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A new socially parasitic *Braunsapis* (Hymenoptera: Apidae: Xylocopinae: Allodapini) from Vietnam, with a key to female socially parasitic *Braunsapis* in Asia

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Abstract. *Braunsapis scorpius* Packer, new species, from Vietnam, is diagnosed, described, and illustrated. In addition to adaptations commonly associated with related social parasites (*i.e.*, reduced metatibial hairs, short mouthparts, and absence of a basitibial plate), it has a remarkably recurved metasomal apex. It is compared to other socially parasitic members of its genus from Asia and a key to females of these social parasites is provided.

INTRODUCTION

During the course of bee sampling in Vietnam in 2008, one of my students (Hien Ngo) found a specimen of the allodapine genus *Braunsapis* Michener with clear modifications suggestive of a socially parasitic mode of life. The purpose of this paper is to describe this new species to permit loans of related species to be returned, to compare its adaptations to a socially parasitic mode of life with those of related taxa, and to provide an identification key to female socially parasitic *Braunsapis* from Asia.

Social parasitism is a well-known phenomenon among the Allodapini with multiple independent origins (Michener, 1970, 2007; Smith *et al.*, 2007, 2013). For Asian species, Reyes & Michener (1990) provided some details on the biology of the socially parasitic *Braunsapis breviceps* (Cockerell) and its congeneric hosts, and Batra *et al.* (1993) did the same for *B. kaliago* Reyes & Sakagami. While social parasitism and host relations have been established for these two species, the parasitic lifestyle is inferred based upon morphology shared with the species above (*i.e.*, reduced metatibial hairs, mouthparts, and basitibial plate) for both *B. bislensis* Michener & Borges and the new species described herein.

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MATERIAL AND METHODS

The description follows the format of recent bee taxonomic research from my laboratory (*e.g.*, Packer & Dumes, 2014), with terminology following Michener (2007) and Harris (1979) except as follows. The term metapostnotum is used instead of dorsal surface of the propodeum (following Brothers, 1976). The following acronyms are used: F, LbP, S, and T followed by a number to refer to flagellomeres, labial palpomeres, and metasomal sterna and terga, respectively. UOD and LOD indicate upper and lower interocular distances, respectively. ITW, MSL, MTL, and MPL refer to intertegular width and mesocutellar, metanotal, and metapostnotal lengths, respectively, the latter measured from the anterior margin to the point where the dorsal surface curves strongly ventrad. Hair lengths are given in terms of the transverse diameter of the median ocellus (MOD) and puncture spacing is noted in terms of the relative sizes of puncture diameters (d) and interspaces (i).

Measurements were made using an eyepiece graticule in a Leitz Wetzlar 16× lens attached to a Leica MZ 12.5 microscope, when suitable, these data are expressed as ratios of whole numbers. Images were taken with a Visionary Digital imaging system and a Canon 5D Mark II digital SLR camera with images amalgamated using Zerene Stacker and additional image processing performed with Adobe Photoshop CS6. Locality information is obtained verbatim from the data label with terms requiring explanation treated in square brackets.

SYSTEMATICS

Genus *Braunsapis* Michener*Braunsapis scorpius* Packer, new species

ZooBank: urn:lsid:zoobank.org:act:35F3F2B3-283B-43BD-B806-8968FC873CCD
(Figs. 1–6)

DIAGNOSIS: The new species is clearly not a pollen collecting species based upon the short hairs of the metatibia (*i.e.*, not forming a distinct scopa), especially of the dorsal surface, which are clearly shorter than the greatest depth of tibia (Figs. 1, 4). It is unique among Asian socially parasitic species of *Braunsapis* in the mostly orange metasoma with T6 recurved with its dorsal surface at approximately a right angle in comparison to T2–T4 (Fig. 1), and with its sides largely evenly convex and only feebly sinuate apically (Fig. 6). All other Asian socially parasitic *Braunsapis* except *B. bislensis* from southern India have a dark brown to blackish metasoma, T6 at most weakly concave in profile, and have the sides of T6 more strongly sinuate with distinct lateral “shoulders” *sensu* Reyes & Sakagami (1990) (*e.g.*, figure 7 herein and their figure 3). The new species can be differentiated from *B. bislensis* due to its dark, rather than ivory, mandible and almost entirely pale, as opposed to mostly dark, metasoma. It can also be differentiated from all other congeners from the Southeast Asian tropics, except *B. flaviventris* Reyes, based upon metasomal coloration. The two can be differentiated by the presence of a true scopa and absence of pale marks on the lower paraocular area in *B. flaviventris*.

DESCRIPTION: ♀: Body length 5.0 mm, forewing length 3.55 mm, intertegular distance 1.0 mm, head width 1.3 mm.

Coloration. Head and thorax black-brown except as follows: labrum, clypeus, mark on lower paraocular area, anterior surface of scape and pronotal lobe off-white;



Figures 1–6. Holotype of *Braunsapis scorpius*, new species. 1. Lateral habitus (scale bar = 2 mm). 2. Mouthparts to show reduced lengths of labial palpomeres and glossa (scale bar = 1 mm). 3. Head, frontal view (scale bar = 1 mm). 4. Close-up of metatibia to show short hairs (scale bar = 1 mm). 5. Base of midleg to show reduced brush of hairs at base of mesofemur and on mesotrochanter (compare to figure 12) (scale bar = 0.5 mm). 6. 6th metasomal segment to show feebly sinuate apical margin, ventral view (scale bar = 0.5 mm).

scutellum, metanotum, and anterior surface of pedicel and flagellum brown, apices of anterior surface of F5–F10 marked with orange-brown, this mark larger on successive

flagellomeres; legs brown except apices of all femora; all tibiae and tarsi pale yellow-brown; tegula translucent, wing veins pale brown, vein R and stigma somewhat darker; metasoma pale orange except red-brown as follows: T1 with medially interrupted irregular transverse band, T2–T3 and T6 with lateral marks; sterna orange, S6 in particular translucent (such that some details of the sting apparatus are visible; Fig. 6).

Pubescence. Hairs on head and mesoscutum whitish, erect, mostly simple, length 1.3 MOD and <0.7 MOD, respectively; pronotum with short, dense, appressed, feathery hairs; sides of mesosoma with long (<2.5 MOD), finely branched hairs; scutellum and metanotum with shorter (<0.7 MOD), sparse, suberect hairs and few, longer erect hairs ≈ 2 MOD; metatibial hairs subappressed, finely branched, <1.6 MOD; metasomal terga with fine, unbranched, mixed subappressed and erect hairs mostly <0.7 MOD; T6 hairs long, erect on ventrally reflexed portion, ≈ 2 MOD, shorter ≈ 1 MOD on upper surface.

Surface Sculpture. Head and mesosoma shiny, microsculpture weak, metapostnotum more distinctly imbricate; punctures minute, obscure and sparse, slightly more distinct on scutellum and metanotum $i \approx d$; metasomal terga weakly imbricate, punctures larger than on scutellum, shallow, $i \approx d$ except T1 disc and apical half of T6 almost impunctate; metasomal sterna impunctate except few weak punctures subapically.

Structure. Head $1.1\times$ broader than long. LbP1=LbP2, each $\approx 4\times$ longer than LbP3 and LbP4 and only slightly longer than the basal depth of the mandible (13:12). Glossa somewhat shorter than labial palpus. Malar space more than $2.4\times$ longer posteriorly than anteriorly. Compound eyes convergent below: UOD:LOD $\approx 4:3$. Frontal line broadly impressed from close to epistomal sulcus to within 1MOD of lower tangent of median ocellus. Scape almost attaining lower tangent of median ocellus; F1 $0.4\times$ as long as wide, F2 approximately half as long as wide, F3 $0.75\times$ as long as wide, remaining flagellomeres with length and width subequal.

Mesoscutum wider than long (ITW $1.4\times$ MSL). Scutellum more than twice as long as metanotum, slightly longer than metapostnotum (MSL:MTL:MPL: 26:11:21). Basitibial plate entirely undefined. Posterior metatibial spur more than half as long as metabasitarsus (25:48) and slightly longer than anterior metatibial spur (23).

Metasoma with sides of T1 mostly straight, convergent towards base. T4 and T5 not depressed medially. T6 concave dorsally, sides evenly convex except weakly sinuate subapically; entire 6th metasomal segment recurved, dorsal surface of T6 forming angle of $<90^\circ$ with dorsal surface of T2–T4 in profile, sides sharply reflexed ventrad, carinate except more gradually rounded for basal one quarter.

♂: Unknown.

HOLOTYPE: ♀, VIETNAM: Dak Lak, Anh Phuc Cu Prao, N12°52.912' E108°38.627', 23.ix.08 [2008], MT [malaise trap], H. Ngo, PCYU-HNV-2842. To be deposited in Vietnamese Academy of Science and Technology, Hanoi City, Vietnam (VAST) pending completion of ongoing bee systematic research at the Packer Collection at York University, Toronto, Canada (PCYU).

ETYMOLOGY: The specific epithet is a noun in apposition and refers to the recurved apex to the metasoma which gives a superficial resemblance to the apex of the telson and more anterior metasomal segments of a scorpion.

COMMENTS: Other than for a dent in the integument of the head and the broken right antenna, which is glued to the pin beneath the specimen, and loss of the sting shaft, the holotype is in good condition.

Other specimens of *Braunsapis* collected at the type locality and identified using Reyes (1991) include *B. hewitti* (Cameron), *B. pangensis* (Cockerell), and *B. philippinen-*



Figures 7–9. *Braunsapis breviceps* Michener for comparison with *B. scorpilus*. 7. Dorsal view of metasoma to show depressed surface of T4 and T5 and strongly sinuate sides to T6 in comparison to the situation in *B. scorpilus* (Fig. 6) (scale bar = 1 mm). 8. Detail of mouthparts (scale bar = 0.5 mm). 9. Base of midleg to show unusually strongly developed (albeit not “brush-like”) hairs at base of mesofemur and on mesotrochanter (scale bar = 0.5 mm).

sis (Ashmead), but it is not possible to suggest which *Braunsapis* might be the host(s) of *B. scorpius*.

Key to Asian Socially Parasitic Females of *Braunsapis*
(reference citations in the key are to images of the key characteristic)

1. Metasoma with distinct pale markings, either almost entirely (Fig. 1) or at least broadly towards apices of T1–T6 (Michener *et al.*, 2003: figs. 1, 10); T6 lacking distinct lateral shoulders (Fig. 6; Michener *et al.*, 2003: fig. 10) 2
- . Metasoma dark except for somewhat translucent apical impressed areas (Fig. 7); T6 with distinct lateral shoulders (Fig. 7; Reyes & Sakagami, 1990: fig. 3) 3
2. T1–T4 mostly dark brown (Michener *et al.*, 2003: figs. 1, 10); paraocular area with pale mark narrowly extending dorsally almost level with transverse portion of epistomal sulcus (Michener *et al.*, 2003: fig. 3); T6 dorsal surface weakly convex (Michener *et al.*, 2003: fig. 1) (S. India) *B. bislensis* Michener & Borges
- . Only T1 extensively marked with brown (Fig. 1); paraocular area with small pale mark not narrowly extended above (Fig. 3); T6 dorsal surface concave (Vietnam) *B. scorpius* Packer, n. sp.
3. Pronotum with yellow spots, tarsi orange to yellow (N. India)
..... *B. kaliago* Reyes & Sakagami
- . Pronotum and tarsi dark (Java, Malaysia) *B. breviceps* (Cockerell)

DISCUSSION

Social parasitism has originated multiple times among the Allodapini (at least four times according to Smith *et al.*, 2013), with some genera such as *Effractapis* Michener being exclusively parasitic (Michener, 2007). Some other genera contain one or more socially parasitic species: Michener (2007) mentions two species of *Braunsapis* for which this is confirmed (*B. breviceps* and *B. kaliago*), with an additional two species considered to be probable social parasites, *B. natalica* Michener and *B. pallida* Michener, both of which are African. In addition, *B. bislensis* is almost certainly socially parasitic, albeit with less well-developed modifications to this mode of life than the aforementioned species (Michener *et al.*, 2003). Adaptations to the socially parasitic way of life within *Braunsapis* typically involve a reduction in the metatibial hairs (Fig. 4) and mouthparts (compare figures 2 and 8 with figure 11), and a scoop-shaped T6 (Fig. 7). Such modifications are less marked in *Braunsapis* than in some of the entirely socially parasitic genera, *Eucondylops* Brauns for example, which has protuberances on the frontal area and extremely reduced mouthparts.

Michener (1970) noted that socially parasitic *Braunsapis* exhibited comparatively few adaptations to social parasitism compared to others, with some not even exhibiting a reduction in the tibial hairs (the social parasites with what seems to be a complete scopa are Australian, and likely more recently arisen). Reduction in mouthparts was noted in *B. breviceps*, and this has since been found in the other three Asian species, including the new species described herein. Thus, LbP1 is only slightly longer than the basal depth of the mandible in *B. scorpius*, the two are subequal in *B. breviceps* but LbP1 is more than 1.5× as long as the basal depth of the mandible in the non-socially parasitic *B. hewitti*. The new species has reduced hairs on the mesotrochanter and mesofemur in comparison to those of pollen collecting sympatric *Braunsapis* (compare figures 5 and 12). In contrast, despite being a confirmed social parasite, *B. breviceps* has



Figures 10–12. *Braunsapis hewitti* (Cameron) for comparison with socially parasitic congeners. **10.** Metasoma, dorsal view to show lack of depression on T4 and T5 and lack of sinuate lateral margin of T6 (scale bar = 1 mm). **11.** Apex of head, lateral view to show relatively longer labial palpomeres and glossa in comparison to those of the socially parasitic species (Figs. 2, 8) (scale bar = 0.5 mm). **12.** Base of midleg to show normal development of brush of hairs at base of mesofemur and on mesotrochanter (scale bar = 0.5 mm).

these hairs elaborately developed (Fig. 9) although they presumably serve an entirely different, albeit unknown, function.

Michener *et al.* (2003) suggested that *B. bislensis* probably represented an independent origin of socially parasitic behavior from *B. breviceps* and *B. kaliago* without providing a rationale. The different modifications of the metasomal apex might have prompted this thought with the two latter species having T6 distinctly concave “scoop-shaped” (Reyes, 1991), with distinct lateral “shoulders” (Reyes & Sakagami, 1990; Fig. 7 herein), whereas the T6 of *B. bislensis* is weakly convex and its sides are weakly sinuate (Michener *et al.*, 2003). The new species would seem most similar to *B. bislensis* as the two share extensive pale markings on the metasoma and a T6 without lateral “shoulders”.

Smith *et al.* (2013) provided a phylogeny of 84 allodapines of which 19 were social parasites. They included 24 species of *Braunsapis* (plus two more if *Nasutapis* Michener, which was deeply nested among *Braunsapis*, is added), seven of which were socially parasitic with parasitism arising independently four times within the genus (*Nasutapis* included); none of the taxa treated herein were among those studied, which suggests the possibility of even more independent origins of social parasitism in these bees. Two of the socially parasitic species included by Smith *et al.* (2013) were undescribed species from Malaysia. Neither of them is considered conspecific with *B. scorpilus* in that their metasomas are black and their apparent morphological modifications to social parasitism are less marked than in the new species described herein (Michael Schwarz, pers. comm., 2018). Clearly there remains a great deal to discover about these rarely collected social parasites.

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