

THE THREAD-LEGGED ASSASSIN BUG GENUS  
*GARDENA* (HETEROPTERA: REDUVIIDAE)  
FROM JAPAN

Ishikawa, T., 2005. The thread-legged assassin bug genus *Gardena* (Heteroptera: Reduviidae) from Japan. – Tijdschrift voor Entomologie 148: 209-224, figs. 1-55. [ISSN 0040-7496]. Published 1 December 2005.

Five species of the reduviid genus *Gardena* are recognized in Japan. Two species, *G. albiannulata* sp. n. and *G. boninensis* sp. n., are newly described here. Detailed descriptions and illustrations of male and female genitalia are provided for all species.

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Key words. – Heteroptera; Reduviidae; Emesinae; Emesini; *Gardena*; Japan; new species.

*Gardena* Dohrn, 1860 is the second largest genus in the tribe Emesini of the reduviid subfamily Emesinae, comprising 46 species from all zoogeographical regions (Maldonado Capriles 1990). In Japan, the genus was represented by three species up till now: *G. melinarthrum* Dohrn (type of the genus), *G. brevicollis* Stål and *G. muscicapa* (Bergroth) (Putshkov & Putshkov 1996). Recently, however, five species of the genus have been recognized through field surveys made by my colleagues and me and by investigations of reduviid collections housed at several institutes in Japan. Three of them belonged to the previously known species, mentioned above. The other two were found to be undescribed, one from the Ryūkyū Islands and the other from the Ogasawara Islands.

Discrimination among species of *Gardena* has been based on a combination of several morphological characters, such as the structures of head, pronotum and forelegs. Genitalia present valuable information as well, such as the shape of the genital capsule, parameres and endosoma of phallus, which are frequently very useful in other genera of the Emesinae as well as in many other reduviid groups. Careful study of the genital morphology of *Gardena* revealed that the shape of struts in the male and that of styloides in the female provided useful information for distinguishing the species. Although Wygodzinsky (1966) has provided illustrations of these structures for the genus in his monographic work of the world Emesinae, these

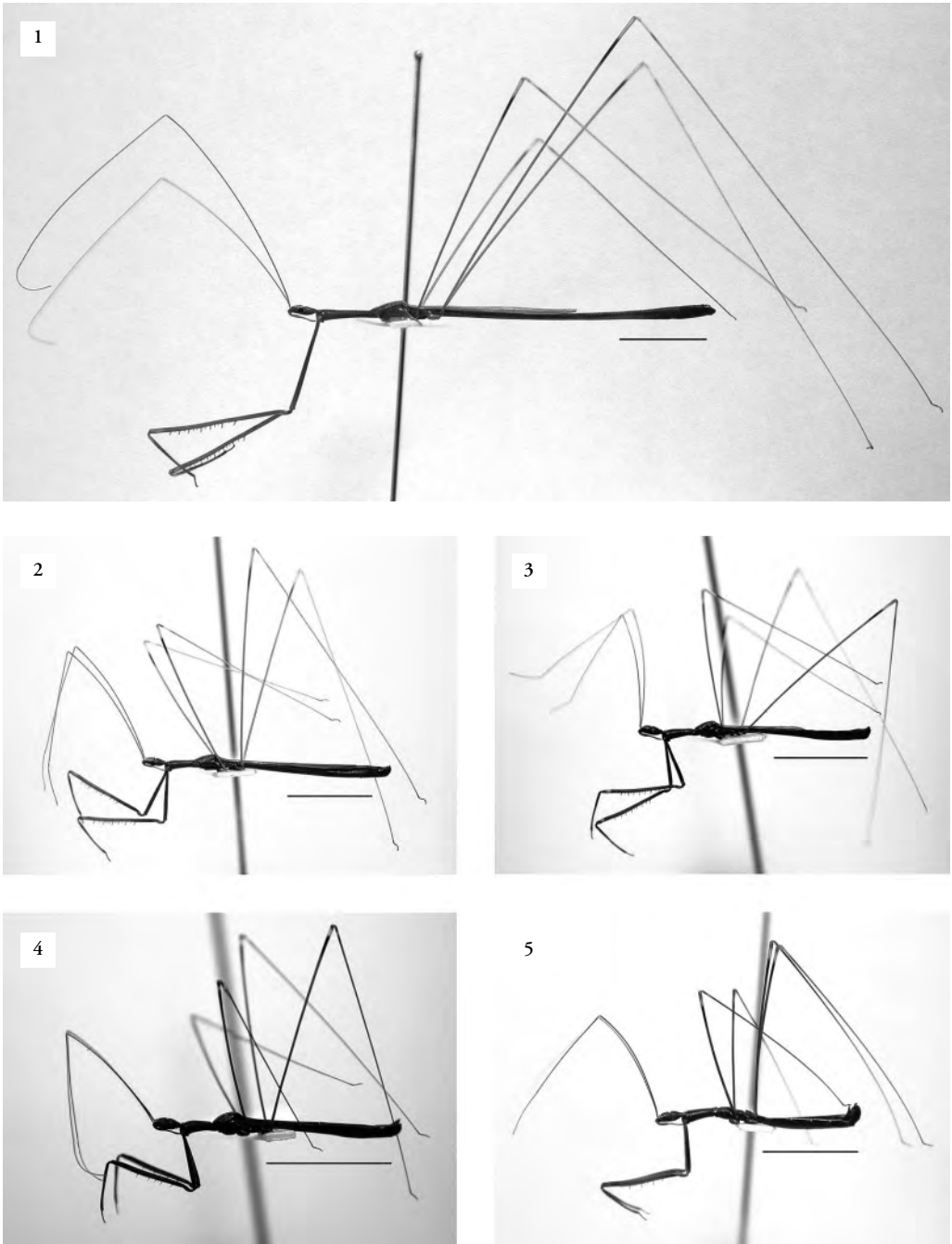
are limited to a few species only.

In the present paper, *Gardena* of Japan is revised, with descriptions of two new species. A diagnosis and illustrations of male and female genitalia, including the struts and styloides, are provided for all Japanese species. A key to the Japanese species is also given.

#### MATERIAL AND METHODS

Dried specimens of each species were used. All illustrations are based on specimens collected from Japan, except that a male specimen of *Gardena melinarthrum* from Malaysia was used for illustrating the genitalia (figs. 26, 31, 36). Claws of forelegs and male and female genitalia were macerated in a hot 10% KOH solution for about five minutes. The endosoma was pulled out of the phallosoma under a stereoscopic dissecting microscope with forceps. Illustrations of claws of forelegs and male and female genitalia were drawn with the aid of an optical microscope equipped with a drawing tube. The endosoma was omitted from the illustrations of the phallus because it hardly represents distinguishing features for at least the Asian species of *Gardena*. After observation, these parts were preserved in small glass vials with glycerol.

Terminology generally follows that of Wygodzinsky (1966), but terms for the male and female genitalia mainly follow Davis (1966). All measurements in the text are given in millimeters. Depositories of the



Figs. 1-5. *Gardena* spp. – 1, *G. melinarthrum*, female; 2, *G. brevicollis*, male; 3, *G. albiannulata* sp. n., male (holotype); 4, *G. muscipa*, male; 5, *G. boninensis* sp. n., male (holotype). Scales: 5.0 mm.

material are abbreviated as follows:

- ELEU Entomological Laboratory, Faculty of Agriculture, Ehime University, Matsuyama  
 ELKU Entomological Laboratory, Faculty of Agriculture, Kyushu University, Fukuoka  
 NSMT Department of Zoology, National Science Museum, Tokyo  
 OMM Omogo Mountain Museum, Ehime  
 SMC Dr. S. Miyamoto's personal collection, Fukuoka  
 TUA Laboratory of Insect Resources, Faculty of Agriculture, Tokyo University of Agriculture, Atsugi

Abbreviations are also used for several collectors of the material as follows: KM: Keiichi Matsumoto; KO: Katsuyuki Ohgi; KY: Kazutaka Yamada; MT: Mikio Takai; SM: Syoiti Miyamoto; SN: Seidai Nagashima; SY: Shinji Yano; TI: Tadashi Ishikawa; TK: Toshio Kishimoto; TO: Masaaki Tomokuni.

#### TAXONOMY

#### Genus *Gardena* Dohrn

[*Gardena* Dohrn, 1859: 252. Nomen nudum.]

*Gardena* Dohrn, 1860: 214 (n. gen.), type species by monotypy: *Gardena melinarthrum* Dohrn, 1860.

*Luteovopsis* Champion, 1898: 165, type species by subsequent designation (Kirkaldy 1907: 249): *Luteovopsis longimanus* Champion, 1898 (syn. by Wygodzinsky 1966: 246).

This genus is easily recognized by a combination of the following characters: the rostral segment I apparently shorter than the segment II, the scutellum not spined or tuberculate, the anteroventral series of fore femora composed of delicate spine-like setae or very small spines only, the three-segmented fore tarsi, the hemelytra each with a single cell, and a single vein (M+Cu) extending basad from base of a discal cell. Wygodzinsky (1966) provided a detailed description.

Wygodzinsky (1966) divided this genus into four species groups, the *melinarthrum*, *brevicollis*, *longimana* and *pipara* groups, based on external morphology of legs and male genitalia. Among the Japanese species, *G. melinarthrum* belongs to the *melinarthrum* group and the others, including two new species described below, are associated with the *brevicollis* group.

#### *Gardena melinarthrum* Dohrn

(figs. 1, 6, 7, 16, 21, 26, 31, 36, 41-43)

*Gardena melinarthrum* Dohrn, 1860: 214 (n. sp.). Type locality: Sri Lanka. Type depository: unknown.

*Gardena semperi* Dohrn, 1863: 64 (syn. by McAtee & Malloch 1926: 136). Type locality: Luson, Philippines.

Type depository: unknown.

*Gardena melinarthrum* var. *femoralis* McAtee & Malloch, 1926: 136. Type locality: Kuala Tahan, Pahang, Malaysia. Type depository: Museum of Natural History, London.

#### Diagnosis

Recognized by the brownish yellow to yellowish brown body, the pronotum 2.7 times as long as the head and lacking a transverse sulcus at the border of the anterior and posterior lobes (figs. 6, 7), the unspined basal portion of the fore femur 0.32 times as long as the whole length of the fore femur (fig. 16), the foretibia less than the half length of the fore femur (fig. 16), the outer claw of the foreleg with four triangular ventral projections (fig. 21), the struts of the phallus thickened moderately at the basal portion (fig. 36), and the female styloides with a weakly concave posterior margin (fig. 43). Body length 20.0-26.0 mm.

#### Description of genitalia

Male. – Pygophore (fig. 26) evenly expanded ventrally in lateral view, with posterior process; posterior process (fig. 26) erect, weakly curved posteriorly, rounded at apex. Parameres (fig. 31) gently curved inwards, rounded at apex, with erect and suberect setae; these setae as long as or shorter than maximum width of paramere. Phallosoma of phallus (fig. 36) sclerotized on dorsal and ventral surfaces; struts (fig. 36) slender in apical four-fifths and moderately thickened in basal one-fifth in lateral view.

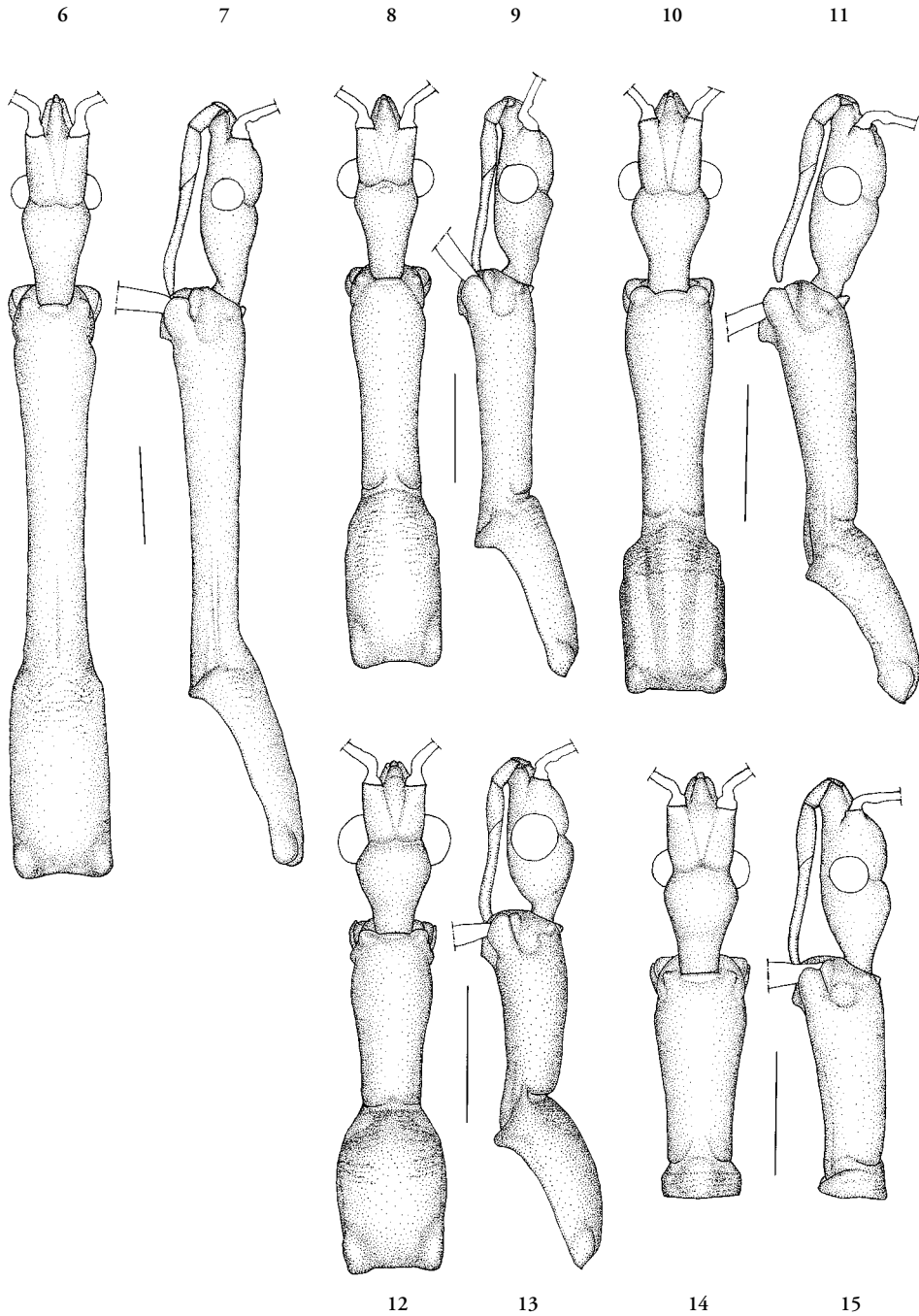
Female. – posterior margin of abdominal tergite VIII arcuate posteriorly (fig. 41). Tergite IX about 1.5 times as long as tergite VIII (fig. 41). Valvifers I (fig. 42) large; valvulae I (fig. 42) curved inwards, acute at apex. Styloides (fig. 43) discally elevated, carinate ventrally along meson, covered with erect setae along and near lateral margins, and with weakly concave anterior and posterior margins.

#### Distribution

Japan: Honshû, Shikoku, Kyûshû, Yaku-shima Island, the Ryûkyû Islands (Okinawa-hontô Island); Taiwan, Korea, China, Sri Lanka, Philippines, Malaysia, Indonesia, Australia. The records from Honshû and the Ryûkyû Islands are uncertain because the material could not confirmed through the present study.

#### Remarks

This species is very rare in Japan. Previous records from various areas of Japan, including Shikoku and Kyûshû, seem doubtful in most cases, because large specimens (mostly female) of *G. brevicollis* have often been misidentified as *G. melinarthrum*. According to Dr. S. Miyamoto (pers. comm.), however, this species had frequently been found at Fukuoka before 1970.



Figs. 6-15. Head and prothorax, dorsal (6, 8, 10, 12, 14) & lateral (7, 9, 11, 13, 15) views (setae omitted). – 6, 7, *G. melinarthrum*, female; 8, 9, *G. brevicollis*, male; 10, 11, *G. albiannulata* sp. n., male (holotype); 12, 13, *G. muscicapa*, male; 14, 15, *G. boninensis* sp. n., male (holotype). Scales: 1.0 mm.

Material examined. – JAPAN: Shikoku: Kôchi-ken: Tachikawa, Ôtoyo-chô: 1 ♀ (shown in figs. 1, 6, 7, 16), 31.viii.1992, T. Ohno (TUA); Nakasuji Dam, Sukumo-shi: 1 ♀ (shown in figs. 21, 41-43), 27.ix.1997, T. Befu (TUA). – Kyûshû: Fukuoka-ken: Chikuzen: 1 ♂, 15.ix.1955, SM (SMC); 1 ♂, 15.ix.1956, SM, with labels “*Gardena melinarthrum* Dohrn ? var. *femoralis* McAtee & Malloch, det. Wygodzinsky” and “3” (ELKU). – Yaku-shima Is.: Aiko-dake (more than 400 m alt.), Kamiyaku-chô: 1 ♀, 4.x.1969, K. Kanmiya (SMC). – MALAYSIA: 19 miles from Tapah, Cameron Highlands: 1 ♂ (shown in figs. 26, 31, 36), 9.iv.1996, TK (TUA).

### *Gardena brevicollis* Stål

(figs. 2, 8, 9, 17, 22, 27, 32, 37, 44-46)

*Gardena brevicollis* Stål, 1871: 704 (n. sp.). Type locality: Philippines. Type depository: Naturhistoriska Riksmuseet, Stockholm.

*Gardena australis* Horváth, 1902: 606 (syn. Wygodzinsky, 1956: 212). Type locality: New South Wales, Australia. Type depository: Hungarian Natural History Museum, Budapest.

*Gardena fasciata* Distant, 1909: 505 (syn. Wygodzinsky, 1966: 253). Type locality: Sri Lanka. Type depository: Museum of Natural History, London.

*Gardena fusca* Fukui, 1926: 13 (syn. Wygodzinsky, 1966: 253). Type locality: Japan. Type depository: unknown.

### Diagnosis

Recognized by the yellowish brown to brown body, the pronotum twice as long as the head and having a distinct transverse sulcus at the border of the anterior and posterior lobes (figs. 8, 9), the unspined basal portion of the fore femur 0.24 times as long as the whole length of the fore femur (fig. 17), the fore-tibia 0.56 times as long as the fore femur (fig. 17), the outer claw of the foreleg with four triangular ventral projections (fig. 22), the struts of the phallus thickened at the base and basal one-fourth in lateral view (fig. 37), and the female styloides with gently concave anterior and posterior margins (fig. 46). Body length 15.0-19.5 mm.

### Description of genitalia

Male. – Pygophore (fig. 27) evenly expanded ventrally in lateral view, with posterior process; posterior process (fig. 27) erect, weakly bent at basal one-third, rounded at apex. Parameres (fig. 32) gently curved inwards, rounded at apex, with erect and suberect setae; longest setae longer than maximum width of paramere. Phallosoma of phallus (fig. 37) sclerotized on dorsal and ventral surfaces; struts (fig. 37) thickened at base and basal one-fourth in lateral view.

Female. – Posterior margin of abdominal tergite VIII arcuate posteriorly (fig. 44). Tergite IX about 1.2 times as long as tergite VIII (fig. 44). Valvifers I

(fig. 45) large; valvulae I (fig. 45) curved inwards, acute at apex. Styloides (fig. 46) discally elevated, carinate ventrally along meson, covered with erect setae along and near lateral margins in apical half, and with gently concave anterior and posterior margins.

### Distribution

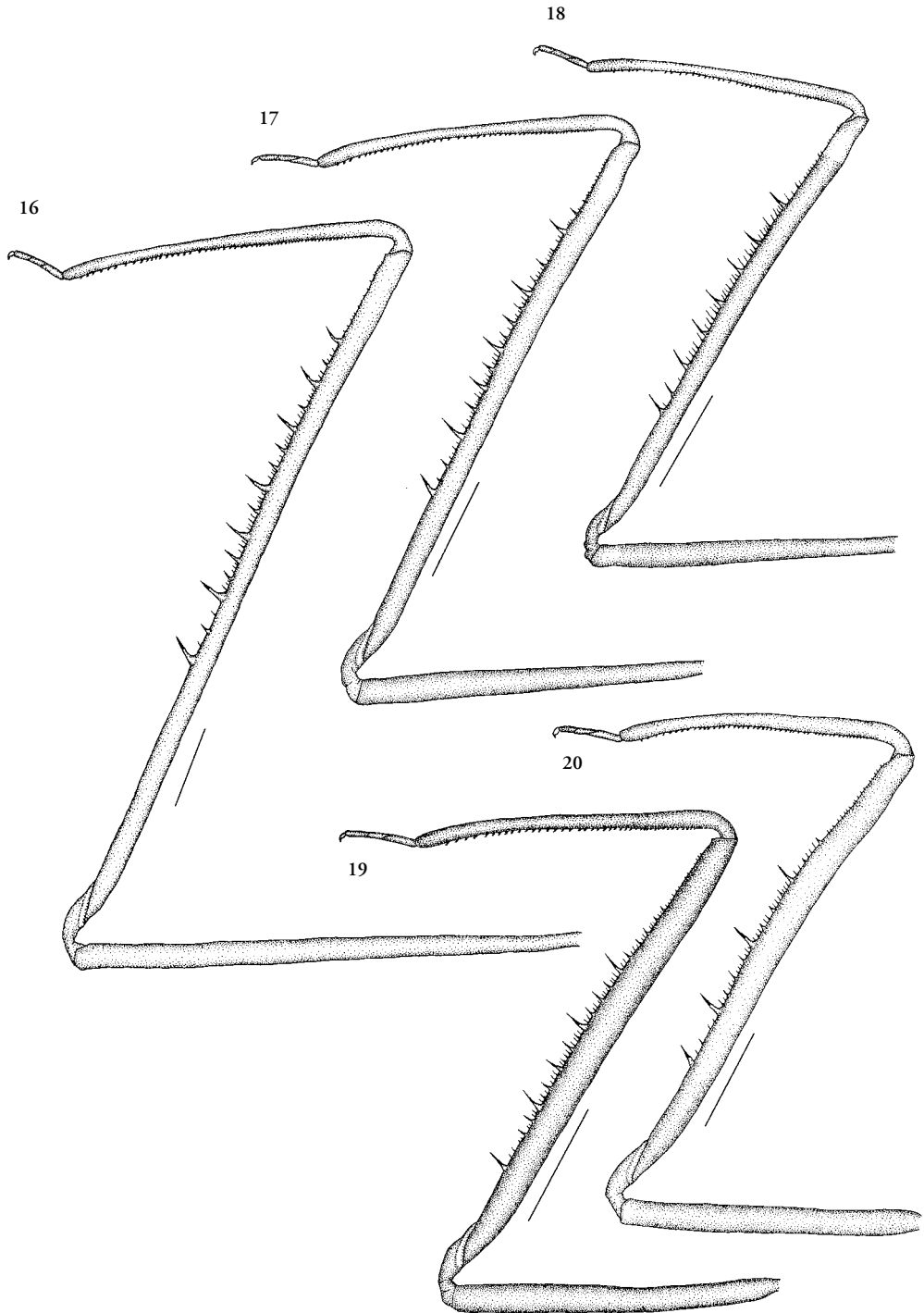
Japan: Hokkaidô, Honshû, Shikoku, Kyûshû, Okinoshima Islands, Tsushima Island, Yaku-shima Island, Ryûkyû Islands (Okinawa-hontô Island, Ishigaki-jima Island, Iriomote-jima Island, Yonaguni-jima Island); Russian Far East, Korea, Taiwan, Philippines, Malaysia, Indonesia, Solomon Islands, Australia.

### Remarks

This species differs in coloration of the mid- and hindcoxae between specimens from Hokkaidô, Honshû, Shikoku, Kyûshû and the Okinoshima Islands and those from Tsushima Island, Yaku-shima Island and the Ryûkyû Islands. The former has the entirely brownish yellow coxae, whereas the latter shows the basally darkened mid coxae and the wholly darkened hind coxae.

As mentioned above, Japanese entomologists have often erroneously identified *G. brevicollis* as the preceding *G. melinarthrum* because the female of the former species is frequently much larger in body size than the male. The two species are easily distinguished by the ratio in length of the head and pronotum, presence or absence of a transverse sulcus at the border of the anterior and posterior pronotal lobes, the ratio in length of the fore femur and unspined portion of the fore femur, and the ratio in length of the femur and tibia of the forelegs.

Material examined. – JAPAN: Hokkaidô: Hitsujigaoka: 1 ♂, 2.ix.1977, TO (NSMT). – Honshû: Ibaraki-ken: Ushikunuma, Ryûgasaki-shi: 1 ♀, 19.xi.2001, H. Mizushima (TUA); Saitama-ken: Ketsuka, Higashi-matsuyama-shi: 2 ♂ 2 ♀, 31.viii.1997, TI (TUA); Chiba-ken: Ichihara-shi: 1 ♂, 11.x.2000, TK (TUA); Tôkyô: Tanakayato, Machida-shi: 1 ♀, 9.x.1994, TK (TUA); Kanagawa-ken: Kôhoku-ku, Yokohama-shi: 1 ♀, 24-26.ix.1998, T. Shimada (TUA); Daishi, Kawasaki-shi: 1 ♀, 21.xi.2000, KM (TUA); Gifu-ken: Kishôdani, Fujihashi-mura: 1 ♂, 27.ix.1992, H. Yoshitomi (TUA); Yamaguchi-ken: Ajisu-kantaku, Ajisu: 1 ♀, 23.x.1997, KO (TUA); Aohata, Ajisu, Yoshiki: 1 ♂, 10.x.1999, KO (TUA). – Shikoku: Ehime-ken: Niban-ike, Matsuyama-shi: 2 ♀ (one shown in figs. 44-46), 26.x.1999, KO (TUA); Kôchi-ken: Irino, Ôgata-chô: 1 ♀, 13.vi.2003, MT (TUA); 3 ♂, 19.ix.2003, MT & TI (TUA); river mouth of Monobe-gawa, Yoshikawa-mura: 1 ♀, 15.1.2002, MT (TUA); Teragawa, Honkawa-mura: 1 ♀, 25.ix.1999, TI (TUA). – Kyûshû: Fukuoka-ken: Sefuri-yama: 1 ♂, 21.ix.1939, without collector (ELKU); Miyazaki-ken: Kawaminami-chô: 1 ♂, 21.ix.2002, MT (TUA). – Okinoshima Islands: Fuse, Fusemura: 1 ♂, 11.ix.1984, TO (NSMT). – Tsushima Is.: Mitake, Kamiagata-chô: 1 ♂, 31.vii.1998, H. Yoshitake (TUA).



Figs. 16-20. Left foreleg (setae omitted). – 16, *G. melinarthrum*, female; 17, *G. brevicollis*, male; 18, *G. albiannulata* sp. n., male (holotype); 19, *G. muscipala*, male; 20, *G. boninensis* sp. n., male (holotype). Scales: 1.0 mm.

– Yaku-shima Is.: Nagakubo, Yaku-chô: 1 ♂, 18.viii.1998, KM (TUA). – Ryûkyû Islands: Okinawa-hontô Is.: Kudeken, Chinen-son: 1 ♀, 17.xii.2002, SY (TUA); Yona Resaerch Foreset, Ryûkyû University, Yona, Kunigami-son: 2 ♂ 1 ♀, 4.xi.1999, TO (NSMT); Ishigaki-jima Is.: Fukaiomoto: 1 ♂, 7.iii.2002, TI (TUA); 1 ♂, 16.vi.2002, TI (TUA); Omoto-dake: 1 ♀, 6.iv.2001, KY (TUA); Shiraho: 1 ♂ (shown in figs. 2, 17), 9.vi.2003, at light, TI (TUA); Iriomote-jima Is.: Funaura: 1 ♀, 1.vi.2003, SN (TUA); 1 ♂, 6.vi.2003, TI (TUA); Ôhara: 1 ♂ (shown in figs. 8, 9) 1 ♀, 20.v.2002, MT (TUA); 1 ♀, 7.iv.2003, MT (TUA); Sonai: 4 ♂ (one shown in fig. 22 and another shown in figs. 27, 32, 37) 1 ♀, 19.v.2002, MT (TUA); Yonaguni-jima Is.: Kubura-dake: 1 ♀, 28.v.2003, TI (TUA); 1 ♂, 1.vi.2003, TI (TUA).

*Gardena albiannulata* sp. n.

(figs. 3, 10, 11, 18, 23, 28, 33, 38, 47-49)

Type material. – Holotype ♂ (type no. TUA-HE-200405), JAPAN: Takeda-rindô, Ishigaki-jima Is., Ryûkyû Islands, Japan, 5.iii.2002, TI (TUA). – Paratypes: JAPAN: Ryûkyû Islands: Ishigaki-jima Is.: same data as for holotype: 1 ♀ (TUA); Banna-dake: 1 ♀, 24.v.2002, MT (TUA); Nosoko-rindô: 1 ♂, 22.v.2002, MT (TUA); Ôzato: 1 ♂, 26.ii.2004, SY (OMM); Iriomote-jima Is.: Komi: 1 ♂, 2.iii.2002, TI (TUA); 1 ♂, 10.vi.2002, TI (TUA); Sonai: 2 ♂ (one shown in figs. 23, 28, 33, 38) 1 ♀ (shown in figs. 47-49), 19.v.2002, MT (TUA); Toyohara: 1 ♂, 7.iv.2003, MT (TUA); detailed locality not given: 1 ♀, 20.v.2002, MT (TUA); Yonaguni-jima Is.: Kubura-dake: 1 ♀, 1.vi.2003, TI (TUA).

**Diagnosis**

Recognized by the dark brown to blackish body, the pronotum which is twice as long as the head and having a distinct transverse sulcus at the border of the anterior and posterior lobes (figs. 10, 11), the brownish yellow disc of the posterior pronotal lobe with a pair of dark longitudinal stripes (fig. 10), the fore femora with a subapical pale annulation (fig. 18), the unspined basal portion of the fore femur 0.25 times as long as the whole length of the fore femur (fig. 18), the basally thickened struts of the phallus (fig. 38), and the female styloides with deeply incised anterior margin and strongly concave posterior margin (fig. 49). Body length 11.9-15.7 mm.

**Description**

Winged male: coloration. – Body generally dark brown to blackish. Disc of posterior pronotal lobe brownish yellow, with a pair of dark longitudinal stripes (fig. 10). Antennal segment I yellowish brown, with pale apex; segment II brown, paler basad, with pale apex; segments III and IV dark brown. Supracoxal areas of prothorax pale. Forelegs yellowish brown to dark brown, with pale annulation on

subapical part of fore femur (fig. 18); tarsi basally pale. Mid and hindlegs yellowish brown, with coxae and trochanters dark brown; femora pale on apical part, with dark annulation subapically; apical parts of femora often with reddish suffusion dorsally; tibiae pale on basal part, with dark annulation subbasally; basal parts of tibiae often fuscous dorsally. Hemelytra brownish yellow.

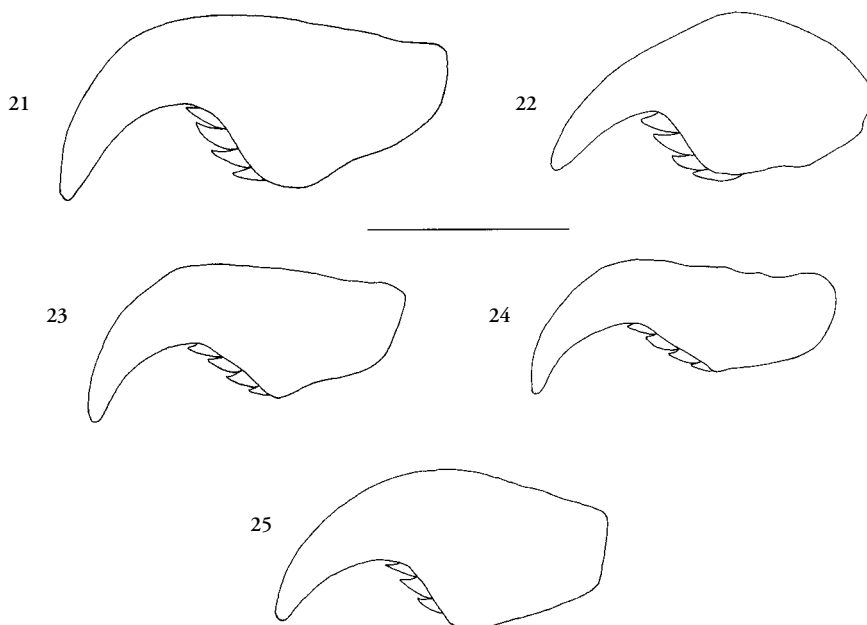
Structure. – Head (figs. 10, 11) 1.9 times as long as width across eyes, furnished with short decumbent setae; anteoculus about 0.76 times as long as postoculus. Eye (figs. 10, 11) moderately large, prominent laterad, 0.4 times as wide as interocular space in dorsal view. Antennal segment I covered with short decumbent setae intermixed with long erect setae; longest setae about 6 times as long as width of segment I medially; segment II entirely furnished with short decumbent setae, and with long erect setae in basal one-fourth; segments III and IV with short decumbent setae; proportion of segments I to IV 18:15:1:5. Rostral segments I and II covered with short, curved and decumbent setae; segment III sparsely furnished with short suberect setae; proportion of segments I to III 5:8:15.

Pronotum (figs. 10, 11) twice as long as head, 4 times as long as humeral width, covered with short, suberect and decumbent setae, and with distinct transverse sulcus at border of anterior and posterior lobes; anterior lobe about 1.3 times as long as posterior lobe, 2.7 times as long as its maximum width; posterior lobe parallel-sided, with straight posterior margin.

Forelegs (fig. 18) densely furnished with short, suberect and decumbent setae; coxa about 12.5 times as long as its maximum width; femur 1.6 times as long as coxa, about 22 times as long as its maximum width, with posteroventral series of 7 large, about 6 medium-sized and about 50 small and slender spiniferous tubercles; unspined basal portion of fore femur 0.25 times as long as whole length of fore femur; tibia 0.6 times as long as femur, with about 45 peg-like projections; tarsus 0.18 times as long as tibia; outer claw (fig. 23) with 4 triangular ventral projections. Hemelytron reaching anterior part of abdominal segment V.

Abdomen slender, furnished with short decumbent setae. Pygophore (fig. 28) evenly expanded ventrally in lateral view, with posterior process; posterior process (fig. 28) erect, almost straight, rounded at apex. Parameres (fig. 33) curved inwards, obtuse at apex, with erect and suberect setae; these setae shorter than maximum width of paramere. Phallosoma of phallus (fig. 38) ventrally sclerotized; struts (fig. 38) strongly thickened basally in lateral view.

Winged female. – Almost the same in general appearance as male. Head twice as long as width



Figs. 21-25. Outer claw of foreleg. – 21, *G. melinarthrum*; 22, *G. brevicollis*; 23, *G. albiannulata* sp. n.; 24, *G. muscipapa*; 25, *G. boninensis* sp. n. Scales: 0.1 mm.

across eyes. Eye 0.3 times as wide as interocular space in dorsal view. Antennae furnished with short decumbent setae only. Anterior pronotal lobe about 1.6 times as long as posterior lobe, 2.9 times as long as its maximum width. Posterior margin of abdominal tergite VIII arcuate posteriorly (fig. 47). Tergite IX 1.2 times as long as tergite VIII (fig. 47). Valvifers I (fig. 48) large; valvulae I (fig. 48) broad, curved inwards, acute at apex. Styloides (fig. 49) discally elevated, carinate ventrally along meson, covered with erect setae along and near lateral margins in apical two-thirds, and with deeply incised anterior margin and strongly concave posterior margin.

Apterous form: unknown.

Measurements. – ♂/♀ (holotype in parentheses): body length 11.9-13.7/14.6-15.7 (12.4). Head length including neck 1.26-1.43/1.48-1.62 (1.35); width across eyes 0.72-0.82/0.74-0.80 (0.72); interocular space 0.38-0.45/0.43-0.48 (0.41). Antenna length 13.23-15.41/16.22-17.93 (13.79); lengths of segments I, II, III and IV 5.90-7.10/7.70-8.35 (6.27), 5.33-6.07/6.60-7.25 (5.33), 0.35-0.40/0.33-0.45 (0.35) and 1.65-1.84/1.59-1.88 (1.84). Rostrum length 1.33-1.51/1.57-1.88 (1.53); lengths of segments I, II and III 0.22-0.27/0.30-0.34 (0.26), 0.39-0.47/0.47-0.52 (0.42) and 0.72-0.77/0.80-0.91

(0.75). Pronotum length 2.70-3.00/3.05-3.25 (2.70); width across humeri 0.63-0.75/0.63-0.72 (0.67). Hemelytron length 5.80-6.24/4.43-5.17(6.00). Lengths of femur, tibia and tarsus of foreleg 3.97-4.68/5.00-5.47 (4.07), 2.22-2.73/2.85-3.07 (2.35) and 0.42-0.48/0.48-0.55 (0.42); of midleg 7.25-8.40/9.40-10.15 (7.60), 10.10-11.15/12.40-13.30 (10.40) and 0.34-0.35/0.35-0.37 (0.34); of hindleg 10.15-11.65/12.60-13.60 (10.35), 14.80-16.20/17.60-19.00 (15.00) and 0.37-0.39/0.42-0.44 (0.39), respectively. Abdomen length 7.20-8.30/9.15-10.00 (7.47).

#### Distribution

Japan: Ryūkyū Islands (Ishigaki-jima Island, Iriomote-jima Island, Yonaguni-jima Island).

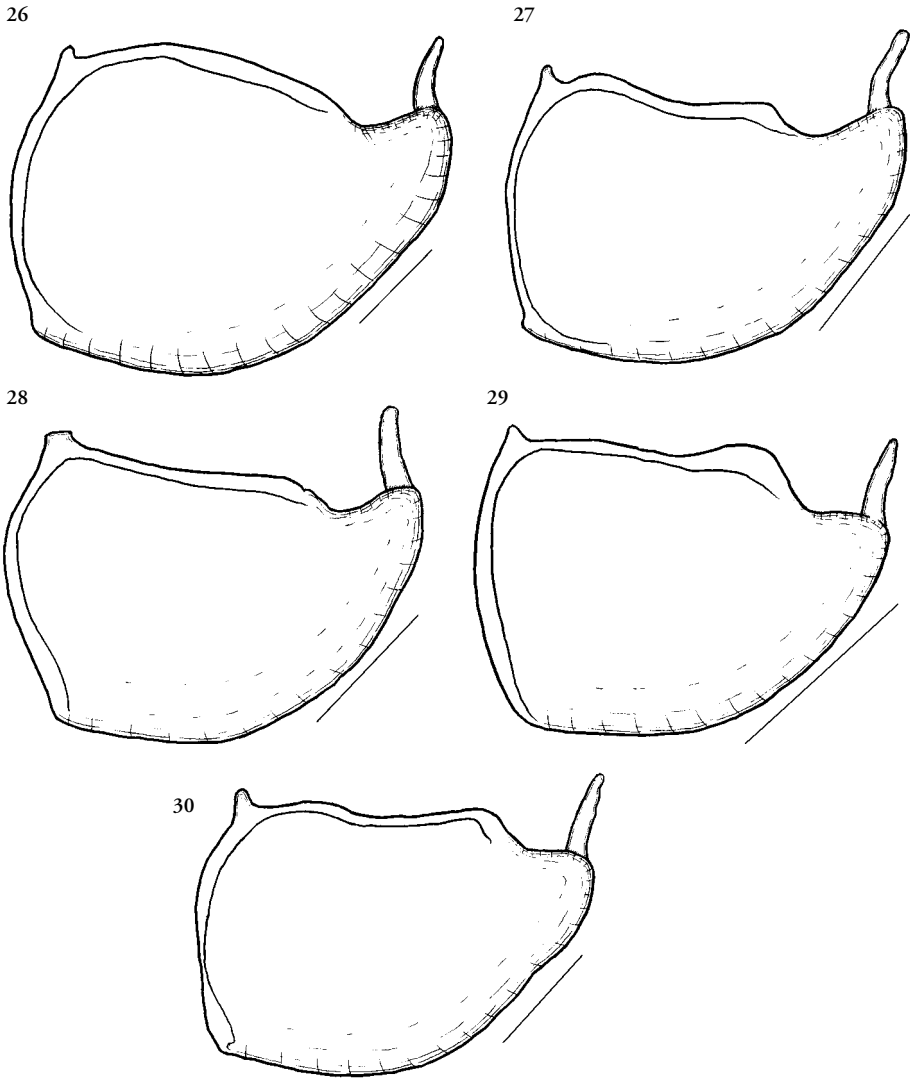
#### Etymology

From Latin, *albiannulata*, referring to the pale annulation on the fore femora; an adjective.

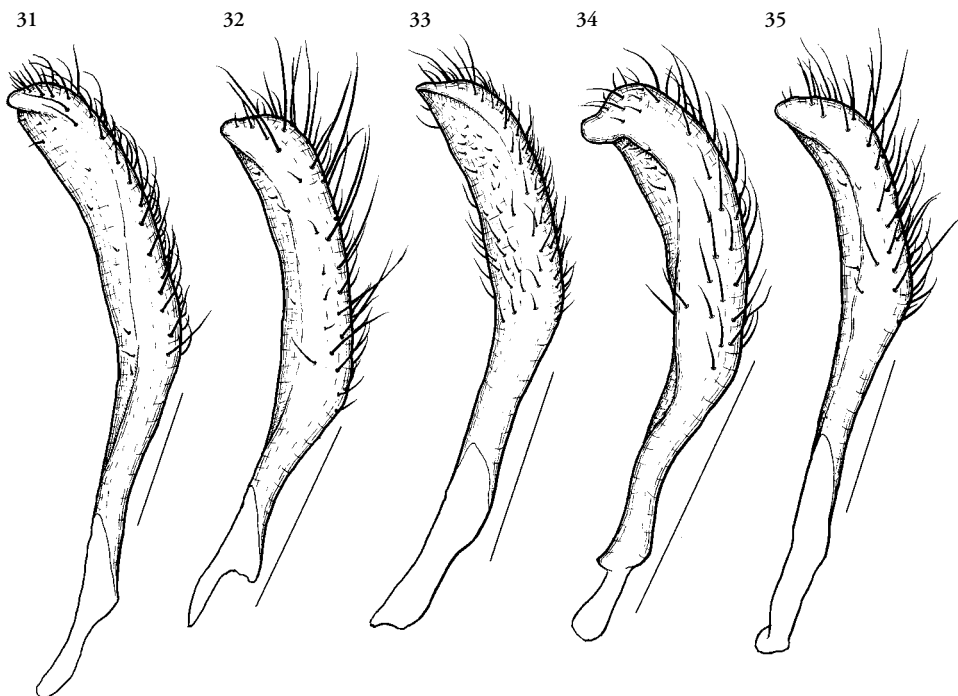
#### Remarks

This species resembles *Gardena brevicollis* Stål, 1871, in general appearance. However, it is separable from the latter (its characters given in parentheses) by the dark brown to blackish body (yellowish brown to brown body), the struts of the phallus strongly





Figs. 26-30. Pygophore, lateral view (setae omitted). – 26, *G. melinarthrum*; 27, *G. brevicollis*; 28, *G. albiannulata* sp. n.; 29, *G. muscipata*; 30, *G. boninensis* sp. n. Scales: 0.3 mm.



Figs. 31-35. Left paramere, dorsal view. – 31, *G. melinarthrum*; 32, *G. brevicollis*; 33, *G. albiannulata* sp. n.; 34, *G. muscicapa*; 35, *G. boninensis* sp. n. Scales: 0.2 mm.

thickened basally in lateral view (fig. 38) (struts moderately thickened at the base and basal one-fourth, fig. 37), and the deeply incised anterior margin of female styloides (fig. 49) (gently concave anterior margin of female styloides, fig. 46). This new species is also similar to *Gardena muscicapa* (Bergroth, 1906) (its characters given in parentheses) in general habitus, but can be distinguished by body usually 12.0-15.5 mm long (body usually 9.5-11.0 mm long), the anterior pronotal lobe distinctly longer than the head (fig. 10) (anterior pronotal lobe as long as head, fig. 12), and fore femora with a subapical pale annulation (fig. 18) (fore femora without pale annulation, fig. 19).

This species inhabits relatively dry grasslands composed mainly of *Miscanthus* spp. and *Imperata cylindrica* (Poaceae), and was collected simultaneously with *G. brevicollis* on the low parts of the plants.

*Gardena muscicapa* (Bergroth)  
(figs. 4, 12, 13, 19, 24, 29, 34, 39, 50-52)

*Luteovopsis muscicapa* Bergroth, 1906: 311 (n. sp.). Type locality: Borneo. Type depository: United States National

Museum of Natural History, Washington, D.C.

*Gardena polita* Miller, 1941: 779 (syn. Wygodzinsky, 1966: 264). Type locality: Selangor, Malaysia. Type depository: Museum of Natural History, London.

*Gardena chinai* Wygodzinsky, 1952: 155 (syn. Wygodzinsky, 1966: 264). Type locality: South Africa. Type depository: Museum of Natural History, London.

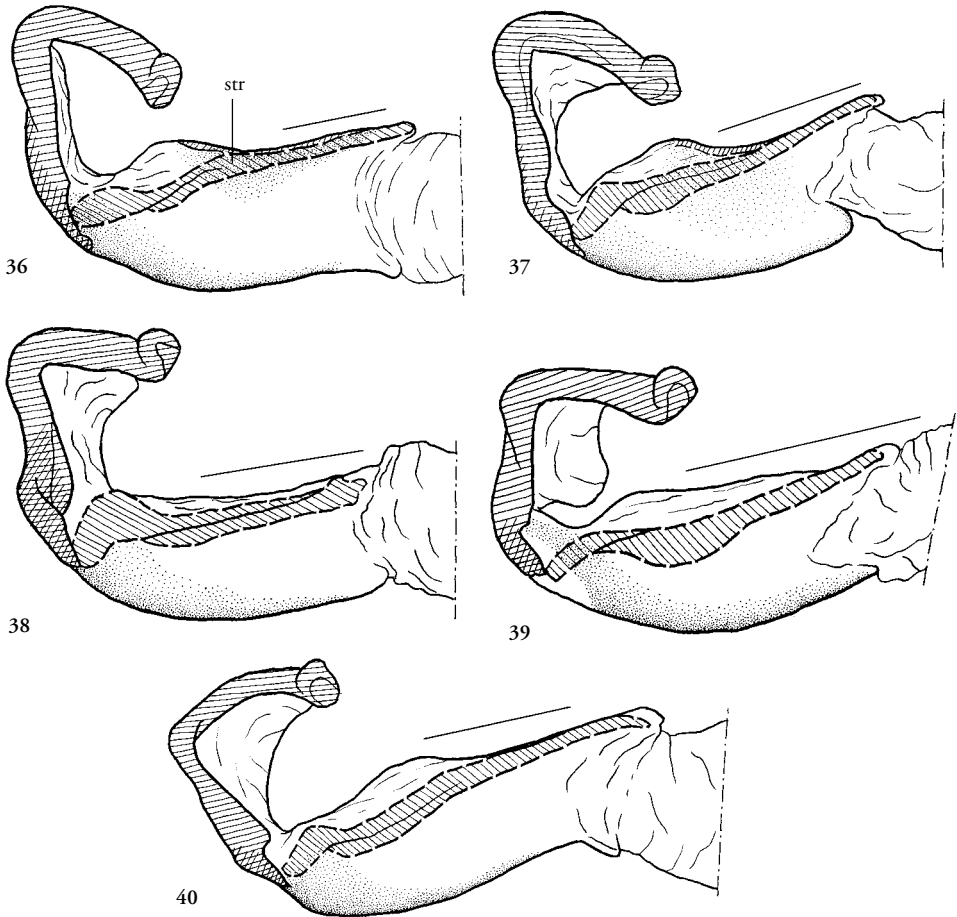
*Gardena muscicapa*: Wygodzinsky, 1958: 335 (n. comb.).

*Gardena kivuensis* Villiers, 1958: 277 (syn. Villiers, 1982: 30). Type locality: Zaire. Type depository: Musée Royal de l'Afrique Centrale, Tervuren.

*Gardena etiennei* Villiers, 1976: 205 (syn. Villiers, 1982: 30). Type locality: Réunion. Type depository: Muséum National d'Histoire Naturelle, Paris.

### Diagnosis

Easily recognized by the blackish body, the pronotum twice as long as the head and having a narrow but distinct transverse sulcus at the border of the anterior and posterior lobes (figs. 12, 13), the unspined basal portion of the fore femur 0.11 times as long as the whole length of the fore femur (fig. 19), the foretibia 0.63 times as long as the fore femur (fig. 19), the outer claw of the foreleg with four triangular ventral projections (fig. 24), the struts of the phallus thinned at the basal portion in lateral view (fig. 39), and the



Figs. 36-40. Phallus, left-lateral view (most of endosoma omitted). - 36, *G. melinarthrum*; 37, *G. brevicollis*; 38, *G. albiannulata* sp. n.; 39, *G. muscipapa*; 40, *G. boninensis* sp. n. Scales: 0.3 mm. Abbreviation: *str* = struts.

female styloides with gently concave anterior and posterior margins (fig. 52). Body length 9.5-11.0 mm.

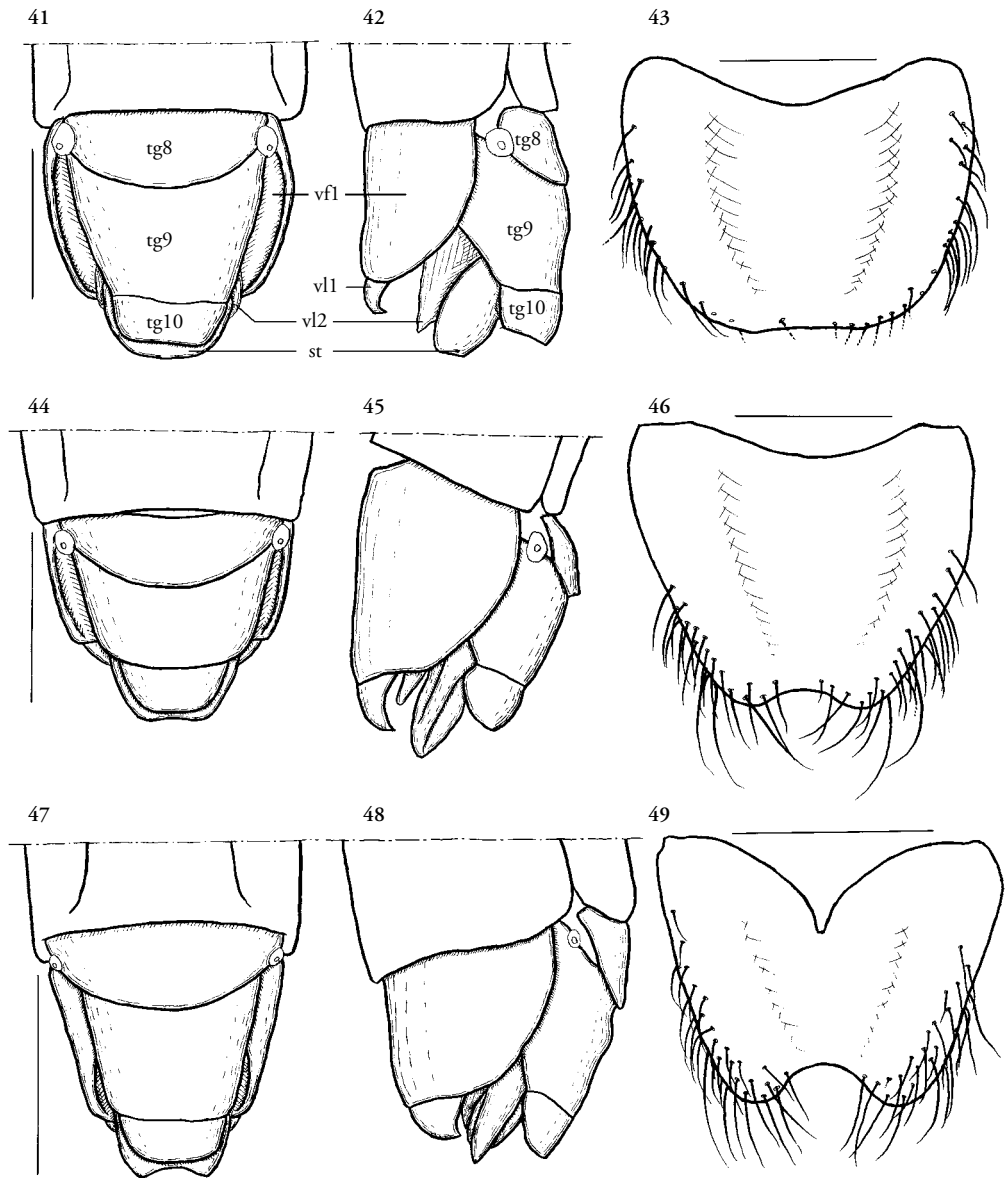
**Description of genitalia**

Male. - Pygophore (fig. 29) evenly expanded ventrally in lateral view, with posterior process; posterior process (fig. 29) erect, almost straight, weakly tapering, obtuse at apex. Parameres (fig. 34) gently curved inwards, rounded at apex, with erect and suberect setae; longest setae as long as maximum width of paramere. Phallosoma of phallus (fig. 39) sclerotized on ventral surface; struts (fig. 39) thinned at basal part and thickened at around basal one-third in lateral view.

Female. - Posterior margin of abdominal tergite VIII arcuate posteriorly (fig. 50). Tergite IX about 1.2 times as long as tergite VIII (fig. 50). Valvifers I (fig. 51) large; valvulae I (fig. 51) curved inwards, acute at apex. Styloides (fig. 52) discally elevated, carinate ventrally along meson, covered with erect setae along and near lateral margins in apical two-thirds, and with gently concave anterior and posterior margins.

**Distribution**

Japan: Honshû, Shikoku, Kyûshû, Izu Islands (Hachijô-jima Island), Ryûkyû Islands (Ishigaki-jima Island, Iriomote-jima Island, Yonaguni-jima Island);



Figs. 41-49. Female genital segments, dorsal (41, 44, 47) & left-lateral (42, 45, 48) views (setae omitted) & styloides (43, 46, 49), dorsal view. – 41-43, *G. melinarthrum*; 44-46, *G. brevicollis*; 47-49, *G. albiannulata* sp. n. Scales: 0.5 mm for 41, 42, 44, 45, 47, 48, 0.2 mm for 43, 46, 49. Abbreviations: *st* = styloides; *tg8* = tergite VIII; *tg9* = tergite IX; *tg10* = tergite X; *vfl* = valvifer I; *vl1* = valvula I; *vl2* = valvula II.

Philippines, Sumatra, Borneo, New Guinea, Uganda. This species is probably distributed widely over tropical Africa and tropical Asia.

### Remarks

This species was collected from similar grasslands to the habitat of *G. brevicollis* and *G. albiannulata*, and was more abundant in moist habitats with such vegetation as sedges and other lower plants.

Material examined. – JAPAN: Honshū: Toyama-ken: Ōyama-rindō, Yatsuno-chō: 1♂ 1♀, 22.ix.2000, SN (TUA); Chiba-ken: Ichihara-shi: 1♀, 11.x.2000, TK (TUA); Yamaguchi-ken: Oji, Shimonoseki-shi: 1♂, 3.x.1999, KO (TUA). – Shikoku: Ehime-ken: Wakayama, Omogo-mura: 1♂, 18.viii.2001, SY (ELEU). – Kyūshū: Fukuoka-ken: Chikuzen: 1♂, 9.xi.1957, SM, with labels “*Gardena muscipala* (Bergroth) det. Wygodzinsky” and “3” (ELKU); Saga-ken: Tōsen-zan, Shioda-chō: 1♂, 18.vii.1998, KM (TUA); Nagasaki-ken: Taka-dake, Isahaya-shi: 1♀, 4.x.2001, KY (TUA). – Izu Islands: Yasaki, Mitsune, Hachijō-jima Is.: 1♂ 1♀, 4.vii.2001, TI (TUA); 1♂ 1♀, 6.vii.2001, TI (TUA). – Ryūkyū Islands: Ishigaki-jima Is.: Fukaiomoto: 1♂ (shown in figs. 12, 13) 2♀, 16.vi.2002, TI (TUA); Ōzato: 1♂ 1♀, 15.vi.2002, TI (TUA); 1♂, 4.v.2004, TI (TUA); 1♂ 1♀, 4-5.v.2004, TI (TUA); Takeda-rindō: 1♂, 15.vi.2002, TI (TUA); Iriomote-jima Is.: Komi: 1♂ (shown in figs. 29, 34, 39), 2.iii.2002, SN (TUA); 1♂, 2.iii.2002, TI (TUA); 1♂, 9.vi.2002, T. Tsuru (TUA); 3♂ 3♀, 11.vi.2002, TI (TUA); 1♀, 4.vi.2003, TI (TUA); 1♂ (shown in fig. 4) 3♀, 5.vi.2003, TI (TUA); Shirahama-rindō: 1♀ (shown in figs. 50-52), 1.iii.2002, TI (TUA); 1♂ 3♀, 8.vi.2002, TI (TUA); 1♂ 2♀, 3.vi.2003, TI (TUA); 1♂ 1♀ (shown in fig. 19), 3.vi.2003, T. Osafune (TUA); Urauchi: 1♂, 21.vi.1998, TI (TUA); 1♀, 30.v.2000, TI (TUA); Yonaguni-jima Is.: Kubura-dake: 1♀, 28.v.2003, TI (TUA); 2♂ 2♀, 29.v.2003, TI (TUA); 2♂, 1.vi.2003, TI (TUA); Tarumai: 2♂ (one shown in fig. 24) 1♀, 20.v.2000, TI (TUA); 2♀, 20.v.2000, by light trap, TI (TUA).

### *Gardena boninensis* sp. n.

(figs. 5, 14, 15, 20, 25, 30, 35, 40, 53-55)

Type material. – Holotype ♂ (type no. TUA-HE-200406), JAPAN: Kita-kō - Ōsawa-kaigan, Haha-jima Island, Ogasawara Islands, Japan, 1.vii.2003, KM (TUA). – Paratypes: JAPAN: same data as for holotype: 8♂ (one shown in figs. 25, 30, 35, 40) 5♀ (one shown in figs. 53-55) (TUA); Mikazuki-yama, Chichi-jima Is.: 1♂, 3.iv.2004, TI (TUA).

### Diagnosis

Recognized by the dark brown body, the collar-shaped posterior pronotal lobe (figs. 14, 15), the unspined basal portion of the fore femur 0.17 times as long as the whole length of the fore femur (fig. 20), the outer claw of the foreleg with three triangular ventral projections (fig. 25), the slender struts of the phallus in lateral view (fig. 40), and the female styloides covered with setae in the posterior half (fig. 55). Body length 10.4-12.5 mm.

### Description

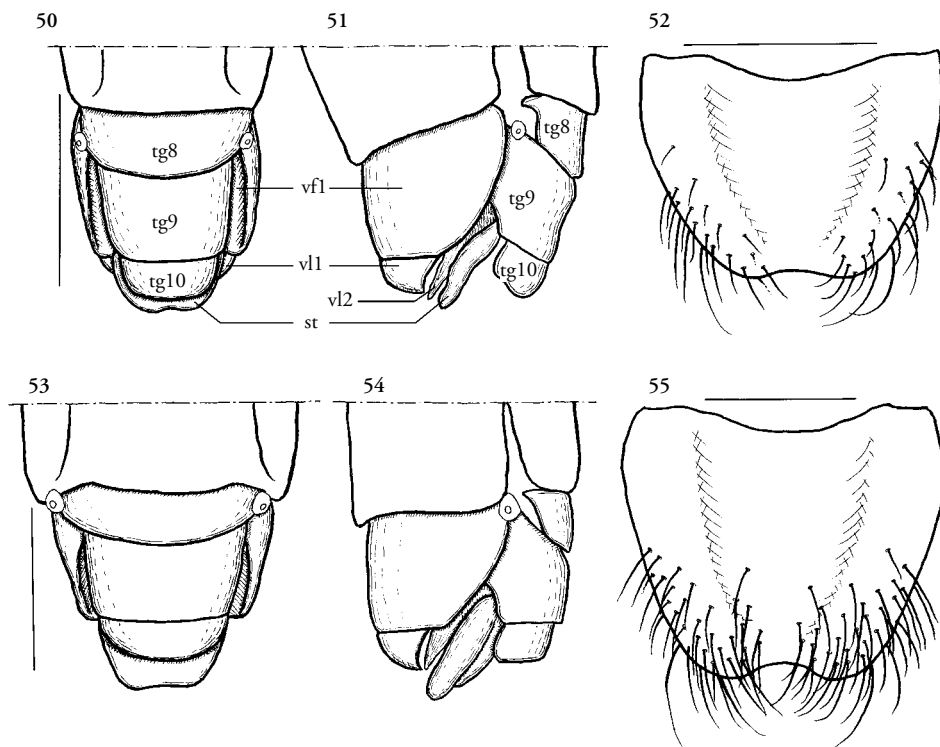
Apterous male. – Coloration: body generally brown to dark brown. Antennae dark brown, with extreme base of segment I pale. Rostrum yellowish brown. Pronotum dark brown, somewhat pale along meson. Fore coxae dark brown, with apical parts yellowish brown; femora and tibiae of forelegs yellowish brown with basal and apical parts brown; fore tarsi yellowish brown on segment I and brown on segments II and III. Mid and hindlegs brown; femur with dark annulation adjacent to pale subapical part; tibia dark annulation adjacent to pale subbasal part. Abdomen dark brown, with lateral margins brownish yellow.

Structure. – Head (figs. 14, 15) 2.1 times as long as width across eyes, furnished with short decumbent setae; anteoculus about 0.85 times as long as postoculus. Eye (figs. 14, 15) moderately large, prominent laterad, 0.34 times as wide as interocular space in dorsal view. Antennal segment I covered with short decumbent setae intermixed with long erect setae; longest setae about 3 times as long as width of segment I medially; segments II to IV with short, suberect and decumbent setae; proportion of segments I to IV 19: 16: 1: 7. Rostral segments I and II covered with short, curved and suberect setae; segment III sparsely furnished with short suberect setae; proportion of segments I to III 5: 9: 14.

Pronotum (figs. 14, 15) 1.1 times as long as head, 2.5 times as long as maximum width of posterior lobe, covered with short, suberect and decumbent setae, and with distinct transverse sulcus at border of anterior and posterior lobes; anterior lobe about 4 times as long as posterior lobe, twice as long as its maximum width; posterior lobe collar-shaped, covering only anterior part of mesonotum, with slightly convex posterior margin.

Forelegs (fig. 20) densely furnished with short, suberect and decumbent setae; coxa about 10 times as long as its maximum width; femur 1.7 times as long as coxa, about 13.5 times as long as its maximum width, with posteroventral series of 4 large, about 8 medium-sized and about 50 small and slender spiniferous tubercles; unspined basal portion of fore femur 0.17 times as long as whole length of fore femur; tibia 0.58 times as long as femur, with about 50 peg-like projections; tarsus 0.22 times as long as tibia; outer claw (fig. 25) with 3 triangular ventral projections.

Abdomen elongate elliptic, furnished with short, suberect and decumbent setae. Pygophore (fig. 30) evenly expanded ventrally in lateral view, with posterior process; posterior process (fig. 30) erect, almost straight, weakly tapering apicad, rounded at apex. Parameres (fig. 35) curved inwards, blunt at apex, with erect and suberect setae; longest setae longer



Figs. 50-55. Female genital segments, dorsal (50, 53) & left-lateral (51, 54) views (setae omitted) & styloides (52, 55), dorsal view. – 50-52, *G. muscicapa*; 53-55, *G. boninensis* sp. n. Scales: 0.5 mm for 50, 51, 53, 54, 0.2 mm for 52, 55. Abbreviations: *st* = styloides; *tg8* = tergite VIII; *tg9* = tergite IX; *tg10* = tergite X; *vfl* = valvifer I; *vl1* = valvula I; *vl2* = valvula II.

than maximum width of paramere. Phallosoma of phallus (fig. 40) ventrally sclerotized; struts (fig. 40) slender throughout in lateral view.

Apterous female. – Almost the same in general habitus as male. Head 1.2 times as long as pronotum. Eye 0.3 times as wide as interocular space in dorsal view. Antennal segment I furnished with short suberect setae only. Posterior margin of abdominal tergite VIII arcuate posteriorly (fig. 53). Tergite IX 1.5 times as long as tergite VIII (fig. 53). Valvifers I (fig. 54) large; valvulae I (fig. 54) broad, curved inwards, acute at apex. Styloides (fig. 55) discally elevated, carinate ventrally along meson, covered with erect setae in posterior half, and with concave anterior and posterior margins.

Winged form: unknown.

Measurements. – ♂/♀ (holotype in parentheses): body length 10.4-10.9/12.3-12.5 (10.8). Head length including neck 1.40-1.53/1.56-1.62 (1.53); width across eyes 0.71-0.73/0.74-0.77 (0.73);

interocular space 0.40-0.43/0.44-0.45 (0.43). Antenna length 13.32-13.83/13.47-14.15 (13.69); lengths of segments I, II, III and IV 5.90-6.07/6.00-6.24 (6.07), 5.06-5.24/5.00-5.37 (5.10), 0.30-0.32/0.31-0.33 (0.32) and 2.06-2.20/2.16-2.21 (2.20). Rostrum length 1.47-1.56/1.64-1.73 (1.54); lengths of segments I, II and III 0.24-0.28/0.27-0.28 (0.28), 0.49-0.51/0.53-0.57 (0.51) and 0.74-0.77/0.84-0.88 (0.75). Pronotum length 1.68-1.81/1.83-1.99 (1.68); maximum width of posterior lobe 0.57-0.59/0.60-0.62 (0.58). Lengths of femur, tibia and tarsus of foreleg 4.15-4.25/4.50-4.90 (4.20), 2.40-2.49/2.78-2.87 (2.40) and 0.50-0.53/0.56-0.59 (0.53); of midleg 6.63-6.90/6.80-7.27 (6.73), 8.55-9.65/9.60-10.10 (9.53) and 0.37-0.47/0.46-0.53 (0.47); of hindleg 8.50-9.30/9.05-9.85 (9.05), 12.80-13.50/13.00-14.20 (12.80) and 0.46-0.51/0.49-0.58 (0.51), respectively. Abdomen length 5.93-6.23/7.13-7.44 (5.93).

**Distribution**

Japan: Ogasawara Islands (Chichi-jima Island, Haha-jima Island). This species is endemic to the islands.

**Etymology**

Derived from the type locality, the Bonin Islands (another name of the Ogasawara Islands); an adjective.

**Remarks**

This new species is very similar to *Gardena catenaria* Wygodzinsky & Usinger, 1960 from the Caroline Islands, in its general appearance. However, the present new species (characters given in parentheses) can be distinguished by the pronotum being 1.1 to 1.2 times as long as the head (fig. 14) (pronotum about 1.9 times as long as head), the slightly convex posterior margin of the pronotum (fig. 14) (strongly convex posterior margin of pronotum), the unspined basal portion of the fore femur 0.17 times as long as the whole length of the fore femur (fig. 20) (unspined basal portion of fore femur 0.28 times as long as whole length of fore femur), and the outer claw of the foreleg with three triangular ventral projections (fig. 25) (outer claw of foreleg with four triangular ventral projections).

According to Mr. K. Matsumoto (pers. comm.), the species was found at night on the ground of moist habitats covered with mosses in Haha-jima Island. A male specimen from Chichi-jima Island was collected from vegetation with monocots and ferns.

**KEY TO THE JAPANESE SPECIES OF GARDENA**

1. Pronotum more than 2.5 times as long as head, without transverse sulcus at border of anterior and posterior lobes; unspined basal portion of fore femur more than 0.30 times as long as whole length of fore femur..... *G. melinarthrum* Dohrn
  - Pronotum less than 2.2 times as long as head, with distinct transverse sulcus at border of anterior and posterior lobes; unspined basal portion of fore femur less than 0.27 times as long as whole length of fore femur.....2
2. Pronotum 1.1 to 1.2 times as long as head; posterior pronotal lobe poorly developed, collar-shaped; outer claws of forelegs with three triangular ventral projections..... *G. boninensis* sp. n.
  - Pronotum twice as long as head; posterior pronotal lobe well developed, covering most part of mesonotum; outer claws of forelegs with four triangular ventral projections .....3
3. Body small, about 10 mm; unspined basal portion of fore femur less than 0.15 times as long as whole length of fore femur .....
  - ..... *G. muscicap* (Bergroth)

- Body larger, usually more than 12 mm; unspined basal portion of fore femur more than 0.23 times as long as whole length of fore femur .....4
4. Body yellowish brown to brown; posterior pronotal lobe without a pair of dark longitudinal stripes..... *G. brevicollis* Stål
    - Body dark brown to blackish; posterior pronotal lobe with a pair of dark longitudinal stripes.....
      - ..... *G. albiannulata* sp. n.

**ACKNOWLEDGMENTS**

I am much indebted to the following persons for kindly providing the material used in this study: S. Miyamoto (Fukuoka), J. Yukawa (Fukuoka), N. Ohbayashi (ELEU), M. Sakai (ELEU), M. Tomokuni (NSMT), M. Takai (Kôchi), T. Befu (Kôchi), S. Kamitani (ELKU), K. Ohgi (Yamaguchi), T. Kishimoto (Japan Wildlife Research Center), K. Matsumoto (Kagawa), H. Yoshitomi (Bioindicator Co., Ltd.), S. Yano (OMM), H. Mizushima (TUA), H. Yoshitake (ELKU), K. Yamada (Osaka Prefecture University), T. Shimada (Oki Natural Museum), S. Nagashima (Okayama University), T. Tsuru (TUA) and T. Osafune (TUA). My thanks are also due to B. Kranz (University of Adelaide) and an anonymous referee for reviewing the manuscript with useful comments and suggestions.

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Received: 5 October 2004

Accepted: 21 February 2005