., Misato-shi, dry riverbed of Edo-gawa Riv., 25. VII. 2004, T. Tago leg.” (ELKU).

**Distribution.** Japan (Honshu).

**Hosts.** Unknown.

**Etymology.** The species name is derived from Toshihiro Tago, the collector of the holotype.

**Remarks.** The new species is classified to *Gonatopus* species group 4 because the holotype is apterous female with following characters: palpal formula 6/3; pronotum crossed by a strong transverse impression; enlarged claw with lamellae and one large apical tooth. Compared to the Palaearctic and Oriental species of group 4, there are no closely related species to the new species. According to the key (Eastern Palaearctic: Olmi & Xu 2015; Oriental: Xu *et al.* 2013), it can be compared to *G. gobiensis* (Ponomarenko, 1979) (usually testaceous species with meso-metapleural suture distinct and producing mesoscutellum), *G. asiae* Olmi, 1984 (testaceous species with lateral pointed protrusion of mesoscutum and distinct meso-metapleural suture) or *G. insulae* Olmi, 1984 (testaceous species with sides of mesopleuron distinctly rounded). However, it is clearly differentiated by the bicolored body, the inclined mesoscutellum, the flat metanotum, the flat mesopleuron and the laterally fully costate but longitudinal carinae and furrow missing on metapectal-propodeal disc. The holotype was collected by net-sweeping from the grassland on the dry riverbed of the Edo-gawa River, Central Honshu.

## Group 7, *Gonatopus gigantestratiotes*, new name

(Figs 5–9, 11)

*Agonatopus gracilis* Esaki & Hashimoto, 1932: 30; holotype female lost (Mita *et al.* 2021). Type locality: Chikuzen-wakasugiyama (Fukuoka, Japan).

*Gonatopus gracilis*: Olmi & Xu, 2015: 153; Mita, 2020: 39, preoccupied, nec *Gonatopus gracilis* Kieffer in Kieffer & Marshall, 1905: 115 (= *Gonatopus lunatus* Klug, 1810).

**Redescription based on newly collected material.** *Female.* Apterous. Head (Fig. 7) excavated, 0.54–0.56× longer than wide; frons granulated except median part smooth (Fig. 7); frontal line complete (Fig. 7); malar space smooth; gena smooth; OL = 4.5; POL = 3.0; OOL = 17.0; maximum diameter of anterior ocellus 2.5; occipital carina partly present, posterior to ocelli (Mt. Hiko-san) or absent (Mt. Iwara-yama); antenna distally thickened; each antennomere showing following ratio (F3–8 missing in a specimen from Iwara-yama): 9.0–10.5: 7.0–7.5: 23.5–24.0: 19.0–19.5: 13.5: 12.0: 10.5: 8.5: 7.5: 10. Palpal formula 6/3. Pronotum (Figs 6, 8) smooth; anterior transverse groove and

strong transverse impression present. Mesoscutum granulated and rugose (Figs 8, 9); lateral pointed apophyses present (Fig. 8); mesoscutellum sculptured, producing and posteriorly inclined; mesopleuron transversely striate with granules; sides of mesopleuron rounded (Fig. 8); meso-metapleural suture distinct, at most only partly effaced (Fig. 8). Metanotal region as long as mesoscutellum, rugose, flat in lateral view; mesopleuron dorsally granulated and weakly rugose, ventrally less granulated and strongly rugose; metapectal-propodeal complex strongly rugose, partly granulate, disc longitudinally striate (Figs 8, 9). Protaromeres showing following ratio: 62–65; 11–12; 19; 85; 120–123; T1 0.76× T4; T3 producing into one hook; chela (Fig. 11) with T5 bearing two rows of approximately 20 + 25 lamellae; apex of T5 bearing approximately 25 lamellae; enlarged claw with one small subapical tooth located on distal 1/3 and one row of 6–7 peg-like setae. Tibial spurs formula 1/0/1.



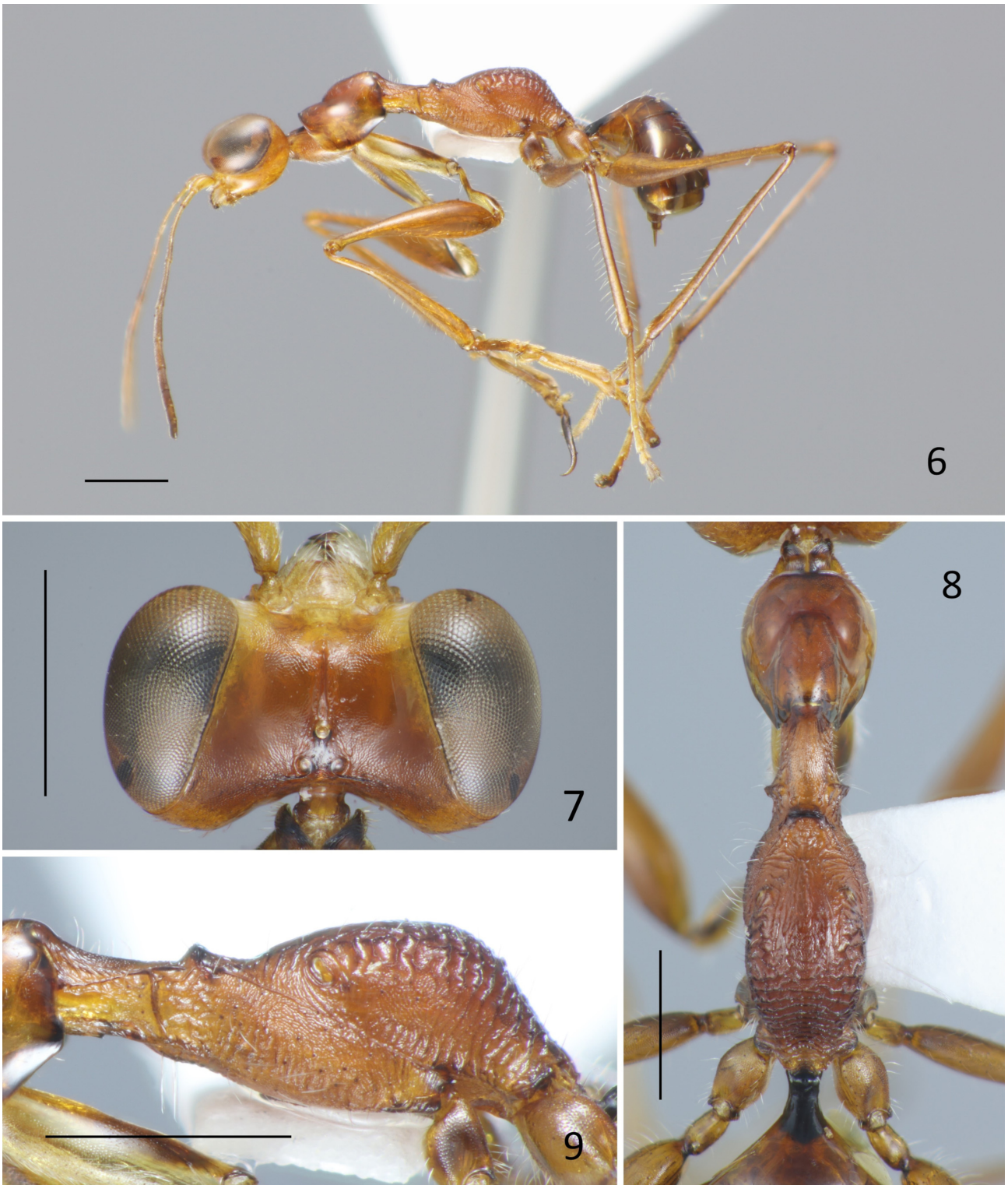
**FIGURE 5.** *Gonatopus gigantestratiotes* **nom. nov.**, female.

**Color.** In living individuals, the body color appears crimson red (Fig. 5), but in dried specimens, it becomes pale ferruginous over time. The following description is based on the dried specimens. Head reddish brown except anterior part of frons, malar spaces, and clypeus testaceous, genae brown; mandibles testaceous with reddish brown teeth; antennae brown except scape to basal half of F1 testaceous; mesosoma reddish brown; legs reddish brown but profemur and protrochanter testaceous with large dark spot on outer surface, dark spot present on mesocoxa of a specimen from Iwara-yama; metasoma dark brown except petiole black.

**Measurements (in mm).** Head 0.89–0.92 long, 1.62–1.63 wide; antenna 4.0 (Hiko-san); mesosoma 3.00–3.38; procoxa 1.17–1.29; protrochanter 1.02–1.06; profemora 2.14–2.15; protibia; 1.90–2.05; T5 1.20–1.23; total body length 6.02 (Hiko-san)–7.28 (Iwara-yama). The body size of the female from Mt. Hiko-san appears smaller because of the shrunk metasoma.

**Male.** Unknown.

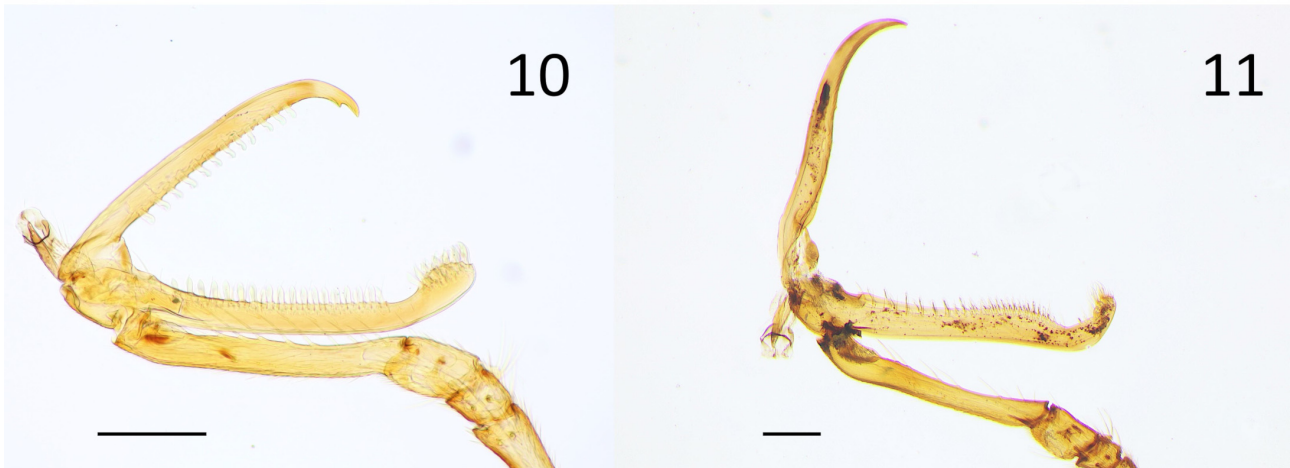
**Specimens examined.** Japan, Fukuoka Pref.: 1♀, Mt. Hiko-san, 650 m alt., on fallen tree, 8. VIII. 2019, S. Tomura leg. (ELKU); 1♀, Mt. Iwara-yama, 2. IX. 2020, collected from *Arachniodes standishii* (T. Moore) Ohwi, K. Nishiya leg. (ELKU).



**FIGURES 6–9.** *Gonatopus gigantestratiotes* **nom. nov.**, female. 6, habitus; 7, head; 8, mesosoma, lateral view; 9, mesosoma, dorsal view. Scales = 1.0 mm.

**Etymology.** The replacement name is derived from Greek words, “gigantis” and “stratiotes”, meaning the Giant Warrior. It is the English name of the huge ancient bioweapon (“Kyoshinhei” in Japanese) featured in Hayao Miyazaki’s 1984 animated film, “Nausicaä of the Valley of the Wind”. The name refers to the exceptionally large-sized species among Japanese *Gonatopus*. The name is a noun in the nominative singular standing in apposition.

**Distribution.** Japan (Kyushu).



FIGURES 10–11. Chelae. 10, *Gonatopus tagoi* sp. nov., holotype; 11, *G. gigantestratiotes*. Scales = 0.2 mm.

**Hosts.** Unknown.

**Remarks.** Because the holotype is considered to be lost, *Agonatopus gracilis* Esaki & Hashimoto, 1932 has been treated as a species *incertae sedis* (Mita *et al.* 2021). According to the original description, it is a very large, peculiar species with the body size 5.8 mm, and the combination of the following features: labial palpus with three palpomeres; the distinct transverse impression of the pronotum; one pair of lateral pointed apophyses of the mesoscutum; the producing mesoscutellum; and the amber testaceous body color (Esaki & Hashimoto 1932). Although the detailed description is not provided for the chela, they compared and mentioned the similarity with an American species, *Agonatopus pallidicornis* Perkins, 1907 (= *Gonatopus frequens* Perkins, 1907). It leads to the conclusion that this species should be a member of the group 7. Considering the dryinid fauna of Japan, it is unlikely that multiple species showing the above peculiar characters occur in a narrow area (Northern part of Fukuoka). Therefore, I identified the two recently collected females as *A. gracilis*. The female from Mt. Hiko-san was found on a dead tree on forest floor and the other female was collected from Mt. Iwara-yama by net-sweeping from a fern, *Arachniodes standishii* (T. Moore) Ohwi (Dryopteridaceae). The holotype was also found in a forest (Esaki & Hashimoto, 1932). Although it should not affect the reliability of the identification, there are some minor differences or ambiguities left especially in the nuances of the coloration and the surface sculpture on the metapectal-propodeal disc.

As already mentioned by Olmi & Xu (2015) and Mita (2020), *Agonatopus gracilis* should be transferred to *Gonatopus*. However, the name, *Gonatopus gracilis* is preoccupied by *Gonatopus gracilis* Kieffer, 1905, a junior synonym of *Gonatopus lunatus* Klug, 1810, and no junior synonym is available. Therefore, a replacement name, *Gonatopus gigantestratiotes*, **nom. nov.** is proposed here to remove a nomenclatorial conflict. The female of *G. gigantestratiotes* is distinguished from the other species of *Gonatopus*, belonging species group 7 in the eastern Palaearctic and Oriental regions by the uniformly ferruginous brown body color (dark red in living females), the developed and pointed lateral apophyses, the producing mesoscutellum, the distinct meso-metapleural suture, longitudinal irregular keels (not furrow) on metapectal-propodeal disc, T1 of proleg 0.8× longer than T4, and the serrated part missing in the inner proximal region of T5, lamellae beginning in proximal part of T5.

### Key to the females of *Gonatopus* in Japan

(modified from Mita & Olmi, 2013)

- |    |  |    |
|----|--|----|
| 1. | Enlarged claw with one small subapical tooth .....                     | 2  |
| -  | Enlarged claw with one large subapical tooth .....                     | 3  |
| 2. | Pronotum rounded, not crossed by transverse impression (Group 6) ..... | 11 |
| -  | Pronotum crossed by transverse impression (Group 7) .....              | 5  |

3.	Palpal formula 6/3 (Group 4) .....	12
-	Palpal formula different, at least labial palpus with two palpomeres .....	4
4.	Palpal formula 2–4/2 (Group 2) .....	13
-	Palpal formula 5/2 (Group 10) .....	17
5.	Metapectal-propodeal complex mostly granulated, at most faintly striated on propodeal declivity; T1 of proleg longer, at least $1.5 \times T4$ .....	<i>G. yasumatsui</i> Olmi
-	Metapectal-propodeal complex distinctly striated by transversal carinae, with or without granules on surface between carinae; and/or T1 of proleg shorter, at most $1.2 \times T4$ .....	6
6.	Metapectal-propodeal complex distinctly granulated and with transversal carinae; chela with inner margin of T5 bearing two rows of lamellae on distal half; body black .....	<i>G. javanus</i> (R.C.L. Perkins)
-	Metapectal-propodeal complex transversely striated, with or without granules; chela with inner margin of T5 of foreleg bearing one or two rows of lamellae entirely; body color variable, at least head or part of mesosoma testaceous to reddish .....	7
7.	Meso-metapleural suture absent .....	8
-	Meso-metapleural suture distinctly present .....	9
8.	Mesothorax distinctly slender; mesosoma bi-colored .....	<i>G. schenklingsi</i> Strand
-	Mesothorax not slender; mesosoma brown with dark spots. ....	<i>G. adelphos</i> Mita & Olmi
9.	Mesoscutum flat, not producing; lateral pointed apophysis absent .....	<i>G. clavipes</i> (Thunberg)
-	Mesoscutum producing; lateral pointed apophysis developed .....	10
10.	Mesopleuron and anterior part of metapectal-propodeal complex striate with surface between carinae granulate; very large species (5.8–7.2mm) .....	<i>G. giganteostratiotes</i> Mita, <b>nom. nov.</b>
-	Mesopleuron and anterior part of metapectal-propodeal complex smooth, not striate; not very large species (2.5–5.4 mm) .....	<i>G. hishimonovolus</i> Xu & He, 1997
11.	Chela with inner margin of T5 bearing one row of lamellae on distal half .....	<i>G. pedestris</i> (Dalman)
-	Chela with inner margin of T5 bearing 1–2 rows of lamellae entirely. ....	<i>G. andoi</i> (Esaki & Hashimoto)
12.	Meso-metapleural suture distinct; mesopleuron and metapectal-propodeal complex smooth, not striate except propodeal declivity .....	<i>G. tambinia</i> (Esaki & Hashimoto)
-	Meso-metapleural suture absent; mesopleuron and metapectal-propodeal complex largely striate except metapectal-propodeal disc .....	<i>G. tagoi</i> Mita, <b>sp. nov.</b>
13.	Temple developed. ....	14
-	Temple absent .....	16
14.	Metanotum longer, more than twice as long as mesoscutellum .....	<i>G. nigricans</i> (R.C.L. Perkins)
-	Metanotum shorter, at most as long as mesoscutellum .....	15
15.	Mesopleuron and metathorax strongly striate; species found in rice paddy .....	<i>G. flavifemur</i> (Esaki & Hashimoto)
-	Mesopleuron and metathorax weakly striate; species found in grassland .....	<i>G. camelinus</i> Kieffer
16.	Metanotum smooth, excluding posterior margin of mesoscutellum sculptured by short longitudinal keels; meso-metapleural suture absent; metapectal-propodeal disc without longitudinal furrow .....	<i>G. malesiae</i> (Olm)
-	Metanotum transversely striated; meso-metapleural suture obsolete, but present; metapectal-propodeal disc with longitudinal furrow .....	<i>G. lankae</i> (Ponomarenko)
17.	Mesoscutum longitudinally carinate; metanotal region more steep. ....	<i>G. formicicolus</i> (Kiffer)
-	Mesoscutum smooth excluding pair of longitudinal carinae on lateral margins; metanotal region less steep. ....	<i>G. asiaticus</i> (Olm)

## Discussion

Among well-known Gonatopodinae in Asia, species showing restricted distribution are uncommon. In Japan, only two species, *Gonatopus tambinia* (Esaki & Hashimoto, 1935) (Izu Islands, Ogasawara Islands and the Ryukyus) and *G. adelphos* Mita & Olmi, 2017 (Ogasawara Islands), are endemic to Japan (Mita *et al.* 2017), while others

are recorded across a wide range in the Palaearctic and/or Oriental regions. In addition, Japan (Mita & Matsumoto 2012; Mita & Olmi 2013; Mita *et al.* 2012, 2013, 2017) and Korea (Kim & Lee 2015; Olmi & Xu 2015) have mixed elements of both Palaearctic and Oriental regions. Therefore, among above-mentioned species and the two species treated in this paper, there is the potential to be discovered in western regions in the future. Their potential hosts are limited because both *Gonatopus tagoi* **sp. nov.** and *G. gigantestratiotes*, **nom. nov.** are remarkably larger species as Japanese *Gonatopus*. Considering host records of groups 4 and 7 (Guglielmino *et al.* 2013), the former is considered to parasitize Fulgoromorpha in grasslands, while the latter possibly parasitize large Cicadellidae living in the forest. In general, wingless *Gonatopus* species are not frequently collected through trapping (Hansen & Olmi 1996; Martins & Domahovski 2022; Olmi 1984). It makes field survey challenging without knowledge of their life history. Therefore, the current understanding of the species abundance of *Gonatopus* in Japan may be still underestimated. Further taxonomic research is needed to elucidate their species diversity.

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