

Revision of the East Asian *Plagiophorus hispidus* species group (Coleoptera: Staphylinidae, Pselaphinae, Cyathigerini)¹

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Abstract—The *hispidus* species group is formed for four new species from East Asia of the genus *Plagiophorus* Motschulsky: *P. hispidus* **sp. nov.**, *P. hlavaci* **sp. nov.**, *P. serratus* **sp. nov.**, and *P. grandoculatus* **sp. nov.** Uncoated specimens were examined using field-emission scanning electron microscopy, and micrographs of the holotypes are presented. Keys to the species groups of the genus occurring in East Asia and to the species of the *hispidus* group are given. The *hispidus* group is probably monophyletic, having peculiar spinous setae on the male metasternum. The chaetotaxy of the labrum and clypeus is useful for distinguishing species of *Plagiophorus*.

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Résumé—Le groupe d'espèces de *hispidus* du genre *Plagiophorus* Motschulsky réunit quatre espèces nouvelles récoltées en Asie de l'Est : *P. hispidus* **sp. nov.**, *P. hlavaci* **sp. nov.**, *P. serratus* **sp. nov.** et *P. grandoculatus* **sp. nov.** Les spécimens ont été examinés au microscope électronique à balayage à émission de champs et on trouvera ici des microphotographies des holotypes. Des clefs d'identification permettent de distinguer les différents groupes d'espèces du genre présents en Asie de l'Est, de même que les espèces du groupe de *hispidus*. Le groupe de *hispidus* est probablement monophylétique, car les mâles possèdent des soies épineuses particulières sur le métasternum. La chétotaxie du labre et du clypéus est utile pour distinguer les espèces de *Plagiophorus*.

[Traduit par la Rédaction]

Introduction

Plagiophorus (Coleoptera: Staphylinidae, Pselaphinae, Cyathigerini) is a morphologically diverse genus, being especially variable in the number of antennomeres (6–11) and exhibiting remarkable sexual dimorphism. Species of the *P. hispidus* species group, which we deal with in this study, apparently have only 7 antennomeres (Figs. 3E, 5E,

¹ First part of revision of the East Asian genus *Plagiophorus*.

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7E, 9E) and possess several secondary sexual characters such as the excavated club in males (Figs. 3E, 3F, 5E, 5F, 7E, 7F, 7G, 9E, 9F, 9G) and spinous setae on the metasternum of males (Figs. 4A, 4B, 6A, 6B, 8A, 8B, 10A, 10B). The functional significance of such secondary sexual characters is unclear because the bionomics of the beetles is poorly known. Beetles of this genus are usually found in leaf litter or under bark and are occasionally associated with ants.

There are 84 described species of *Plagiophorus* from the Oriental region (including China, Japan, and Korea), the Afrotropical region, and the Australasian region (including New Guinea and the Solomon Islands). According to Burckhardt and Löbl (2002), these beetles are abundant and species rich in the Oriental region, where there may be 400 species. Phylogenetic relationships among species in the genus have not been studied.

During the course of our study of material from East Asia, we have recognized seven species groups in the genus based mainly on the states of the following characters: (i) structure of the ventral surface of the maxillary palpomere III (Fig. 2D, mpIII), (ii) form of the antennal club of the male (Figs. 3E, 3F, 5E, 5F, 7E, 7F, 7G, 9E, 9F, 9G), (iii) structure of the metasternum of the male (Figs. 4A, 4B, 6A, 6B, 8A, 8B, 10A, 10B), and (vi) presence or absence of a denticle on the pro- and meso-tibiae of the male (Figs. 2F, 2G). Characters i, iii, and vi are secondary sexual characters. The four characters are useful for systematic studies of the genus because the combination of character states is stable within each species group.

The objectives of the present study were to (i) provide a key to the species groups of the genus present in East Asia, (ii) define the *P. hispidus* species group in East Asia, and (iii) describe four species of the *hispidus* group and present a key to the species.

Historical review

The genus *Plagiophorus* was established for two species of Pselaphinae from "Indes orientales" by Motschulsky (1851). The genus had been merely mentioned in catalogues (Raffray 1904, 1908, 1911; Newton and Chandler 1989) and left unrevised until Burckhardt and Löbl (2002) examined the type species. Raffray (1904, 1908, 1911) erroneously regarded the genus as a synonym of the genus *Sathytes* Westwood, 1870, which belongs to the tribe Batrisini. Newton and Chandler (1989) designated *P. paradoxus* as the type species of *Plagiophorus* and included the genus in the tribe Batrisini.

King (1865) established the genus *Cyathiger* based on a species from Australia. Subsequently, 48 species were described in *Cyathiger*. The tribe Cyathigerini was established to accept this genus by Schaufuss (1872).

Jeannel (1951) divided the genus *Cyathiger* into four genera, viz. *Cyathiger* King, *Paracyathiger* Jeannel, *Denicyathiger* Jeannel, and *Cyathigerodes* Jeannel, on the basis of the following characters: (i) number of antennomeres and form of the antennal club, (ii) form of the male genitalia, and (iii) width of the frontal rostrum. Later, Jeannel (1961) described the genus *Manuleiger* from Sri Lanka. Jeannel (1952, 1953, 1954, 1956, 1957, 1959, 1960), Löbl (1964), Leleup (1974, 1975), and Nomura (1989) followed Jeannel's (1951) classification of the tribe Cyathigerini. On the other hand, Burckhardt (1985) and Chandler (1986) criticized Jeannel's classification. Burckhardt (1985, 1988a, 1988b), by implication, treated Cyathigerini as including only one genus, *Cyathiger*.

Recently, Burckhardt and Löbl (2002) redescribed *P. paradoxus*, the type species of *Plagiophorus*, and transferred *Plagiophorus* from the tribe Batrisini to the tribe Cyathigerini. They regarded Jeannel's (1951) system as superficial and synonymized

the five genera (*Cyathiger*, *Paracyathiger*, *Denicyathiger*, *Cyathigerodes*, and *Manuleiger*) with *Plagiophorus*. Thus, *Plagiophorus* is now the only remaining genus in the tribe Cyathigerini.

In East Asia, only two species of the genus have been described: *P. fujiyamai* (Kubota, 1944) from Japan and *P. matousheki* (Löbl, 1964) from China. Nomura (1989) gave descriptions of both species from Japan; however, the species that he referred to as *P. matousheki* was misidentified. It is a previously undescribed species, which is described below as *P. hispidus*.

Materials and methods

Repository abbreviations

IZCAS	Institute of Zoology, Chinese Academy of Sciences, Beijing, China
MHNG	Muséum d'Histoire Naturelle, Genève, Switzerland
NHMB	Naturhistorisches Museum, Basel, Switzerland
NMNS	National Museum of Natural Science, Taichung, Taiwan
NSMT	National Science Museum (Natural History), Tokyo, Japan
SEHU	Systematic Entomology, Hokkaido University, Sapporo, Japan
chs	Private collection of H Sugaya, Hokkaido University, Sapporo, Japan

Methods of examination

We examined specimens mainly by field-emission scanning electron microscopy (FESEM, JEOL JSM-6301F). The specimens were not coated and were digital-micrographed from various angles. We compiled the FESEM micrographs and measured body parts using Adobe Photoshop®. Measurements of body length and width were made with a stereo microscope (Olympus SZ40). Scale bars in all figures are in micrometres.

For FESEM observations, specimens were washed in an ultrasonic cleaner using 30% ammonia for about 10 s, heated in 90% lactic acid at 60 °C for about 30 min, soaked in 30% hydrogen peroxide for about 5 min, and rinsed in absolute ethanol for >2 min. The SEM was set with a working distance of 39 mm and an accelerating voltage of 0.7–1.0 kV.

Terminology

The terminology adopted in the present study mostly follows Chandler (2001). Abbreviations employed herein are as follows: TL, total length (HL + PL + EL + AL); HL, maximum length of head (from apical margin of frontal rostrum to posterior margin of tempora); PL, maximum length of pronotum; EL, maximum length of elytra; AL, maximum length of abdomen; HW, maximum width of head (not including eyes); FW, maximum width of frontal rostrum; PW, maximum width of pronotum; EW, maximum width of elytra; AW, maximum width of abdomen; dcs, distance between clypeal setae (Figs. 3C, 5C, 7C, 9C, 11); mp, median projection of labrum (Fig. 3C); ip, inside projection of labrum (Fig. 3C); op, outside projection of labrum (Fig. 3C).

Notes on sexual dimorphism

The metasternal setae may be useful for keeping the male mounted on the female during copulation. Males of the genus *Scaphidium* Olivier (Scaphidiinae) have long setae forming a patch on the mesal area of the metasternum. Observation of copulating

pairs has suggested that these setae are used to keep the male body in a stable position on the convex dorsum of the female. Similar setae occur on other Scaphidiinae genera such as *Euscaphidium* Achard, *Cerambyciscapha* Pic, and *Diatelium* Pascoe (Leschen and Löbl 1995), which also have plump bodies like the genus *Plagiophorus*.

Some species groups of the genus *Plagiophorus*, including the *hispidus* group, exhibit remarkable sexual dimorphism in the antennal club, which is broadly excavated on the dorsal side in the male. During copulation, the pair might be held together by insertion of the female antennal club into the male excavation (Raffray 1908). In fact, in all species observed, the female club fits easily into the excavation of the male club. Such an exact agreement in size cannot be coincidental, and the hypothesis should be tested.

Chaetotaxy of labrum and clypeus

Sawada (1972) introduced labral chaetotaxy into one classification of the subfamily Aleocharinae and demonstrated that it is useful for identifying species including both of the sexes and local forms. Recently, Ohishi (2001) also suggested the usefulness of the labral chaetotaxy in the classification of the Pselaphinae, though he made no mention of infraspecific variation. Our study of the genus *Plagiophorus* shows that the labral chaetotaxy and the distance between the clypeal setae are useful for identifying species, sexes, and local forms in this genus. Our examinations have revealed that the combined chaetotaxy of the labrum and clypeus is useful in recognizing species in many Pselaphinae genera such as *Nipponozetus* Coulon, *Philoscotus* Sawada, *Bryaxis* Kugelann, *Triomicrus* Sharp, *Tribasodes* Jeannel, *Batrisceniola* Jeannel, *Pselaphogenius* Reitter, *Hirashimanymus* Nomura, *Apharinodes* Raffray, and *Lasinus* Sharp.

The usefulness of the chaetotaxy of the labrum and clypeus in the genus *Plagiophorus* is documented here for the first time. The two characters used are the distances between the three principal setae (*a*, *b*, *c*) of the labrum, which form a triangle (the setal triangle), and the distance between the two setae on the clypeus (*dcs*) (Figs. 3C, 5C, 7C, 9C, 11). After examination of species representing all the species groups recognized in our study, we found that the relative position of these setae were useful in distinguishing species. In *P. hispidus*, these characters vary slightly between the sexes and between the islands (Ishigaki Shima and Iriomote Jima) (Fig. 11). In particular, the female specimens from Iriomote Jima (Fig. 11D) are somewhat different from the others (Figs. 11A–11C); *dcs* is shorter and principal seta *b* is located more apically than *c*. These differences, however, are much smaller than those between other species.

Systematics

Genus *Plagiophorus* Motschulsky, 1851

Plagiophorus Motschulsky, 1851: 496. Newton and Chandler, 1989: 39.

Type species: *Plagiophorus paradoxus* Motschulsky, by subsequent designation. *Cyathiger* King, 1865: 173. Burckhardt and Löbl, 2002: 400 (as junior synonym of *Plagiophorus* Motschulsky).

Type species: *Cyathiger punctatus* King, by monotypy.

Paracyathiger Jeannel, 1951: 109. Burckhardt and Löbl, 2002: 400 (as junior synonym of *Plagiophorus* Motschulsky).

Type species: *Cyathiger heterocerus* Raffray, by original designation.

Denicyathiger Jeannel, 1951: 109. Burckhardt and Löbl, 2002: 400 (as junior synonym of *Plagiophorus* Motschulsky).

Type species: *Cyathiger bironis* Raffray, by original designation.

Cyathigerodes Jeannel, 1951: 109. Burckhardt and Löbl, 2002: 400 (as junior synonym of *Plagiophorus* Motschulsky).

Type species: *Cyathigerodes machadoi* Jeannel, by original designation.

Manuleiger Jeannel, 1961: 449. Burckhardt and Löbl, 2002: 400 (as junior synonym of *Plagiophorus* Motschulsky).

Type species: *Manuleiger remyi* Jeannel, by original designation.

Diagnosis

The genus is distinguished from all other Pselaphinae genera by the combination of the following character states: (i) dorsal surface densely covered with punctures, (ii) antenna with 6–11 antennomeres, (iii) terminal antennomere much larger than each of the preceding antennomeres, (vi) 4th to 7th abdominal tergites fused to form a composite tergum, and (v) 4th to 7th abdominal sternites fused to form a composite sternum.

Remarks

The genus *Plagiophorus* is characterized by the composite tergum formed by the fused 4th to 7th abdominal tergites and the composite sternum formed by the fused 4th to 7th abdominal sternites. These autapomorphies support its monophyly.

We recognize seven species groups of East Asian species of *Plagiophorus* and have tried to assign other species to these species groups. We have found that most of the described species of the genus from other regions are assignable to one of the species groups recognized in our study.

Key to East Asian species groups of *Plagiophorus* (male)

1. Maxillary palpomere III lacking granulae on ventral surface; mesotibia with a denticle; mesofemur lacking projection 2
- Maxillary palpomere III with granulae on ventral surface; mesotibia lacking denticle; mesofemur with 1 or a few projections 6
2. Metasternal apex with a pair of sharp projections; apparently 11 antennomeres A group
- Metasternal apex lacking sharp projections; apparently 7 antennomeres 3
3. Antennal club lacking excavation; protibia each with a denticle 4
- Antennal club with an excavation; protibia with or lacking denticle 5
4. Antennomere III with 2 distinct sutures; frontal rostrum subparallel-sided; sternite IX partly visible externally *fujiyamai* group
- Antennomere III with 3 distinct sutures; frontal rostrum dilated posteriorly; sternite IX not visible externally. B group
5. Metasternum with spinous setae; inner margin of excavation of antennal club simple, lacking projection and fringe; protibia with a denticle *hispidus* group
- Metasternum lacking spinous setae; inner margin of excavation of antennal club with projection and fringe; protibia lacking denticle C group
6. Antennal club lacking distinct excavation; apparently 10 antennomeres D group
- Antennal club with a distinct excavation; apparently 7 antennomeres E group

Remarks

A group, B group, C group, D group, and E group will be named in future studies.

The *hispidus* group

Species included: *P. hispidus*, *P. hlavaci*, *P. serratus*, and *P. grandoculatus*.

Key to East Asian species of the *hispidus* group (male)

1. Frontal rostrum lacking longitudinal groove (Figs. 3A, 5A) 2
- Frontal rostrum with longitudinal groove (Figs. 7A, 9A) 3
2. Each elytron with basal fovea (Fig. 3D, arrow); eye with 2 to 4 facets (Fig. 3B, arrow); inner surface of antennal club with longitudinal stria (Fig. 3F, arrow 1) *P. hispidus*
- Each elytron with 2 basal foveae (Fig. 5D, arrows); eye with about 12 facets (Fig. 5B, arrow); inner surface of antennal club lacking longitudinal stria (Fig. 5F); antennomere III produced and angulate on inner margin, thus nearly pentagonal in profile (Fig. 5E, arrow; Fig. 5H); protibia with outer margin strongly constricted at middle (Fig. 5I, arrow) *P. hlavaci*
3. Each elytron with basal fovea (Fig. 7D, arrow); eye with about 7 facets (Fig. 7B, arrow); inner surface of antennal club with longitudinal stria (Fig. 7F, arrow); sternal carina with 4 teeth (Fig. 8D, arrow) *P. serratus*
- Each elytron with 2 basal foveae (Fig. 9D, arrows); eye reniform with about 40 facets (Fig. 9B); inner surface of antennal club lacking longitudinal stria (Fig. 9F); sternal carina with a weak tooth (Fig. 10D) *P. grandoculatus*

Diagnosis

The *hispidus* group is distinguished from the other species groups of the genus *Plagiophorus* by the combination of the following character states in the male: (i) maxillary palpomere III reticulate on ventral surface (Fig. 2D, mpIII), (ii) excavation of club lacking projection and fringe on inner margin (Figs. 3E, 5E, 7E, 9E), (iii) metasternum with 1–2 pairs of setigerous patches (Figs. 4A, 4B, 6A, 6B, 8A, 8B, 10A, 10B), and (vi) pro- and meso-tibia each with a denticle (Figs. 2F, 2G).

Description

Male and female. Body. Dark reddish brown, dorsal surface with dense punctures and short and flattened setae (Figs. 1, 2A). **Head** (Figs. 2B, 2C, 3A, 3B, 5A, 5B, 7A, 7B, 9A, 9B). Frontal rostrum narrower than postgena; clypeus with pair of setae (Figs. 3C, 5C, 7C, 9C); gena well expanded, with obtuse anterolateral corner; vertexal fovea small, situated posterior to middle; postgena broad and rounded; eye situated before vertexal fovea; ocular–mandibular carina weak (Fig. 2B, omc); ventrolateral margin not carinate (Fig. 2B, vm); gula with blunt median gular spine (Fig. 2C, mgs), lacking median gular carina. Labrum: 2 pairs of projections (Fig. 3C, op, ip; Figs. 5C, 7C, 9C) and 1 median projection on anterior margin (Fig. 3C, mp; Figs. 5C, 7C, 9C), with 3 distinct principal setae labelled *a*, *b*, and *c* from inside to outside (Figs. 3C, 5C, 7C, 9C, 11). Maxillary palpus (Fig. 2D): 3 segments; palpomere I dilated apically; palpomere II smallest; palpomere III (Fig. 2D, mpIII) largest and fusiform, reticulate and sparsely pubescent on ventral surface, with palpal cone. Antenna (Figs. 3E, 5E, 7E, 9E): shorter than HL + PL, twisted, thick, apparently with 7 antennomeres; antennomere I greater in length than width, weakly dilated apically; antennomere II shorter and narrower than I; antennomere III with 2 transverse sutures near base; antennomeres IV, V, and VI subequal in shape and size; antennomere VII largest, forming large club, with basal suture (Fig. 3E, bs). **Thorax.** Pronotum: longer than head, broadest at middle, with small median antebasal fovea and small lateral antebasal foveae. Prosternum: with small lateral procoxal foveae. Metasternum (Figs. 4A, 4C, 6A, 6C, 8A, 8C, 10A, 10C): with median metasternal fovea (Fig. 4A, mmtf), with depression (Figs. 4C, 6C, 8C, 10C, md) around lateral mesocoxal fovea (Figs. 4C, 6C, 8C, 10C, lmc). Elytra: each elytron with basal ridge nearly horizontal, with 1 or 2 basal fovea(e) (Figs. 3D, 5D, 7D, 9D, arrow(s)). Leg: metatibia more or less sinuate. **Abdomen.** Composite tergum (tergites IV to VII) rounded posteriorly; composite sternum (sternites IV to VII) concave

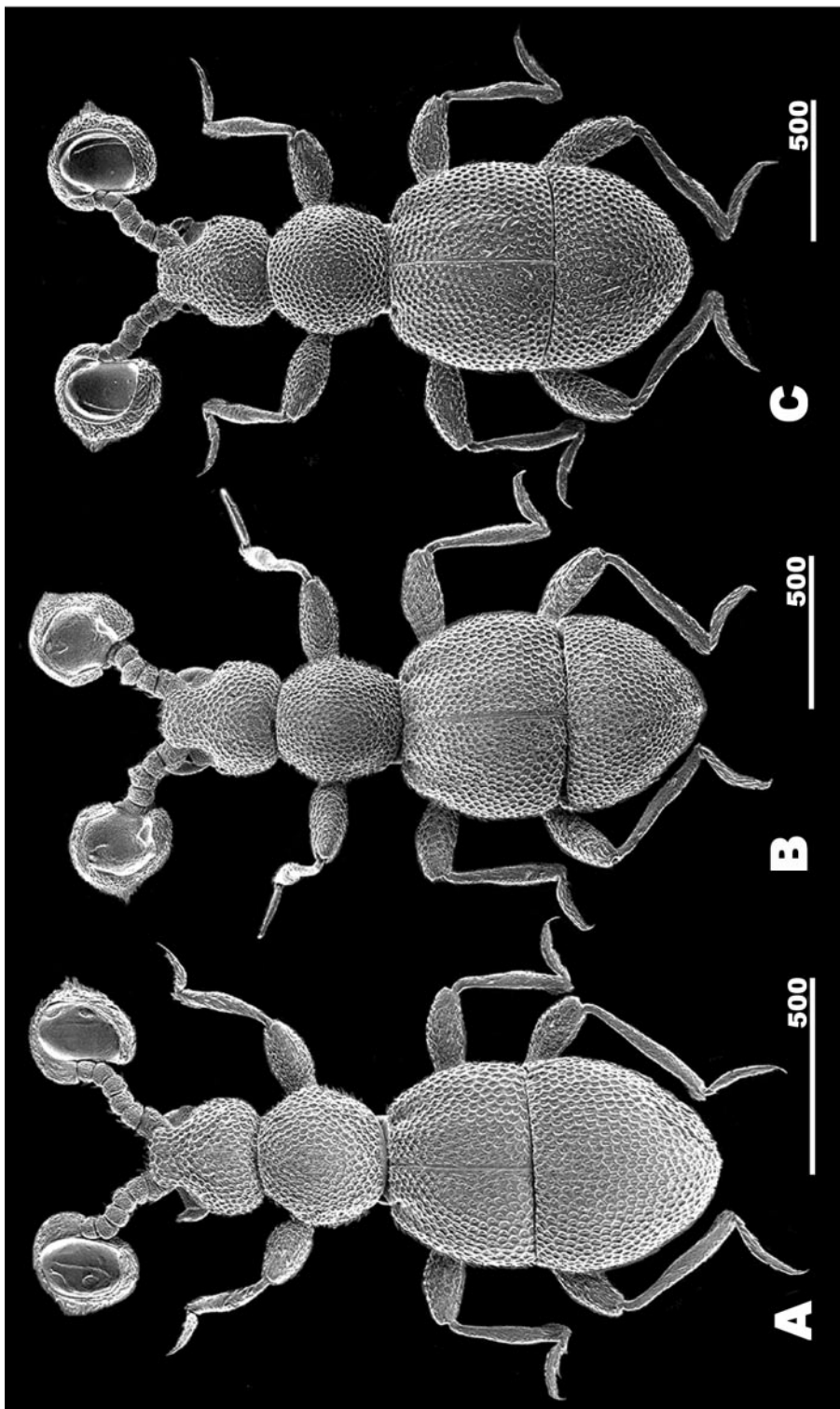


FIGURE 1. Habitus of *Plagiophorus* species of the *hispidus* group (holotypes). (A) *Plagiophorus hispidus*; (B) *P. hlavaci*; (C) *P. serratus*. Scale bars are in micrometres.

medially, with deep basal cavity; sternal carina (Fig. 2E, sc; Figs. 4D, 6D, 8D, 10D, arrow) with 1 or more teeth.

Sexual characters. Male. Antenna (Figs. 3E, 5E, 7E, 9E): antennomere VII distinctly larger than that of female; bowl-shaped; inner surface deeply excavated (Fig. 3E, is); inner margin of excavation simple, lacking projection and fringe (Fig. 3E, im). Metasternum: with 1 pair or 2 pairs of setigerous patches (Figs. 4A, 6A, 8A, 10A, sp), the setae being spinous (Figs. 4B, 6B, 8B, 10B). Leg: pro- and meso-tibia each with small apical denticle on inner margin (Figs. 2F, 2G, arrow). Abdominal composite sternum: flattened on posterior portion; tergite VIII convex in medioapical part; sternite VIII transverse, with a pair of long basal stalks; sternite IX semicircular, posterior half visible externally. Genitalia (Figs. 4E–4I, 6E–6I, 8E–8I, 10E–10I): median lobe of aedeagus consisting of basal bulb (Fig. 4F, bb), inner sclerite (Fig. 4H, is), and apical process (Fig. 4H, ap); inner sclerite arising from inside of basal bulb and apical process from outside of basal bulb. Parameres (Fig. 4F, lp, rp): asymmetrical, weakly sclerotized. **Female.** Antenna: antennomere VI larger than that of male; antennomere VII (Figs. 3G, 5G) cordiform, lacking excavation. Metasternum: lacking setigerous patches. Leg: pro- and meso-tibia lacking denticle. Abdominal composite sternum: weakly convex on posterior portion; tergite VIII triangular, weakly convex, arcuate posteromedially; sternite VIII arcuate, with semicircular internal lobe.

Remarks

The *hispidus* group is unique in having spinous setae on the male metasternum, an apomorphy shared by the species of the group, which therefore should be monophyletic.

1. *Plagiophorus hispidus* sp. nov.

(Figs. 1A, 2, 3, 4, 11, 12)

Paracyathiger matousheki: Nomura 1989: 529, nec Löbl, 1964: 297 (misidentification).

Type material

Holotype: male (Figs. 1A, 2, 3A–3F, 4). **JAPAN. The Ryukyus. Ishigaki Shima:** Omoto-dake, 300 m alt., 18–19.iii.2002, H Sugaya (SEHU). **Paratypes. Ishigaki Shima:** 1 male, same locality as holotype but 22.iii.1984, S Nomura (NSMT). 1 male, 3 females, same locality as holotype but 9.iv.1986, S Nomura (NSMT). 2 males, same data as holotype but 11.iii.1986, S Nomura (NSMT). 3 males, 1 female, same locality as holotype but 14.x.1988, M Sakai (NSMT). 2 males, 4 females, same data as holotype (cHS, NHMB). **Iriomote Jima:** 1 female, Noyashi, 19.vii.1969, K Ishikawa (MHNG). 3 males, 1 female, Komi, 15–16.iii.2002, H Sugaya (cHS, NHMB, NMNS).

Etymology

In Latin *hispidus* means setal, referring to the presence of the spinous setae on the male metasternum.

Diagnosis

This species is distinguished from the other members of the species group by the combination of the following character states in the male: (i) frontal rostrum lacking longitudinal groove (Fig. 3A), (ii) eye with 2 to 4 facets (Fig. 3B, arrow), (iii) inner surface

TABLE 1. Measurements of holotypes of the new *Plagiophorus* species of the *hispidus* group (mm).

	TL	HL	PL	EL	AL	HW	FW	PW	EW	AW
<i>P. hispidus</i>	1.42	0.30	0.31	0.35	0.46	0.30	0.15	0.35	0.52	0.53
<i>P. hlavaci</i>	1.65	0.33	0.38	0.51	0.43	0.38	0.18	0.40	0.68	0.64
<i>P. serratus</i>	1.78	0.37	0.41	0.54	0.46	0.35	0.20	0.46	0.74	0.71
<i>P. grandoculatus</i>	1.66	0.36	0.38	0.52	0.40	0.34	0.19	0.40	0.73	0.67

NOTE: TL, total length; HL, maximum length of head; PL, maximum length of pronotum; EL, maximum length of elytra; AL, maximum length of abdomen; HW, maximum width of head; FW, maximum width of frontal rostrum; PW, maximum width of pronotum; EW, maximum width of elytra; AW, maximum width of abdomen.

of antennal club with a longitudinal stria (Fig. 3F, arrow 1), (vi) elytra shorter than abdomen (Fig. 1A), and (v) each elytron with a basal fovea (Fig. 3D, arrow).

Description

Male and female. Body (Figs. 1A, 2A). Length, 1.3–1.4 mm; width, 0.4–0.5 mm (see Table 1 for measurements of holotype); broadest at anterior 1/3 of abdomen, dorsal surface shallowly favose-punctured. **Head** (Figs. 3A, 3B). As wide as long (HW/HL = 1.00), broadest at posterior 1/3; frontal rostrum flat on median part, relatively narrow (HW/FW = 2.00), arcuate on anterior margin; gena well expanded laterally; eye (Fig. 3B, arrow) reduced, with 2 to 4 facets. Labral and clypeal chaetotaxy (Fig. 3C): setal triangle with side *a–c* longer than *dcs*; side *b–c* shortest. Labrum: *mp* (Fig. 3C) and *ip* (Fig. 3C) less projecting than *op* (Fig. 3C). Maxillary palpomere III (Fig. 2D, *mpIII*): about 2.1 times as long as wide, distinctly reticulate on ventral surface. **Thorax.** Pronotum: longer than head (PL/HL = 1.03), broader than long (PW/PL = 1.13). Metasternum (Fig. 4A): short, distance from metasternal process (Fig. 4A, *mp*) to metasternal apex (Fig. 4A, *ma*) about 2.9 times as long as longitudinal diameter of median metasternal fovea; metasternal process narrow and rounded; lateral mesocoxal foveae (Fig. 4C, *lmc*) almost circular; depression around lateral mesocoxal fovea (Fig. 4C, *md*) not extending posteriorly. Elytra: shorter than abdomen (EL/AL = 0.76), broader than long (EW/EL = 1.49), broadest at posterior 1/3, weakly convex, constricted at anterior part, each elytron with a basal fovea (Fig. 3D, arrow); hind wing reduced. Leg: metatibia weakly sinuate. **Abdomen.** Composite tergum wider than long (AW/AL = 1.15), broadest at basal 1/3, constricted at base; sternal carina (Fig. 4D) with small tooth located at apical 1/3.

Sexual characters. Male. Antenna (Fig. 3E): antennomere III about 1.5 times as wide as long, with 2 indistinct sutures; antennomere VI smallest; antennomere VII (Fig. 3F) about 1.2 times as long as wide, reniform, its excavation opened basimedially, inner surface (Fig. 3E, *is*) almost glabrous, bearing a longitudinal stria (Fig. 3F, arrow 1), a semicircular carina and pores (Fig. 3F, arrow 2), and a “sensory pad” with setae and glands (Fig. 3F, arrow 3). Metasternum (Fig. 4A): with a pair of setigerous patches (Fig. 4A, *sp*) just posterior to middle, each with 4 to 6 spinous setae (Fig. 4B). Leg: protibia slender and straight, with denticle at apical 1/5; mesotibia with denticle at apical 1/8. Genitalia: median lobe of aedeagus (Figs. 4E–4I) strongly sclerotized; basal bulb (Fig. 4F, *bb*) with small dorsal diaphragm (Fig. 4F, *dd*); inner sclerite (Fig. 4H, *is*) and apical process (Fig. 4H, *ap*) curved to the right in dorsal view. Parameres: right paramere (Fig. 4F, *rp*) shorter than left, broadened in apical 1/3 and narrowed at apex, with a projection at apical 1/3 of its outer margin; left paramere (Fig. 4F, *lp*) slender, twisted in basal 1/2, broadened apically. **Female.** Antenna: antennomere VII (Fig. 3G) about 1.1 times as long as wide, angulate at apical part (Fig. 3G, arrow), slightly depressed basimedially.

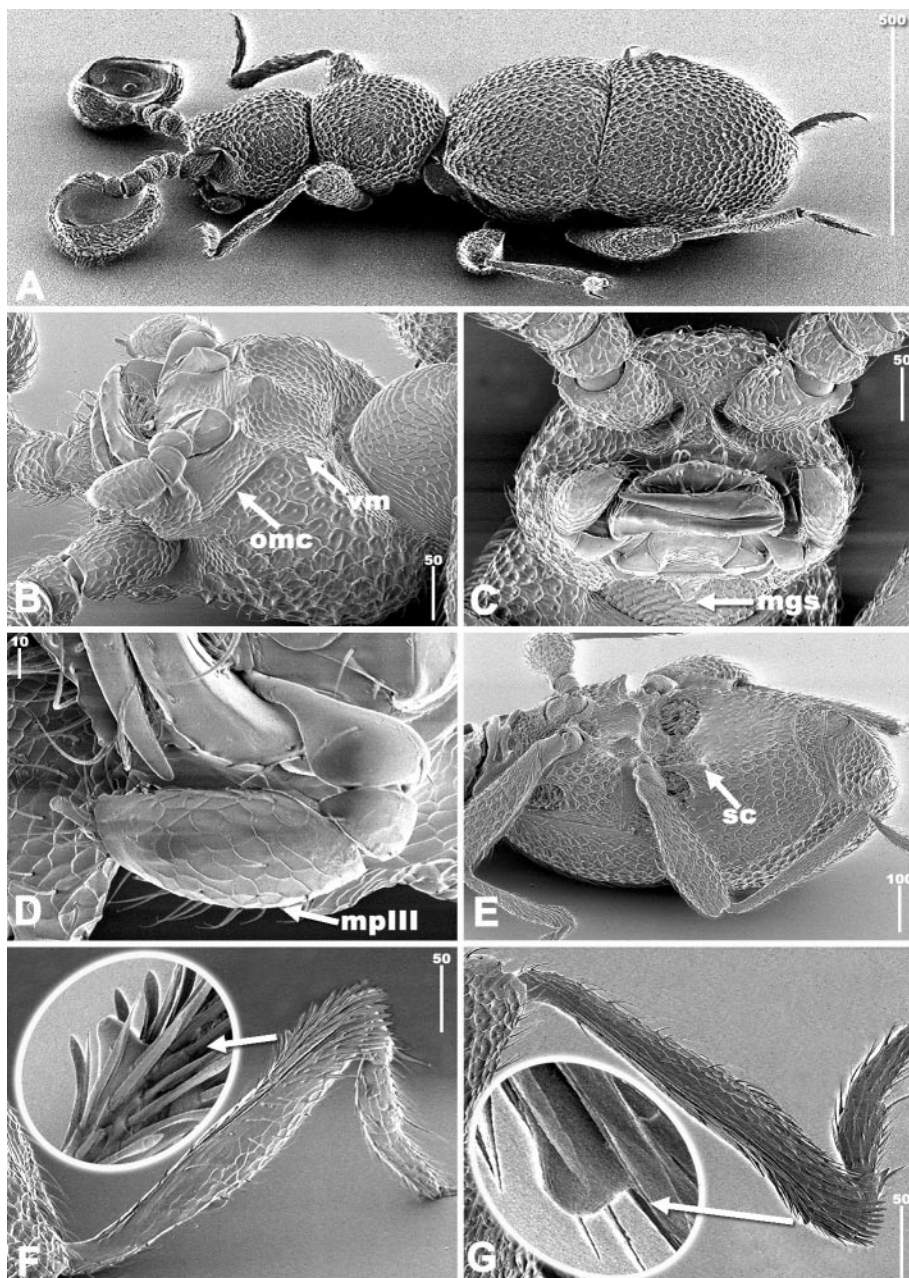


FIGURE 2. *Plagiophorus hispidus* (holotype). (A) Habitus, dorsolateral view; (B) head, ventrolateral view; (C) head, frontal view; (D) right maxillary palpus, ventral view; (E) metathorax, mesothorax, and abdomen, ventrolateral view; (F) left protibia, ventral view: arrow showing enlarged denticle; (G) left mesotibia, ventral view: arrow showing enlarged denticle. mgs, median gular spine; mpIII, maxillary palpomere III; omc, ocular-mandibular carina; sc, sternal carina; vm, ventrolateral margin. Scale bars are in micrometres.

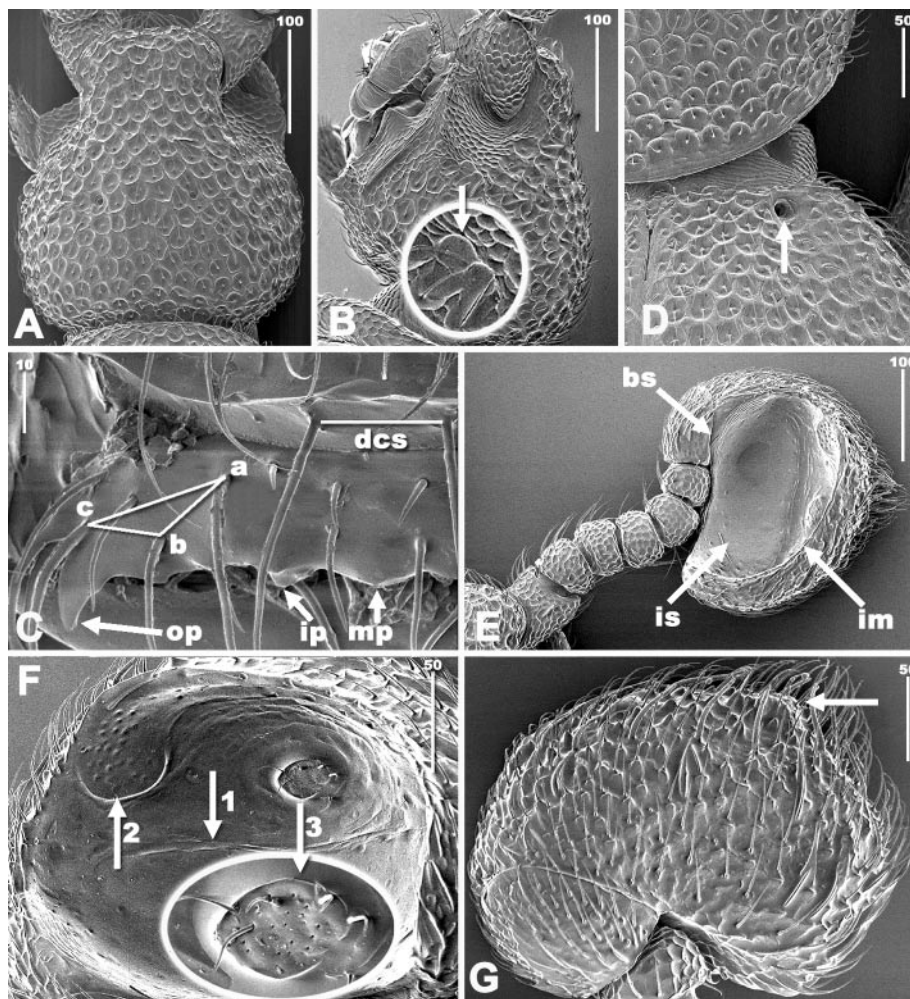


FIGURE 3. *Plagiophorus hispidus* (A–F, holotype, male; G, paratype, female). (A) Head, dorsal view; (B) head, lateral view: arrow showing enlarged eye; (C) chaetotaxy of labrum and clypeus; (D) right elytron, dorsal view: arrow indicating a basal fovea; (E) right antenna, dorsal view; (F) inner surface of right antennal club: arrow 1, longitudinal stria; arrow 2, semicircular carina; arrow 3, sensory pad; (G) right antennal club, dorsal view: arrow indicates angle. *a–c*, principal setae; *bs*, basal suture; *dcs*, distance between clypeal setae; *im*, inner margin; *ip*, inside projection of labrum; *is*, inner surface; *mp*, median projection of labrum; *op*, outside projection of labrum. Scale bars are in micrometres.

Intraspecific variation

The excavation on male antennomere VII is slightly shallower in the Iriomote Jima specimens than in those from Ishigaki Shima. These differences are interpreted as geographical variation.

Distribution

Japan (The Ryukyus: Ishigaki Shima and Iriomote Jima). Figure 12.

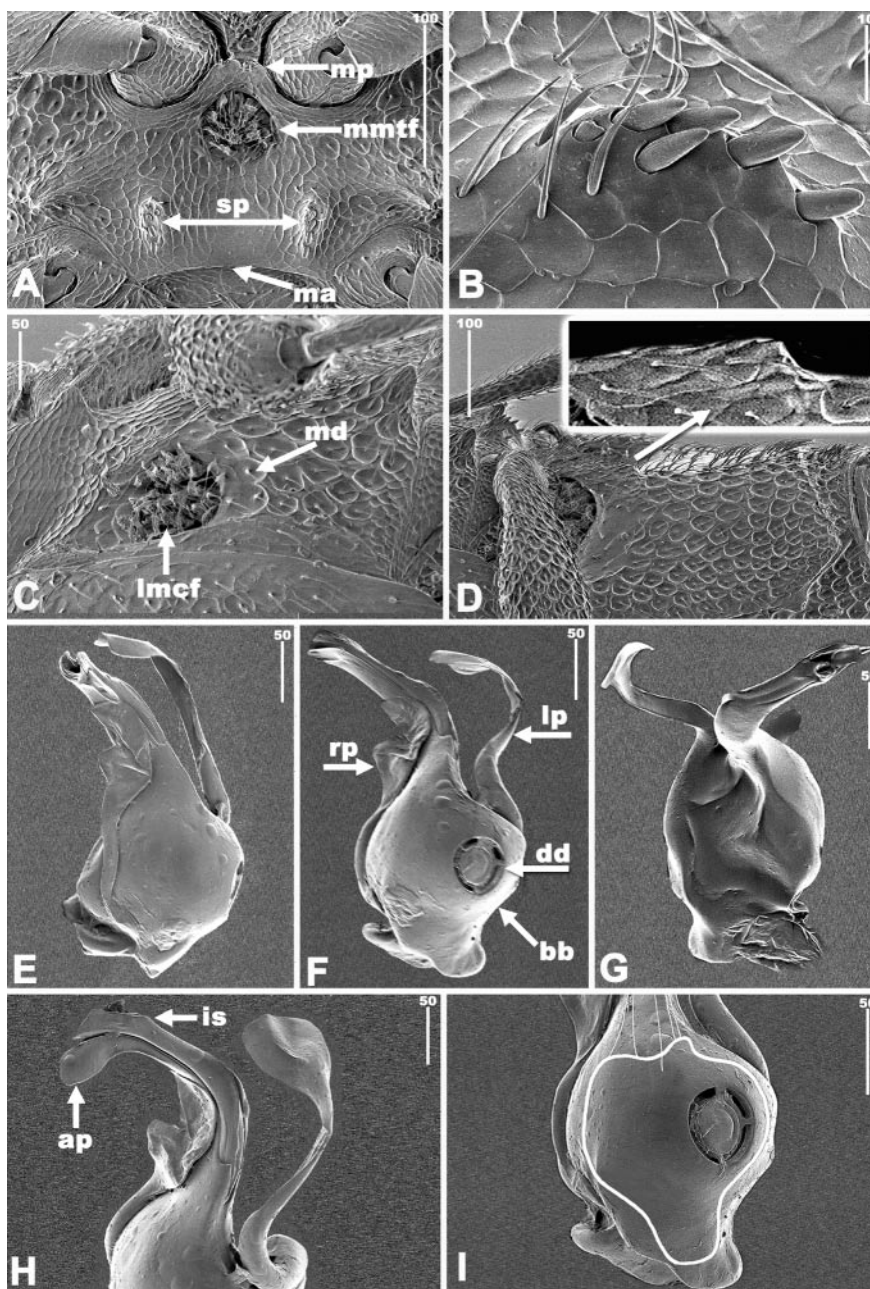


FIGURE 4. *Plagiophorus hispidus* (holotype, male). (A) Metasternum, ventral view; (B) right spinous setae at metasternum; (C) metasternum, lateral view; (D) sternal carina on abdomen, lateral view: arrow showing enlarged sternal carina; (E) aedeagus, lateral view; (F) aedeagus, dorsal view; (G) aedeagus, ventral view; (H) aedeagus, frontal–dorsal view; (I) basal bulb of aedeagus: white drawing showing inner structures, dorsal view. ap, apical process; bb, basal bulb; dd, dorsal diaphragm; is, inner sclerite; lmcf, lateral mesocoxal fovea; lp, left paramere; ma, metasternal apex; md, depression; mmtf, median metasternal fovea; mp, metasternal process; rp, right paramere; sp, setigerous patches. Scale bars are in micrometres.

Biological notes

One of the authors, HS, collected specimens by sifting leaf litter from the natural evergreen forest in Ishigaki Shima and Iriomote Jima, which is dominated by *Castanopsis sieboldii* (Makino) (Fagaceae). He observed that male individuals walked with the excavation of the antennomere VII turned almost upward and often pulled antennomere VII through the protibiae and cleaned it with their mouthparts. They walked slowly and, when disturbed, rolled into a compact ball, "playing dead".

Remarks

Nomura (1986) misidentified this species as *Paracyathiger matousheki* Löbl 1964 (= *Plagiophorus matousheki*) and redescribed it on the basis of Japanese specimens. Our comparison of the present material with the type specimen of *P. matousheki* has revealed that it is the new species described above.

2. *Plagiophorus hlavaci* sp. nov.

(Figs. 1B, 5, 6, 12)

Type material

Holotype: male (Figs. 1B, 5A–5F, 5H, 5I, 6). **CHINA. Fujian:** Wuyi Shan, Nature Reserve Area, Sangan, 30.v.–12.vi.2001, P Hlavac and J Cooter (IZAS). **Paratypes. Fujian:** 3 males, 2 females, same data as holotype (cHS, private collection of J Cooter, private collection of P Hlavac). **Zhejiang:** 2 males, 1 female, Wuyanlin, Taishun, 11.xi.1990, Y Watanabe (NSMT).

Etymology

Dedicated to Peter Hlavac, a collector of the type material.

Diagnosis

This species is distinguished from the other members of the species group by the combination of the following character states in the male: (i) frontal rostrum lacking longitudinal groove (Fig. 5A), (ii) eye with about 12 facets (Fig. 5B, arrow), (iii) antennomere III produced and angulate on inner margin, thus nearly pentagonal in profile (Fig. 5E, arrow; Fig. 5H), (iv) inner surface of antennal club lacking longitudinal stria (Fig. 5F), (v) each elytron with 2 basal foveae (Fig. 5D, arrows), and (vi) protibia with outer margin strongly constricted about middle (Fig. 5I, arrow).

Description

Male and female. Body (Fig. 1B). Length, 1.6–1.7 mm; width, 0.5–0.6 mm (see Table 1 for measurements of holotype); broadest at middle of elytra, dorsal surface shallowly favose-punctured. **Head** (Figs. 5A, 5B). Slightly wider than long (HW/HL = 1.15), broadest at posterior 1/3; frontal rostrum flat in the median part, relatively wide (HW/FW = 2.11), arcuate at anterior margin; gena well expanded laterally. Labral and clypeal chaetotaxy (Fig. 5C): setal triangle with side *a–c* about as long as *dcs*, side *b–c* shortest. Labrum: ip more projecting than mp. Maxillary palpomere III: about twice as long as wide, distinctly reticulate on ventral surface. **Thorax.** Pronotum: longer than head (PL/HL = 1.15), broader than long (PW/PL = 1.05). Metasternum (Fig. 6A): long, distance from metasternal process to metasternal apex about 3.4 times as long as longitudinal diameter of median metasternal fovea; metasternal process broadly truncate;

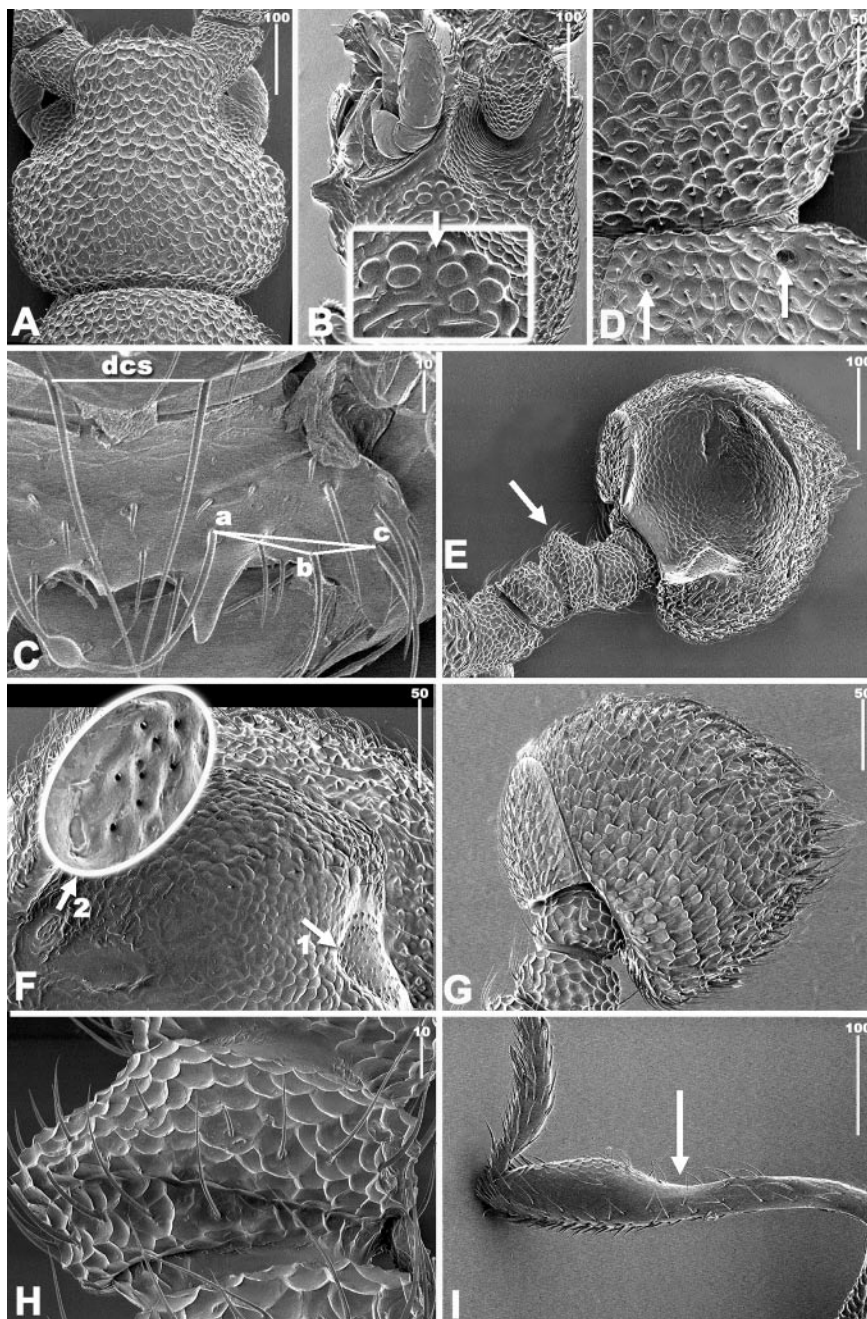


FIGURE 5. *Plagiophorus hlavaci* (A–F, holotype, male; G, paratype, female). (A) Head, dorsal view; (B) head, lateral view: arrow showing enlarged eye; (C) chaetotaxy of labrum and clypeus; (D) elytron, dorsal view: arrows indicating basal foveae; (E) right antenna, dorsal view: arrow indicating projection of antennomere III; (F) inner surface of right antennal club: arrow 1, triangular depression; arrow 2, sensory pad; (G) right antennal club, dorsal view; (H) right antennomere III, dorsal view; (I) right protibia, dorsal view: arrow indicating constriction. *a–c*, principal setae; *dcs*, distance between clypeal setae. Scale bars are in micrometres.

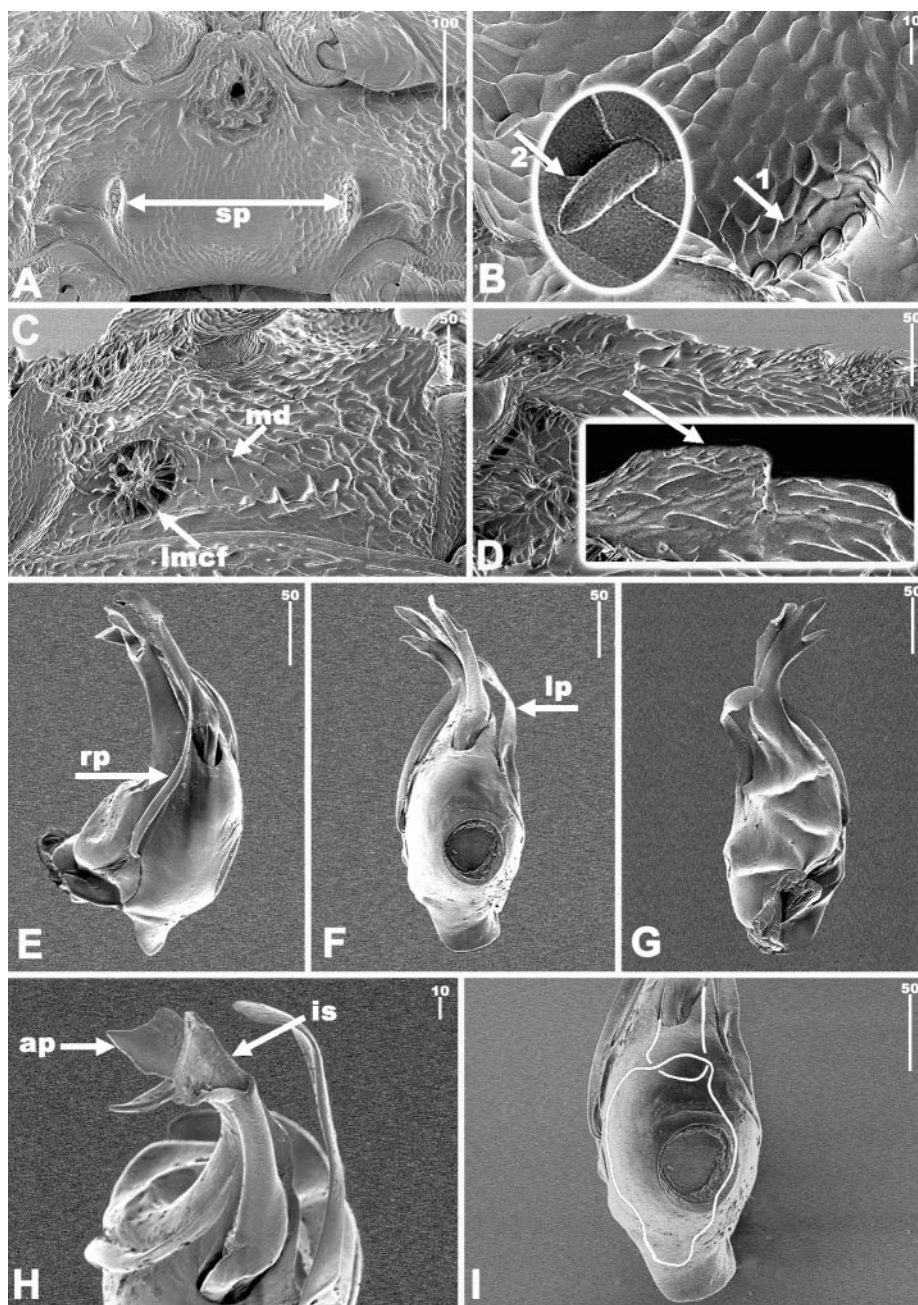


FIGURE 6. *Plagiophorus hlavaci* (holotype, male). (A) Metasternum, ventral view; (B) right spinous setae at metasternum: arrows 1 and 2, setigerous patches; (C) metasternum, lateral view; (D) sternal carina on abdomen, lateral view: arrow indicating enlarged sternal carina; (E) aedeagus, dorsal view; (F) aedeagus, dorsal view; (G) aedeagus, ventral view; (H) aedeagus, frontal-dorsal view; (I) basal bulb of aedeagus: white drawing showing inner structures, dorsal view. ap, apical process; is, inner sclerite; lmcf, lateral mesocoxal fovea; lp, left paramere; md, depression; rp, right paramere; sp, setigerous patches. Scale bars are in micrometres.

lateral mesocoxal fovea almost circular (Fig. 6C, lmcf); depression around lateral mesocoxal fovea extending posteriorly to posterior 1/3 of metasternum (Fig. 6C, md). Elytra: longer than abdomen (EL/AL = 1.18), broader than long (EW/EL = 1.33), broadest at middle, convex, each elytron with 2 basal foveae (Fig. 5D, arrows); hind wing reduced. Leg: metatibia slightly sinuate. **Abdomen.** Composite tergum wider than long (AW/AL = 1.49), broadest just behind base; composite sternum shallowly concave at median part.

Sexual characters. Male. Eye with about 12 facets (Fig. 5B, arrow). Antenna (Fig. 5E): antennomere III (Fig. 5E, arrow; Fig. 5H) about 1.9 times as wide as long, produced and angulate on inner margin, thus nearly pentagonal in profile, with 2 indistinct sutures; antennomeres V and VI partly covered by VII in dorsal view; antennomere VII (Fig. 5F) about 1.2 times as long as wide, reniform, its excavation open basimedially, inner surface reticulate, bearing a triangular depression (Fig. 5F, arrow 1) and small sensory pad with pores (Fig. 5F, arrow 2). Metasternum (Fig. 6A): pair of setigerous patches (Fig. 6A, sp) situated posterior to middle, each with 4 to 7 spinous setae (Fig. 6B, arrow 1). Leg: protibia with outer margin strongly constricted about middle (Fig. 5I, arrow), with denticle at apical 1/5; mesotibia with denticle at apical 1/12. Abdomen with composite sternum: flattened at posterior 1/3; sternal carina with 2 teeth, anterior tooth weakly convex and situated at apical 1/3, posterior tooth just posterior to anterior tooth and lower and shorter than anterior tooth (Fig. 6D). Genitalia: median lobe of aedeagus (Figs. 6E–6I) strongly sclerotized; basal bulb with small dorsal diaphragm; inner sclerite (Fig. 6H, is) curved to right, its apical part depressed; apical process (Fig. 6H, ap) slightly shorter than inner sclerite, curved to right in dorsal view, its apical part forked. Parameres: right paramere shorter than left, slender, curved inwardly in dorsal view (Fig. 6E, rp); left paramere slender, basal 1/2 curved inwardly in dorsal view (Fig. 6F, lp). **Female.** Eye with 3 to 4 facets. Antenna: antennomere III less angular than that of male; antennomere VII about as long as wide, slightly depressed on basimedial margin (Fig. 5G). Abdominal sternal carina with tooth lower than that in male.

Intraspecific variation

Holotype has 1 extra spinous seta, which is situated behind the right setigerous patch (Fig. 6B, arrow 2).

Distribution

China (Fujian sheng, Zhejiang sheng). Figure 12.

3. *Plagiophorus serratus* sp. nov.

(Figs. 1C, 7, 8, 12)

Type material

Holotype: male (Figs. 1C, 7, 8). **CHINA. Yunnan:** Huanxipo, 1750 m alt., Tengchong, 14.x.1996, S Nomura (NSMT).

Etymology

The Latin *serratus* meaning serrate, in reference to the serrate teeth on the sternal carina.

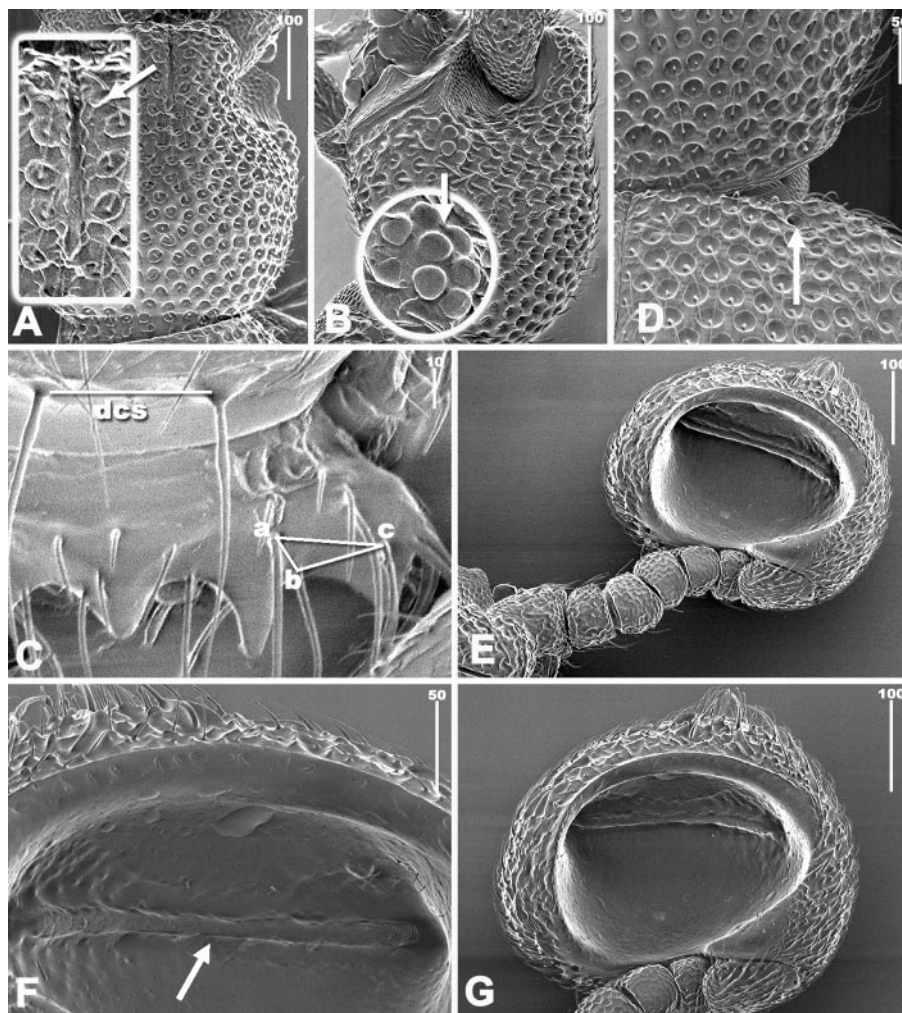


FIGURE 7. *Plagiophorus serratus* (holotype, male). (A) Head, dorsal view: arrow showing enlarged groove; (B) head, lateral view: arrow showing enlarged eye; (C) chaetotaxy of labrum and clypeus; (D) elytron, dorsal view: arrow indicating basal fovea; (E) left antenna, dorsal view; (F) left inner surface of antennal club: arrow indicating longitudinal stria; (G) left antennal club. *a-c*, principal setae; *dcs*, distance between clypeal setae. Scale bars are in micrometres.

Diagnosis

This species is distinguished from the other members of the species group by the combination of the following character states in the male: (i) frontal rostrum with a longitudinal groove (Fig. 7A, arrow), (ii) eye with about 7 facets (Fig. 7B, arrow), (iii) inner surface of antennal club with a longitudinal stria (Fig. 7F, arrow), (iv) each elytron with a basal fovea (Fig. 7D, arrow), and (v) sternal carina with 4 teeth (Fig. 8D, arrow).

Description

Male (holotype). Body. Length (TL), 1.7 mm; width (EW), 0.7 mm (see Table 1 for measurements of holotype); broadest at posterior 1/3 of elytra, densely covered in

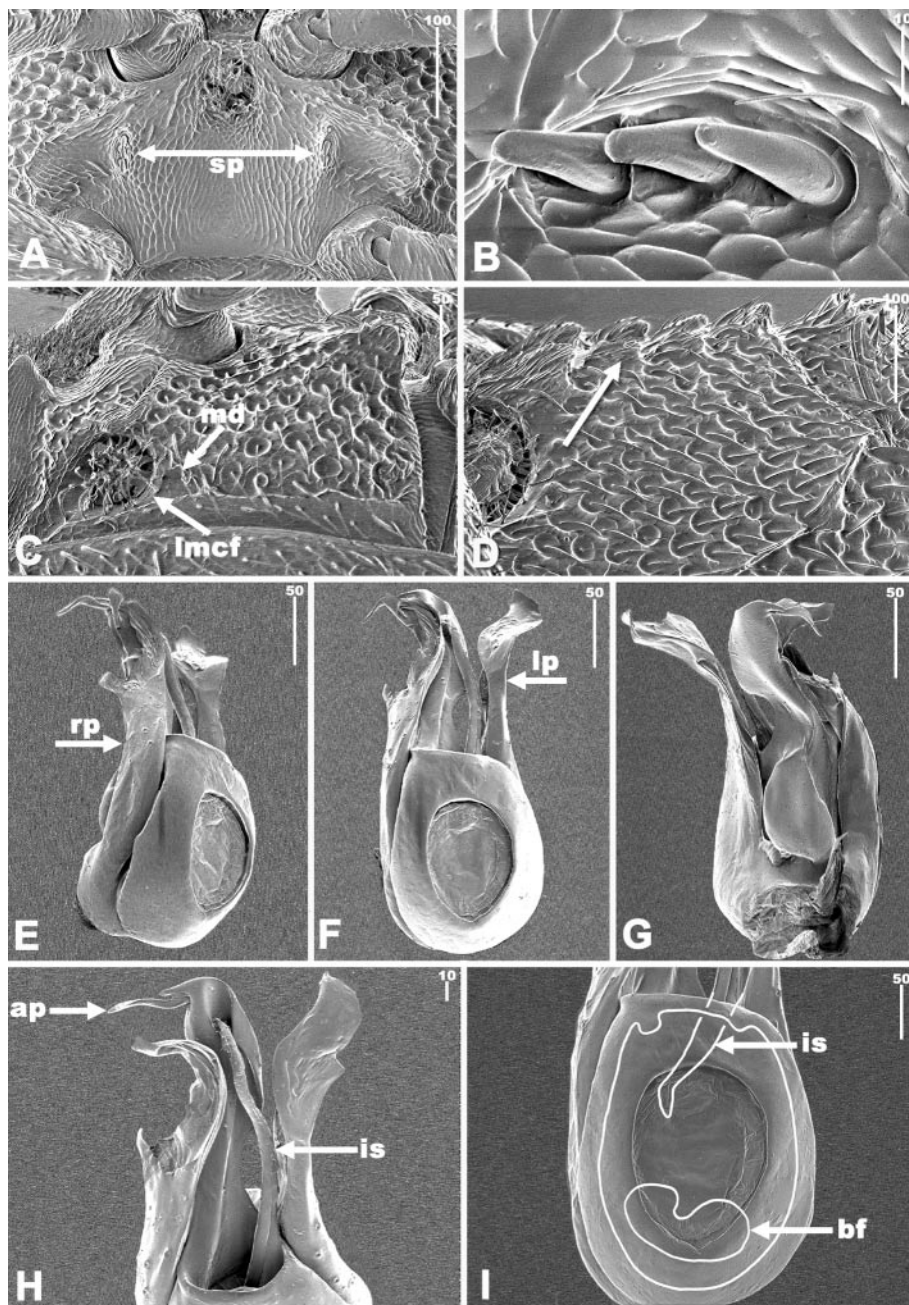


FIGURE 8. *Plagiophorus serratus* (holotype, male). (A) Metasternum, ventral view; (B) left spinous setae at metasternum; (C) metasternum, lateral view; (D) sternal carina on abdomen, lateral view: arrow showing enlarged sternal carina; (E) aedeagus, lateral view; (F) aedeagus, dorsal view; (G) aedeagus, ventral view; (H) aedeagus, frontal-dorsal view; (I) basal bulb of aedeagus: white drawing showing inner structures, dorsal view. ap, apical process; bf, basal foramen; is, inner sclerite; lmcf, lateral mesocoxal fovea; lp, left paramere; rp, right paramere; sp, setigerous patches. Scale bars are in micrometres.

fine punctures dorsally. **Head** (Figs. 7A, 7B). Slightly longer than wide ($HW/HL = 0.95$), broadest at middle; frontal rostrum relatively narrow ($HW/FW = 1.75$), bisinuate on anterior margin, with a deep longitudinal groove (Fig. 7A, arrow); gena expanded anterolaterally; eye reduced, with about 7 facets (Fig. 7B, arrow). Labral and clypeal chaetotaxy (Fig. 7C): setal triangle with side $a-c$ shorter than dcs ; side $a-b$ shortest. Labrum: ip distinctly projecting and longer than op . Maxillary palpomere III: 2.2 times as long as wide, distinctly reticulate on ventral surface. Antenna (Fig. 7E): antennomere III about 1.2 times as wide as long, with 2 indistinct sutures; antennomere VI partly covered by VII in dorsal view; antennomere VII (Fig. 7F) about 1.2 times as long as wide, nearly ovate, inner surface with a longitudinal stria (Fig. 7F, arrow), almost glabrous except around longitudinal stria. **Thorax**. Pronotum: longer than head ($PL/HL = 1.11$), broader than long ($PW/PL = 1.12$). Metasternum (Fig. 8A): long, distance from metasternal process to metasternal apex about 3.7 times as long as longitudinal diameter of median metasternal fovea; metasternal process broad and truncate; with pair of setigerous patches just anterior to middle (Fig. 8A, sp); each setigerous patch with 3 spinous setae (Fig. 8B); lateral mesocoxal fovea almost circular (Fig. 8C, $lmcf$); depression around lateral mesocoxal foveae not extending posteriorly (Fig. 8C, md). Elytra: longer than abdomen ($EL/AL = 1.17$), broader than long ($EW/EL = 1.37$), convex, broadest at middle, each elytron with basal fovea (Fig. 7D, arrow); hind wing reduced. Leg: protibia slender and straight, with denticle at apical 1/5; mesotibia with denticle at apical 1/6, sinuate at middle and curved inwardly at apex; metatibia distinctly sinuate. **Abdomen**. Long, composite tergum wider than long ($AW/AL = 1.54$), broadest at basal 1/4; composite sternum shallowly concave medially; sternal carina (Fig. 8D) with 4 teeth of equal height. Genitalia: median lobe of aedeagus (Figs. 8E–8I) strongly sclerotized; basal bulb with large dorsal diaphragm; inner sclerite slender, arising from inside of posterior 1/3 of basal bulb (Fig. 8I, is), curved inwardly in dorsal view (Fig. 8H, is); apical process longer than inner sclerite, stout, constricted at middle, apical part with needle-shaped projection (Fig. 8H, ap). Parameres: right paramere shorter than left, stout, with projection at apical 1/4, its apical part curved outward in dorsal view (Fig. 8E, rp); left paramere stout, markedly broad at apical 1/3, forked laterally (Fig. 8F, lp).

Female. Unknown.

Distribution

China (Yunnan sheng). Figure 12.

Remarks

We could not define sexual characters because no female specimen was available for comparison in this study.

4. *Plagiophorus grandoculatus* sp. nov.

(Figs. 9, 10, 12)

Type material

Holotype: male (Figs. 9, 10). **CHINA**. **Yunnan**: Menglien, Tengchong, 15.x.1996, S Nomura (NSMT).

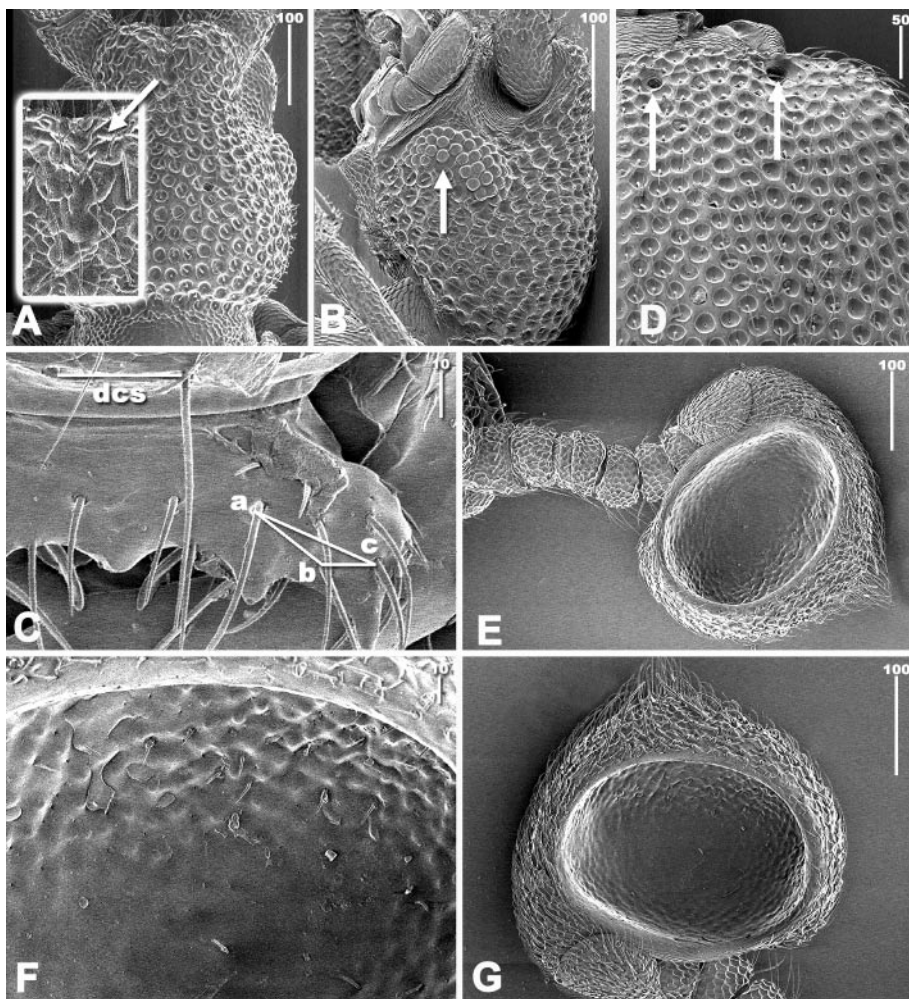


FIGURE 9. *Plagiophorus grandoculatus* (holotype, male). (A) Head, dorsal view: arrow showing enlarged groove; (B) head, lateral view: arrow showing enlarged eye; (C) chaetotaxy of labrum and clypeus; (D) elytron, dorsal view: arrows indicating basal foveae; (E) right antenna, dorsal view; (F) inner surface of right antennal club; (G) right antennal club. *a-c*, principal setae; *dcs*, distance between clypeal setae. Scale bars are in micrometres.

Etymology

The Latin *grandoculatus* means large eye.

Diagnosis

This species is distinguished from the other members of the species group by the combination of the following character states in the male: (i) frontal rostrum with a longitudinal groove (Fig. 9A, arrow), (ii) eye reniform with about 40 facets (Fig. 9B), (iii) inner surface of antennal club lacking longitudinal stria (Fig. 9F), (iv) each elytron with 2 basal foveae (Fig. 9D, arrows), and (v) sternal carina with a weak tooth located at apical 2/5 (Fig. 10D).

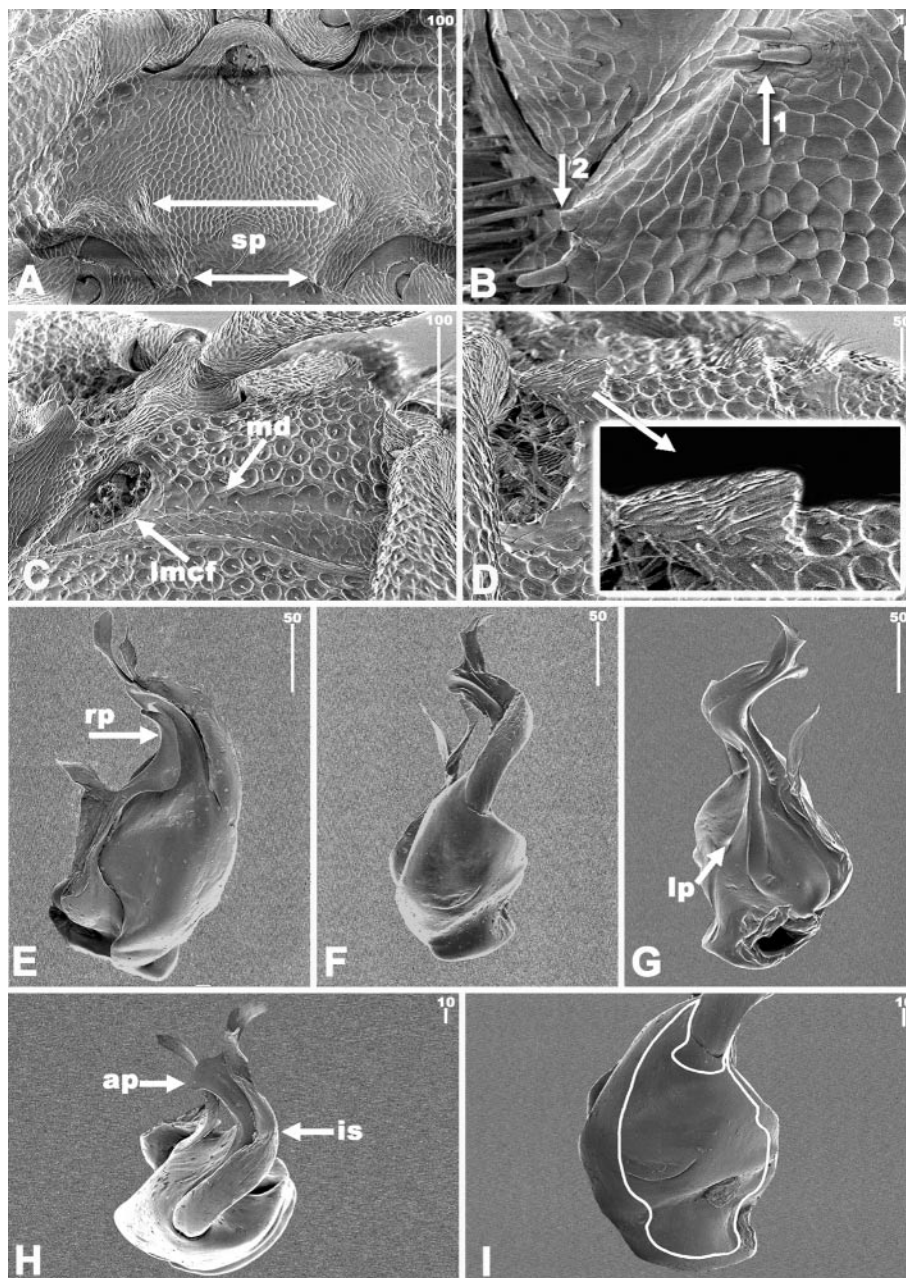


FIGURE 10. *Plagiophorus grandoculatus* (holotype, male). (A) Metasternum, ventral view; (B) left spinous setae at metasternum: arrow 1, anterior setigerous patch; arrow 2, posterior setigerous patch; (C) metasternum, lateral view; (D) sternal carina on abdomen, lateral view: arrow showing enlarged sternal carina; (E) aedeagus, lateral view; (F) aedeagus, dorsal view; (G) aedeagus, ventral view; (H) aedeagus, frontal–dorsal view; (I) basal bulb of aedeagus: white drawing showing inner structures, dorsal view. ap, apical process; is, inner sclerite; lmcf, lateral mesocoxal fovea; lp, left paramere; md, depression; rp, right paramere; sp, setigerous patches. Scale bars are in micrometres.

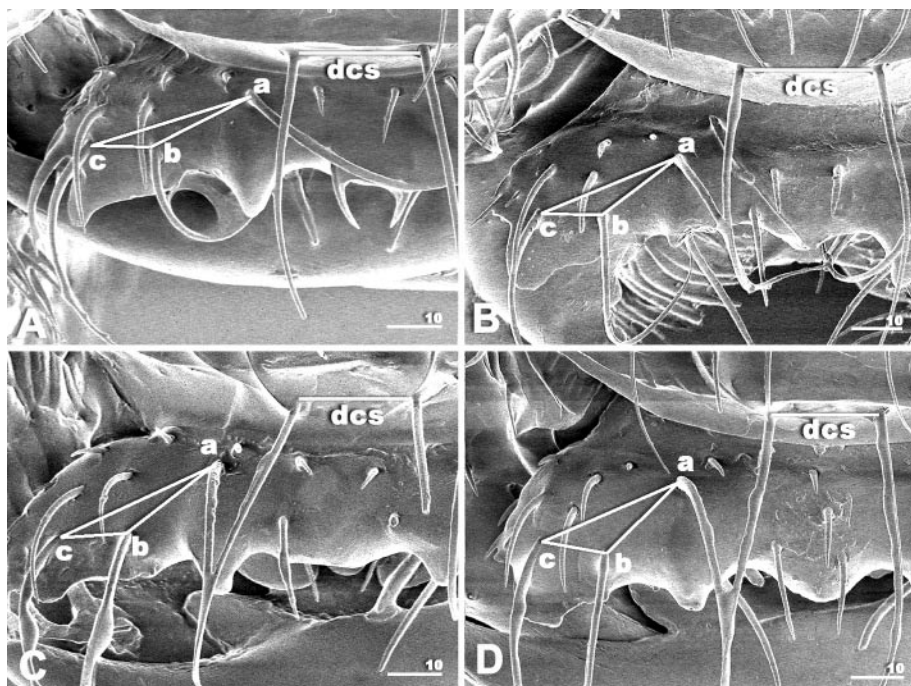


FIGURE 11. Chaetotaxy of labrum and clypeus of *Plagiophorus hispidus* (paratypes). (A) male, Ishigaki Shima; (B) female, Ishigaki Shima; (C) male, Iriomote Jima; (D) female, Iriomote Jima. *a-c*, principal setae; *dcs*, distance between clypeal setae. Scale bars are in micrometres.

Description

Male (holotype). Body. Length, 1.7 mm; width, 0.7 mm (see Table 1 for measurements of holotype); broadest at anterior 1/3 of abdomen, densely covered with fine punctures dorsally. **Head** (Figs. 9A, B). Slightly longer than wide ($HW/HL = 0.94$), broadest at posterior 1/3; frontal rostrum relatively narrow ($HW/FW = 1.79$), distinctly bisinuate on anterior margin, with shallow longitudinal groove (Fig. 9A, arrow); gena well expanded anterolaterally; eye reniform with about 40 facets (Fig. 9B). Labral and clypeal chaetotaxy (Fig. 9C): setal triangle with side *a-c* longer than *dcs*; side *b-c* shortest. Labrum: *ip* more projecting than *mp* and shorter than *op*. Maxillary palpomere III: about 2.1 times as long as wide, distinctly reticulate on ventral surface. Antenna (Fig. 9E): antennomere III about 1.3 times as wide as long, with 2 indistinct sutures; antennomere VI partly covered by VII in dorsal view; antennomere VII (Fig. 9G) about 1.1 times as long as wide, nearly ovate, inner surface granulate on peripheral portion (Fig. 9F). **Thorax.** Pronotum: longer than head ($PL/HL = 1.06$), broader than long ($PW/PL = 1.05$). Metasternum: long (Fig. 10A), distance from metasternal process to metasternal apex about 6.2 times as long as longitudinal diameter of median metasternal fovea; metasternal process broad and rounded; with 2 pairs of setigerous patches (Fig. 10A, *sp*) just posterior to middle and near posterior margin, the anterior pair each with 3 to 5 spinous setae (Fig. 10B, arrow 1), the posterior pair with 1–2 spinous setae (Fig. 10B, arrow 2); lateral mesocoxal foveae elliptical (Fig. 10C, *lmcf*); depression around lateral mesocoxal foveae narrowed posteriorly and extending to just anterior to metacoxa (Fig. 10C, *md*). Elytra: longer than abdomen ($EL/AL = 1.30$), broader than long ($EW/EL = 1.40$), convex, broadest at middle, each elytron with 2 basal foveae (Fig. 9D, arrows); hind wing developed. Leg: protibia slender and straight, with denticle

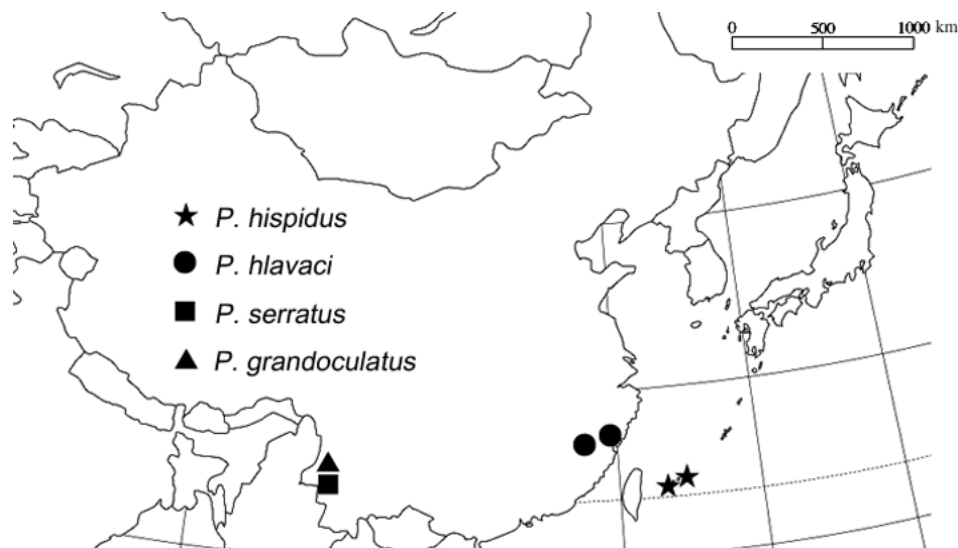


FIGURE 12. Map of distribution of *Plagiophorus* species of the *hispidus* group.

at apical 1/4; mesotibia with denticle just before apex; metatibia distinctly sinuate. **Abdomen.** Composite tergum wider than long ($AW/AL = 1.68$), broadest at basal 1/5; composite sternum deeply excavated at median part; sternal carina with weak tooth located at apical 2/5 (Fig. 10D). Genitalia: median lobe of aedeagus (Figs. 10E–10I) weakly sclerotized; inner sclerite stout, S-shaped in dorsal view, gradually narrowed from middle to apex (Fig. 10H, is); apical process longer than inner sclerite, stout, S-shaped in dorsal view, with wide projection at apical 1/3 of outer margin (Fig. 10H, ap). Parameres: right paramere stout, shorter than left, constricted at middle, curved outward apically (Fig. 10E, rp); left paramere, long (Fig. 10G, lp).

Female. Unknown.

Distribution

China (Yunnan sheng). Figure 12.

Remarks

We could not define sexual characters because no female specimen was available for comparison in this study.

Acknowledgments

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