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Nematinae (Hymenoptera, Tenthredinidae) of Thailand, with notes on some other southeastern Asian nematines

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Abstract

Nine species in five genera of Nematinae are recorded for the first time from Thailand: *Trichiocampus pruni* Takeuchi, *Dineura sharkeyi*, **sp. n.**, *Moricella rueaensis*, **sp. n.**, *Nematus soidaoi*, **sp. n.**, *Pristiphora chalybeata* Benson, *Pristiphora ettera*, **sp. n.**, *Pristiphora inthanoni*, **sp. n.**, *Pristiphora annetna*, **sp. n.**, and *Pristiphora phahompoki*, **sp. n**. A key is given for the genera and species of Thailand. New records and description of the male are given for *Pristiphora borneensis* Forsius from Sabah, Malaysia, and a new record is given for *Pristiphora sinensis* Wong from China.

Keywords

sawflies, Symphyta, southeastern Asia

Introduction

Nematinae are the dominant sawflies in the arctic and subarctic regions of the world. Numbers of species drop sharply toward the south, and very few occur in tropical regions. In the Western Hemisphere, only a few extend southwards into Mexico

and only six species, all *Pristiphora* Latreille, are native to southern Mexico, Central, and South America (Smith 2003). In southeastern Asia, one species is known from Borneo and only a few from as far south as Myanmar, Taiwan, Thailand, and Vietnam. Benson (1963) first summarized what was known of the southeastern Asian Nematinae, and Wong (1977) treated *Pristiphora* in China and southeastern Asia. Saini and Chambal (1996) and Saini (2006) recognized three *Pristiphora* species from India, and Wei (Wei 1995, 1998, 2002a; in Nie and Wei 1998, 2009; in Wei and Nie 1998, 2002, 2003; in Wei et al. 1999, 2003a, 2003b) described a number of *Pristiphora* species from China. Haris (2007) added an additional species of *Pristiphora*. Nematinae are not commonly collected this far south; therefore, it is intriguing to find and record additional species from these southern localities. During the Thailand Biodiversity Inventory, a collaborative project initiated by M. J. Sharkey, University of Kentucky, Knoxville, and the Queen Sirikit Botanical Garden and the National Parks, Wildlife, and Plant Conservation Department of Thailand, nine species in five genera of Nematinae were collected. Only two of these species corresponds to those treated by Benson (1963), Wong (1977), Saini (2006), Haris (2007), or any Chinese or Palearctic or Holarctic species, and the rest are described as new. It is probable that more will be found through further intense collecting in this region.

Materials and methods

Specimens are deposited in the Queen Sirikit Botanical Garden Entomological Collection, Chiang Mai, Thailand (QSBG); the National Museum of Natural History, Smithsonian Institution, Washington, DC, USA (USNM); and the Bernice P. Bishop Museum, Honolulu, HI, USA (BPBM).

Images for plates were acquired through an EntoVision micro-imaging system. This system included a Leica M16 or Leica DRMB compound microscope with a JVC KY-75U 3-CCD digital video camera or a GT-Vision Lw11057C digital camera attached that fed image data to a notebook or desktop computer. The program Cartograph 5.6.0 was then used to merge an image series (typically representing 30 focal planes) into a single in-focus image. Lighting was achieved using techniques summarized in Buffington et al. (2005), Kerr et al. (2009), and Buffington and Gates (2009). All specimens were mounted from material collected in alcohol.

Results

Nine species in five genera were collected during the Thailand Biodiversity Survey, one species each of *Trichiocampus* Hartig, *Dineura* Dahlbom, *Moricella* Rohwer, and *Nematus* Panzer, and five species of *Pristiphora*.

Key to Genera and Species of Thailand

1 Forewing with base of vein 2A&3A present, joining to 1A to form a small basal anal cell (Fig. 1, left line); vein M joins Sc+R near Rs+M (Fig. 1, right line) ..... ***Trichiocampus pruni* Takeuchi**

– Forewing lacking basal anal cell, 2A&3A straight; M joins Sc+R widely separated from Rs+M (as in Fig. 9, left line) **2**

2 Forewing with vein 2r present (Figs 4, 9); left mandible in lateral view gradually tapering from base to apex **3**

– Forewing with vein 2r absent (as in Fig. 17); left mandible in lateral view with base bulbous and apical portion long, thin, and bladelike **4**

3 Tarsal claws simple ..... ***Dineura sharkeyi* sp. n.**

– Tarsal claws with long inner tooth, longer and stouter than outer tooth ..... ***Moricella rueaensis* sp. n.**

4 Clypeus emarginated (Fig. 12); tarsal claws with long inner tooth; female sheath from above narrowing to acute apex, without scopae ..... ***Nematus soidaoi* sp. n.**

– Clypeus truncate; tarsal claws with small or long inner tooth; female sheath broad at apex, with scopae; *Pristiphora* **5**

5 Female **6**

– Male (*P. inthanoni* and *P. phahompoki* unknown) **10**

6 Third abdominal segment and underside of fourth segment white; body with bluish metallic sheen [inner tooth of tarsal claws about as long as outer tooth; hind tibial spurs half length of hind basitarsomere; hind basitarsomere equal to length of 3 following tarsomeres] (not seen, from Benson 1963; lancet illustrated by Benson, fig. 11) ..... ***Pristiphora chalybeata* Benson**

– Abdomen black or mostly black above and white below; body without metallic sheen **7**

7 Venter of abdomen white; legs white (at most narrow apical ring on hind tibia) (Figs 14–16); 4 cubital cells in forewing; tarsal claws with long inner tooth, equal to or nearly length of outer tooth **8**

– Venter of abdomen black; legs with more black, apical third or half of hind tibiae black, femora mostly black (Figs 17, 19); 3 cubital cells in forewing; tarsal claws with small inner tooth, about half length of outer tooth **9**

8 Pronotum white (Fig. 14); clypeus and supraclypeal area black; serrulae of lancet shallow, flat; serrulae with anterior subapical spurette (Fig. 21) ..... ***Pristiphora ettera* sp. n.**

– Pronotum mostly black (Fig. 15); clypeus and supraclypeal area brown; basal serrulae of lancet broad, rounded, apical serrulae flat; serrulae without anterior subapical spurette (Fig. 22) ..... **Pristiphora inthanoni sp. n.**

9 Antennal length 2.3× head width (Fig. 20); tegula black; apical 1/3 hind tibia and apical 4 tarsomeres black, basitarsomere white; forewing with intercostal

crossvein; serrulae of lancet serrate, annuli with stout spines nearly as long as segment width(Fig. 24) ..... ***Pristiphora phahompoki* sp. n.**

– Antennal length 3.7× head width (Fig. 17); tegula white; apical half of hind tibia and hind tarsus black; forewing without intercostal crossvein; serrulae of lancet deeper, more rounded at apices, annuli with short, fine hairs, length much less than segment width (Fig. 23) ..... ***Pristiphora annetna* sp. n.**

10 Black; penis valve with perpendicular spine across width (Fig. 29) ..... ***Pristiphora chalybeata* Benson**

– Parts of pronotum, tegula, and legs white; penis valve with short, vertical valvispina (Figs 31, 33) **11**

11 Antenna long, 3.7× head width; penis valve broad, rounded on dorsal and ventral margins (Fig. 31) ..... ***Pristiphora annetna* sp. n.**

– Antenna short, about 2.2 X head width; penis valve slender, dorsal and ventral margins straight (Fig. 33) ..... ***Pristiphora ettera*, sp. n.**

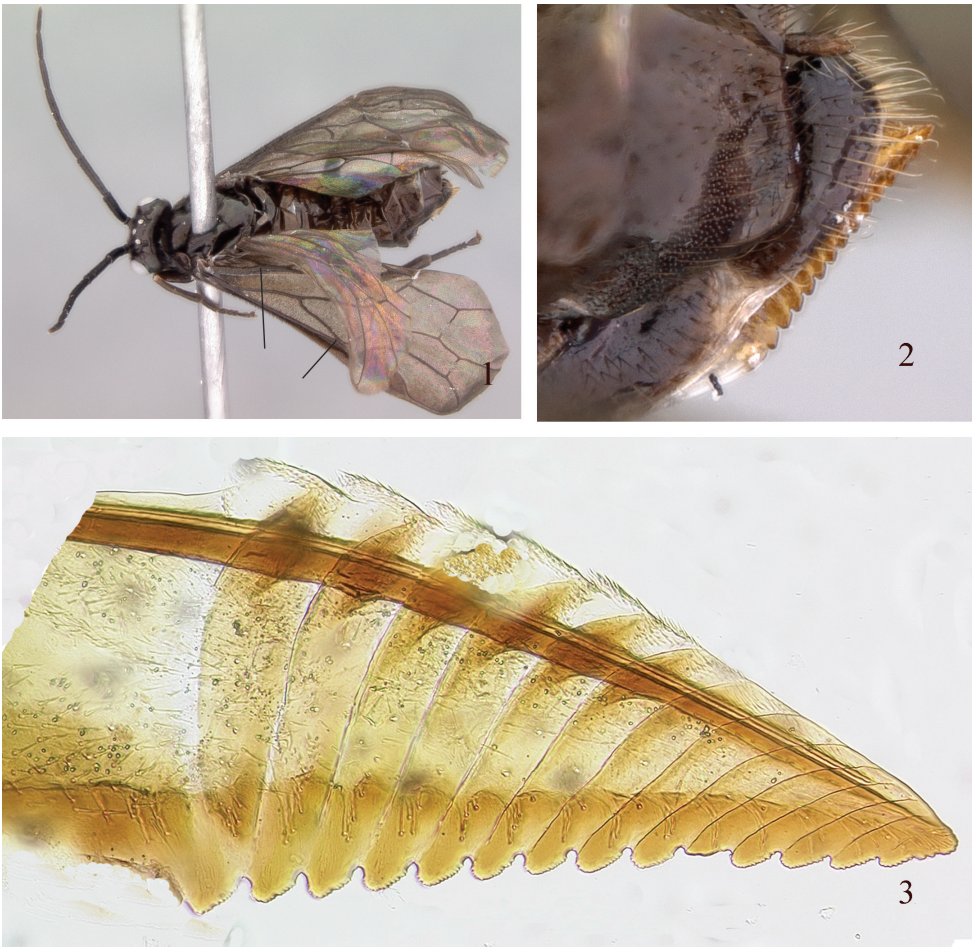
***Trichiocampus pruni* Takeuchi**
http://species-id.net/wiki/Trichiocampus_pruni
Figs 1–3

Trichiocampus pruni Takeuchi 1956: 78, Figs 11, A–D.
Cladius takeuchii Liston, Taeger, and Blank, in Blank et al. 2009: 20. New name for *Trichiocampus pruni* Takeuchi, considered a secondary homonym of *Priophorus pruni* Rohwer, 1922, if all placed in *Cladius*.

Description. Female. Length, 6.0 mm. Entirely black; wings uniformly infuscated. Antennal length 3.0× head width; 3rd antennomere 0.7× length of 4th antennomere. Malar space 2.0× diameter of front ocellus. Lower interocular distance 1.4× eye height. Tarsal claw with long inner tooth, almost equal in length and width to outer tooth; with very small, indistinct basal lobe. Fore and hind basitarsomere subequal in length to following 3 tarsomeres combined. Sheath from above broad at base, evenly tapering to acute apex; in lateral view rounded with long, curved hairs (Fig. 2). Lancet (Fig. 3) broadly triangular; annuli without teeth or hairs; basal 6 annuli curved dorsally; serrulae lobelike, asymmetrical, with fine subbasal teeth.

Male. Not seen. Described as similar to the female and male genitalia illustrated by Takeuchi (1956).

Material examined. "THAILAND Mae Hong Son, Namtok Mae Surin NP, Visitor's center, 19°21.593'N, 97°59.254'E, 228 m, Malaise trap, 19–26.viii.2007, Manu Namadkum leg., T5872"; "THAILAND Chiang Mai, Doi Phahompok NP, Doi Phaluang, 20°1.06'N, 99°9.581'E, 1449 m, Malaise trap, 14–21.x.2007, P. Wongchai leg., T6187"; "THAILAND Chiang Mai, Doi Phahompok NP, Doi Phaluang, 20°0.966'N, 99°9.579'E, 1449 m, Malaise trap, 7–14.viii.2007, Komwuan Srisom & Prasit Wongchai leg., T2850" (QSBG, USNM).



Figures 1–3. *Trichiocampus pruni* **1** Dorsolateral view; left line points to basal anal cell; right line to position of M joining Sc+R **2** Sheath and ovipositor **3** Lancet.

Discussion. This species belongs to the tribe Cladiini, characterized by the forewing venation: vein M meeting Sc+R close to the point where Rs meets Sc+R and vein 2A+3A complete, fused with 1A at its center and forming a basal anal cell. For Cladiini, Benson recorded *Priophorus nigricans* (Cameron) and *P. brullei* Dahlbom from Myanmar, and *Cladius pectinicornis* (Geoffroy) from the Himalayas. All three have a narrow, well-sclerotized lancet with lateral teeth on the annuli, not the *Trichiocampus*-like saw as in Fig. 3, which is broadly triangular, lacks annular spines or hairs, and has deep, rounded serrulae.

I refer the Thai specimens to *Trichiocampus pruni* because of their similarity to the description and illustrations of *T. pruni* provided by Takeuchi (1956). The serrulae of the Thai specimens are slightly more asymmetric than those illustrated by Takeuchi, but other than this they appear identical. *Trichiocampus pruni* was described from the Kuriles and Japan (Hokkaido and Honshu) and has since been

recorded in China (Nie and Wei 2009), so it is not improbable that it could occur as far south as Thailand.

Nie and Wei (2009) included *T. pruni* in their key to the *Trichiocampus* species of China. It is the only entirely black species they treat. In the key, two groups of *Trichiocampus* are distinguished in the first couplet, one with the fore- and hind basitarsomeres distinctly shorter than the three following tarsomeres together and the other with the fore- and hind basitarsomeres longer than the three following tarsomeres together. *Trichiocampus pruni* is included with those species with the fore and hind basitarsomeres "distinctly shorter" that the three following tarsomeres together. Takeuchi (1956) described the front basitarsomere about as long as the three following together, and in the Thai specimens, the fore and hind basitarsomeres are subequal to the length of the three following tarsomeres together; thus, the Thai specimens examined could not be keyed past couplet one in Nie and Wei (2009).

I consider *Trichiocampus* as a valid genus, following Smith (1974), Smith (1979), and Nie and Wei (2009). *Trichiocampus pruni* is therefore not a secondary homonym, and the replacement name *Cladius takeuchii* is unnecessary. Therefore I use *T. pruni* as the valid name (ICZN 1999, Article 59.4).

***Dineura sharkeyi* Smith, sp. n.**
urn:lsid:zoobank.org:act:F3422910-6C2D-431D-929A-411D54CFEF8
http://species-id.net/wiki/Dineura_sharkeyi
Figs 4–7

Description. Female. Length, 4.5 mm. Head black with clypeus brown and mouthparts white. Thorax black with posterior angles or pronotum and tegulae white; small orange-brown spot on central posterior margin of mesepisternum. Legs white with femora light orange. Abdomen brown, lighter than thorax, with narrow posterior margin of segments white; sheath black; 9th tergite, cercus, and apical sternite orange brown. Wings hyaline; veins and stigma brown with extreme bases of veins white.

Head and thorax shiny, with fine white pubescence; abdomen shiny with very fine microsculpture on tergites. Antennal length (apical antennomere missing) about 2.1× head width; 3rd antennomere subequal in length to 4th antennomere. Clypeus circularly emarginated, emargination about half medial length of clypeus. Malar space about 1.5× diameter of front ocellus. Postocellar area 3.6× broader than long. Left mandible evenly tapering from base to apex. Distance between eye and lateral ocellus about 1.2× distance between lateral ocelli. Lower interocular distance 1.6× eye height. In dorsal view, head rounded behind eyes, distance behind eyes about 0.8× eye length. Forewing with 2A+3A straight; 2r present; crossvein 2r-m absent; intercostal crossvein basal to M. Hind basitarsomere subequal to length of following 3 tarsomeres combined. Tarsal claws simple. Tibial spurs short, inner spur about 0.4× length of basitarsomere. Sheath simple (Fig. 6), from above broad at base evenly tapering to acute apex; hairs straight.

Figures 4–7. *Dineura sharkeyi*, holotype **4** Lateral view; line points to vein 2r **5** Dorsal view **6** Apex of abdomen and sheath, dorsal view **7** Lancet.

Cerci shorter than sheath in dorsal view. Lancet long, slender, well sclerotized, serrulae most evident on apical third; annuli with short, stout spines (Fig. 7).

Male. Unknown.

Holotype. Female labeled "Thailand, Soi Dao, 500-1850 m., sweep, UTM 1429610, Jan. 16, 2005, Sharkey" (QSBG).

Etymology. The species is named for the collector, M. J. Sharkey, University of Kentucky.

Discussion. This species is assigned to *Dineura*. It shares most characters with species of *Dineura* except for the simple tarsal claws and absence of vein 2r-m in the forewing: broad malar space, emarginated clypeus, forewing with vein 2r present, intercostal crossvein basal to vein M, and similarities of the sheath and lancet. All other species have the tarsal claw with long inner tooth. The lancet is almost identical to species in *Pristiphora* subgenus *Sharliphora*, previously known as the *Pristiphora ambigua* group. The lancets of the three *Pristiphora* (*Sharliphora*) species are illustrated by Wong (1969: Figs 1–6), and that of *P. amphibola* (Förster) is the closest. However, *Dineura sharkeyi* shares most characters with *Dineura* and cannot be a *Pristiphora*.

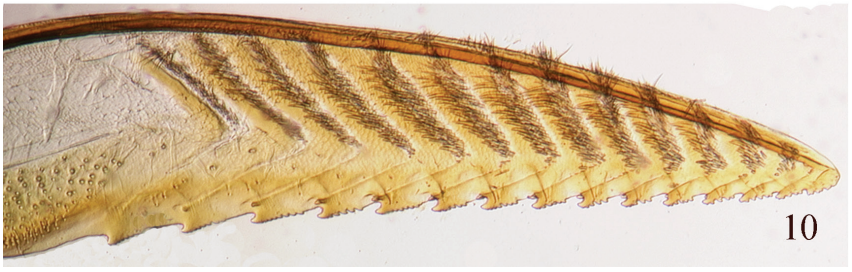
Dineura sharkeyi differs from the two species known from China, *D. blanki* Wei and *D testaceipes* (Klug) by the simple tarsal claws and long lancet with short annular spines. Other species of the genus have a long inner tooth on the tarsal claws and the lancet is shorter and broader and usually with long annular teeth on the central segments (Wei 2002b, Schmidt and Walter 1995).

***Moricella rueaensis* Smith, sp. n.**
urn:lsid:zoobank.org:act:7DFF3E30-74B9-400D-A337-1B2EA0FF09C2
http://species-id.net/wiki/Moricella_rueaensis
Figs 8–10

Description. Female. Length, 8.0 mm. Antenna black. Head black with clypeus light orange, apex of mandible red brown, labrum and maxilla white to light orange with upper surfaces mostly black. Thorax and abdomen orange; sheath black. Legs orange with apical foretarsomere black, midtarsus brown to black, and apical half of hind femur, tibia, and tarsus black. Wings hyaline; veins and stigma black.

Head smooth, shiny, without punctures. Antennal length 2.3× head width; 3rd antennomere 1.2× length of 4th antennomere. Clypeus short, broad, about 4.0× broader than long, slightly broadly emarginated in front. Malar space short, about 0.25× diameter of front ocellus. Left mandible evenly tapering from base to apex. Distance between eye and hind ocellus subequal to distance between hind ocelli; postocellar area about 2.0× broader than long. Lower interocular distance about 1.1× eye height. Forewing with 3 cubital cells; intercostal crossvein absent; crossvein 2r present in one wing, absent in the other. Pulvilli small, on tarsomeres 1–4. Inner hind tibial spur about ¼ length of hind basitarsomere and equal to width of hind tibia at apex. Hind basitarsomere 1.1× length of remaining tarsomeres combined. Tarsal claws with long inner tooth, equal in length to outer tooth. Sheath from above broad, with short lateral scopae (similar to Benson 1968, fig. 412). Lancet (Fig. 10) with 15 serrulae; annuli strongly curved, V-shaped, with thick, stout spines on dorsal curve and lacking hairs or spines on ventral curve; serrulae with 6 or 7 subbasal teeth on basal serrulae, gradually decreasing to 3 or 4 on apical serrulae; serrulae 2–10 with small spurette dorsal to anterior margin of serrula.

Male. Unknown.



Figures 8–10. *Moricella rueaensis*, holotype **8** Lateral view **9** Dorsal view; left line points to position of M joining Sc+R, right line points to vein 2r **10** Lancet.

Holotype. Female, labeled "THAILAND Loei, Phu Ruea NP, Pah Lo Nay, 17°30.502'N, 101°20.868'E, 1343 m, Malaise trap, 26.ix–2.x.2006, Nu Koonchal Jaaroenchal leg., T833" (QSBG).

Etymology. The species name is derived from the type locality, Phu Ruea National Park.

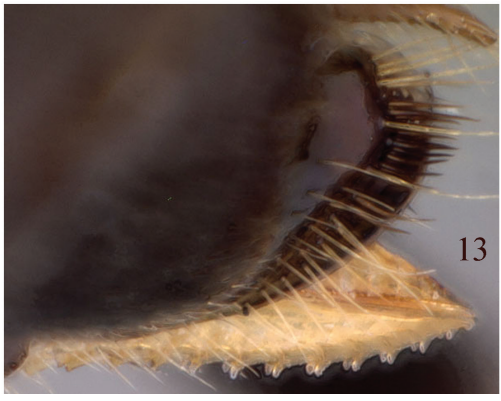
Discussion. *Moricella* is close to *Mesoneura* and *Dineura* and is characterized by the narrower malar space equal to or less than diameter of the front ocellus, clypeus truncate with slight median depression; pentagonal area obsolete; left mandible in lateral view evenly tapering from base to apex, third antennomere slightly longer than the fourth, forewing with intercostal crossvein present and interstitial with vein M and with four cubital cells, the hind basitarsomere equal to the following three tarsomeres combined, and the tarsal claws cleft with the inner tooth slightly long and broader than the outer tooth. The new species shares most characters with *Moricella* except the forewing lacks the intercostal crossvein and has only three cubital cells. Because of the similarities, including the presence of spurettes near the serrulae and stout, thick spines on the annuli of the lancet, I place this species in *Moricella*. *Moricella* includes two other species, *M. rufonota* Rohwer (1916) from Taiwan and *M. nigrita* Wei, 1998, from Yunnan, China. Wei (1998) illustrated both species. Wu et al. (1982) recorded the host of *M. rufonota* as *Cinnamomum camphora* Nees. and Eberm. (Lauraceae).

The orange thorax and abdomen and mostly orange legs are diagnostic for *M. rueaensis*. *Moricella rufonota* is black with the pronotum, mesonotum, and upper half or more of the mesepisternum red and the legs have the coxae white apically, femora black, and tibiae white except for the black apical quarter of the hind tibia.

***Nematus soidaoi* Smith, sp. n.**
urn:lsid:zoobank.org:act:058DF73A-3702-41E2-AB39-CA729691B715
http://species-id.net/wiki/Nematus_soidaoi
Figs 11–13

Description. Female. Length, 7.5 mm. Antenna and head black; spot at center of clypeus, labrum, and mouthparts white. Thorax black with posterior half of pronotum and tegula white. Abdomen and sheath black. Foreleg mostly white, coxa at apex, trochanter, femur except basal and apical parts black; midleg mostly white, coxa at apex and apex of tibia and apical 4 tarsomeres brown to black; hind leg with coxa at apex white, femur black with extreme basal and apical parts white; tibia with two-thirds white, apical third black; basitarsomere with basal half white and apical half black, rest of tarsomeres black. Wings hyaline, veins and stigma black.

Head and body smooth, shiny, without punctures; with fine white pubescence. Antennal length 2.3× head width; 3rd antennomere subequal in length to 4th antennomere. Clypeus roundly emarginated anteriorly. Malar space equal to diameter of front ocellus. Left mandible bulbous at base, apical portion slender. Lower interocular distance 1.3× eye height. Distance between eye and hind ocellus 0.7× distance between



Figures 11–13. *Nematus soidaoi*, holotype **11** Lateral view **12** Head, front view **13** Sheath and lancet.

hind ocelli; postocellar area about 2.6× broader than long. Forewing with intercostal crossvein present, basal to M; 3 cubital cells. Hind basitarsomere about 0.8× length of remaining tarsomeres combined; pulvilli large, almost equal to breadth of tarsomeres, on tarsomeres 1–4. Hind tibia with longitudinal groove on outer surface. Tarsal claws with long inner tooth, slightly shorter than outer tooth. Inner hind tibial spur about half length of hind basitarsomere and slightly longer than apical width of hind tibia at apex. Sheath in dorsal view broad at base with slight, rounded scopae much shorter than central portion, central portion acuminate at apex, with long setae arising from scopae; in lateral view straight above, rounded below (Fig. 13). In dorsal view, cerci equal to sheath length. Lancet (Fig. 13) with serrula long, lobelike, length more than 2× width.

Male. Unknown.

Holotype. Female, labeled "Thailand, Soi Dao, 500-1850 m, sweep, UTM 1429610, Jan. 16, 2005, Sharkey" (QSBG).

Etymology. The species name is derived from the type locality.

Discussion. This species is assigned to *Nematus* by similarity of the long inner tooth of the tarsal claws, emarginated clypeus, and similar wing venation. I have not seen any species of *Nematus* with such long, lobelike serrulae (Fig. 13). The basal rounded portion of the sheath with long setae representing small lateral scopae (as can be seen in the lateral view in Fig. 13) is also unusual for species of *Nematus*, most of which have an evenly slender sheath in dorsal view. Because the lancet is partly exerted and the long serrulae are diagnostic, I have not dissected the specimen for a close-up of the lancet.

Pristiphora **Latreille**

http://species-id.net/wiki/Pristiphora

Discussion. This is a large Holarctic genus with well over 100 species (Taeger et al. 2010). All species treated here, except *P. chalybeata*, differ from the others described from southeastern Asia, and I have found nothing in the Palearctic fauna that agree with these species. I have checked descriptions and available specimens of species treated by Benson (1958), Wong (1960, 1977), Saini (2006), Haris (2006, 2007), and in the literature covering species from China. Taeger et al. (2010) separated several subgenera of *Pristiphora* but the species from southeastern Asia were not assigned to subgenus. So far as I can tell, all species examined and for which the original descriptions were checked would belong to the subgenus *Pristiphora*.

Wong (1960, 1977) proposed several species complexes. The species he treated in 1977 were placed in the *chlorea* complex and the *pallidiventris* complex, with one species, *P. sinensis* Wong, not assigned to a complex but placed near *P. geniculata* (Hartig).

The *pallidiventris* complex of Wong (1977) includes the largest number of species, characterized by the lack of hairs or spines on the annuli of the lancet (as in Fig. 25), the annuli on the lancet becoming progressively more slanted towards the apex, a short scopa on the sawsheath, pale venter of the abdomen, antenna pale beneath, and penis valve of male with a valvispina located vertically near the center of the apically tapered paravalva. None of the species described here fall into this complex. The following species from southeastern Asia were checked, and all lack hairs or spines on the annuli and appear to belong to the *pallidiventris* complex: *P. alta* Saini and Chambal, 1996 (India: West Bengal); *P. basidentata* Wei, 1998 (in Wei and Nie 1998) (China: Zhejiang); *P. caiwanzhii* Wei, 1998 (in Nie and Wei 1998) (China: Henan); *P. chonganica* Wei, 2003 (in Wei and Nie 2003) (China: Fujian); *P. ecarinata* Saini and Chambal, 1996 (India: Himachal Pradesh, Uttarauchal); *P. formosanus* Rohwer, 1916 (Taiwan) (Fig. 25); *P. lii* Wei, 1998 (in Nie and Wei 1998) (China: Henan); *P. longitangia* Wei, 1998 (in Wei and Nie 1998) (China: Zhejiang); *P. melanopygiolia* Wei, 1999 (in Wei et al. 1999) (China: Henan); *P. nigrotarsalina* Wei, 2003 (in Wei et al. 2003a) (China: Guangxi); P. *obliqualis* Wei, 2003 (in Wei and Nie 2003) (China: Fujian); *P. sauteri* Rohwer, 1916 (Taiwan); *P. tuberculatina* Wei, 2003 (in Wei and Nie 2003) (China: Fujian); *P. zhongi* Wei, 2002 (China: Henan).

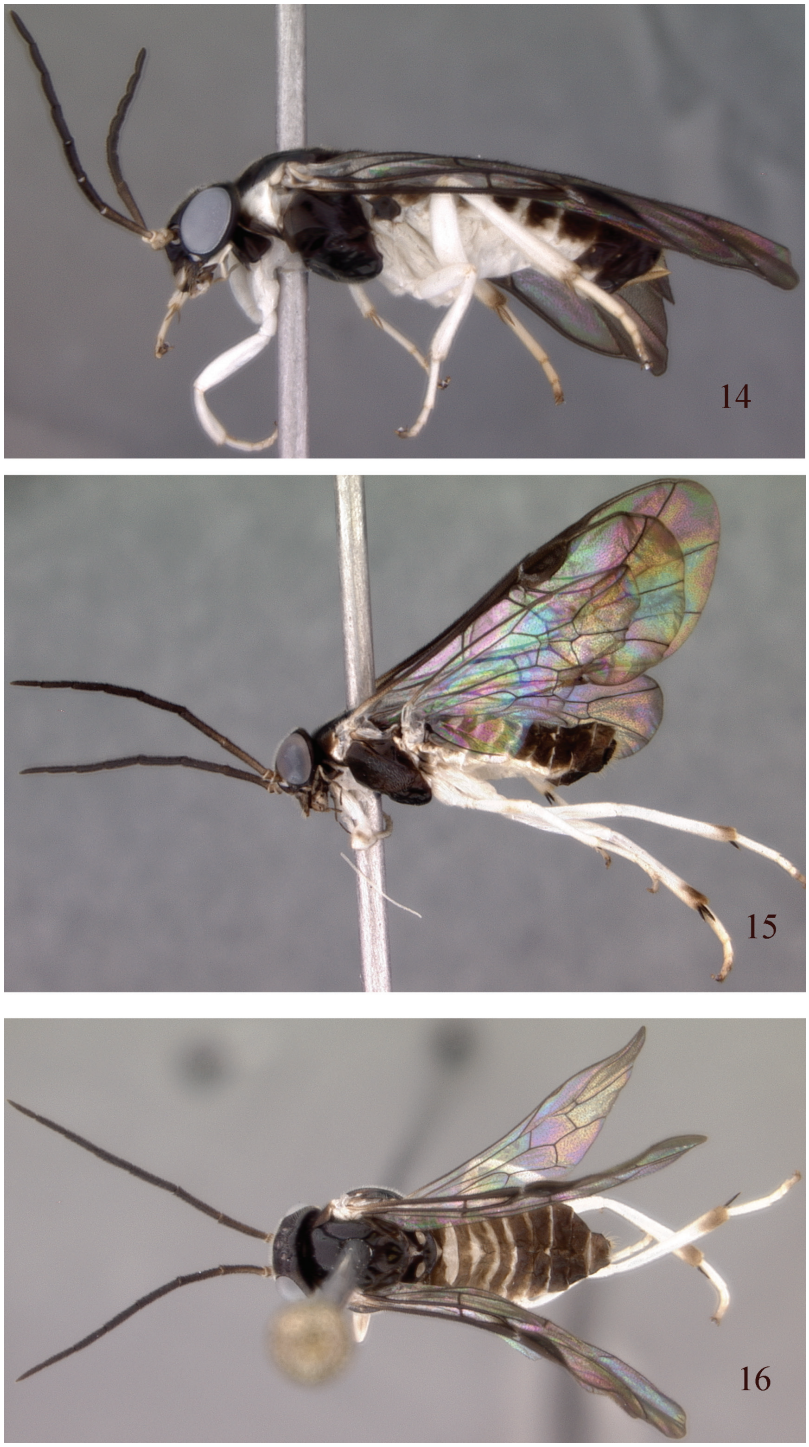
The *chlorea* complex of Wong (1977) includes those species with the tarsal claw with a prominent inner tooth, the lancet with stout annular spines or hairs, concave basal annuli, and median annuli not reaching the dorsal margin, the lance with a carina on the radix, and males with a hooklike valvispina. Wong (1977) included *P. borneensis* Forsius, 1933 (Malaysia: Sabah) and *P. nankingensis* Wong, 1977 (China: Nanking) in this complex, and, according to descriptions, *P. chalybeata* Benson, 1963 (Myanmar), *P. lineogenata* Wei, 2002 (in Wei and Nie 2002) (China: Guizhou), *P. rufocincta* Benson, 1963 (Myanmar), *P. nigrescenta* Saini and Chambal, 1996 (India: Uttaranchal), and *P. zhejiangensis* Wei, 1995 (China: Zhejiang) may fall into this complex. The species described here may also belong to this complex, but none have the lancet structure similar to the above and the males, where known, do not have a hooklike valvispina. Thus, these new species appear to be closest to those included in the *geniculata* group of Wong (1960, 1977). Also, the male of *P. borneensis*, described below, was unknown to Wong (1977), and it does not have the hooklike valvispina typical for this complex (Fig. 27).

Pristiphora oligalucina Wei, 2002a (China: Henan), is said to have no annular hairs (Wei 2002a), which would place it in the *pallidiventris* complex, but the species is stated to be near *P. geniculata*, which might place it near *P. sinensis* (China: Fujian, Nanking). I am unable to place *P. beijingensis* Zhou and Zhang, 1993 (in Zhou et al. 1995), but this occurs farther north in the Beijing area, is associated with *Populus* sp., and is unlikely to occur in Thailand. *Pristiphora lamdongensis* Haris, 2007, cannot be placed because the lancet was not illustrated. It differs from all species described here by the very minute inner tooth of the tarsal claws. The species described here have a long inner tooth half or more the length of the outer tooth. Haris (2007) also noted that the elongated maxillary palpus and brown rounded spot in the first cubital cell in the forewing are unique.

Both *P. chalybeata* Benson and *P. rufocincta* Benson have the abdomen red or yellow; the former has the third abdominal segment red in the female but the male recorded below has identical male genitalia as Benson (1963) illustrated though it is mostly black. All species described here have the abdomen black or mostly black above and white below.

***Pristiphora ettera* Smith, sp. n.**
urn:lsid:zoobank.org:act:18A4769D-60A4-4890-B62C-9608705C28C3
http://species-id.net/wiki/Pristiphora_ettera
Figs14, 21, 32, 33

Description. Female. Length, 7.0 mm. Antenna black; scape and pedicel white. Head black with labrum and palpi white. Thorax black; tegula, pronotum, and postspiracular sclerite (except anterior margin) white; mesoscutellum white at center, black at sides, scutellar appendage and metanotum pale orange. Abdomen with basal plates black; tergites 4–5 with broad anterior halves half or more black; posterior portion



Figures. 14–16. *Pristiphora*, holotypes **14** *P. ettera*, lateral view **15** *P. inthanoni*, lateral view **16** *P. inthanoni*, dorsal view.

black, 6-9 with very narrow posterior portion white; sheath black. Legs white, only apical tarsomeres black. Wings hyaline, veins and stigma black.

Head and body shiny, with fine, minute punctures; covered with fine, white pubescence. Antennal length 2.3× head width; 3rd and 4th antennomeres subequal in length. Malar space linear. Distance between eye and hind ocellus subqual to slightly shorter than distance between hind ocelli. Postocellar area 2.4× broader than long. Lower interocular distance slightly less than eye height. Forewing with 4 cubital cells; intercostal crossvein present and interstitial with M. Pulvilli small; only evident on tarsomeres 3 and 4. Hind basitarsomere subequal to slightly shorter than length of remaining tarsomeres combined; inner hind tibial spur about 0.4× length of basitarsomere and subequal to width of hind tibia at apex. Tarsal claws with long inner tooth, about equal in length and width of outer tooth. Sheath broadened at apex, with distinct rounded scopae (similar to Benson 1958, fig. 414). Lancet (Fig. 21) with 14 serrulae; each with 6–8 very fine subbasal teeth, large spurette dorsal to anterior edge of serrulae 3 to apex, spurette about as large as serrula; basal annuli curved, each with broad band of long stout spines.

Male. Length, 6.5 mm. Similar to female except head with clypeus and spot on lower inner orbit white; pronotum black with posterior edge narrowly white; and mesoscutellum black. Malar space about half diameter of front ocellus. Lower interocular distance about 1.1× eye height. Forewing with intercostal crossvein present and basal to vein M; with 3 cubital cells. Genitalia in Figs 32, 33; penis valve slender, with a short small valvispina directed vertically near center of valve.

Type material. Holotype female, labeled "THAILAND Chiang Mai, Huai Nam Dang NP, Helipad, 19°18.33'N, 98°36.289'E, Malaise trap, 14–21.xi.2007, Anuchart & Thawatchai leg., T5550" (QSBG). Paratypes: "THAILAND, Han Doi Kha NP, Office 12, 19°12.138'N, 101°4.711'E, 1331 m, Malaise trap, 8–15.xi.2007, Chavoen & Nikom leg., T3261" (1 ♀); "THAILAND Chiang Mai, Doi Phahompok NP, Doi Phaluang, 20°1.06'N, 99°9.581'E, 1449 m, Malaise trap, T2928, 20–27.vii.2007, Wongchai P. leg." (1 ♂); "THAILAND, Chiang Mai, Doi Phahompok NP, Kiewlom1/montane forest, 20°3.549'N, 99°8.552'E, 2174 m, Malaise trap, 21–28.v.2008, P. Wongchai leg. T6100" (1 ♂); "THAILAND Chiang Mai, Doi Phahompok NP, Kiewlom1/montane forest, 20°3.549'N, 99 °8.552'E, 2174 m, Malaise trap, 21–28.x.2007, P. Wongchai leg. T6181" (2 ♂); "THAILAND Chiang Mai, Doi Phahompok NP, Doi Phaluang, 20°1.06'N, 99°9.581'E, 1449 m, Malaise trap, –14.xi.2007, P. Wongchai leg, T6209" (2 ♂); "THAILAND Chiang Mai, Doi Phahompok NP, Doi Phaluang, 20°1.06'N, 99°9.581'E, 1449 m, Malaise trap, 21–28.xi.2007, P. Wongchai leg., T6211" (2 ♂); "THAILAND Chiang Mai, Doi Phahompok NP, Doi Phaluang, 20°1.06'N, 99°9.581'E, 1449 m, Malaise trap, 21–28.x.2007, P. Wongchai leg., T6188" (1 ♂). (QSBG, USNM).

Etymology. The species name is an arbitrary combination of letters and is to be treated as a noun.

Discussion. I have not seen other species of *Pristiphora* with large spurettes above the serrulae plus the strong, stout spines on the annuli (Fig. 21). The only other *Pris-*

tiphora species illustrated that apparently has such spurettes on the lancet is *P. lineogenata* Wei (in Wei and Nie 2002: fig. 67) from Guizhou Province, China, but Wei illustrated only two serrulae and he compares his species with *P. borneensis*, with which *P. ettera* has no similarities (see Wong 1977: fig.15). *Pristiphora etteri* also has the scape, pedicel, mesoscutellum, posterior margins of the tergites, and the sternites white, whereas these are black in *P. lineogenata*. The male penis valve (Fig. 33) is similar to that of *P. sauteri*, illustrated by Wong (1977: fig. 8).

***Pristiphora inthanoni* Smith, sp. n.**
urn:lsid:zoobank.org:act:C1D614DE-036A-4656-9B59-BD9F747D29F8
http://species-id.net/wiki/Pristiphora_inthanoni
Figs 15, 16, 22

Description. Female. Length, 5.0 mm. Antenna black, scape and pedicel and undersurface of flagellomeres 1 and 2 brown. Head black with supraclypeal area, clypeus, and labrum brown; mouthparts white. Thorax black with postspiracular sclerite, and tegula white; posterior margin of metapleuron white. Legs white, apical ring on hind tibia black. Abdomen black above; tergites 2 to apex with narrow white posterior band; venter white except apical 3 sternites and sheath black. Wings hyaline, veins and stigma black.

Head and body shiny, finely punctuate, covered with fine white pubescence. Antennal length 2.8× head width; 3rd antennomere equal in length to 4th antennomere. Malar space equal to about half diameter of front ocellus. Distance between eye and hind ocellus about 0.9× distance between hind ocelli. Postocellar area about 3.0× broader than long. Lower interocular distance slightly longer than eye height. Forewing with intercostal crossvein present, interstitial with M; 4 cubital cells (vein separating first two faint). Pulvilli small, on tarsomeres 1–4. Hind basitarsomere subequal to length of remaining tarsomeres combined; inner hind tibial spur about 0.5× length of basitarsomere and slightly longer than width of hind tibia at apex. Tarsal claws with long inner tooth, slightly shorter than outer tooth. Sheath broadened at apex, with rounded distinct lateral scopae (similar to Benson 1958, fig. 414). Lancet (Fig. 22) with 14 serrulae, serrulae diminishing in size toward apex and apical portion without serrulae; basal 7 serrulae rounded, becoming flatter toward apex, subbasal teeth absent; annuli curved, each with band of stout spines; spines on upper half of annuli 1 and 2, complete on annuli 3 and 4, on lower half or less of annuli 5–11, and absent at apex.

Male. Unknown.

Holotype. Female labeled "THAILAND Chiang Mai, Doi Inthanon NP, Checkpoint 2, 18 °31.554'N, 98 °29.940'E, 1700 m, Malaise trap, 24.xi–1.xii.2006, Y. Areeluck leg., T1870" (QSBG).

Etymology. The species name is derived from the type locality, Doi Inthanon National Park.

Discussion. The lancet with rounded serrulae at the base becoming flatter toward the apex and absent at the extreme apex, the white legs and venter of the abdomen, and mostly black pronotum are characteristic for this species. It is similar to *P. ettera* in color except for the mostly black pronotum and brown clypeus and supraclypeal area. The color is also similar to *P. formosana,* but the lancet of *P. formosana* lacks annular spines or hairs (Wong 1977: fig. 20).

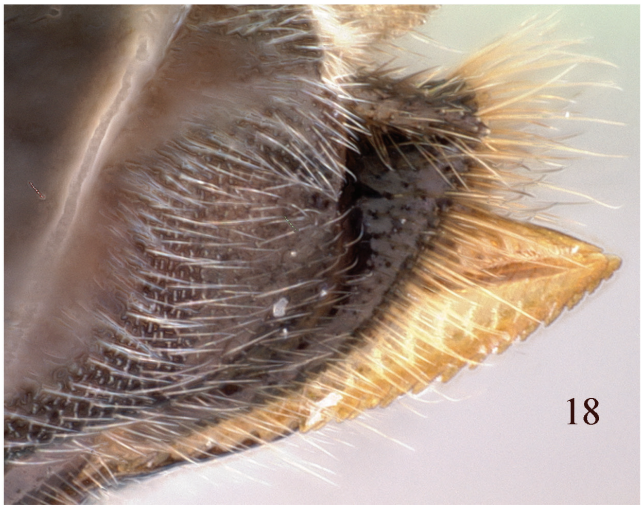
***Pristiphora annetna* Smith, sp. n.**
urn:lsid:zoobank.org:act:2C754930-3974-4B0B-AE8E-CBAAECF6C03D
http://species-id.net/wiki/Pristiphora_annetna
Figs 17, 18, 23, 30, 31

Description. Female. Length, 6.0 mm. Black with anterior edge of labrum and mouthparts dull white; scape and pedicel white at apices; tegula and postspiracular sclerite white; apical third of mesoscutellum white. Legs with trochanters white; foreleg white with coxa and inner surface of femur black; midleg with coxa black, trochanter white, femur black, tibia white on basal three-fourths, brown on apical fourth, tarsus with basitarsomeres white to brown with remaining tarsomeres black; hind leg with coxa black, trochanter and base of femur white, basal two-fifths of tibia white, apical three-fifths of tibia and entire tarsus black. Abdomen black. Wings hyaline; veins and stigma black.

Head smooth, shiny, without punctures; head and body densely covered with fine white pubescence. Antennal length 3.7× head width; 3rd antennomere equal to length of 4th antennomere. Malar space about half diameter of front ocellus. Distance between eye and hind ocellus about 0.8× distance between hind ocelli. Postocellar area 3.0× broader than long. Lower interocular distance slightly longer than eye height. Forewing with intercostal crossvein absent; with 3 cubital cells. Pulvilli minute, on tarsomeres 1–4. Tarsal claws with small inner tooth, about half length of outer tooth. Hind basitarsomere subequal to or very slightly shorter than length of remaining tarsomeres combined; hind tibial spur about 0.4× length of hind basitarsomere and equal to width of inner hind tibia at apex. Sheath broadened at apex, with distinct lateral scopae (similar to Benson 1958, fig. 414). Lancet (Fig. 23) with about 19 serrulae, serrulae on basal half rounded, those on apical half becoming flat, with very fine subbasal teeth; annuli straight but basal 3 or 4 slanted forward, each with very narrow band of fine hairs less than half width of segments.

Male. Length, 5.0 mm. Similar to female except malar space narrower, almost linear, about ¼ width of front ocellus and postocellar area about 2.2× broader than long. Genitalia in Figs 30, 31; penis valve oval, dorsal and ventral margins rounded, with a short, small valvispina directed vertically near center of valve.

Type material. Holotype female labeled "THAILAND Nan Doi Phu Kha NP, Office 14, 19°12.488'N, 101 °4.907'E, 1375 m, Malaise trap, 22–29.xii.2007, Charoen & Nikim leg., T3280" (QSBG). Paratype: Same data as for holotype (1 ♂, USNM).



Figures 17–18. *Pristiphora annetna*, holotype **17** Lateral view **18** Apex of abdomen, sheath, and lancet.

Etymology. The species name is an arbitrary combination of letters and is to be treated as a noun.

Discussion. This species seems closest to *P. lamdongensis* from southern Vietnam, sharing the 3 cu cells and lack of the intercostal crossvein in the forewing and the small inner tooth of the tarsal claws. However, the inner tooth of the tarsal claws is minute in *P. lamdongensis* (Haris 2007: fig. 10), whereas it is about half the length of the outer tooth in *P. annetna*. The unusually long antennae, which are 3.7× the head width (Fig. 17), are also distinctive for this species. Haris (2007) compares the length of the

antenna as equal to the body length, though they are shorter than the body length in his illustration (Haris 2007: fig. 11). The antennae are about as long as the body length in *P. annetna*. *Pristiphora annetna* might also be confused with *P. sauteri*, but the lancet of *P. sauteri* lacks annular spines or hairs (Benson 1963: fig. 12) and the pronotum is largely white and only the apex of the hind femora and apical quarter of the hind tibiae are black to dark brown.

***Pristiphora phahompoki* Smith, sp. n.**
urn:lsid:zoobank.org:act:1E7C000E-C40A-4FFF-92DA-12223DCDF1A6
http://species-id.net/wiki/Pristiphora_phahompoki
Figs 19, 20, 24

Description. Female. Length 5.5 mm. Black; mouthparts brown. Foreleg white with inner surface of femur black. Mid- and hind legs white; femora and apical third or less of hind tibiae black and apical four tarsomeres of hind leg brown to black. Wings hyaline, veins and stigma black.

Head smooth and shiny, covered with fine, white pubescence, without noticeable punctures. Antennal length 2.3× head width; 3rd antennomere equal in length to 4th antennomere. Malar space about half diameter of front ocellus. Lower interocular distance 1.2× eye height. Distance between eye and hind ocellus 0.8× distance between hind ocelli. Postocellar area about 2.7× broader than long. Forewing with intercostal crossvein present, basal to vein M; with 3 cubital cells. Pulvilli small, on tarsomeres 1–4. Hind basitarsomere slightly shorter than length of remaining tarsomeres combined. Hind tibial spurs about 0.4× length of hind basitarsomere. Tarsal claws with long inner tooth, slightly more than half length of outer tooth. Sheath broadened at apex, with lateral scopae (similar to Benson 1958, fig. 414). Lancet (Fig. 24) with about 20 serrulae, serrulae flat with very fine subbasal teeth; basal 3 annuli slightly curved, rest straight, each annulus with stout spines more than half width of segments, spines only on upper portion of annuli 1 and 2.

Male. Unknown.

Holotype. Female labeled "THAILAND Chiang Mai, Doi Phahompok NP, Kewlom1/montane forest, 20°3.549'N, 99°8.552'E, 2174 m, Malaise trap, 28.ii-7.iii.2008, Seesom. K. leg, T2960" (QSBG).

Etymology. The species name is derived from the type locality, Doi Phahompok National Park.

Discussion. This species is mostly black, similar to *P. annetna*, but the antennae are short, only about 2.2× the head width, the tegulae are black, the basitarsomeres are white, the forewing has the intercostal crossvein, and the lancet (Fig. 24) has flatter serrulae and longer annular spines. I have not found other species of *Pristiphora* with the color combination and lancet characters of this species.

Figures 19–20. *Pristiphora phahompoki*, holotype **19** Lateral view **20** Dorsal view.

***Pristiphora chalybeata* Benson**
http://species-id.net/wiki/Pristiphora_chalybeata
Figs 28, 29

Pristiphora chalybeata Benson 1963: 23, Figs 6, 11

Description. Female. Described by Benson (1963).

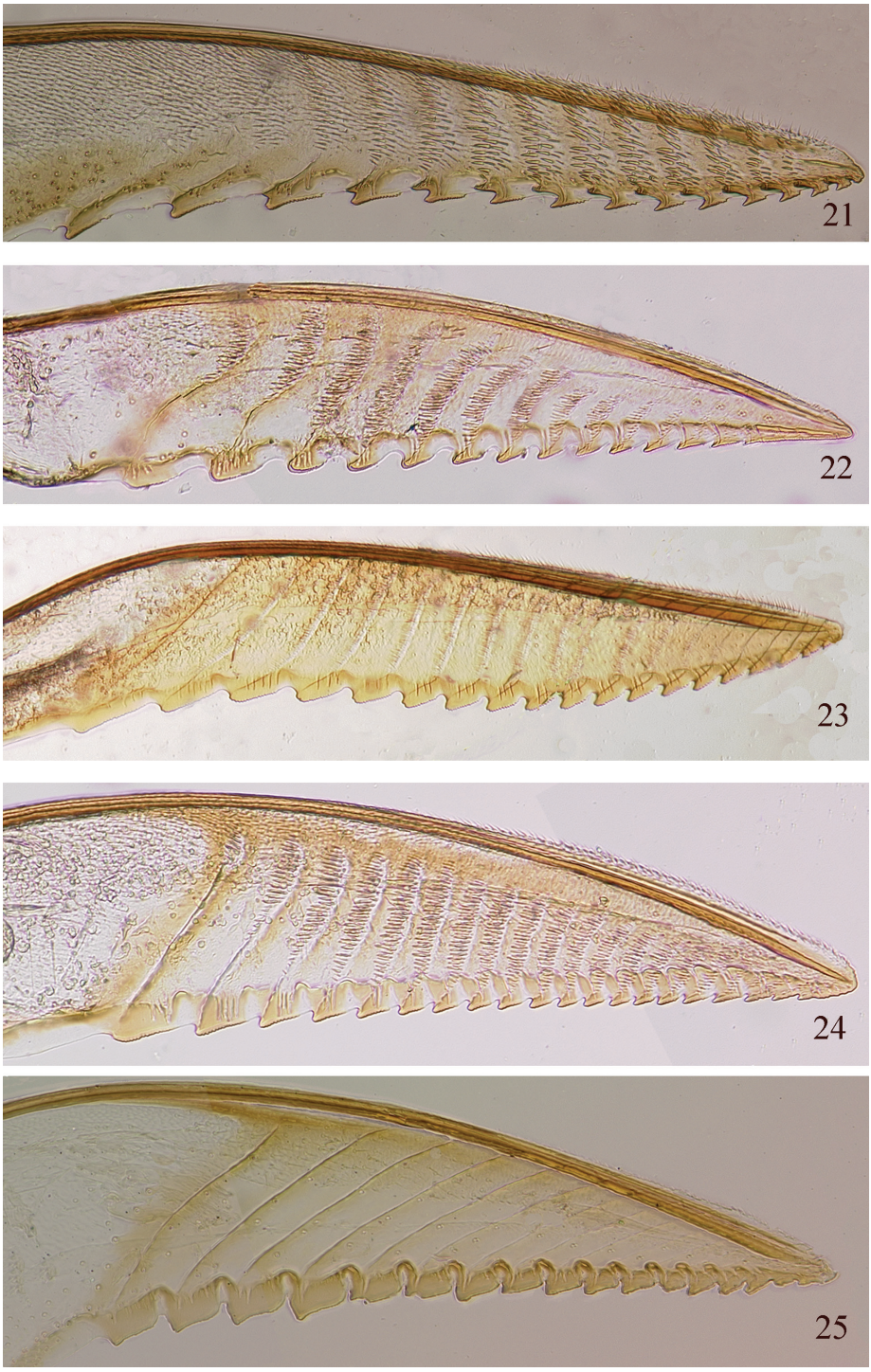
Male. Length, 5.0 mm. Black with narrow posterior margins of abdominal segments white; legs with coxae black, trochanters white, femora black except extreme apex and base of fore- and midfemora white, tibiae white except apical half of hind tibia black, fore- and midtarsi white with apical 3 tarsomeres black, hind tarsus black with small white spot at base of hind basitarsomere. Wings lightly, uniformly infuscated; veins and stigma black.

Head and body shiny, covered with short white pubescence; head and thorax with widely spaced minute punctures. Antennal length about 2.2× head width, flagellum without thick interspersed spines. Mandible in lateral view swollen at base, with slender bladelike apex. Malar space nearly linear, about one-fourth width of front ocellus. Lower interocular distance about 1.3× eye height. Distance between eye and hind ocellus about 0.9× distance between hind ocelli. Postocellar area about 2.2× broader than long. Tarsal claws with long inner tooth, slightly shorter than outer tooth. Hind basitarsomere 0.8× length of following tarsomeres combined; inner hind tibial spur about 0.2× length of basitarsomere. Genitalia in Figs 28, 29; penis valve slender with strong transverse spine; gonodcardo narrow.

Specimen examined. THAILAND, Chiang Mai, Doi Inthanon NP, Kew Maepan Trail, 8°33.162'N, 98°28.810'E, 2200 m, Malaise trap, 29.xii.2006–5.i.2007, Y. Areeluck leg., T1893 (1 ♂).

Discussion. Wei (1998: fig. 5) illustrated the apex of the penis valve of *Moricella rufonota*. The specimen examined has a transverse spine very much like *P. chalybeata*; however, the penis valve (Fig. 29) is identical to that illustrated by Benson (1963: fig. 6) for *P. chalybeata*, though in the slide mount of the valve, it appears at a slightly different angle. I have not seen this type of spine in specimens or descriptions of other *Pristiphora* species.

It is possible Benson (1963) made the wrong association of the male with the female holotype of *P. chalybeata*. The female Benson described is a typical *Pristiphora*, with characteristic mandibles, wing venation, and lancet (Benson 1963, Figs 3, 11). The females of *Moricella* have an evenly tapering left mandible, crossvein 2r is present in the forewing, and the lancets have numerous annular spines and a strong spurette above the anterior portion of each serrula (as in Fig.10). The male, described here, appears to belong to *Pristiphora* because of the more slender, less evenly tapering left mandible and absence of 2r in the forewing; however, it shares with *Moricella* the transverse spine of the penis valve, very narrow gonocardo, and absence of strong interspersed setae on the flagellum. It is possible this is actually the male of *Moricella rueaensis*, but inasmuch as this was associated with *P. chalybeata* by Benson (1963), I retain this placement until sexes can be associated with certainty.



Figures 21–25. *Pristiphora* lancets **21** *P. ettera* **22** *P. inthanoni* **23** *P. annetna* **24** *P. phahompoki* **25** *P. borneensis*.

***Pristiphora borneensis* Forsius**
http://species-id.net/wiki/Pristiphora_borneensis
Figs 26, 27

Pristiphora borneensis Forsius 1933: 177.

Specimens examined. MALAYSIA: SABAH: British North Borneo, Tenompok, 10–14.II.1959, T. C. Maa, collector (3 ♀, BPBM); British North Borneo, Tenompok, 1460 m, Jesselton, 48 km E., 26–31.I.1959, T. C. Maa, collector (1 ♀, BPBM); North Borneo, Ranau, 22–25.II.1959, T. C. Maa, collector (1 ♂, BPBM).

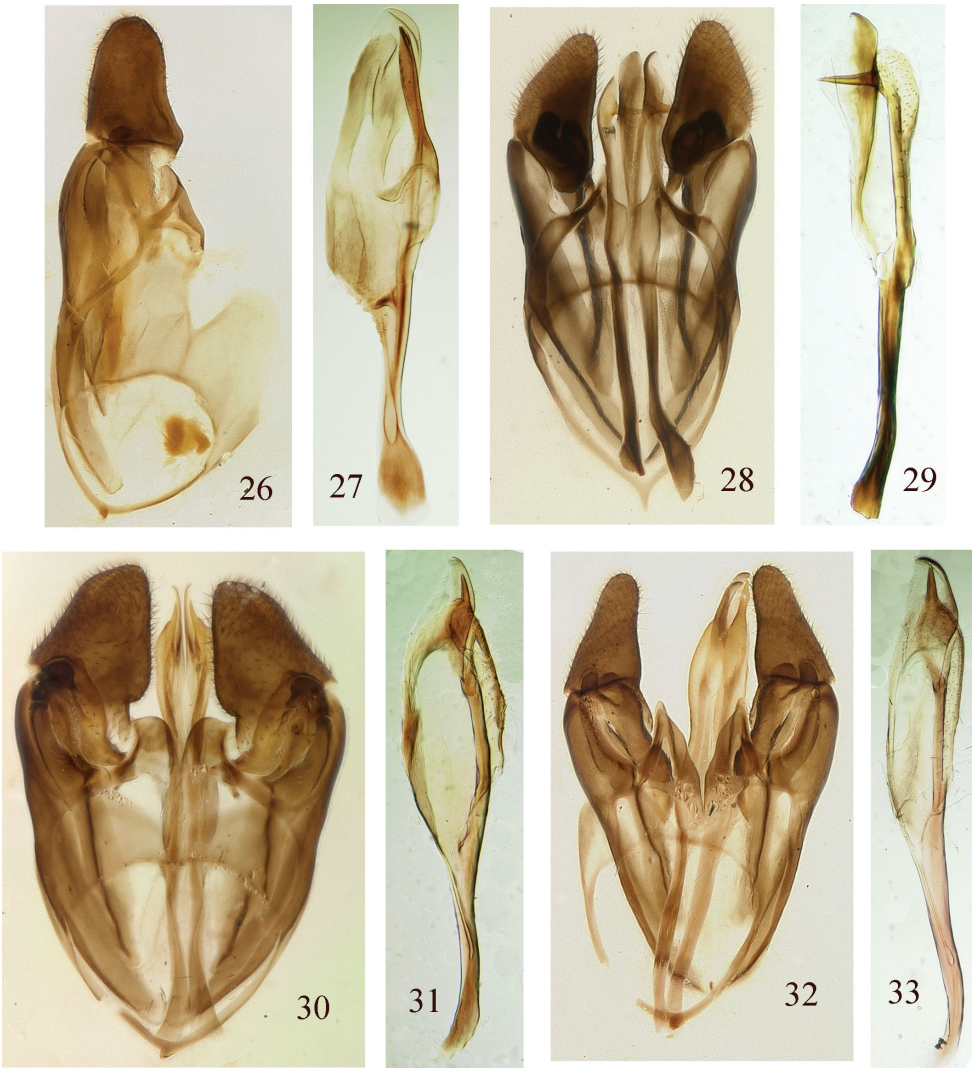
Discussion. The male has not been described. It is black with the apex of the fore- and midfemora, fore- and midtibiae and tarsi, and the basal half of the hind tibia white. The lancet was illustrated by Wong (1977: fig. 15). Benson (1963) and Wong (1977) distinguished it from all other Oriental *Pristiphora* by its linear malar space, but *Pristiphora ettera* has a similar malar space and *Pristiphora annetna* and *P. inthanoni* approach it. Wong (1977) placed it in his *Pristiphora chlorea* complex, near *P. fausta* (Hartig). The male genitalia are illustrated here (Figs 26, 27) and do not have the curved valvispina typical of the *chlorea* complex. The genitalia are unusual among *Pristiphora* because of the unusually long, straight valvispina and the extremely broad gonocardo. *Pristiphora fausta* also has a long valvispina (Wong 1977: fig.7), but it is curved at its apex. I have not seen such a broad gonocardo in other *Pristiphora* species, but this is not usually illustrated by authors who illustrate the male genitalia. The additional records are close to the type locality. The species was described from one female from "North Borneo: Mt. Kinabala, Maru Parei, 5,000 ft., 27 April 1929, H. M. Pendlebury" (Forsius 1933).

***Pristiphora sinensis* Wong**
http://species-id.net/wiki/Pristiphora_sinensis

Pristiphora sinensis Wong, 1977: 101, Figs 1, 2, 4.

Specimen examined. "China, Hupeh, Lichuan Dist., Sui-sa-pa, 27.VII.1948, L. & M. Gressit, collectors" (1 ♀, BPBM).

Discussion. This species was described from both males and females from Nanking, China. I have seen an additional specimen from China. Wei (in Wei and Nie 2003: 50, fig. 28-55) also illustrated the female and male genitalia.



Figures 26–33. Male genitalia. Genital capsule ventral view; penis valve lateral view **26** Genital capsule, *Pristiphora borneensis* **27** Penis valve, *P. borneensis* **28** Genital capsule, *P. chalybeata* **29** Penis valve, *P. chalybeata* **30** Genital capsule, *P. annetna* **31** Penis valve, *P. annetna* **32** Genital capsule, *P. ettera* **33** Penis valve, *P. ettera*.

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RESEARCH ARTICLE

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The genus *Quartinia* Ed. André, 1884 (Hymenoptera, Vespidae, Masarinae) in Southern Africa. Part V. New and little known species with incomplete venation

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Abstract

In this publication, the fifth of a projected series revising the Afrotropical species of the genus *Quartinia* Ed. André, 1884 (Hymenoptera: Vespidae: Masarinae), six species with incomplete venation are dealt with. Two new species are described, *aenea* from southern Namibia and *aerosa* from the Northern Cape of South Africa. These two species with greenish-metallic or broze-metallic head and mesosoma are compared with the known and similar looking *helichrysi* (Richards) and *metallescens* von Schulthess. Two further known species are dealt with, namely *capensis* Kohl and *senecionis* (Richards). Extensive collection data pertaining to most of the species contribute to the knowledge of their distribution and floral associations.

Keywords

Southern Africa, taxonomy, floral associations

Introduction

The background to the present state of knowledge of the taxonomy of the genus *Quartinia* Ed. André, 1884 has been fully stated in Gess (2007).

Desirable as it might be to undertake a complete revision of the genus, this is at present not practicable. Rather than to get bogged down in a study which might never

be completed and published, it is intended to publish a series of papers describing new species as well as reviewing some known species. It is envisioned that a new key to species will complete the series. To date Parts I, II and III have been published as Gess (2007), Gess (2008) and Gess (2009).

Quartinia species range in length from a little over 2 mm to 7 mm. In comparison with the great majority of species of other genera of Masarinae even the largest *Quartinia* are relatively small. In view of the considerable range in size shown by species of *Quartinia* and in order to express relative size, categories based on length have been established for species of the genus. These are minute (1.5–2.5 mm); small (2.5–3.5 mm); medium (3.5–4.5mm); large (4.5–5.5 mm); very large (5.5–6.5 mm) and gigantic (6.5–7.5 mm).

The present paper deals only with species with incomplete venation (2*m-cu* present but attenuate and interrupted). In the past these species would have been placed in *Quartinioides* Richards 1962 but synonymized with *Quartinia* Ed. André by van der Vecht and Carpenter (1990).

Acronyms for institutions in which material is housed are: **AMG** = Albany Museum, Grahamstown, South Africa; **BMNH** = Natural History Museum, London, England.

Taxonomy

A. Species with black head and mesosoma

***Quartinia capensis* Kohl**
http://species-id.net/wiki/Quartinia_capensis
Figs 1–7

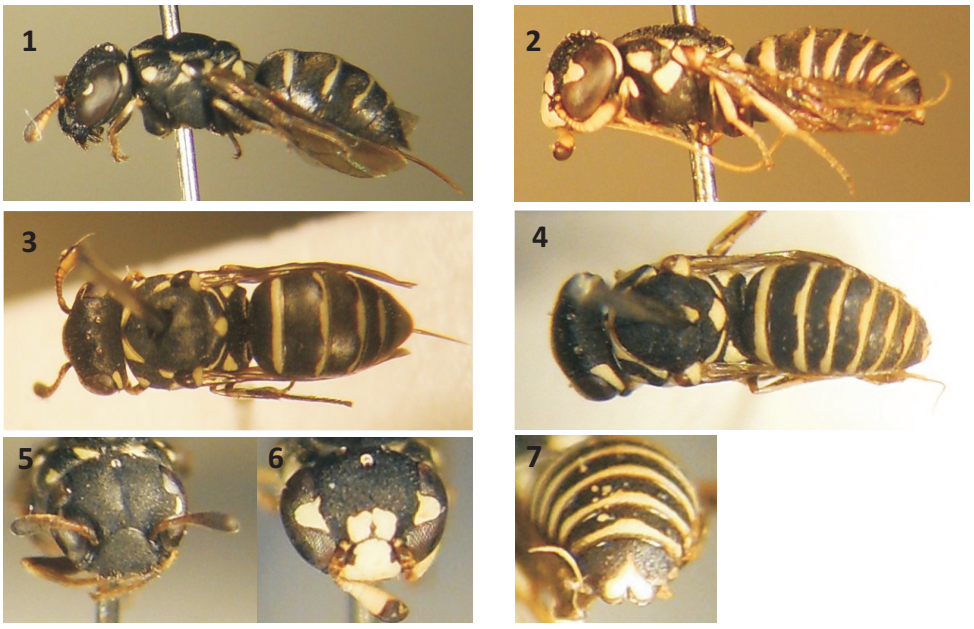
Quartinia capensis Kohl 1898: 365, female. Holotype: female, South Africa: Algoa Bay (Vienna). – von Schulthess 1929 : 504 (key), 508 (listed); von Schulthess 1935: 386 (key), 389 (discussion); Carpenter 2001: 23 (listed).

Quartinioides capensis (Kohl): Richards 1962: 173 and 175 (key), 185 (description of ♀, ♂; discussion).

Quartinia scutellimacula von Schulthess 1929: 504 and 505 (key), 508, male, female. Lectotype; female, South Africa: Mossel Bay (BMNH). – von Schulthess 1930: 327 (key); Richards 1962: 187 (lectotype designation, discussion).

Quartinia capensis scutellimacula von Schulthess: von Schulthess 1935: 386 (key), 389 (discussion).

Diagnosis. Small to medium sized (2.9–3.8 mm). Fore wing with Cu1a and 2*m-cu* present but attenuate, much thinner than other veins, and with 2*m-cu* interrupted before reaching M. Tegula white anteriorly and posteriorly; posterior inner corner in-



Figures 1–7. *Quartinia capensis* **1** ♀, lateral view (× 13) **2** ♂, lateral view (× 15) **3** ♀, dorsal view (× 13) **4** ♂, dorsal view (× 15) **5** ♀, head, front view (× 16) **6** ♂, head, front view (× 20) **7** ♂, tergum VII, dorsal view (× 22).

wardly produced. Black with white markings. Tibiae of female black except basally, those of male white. Male with labrum, clypeus, pair of large spots ventrally on frons, ocular sinus, streak on temple, underside of flagellomeres (except last flagellomere of club) white; clypeus falling steeply to anterior margin, with a marked median carina on anterior half.

Description. *Female* (previously adequately described) (Figs 1, 3, 5).

Male (previously adequately described) (Figs 2, 4, 6, 7).

Material examined. SOUTH AFRICA: EASTERN CAPE: Skoenmakerskop (34.04S 25.35E) [near Port Elizabeth], 8.xi.2006 (F. W. and S. K. Gess), 4 ♀♀ (visiting white flowers of *Sphalmanthus plenifolius* (N. E. Br.) L. Bol., Aizoaceae: Mesembryanthema)*;* same locality, 24.xi.2008 (F. W. and S. K. Gess), 1 ♀ (visiting white flowers of *Sphalmanthus plenifolius*) [AMG]. WESTERN CAPE: Fransmanspunt (34.18S 21.57E) [near Mossel Bay], 22.i.2002 (F. W. and S. K. Gess), 4 ♀♀, 5 ♂♂ (2 ♀♀, 5 ♂♂ visiting violet flowers of *Limonium scabrum* (Thunb.) Kuntze, Plumbaginaceae); 2 ♀♀ visiting pink flowers of "*Drosanthemum*" sp., Aizoaceae: Mesembryanthema) [AMG].

Floral associations. Aizoaceae: Mesembryanthema ("*Drosanthemum*", *Sphalmanthus*); Plumbaginaceae (*Limonium*).

Nesting. Unknown.

***Quartinia senecionis* (Richards)**
http://species-id.net/wiki/Quartinia_senecionis
Figs 8–14

Quartinioides senecionis Richards 1962: female, male. Holotype: male, South Africa: Thaba Nchu (BMNH); Gess and Gess 1989: 128 (flower visiting); Gess 1996: 253 (flower visiting).

Diagnosis. Small (2.5–3.0 mm). Fore wing with Cu1a and 2*m-cu* present but attenuate, much thinner than other veins, and with 2*m-cu* interrupted before reaching M. Tegula largely white, with a small brown area antero-medially; posterior inner corner absolutely rounded. Black with yellowish-white markings; mid and hind tibiae and tarsi mostly brown; frons and mesoscutum not appreciably shiny. Male with labrum, clypeus, large trapezoidal mark on frons, bottom of ocular sinus and spot on temple yellowish-white.

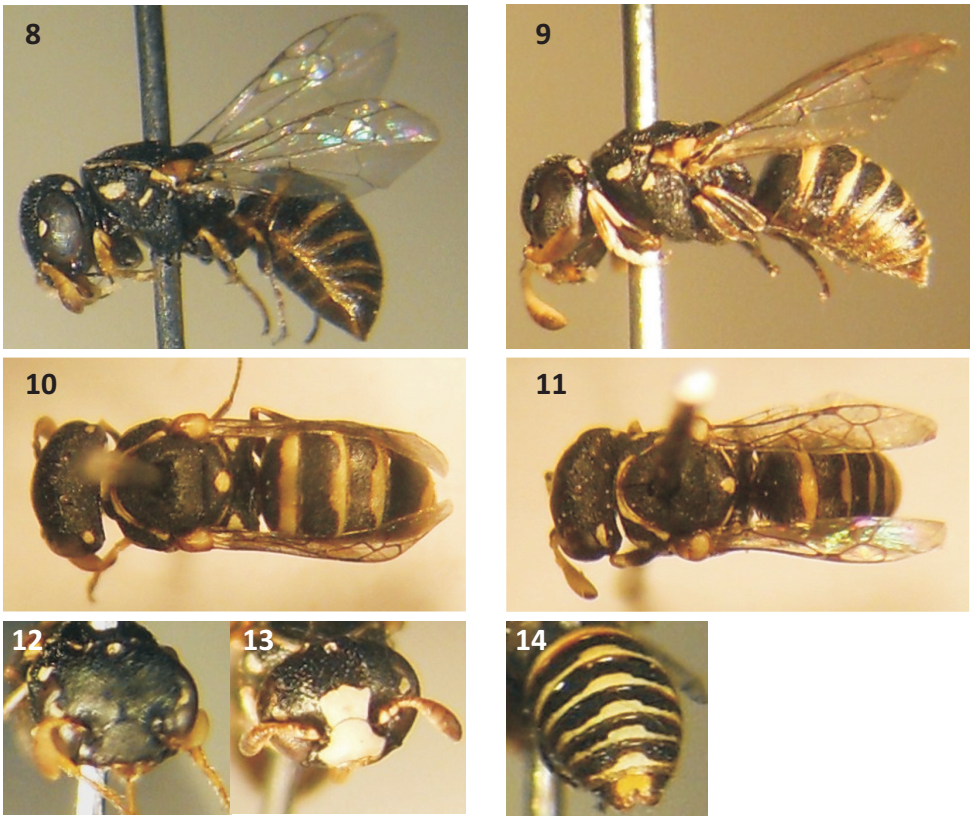
Description. *Female* (previously adequately described) (Figs 8, 10, 12).

Male (previously adequately described) (Figs 9, 11, 13, 14).

Material examined. NAMIBIA: E[ast] of Gamsberg Pass (23.19S 16.31E), 12.iii.1999 (F. W. and S. K. Gess), 3 ♀♀, 1 ♂ (visiting yellow flowers of *Pentzia incana* (Thunb.) Kuntze, Asteraceae). LESOTHO (formerly Basutoland]: Mamathes [29.07S 27.49E], 12.xii.1954 (C. Jacot Guillarmod), 6 ♀♀, 1 ♂ paratypes (on flowers of *Felicia muricata* (Thunb.) Nees, Asteraceae) [as *Aster muricatus*]. SOUTH AFRICA: FREE STATE (formerly Orange Free State): Chard, near Ficksburg (28.56S 27.45E), 6–8. xii.2008 (F. W. and S. K .Gess), 16 ♀♀, 2 ♂♂ (visiting flowers, disc yellow, rays mauve, of *Felicia muricata*); Thaba Nchu [29.13S 26.51E] , 1.xii.1952 (C. Jacot Guillarmod), 9 ♀♀, 1 ♂ paratypes (on *Senecio laevigatus* Thunb.); S of Ladybrand (29.14S 27.23 E), 9.xii.2008 (F.W. and S. K. Gess), 32 ♀♀, 2 ♂♂ (visiting flowers of *Felicia muricata*); N of Wepener (29.27S 27.13E), 9.xii.2008 (F. W. and S. K. Gess), 1 ♂ (visiting flowers of *Felicia muricata*); 8 km NE Smithfield (30.09S 26.36E), 3.xii.2008 (F. W. and S. K. Gess), 1 ♀ (visiting flowers of *Felicia muricata*); 1 km NE Smithfield (30.11S 26.33E), 3.xii.2008 (F. W. and S. K. Gess), 5 ♀♀, 1 ♂ (visiting yellow flowers of *Pentzia incana*). EASTERN CAPE: Near Aliwal North (30.44S 26.47E), 11.xii.2008 (F. W. and S. K. Gess), 1 ♀, 3 ♂♂ (visiting flowers of *Felicia muricata*) – [all AMG].

Provenance of material examined by Richards (1962). SOUTH AFRICA: FREE STATE: Thaba Nchu [29.13S 26.51E] (on flowers of *Senecio laevigatus* Thunberg). LESOTHO (formerly Basutoland): Mamathes [29.07S 27.49E] (on flowers of *Felicia muricata* [as *Aster muricatus*]; Tebetebeng Mill [circa 29.11S 27.57E (on flowers of *Gazania* sp.).

Geographic distribution. In Namibia the species if known only from E of the Gamsberg Pass in the Highland Savanna of Giess (1971). In South Africa it is known from several localities in the eastern Free State and from one locality in the north-east-



Figures 8–14. *Quartinia senecionis* **8** ♀, lateral view (× 20) **9** ♂, lateral view (× 22) **10** ♀, dorsal view (× 19) **11** ♂, dorsal view (× 19) **12** ♀, head, front view (× 22) **13** ♂, head, front view (× 23) **14** ♂, tergum VII, dorsal view (× 26).

ern Eastern Cape, these localities bordering Lesotho to the west and south respectively. From Lesotho itself it is known from two localities. All these southern localities are in Pure Grassveld, subdivided and characterised by Acocks (1953) as various types (nos. 48, 50 and 56) of *Cymbopogon-Themeda* Veld.

Discussion of distribution. The apparent disjunct distribution, possibly no more than a consequence of a geographical hiatus of collecting, finds a striking parallel in the distribution of *Jugurtia confusa* Richards (see Gess 2004: 691 and Fig. 3f). That species, collected in the Khomas Highlands of Namibia at the same site and date as *Q. senecionis*, exhibits a more extensive development of the pale markings in comparison with specimens from the eastern Free State and Eastern Cape. No such geographical variation is evident with respect to *Q. senecionis*.

Floral associations. Asteraceae (*Felicia*, *Gazania*, *Pentzia* and *Senecio*).

Nesting. Unknown.

B. Species with greenish-metallic or bronze-metallic head and mesosoma

***Quartinia aenea* sp. n.**
urn:lsid:zoobank.org:act:45124B59-75AE-45BE-9E16-81908C6FFC73
http://species-id.net/wiki/Quartinia_aenea
Figs 15–21

Holotype. ♀, NAMIBIA: 10 km west of Aus (26.39S 16.09E), 7.ix.2002 (F. W. and S. K. Gess) (visiting yellow fls of *Leysera gnaphalodes* (L.) L., Asteraceae) [AMG].

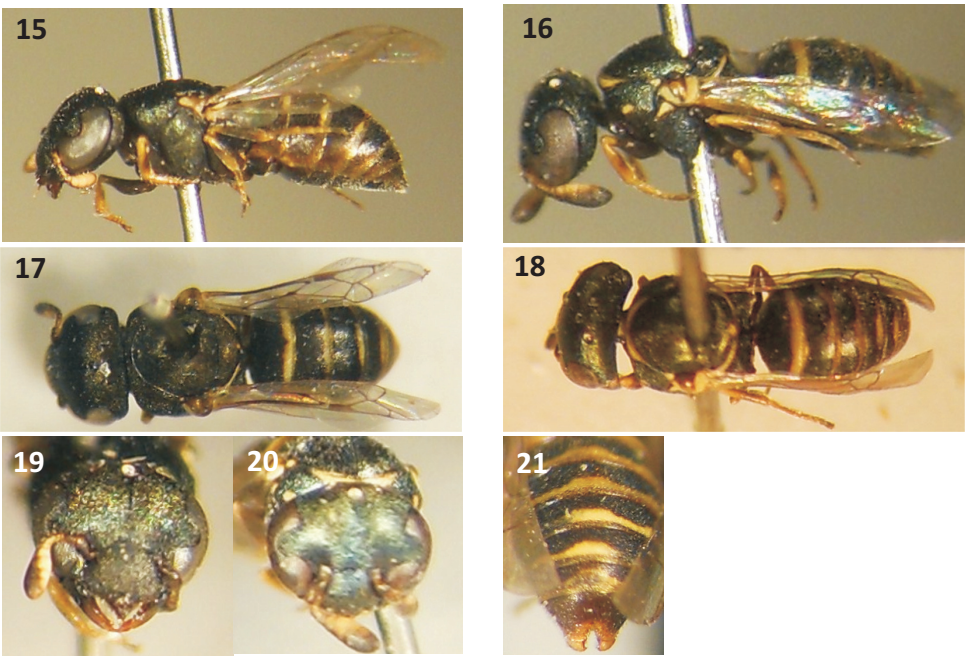
Paratypes: NAMIBIA: c 15 km W Aus on road to Lüderitz[bucht] (26.37S 16.06E), 21.ix.2003, 1 ♂ (visiting yellow fls, Asteraceae); NW Aus, drainage channel (26.37S 16.12E), 17.ix.2005, 1 ♀ (visiting yellow fls *Leysera* [*tenella* DC.], Asteraceae); 10 km west of Aus (26.39S 16.09E), 7.ix.2002, 39 ♀♀, 1 ♂ (visiting yellow fls of *Leysera gnaphalodes* (L.) L., Asteraceae); Klein-Aus Vista (26.39S 16.12 E), 8.ix.2002, 4 ♀♀ (visiting small yellow daisy [*Dimorphotheca polyptera* DC.], Asteraceae); SW Klein-Aus Vista (26.44S 16.10E), 24.ix.2003, 1 ♀ (visiting yellow fls of *Leysera*, Asteraceae) – (all F. W. and S. K. Gess) [all AMG].

Diagnosis. Small (2.7–3.2 mm). Fore wing with Cu1a and 2*m-cu* present but attenuate, much thinner than other veins, and with 2*m-cu* interrupted before reaching M. Head and mesosoma greenish-metallic. Tegula with posterior inner corner inwardly produced and angular, in dorsal view not attaining level of suture between mesoscutum and scutellum. Both sexes with head and dorsum of propodeum lacking white markings.

Description. *Female* (Figs 15, 17, 19): Head and mesosoma dark metallic green with, depending on the angle of illumination, reddish-bronze lustre; gaster black. The following are whitish-yellow: underside of antenna; in a few specimens narrow transverse band, medially interrupted, on anterior margin of pronotum and in all specimens minute spot on postero-dorsal angle of same; tegula anteriorly and posteriorly; a minute to small spot postero-medially on scutellum; scutellar lamella laterally; posterior bands not reaching sides on terga I – IV (that on tergum I widest, those of terga II – IV anteriorly produced medially and laterally). Light ferruginous are: apex of femur of all legs, most of tibia of fore and middle legs, base and apex of hind leg, fore tarsomeres (in part). Darker ferruginous are: mandible distally; upper side of antenna; median band on hind tibia; tarsomeres (in part). Wings very lightly browned, slightly iridescent; veins brown.

Length 3.04–3.2 mm (average of 3: 3.13 mm); length of fore wing 2.1 mm; hamuli 4.

Head in front view 1.24 × as wide as long; microreticulate (shagreened); moderately shiny; with punctures barely discernable. POL: OOL = 1: 0.77. Clypeus 1.6 × as wide as long (to bottom of emargination); dorsal margin exceeding by about diameter of antennal socket level of an imaginary line joining top of antennal sockets; distal margin widely and shallowly emarginate, narrowly laminate.



Figures 15–21. *Quartinia aenea* **15** ♀, lateral view (× 16) **16** ♂, lateral view (× 21) **17** ♀, dorsal view (× 16) **18** ♂, dorsal view (× 16) **19** ♀, head, front view (× 22) **20** ♂, head, front view (× 23) **21** ♂, tergum VII, dorsal view (× 24).

Mesosoma microreticulate (shagreened) like head; moderately shiny; with punctures slightly more obvious than on head.

Gaster finely microreticulate, very indistinctly punctured, moderately shiny.

Male (Figs 16, 18, 20, 21): Coloration and markings as in female, with in addition the following whitish-yellow markings: short band on anterior margin of pronotum; small spot on humeral angle and streak at top of mesopleuron (both in one specimen only); short transverse bands on terga V and VI. Apex of tergum VII and parameres ferruginous. Surface sculpture and puncturation as in female.

Length 2.7 mm; length of fore wing 1.8 mm.

Head 1.28 × as wide as long; POL: OOL = 1: 0.82.

Tergum VII with a deep V-shaped slit; lateral lobes smoothly rounded apically. Sterna atuberculate.

Etymology. The name *aenea*, a Latin female adjective meaning bronze- or ore-coloured, refers to the greenish-metallic appearance of the head and mesosoma.

Geographic distribution. As far as indicated at present the species appears to be restricted to the area around Aus in south-western Namibia, in the Desert and Succulent Steppe of Giess (1971).

Floral associations. Asteraceae (*Dimorphotheca, Leysera*).

***Quartinia aerosa* sp. n.**
urn:lsid:zoobank.org:act:D773E7CA-B62F-4E53-A0F9-D525C576BAFE
http://species-id.net/wiki/Quartinia_aerosa
Figs 22–28

Holotype. ♀, SOUTH AFRICA: NORTHERN CAPE: Sutherland District: Rooikloof Farm (32.26S 20.39E), 8.x.2009 (F. W. and S. K. Gess) (visiting yellow flowers of *Leysera tenella* DC., Asteraceae).

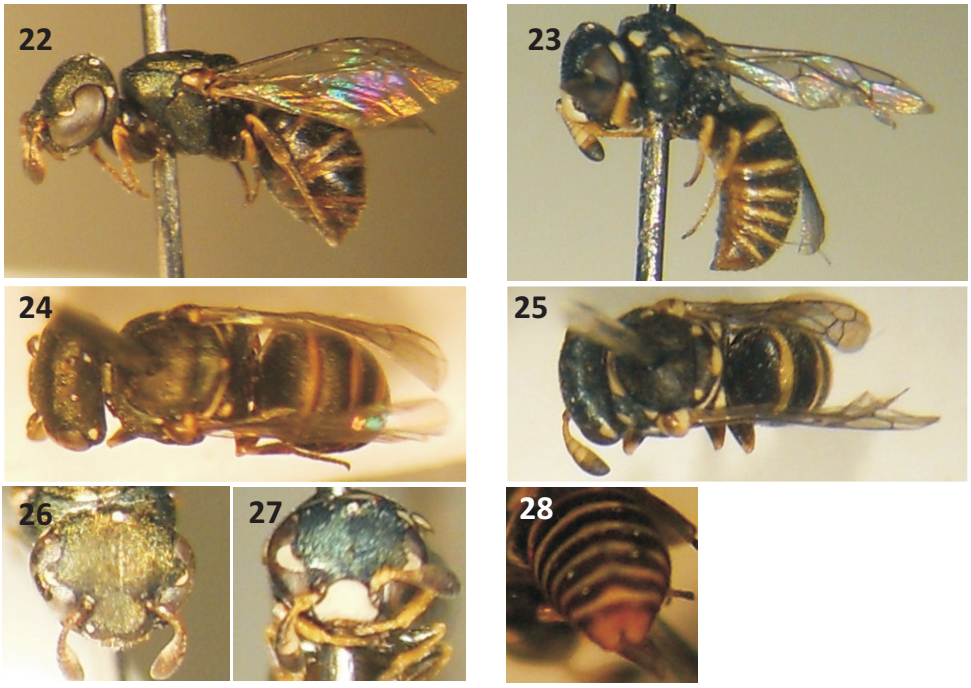
Paratypes: SOUTH AFRICA: NORTHERN CAPE: Sutherland District: Rooikloof Farm (32.26S 20.39E), 1–10.x.2009 (F. W. and S. K. Gess), 21 ♀♀, 6 ♂♂ (12 ♀♀, 4 ♂♂ visiting yellow flowers of *Leysera tenella*; 2 ♀♀, 1 ♂ visiting pale violet flowers of *Wahlenbergia* near *polyclada* A.DC., Campanulaceae; 1 ♀ on ground between flowering plants of *Wahlenbergia* near *polyclada*; 3 ♀♀ from yellow pan trap associated with flowering plants of *Wahlenbergia* near *polyclada* and *Selago* p., Scrophulariaceae); same locality, 10.x.2009 (D. W. Gess), 1 ♀ (visiting ale violet flowers of *Wahlenbergia* near *polyclada*) [all AMG].

Diagnosis. Small (2.8–3.1 mm). Fore wing with Cu1a and 2*m-cu* present but attenuate, much thinner than other veins, and with 2*m-cu* interrupted before reaching M. Head and mesosoma greenish-metallic. Tegula with posterior inner corner inwardly produced and angular, in dorsal view not attaining level of suture between mesoscutum and scutellum. Both sexes with head with white markings (crescent in ocular sinus, spot flanking inner margin of eye, spot on temple behind eye; male with white clypeus. Dorsum of propodeum with yellow marking.

Description. *Female* (Figs 22, 24, 26): Head and mesosoma dark metallic green with, depending on the angle of illumination, reddish-bronze lustre; gaster black but depending upon the angle of illumination with a similar but reduced lustre. The following are whitish-yellow: underside of antennal club; crescent at bottom of ocular sinus; a small spot flanking inner margin of upper part of eye at level of ocelli (in majority of specimens); spot on temple behind top of eye; minute spot at postero-dorsal angle of pronotum; tegula anteriorly and posteriorly; small spot at top of mesopleuron (in majority of specimens); a minute to small transverse spot (tending to be suffused by light ferruginous) postero-medially on scutellum; scutellar lamella laterally; a minute spot to small transverse streak laterally on dorsum of propodeum (in majority of specimens). Yellow, to variable degree suffused by ferruginous (especially laterally), are transverse bands on terga I – V (those on terga II – V slightly anteriorly produced medially and laterally). Various shades of ferruginous are: apical half of mandible; apical third of tergum IV; sterna; apex of femur, part of tibia of all legs.

Length: 3.04–3.08 mm (average of 3: 3.07 mm); length of fore wing: 2.08–2.12 mm (average of 3: 2.09 mm); hamuli 3.

Head in front view 1.3 × as wide as long; POL: OOL = 1: 0.85. Clypeus 1.6 × as wide as long; anterior margin shallowly emarginate; lateral angles rounded.



Figures 22–28. *Quartinia aerosa* **22** ♀, lateral view (× 18) **23** ♂, lateral view (× 24) **24** ♀, dorsal view (× 19) **25** ♂, dorsal view (× 19) **26** ♀, head, front view (× 23) **27** ♂, head, front view (× 24) **28** ♂, tergum VII, dorsal view (× 19).

Head, mesosoma and gaster finely microsculptured (shagreened); punctures everywhere barely discernable.

Male (Figs 23, 25, 27, 28): Head and mesosoma dark metallic green with, depending on the angle of illumination, reddish-bronze lustre; gaster black but depending upon the angle of illumination with a similar but reduced lustre. The following are whitish-yellow: underside of scape, pedicel, intermediate flagellomeres and proximal half of club; most of labrum; entire clypeus (except lamellate distal margin and, in some specimens, area immediately proximal to it); broad crescent at bottom of ocular sinus; small spot flanking inner margin of upper part of eye at level of ocelli; spot on temple behind top of eye; transverse band (in some specimens narrowed medially) on anterior margin of pronotum and small spot on postero-dorsal angle of same; humeral angle; tegula anteriorly and posteriorly; streak at top of mesopleuron; lateral and postero-medial spots on scutellum (lateral spots effaced in one specimen); scutellar lamella laterally; dorsum of propodeum. Yellow, to a variable degree suffused by ferruginous (especially laterally), are transverse bands on terga I – VI (those on terga II – IV slightly anteriorly produced medially and laterally). Various shades of ferruginous are: apical half of mandible; apical half of tergum VII; sterna; apex of femur, most of tibia and proximal three tarsomeres of all legs (last two tarsomeres darker).

Length: 2.8 mm (consistent for 3 specimens); length of fore wing 1.8 mm (consistent for 3 specimens); hamuli 3.

Head in front view 1.3 × as wide as long; POL: OOL = 1: 0.9. Clypeus 1.7 × as wide as long; anterior margin shallowly emarginate; lateral angles rounded.

Tergum VII with a deep V-shaped slit; lateral lobes smoothly rounded apically. Sterna atuberculate.

Etymology. The name *aerosa*, a Latin female adjective meaning ore-coloured, refers to the greenish-metallic appearance of the head and mesosoma.

Geographic distribution. At present known only from the type locality, Rooikloof Farm, near Sutherland, in the Arid Karoo and Desert False Grassveld of Acocks (1953).

Floral associations. Asteraceae (*Leysera*), Campanulaceae (*Wahlenbergia*).

Nesting. Unknown.

***Quartinia helichrysi* (Richards)**
http://species-id.net/wiki/Quartinia_helichrysi
Figs 29–31

Quartinioides helichrysi Richards 1962: 175 (key), 198, female. Holotype: female Lesotho (formerly Basutoland): Mamalapi Mts (BMNH); Carpenter 2001: 25 (listed).

Diagnosis. Small (2.8–3.5 mm). Fore wing with Cu1a and 2*m-cu* present but attenuate, much thinner than other veins, and with 2*m-cu* interrupted before reaching M. Head and mesosoma greenish-metallic. Tegula with posterior inner corner rounded, in dorsal view attaining level of suture between mesoscutum and scutellum. Female (male unknown) with head densely coriaceous, almost without punctures; mesoscutum sparsely punctured. Head with white marking in bottom of ocular sinus only.

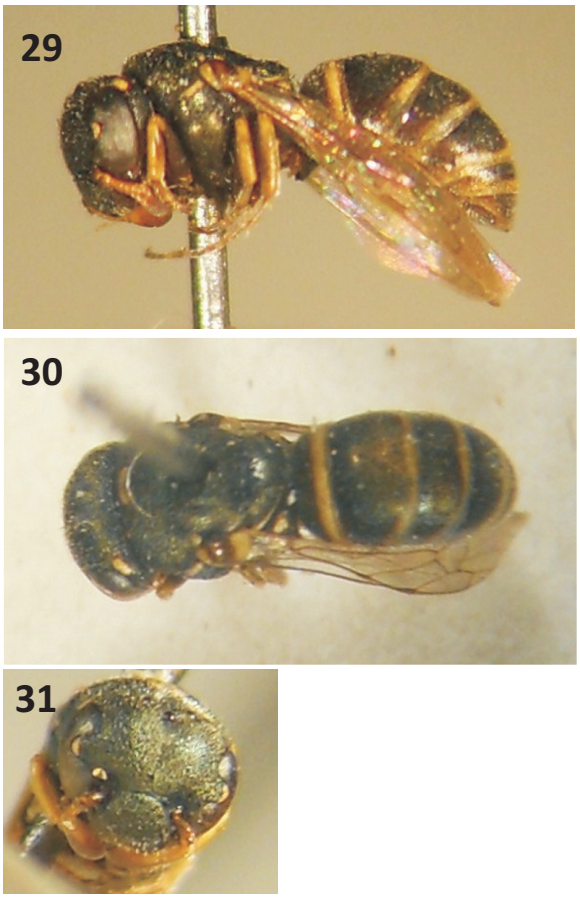
Description. *Female* (previously adequately described) (Figs 29, 30, 31).

Material examined. LESOTHO (formerly Basutoland): Mamalapi Mtn, 28.xii.1948 (C. Jacot Guillarmod), 3 ♀♀ (on flowers of *Helichrysum fulgidum*) [AMG]. These specimens bear determination labels in Richards' handwriting: "*Quartinia* sp. near *metallescens* Schulth." and, though not labelled as such, are clearly the paratypes recorded by Richards (1962: 198) as being in the collection of Mr C. F. Jacot Guillarmod. That collection was in 1958 incorporated by Jacot Guillarmod with that of the Albany Museum.

Geographic distribution. Known only from the single locality in Lesotho.

Floral associations. Asteraceae (*Helichrysum fulgidum* [probably = *Helichrysum aureum* (Houtt.) Merr.]).

Nesting. Unknown.

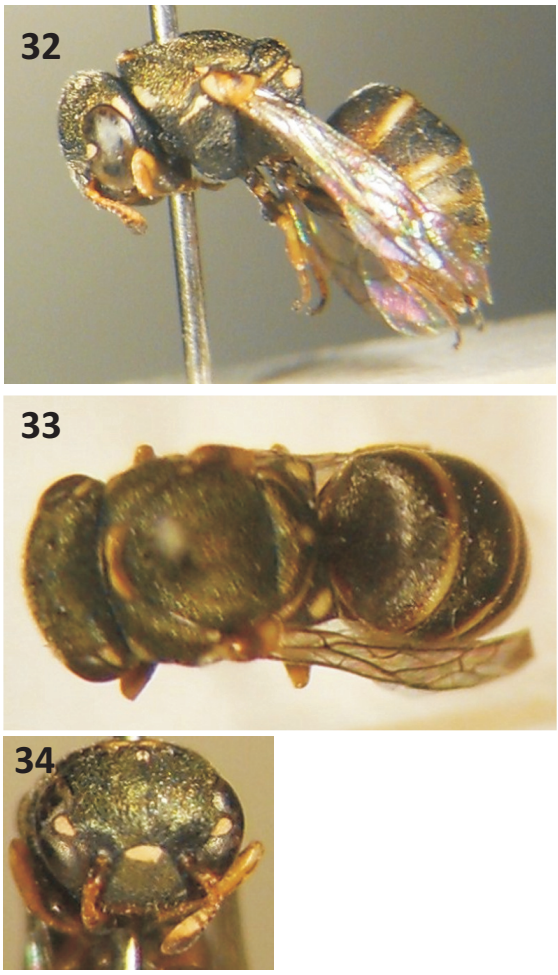


Figures 29–31. *Quartinia helichrysi* **29** ♀, lateral view (× 17) **30** ♀, dorsal view (× 17) **31** ♀, head, front view (× 22).

***Quartinia metallescens* von Schulthess**
http://species-id.net/wiki/Quartinia_metallescens
Figs 32–34

Quartinia metallescens von Schulthess 1929: 504, 505, female. Holotype: female, South Africa: Queenstown, 3500 feet (BMNH); von Schulthess 1935: 385 (key); Carpenter 2001: 26 (listed).
Quartinioides metallescens (von Schulthess): Richards 1962: 175 (key), 196 (description of female, male).

Diagnosis. Medium sized (3.8–4.2 mm). Fore wing with Cu1a and 2*m-cu* present but attenuate, much thinner than other veins, and with 2*m-cu* interrupted before reaching



Figures 32–34. *Quartinia metallescens* **32** ♀, lateral view (× 15) **33** ♀, dorsal view (× 18) **34** ♀, head, front view (× 19).

M. Head and mesosoma greenish-metallic. Tegula with posterior inner corner rounded, in dorsal view attaining level of suture between mesoscutum and scutellum. Head and thorax both with dense, very shallow, flat-bottomed punctures. Female head with white markings both in bottom of ocular sinus and at top of clypeus. Male head with mandibles, labrum, most of clypeus, lower part of orbits, ocular sinus, two frontal dots adjacent of clypeus and spot behind eye dorsally white.

Description. *Female* (previously adequately described) (Figs 32, 33, 34).

Material examined. SOUTH AFRICA: FREE STATE (formerly Orange Free State): Chard, near Ficksburg (28.56S 27.45E), 6–8. xii.2008 (F. W. and S. K Gess), 1 ♀ (visiting yellow flowers of *Berkheya* sp., Asteraceae) [AMG]. LESOTHO (formerly Basutoland): Mamathes [29.07S 27.49E], 9.xi.1952 (C. Jacot Guillamod), 2 ♀♀* (on flowers of *Gazania longiscapa*); Malubalube Str[ea]m, Teyateyaneng [29.08S 27.43E

], 4.xi.1956 (C. Jacot Guillarmod), 2 ♀♀; Tebetebeng Mill [circa 29.11S 27.57E], 13.xi.1948 (C. Jacot Guillarmod), 1 ♀* (on flowers of *Gazania* sp.) [all AMG].

Provenance of material examined by Richards (1962). SOUTH AFRICA: EASTERN CAPE: Queenstown [31.54S 26.53E], 3500 feet. LESOTHO (formerly Basutoland): Tebetebeng [circa 29.11S 27.57E] (on flowers of *Gazania* sp.); Mamathes [29.07S 27.49E] (on flowers of *Helichrysum* sp. and of *Gazania longiscapa)*. In the paragraph above, material examined, the specimens marked with an * bear Richards' determination labels.

Geographic distribution. Known from the type locality in the north eastern Eastern Cape, one locality in the eastern Free State and three localities in Lesotho. All the localities are in Pure Grassveld, subdivided and characterised by Acocks (1953) as various types (nos. 48, 50 and 56) of *Cymbopogon-Themeda* Veld.

Floral associations. Asteraceae (*Berkheya, Gazania* and *Helichrysum*).

Nesting. Unknown.

Key to separate species with greenish-metallic or bronze-metallic head and mesosoma

1 Tegula relatively long (in dorsal view attaining level of suture between mesoscutum and scutellum), with posterior inner corner rounded **2**

– Tegula relatively short (in dorsal view not attaining level of suture between mesoscutum and scutellum), with posterior inner corner inwardly produced and angular **3**

2 Head densely coriaceous, almost without punctures. Mesoscutum sparsely punctured. Female head with white marking in bottom of ocular sinus only. (Male not known.) ..... ***helichrysi*** **(Richards)**

– Head and thorax both with dense, very shallow, flat-bottomed punctures. Female head with white markings both in bottom of ocular sinus and at top of clypeus. Male head with mandibles, labrum, most of clypeus, lower part of orbits, ocular sinus, two frontal dots adjacent of clypeus and spot on temple behind eye white ..... ***metallescens*** **(Schulthess)**

3 Both sexes with head and dorsum of propodeum lacking white markings ..... ***aenea*** **Gess**

– Both sexes with head with white markings (crescent in ocular sinus, spot flanking inner margin of eye, spot on temple behind eye; male clypeus). Dorsum of propodeum with yellow marking ..... ***aerosa*** **Gess**

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RESEARCH ARTICLE

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Tiphiidae wasps of Madagascar (Hymenoptera, Tiphiidae)

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Abstract

The tiphiid wasp fauna of Madagascar consists of 28 endemic species, including 12 species of *Anthobosca* (Anthoboscinae), nine species of *Methocha* (Methochinae), two species of *Tiphia* (Tiphiinae) and in the Myzininae three species of *Meria*, eight species of *Mesa* and two species of *Myzinella*. Seven species of *Methocha*, *arcuata*, *depressa, flavipalpus, impunctata, nasiformis, robusta* and *strigosa*, and one species of *Myzinella*, *minima*, are described as new. All of the genera are shared with mainland Africa.

Keywords

Tiphiidae, *Anthobosca*, *Meria*, *Mesa*, *Methocha*, *Myzinella*, *Tiphia*

Introduction

Madagascar has a relatively diverse, though seemingly recent tiphiid fauna. The least derived tiphiid subfamily Anthoboscinae is particularly species-rich on Madagascar, with nearly as many species as are found on continental Africa (Kimsey 2009). Three other tiphid subfamilies, Methochinae, Myzininae and Tiphiinae, are present as well, although they are less diverse relative to the mainland fauna than are the anthobos-

cines. None of the Malagasy tiphiid genera are endemic to the island, but all of the tiphiid species in Madagascar are endemic. There are seven myzinine genera in the Afrotropical Region including *Braunsomeria* Turner, *Meria* Illiger, *Mesa* Saussure, *Myzinella* Guiglia, *Parameria* Guérin de Menevile, *Poecilotiphia* Cameron and *Pseudomeria* Saunders. Only *Meria*, *Mesa* and *Myzinella* are recorded from Madagascar. The subfamilies Methochinae and Tiphiinae are represented by species in the genera *Methocha* and *Tiphia* respectively.

The modern Malagassy tiphiid fauna clearly derives from mainland Africa. These wasps are strong fliers but many species have wingless or brachypterous females. Tiphiid wasps are, where known, parasites of beetle larvae, particularly in the Scarabaeidae and Cicindellidae, Their host larvae are largely found in the soil and the tiphiid females spend considerable time on the ground, which makes rafting on plant debris unlikely but not impossible. Thus, dispersal of tiphiid wasps across the oceanic channel to Madagascar from mainland Africa seems unlikely. However, over a period of tens of millions of years even a small number of successful dispersals might be sufficient to establish populations on the island (Tattersall 2008). Studies of other animals with relatively poor dispersal capabilities, such as non-flying vertebrates (Vences 2004) and ants (Fisher 1996) show a similar pattern of origin from Africa.

The California Academy of Sciences' Arthropods of Madagascar Project funded by the U.S. National Science Foundation revealed a more diverse tiphiid fauna than previously recorded, including seven new species of *Methocha* and one species of *Myzinella* that are described below.

Materials and methods

Specimens in this study were obtained from the California Academy of Sciences Arthropods of Madagascar Project and the Bohart Museum of Entomology. Holotypes and paratypes are deposited in the California Academy of Sciences, San Francisco (SAN FRANCISCO) and the Bohart Museum of Entomology, University of California, Davis (DAVIS). Other type repositories are indicated by the city names in parentheses in the species lists: BERLIN = Museum für Naturkunde, Berlin, Germany; BOLOGNA = Bologna Zoological Museum, Bologna, Italy; GENEVA = Museum of Natural History, Geneva, Switzerland; ITHACA = Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands; LONDON = Department of Entomology, the Natural History Museum, London; PARIS = Muséum National d'Histoire Naturelle, Laboratoire d'Entomologie, Paris, France; VIENNA = Naturhistorisches Museum, Vienna, Austria, and WASHINGTON = U.S. National Museum, Washington, D. C., USA.

The systematics of members of the family Tiphiidae is largely based on males. Females are less commonly collected and association of the sexes is problematic at best. This situation is also true in Madagascar, as a result the species level keys below are only to males where indicated as most of the females are unknown or unassociated.

Key to the Tiphiid Genera of Madagascar

1 Wingless, slender, ant-like; hindtibia with one apical spur; Subfamily Methochinae (females)..... ***Methocha* Latreille**
– Winged, heavy-bodied or elongate and slender, not ant-like; hindtibia with two apical spurs (males and females) **2**
2 Frons flattened medially, without frontal lobes, antenna inserted vertically... **3**
– Frons strongly produced medially into lobes or platform above antennae, antenna inserted obliquely beneath..... **4**
3 Male apical metasomal sternum modified into curved, spine-like uncus (Fig. 3); marginal cell incomplete apically; Subfamily Tiphiinae.... ***Tiphia* Fabricius**
– Male apical metasomal sternum unmodified (Fig. 2); forewing marginal cell complete (Fig. 2); Subfamily Anthoboscinae*Anthobosca* Guérin de Méneville
4 Mesopleural lamella small, digitate; parameres always exserted well beyond apex of apical tergum (Fig. 1); antennal lobes tooth-like or simple; Subfamily Methochinae..... ***Methocha* Latreille**
– Mesopleural lamella large, broad, flattened; parameres generally not visible externally (Figs 4–6); antennal lobes rounded, often forming platform above antennal sockets; Subfamily Myzininae..... **5**
5 Metasomal segment I broadly sessile, broader than long, not nodose (Fig. 5).... ..... ***Meria* Illiger**
– Metasomal segment I with narrow elongate petiole, twice as long as or longer than broad, posteriorly nodose (Figs 4, 6) **6**
6 Metasomal segment I more than 3× as long as broad, terga without transverse subbasal carina (Fig. 4) ..... ***Mesa* Saussure**
– Metasomal segment I less than twice as long as broad, terga with transverse subbasal carina (Fig. 6) ..... ***Myzinella* Guiglia**

Systematics

Subfamily Anthoboscinae
Genus *Anthobosca* Guérin de Méneville
http://species-id.net/wiki/Anthobosca
Fig. 2

Anthobosca Guérin de Méneville 1838:237.

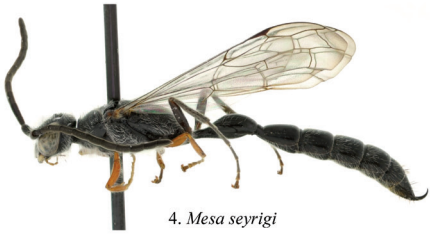
Type species: *Anthobosca australasiae* Guérin de Méneville 1838:237.

Discussion. This is the least derived genus in the family Tiphiidae (Kimsey 1991). Both sexes are fully winged, with complete venation. Males are slenderer than females, with linear, cylindrical antennae. Females are less commonly collected than males, and are heavy-bodied with coiled antennae. The face is flat, without supraantennal lobes,

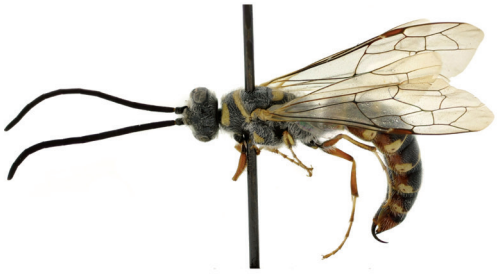
1. *Methocha robusta*

2. *Anthobosca insularis*

3. *Tiphia*



4. *Mesa seyrigi*



5. *Meria vonizongo*

6. *Myzinella minima*

Figures 1–6. Lateral view of males. **1** *Methocha* **2** *Anthobosca* **3** *Tiphia* (uncus obscured by genital capsule shown in inset) **4** *Mesa* **5** *Meria* **6** *Myzinella*.

similar to the face in Tiphiinae. There are fourteen *Anthobosca* species described from mainland Africa and ten from Madagascar (Kimsey 2009). Hosts are unknown for the subfamily.

Key to species of *Anthobosca* (modified from Kimsey 2009)

1 Metasoma 6-segmented; ten flagellomeres; females **2**

– Metasoma 7-segmented; eleven flagellomeres; males **4**

2 Head, mesosoma and metasoma concolorous brown; wing membrane amber-tinted; body over 25 mm long ..... ***insularis* F. Smith**

– Head, mesosoma and metasoma blackish or blackish and red, often with whitish spots; wing membrane untinted or tinted with brown to black; body length less than 15 mm long **3**

3 Metasoma black to dark brown, terga II–III with whitish lateral spots ..... ***madecassa* Krombein**

– Metasoma red, terga II–III without lateral spot ..... ***dimidiata* Bartalucci**

4 Metasomal sterna II and III with large spoon-like ventral projections; metasoma with extensive yellow markings ..... ***hallucigenia* Kimsey**

– Metasomal sterna II and III unmodified, without projections; metasoma without yellow markings **5**

5 Body length 17–20 mm; wings dark amber-tinted; flagellomeres without tyloids; tegula brown ..... ***insularis* F. Smith**

– Body length 11 mm or less; wings untinted; three or more flagellomeres with tyloids; tegula white **6**

6 Flagellomere XI less than 2.2× as long as broad **7**

– Flagellomere XI more than 2.4× as long as broad **10**

7 Flagellomere VIII without tyloids; clypeus evenly convex with narrow ventrally facing flattened apical surface ..... ***micromeria* Bartalucci**

– Flagellomere VIII with one tyloid; clypeus without ventrally facing flattened apical surface **8**

8 Flagellomere VII with one small tyloid ..... ***nigrimacula* Kimsey**

– Flagellomere VII without tyloids **9**

9 Volsella broadest submedially, dorsal lobe oriented diagonally; paramere apex brown ..... ***castanea* Kimsey**

– Volsella broadest dorsally, dorsal lobe oriented horizontally; paramere apex whitish ..... ***toliaraensis* Kimsey**

10 Paramere apex white; flagellum strongly bicolored brown to black dorsally, yellow ventrally; digitus extending diagonally to horizontally toward paramere in profile **11**

– Paramere apex brown; flagellum brown to black, may be slightly paler ventrally; digitus extending diagonally toward paramere in lateral view **12**

11 Clypeus evenly convex medially, entirely white or less commonly bicolored, black and white; volsella broadest dorsally, digitus horizontally oriented in lateral view ..... ***mahajangaensis* Kimsey**

– Clypeus flattened medially, entirely brown or bicolored brown and black; volsella narrowed dorsally, digitus oriented obliquely in lateral view ..... ***namorokaensis* Kimsey**

12 Flagellomere XI 2.6–3.0× as long as broad; digitus diagonally to vertically oriented in lateral view ..... ***harinhalai* Kimsey**

– Flagellomere XI 2.3–2.4× as long as broad; digitus horizontally oriented in lateral view ..... ***fisheri* Kimsey**

Checklist of *Anthobosca* species

1. *castanea* Kimsey 2009:2. Holotype male: Madagascar: Mahajanga Prov., Parc National d'Ankarafantsika, Ampijoroa Station Forestiére, 40 km 306° 2nw Andranofasika (SAN FRANCISCO). Distribution: Mahajanga and Toliara Provinces.
2. *dimidiata* Bartalucci 2005:1082. Holotype female; Madagascar: Tuléar Berenti, 12 km nw Amboasary (LONDON). Distribution: Toliara Prov.
3. *fisheri* Kimsey 2009:5. Holotype male: Madagascar: Toliara Prov. Forêt de Mahavelo Isantoria River (SAN FRANCISCO). Distribution: Toliara, Toamasina, Antsiranana and Mahajanga Provinces.
4. *hallucigenia* Kimsey 2009:9. Holotype male: Madagascar: Toamasina Prov., Andasibe National Park (SAN FRANCISCO). Distribution: Antsiranana, Finanarantsoa and Toamasina Provinces.
5. *harinhalai* Kimsey 2009:11. Holotype male: Madagascar: Toliara Prov. Forêt de Mahavelo Isantoria River (SAN FRANCISCO). Distribution: Toliara and Tuléar Provinces.
6. *insularis* (Smith) 1879:178. (*Myzine*). Holotype female; Madagascar (LONDON). Distribution: Ranomafana National Park and adjacent Fianarantsoa Prov.
7. *madecassa* Krombein 1949:52. Holotype female; Madagascar: Bekily (ITHACA). Distribution: Antsiranana and Toliara Provinces.
8. *mahajangaensis* Kimsey 2009:12. Holotype male: Madagascar: Mahajanga Prov., Parc National de Baie de Baly (SAN FRANCISCO). Distribution: Mahajanga Prov.
9. *micromeria* Bartalucci 2005:1083. Holotype male; Madagascar: Tuléar Morondava (LONDON). Distribution: Mahajanga Prov.
10. *namorokaensis* Kimsey 2009:15. Holotype male: Madagascar: Mahajanga Prov., Namoroka National Park, 16.9 km, 317° nw Vilanandro (SAN FRANCISCO). Distribution: Mahajanga Prov.
11. *nigrimacula* Kimsey 2009:16. Holotype male: Madagascar: Toliara Prov., Réserve Spéciale de Cap Sainte Marie (SAN FRANCISCO). Distribution: Toliara Prov.
12. *toliaraensis* Kimsey 2009:16. Holotype male: Madagascar: Toliara Prov., 12 km se Tuléar, (DAVIS). Distribution: Mahajanga and Toliara Provinces.

Subfamily Tiphiinae

Genus *Tiphia* Fabricius
http://species-id.net/wiki/Tiphia
Fig. 3

Discussion. The genus *Tiphia* occurs worldwide, but the majority of species are found in the Northern Hemisphere. Only two species are recorded from Madagascar whereas 29 are known from mainland Africa. Members of the genus are known to parasitize scarab beetle larvae.

Tiphia are medium-sized, black wasps. They are characterized by a flat face, incomplete forewing marginal cell, oral fossa and associated hypostomal plate broader than long, male metasomal sternum VI notched apicomedially, and sternum VII unciform.

Key to species of *Tiphia*

Metasomal tergum I with transverse anterodorsal carina ... ***bisinuata*** **Saussure**
Metasomal tergum I without transverse carina ..... ***saussurei*** **Krombein**

Checklist of *Tiphia* species

1. *bisinuata* Saussure 1890:236. Syntype females; Madagascar (GENEVA?, unverified).
2. *saussurei* Krombein 1949: 54. Holotype; Madagascar: Fianarantsoa (WASHINGTON). Distribution: Fianarantsoa and Toliara Provnces.

Subfamily Myzininae

Genus *Meria* Illiger
http://species-id.net/wiki/Meria
Fig. 5

Meria Illiger 1807:194.

Type species: *Tiphia tripunctata* Rossi 1790. Monobasic.

Discussion. This is a widespread genus found throughout the Palearctic and Afrotropical Regions. *Meria* species are sexually dimorphic, as are members of the genera *Mesa* and *Myzinella*. Males are elongate and slender with straight, cylindrical antennae. Females are heavy-bodied, with coiled antennae. Males also have the distinctive hook-like apical metasomal sternum (uncus) found in other myzinines. *Meria* males can be distinguished from *Mesa* and *Myzinella* by the short, broad metasomal sternum I and petiolate forewing submarginal cell. Hosts are unknown.

Key to species of *Meria* (males)

1 Scape with densely pitted band on upper surface extending to apex; volsella with strong processes on inner surface..... ***luteipes*** **Bartalucci**
– Scape without densely pitted band on upper surface extending to apex; volsella without processes on inner surface..... **2**
2 Anterior margin of scutum thickened, elevated; metasoma strongly constricted between segments..... ***gradilis*** **Bartalucci**
– Anterior margin of scutum not thickened or elevated; metasoma not strongly constricted between segments ..... ***vonizongo*** **Krombein**

Checklist of *Meria* species

1. *gradilis* Bartalucci 2005:1087. Holotype male; Madagascar: Toliara, Toliara-Sakaraha Flusstal, 9 km vor Sakaraha (VIENNA). Distribution: Toliara Prov.
2. *luteipes* Bartalucci 2005:1086. Holotype male; Madagascar: Toliara, Toliara-Sakaraha Flusstal, 9 km vor Sakaraha (VIENNA). Distribution: Toliara Prov.
3. *vonizongo* Krombein 1949:57. Holotype male; Madagascar: Tananarive (ITHACA). Distribution: Fianarantsoa and Toliara Provinces.

Genus *Mesa* Saussure

http://species-id.net/wiki/Mesa

Fig. 4

Mesa Saussure 1890:244.

Type species: *Mesa heterogamia* Saussure 1890, designated by Krombein 1937.

Discussion. The genus *Mesa* is found from the Afrotropical Region, including Madagascar, north and east into Iran and Myanmar. *Mesa* males are characterized by having metasomal segment I more than three times as long as broad and the terga without a transverse subbasal carina or ridge. Hosts are unknown for the genus.

Although Bartalucci (2005) removed *Mesa hova* (Turner) from synonymy under *nodosa* (Guérin de Meneville 1837) he did not clearly describe the male and it is unclear, which male is associated with the female type of *hova*.

Key to species of *Mesa* (males)

1 Metasomal sternum I basally with narrow punctate groove, margined with longitudinal carinae; clypeal apex and some metasomal terga with whitish markings ..... ***saussurei* (Turner)**

– Metasomal tergum I basally evenly convex, without longitudinal carinae or groove; clypeus and metasoma entirely black **2**

2 Tegula and tibiae with some whitish markings; body 13 mm long or shorter; propodeal posterior face densely punctuate, not rugose ..... ***nodosa* (Guérin de Meneville)**

– Tegula and tibiae without whitish markings; body longer than 15 mm; propodeal posterior face rugosopunctate **3**

3 Paramere broadest apically, apically truncate; cuspis inner surface with scale-like setae ..... ***krombeini* Bartalucci**

– Paramere broadest submedially or subapically, tapering apically; cuspis inner surface without scale-like setae **4**

4 Pygidium delimited by lateral carina extending two-thirds distance from apex to exposed base; metepimeron rugulose; paramere apically hooked ..... ***tandrona* Krombein**

– Pygidium delimited by lateral carina extending less than half distance from apex to exposed base; metepimeron smooth; paramere not apically hooked.....**5**
5 Pygidium apical emargination shallow, broad, twice as wide as deep; foretibia reddish, with whitish marks basally and apically ..... ***marovatana* Krombein**
– Pygidium apical emargination deep, narrow, nearly as deep as wide; foretibia red, without whitish markings ..... ***madecassa* Krombein**

Checklist of *Mesa* species

1. *hova* (Turner) 1908:504. (*Plesia*). Holotype female; Madagascar: Tamatave (LONDON). Synonymized by Krombein 1949. Removed from synonymy under *nodosa* by Bartalucci 2005. Distribution: Antsiranana, Finanarantsoa, Mahajanga and Toliara Provinces.
2. *krombeini* Bartalucci 2005:1086. Holotype male; Madagascar: Tananarive (ITHACA). Based on paratype males of *seyrigi* Krombein 1949. Distribution: Antanarivo and Toliara Provinces.
3. *madecassa* Krombein 1949:66. Holotype male; Madagascar: Bekily (ITHACA). Distribution: Fianarantsoa Prov.
4. *marovatana* Krombein 1949:68. Holotype male; Madagascar: Tananarive (ITHACA). Distribution: Antsiranana, Fianarantsoa, Mahajanga, Toliara Provinces.
5. *nodosa* (Guérin Méneville) 1837:584. (*Myzine*). Lectotype male (designated by Bartalucci 2005); Madagascar, Goudot (PARIS). Distribution: Antsiranana, Fianarantsoa Provinces.
6. *saussurei* (Turner) 1910:394. (*Plesia*). Holotype female; Madagascar: Tananarive (BERLIN). Distribution: Diego Suarez, Mahajanga, Toamasina and Toliara Provinces.
7. *tandrona* Krombein 1949:69. Holotype male; Madagascar: Vallée de Rivière Sambirano (ITHACA). Distribution: Antsiranana, Fianarantsoa and Toliara Provinces.

Genus *Myzinella* Guiglia

http://species-id.net/wiki/Myzinella
Fig. 6

Myzinella Guiglia 1959:2.

Type species: *Myzinella patrizii* Guiglia 1959. Original designation.

Discussion. Bartalucci (2005) published the first record of *Myzinella* from Madagascar, although the genus is known from mainland Africa, India and Iran. A second, new species, *minima*, was present in the materials examined for this review from the California Academy of Sciences Madagascar project and is described below.

The most distinctive features of male *Myzinella* are the abruptly up curved uncus, short, nodose metasomal tergum I, metasomal terga III–VII with an abruptly elevated

transverse ridge or flange separating the smooth anterior surface that slides beneath the preceding tergum from the tergal disk and the subapical metasomal sternum is broadly truncate apically.

Hosts: unknown for the genus.

Key to species of *Myzinella* (males)

Metasomal segment I red; tegula with posterior depression; flagellum not apically dilated, apical flagellomere more than twice as long as broad ....***festiva*** **Bartalucci**

Metasomal segment I black; tegula evenly rounded; *flagellum* apically dilated, apical flagellomere less than twice as long as broad..... ***minima*** **sp. n.**

Myzinella minima **sp. n.**

urn:lsid:zoobank.org:act:E721E65B-DC86-4CCF-8CA9-3B45A0D06D56

http://species-id.net/wiki/Myzinella_minima

Figs 6–8

Holotype male: Toliara Prov., Réserve Spéciale de Cap Sainte Marie, 14.9 km 261° W Marovato, 160m, 13–19/ii/2002 25°35'40"S 45°8'49"E, Fisher, Griswold et al., pitfall trap in spiny forest thicket, BLF5650 (CAS).

Paratypes (8 males): 5 males, same data as holotype; 2 males: 12.3 km 262° w Marovato, 200m, 11–15/ii/2002, 25°34'54"S 45°10'6"E, Fisher, Griswold et al., Malaise trap in spiny forest thicket, BLF5504; 1 male: Tuléar [Toliara] Prov., Ifaly 22 km north Tuléar, 23°11'S 43°37'E, 18/iv/1998, 30 m, swept from beach dunes, M. E. Irwin & E. I. Schlinger, Schlinger Foundation Expedition (DAVIS, SAN FRANCISCO).

Diagnosis. *Myzinella minima* can be readily distinguished from *Myzinella festiva* by the black metasomal segment I, evenly convex and ovoid tegula and apically thickened antenna. *Myzinella minima* is also smaller than *festiva*, which ranges from 10–12 mm long.

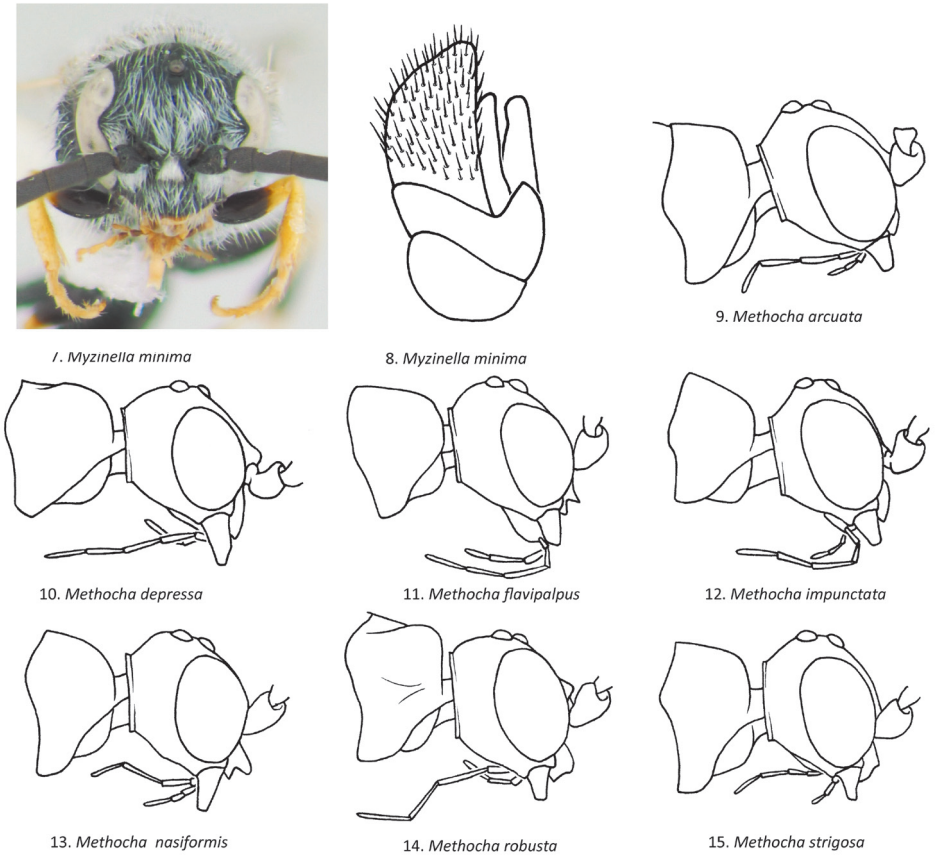
Description. Male (Fig. 6).

Body length. 5–8 mm.

Face (Fig. 7). Oral cavity unmodified; genal bridge opaque, barely covering the tongue base; vertex impunctate between hindocellus and eye, except for single row of punctures along eye margin; flagellomere I twice as long as broad; flagellomeres II and III 1.7× as long as broad; flagellomere XI 1.4× as long as broad, apical flagellar segments twice the breadth of basal segments.

Thorax. Pronotum more than twice as broad as long; metasomal dorsum and mesopleuron with punctures separated by 0.5–2.0 puncture diameters; tegula ovoid, evenly convex; forewing apical cells separated from wing apex by more than length of discoidal cell.

Metasoma. Tergum I highly polished, punctures 2–4 or more puncture diameters apart; terga I–VII polished with punctures 2–4 puncture diameters apart; tergum VII



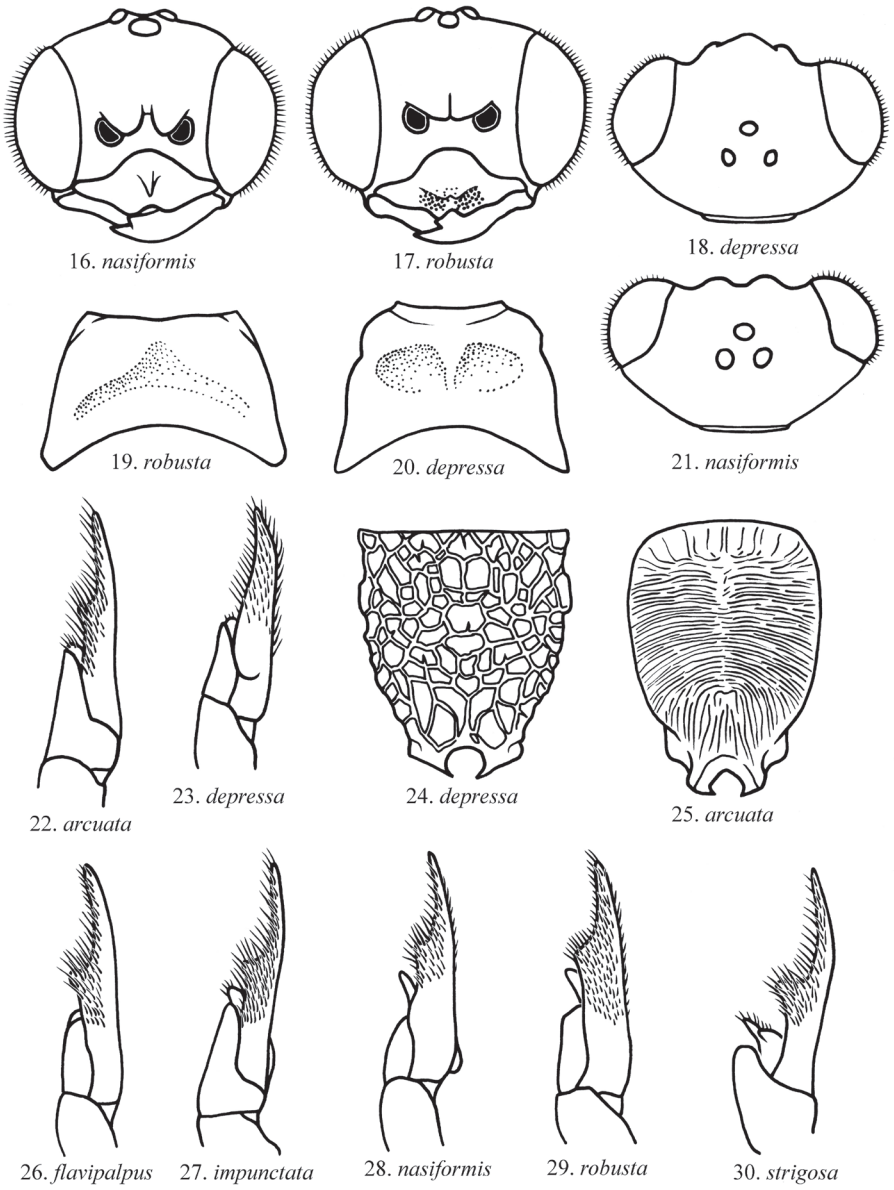
Figures 7–15. Front view of face. **8** Lateral view genital capsule **9–15** Lateral view of head and pronotum.

apically acute on either side of apicomedial notch; sternum I with punctures 1–2 puncture diameters apart; sterna II–V with transverse medial and apical bands of punctures; sternum VI impunctate, except for medial patch of punctures.

Genitalia (Fig. 8). Paramere 1.5× as long as broad, broadly curved dorsally with blunt apex; aedeagus simple, linear two-thirds as long as paramere; volsellar simple, apex rounded.

Color. Black, with pale yellow markings, mandibles pale yellow, pronotum with yellow transverse band, tegula pale yellow, femoral apices, tibiae partly and tarsi completely yellow, metasomal terga II–VI with medial and lateral yellow spots, tergum I with short transverse yellow band along posterior margin; wing veins whitish basally, black apically and medially, wing membrane whitish.

Vestiture. Long white, largely decumbent.



Figures 16–30. *Methocha* species. **16, 17** Front view of face **18, 21** Dorsal view of head **19, 20** Dorsal view of pronotum **22, 23, 26–30** Lateral view of genital capsule **24, 25** Posterior view of propodeum.

Checklist of *Myzinella* Species

1. *festiva* Bartalucci 2005:1088. Holotype male; Madagascar: Tuléar, Tuléar Morombe Pk. (VIENNA). Distribution: Toliara Prov.
2. *minima* sp. n. Distribution: Toliara Prov.

Subfamily *Methochinae*

Genus *Methocha* Latreille
http://species-id.net/wiki/Methocha
Figs 9–30

Discussion. Members of the genus *Methocha* are distinctive wasps. Females are wingless and ant-like. Males are slender and elongate with exserted parameres that protrude as far as the uncus. There are 16 species of *Methocha* in continental Africa, and ten Malagassy species, nine based on males and one species, *cambonini* Saussure, based on females. These wasps are known to be parasites of cicindellid beetles.

Key to species of *Methocha* (males)

1 Pronotal disk strongly depressed posterior to anterior margin (as in Figs 19, 20) **2**
– Pronotal disk not depressed posterior to anterior margin **3**
2 Pronotal disk depressed on either side of medial longitudinal elevation (Fig. 20); frons produced into medial angular projection just above suprantennal projections (Fig. 18) ..... ***depressa* sp. n.**
– Pronotal disk without medial longitudinal elevation (Fig. 19); frons not produced into medial projection or medial projection rounded.... ***robusta* sp. n.**
3 Clypeal deeply apicomedially emarginate; suprantennal projections broadly rounded separated by broadly obtuse, shallow medial depression; parategula yellow; legs usually yellow to reddish ..... ***lambertoni* Krombein**
– Clypeal apex truncate or slightly concave; suprantennal projections strongly convex separated by narrow, acute medial depression; parategula entirely black, brown or bicolored; legs brown to black or yellow **4**
4 Clypeus with acute to digitate medial projection (as in Figs 11, 13, 15)..... **5**
– Clypeus broadly convex, without acute or digitate medial projection (as in Figs 9, 10, 12)..... **7**
5 Parategula yellowish brown to brown with transparent margin; clypeal apical margin emarginate; mandible yellow; legs yellow to yellowish brown..... ..... ***flavipalpus* sp. n.**
– Parategula opaque, evenly black to dark brown; clypeal apical margin linear or shallowly emarginate, mandible dark reddish brown to black; legs dark brown to black..... **6**
6 Propodeum covered with coarse contiguous punctures..... ***nasiformis* sp. n.**
– Propodeum covered with fine transverse parallel ridges (similar to Fig. 25).... ..... ***strigosa* sp. n.**
7 Flagellomere I twice as long as broad, flagellomere II 3× as long as broad; antennal lobes strongly produced, medially forming parallel-sided or apically narrowed notch..... ***arnoldi* Krombein**

– Flagellomere I less than twice as long as broad, flagellomere II twice as long as broad; antennal lobes weakly or strongly produced, forming obtuse medial notch **8**

8 Propodeum covered with dense, fine ridges, dorsally and ventrally arcuate (Fig. 25) ..... ***arcuata* sp. n.**

– Propodeum polished, nearly impunctate, without more than traces of ridges ..... ***impunctata* sp. n.**

***Methocha arcuata* sp. n.**
urn:lsid:zoobank.org:act:C8488898-9AFB-4D40-9D88-802E4D93283E
http://species-id.net/wiki/Methocha_arcuata
Figs 9, 22, 25

Holotype male: Fianarantsoa Prov., Parc Natl. Ranomafana, radio tower at forest edge, 1130 m, 14–21/i/2002, 21°5'05S 47°24'43E, R. Harin'Hala, malaise, mixed tropical forest, MA-02-09B-12 (SAN FRANCISCO).

Paratypes (8 males): 1 male: 23/v–3/vi/2002, MA-02-09C-30; 1 male: Belle Vue at Talatakely, 1020 m 23–28/iv/2002, 21°15'99S 47°25'21E. R. Harin'Hala, malaise, secondary tropical forest, MA-02-09C-26; 2 males: JIRAMA water works, 10–14/i/2002, 21°14'91S 47°27'13E, R. Harin'Hala, MT nr river, 690 m, MA-02-09D-11; 1 male: Antsiranana Prov., Parc Natl. Montagne d'Ambre, 1125m, 14–30/v/2001, 12°31'13S 49°10'45E, R. Harin'Hala, MT, MA-01-01D-11; 1 male: Toamasina Prov., Montagne d'Anjanaharibe, 18.0 km 21° nnw Ambinanitelo, 470m, 8–12/iii/2003, 15°11'18S 049°36'54E, Fisher, Griswold et al. MT, in rainforest, BLF8011 (DAVIS).

Diagnosis. The most distinctive features of *arcuata* are the flattened clypeus, well-developed antennal lobes and propodeal sculpturing consisting of fine transverse to dorsally arcuate ridges. This species most closely resembles *arnoldi* but can be distinguished by the longer flagellomeres and the finely ridged propodeum.

Description. Male.

Body length. 7–11 mm.

Head. Clypeus flattened medially (Fig. 9), apex truncate; antennal lobes rounded; frons without medial projection or lobe above antennal sockets; frons and vertex punctures separated by 1–2 puncture diameters; flagellomere I twice as long as broad; flagellomeres II and III 2.6–2.7× as long as broad; flagellomere XI 4× as long as broad.

Mesosoma. Pronotal disk gently convex medially, shoulders evenly rounded; scutal punctures separated by 1 puncture diameter, except for less densely punctate medial area; scutellum nearly impunctate; mesopleuron highly polished with tiny sparse punctures, more than 4 puncture diameters apart; propodeum with dense, fine ridges, dorsally and ventrally arcuate (Fig. 25).

Metasoma. Terga highly polished, punctures tiny and separated by 4 or more puncture diameters; sterna impunctate except for basal band of punctures 1 puncture diameter apart.

Genitalia (Fig. 22). Paramere slender, with small medial angle, marked by transparent lobe, breadth at medial angle 2.0–2.3× breadth at halfway point between apex and medial angle, paramere length versus breadth at submedial angle is 6×.

Color. Black, with pale yellow mandibles and fore and midcoxae, fore and mid legs may be yellowish brown; palpi whitish; wing membrane faintly brown-tinted apically.

Vestiture. Sparse erect, silvery.

***Methocha depressa* sp. n.**

urn:lsid:zoobank.org:act:32899954-9905-484D-BD83-23FF9B99B049

http://species-id.net/wiki/Methocha_depressa

Figs 10, 18, 20, 21, 23

Holotype male: Fianarantsoa Prov., Parc Natl. Ranomafana, Belle Vue at Talatakely, 1020 m, 12–19/ii/2002, 21°15'99S, 47°25'21E, R. Harin'Hala, Malaise trap, secondary tropical forest, MA-02-09C-16 (SAN FRANCISCO).

Paratypes (12 males): 9 males: same data as holotype; 1 male: 12–23/iv/2003, MA-02-09C-58; 4 males: 16/x–8/xi/2001, MA-02-09C-01; 1 male: 22–28/xi/2001 MA-02-09C-04; 1 male: 10–14/i/2002, MA-02-09C-11; 1 male: 23–28/iv/2002, MA-02-09C-26; 1 male: 28/iv–5/v/2002, MA-02-09C-27; 4 males: 23/v–3/vi/2002, MA-02-09C-30; 1 male: 13–23/vi/2002, MA-02-09C-32; 1 male: 10–21/iii/2003, MA-02-09C-56; 1 male: 21/iii–12/iv/2003, MA-02-09C-57; 1 male: 28/v–6/vi/2003, MA-02-09C-62; 2 males: JIRAMA water works, 21–24/xii/2001, 21° 14.91'S, 47° 27.13'E colr. R. Harin'Hala CAS MT nr river 690 m, MA-02-09D-08; 1 male: 2–10/i/2002, MA-02-09D-10; 3 males: radio tower at forest edge, 1130 m, 14–21/i/2002 21°15'05S, 47°24'43E, R. Harin'Hala, Malaise trap, mixed tropical forest, MA-02-09B-12; 2 males: 12–19/ii/2002, MA-02-09B-16; 1 male: 12–19/iii/2002, MA-02-09B-20; 3 males: 24/v–4/vi/2002, MA-02-09B-30; 1 male: 27/ii–9/iii/2003, MA-02-09B-54; 1 male: 9–20/iii/2003, MA-02-09B-55; 1 male: 29/vi/–6/vii/2003 2,1 MA-02-09B-65; 2 males: 6–17/vii/2003, MA-02-09B-66; 1 male: Vohiparara, at broken bridge, 1110 m, 21°13'57S, 47°22'19E, R. Harin'Hala, Malaise trap in high altitude rainforest, 25/vii–3/viii/2002, MA-02-09A-36; 3 males: 6–15/xii/2001, MA-02-09A-061 male: 15–21/xii/2001, MA-02-09A-07; 3 males: 21-28/i/2002, MA-02-09A-13; 2 males: 26–31/iii/2002 21, MA-02-09A-22; 7 males: 1 male: Antsiranana Prov., Parc Natl Montagne d'Ambre, 1125m, 14-30/v/2001 12°31'13S 49°10'45E, R. Harin'Hala, MT MA-01-01D-11; 1 male: Forêt de Binara, 7.5 km 230° sw Daraina, 375m, 1/xii/2003, 13°15'18S 049°37'00E, B. L. Fisher, MT tropical dry forest, BLF9557 (DAVIS, SAN FRANCISCO).

Diagnosis. The most distinctive features of *depressa* are the coarsely areolate propodeum, the shape of the frontal projection above and between the antennal lobes and the sublaterally impressed pronotal disk. This species does not closely resemble any of the other Malagasy *Methocha* species, although the depressed pronotum resembles that of *robusta*, which differs in having the pronotal depression interrupted medially.

Description. Male.

Body length. 5–7 mm.

Head. Clypeus with obtuse medial projection (Fig. 10), apex linear or shallowly emarginate; antennal lobes rounded; frons with strong medial projection or lobe above antennal sockets (Fig. 18); frons and vertex punctures separated by 1–2 puncture diameters; scapal carina less than half length of scape; flagellomere I 1.7× as long as broad; flagellomere II 2.5× as long as broad; flagellomere III 2.8× as long as broad; flagellomeres IV–X arcuate; flagellomere XI 5× as long as broad.

Mesosoma. Pronotal disk strongly depressed on either side of elevated midline posterior to anterior margin, shoulders evenly rounded (Fig. 18); scutal punctures separated by 1 puncture diameter, except for less densely punctate medial area; scutellum nearly impunctate; mesopleural punctures 1–2 puncture diameters apart; propodeum with coarse, contiguous areolae (Fig. 24).

Metasoma. Terga highly polished, punctures tiny and separated by 4 or more puncture diameters; sternum I punctures 1 puncture diameter apart; sterna II-V anteriorly with contiguous punctures, separated from posterior part by punctulate transverse groove, posteriorly strongly convex, punctures 1–2 puncture diameters apart.

Genitalia (Fig. 23). Paramere breadth at medial angle 1.5× breadth at halfway point between apex and medial angle, paramere length versus breadth at submedial angle is 6×.

Color. black; clypeus sometimes partly reddish brown; mandibles reddish; palpi yellow to pale brown; parategula black; legs dark brown to black; palpi whitish; wing membrane untinted apically.

Vestiture. Sparse erect, silvery.

Methocha flavipalpus sp. n.

urn:lsid:zoobank.org:act:F42DF972-75A7-447F-8C50-A7E2971BF6F3
http://species-id.net/wiki/Methocha_flavipalpus
Figs 11, 26

Holotype male: Mahajanga Prov. Parc Natl. Tsingy de Bemaraha, 10.6 km ese 123° Antsalova, 150m, 16–20/xi/2001, 19°42'34S 44°43'5E, Fisher, Griswold et al., MT, tropical dry forest on Tsingy, BLF4462 (SAN FRANCISCO).

Paratypes: (10 males) 6 males: same data as holotype; 1 male: 2.5 km 62° ene Bekopaka, Ankidrodroa River, 100m, 11–15/xi/2001, 19°07.56S 44°48.53E, Fisher, Griswold et al., MT-tropical dry forest on Tsingy, BLF4345; 1 male: Mahavavy River, 6.2 km 145° se Mitsinjo, 20m, 1–5/xii/2002, 16°03'06S 045°54'30E, Fisher, Griswold et al., MT in gallery forest, BLF6930; 1 male: 3.4 km 93° e Bekopaka, Tombeau Vazimba, 50m, 6–10/xi/2001, 19°8'31S 44°49'41E, Fisher, Griswold et al., MT, in tropical dry forest, BLF4233; 1 male: Forêt Ambohimanga, 26.1 km 314° Mampikony, 250 m, 13/xii/2004, 15°57.46S 047°6.17E, B. L. Fisher, MT tropical dry forest, BLF11670; 1 male: Toliara Prov. Rés. Spéciale d'Ambohijanahary, Forêt d'Ankazotsihitafototra, 35.2

km 312° nw Ambaravaranala, 1050 m, 13–17/i/2003, 18°16'00S 045°24'24E, Fisher, Griswold et al., MT-montane rainforest, BLF7023 (DAVIS, SAN FRANCISCO).

Diagnosis. *Methocha flavipalpus* resembles *nasiformis* and *strigosa* based on the strong medial clypeal projection. It can be distinguished from those species by the coloration of the parategula, which has a transparent margin and the yellowish mandibles, palpi and legs; all black to dark or reddish brown in *nasiformis* and *strigosa*.

Description. Male.

Body length. 9–11 mm.

Head. Clypeus with acute to digitate medial projection (Fig. 11), apical margin emarginate; antennal lobes strongly convex; frons without medial projection or lobe above antennal sockets; frons punctures separated by 1 puncture diameter; vertex nearly impunctate; scapal ridge two-thirds length of scape; flagellomere I 1.7× as long as broad; flagellomere II 2.2× as long as broad; flagellomeres II and III 2.4× as long as broad; flagellomeres III–X arcuate; flagellomere XI 5× as long as broad.

Mesosoma. Pronotal disk gently convex medially, shoulders rounded, punctures large nearly contiguous; scutal punctures contiguous sublaterally becoming sparser medially; scutellum punctures 1–3 puncture diameters apart; mesopleuron with punctures separated by 1–2 puncture diameters apart; propodeum with coarse, contiguous, transversely striatiform punctures.

Metasoma. Terga polished, punctures separated by 1–2 puncture diameters; sterna I and VI with punctures separated by 1–2 puncture diameters; sterna II–V basally with punctures separated by 1 puncture diameter, separated from posterior part by smooth, transverse groove, posteriorly convex, with punctures separated by 2–4 puncture diameters.

Genitalia (Fig. 26). Paramere breadth at medial angle 3.0–3.3× breadth at halfway point between apex and medial angle, paramere length versus breadth at submedial angle is 4.6×.

Color. Black; mandibles and palpi whitish to yellow; fore and midcoxae may be pale brown, fore and mid legs brown with paler joints and tarsi; parategula bicolored, brown and whitish with transparent margin; wing membrane untinted, except posterior margin slightly brown-tinted in some specimens.

Vestiture. Sparse erect, silvery.

***Methocha impunctata* sp. n.**

urn:lsid:zoobank.org:act:635024DC-85DE-4BD7-B527-1EE0A1D566FA
http://species-id.net/wiki/Methocha_impunctata
Figs 12, 27

Holotype male: Toamasina Prov., Andasibe NP, 1–7/xi/2001, 18°55'58S 48°24.47E, R. Harin'Hala colr., Malaise trap, 1025 m, MA-01-08B-18 (SAN FRANCISCO).

Diagnosis. The highly polished, largely impunctate and unsculptured body is the most distinctive feature of *impunctata*. The unsculptured propodeum will immediately

separate it from *arcuata*, which shares the largest number of characteristics with *impunctata*.

Description. Male.

Body length. 8 mm.

Head (Fig. 12). Clypeus flattened medially, apical margin at most slightly concave; antennal lobes rounded; frons without medial projection or lobe above antennal sockets; frons punctures 1 puncture diameter apart; vertex punctures tiny, separated by 2–4 puncture diameters; scapal ridge two-thirds length of scape; flagellomere I 1.4× as long as broad; flagellomeres II–III twice as long as broad; flagellomeres IV–X arcuate; flagellomere XI 4× as long as broad.

Mesosoma. Pronotal disk gently convex medially, shoulders evenly rounded, punctures 0.5–1.0 puncture diameter apart; scutal punctures contiguous to 1 puncture diameter apart, except for less dense medial area; scutellum, mesopleuron and propodeum highly polished, nearly impunctate.

Metasoma. Terga and sterna highly polished, nearly impunctate, subbasal sternal groove smooth impunctate.

Genitalia (Fig. 27). Paramere breadth at medial angle 3.0–3.3× breadth at halfway point between apex and medial angle, paramere length versus breadth at submedial angle 6×.

Color. Black; mandibles and palpi brown; legs dark brown; parategula black; wing membrane untinted.

Vestiture. Sparse erect, silvery.

***Methocha nasiformis* sp. n.**

urn:lsid:zoobank.org:act:27D7C1EB-73EA-441B-B0ED-B7AC1DE25F39

http://species-id.net/wiki/Methocha_nasiformis

Figs 13, 16, 21, 28

Holotype male: Fianarantsoa, Parc Natl. Ranomafana, radio tower at forest edge, 1130 m, 4–12/ii/2002, 21°15.05'S, 47°24.43'E, R. Harin'Hala, Malaise trap, mixed tropical forest, MA-02-09B-15 (SAN FRANCISCO).

Paratypes (5 males): 1 male: same data as holotype; 1 male: 29/vi/– 6/vii/2003, MA-02-09B-65; 1 male: 4–12/ii/2002, 21°15'05S 47°24'43E, R. Harin'Hala, malaise, mixed tropical forest, MA-02-09B-15; 1 male: Belle Vue at Talatakely, 1020 m, 28/iv/–5/v/2002, 21°15.99S 47°25'21E, R. Harin'Hala, malaise, secondary tropical forest, MA-02-09C-27; 1 male: Antsiranana Prov., Parc Natl. de Marojejy, Manantenina River, 28 km 38° ne Andapa, 8.2 km 333° nnw Manantenina, 450m, 12–25/xi/2003, 14°26'12S 049°46'30E, B. L. Fisher et al, MT in rainforest, BLF8723; 1 male: Parc Natl Montagne d'Ambre, 1125m, 14–30/v/2001 12°31'13S 49°10'45 E , R. Harin'Hala, MT, MA-01-01D-11 (DAVIS, SAN FRANCISCO).

Diagnosis. *Methocha nasiformis* is one of three species with an acute or even digitate medial clypeal projection. It can be distinguished from *flavipalpus* by the black,

concolorous parategula, dark legs and nearly straight apical clypeal margin (features shared with *strigosa*). It can be distinguished from *strigosa* by the coarsely punctate, not finely ridged propodeum.

Description. Male.

Body length. 7–13 mm.

Head. Clypeus projecting into acute sometimes digitate medial projection (Fig, 13), apex subtruncate (Fig. 16); antennal lobes rounded; frons without medial projection or lobe above antennal sockets (Fig. 21); frons and vertex punctures separated by 1–2 puncture diameters; scapal ridge more than half length of scape; flagellomere I 1.8× as long as broad; flagellomere II 2.2× as long as broad; flagellomeres II and III 2.5–2.6× as long as broad; flagellomere XI 5× as long as broad.

Mesosoma. Pronotal disk gently convex medially, shoulders evenly rounded; scutal punctures separated by 1 puncture diameter, except for less dense medial area; scutellum with punctuates 1 puncture diameter apart; mesopleuron highly polished with punctures 2–4 puncture diameters apart; propodeum covered with dense, contiguous punctures, becoming striatiform dorsally, dorsally with transverse ridges becoming U-shaped basally.

Metasoma. Terga polished, punctures separated by 2–4 or more puncture diameters; sternum I punctures 1–4 puncture diameters apart; sterna II–VI basal part with punctures 0.5–1.0 puncture diameters apart, separated from posterior convex part by small transverse groove, posterior part with punctures 2–4 puncture diameters apart.

Genitalia (Fig. 28). Paramere breadth at medial angle 4.5× breadth at halfway point between apex and medial angle, paramere length versus breadth at submedial angle 5×.

Color. Black, with dark red mandibles, scapal carina yellow legs black to dark brown, trochanters sometimes paler; palpi reddish; wing membrane brown-tinted.

Vestiture. Sparse erect, silvery.

***Methocha robusta* sp. n.**

urn:lsid:zoobank.org:act:43F6173E-D6C8-483E-BEA7-CA3D45B86624
http://species-id.net/wiki/Methocha_robusta
Figs 1, 14, 17, 19, 29

Holotype male: Fianarantsoa Prov., Parc Natl. Ranomafana, radio tower at forest edge, 1130 m 14–21/i/2002, 21°15'05S 47°24'43E, R. Harin'Hala, malaise, mixed tropical forest, MA-02-09B-12 (SAN FRANCISCO).

Paratypes (4 males): 1 male: 15–27/iv/2003, MA-02-09B-58; 1 male: Belle Vue at Talatakely, 1020 m, 10–14/i/2002, 21°15'99S 47°25'21E, R. Harin'Hala, malaise, secondary tropical forest, MA-02-09C-11; 1 male: 23/v–3/vi/2002, 21°15'99S 47°25'21E, R. Harin'Hala, malaise, secondary tropical forest, MA-02-09C-30; 1 male: Toamasina Prov., botanic garden nr entrance to Andasibe Natl. Park, 1–7/xi/2001, 18°55'58S 48°24'47E, R. Harin'Hala, MT-tropical forest ,1025 m, MA-01-08B-18 (DAVIS, SAN FRANCISCO).

Diagnosis. *Methocha robusta* is one of two species with a medial depressed pronotal disk. It can be distinguished from the other species, *depressa,* by the frons concave between the antennal lobes and the strongly convex clypeus. In addition, the pronotal depression lacks the longitudinal medial elevation seen in *depressa*.

Description. Male.

Body length. 10–13 mm.

Head. Clypeus elevated medially into two broad submedial tubercles (Fig. 17) strongly convex in profile (Fig. 14), apex emarginate, with densely shagreened patch on either side of emargination (Fig. 17); antennal lobes elevated with obtuse depression between; frons without medial projection or lobe above antennal sockets; frons and vertex punctures separated by 1 puncture diameters, becoming nearly impunctate behind ocelli; scapal ridge half scapal length; flagellomere I 2.5× as long as broad; flagellomere II 3× as long as broad; flagellomeres III–X arcuate; flagellomere XI 7–8× as long as broad.

Mesosoma. Pronotal disk transversely depressed medially, anterior margin elevated in lateral view, shoulders angulate (Fig. 19); scutal and mesopleural punctures separated by 1 puncture diameter; scutellar punctation sparser, 2–3 puncture diameters apart; propodeum completely coarsely areolate.

Metasoma. Terga polished, punctures small separated by 2–4 puncture diameters; sterna I and VI with punctures large, 0.5–1.0 puncture diameters apart; sterna II–V basal area with punctures 0.5–1.0 puncture diameters apart, separated from convex posterior part by punctulate groove, posterior part with punctures tiny and 2–4 puncture diameters apart.

Genitalia (Fig. 29). Paramere breadth at medial angle 2.5× breadth at halfway point between apex and medial angle, paramere length versus breadth at submedial angle 4.7×.

Coloration. Black, mandibles, scapal carina and palpi red; parategula black, legs black to dark brown fore; wing membrane untinted.

Vestiture. Sparse erect, silvery.

***Methocha strigosa* sp. n.**

urn:lsid:zoobank.org:act:1CC35A15-DEA2-415B-82C8-DB85827712B1
http://species-id.net/wiki/Methocha_strigosa
Figs 15, 30

Holotype male: Fianarantsoa Prov., Ranomofana N.P. 21°16'S 47°27'E, 18/iv/1994, M. Wasbauer (DAVIS).

Paratypes (91 males): 4 males: Belle Vue at Talatakely, 1020 m, 21°15.99'S, 47°25.21'E, R. Harin'Hala, Malaise trap, secondary tropical forest, 23–28/iv/2002, MA-02-09C-26; 1 male: 22–28/xi/2001, MA-02-09C-04; 1 male: 10–14/i/2002, MA-02-09C-11; 2 males: 23/v–3/vi/2002, MA-02-09C-30; 1 male: 12–19/ii/2002, MA-02-09C-16; 1 male: 24/vii–4/viii/2002, MA-02-09C-36; 1 male: 16–26/ii/2003,

MA-02-09C-54; 1 male: 12–23/iv/2003, MA-02-09C-58; 1 male: 14–21/i/2002, MA-02-09C-12; 3 males: 26/ii–4/iii/2002, MA-02-09C-18; 2 males: radio tower at forest edge, 1130 m, 21°15'05S, 47°24'43E, R. Harin'Hala, Malaise trap, mixed tropical forest, 9–20/iii/2003, MA-02-09B-55; 1 male: 6–17/vii/2003, MA-02-09B-66; 1 male: 4–12/ii/2002, MA-02-09B-15; 2 males: 15-21/xii/2001, MA-02-09B-07; 1 male: 12–19/iii/2002, MA-02-09B-20; 1 male: 14–24/vi/2002 21, MA-02-09B-32; 2 males: 24/v–4/vi/2002 t, MA-02-09B-30; 1 male: 15–25/vii/2002, MA-02-09B-35; 1 male: 9–20/iii/2003, MA-02-09B-55; 4 males: 29/vi–6/vii/2003, MA-02-09B-65; 1 male: 6–17/vii/2003, MA-02-09B-66; 6 males: Vohiparara, at broken bridge, 1110 m, 25/vii/–3/viii/2002, 21°13.57S, 47° 22.19E, R. Harin'Hala, MT in high altitude rainforest, MA-02-09A-36; 1 male: 15–21/xii/2001, MA-02-09A-07; 2 males: 4–12/ii/2002, MA-02-09A-15; 1 male: 26–31/iii/2002, MA-02-09A-22; 2 males: radio tower at forest edge, 1130 m, 17–30/v/2003, 21°5.05S, 47°24.43E, R. Harin'Hala, malaise, mixed tropical forest, MA-02-09B-61; 4 males: 20/iii–3/iv/2003, MA-02-09B-56; 8 males: Montagne d'Anjanaharibe, 18.0 km 21° NNE Ambinanitelo, 470m, 8-12/iii/2003, 15°11'18"S 049°36'54"E, Fisher, Griswold et al., Malaise trap, in rainforest, BLF8011; 15 males: Toamasina Prov., Montagne d'Anjanaharibe, 19.5 km 27° nne Ambinanitelo 1100 m, 12-16/iii/2003, 15°10'42"S 049°38'06"E, Fisher, Griswold et al., Malaise trap, in montane rainforest, BLF8149; 3 males: botanic garden nr entrance to Andasibe Natl. Park, 24/x/–1/xi/2001, 18°55.58S 48°4.47E, R. Harin'Hala, MT-tropical forest, 1025 m, MA-01-08B-17; 1 male: 1-7/xi/2001, MA001-08B-18; 2 males: Antsiranana Parc Natl. de Marojejy, Manantenina River, 28.0 km 38° ne Andapa, 8.2 km 333° nnw Manantenina, 450m, 12-25/xi/2003, 14°26'12S 049° 46'30E, B.L. Fisher et al, MT in rainforest, BLF8723; 1 male: Parc Natl Montagne d'Ambre, 1125m, 14-30/v/2001, 12°31'13S 49°10'45E, R. Harin'Hala, MT, MA-01-01D-11; 5 males: Toliara Prov., Rés. Spéciale d'Ambohijanahary, Forêt d'Ankazotsihitafototra, 35.2 km 312° nw Ambaravaranala, 1050m, 13-17/i/2003, 18°16'00S 045°24'24E, Fisher, Griswold et al., MT-montane rainforest, BLF7023; 1 male: Forêt Classée d'Analavelona, 29.2 km 343° nnw Mahaboboka, 1100m, 18-22/ii/2003, 22°40'30S 044°11'24E, Fisher, Griswold et al., MT, in montane rainforest, BLF7818; 4 males: Mahajanga Prov., Parc Natl. Tsingy de Bemaraha, 3.4 km 93° e Bekopaka, Tombeau Vazimba, 50m, 6-10/xi/2001, 19°8'31S 44°49'41E, Fisher, Griswold et al., MT, in tropical dry forest, BLF4233; 3 males: Diego Suarez Prov., PN Montagne d'Ambre, 1125 m, 12°31'13S 49°10'45E, 14-30/v/2001, R. Harin'Hala, MT, MA01-01D-11 (DAVIS, SAN FRANCISCO).

Diagnosis. *Methocha strigosa* is one of three species, including *nasiformis* and *flavipalpus* with an acute to digitate medial clypeal projection as discussed under *nasiformis*. It can be distinguished from those species by the dark coloration and propodeum covered fine transverse ridges.

Description. Male.

Body length. 6–11 mm.

Head. Clypeus forming obtuse angle medially (Fig. 15), apex linear or shallowly emarginate; antennal lobes well-developed, with narrow, deep notch between; frons

with/without medial projection or lobe above antennal sockets; frons and vertex punctures separated by 1–4 puncture diameters; scapal ridge two-thirds length of scape; flagellomere I 1.8× as long as broad; flagellomere II 2.2× as long as broad; flagellomere III 2.2× as long as broad; flagellomeres III–X arcuate; flagellomere XI 5× as long as broad.

Mesosoma. Pronotal disk transversely striatiform anteriorly, evenly convex medially, shoulders evenly rounded, punctures separated by 0.5–2.0 puncture diameters; scutal punctures separated by 0.5–1.0 puncture diameter, becoming less dense medially; scutellum and mesopleuron highly polished, punctation 4–5 puncture diameters apart or more; propodeum covered with dense fine, transverse ridges, becoming U-shaped dorsally.

Metasoma. Terga highly polished, punctures tiny separated by 4–5 puncture diameters; sterna highly polished, with smooth subapical transverse groove, punctures anterior to groove 1 puncture diameter apart, posterior to groove 4–5 puncture diameters.

Genitalia (Fig. 30). Paramere breadth at medial angle 2.2–2.5× breadth at halfway point between apex and medial angle, paramere length versus breadth at submedial angle 4.6×.

Color. Black, with red to brown mandibles; legs black to dark brown becoming paler brown on tarsi in some specimens; palpi yellow; parategula black, without transparent margin; wing membrane untinted or slightly brown tinted.

Vestiture. Sparse erect, silvery.

Checklist of *Methocha* Species

1. *arcuata* sp. n. Distribution: Fianarantsoa Province.
2. *arnoldi* Krombein 1949:72. Holotype male; Madagascar: near Rogez (Krombein, on loan to WASHINGTON). Distribution: Antsiranana, Fianarantsoa, Mahajanga, Toliara and Toamasina Provinces.
3. *cambonini* (Saussure) 1891:259. (*Methoca*). Holotype female; Madagascar (GENEVA).
4. *depressa* sp. n. Distribution: Fianarantsoa Province.
5. *flavipalpus* sp. n. Distribution: Mahajanga, Toliara Provinces.
6. *impunctata* sp. n. Distribution: Toamasina Province.
7. *lambertoni* Krombein 1949:73. Holotype male; Madagascar: near Rogez, (Krombein, on loan to WASHINGTON). Distribution: Antsiranana, Fianarantsoa, Mahajanga, Toamasina and Toliara Provinces.
8. *nasiformis* sp. n. Distribution: Fianarantsoa, Antsiranana Provinces.
9. *robusta* sp. n. Distribution: Fianarantsoa, Toamasina Provinces.
10. *strigosa* sp. n. Distribution: Antsiranana, Fianarantsoa, Mahajanga, Toamasina, Toliara, Diego Suarez Provinces.

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RESEARCH ARTICLE

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A revision of Thai Agathidinae (Hymenoptera, Braconidae), with descriptions of six new species

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Abstract

The Thai fauna of eleven agathidine genera, i.e., *Biroia, Braunsia, Camptothlipsis, Coccygidium, Cremnops, Cremnoptoides*, *Disophrys, Earinus, Gyrochus, Lytopylus,* and *Troticus,* are revised. 25 species are treated, 20 of which are found in Thailand and five that are likely to occur there. Six new species are described, i.e., *Braunsia chaweewanae* Sharkey, **sp. n.**, *Camptothlipsis annemariae* Sharkey, **sp. n.**, *Camptothlipsis sheilae* Sharkey, **sp. n.**, *Coccygidium mastigion* Sharkey, **sp. n.**, *Coccygidium phaeoscapos* Sharkey, **sp. n.**, and *Cremnoptoides yui* Sharkey, **sp. n.** The following new synonomies are proposed: *Isopronotum seminigripenne* Enderlein, 1920, *Isopronotum tricolor* Enderlein, 1920, *Biroia soror* van Achterberg & Long, 2010, are all synonymized with *Biroia fuscicornis* (Cameron, 1903). *Braunsia pumatica* van Achterberg & Long 2010 is synonymized with *B. fumipennis* (Cameron, 1899). *Braunsia devriesi* van Achterberg & Long 2010 is synonymized with *B. smithii* (Dalla Torre, 1898). *Cremnops malayensis* Bhat, 1979 and *Agathis nigritarsus* Cameron 1899 are synonymized with *C. desertor* (Linnaeus, 1758). *Disophrys macilifera* van Achterberg & Long 2010 is synonymized with *Disophrys strigata* Enderlein, 1920. *Disophrys quymanhi* van Achterberg & Long 2010 is synonymized with *Disophrys subfaciata* (Brullé, 1846). *Agathis burmensis* Bhat & Gupta (1977) is synonymized with *Lytopylus ebulus* (Nixon, 1950). *Disophrys ornatipennis* Cameron 1905 is transferred to *Gyrochus ornatipennis* Cameron, 1905, **comb. n.** *Agathis flavipennis* Brullé is transferred to *Gyrochus flavipennis* (Brullé, 1846), **comb. n.** A key to the genera of Thai Agathidinae and keys to the species of each genus with multiple species are presented.

Keywords
Thailand, parasitoid wasp, *Agathidinae,* taxonomy, systematics

Introduction

This is the first in a series of papers revising the agathidine braconids of Thailand. Here we treat species of the genera *Biroia, Braunsia, Camptothlipsis, Coccygidium, Cremnops, Cremnoptoides, Disophrys, Earinus, Gyrochus, Lytopylus,* and *Troticus*. The genera *Aneurobracon, Bassus, Euagathis, Therophilus* and *Zelodia* will be dealt with in subsequent publications. Twenty five species are treated here, twenty of which are found in Thailand and five of which have a high probability of being discovered in Thailand.

During the three year period 2006–2009, an intensive survey of the terrestrial arthropod fauna of Thailand was conducted through a collaborative effort among staff at Queen Sirikit Botanic Garden, The Thai Forestry Group, The Hymenoptera Institute and The Natural History Museum of Los Angeles County. This resulted in collecting at about 30 different parks and 559 different sites (Fig. 1). An electronic version of this map is available at the URL below figure 1. Malaise traps were the primary means of collecting, although pan traps and litter samples were also taken. The latter two methods did not result in any specimens of Agathidinae. Figure 1 shows the localities, mostly national parks, where intensive collecting was conducted with Malaise traps. The southern-most states of Thailand were not sampled due to political unrest in the area. For this reason we have included some agathidine species collected in Peninsular Malaysia, with the thought that they may occur in southern Thailand. Users of the species-level keys in this publication are encouraged to check the van Achterberg and Long (2010) treatment of Vietnamese Agathidinae, especially if their specimens do not match well with the figures and descriptions provided here.

Methods

Species limits were ascertained using standard morphological characters and in several cases with the aid of 28S rDNA sequence data. We obtained 28S sequence data from a total of 41 specimens comprising 18 species. The reasons for the choice of specimens were several. 1. Some of the more variable species, based on morphology, were sampled to ensure that they were homogeneous for sequence data. For example, there was one particularly small specimen of what we thought to be *Cremnops desertor*. To check this hypothesis we compared the 28S data of this and a specimen of normal size. 2. Some of the species delimited on morphological grounds appeared to be separated on trivial morphological characters. For example the three species of *Coccygidium* treated here appeared to be different in general gestalt, but specific morphological differences were few and mostly based on color. Therefore this genus was rather heavily sampled, and our preliminary species definitions were corroborated, i.e., each of our morphological species was also distinguishable using 28S data, and every specimen of each species was identical. 3. In one case, *Biroia*

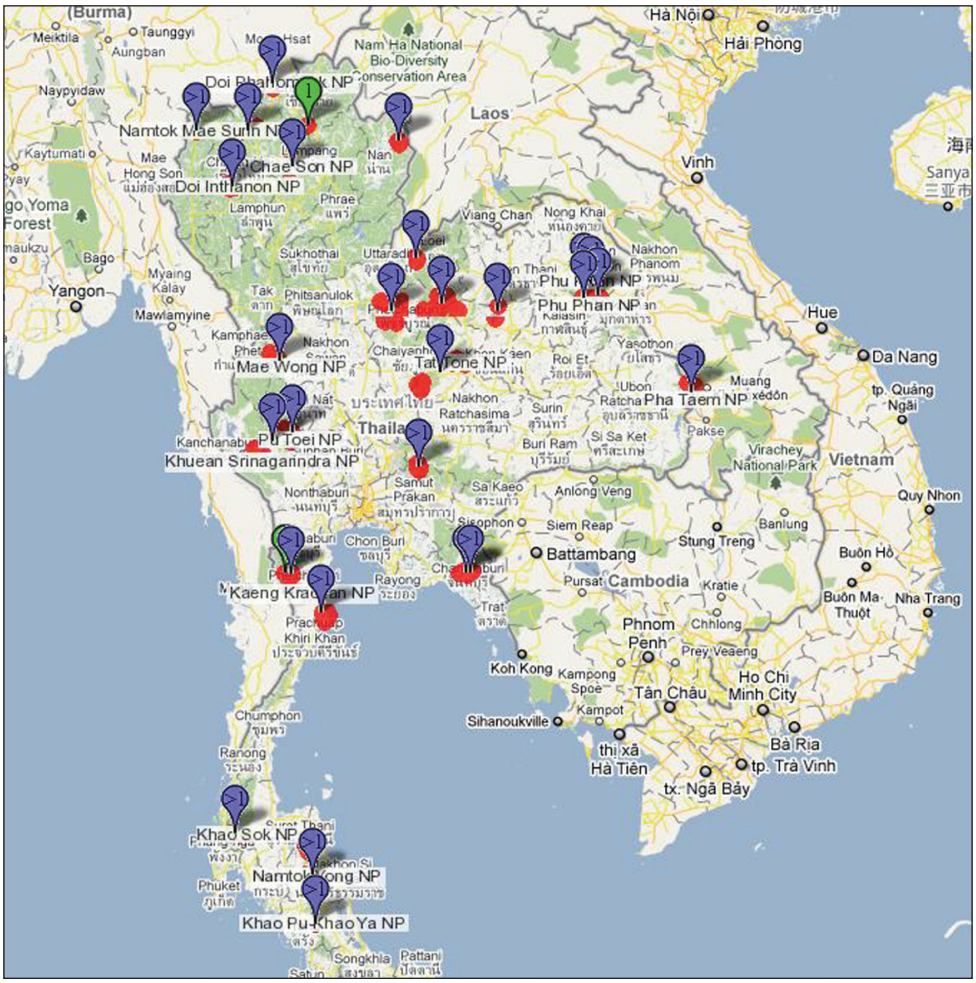


Figure 1. Map showing collection sites in Thailand (Distribution map can be found on http://purl.org/thaimaps/all.

fuscicornis, there are two rather distinct color forms, but otherwise no apparent morphological differences. Because the 28S data are identical between the two color morphs we decided that these represented color variation rather than separate species. 4. In one other case, *Cremnops desertor*, we tested the hypothesis that the Thai specimens were conspecific with those from Europe. Using a specimen from Sweden, the Thai and Swedish specimens differed in one base pair, thus corroborating our hypothesis. We used no magic numbers to determine species limits based on the 28S data. Some species showed some intraspecific variation, e.g., *Camptothlipsis nigra* (Fig. 2) whereas other species differed very little in 28S sequence data but were very distinct morphologically, e.g., *Braunsia chaweewanae* and *B. smithii* (Fig. 2). The sequence data are summarized in a phylogenetic tree in figure 2.

Regions D2-D3 of 28S rDNA (roughly 600 base pairs) were sequenced using the following primers: 28SD2hymF 5' - AGAGAGAGTTCAAGAGTACGTG - 3'

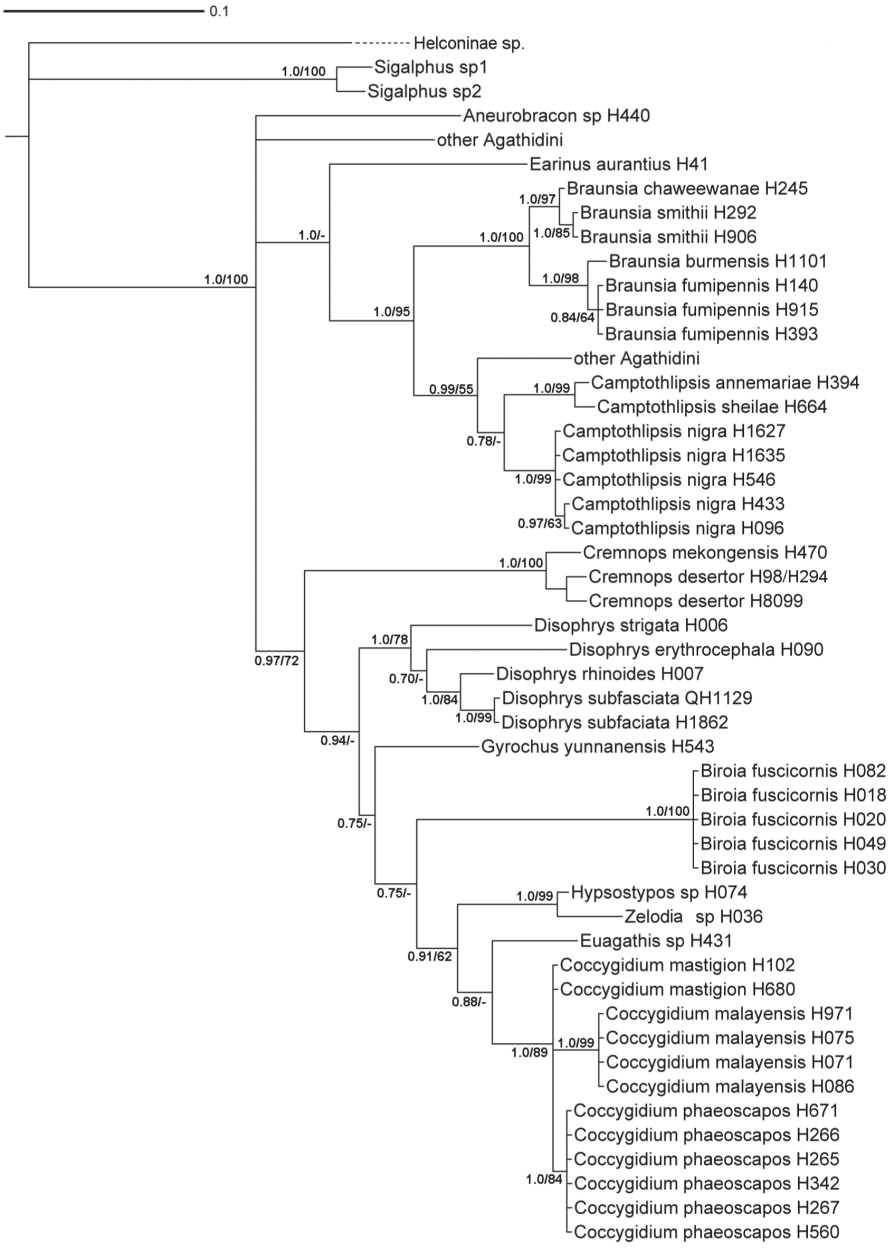


Figure 2. Bayesian phylogram inferred from 28S (region D2-D3) sequence data aligned by secondary structure. Bayesian analysis runtime = 736,000 generations (25% burnin). Branch support: Bayesian posterior probabilities / bootstrap (1,000 replicates). **(-)** indicates bootstrap support below 60.

and 28SD3hymR 5' - TAGTTCACCATCTTTCGGGTC - 3'. Sequences were edited using Geneious Pro v4.7.5 (Drummond et al. 2009) and aligned based on a secondary structure model for Ichneumonoidea developed by Yoder and Gillespie (2004)

and Gillespie et al. (2005). Regions of expansion and contraction (RECs), regions of slipped-strand compensation (RSCs), and short regions of alignment ambiguity were further aligned/corrected by eye. Three of these regions (28 base pairs total) were deleted because they could not be aligned with any confidence, i.e., there were multiple equally supported alignment options. All sequences have been deposited in GenBank and TreeBase (a nexus file can be downloaded at www.treebase.org).

Phylogenetic trees were constructed using maximum parsimony (MP) and Bayesian methods. MP was performed using TNT (Goloboff et al. 2008). A traditional search with 100 random addition sequences followed by branch-swapping, saving 10 trees per replication, was performed. 1000 bootstrap replications were used to estimate branch reliability. The Bayesian analysis was performed using MrBayes v3.1.2 (Ronquist and Huelsenbeck 2003). A best-fitting DNA substitution model was determined using MrModeltest2.2 (Nylander 2004). The general time reversible model of evolution with a parameter for invariant sites and rate heterogeneity modeled under a gamma distribution (GTR+I+G) was determined as the best-fitting model. Each Bayesian analysis consisted of two independent Bayesian MCMC runs initiated from different random starting trees. The analysis ran for 736,000 generations, reaching a topological similarity criterion of 0.01; trees were sampled every 500 generations. 25% of the trees from each run were removed as burn-in upon topological convergence. The tree in figure 2 is that produced by the Bayesian analysis. The support values on the branches are posterior probabilities and where the same clade was present in the MP result a bootstrap value is given. The purpose of the phylogenetic tree is to show distances between, and support for, the species concepts rather than to show relationships among higher taxa. A far larger data set is necessary for the latter and some of the higher relationships shown in figure 2 are contradicted by more thorough analyses, e.g., Sharkey et al. (2006).

Source images for the dichotomous key and the interactive key are in Appendices 1 and 2. Keys were generated using DELTA Editor Dallwitz et al. (1999), DELTA Dallwitz et al. (1993), and Intkey Dallwitz et al. (1995).

Morphological terms follow Sharkey and Wharton (1997) except for the following:

OOL = ocellar ocular length; LOD = lateral ocellar diameter; IOL = inter ocellar length; EH = eye height; MS = malar space length. Measurements are given for the length and apical width of the first metasomal median tergite. Measurement of the apical width is straightforward, however since the base of the tergite is usually hidden from view it is difficult to measure the total length. Instead we measure from the apex of the large tendon that emanates from the propodeum and inserts near the base of the median tergite. Both measurements are illustrated in figure 27.

All 25 species are treated with a diagnosis and distribution data. In a few instances a short description is also given for previously described species. The six new species are described with little text; however they, and most previously described species, are comprehensively illustrated with color photos using a JVC digital camera mounted on a Leica MZ16 microscope and Automontage® stacking software. Written descriptions of color patterns are considered redundant due to the completeness of the color illustrations, however when color variation occurs within a species this is referred to in the text, if it is not illustrated. It has been common practice to carefully describe coloration but in our view this is

a hold-over from the past when extensive color images were impractical or impossible. The color information is much more accurately recovered from the color photos. Tedious measurements and details of sculpture are not included unless they are of diagnostic value. It is difficult to predict which of the hundreds of possible characters are worth describing and this is rather dependent on the discovery of new species that may be similar to some of those described here. However since all body parts are extensively illustrated and if, for example, the sculpture of the metapleuron or the length of the malar space is important to distinguish a new species, this information is contained in the illustrations. Distribution data are listed for all new species and a Google map via Berkeley Mapper is included for all species.

Distribution data, pdf's of non-copywrite references, images, notes, and host and type information can be found by searching TaxaBank (a combined specimen and taxonomic database developed by Dr. Dicky Yu in the Sharkey lab; http://purl.org/taxabank) using the specimen voucher H number.

Abbreviations. Abbreviations used for institutions for where specimens are deposited are as follows:

AEI	American Entomological Institute, Gainesville, Florida, USA.
BMNH	Natural History Museum, London, England.
CNC	Canadian National Collection of Insects, Ottawa, Ontario, Canada.
FSCA	Florida State Collection of Arthropods, Gainesville, Florida, USA.
HIC	Hymenoptera Institute Collection, University of Kentucky, Department of Entomology, Lexington, Kentucky, USA.
HNHM	Hungarian Natural History Museum, Budapest, Hungary.
IZCAS	Chinese Academy of Sciences, Institute of Zoology, Beijing, China.
MNHN	Museum National d'Histoire Naturelle, Paris, France.
MZPW	Polish Academy of Science, Museum of the Institute of Zoology, Warsaw, Poland.
NHRS	Naturhistoriska riksmuseet, Stockholm, Sweden.
OUMNH	University Museum of Natural History, Oxford, United Kingdom QSBG Queen Sirikit Botanic Garden, Chaing Mai. Thailand.
RMNH	NCB Naturalis Collection [formerly Rijksmuseum van Natuurlijke Historie], Leiden, Netherlands.
UKM	Universiti Kebangsaan, Bangi, Selangor, Malaysia.
USNM	National Museum of Natural History, Smithsonian Institution, Washington DC, USA.

Taxonomy

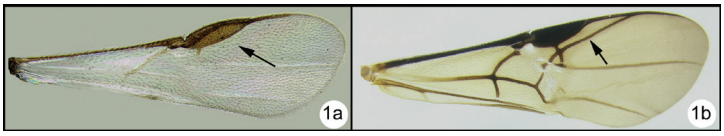
Key to Thai genera of Agathidinae

The key of Sharkey et al. (2009) is modified to allow *Gyrochus* to be properly identified and to include the genus name *Zelodia* for *Amputostypos*, which is a junior synonym of

Coccygidium as demonstrated by van Achterberg and Long (2010). An interactive key built on Delta and Intkey software is included in the appendix along with all supporting data and images.

1 Fore wing venation greatly reduced, last abscissa (segment) of RS vein completely absent (1a) ..... ***Aneurobracon*** **Brues, 1930**

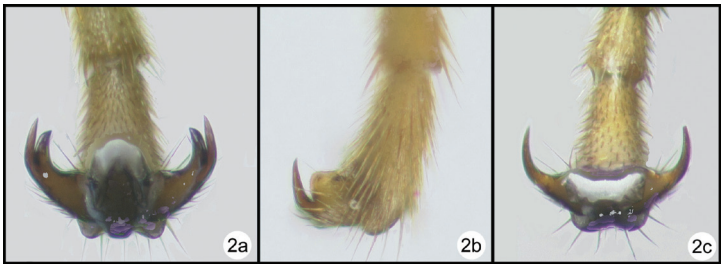
– Fore wing venation more complete, last abscissa of RS vein present though sometimes weak (1b) **2**



2(1) Fore and mid claws cleft (2a) **3**

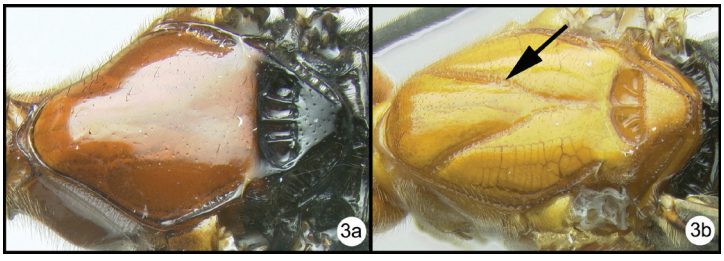
– Fore and mid claws with a basal lobe (2b) **12**

– Fore and mid claws simple (2c) ..... ***Bassus*** **Fabricius, 1804**



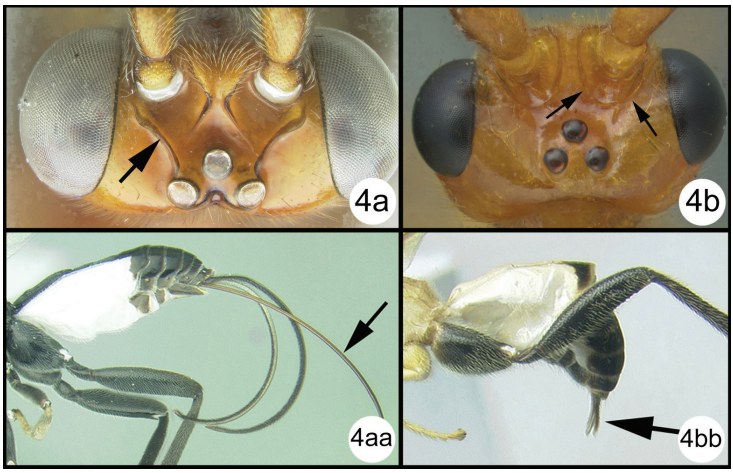
3(2) Notauli absent (3a) **4**

– Notauli present but not necessarily complete (3b) **5**

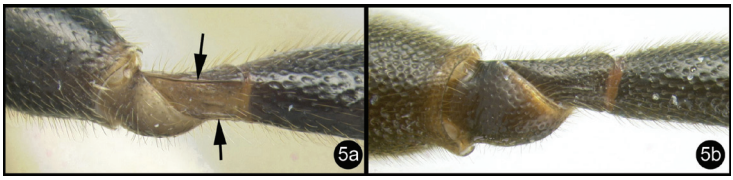


4(3) Lateral carina of frons directed towards lateral ocellus and not fused with medial carina (4a); ovipositor at least as long as metasoma (as in 4aa) .... ***Biroia*** **Szépligeti, 1900**

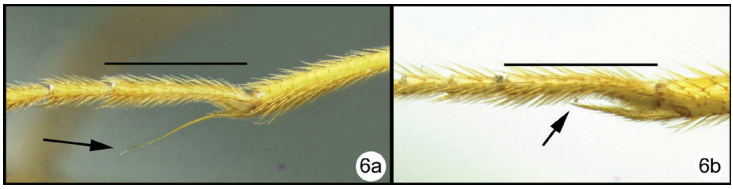
– Lateral carina of frons fused with medial carina forming a circular border around antennal base (4b); ovipositor barely exerted (as in 4bb) .... ***Gyrochus*** **Enderlein, 1920**



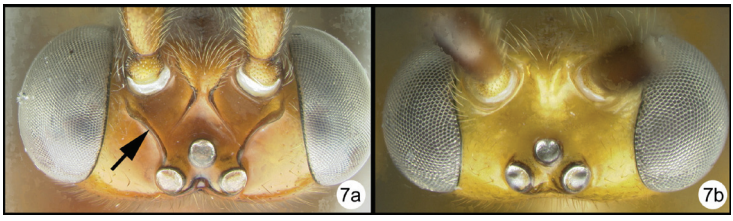
5(3) Hind trochantellus with one or two distinct carinae (5a) **6**
– Hind trochantellus lacking carinae (5b) **9**



6(5) Fore tibial spurs about as long as basitarsus and ending in a long thin style (6a) ..... ***Coccygidium*** **Saussure, 1892**
– Fore tibial spurs less that 3/4 length of fore basitarsus and ending abruptly (6b) 7

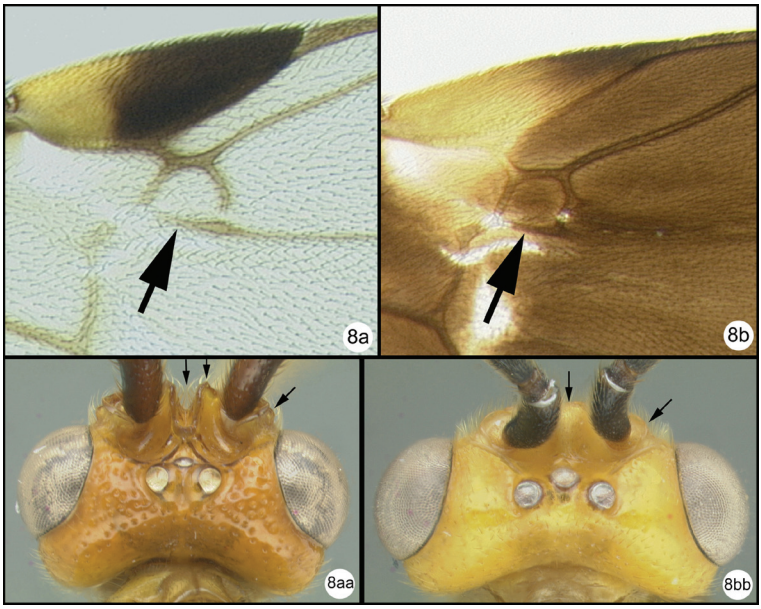


7(6) Posterolateral margins of frons bordered with carinae (7a) **8**
– Posterolateral margins of frons not bordered with carinae (7b)..... ..... ***Zelodia van*** **Achterberg & Long, 2010**



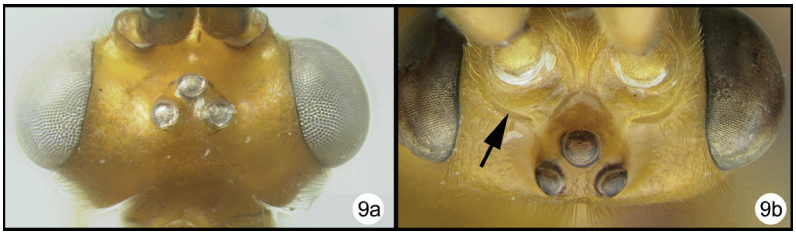
8(7) 2nd submarginal cell of fore wing triangular or distinctly narrowing anteriorly (8a); base of antenna surrounded by pronounced medial, lateral, and anterior ridges; deep groove between antennae (8aa) ..... ***Hypsostypos* Baltazar, 1963***

– 2nd submarginal cell of fore wing quadrate, not distinctly narrowing anteriorly (8b); base of antenna surrounded by weak lateral, and anterior ridges; lacking deep groove between antennae (8bb) ..... ***Cremnoptoides* van Achterberg & Chen, 2004**



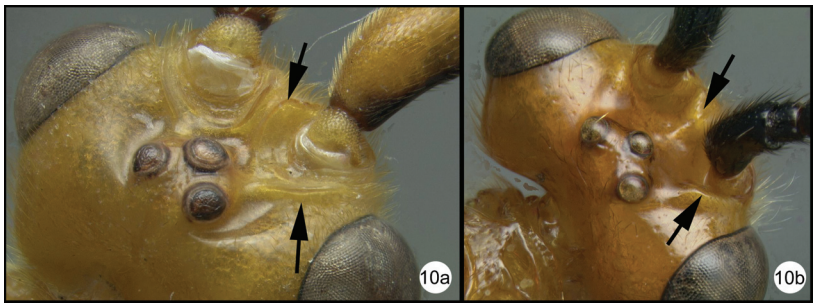
9(5) Posterolateral margins of frons not bordered with carinae (9a) .... ***Euagathis* Szépligeti, 1900**

– Posterolateral margins of frons bordered with carinae (9b) **10**



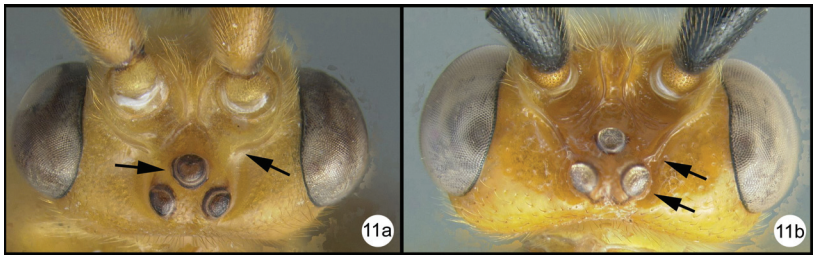
10(9) Medial and lateral carinae of frons lamellate (high and thin) (10a); ovipositor barely exerted, much shorter than half length of metasoma (see 4bb)..... **11**

– Medial and lateral carina of frons in the form of blunt ridges, not lamellate (10b); ovipositor at least as long as the metasoma (see 4aa) .... ***Cremnops* Förster, 1862**



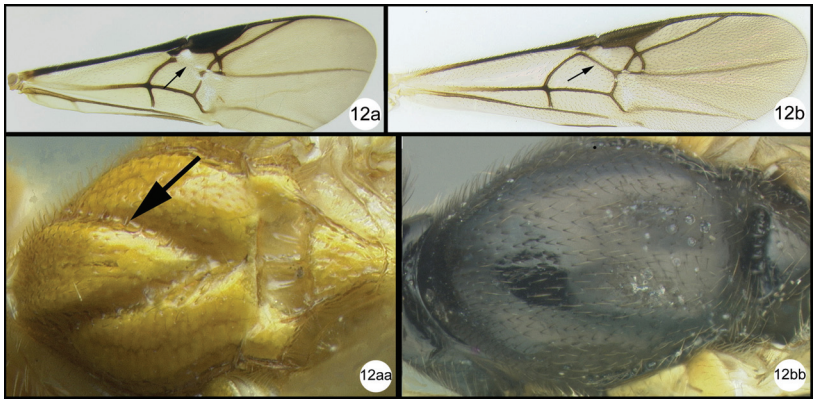
11(10) Lateral carina of frons with posterior ends directed towards median ocellus (11a)..... ***Troticus*** **Brullé, 1846**

– Lateral carina of frons with posterior ends directed towards lateral ocelli (11b) ..... ***Disophrys*** **Förster, 1862**



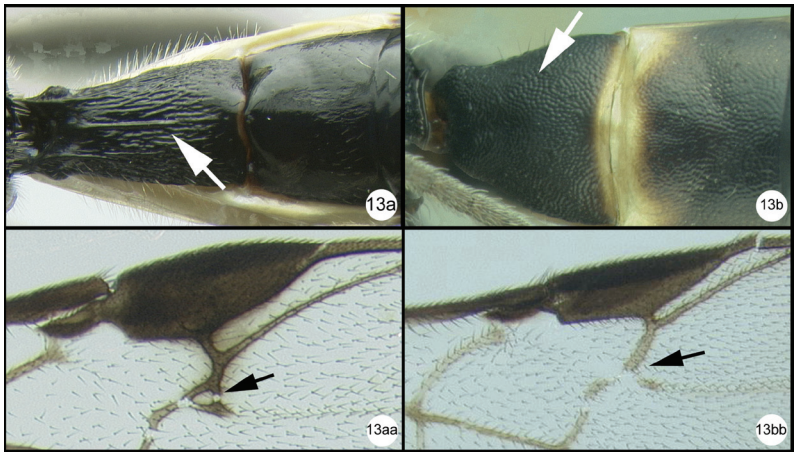
12(2) RS+M vein of fore wing mostly or entirely absent (12a); notauli present but not necessarily complete (12aa)..... **13**

– RS+M vein of fore wing present and complete (12b); notauli absent (12bb)... ..... ***Earinus*** **Wesmael, 1837**



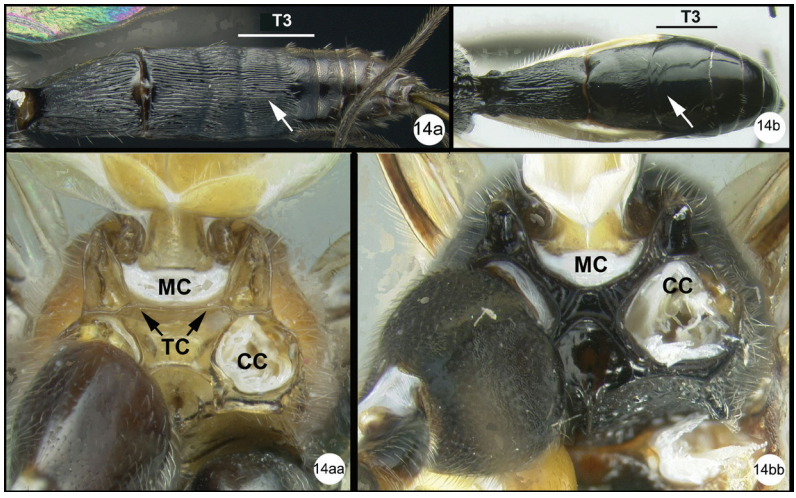
13(12) First median tergite mostly striate (13a) or (rarely) smooth; 2nd submarginal cell of fore wing usually present (13aa)..... **14**

– First median tergite mostly granulate or coriaceous (13b); 2nd submarginal cell of fore wing absent (13bb)..... ***Camptothlipsis*** **Enderlein, 1920**



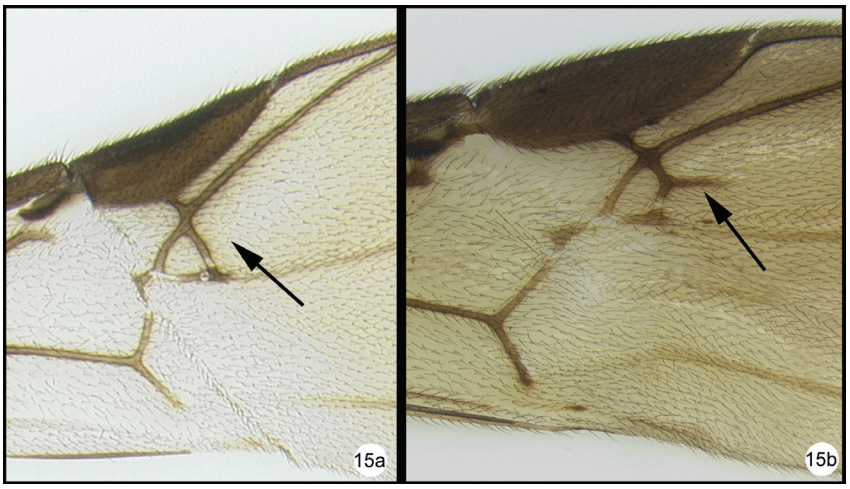
14(13) Median tergite 3 extensively striate in anterior half or more (14a); metasomal cavity (MC) situated entirely dorsal to coxal cavities (CC); a wide, high, straight, transverse carina (TC) present between metasomal cavity (MC) and coxal cavities (CC) (14aa) **15**

– Median tergite 3 smooth (14b); metasomal cavity (MC) situated partly between coxal cavities (CC); wide, high, straight, transverse carina (TC) between metasomal (MC) and coxal cavities absent, usually curved and relatively shallow if present (14bb) **16**



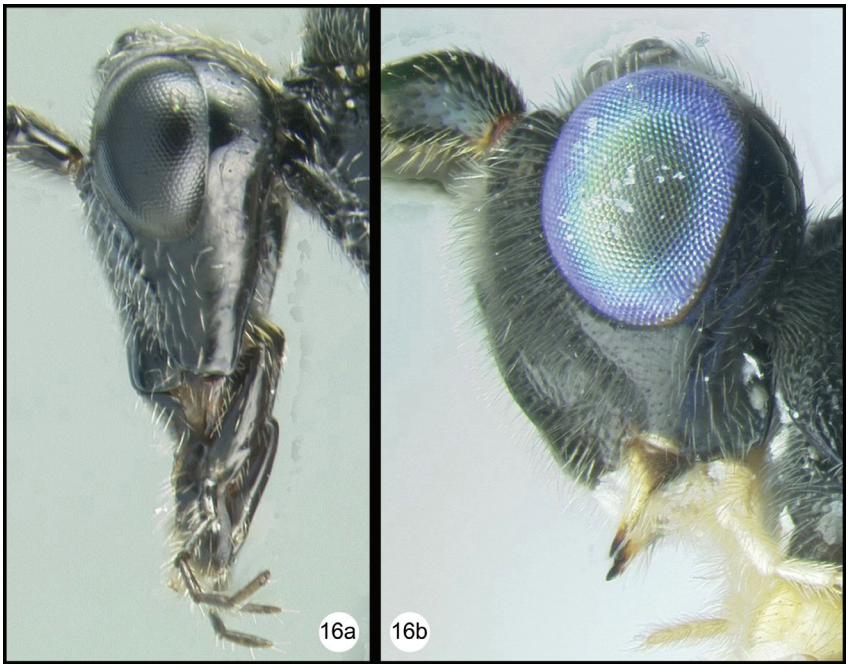
15(14) Adventitious vein (2RS) on r-m crossvein of fore wing absent or indicated only by slight swelling (15a)..... ***Lytopylus*** **Förster, 1862**

– Adventitious vein (2RS) on r-m crossvein of fore wing present and distinct (15b) ..... ***Braunsia*** **Kriechbaumer, 1894**



16(14) Mouthparts long, galea significantly longer than wide; gena usually elongate (16a) ....***Agathis*** **Latreille, 1804** (not yet discovered in Thailand but likely to occur).

– Mouthparts short (normal), galea not longer than wide; gena not elongate (16b) ..... ***Therophilus*** **Wesmael, 1837**



Systematics

***Biroia fuscicornis* (Cameron)**
http://species-id.net/wiki/Biroia_fuscicornis
Figs 3–5

Disophrys fuscicornis Cameron 1903 [BMNH, examined], Malaysia (Sarawak).
Cremnops satapensis Cameron 1907 [BMNH, examined], Malaysia (Sarawak).
Isopronotum seminigripenne Enderlein 1920, syn. n. [MZPW, examined], Indonesia (Sumatra).
Isopronotum tricolor Enderlein 1920, syn. n. [MZPW, examined], Indonesia (Sumatra).
Biroia soror van Achterberg and Long 2010, syn. n. [RMNH, examined], Vietnam.

Diagnosis. There is only one species of *Biroia* in Thailand though it is extreme in its color variation. The head and pro- and mesothorax vary from entirely black to orange. In Thailand there is little variation between these two extremes, although several of the orange forms have the vertex black. One specimen from Brunei has the head mostly black and the mesoscutum black in the posterior 2/3. The wings are melanic-infuscate basally and milky white distally. 28S sequence data for four specimens of the melanic form and one specimen of the orange and black form are identical (Fig. 2).

Biroia fuscicornis Cameron 1903, *Cremnops satapensis* Cameron 1907, *Isopronotum seminigripenne* Enderlein 1920, *Isopronotum tricolor* Enderlein 1920, and *Biroia soror* van Achterberg and Long 2010 are all considered here as junior synonyms of *Biroia fuscicornis*. The major differences between these nominal species are in coloration and it is noteworthy that all three of the taxa described by Enderlein are from the same locality, Sarawak, and presumably from similar dates. *Biroia abdominalis* (Enderlein 1920) is also very similar and may represent the same species but until sequence data are available we choose to keep it separate, in agreement with van Achterberg and Long (2010).

GenBank accessions. *H0030:* #HQ667945 (black form). *H0018:* #HQ667942. *H0020:* #HQ667943. *H0049:* #HQ667944. *H0082:* #HQ667941

Distribution. Peninsular Malaysia, Borneo (Sarawak, Brunei), Indonesia (Sumatra), Singapore, Thailand, Vietnam. Distribution maps can be found at http://purl.org/thaimaps/bfuscicornis.

Examined specimens are deposited in the following collection: MZPW, BMNH, HIC, USNM, UKM, QSBG, RMNH.

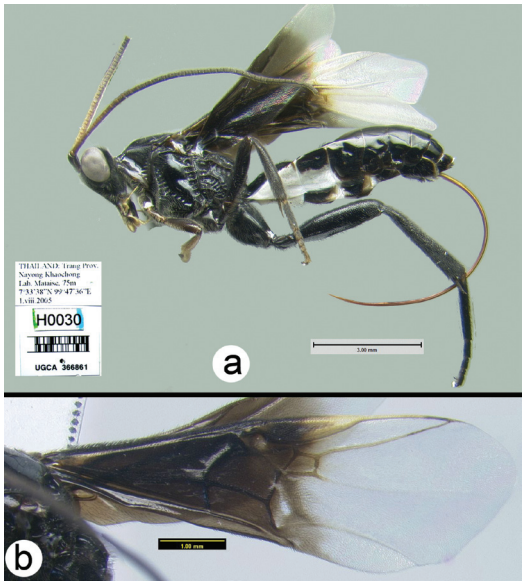


Figure 3. *Biroia fuscicornis* Cameron, dark morph **a** lateral habitus **b** fore wing.

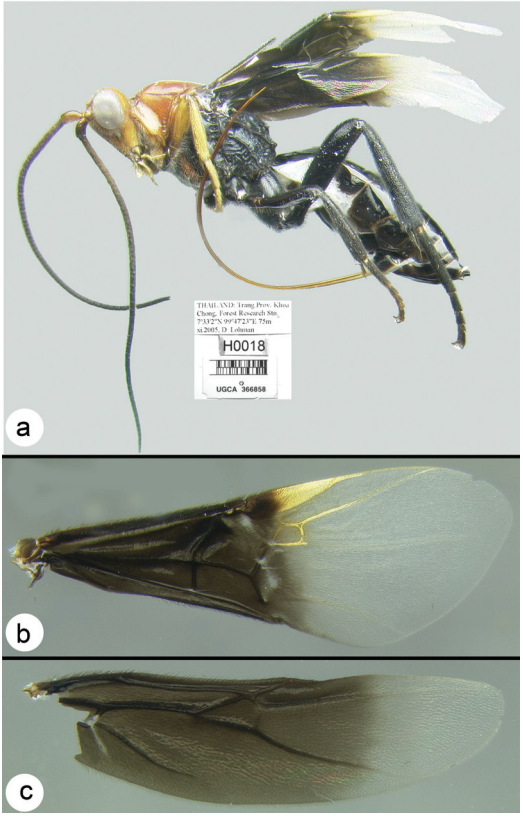


Figure 4. *Biroia fuscicornis* Cameron, light morph **a** lateral habitus **b** fore wing **c** hind wing.

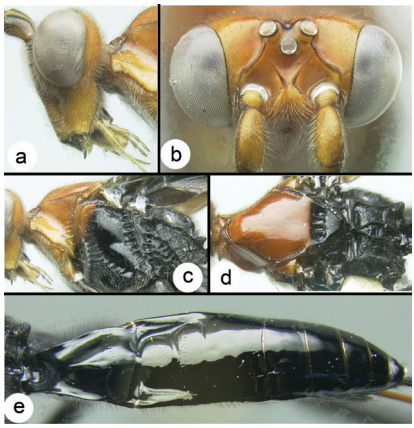


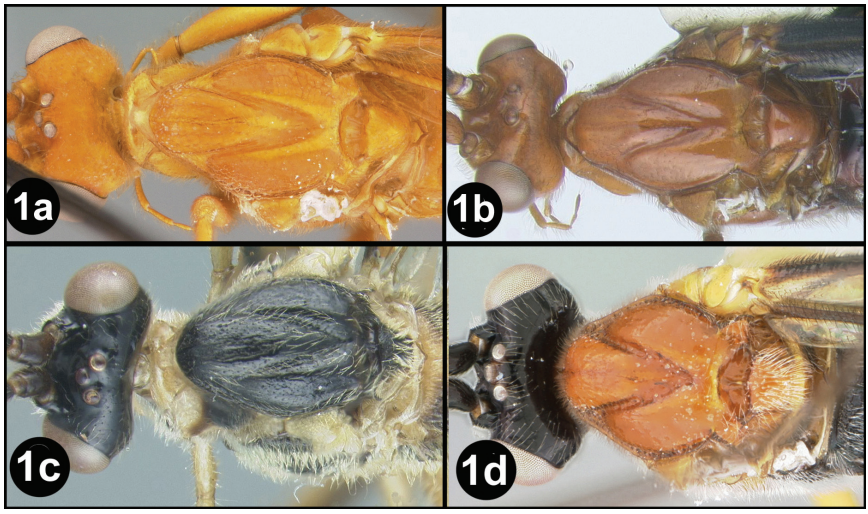
Figure 5. *Biroia fuscicornis* Cameron, light morph **a** lateral head **b** dorsal head **c** lateral mesosoma **d** dorsal mesosoma **e** dorsal metasoma.

Braunsia

Key to Thai species of *Braunsia*

Only two species are known from Thailand; however three species from Peninsular Malaysia are included due to their likelihood of occurring in southern Thailand.

1a Dorsal head and mesoscutum entirely yellow **2**
1b Dorsal head and mesoscutum entirely reddish brown .... ***B. sumatrana* Enderlein**
1c Dorsal head black and mesoscutum melanic or mostly melanic **3**
1d Dorsal head black, mesoscutum yellowish orange... ***B. fumipennis* (Cameron)**

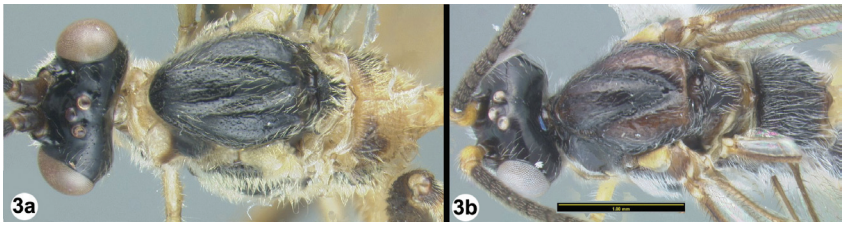


2a Apex of antenna yellow, hind tibia with 13 or more spines.....
.....***B. chaweewanae*** **Sharkey, sp. n.**

2b Apex of antenna melanic, hind tibia with 12 or fewer spines.....
.....***B. smithii*** **Dalla Torre**

3a Mesosoma with many infusions of yellow color especially on pronotum and propodeum.....***B. comosa*** **Enderlein**

3b Mesosoma mostly melanic with the lateral lobes of scutellum sometimes deep reddish black; pronotum and propodeum melanic.....
B. burmensis **Bhat & Gupta**



Braunsia burmensis **Bhat & Gupta**
http://species-id.net/wiki/Braunsia_burmensis
Figs 6

Braunsia burmensis Bhat and Gupta 1977 [NHRS, examined] Myanmar.

Diagnosis. Mesosoma entirely melanic, sometimes with the lateral lobes of the mesoscutum reddish black; wings weakly infuscate; second metasomal median tergite pale in basal half or more.

GenBank accession. *H1101:* #DQ201930

Distribution. Myanmar and Peninsular Malaysia (Cameron Highlands). Specimens are deposited in NHRS (holo- and allotype), and HIC (one specimen). The species is included here due to its likelihood of occurring in Thailand. Distribution maps can be found at http://purl.org/thaimaps/burmensis.

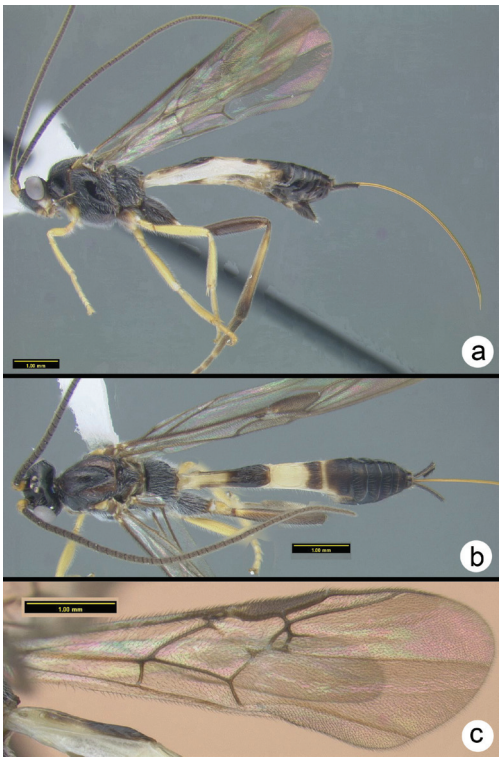


Figure 6. *Braunsia burmensis* Bhat & Gupta **a** lateral habitus **b** dorsal habitus **c** fore wing.

***Braunsia chaweewanae* Sharkey, sp. n.**
urn:lsid:zoobank.org:act:71694C50-E347-46B6-86E4-DDA3FCC668CD
http://species-id.net/wiki/Braunsia_chaweewanae
Figs 7–8

Diagnosis. Differs from *B. smithii* (Dalla Torre 1898) as follows: Apex of antenna yellow; fore wing with a larger melanic parastigmal spot and apex of fore wing darker; mid and hind tibia with more apical spines. The lateral ocelli of *B. chaweewanae* are slightly more than ½ as wide as the distance from the eye to the lateral ocellus, whereas those of *B. smithii* are distinctly less than ½ as wide.

Description. Holotype female. Essentially as in *B. smithii* except as follows:

Body length. 9.5mm.

Head. OOL 0.32; POD 0.13; IOL 0.16; 45 flagellomeres

Mesosoma. tubular portion of 2RS2 of fore wing shorter than length of 2nd submarginal cell; midtibia with 9 (right) to 11 (left) melanic spines; hind tibia with 16 (right) spines.

Metasoma. Median tergite 1 about 1.7X as long as wide apically (length = 1.66mm, width = 1.0mm).

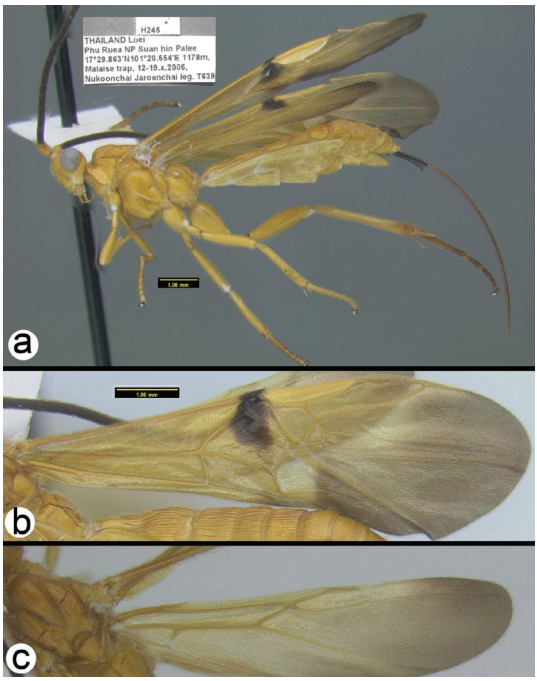


Figure 7. *Braunsia chaweewanae* sp. n. **a** lateral habitus **b** fore wing **c** hind wing.

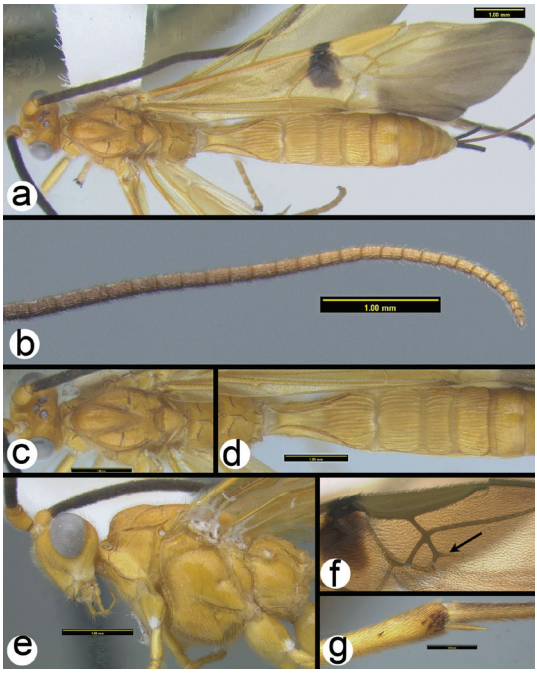


Figure 8. *Braunsia chaweewanae* sp. n. **a** dorsal habitus **b** antenna **c** dorsal head and mesosoma **d** dorsal propodeum and metasomal terga 1–3 **e** lateral head and mesosoma **f** fore wing showing short vein 2RS2 **g** hind tibia showing lateral spines.

Color. Yellow except as follows: the following are melanic: flagellum except apical segments, large parastigmal spot, distal 1/3 of fore wing and hind wing, apex of hind tibia and tarsus somewhat darkened.

Male. Unknown.

GenBank accession. *H245:* #HQ667950

Distribution. Known only from the holotype female from Thailand. Distribution maps can be found at http://purl.org/thaimaps/chaweewanae.

Material examined. Holotype female: H245, Thailand, Loei, Phu Ruea NP, Suan hin Palee, 17.4977°N 101.3425°E, 1178m, MT, 12–19.x.2006, Nukoonchai Jaroenchai [QSBG].

***Braunsia comosa* Enderlein**
http://species-id.net/wiki/Braunsia_comosa
Figs 9–10

Braunsia comosa Enderlein 1920 [MZPW, examined] Indonesia (Sumatra)

Diagnosis. The color of this species is unique in that the mesosoma is yellow and black with most of the central areas of the sclerites black and the margins yellow, and the propodeum is mostly yellow. The first metasomal median tergite is long and narrow. The mesosoma, especially the propodeum laterally, is quite setose.

Male. Unknown.

Distribution. Besides the holotype from Indonesia (Sumatra) one specimen from Peninsular Malaysia is deposited in UKM. Distribution map can be found at http://purl.org/thaimaps/comosa. It is included here due to its likelihood of being present in southern Thailand.

***Braunsia fumipennis* (Cameron)**
http://species-id.net/wiki/Braunsia_fumipennis
Figs 11–12

Microdus fumipennis Cameron 1899, original combination. [OUMNH, examined], North Eastern India
Braunsia pumatica van Achterberg and Long 2010, syn. n. [RMNH, examined], Vietnam.

Diagnosis. The color pattern is somewhat similar to that of *B. sumatrana*, but this is the only similarity between the species. The first median metasomal tergite of *B. fumipennis* is much narrower than that of *B. sumatrana* (compare figures 12f and 16c), and the first metasomal tergum of *B. fumipennis* is entirely melanic whereas that of *B. sumatrana* is white basally.

Variation. The mid femur varies from yellow to black; the fourth metasomal tergum varies from almost completely smooth to aciculate, and may or may not have

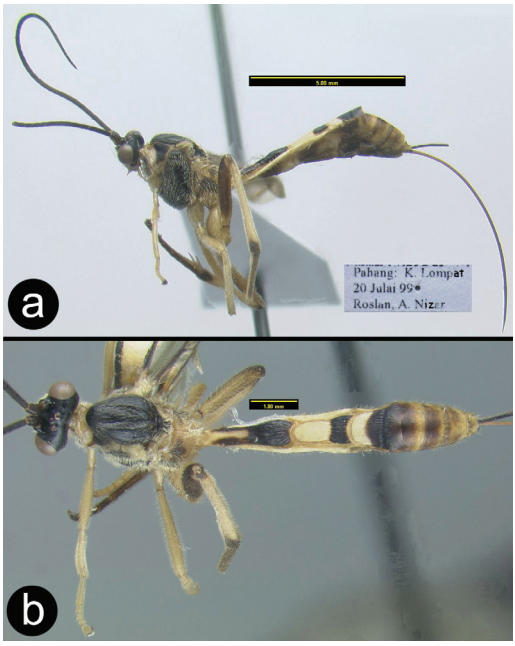


Figure 9. *Braunsia comosa* Enderlein **a** lateral habitus **b** dorsal habitus.

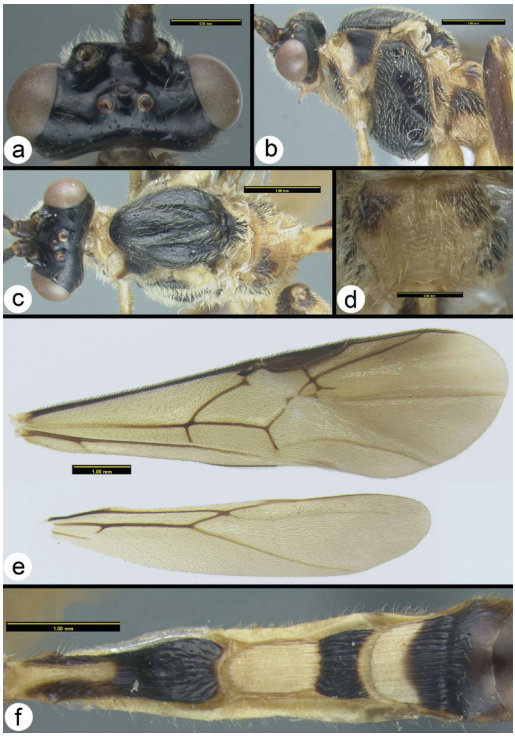


Figure 10. *Braunsia comosa* Enderlein **a** dorsal head **b** lateral mesosoma **c** dorsal head and mesosoma **d** dorsal propodeum **e** wings **f** dorsal metasomal terga 1–3.

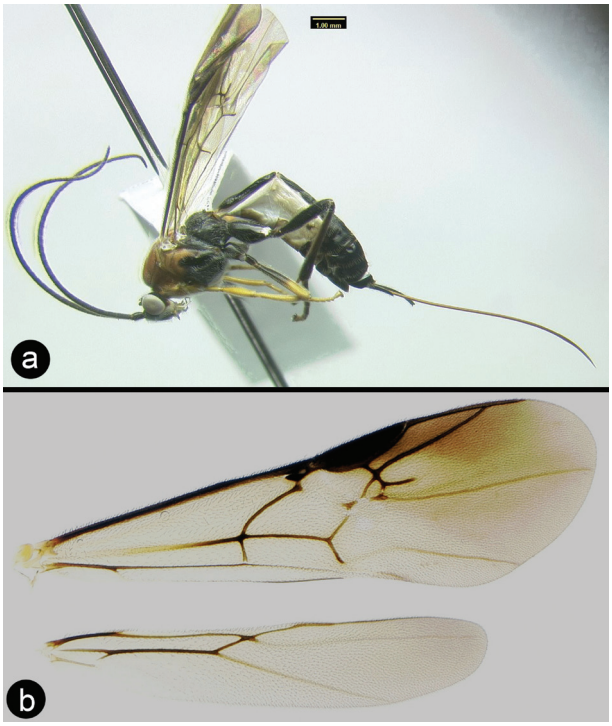


Figure 11. *Braunsia fumipennis* (Cameron) **a** lateral habitus **b** wings.

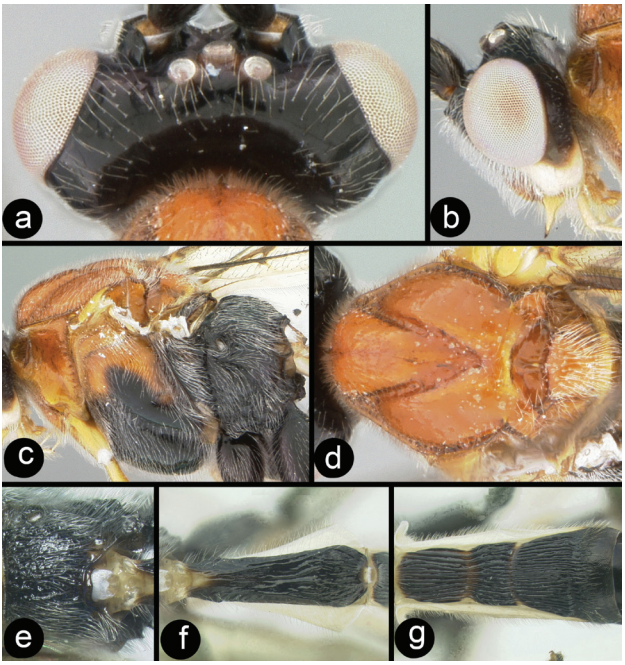


Figure 12. *Braunsia fumipennis* (Cameron) **a** dorsal head **b** lateral head **c** lateral mesosoma **d** dorsal mesothorax **e** dorsal propodeum **f** dorsal metasomal tergum 1 **g** dorsal metasomal terga 2 and 3.

several transverse rows of setae. None of these character states are correlated in such a manner as to suggest different species.

GenBank accessions. *H393:* #HQ667947. *H915:* #HQ667946. *H140:* #HQ667975.

Distribution. North eastern India, Myanmar, Thailand, and Vietnam. This is a wide distribution but the specimens from disparate areas vary only in minor details. Distribution map from Thailand and Myanmar can be found at http://purl.org/thaimaps/fumipennis.

Examined specimens are deposited in OUMNH, RMNH, BMNH, HIC, and QSBG.

***Braunsia smithii* (Dalla Torre)**
http://species-id.net/wiki/Braunsia_smithii
Figs 13–14

Agathis smithii Dalla Torre 1898. [OUMNH, examined] Replacement name for *Agathis flavipennis* Smith 1863, Ceram Island, Indonesia, a primary homonym of *Agathis flavipennis* Brullé 1846. The latter is a species of *Biroia*.
Braunsia devriesi van Achterberg and Long 2010, syn. n. [RMNH, examined], Vietnam.

Diagnosis. Similar species include *B. maculifera* van Achterberg and Long, *B. pappi* Chen and Yang 2006, *B. margaroniae* Bhat and Gupta 1977, *B. bimaculata* Enderlein 1920, *B. bipunctata* Enderlein 1920, *B. matsumurai* Watanabe 1937, and *B. tuberculata* Cameron 1899. All of these differ in having more melanic color either on the wings or on the body or both, and most have the first metasomal median tergite somewhat wider than *B. smithii*. The first metasomal median tergite is about twice as long as wide apically in *B. smithii*, whereas the aforementioned nominal species are approximately 1.5 times as long as wide. Undoubtedly there are more synonymies to be made amongst these nominal species but that is beyond the scope of this paper. *B. smithii* is also similar to *B. chaweewanae*; see the diagnosis of that species for differences between the two.

Notes. The type of B. *smithii* is from Ceram Island, Indonesia (Wallacea). Thus the geographic range of the species is wide. Despite this, examination of specimens from this wide range provides no morphological grounds on which to separate the two nominal species. As a warning to future revisers, all older specimens examined, and these include specimens from Peninsular Malaysia and Borneo, have an oily residue that causes the cuticle to darken in a variety of patterns depending on where the substance contacts the cuticle. This is especially apparent on the metasoma.

GenBank accessions. *H292:* #HQ667948. *H906:* #HQ667949.

Distribution. Examined specimens are from Malaysia (Borneo and Peninsular Malaysia), Thailand, Vietnam, and Indonesia (South Moluccas). It is undoubtedly much more widespread. Distribution map can be found at http://purl.org/thaimaps/smithii.

Specimens are deposited in OUMNH, RMNH, MZPW, BMNH, HIC, UKM, and QSBG.

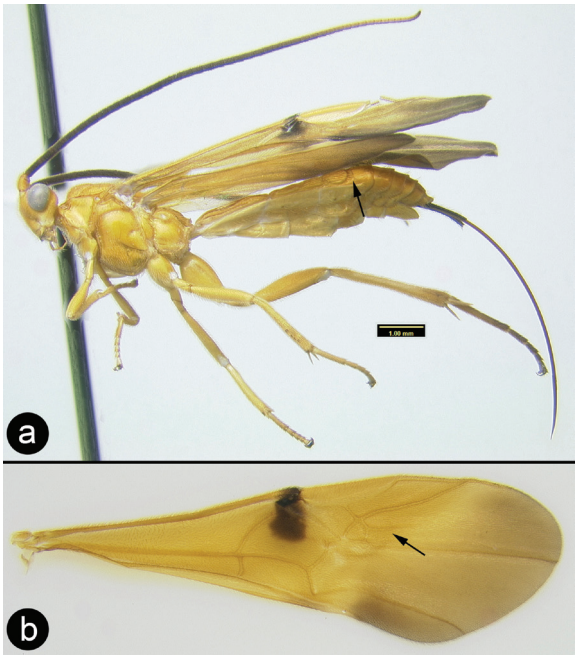


Figure 13. *Braunsia smithii* (Dalla Torre) **a** lateral habitus **b** fore wing.

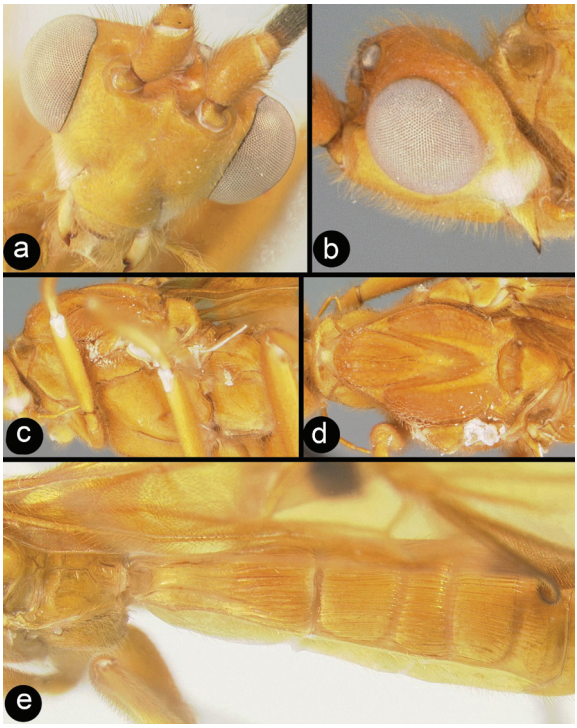


Figure 14. *Braunsia smithii* (Dalla Torre) **a** anterior head **b** lateral head **c** lateral mesosoma **d** dorsal mesothorax **e** dorsal propodeum and metasomal terga 1–3.

***Braunsia sumatrana* Enderlein**
http://species-id.net/wiki/Braunsia_sumatrana
Figs 15–16

Braunsia sumatrana Enderlein 1920 [MZPW, examined]

Diagnosis. Large specimens with unique coloration; especially noteworthy is the extent of white coloration on the first metasomal median tergite.

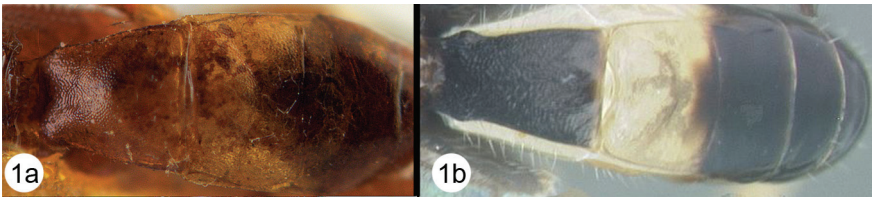
Distribution. Indonesia (Sumatra), Malaysia (Borneo and Peninsular Malaysia). It is included here because of the likelihood that its range extends into southern Thailand. Distribution map can be found at http://purl.org/thaimaps/sumatrana.

Examined specimens are deposited in HIC, UKM, RMNH, USNM.

Key to Thai species of *Camptothlipsis*

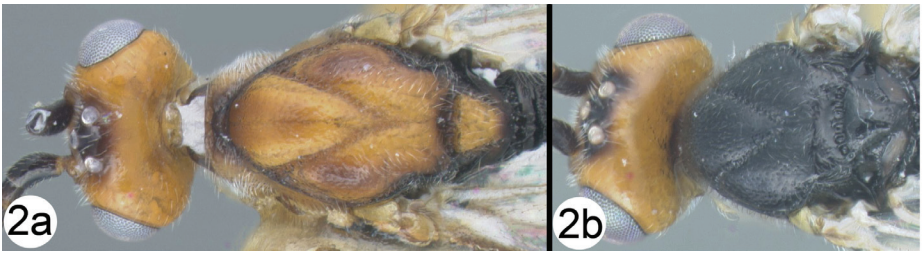
1a Metasomal terga almost entirely orange, and lacking a distinct white band, head entirely orange..... ***C. hanoiensis* van Achterberg & Long**

1b Metasomal terga mostly or entirely melanic with or without a pale transverse band on median tergite 2..... **2**



2a Mesoscutum almost entirely orange..... ***C. philippinensis* Gupta & Bhat**

2b Mesoscutum entirely melanic or almost so..... **3**



3a Penultimate labial palpomere about ½ the length of the apical palpomere (Note: the second palpomere, that which is next to the basal palpomere, is present and it is the thickest palpomere; in this side of the couplet there should be two palpomeres distal to it); mid tibia with more than 8 lateral spines..... ***C. nigra* Gupta & Bhat**

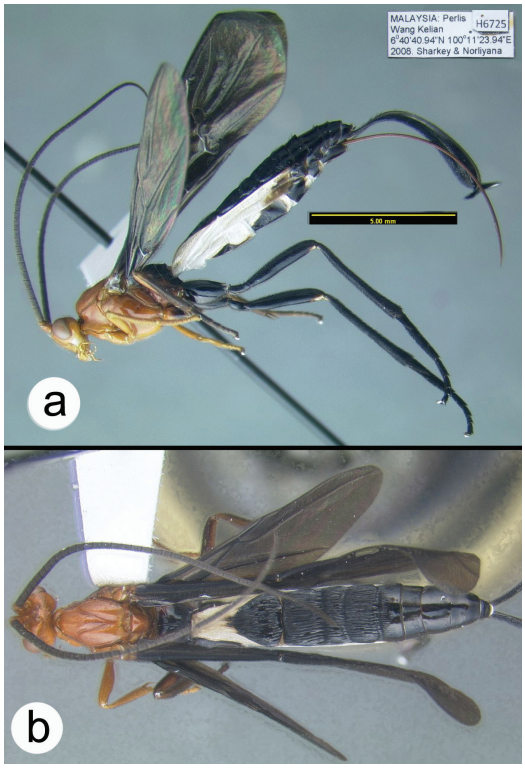


Figure 15. *Braunsia sumatrana* Enderlein **a** lateral habitus **b** dorsal habitus.

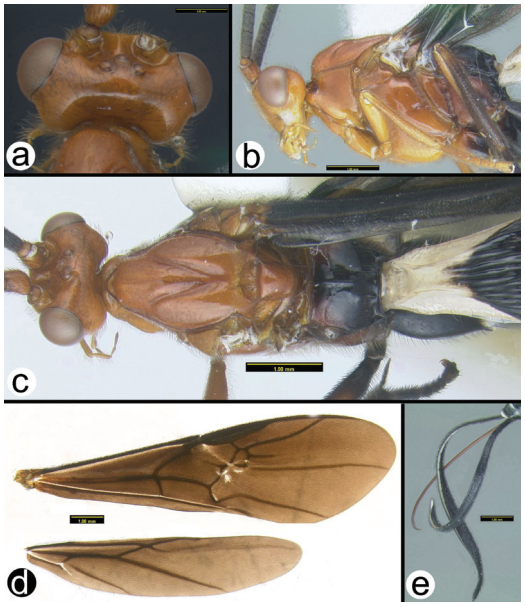
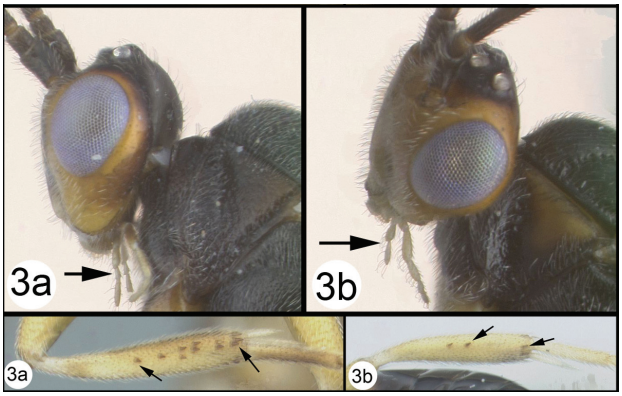
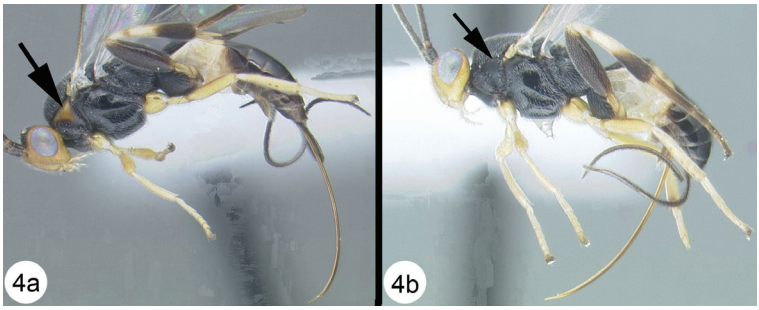


Figure 16. *Braunsia sumatrana* Enderlein **a** dorsal head **b** lateral head and mesosoma **c** dorsal head and mesosoma **d** wings **e** ovipositor and sheaths.

3b Penultimate labial palpomere absent or barely perceptible (Note: only one apparent palpomere distal to the thickest palpomere); mid tibia with less than 6 lateral spines **4**



4a Posterodorsal corner of pronotum orange ..... ***C. sheilae* Sharkey, sp. n.**
4b Posterodorsal corner of pronotum melanic... ***C. annemariae* Sharkey, sp. n.**



***Camptothlipsis annemariae* Sharkey, sp. n.**
urn:lsid:zoobank.org:act:616728A7-5F48-403D-8FD9-5BE69950601B
http://species-id.net/wiki/Braunsia_annemariae
Figs 17–18

Diagnosis. Very similar to its sister species, *C. sheilae.* Similarities include median tergite 2 weakly granulate, pronotum mostly smooth posterodorsally (in the lateral corner) and 28S sequence data that differ at only 3 sites (of roughly 600 base pairs total) (Fig. 2). *Camptothlipsis annemariae* differs as follows: pronotum melanic orange in posterolateral corner, ovipositor distinctly shorter than body (see couplet 4 above to compare ovipositor lengths).

Description. Holotype female.

Body length. 3.0 mm.

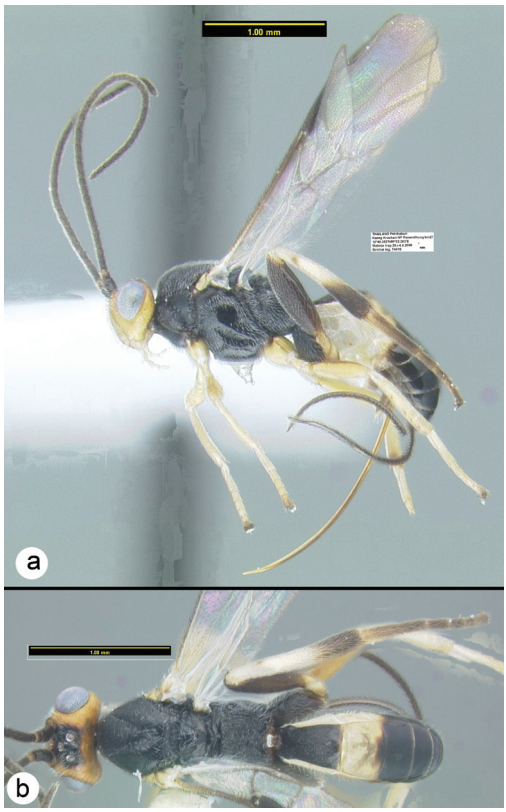


Figure 17. *Camptothlipsis annemariae* sp. n. **a** lateral habitus **b** dorsal habitus.

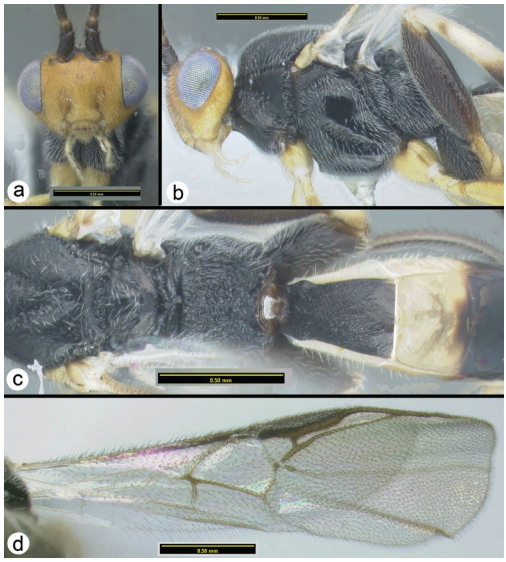


Figure 18. *Camptothlipsis annemariae* sp. n. **a** anterior head **b** lateral head and mesosoma **c** dorsal mesosoma and metasomal terga 1 and 2 **d** fore wing.

Head. Third labial palpomere not visible under a light microscope at 80x (uncertain whether or not a small palpomere remains), OOL 0.14; POD 0.05; IOL 0.11; 27 flagellomeres.

Mesosoma. Pronotum mostly smooth posterodorsally (in the lateral corner); sternaulus well impressed and distinctly crenulate for ¾ mesopleuron length; propodeum evenly areolate rugulose with small areolae; midleg with 5–6 spines; hind leg with 5 spines.

Metasoma. First metasomal median tergite (T1) 1.3 times longer than wide apically and distinctly granulate; T2 weakly granulate, remaining median tergites smooth.

Male. Unknown.

GenBank accession. *H394:* #HQ667953

Distribution. Known only from the type specimen in Thailand. Distribution map can be found at http://purl.org/thaimaps/anemariae.

Etymology. Named in honor of the first author's sister, Annemarie.

Material examined. Holotype female: H394, Thailand, Petchaburi, Kaeng Krachan NP, Panernthung/km27, 12.822°N 99.371°E, MT, 25.i-4.ii.2009, Sirichai [QSBG].

Camptothlipsis hannoiensis van Achterberg & Long

http://species-id.net/wiki/Camptothlipsis_hannoiensis

Camptothlipsis hannoiensis van Achterberg & Long 2010, [RMNH, examined] Vietnam.

Diagnosis. The extensive pale color of the body is not found in other Thai species.

Distribution. The species is only known from Vietnam and is included here due to the possibility that it may occur in Thailand. See van Achterberg and Long (2010).

Camptothlipsis nigra Gupta & Bhat

http://species-id.net/wiki/Camptothlipsis_nigra

Figs 19–22

Camptothlipsis niger Gupta and Bhat 1974 [USNM, examined] Indonesia (Java)

Note: The generic name is feminine therefore the code requires that gender of the species name be changed to agree.

Diagnosis. Quite variable in coloration; mesosoma from mostly black to extensively pale especially laterally; median tergite 2 from completely pale to mostly melanic with a pale transverse band basally. Third labial palpomere well developed, more than 9 spines on the mid tibia. Figures 19, 20 and 21 are of Thai specimens, figure 22 illustrates the holotype.

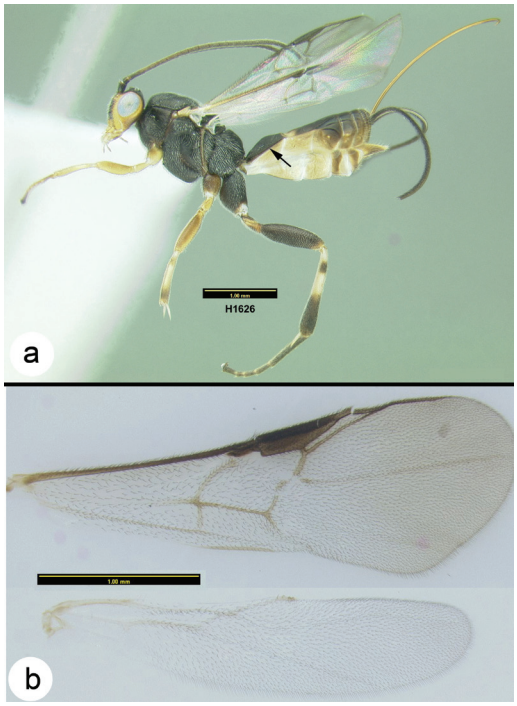


Figure 19. *Camptothlipsis nigra* Gupta and Bhat, melanic specimen **a** lateral habitus **b** wings.

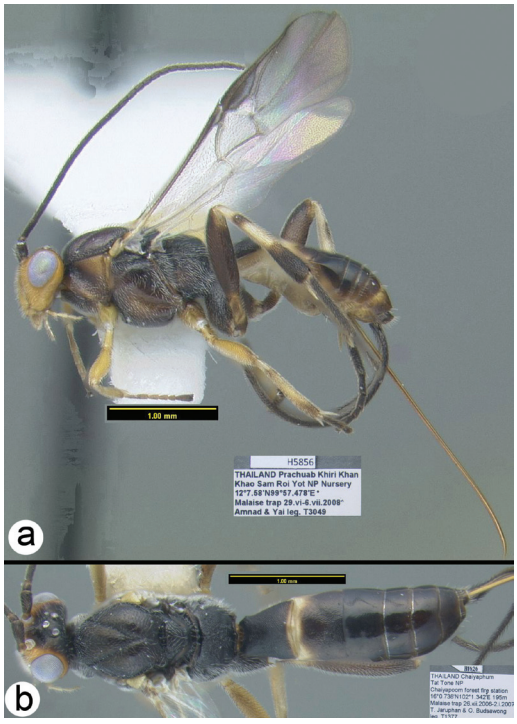


Figure 20. *Camptothlipsis nigra* Gupta and Bhat, pale specimen **a** lateral habitus **b** dorsal habitus.

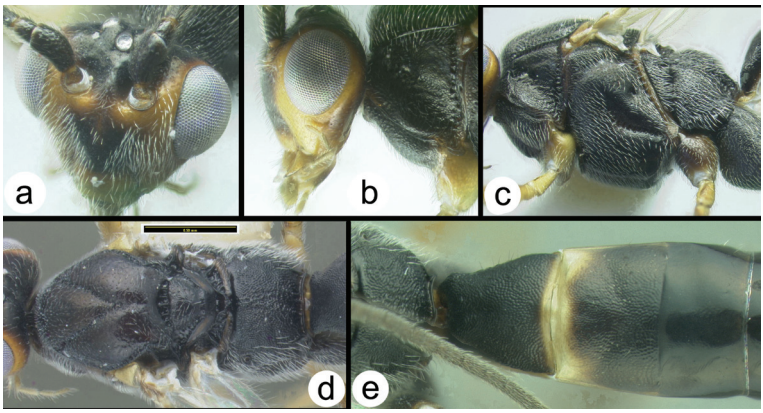


Figure 21. *Camptothlipsis nigra* Gupta and Bhat, melanic specimen **a** anterodorsal head **b** lateral head **c** lateral mesosoma **d** dorsal mesosoma **e** dorsal propodeum and metasomal terga 1–3.

Figure 22. *Camptothlipsis nigra* Gupta & Bhat, holotype, lateral habitus.

GenBank accessions. *H096:* #HQ667952. *H433:* #HQ667951. *H546:* #HQ667957. *H1627:* #HQ667955. *H1635:* #HQ667956.

Description. The holotype is well described in Gupta and Bhat (1974). Based on the original description, and the name of the species, we assume that the melanic color of the type specimen has faded. Below are a few details for the Thai specimens.

Body length: 3.7 - 3.8 mm. Penultimate labial palpomere well developed. OOL 0.17; POD 0.06; IOL 0.10; 26 flagellomeres. Mid tibia with 9–10 spines; hind tibia with 12–13 spines. First metasomal median tergite (T1) 1.3 times longer than wide apically and distinctly granulate; sculpture of T2 distinctly granulate, remaining median tergites smooth.

Distribution. The holotype is from Java and other specimen records include eastern India and Thailand. Distribution map of the Thai specimens can be found at http://purl.org/thaimaps/nigra.

Specimens are deposited in the USNM (holotype, and paratypes), CNC (paratypes), other examined specimens are deposited in QSBG, HIC and RMNH.

***Camptothlipsis philippinensis* Gupta & Bhat**
http://species-id.net/wiki/Camptothlipsis_philippinensis
Figs 23–26

Camptothlipsis philippinensis Gupta & Bhat 1974

Diagnosis. The pale color of this species is enough to distinguish it from others in Thailand. The penultimate labial palpomere is well developed. Figures 22 and 23 are of the sole Thai specimen, a male. Figures 24 and 25 are of the holotype.

Distribution. Known only from Philippines and Thailand. Distribution map of the Thai specimens can be found at http://purl.org/thaimaps/philippinensis.

The holotype, from The Philippines, is deposited in the USNM and the Thai specimen is in QSBG.

***Camptothlipsis sheilae* Sharkey, sp. n.**
urn:lsid:zoobank.org:act:B1A13E1D-79A9-4572-89FD-4BF59E461905
http://species-id.net/wiki/Camptothlipsis_sheilae
Figs 27–28

Diagnosis. Very similar to its sister species, *C. annemariae*. Similarities include median tergite 2 weakly granulate; pronotum mostly smooth posterodorsally (in the lateral corner) and 28S sequence data that differ at 3 sites (Fig. 2). *Camptothlipsis sheilae* differs as follows: pronotum yellowish orange in posterolateral corner, ovipositor about as long as body.

Description. Holotype female.

Body length. 3.4 mm.

Head. Third labial palpomere not visible under a light microscope at 80x (uncertain if a small palpomere remains) OOL 0.15; POD 0.06; IOL 0.10; 26 flagellomeres.

Mesosoma. Pronotum mostly smooth posterodorsally (in the lateral corner); sternaulus well impressed and distinctly crenulate for ¾ mesopleuron length; propodeum evenly areolate rugulose with small areolae; mid leg with 4 spines; hind leg with 7 spines.

Metasoma. First metasomal median tergite (T1) 1.3 times longer than wide apically and distinctly granulate; T2 weakly granulate, remaining median tergites smooth.

Color. Head orange with black in ocellar triangle. Most of mesosoma black; posterolateral corner of pronotum yellowish orange. Median tergites melanic except median tergite 2 yellowish white.

Male. Unknown.

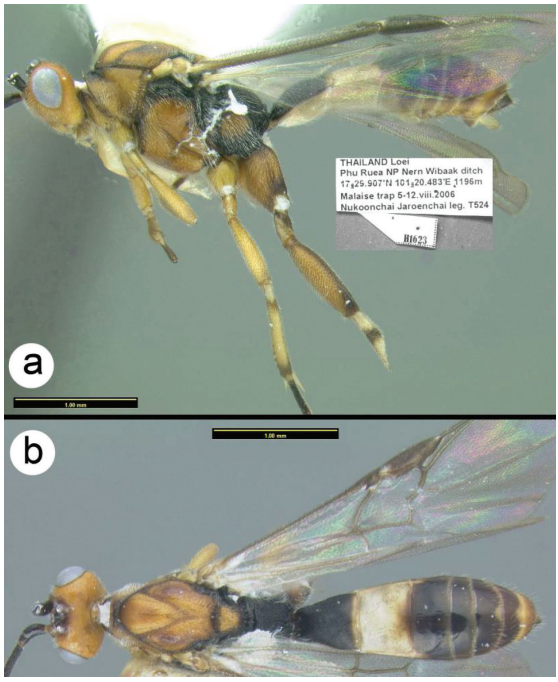


Figure 23. *Camptothlipsis philippinensis* Gupta & Bhat **a** lateral habitus **b** dorsal habitus.

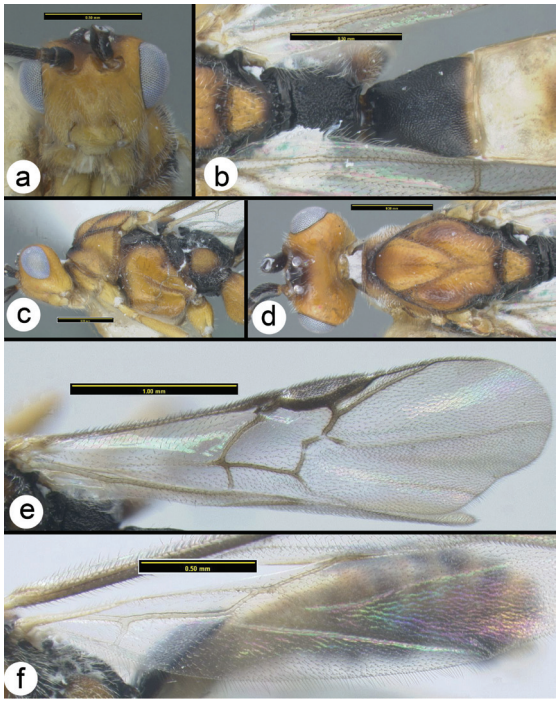


Figure 24. *Camptothlipsis philippinensis* Gupta & Bhat **a** anterior head **b** dorsal propodeum and metasomal terga 1 and 2 **c** lateral head and mesosoma **d** dorsal head and mesothorax **e** fore wing **f** hind wing.

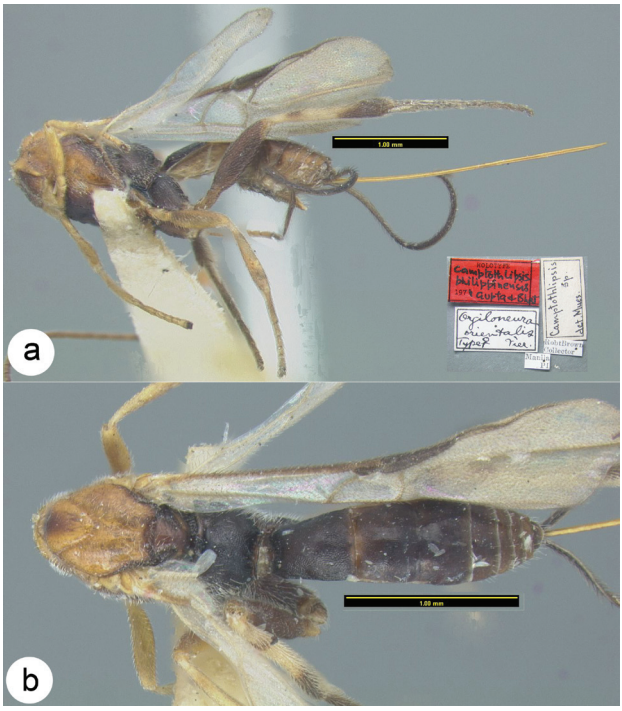


Figure 25. *Camptothlipsis philippinensis* Gupta & Bhat, holotype **a** lateral habitus **b** dorsal habitus.

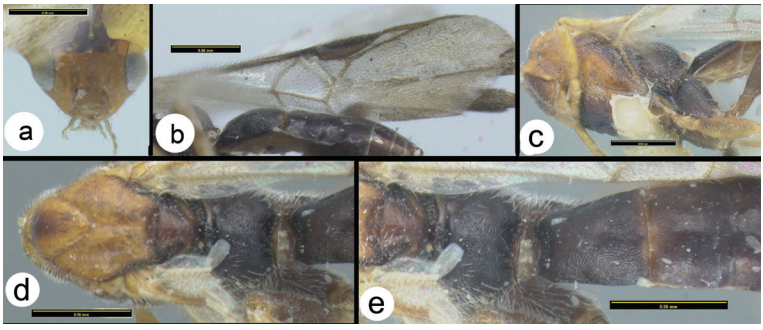


Figure 26. *Camptothlipsis philippinensis* Gupta & Bhat, holotype **a** anterior head **b** fore wing **c** lateral mesosoma **d** dorsal mesosoma **e** dorsal propodeum and metasomal terga 1 and 2.

GenBank accession. *H664:* #HQ667954

Distribution. Known only from the type specimen in Thailand. Distribution map can be found on http://purl.org/thaimaps/sheilae.

Etymology. Named in honor of the first author's sister, Sheila.

Material examined. Holotype female: H664, Thailand, Kanchanaburi, Khuean Srinagarindra NP, Tha Thung-na/Chong Kraborg, 14.5°N 98.884°E, 210m, MT, 9–16.iv.2009 Boonnam & Phumarin [QSBG].

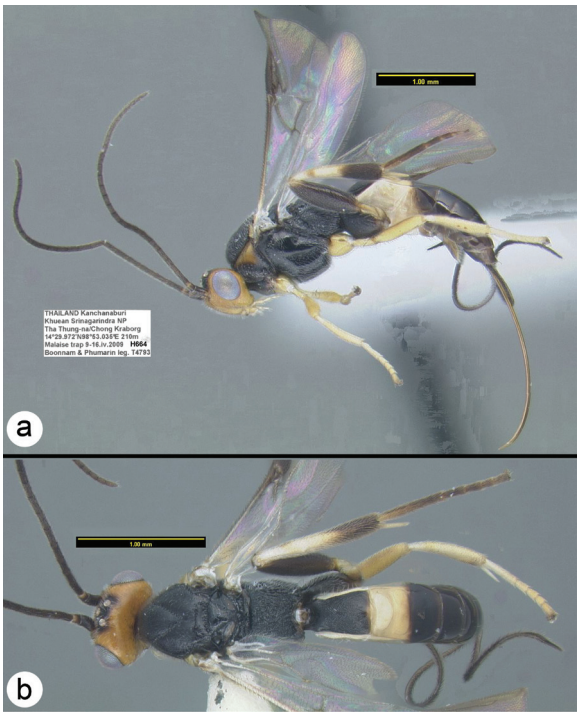


Figure 27. *Camptothlipsis sheilae* sp. n. **a** lateral habitus **b** dorsal habitus.

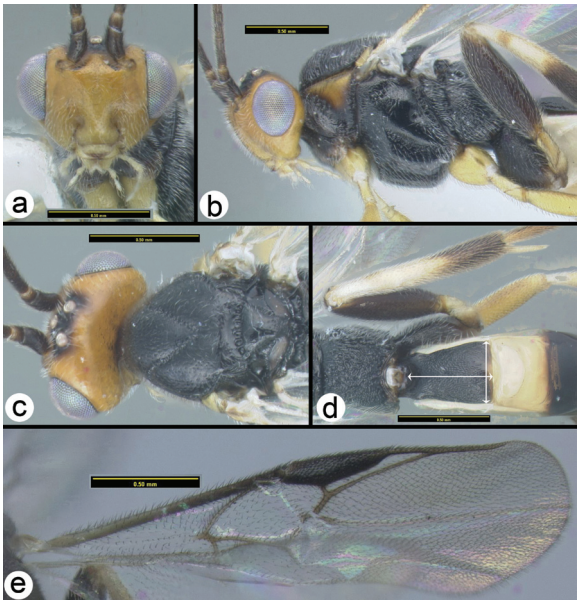


Figure 28. *Camptothlipsis sheilae* sp. n. **a** anterior head **b** lateral head and mesosoma **c** dorsal head and mesothorax **d** dorsal propodeum and metasomal terga 1 and 2. Arrows show positions for length and width measurements **e** fore wing.

Coccygidium

Key to Thai species of *Coccygidium*

1a Fore wing melanic distally with a melanic spot near parastigma. Scape entirely melanic or with some weak pale infusions medially..... ..... ***C. phaeoscapos* Sharkey, sp. n.**

1b Fore wing weakly melanic distally with a basal transverse melanic band posterad parastigma (note the dark veins in this area). At least half of scape pale; scape half melanic (laterally) and half yellow (medially)..... ..... ***C. mastigion* Sharkey, sp. n.**

1c Fore wing mostly hyaline with slight infuscation distally and small melanic area around parastigma; scape mostly yellow with a thin melanic stripe laterally..... ***C. malayensis* (Bhat & Gupta)**

***Coccygidium malayensis* (Bhat & Gupta, 1977), comb. n.**
http://species-id.net/wiki/Coccygidium_malayensis
Figs 29–32

Zelomorpha malayensis Bhat and Gupta 1977 [AEI, type examined], Peninsular Malaysia.

Diagnosis. Fore wing almost evenly hyaline; scape with a narrow melanic band laterally. There is a widespread undescribed species in peninsular Malaysia that is very similar to *C. malayenisis*. The undescribed species differs as follows: ocular- ocellar length (OOL) longer, almost twice as long as lateral ocellar diameter. Yellow coloration on stigma less than 1/3 of stigma surface.

Description. ***Body length***. 6.7mm

Head. OOL 0.19; POD 0.14; IOL 0.08; EH 0.85; MS 0.20; 46 flagellomeres.

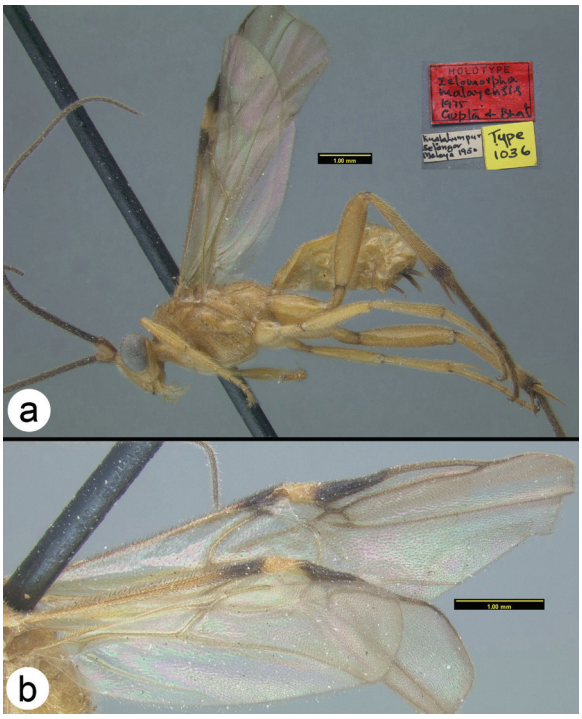


Figure 29. *Coccygidium malayensis* holotype **a** lateral habitus **b** wings.

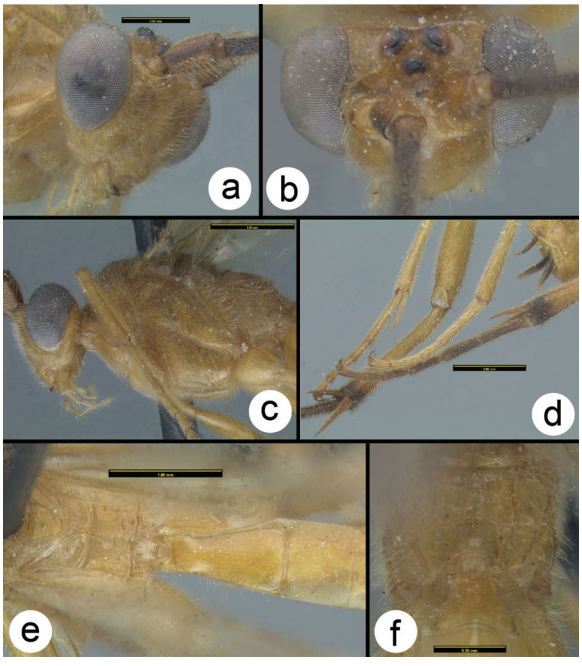


Figure 30. *Coccygidium malayensis* holotype **a** anterolateral head **b** dorsal head **c** lateral head and mesosoma **d** legs **e** dorsal propodeum and metasomal terga 1 and 2 **f** dorsal propodeum.

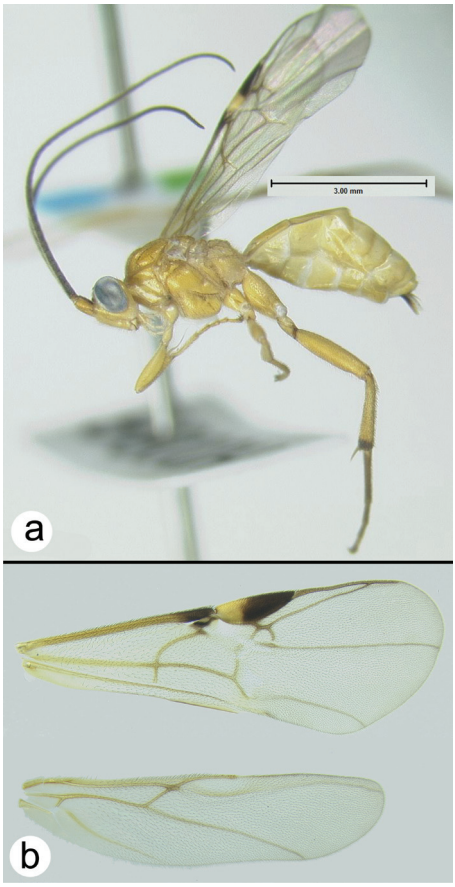


Figure 31. *Coccygidium malayensis* **a** lateral habitus **b** wings.

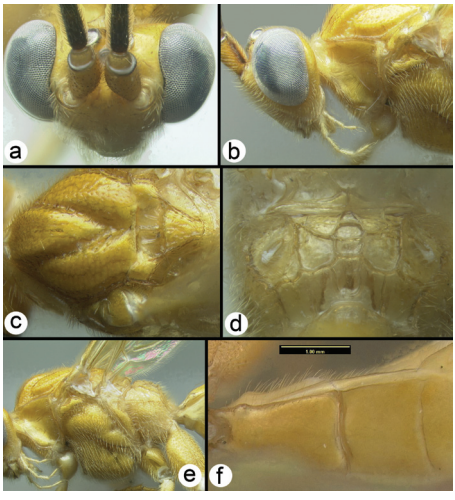


Figure 32. *Coccygidium malayensis* **a** dorsal head **b** lateral head and prothorax **c** dorsal mesoscutum **d** dorsal propodeum **e** lateral mesosoma **f** dorsal metasomal terga 1 and 2.

Mesosoma: Mesoscutum punctate; notauli well impressed and crenulate; scutellum with apical carina and subapical transverse depression; sternaulus well impressed and crenulate, extending about ¾ length of mesopleuron; metapleuron rugose in ventral 1/3, punctate dorsally; fore tibial spur as long as basitarsus.

Metasoma. Median tergite 1 about twice as long as wide apically (length = 1.11mm, width = 0.54mm).

Color. Yellow except as follows: flagellum melanic, scape yellow except for narrow melanic stripe laterally, pedicel yellow; tip of hind tibia black, hind tarsomeres brown to black, hind tibial spurs pale brown. Fore wing almost evenly hyaline, veins mostly yellow, somewhat more melanic apicoanteriorly; stigma yellow in basal 1/3 to 1/2, vein R pale from stigma to union with RS. Hind wing hyaline with yellow veins.

Male. Eyes are somewhat smaller than those of the female. This may be typical of most nocturnal species of *Coccygidium*. OOL 0.22; POD 0.13; IOL 0.12; EH 0.69; MS 0.29; 45 flagellomeres.

GenBank accessions. *H071:* #HQ667960. *H075:* #HQ667959. *H086:* #HQ667961. *H971:* # HQ667958

Distribution. Thailand and Peninsular Malaysia. Distribution map can be found at http://purl.org/thaimaps/malayensis.

Material examined. Holotype female. Malaysia, Kuala Lumpur, Selangor, 1950, AEI. Identified specimens are deposited in HIC, AEI, RMNH, QSBG, and UKM.

Coccygidium mastigion **Sharkey, sp. n.**
urn:lsid:zoobank.org:act:064BB16F-9390-4E81-8EBB-ACB8ADBF573F
http://species-id.net/wiki/Coccygidium_mastigion
Figs 33–34

Diagnosis. Fore wing weakly melanic distally with a basal transverse melanic band posterad parastigma. Scape half melanic (laterally) and half yellow (medially).

Description. Holotype female.

Body length. 6.12 mm

Head. OOL 0.13; POD 0.15; IOL 0.09; EH 0.88; MS 0.16; 38 (38–40) flagellomeres.

Mesosoma. Mesoscutum punctate; notauli well impressed and crenulate; scutellum with apical carina and subapical transverse depression; sternaulus well impressed and crenulate, extending about ¾ length of mesopleuron; metapleuron rugose in ventral 1/3, punctate dorsally; fore tibial spur as long as basitarsus.

Metasoma. Median tergite 1 about twice as long as wide apically (length = 0.94mm, width = 0.48mm).

Color. Yellow, except as follows: flagellum melanic, scape melanic in lateral half, yellow in medial half, pedicel melanic; tip of hind tibia black, hind tarsomeres mostly black but each paler basally, hind tibial spurs yellow to pale brown. Fore wing weakly infumate in distal half and in a longitudinal stripe basad stigma, veins yellow basally,

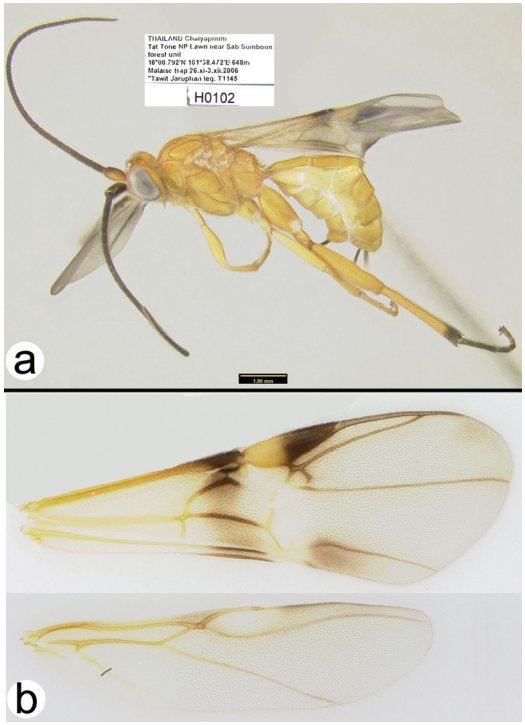


Figure 33. *Coccygidium mastigon* **a** lateral habitus **b** wings.

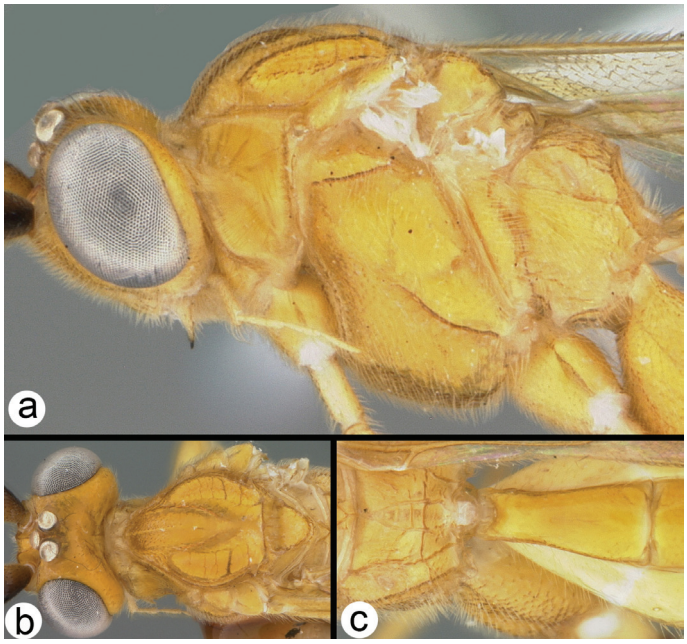


Figure 34. *Coccygidium mastigon* **a** lateral head and mesosoma **b** dorsal head and mesoscutum **c** dorsal propodeum and metasomal tergum 1.

melanic where the membrane is weakly melanic; stigma yellow in basal half, vein R pale from stigma to union with RS. Hind wing hyaline with yellow veins.

Male. Eyes smaller than those of female. OOL 0.17; POD 0.15; IOL 0.11; EH 0.79; MS 0.23; 40 flagellomeres.

GenBank accessions. *H102:* #HQ667977. *H680:* #HQ667962.

Distribution. Known only from Thailand. Distribution map can be found at http://purl.org/thaimaps/mastigion.

Etymology. *Mastigion* is the diminutive form of the Greek word *mastix*; it is a reference to the short flagellum of this species.

Material examined. Holotype female: H102, Thailand, Chaiyaphum, Tat Tone NP, lawn near Sab Somboon forest unit, 16.013°N 101.975°E, 648m, MT, 26.xi-3.xii.2006, Tawit Jaruphan [QSBG], Paratype male: H680, Thailand, Chaiyaphum, Tat Tone NP, 15.9586°N 101.9073°E, MT, 12–19.iv.2007, Tawit Jaruphan & Orawan Budsawong [HIC].

***Coccygidium phaeoscapos* Sharkey, sp. n.**
urn:lsid:zoobank.org:act:C35E0315-D198-46D3-9511-205DB307F497
http://species-id.net/wiki/Coccygidium_phaeoscapos
Figs 35–36

Diagnosis. Fore wing melanic distally with a melanic spot near parastigma. Scape entirely melanic or with some weak pale infusions medially.

Description. Holotype female.

Body length. 7.1 mm

Head. OOL 0.17; POD 0.17; IOL 0.12; EH 1.04; MS 0.18; 42 flagellomeres.

Mesosoma: Mesoscutum punctate; notauli well impressed and crenulate; scutellum with apical carina and subapical transverse depression; sternaulus well impressed and crenulate, extending about ¾ length of mesopleuron; metapleuron rugose in ventral 1/3, punctate dorsally; fore tibial spur distinctly longer than basitarsus.

Metasoma. Median tergite 1 about twice as long as wide apically (length = 1.11mm, width = 0.59 mm).

Color. Yellow except as follows: flagellum melanic, scape entirely melanic or rarely with some weak pale infusions medially, pedicel melanic; tip of hind tibia varying from black to brown, hind tarsomeres varying from dark yellow to black, hind tibial spurs yellow to pale brown. Fore wing infumate in distal half and with a dark spot near parastigma, veins yellow basally, melanic distally; stigma yellow in basal half, vein R pale from stigma to union with RS. Hind wing yellowish hyaline basally and distinctly melanic distally.

Male. Unknown.

GenBank accessions. *H265:* #HQ667965. *H266:* #HQ667964. *H267:* #HQ667967. *H342:* #HQ667966. *H560:* #HQ667968. *H671:* #HQ667963.

Distribution. Known only from Thailand. Distribution map can be found at http://purl.org/thaimaps/phaeoscapos.

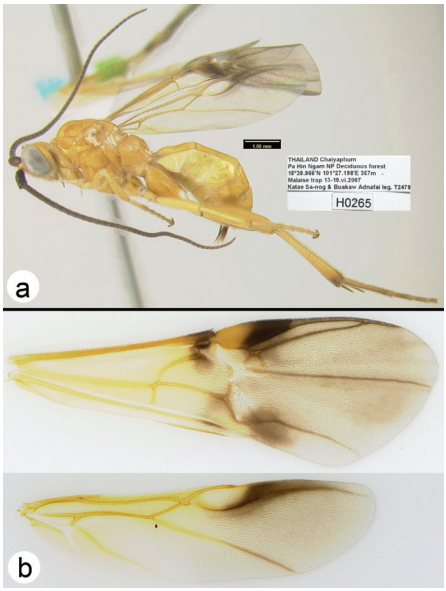


Figure 35. *Coccygidium phaeoscapos* **a** lateral habitus **b** wings.

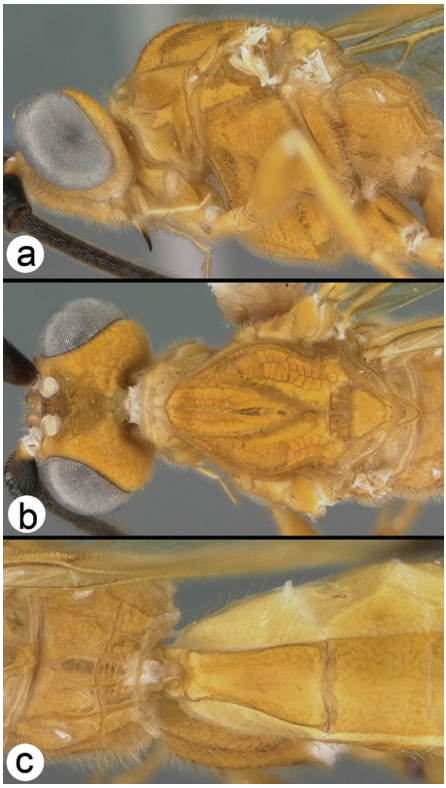


Figure 36. *Coccygidium phaeoscapos* **a** lateral head and mesosoma **b** dorsal head and thorax **c** dorsal propodeum and metasomal terga 1 and 2.

Etymology. From the Greek *phaios* meaning dusky or brown, and *scapos*; this is a reference to the dark scape which distinguishes this species.

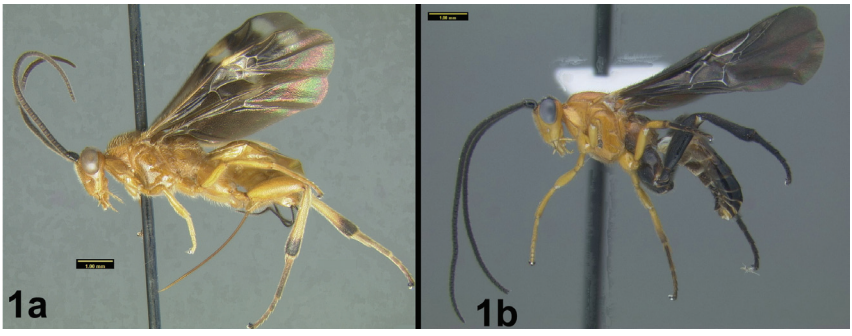
Material examined. Holotype female: H267, Thailand, Ubon Ratchathani, Pha Taem NP,Phu Krajeaw foothill 15.667°N 105.508°E 246m MT 2–9.vi.2007 Tongcam & Banlu [QSBG].

Paratypes ♀: Thailand: H671, Chaiyaphum, Pha Hin Ngam NP, deciduous forest/ Tepa Waterfall, 15.649°N 101.418°E, 614m, MT, 19–25.iv.2007, Katae Sa-nog & Buakaw Adnafai [QSBG]; H265, Chaiyaphum, Pa Hin Ngam NP, deciduous forest, 15.666°N 101.453°E, 357m, MT, 13–19.vi.2007, Katae Sa-nog & Buakaw Adnafai[HIC]; H342, Loei, Phu Kradueng NP, Mixed deciduous/S Na Noy office 16.817°N 101.794°E, 276m, MT, 14–21.v.2008, Thonghuay Phatai; H266, Sakon Nakhon, Phu Phan NP16.81°N 103.892°E, 512m, MT, 16–22.vi.2007, Winlon Kongnara [QSBG]; H631, Tat Tone NP, 16°0.79N 101°58.472E, 648m, MT, 12–19.v.2007, Jaruphan & Budsawong [QSBG]; H553 & H560, Chaiyaphum, Tat Tone NP, Dipterocarp forest at Sapsomboon substation 16.018°N 101.977°E, 674m, MT, 19–26.v.2007, Tawit Jaruphan & Orawan Budsawong [QSBG, HIC]; H306, Chaiyaphum, Tat Tone NP, Dipterocarp forest at Sapsomboon substation, 16.043°N 101.977°E, 675m MT, 5–12.v.2007, Tawit Jaruphan & Orawan Budsawong [QSBG]; H395 & H398, Chaiyaphum, Tat Tone NP, Dipterocarp forest at Sapsomboon substation, 16.043°N 101.977°E, 675m, MT, 26.v.-2.vi.2007, Tawit Jaruphan & Orawan Budsawong [QSBG, HIC].

Key to Thai Species of *Cremnops*

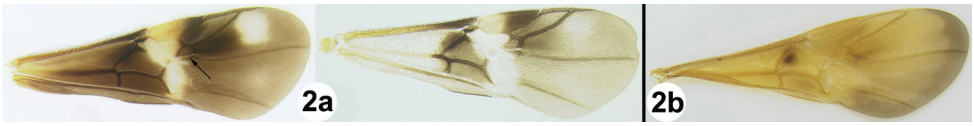
1a Metasoma and hind leg mostly or entirely pale **2**

1b Metasoma and hind leg mostly or entirely melanic ..... ***C. fuscipennis*** **Brullé**



2a Fore wing variable but never as in 2b and usually with a yellow stigma area and two or three pale bands ..... ***C. desertor*** **(Linnaeus)**

2b Fore wing mostly deep yellow with the distal edge infumate and a small infumate patch below the parastigma (The latter may be variable.) ..... ***C. mekongensis*** **Turner**



***Cremnops desertor* (Linnaeus)**
http://species-id.net/wiki/Cremnops_desertor
Fig. 37

Ichneumon desertor Linnaeus 1758.
Agathis atricornis Smith 1874. Synonymized by Sharkey 1996. [BMNH, examined]
Bracon deflagrator Spinola 1808. Synonymized by Curtis 1837. [type presumably lost]
Cremnops alternans Enderlein 1920. Synonymized by Sharkey 1996. [MZPW, examined].
Cremnops lemniscatus Enderlein 1920. Synonymized by Sharkey 1996. [MZPW, examined].
Cremnops malayensis Bhat 1979. syn. n. [FSCA, examined]
Agathis nigritarsus Cameron 1899. syn. n. [OUMNH, examined], India.
Ichneumon purgator Fabricius 1793. Synonymized by Latreille1805. [type presumably lost]

Diagnosis. This is a highly variable and widespread species. The fore wing varies from completely infuscate to mostly hyaline with dark and yellow bands. The images in the key (above) show a good range of variation. The combination of characters given in the key is sufficient to identify Thai specimens.

Notes. Contrary to van Achterberg and Long (2010) we do not recognize the species status of *C. atricornis* (Smith) but rather consider it to be a junior synonym of *C. desertor*. The character that van Achterberg and Long used to separate eastern and western specimens of *C. desertor* is the relative lengths of the fore tibia and tarsus. The first two specimens that we checked from Thailand fit their concept of the West Palearctic forms, and looking at all specimens from a large number of Oriental specimens the measurements are variable with no clear gap between long and short. *Cremnops desertor* has recently been found in North America. There is one specimen from Ottawa, Canada and one from Washington DC. These are in the Canadian National Collection in Ottawa and the US National Museum in Washington, respectively. Among the specimens of *C. desertor* from Thailand one was particularly small, *i.e.*, 5.4 mm rather than the average length of 6.8 mm. 28S sequence data of several specimens, including the smallest, were identical (Fig. 2). A recently collected specimen of *C. desertor* from Sweden differed in only 4 positions (~600 bps total) from the two Thai specimens that were checked (Fig. 2). The specimen of *C. mekongensis*, which is very similar morphologically to *C. desertor*, differed in 11 sites in the 28S rDNA (Fig. 2). There is no magic number as to how many site changes constitute a distinct species but we predict that as 28S sequence data are obtained for specimens of *C. desertor* from sites between Europe and Thailand that there will be a grade in the 4 sites in which the 28S sequences differ.

GenBank accession. *H098:* #JF506256. H8099: #JN019810. H294: #JN019811

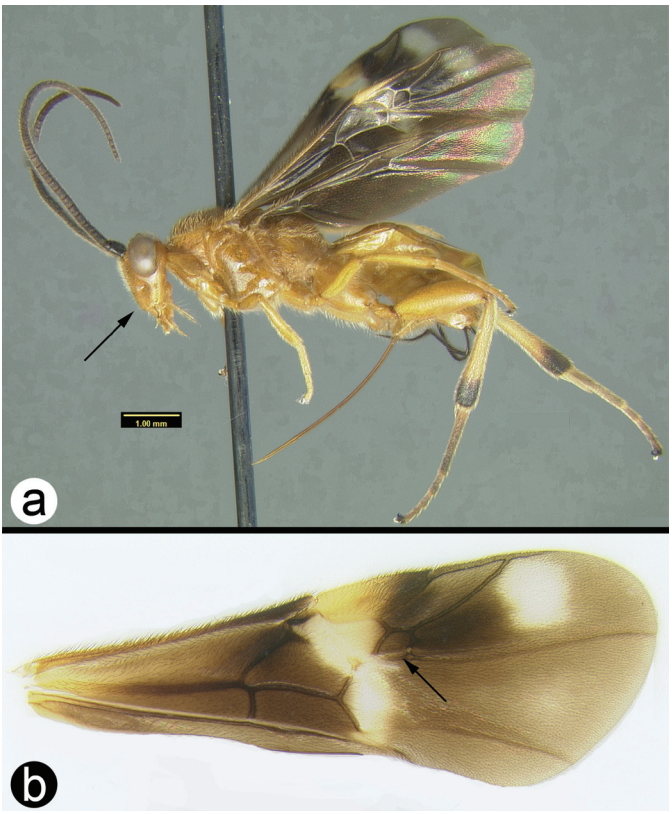


Figure 37. *Cremnops desertor* **a** lateral habitus **b** fore wing.

Distribution. Widespread over temperate and tropical Eurasia and, recently, accidentally introduced to eastern North America. Distribution map of Thai and Peninsular Malaysia specimens can be found at http://purl.org/thaimaps/desertor.

Examined specimens are in the following collections: BMNH, HIC, QSBG, CNC and UKM.

***Cremnops fuscipennis* (Brullé)**
http://species-id.net/wiki/Cremnops_fuscipennis
Fig. 38

Agathis fuscipennis Brullé 1846. [MNHN, examined], Indonesia, Java.
Cremnops persimillis Szépligeti 1908. Synonymized by Bhat 1979. [HNHM], Indonesia, Java.

Diagnosis. Fore wing evenly and darkly infuscate, with or without a small clear patch posterior to the stigma; hind leg and metasoma black; head yellow with black vertex,

mesosoma yellow except metathorax and propodeum which vary from yellow to black; notauli smooth and weakly impressed, especially anteriorly.

Notes. Very similar to *Cremnops collaris* Ashmead 1904, the type of which is from the Philippines, and *Cremnops indicus* Bhat 1979, from India. The three nominal species may represent one variable widespread species. The only obvious differences are minor variation in body color and wing color pattern.

Distribution. Examined specimens are from Java and Peninsular Malaysia. Literature records are only from Java. Although the species has not been recorded in Thailand it is included here due to the likelihood that its range extends into southern Thailand. Distribution map of Peninsular Malaysia specimens can be found at http://purl.org/thaimaps/fuscipennis.

Examined specimens are in the following collections: BMNH, HIC, and UKM.

***Cremnops mekongensis* Turner, 1919**
http://species-id.net/wiki/Cremnops_mekongensis
Figs 39–40

Cremnops mekongensis Turner 1919 [BMNH, type examined] Laos.

Diagnosis. Easily distinguished from other species by body and/or fore wing color. This is only the second specimen of the species collected, the other being the holotype.

GenBank accession. *H470:* #HQ667976

Distribution. Thailand and Laos. Distribution map of the sole Thai specimen deposited in HIC can be found at http://purl.org/thaimaps/mekongensis.

***Cremnoptoides yui* Sharkey, sp. n.**
urn:lsid:zoobank.org:act:A118E588-FD32-49E4-AC32-A9D47FCB2CFB
http://species-id.net/wiki/Cremnoptoides_yui
Figs 41–42

Diagnosis. This is the only species of *Cremnoptoides* that is not almost entirely black. The other two species, *C. furcatus* and *C. pappi*, do not have the extensive yellow coloration present in *C. yui*. For descriptions of the other two species see van Achterberg and Chen (2004).

Description. Holotype female.

Length. 7.0 mm.

Head. Antenna with 40 flagellomeres; head slightly elongate; frons with sharp lateral carinae extending to lateral ocelli.

Mesosoma. Sternaulus weakly impressed with elongate transverse, shallow carinae extending the length of the mesopleuron; metapleuron aciculate to rugose and moderately setose; propodeum areolate with a spindle-shaped medial cell; propodeum moderately setose except medial cell; hind trochantellus with longitudinal carina, medial and lateral

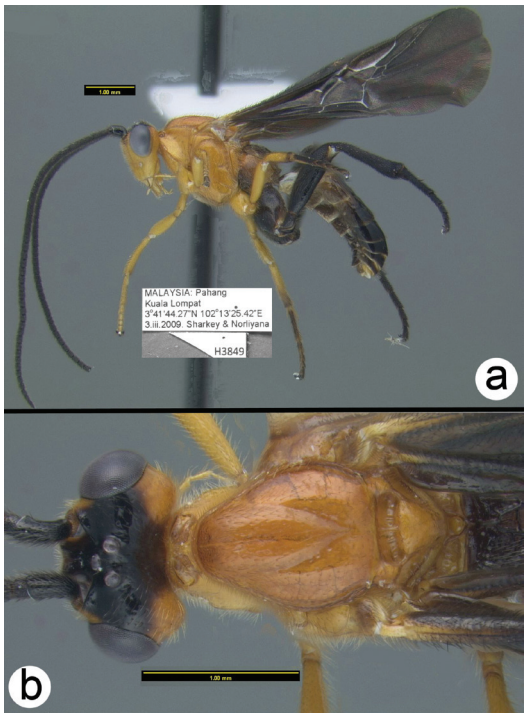


Figure 38. *Cremnops fuscipennis* **a** lateral habitus **b** dorsal head and thorax.

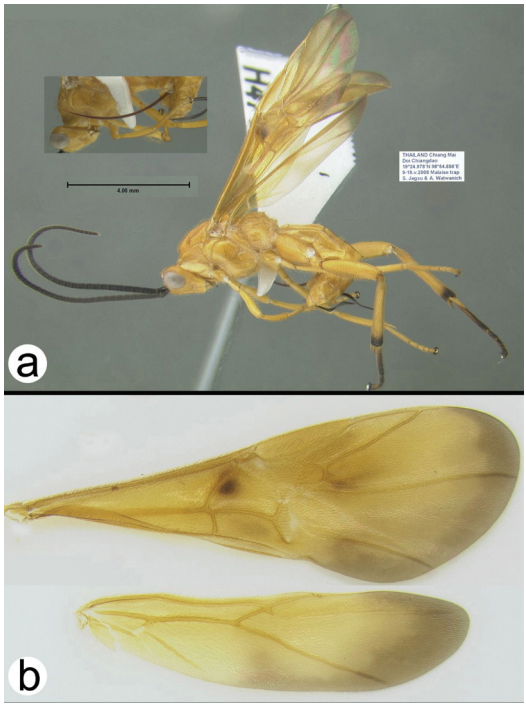


Figure 39. *Cremnops mekongennsis* **a** lateral habitus, inset showing ovipositor length **b** wings.

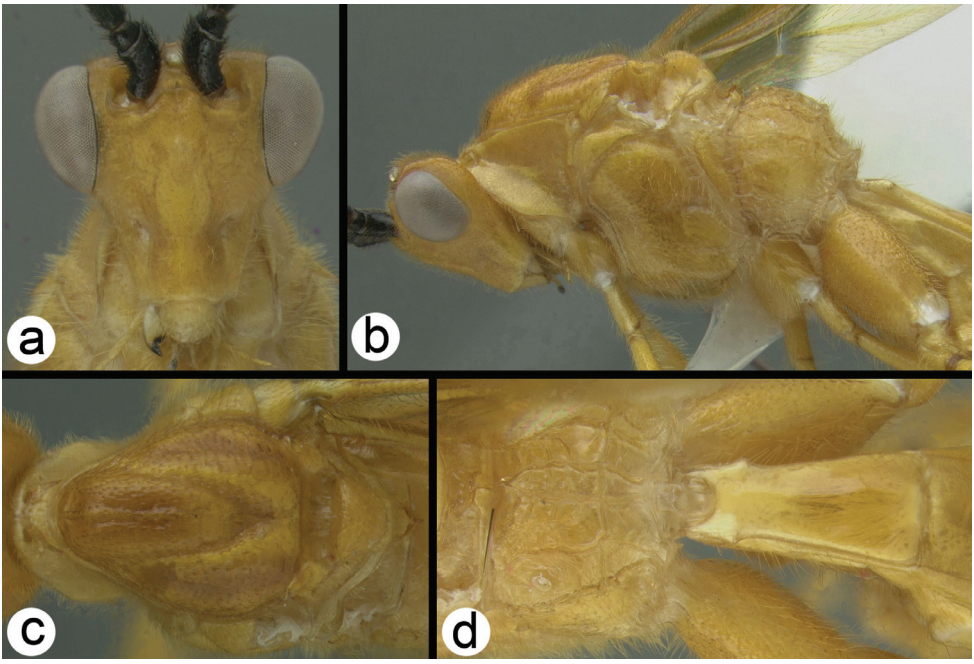


Figure 40. *Cremnops mekongennsis* **a** anterior head **b** lateral head and mesosoma **c** dorsal thorax **d** dorsal propodeum and metasomal tergum 1.

hind claws both with a right-angled or slightly acute basal lobe, hind femur aciculate; mid tibia with one peg; hind tibia with 3 pegs; last abscissa of RS of fore wing sinuate.

Metasoma. Metasomal tergum 1 with a smooth transverse groove; border between tergum 2 and 3 marked by a smooth transverse groove; ovipositor slightly shorter than body length.

Male. Essentially as in the holotype.

Variation. The holotype is representative of darker specimens. Other specimens may have more extensive yellow color on the metasomal tergites and the flagellum may be pale brown, almost dark yellow.

Distribution. Known only from the above localities in Thailand. Distribution map can be found at http://purl.org/thaimaps/yui.

Etymology. Named in honor of Dr. Dicky Yu, for his immense contributions to hymenopterology.

Material examined. Holotype female: H039, Thailand, Phitsanulok, Thung Salaeng Luang NP, Mixed deciduous forest (Gang Sopa waterfall), Malaise trap, 4–12. xi.2006, Pongpitak Pranee, [QSBG].

Paratypes: Thailand: 1♀, H1182, Chiang Mai, Pa Huay Tong Moo 8 Tambon Bo Luang, 1–20.ix.1997, S. Sonthichai, [HIC]; 2♀♀, H1183 & H1184, Loei, Phu Kradueng NP, Huay Lao Kao, Malaise trap, 9–16.viii.2006, Sutin Khonglasae, [HIC, QSBG]; 2♀♀, H632 & H644, Phetchabun, Nam Nao NP, Check point, Malaise trap, 5–12.v.2007, Noopean Hongyothi, [HIC]; 1♀, H681, Suphanburi,

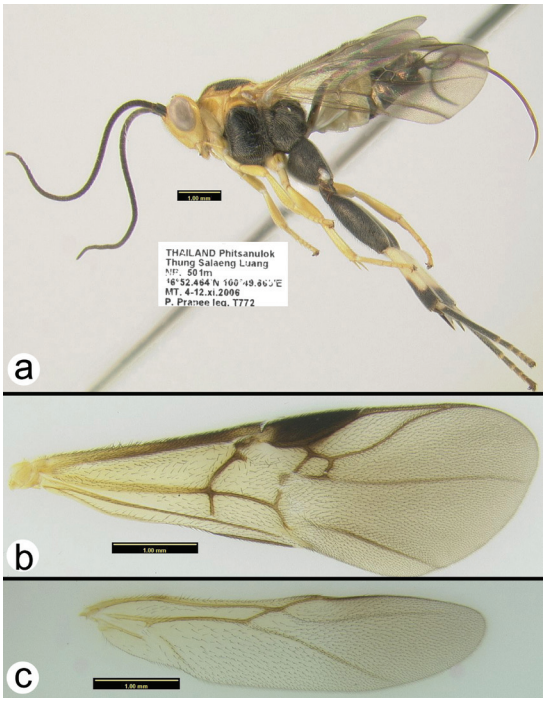


Figure 41. *Cremnoptoides yui* **a** lateral habitus **b** fore wing **c** hind wing.

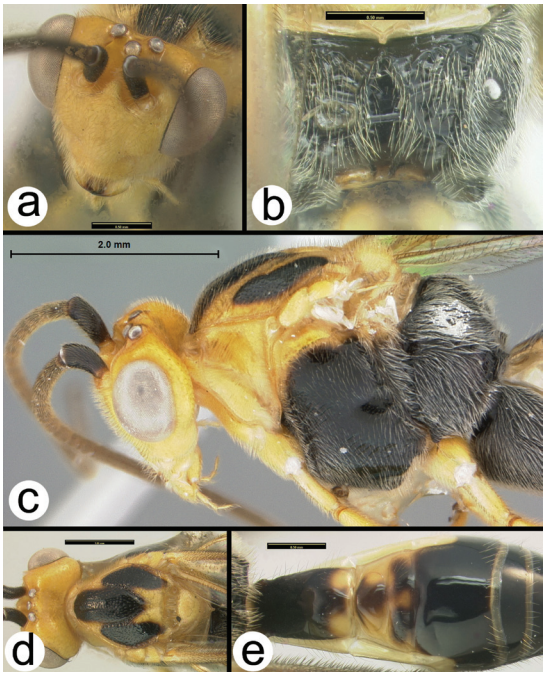


Figure 42. *Cremnoptoides yui* **a** anterodorsal head **b** dorsal propodeum **c** lateral head and mesosoma **d** dorsal head and thorax **e** dorsal metasomal terga 1–4.

Pu Toei NP, Phu Toei hill top/road, Malaise trap,1–8.viii.2008, Saunbua. L. , [QSBG]; 1♀, H1185, Ubon Ratchathani, Pha Taem NP, Don Huay Can, Malaise trap, 9–15.vi.2007, Tongcam & Banlu, [QSBG]; 1♀, H1181, Ubon Ratchathani, Pha Taem NP, Huay Sa Nhom plateau, Malaise trap, 11–18.xi.2006, Sorawit and Thongdee, [QSBG]; 1♂, H1186, Ubon Ratchathani, Pha Taem NP, Kua nang nee, Malaise trap, 25.viii-2.ix.2006, Bunlu Subsiri, [HIC]; 1♀, H766, Ubon Ratchathani, Pha Taem NP, Phu Krajeaw foothill, Malaise trap, 9–15.vi.2007, Tongcam & Banlu, [HIC]; 1♀, H001, Chaiyaphum Tat Tone NP, Malaise Trap, 12–19.x.2006, Tawit Jaruphan, [HIC].

Key to Thai Species of *Disophrys*

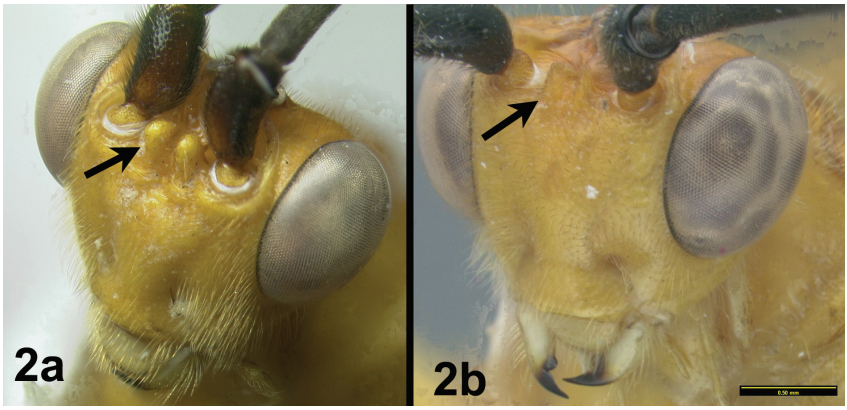
1a Mesoscutum yellow with a black spot on each lobe; notauli with wide crenulations.....***D. strigata* Enderlein**

1b Mesoscutum reddish orange; notauli with wide crenulations .....
.....***D. erythrocephala* Cameron**

1c Mesoscutum yellow; notauli without wide crenulations.....**2**

2a Blunt tubercles between antennae.....
..... ***D. rhinoides* van Achterberg & Long**

2b Sharp carinae between antennae..... ***D. subfaciata* (Brullé)**



***Dispophrys erythrocephala* Cameron**
http://species-id.net/wiki/Dispophrys_erythrocephala
Figs 43–44

Dispophrys erythrocephala Cameron 1900 [OUMNH, type examined] Indonesia (Sumatra)

Diagnosis. The color of this species is unique to *Disophrys* in the region.

GenBank accession. *H090:* #HQ667971

Distribution. Thailand, Vietnam, China, Taiwan, India, Sri Lanka, Peninsular Malaysia and Indonesia (Sumatra, Krakatau, Kangean Islands) (van Achterberg and Long 2010). Distribution map of the Thai specimens can be found at http://purl.org/thaimaps/erythrocephala.

Identified specimens are deposited in HIC and QSBG.

***Disophrys rhinoides* van Achterberg & Long**
http://species-id.net/wiki/Disophrys_rhinoides
Figs 45–46

Disophrys rhinoides van Achterberg and Long 2010 [RMNH, type examined] Vietnam.

Diagnosis. The rounded protuberances between the antennae are unique.

GenBank accession. *H007:* #HQ667970

Distribution. Vietnam and Thailand. Distribution map of the Thai specimens can be found on http://purl.org/thaimaps/rhinoides.

Identified specimens are deposited in HIC and QSBG.

***Disophrys strigata* Enderlein**
http://species-id.net/wiki/Disophrys_strigata
Fig. 47

Disophrys strigata Enderlein 1920 [MZPW, type examined] Indonesia, Sumatra.
Disophrys macilifera van Achterberg and Long 2010 syn. n. [RMNH, type examined] Vietnam.

Diagnosis. The general color pattern and the wide crenulae on the notauli are sufficient to distinguish this species.

Notes. Van Achterberg and Long (2010) described *D. maculifera* as a distinct species based on the following distinctions. "*Disophrys strigata* differs by having the hind leg completely black (*Disophrys maculifera* has at least hind coxa, trochanter and trochantellus yellowish ventrally), fore coxa with a black patch, middle of mesopleuron and dorsal third of metapleuron and propodeum medially

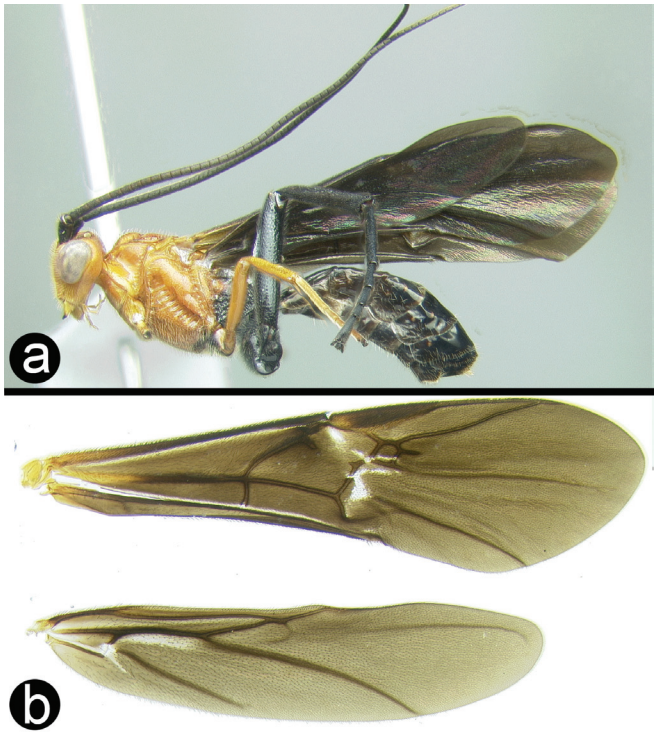


Figure 43. *Disophrys erythrocephala* **a** lateral habitus **b** wings.

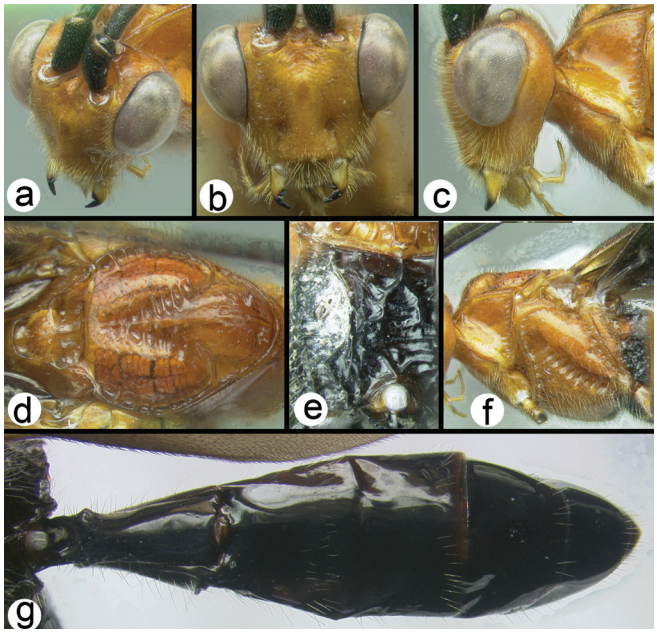


Figure 44. *Disophrys erythrocephala* **a** dorsolateral head **b** anterior head **c** lateral head and prothorax **d** dorsal mesothorax **e** dorsal propodeum **f** lateral pro- and mesothorax **g** dorsal metasoma.

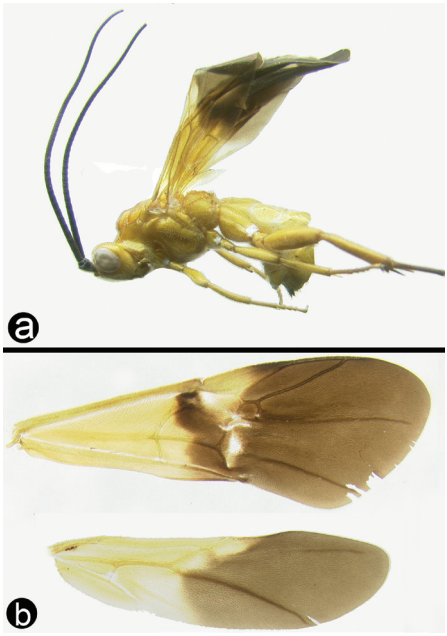


Figure 45. *Disophrys rhinoides* **a** lateral habitus **b** wings.

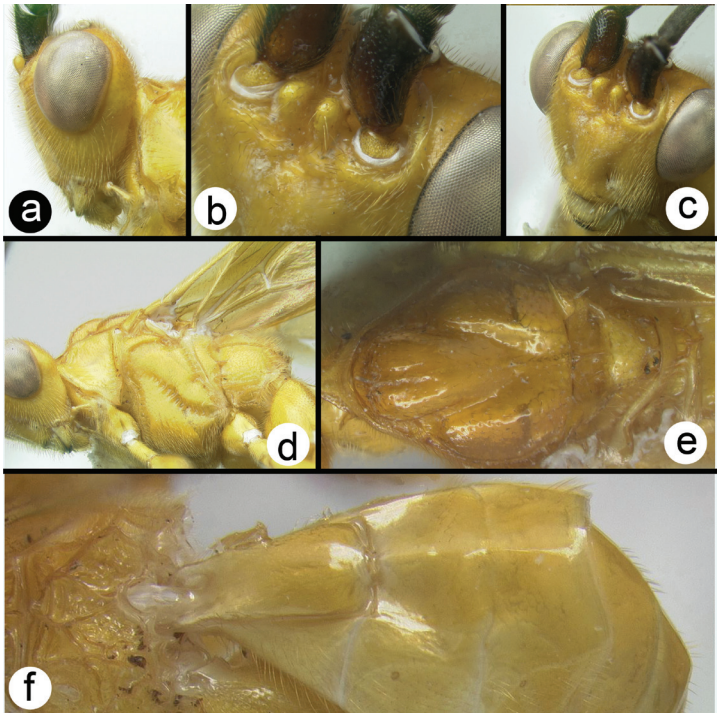


Figure 46. *Disophrys rhinoides* **a** lateral head **b** anterodorsal head showing closeup of interantennal region **c** anterodorsal head **d** lateral head and mesosoma **e** dorsal mesosoma **f** dorsal propodeum and metasoma.

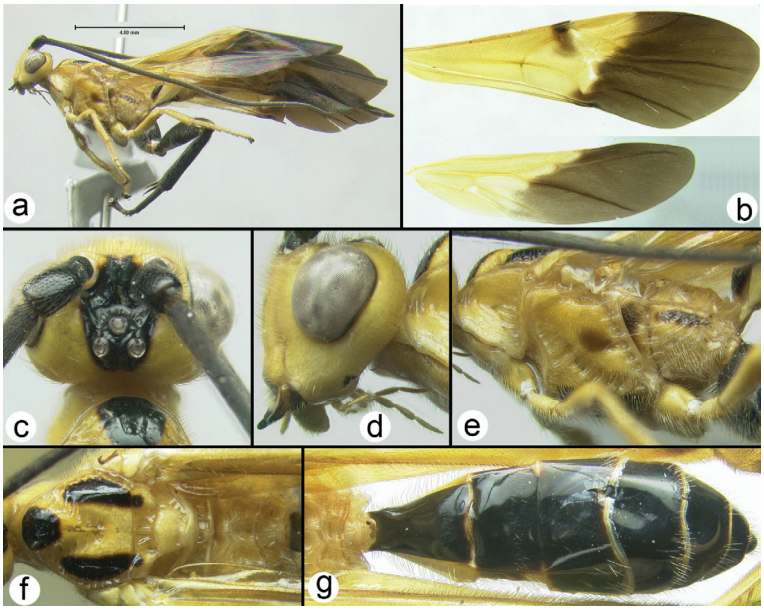


Figure 47. *Disophrys strigata* **a** lateral habitus **b** wings **c** dorsal head **d** lateral head **e** lateral mesosoma **f** dorsal mesosoma **g** dorsal propodeum and metasoma.

black (brownish-yellow in *Disophrys maculifera*)." Contrary to the preceding, the ventral surface of the hind coxa is yellow in the type of *D. strigata*. However the major reason for synonymizing the two is that the Thai specimens are intermediate in coloration between the Vietnamese (*D. maculifera*) and Sumatran (*D. strigata*) specimens, which is what one would expect if they represent the same species. For example, the Thai specimens have yellow on the hind coxa and femur ventrally, agreeing with *D. maculifera*, and the metasomal median tergites are entirely black, agreeing with *D. strigata*.

This species is very similar to *Disophrys insignis* Roman, 1913 from the Philippines but differs in that the latter has much shallower notauli and the lateral carinae of the frons are much higher than those of *D. macilifera*. They are undoubtedly closely related in that the pattern of the propodeal carinae is unlike those of other *Disophrys*. Normally the medial cell of the propodeum is greatly expanded anteriorly and laterally, however in these two species it is in the form of a small pentagon. The Thai specimens are somewhat darker than those of Vietnam.

GenBank accession. *H006:* # HQ667969

Distribution. Indonesia, Vietnam, Thailand. Distribution map of the Thai specimens can be found at http://purl.org/thaimaps/strigata.

Identified specimens are deposited in HIC and QSBG.

***Disophrys subfaciata* (Brullé)**
http://species-id.net/wiki/Disophrys_subfaciata
Figs 48–49

Agathis subfaciata Brullé, 1846 [MNHM, type examined] India
Disophrys quymanhi van Achterberg and Long 2010. syn. n. [RMNH, type examined] Vietnam.

Diagnosis. The color patterns, the relatively smooth notauli, and the sharp ridges between the antennae are sufficient to distinguish this species.

Notes. Van Achterberg and Long (2010) wrote the following concerning the similarity between their new species *D. quymanhi* and *D. subfasciata*, "Similar to *Disophrys subfasciata* (Brullé, 1846) from India, but that species has the scapus partly yellowish (entirely black in *Disophrys quymanhi*), no ramellus (present) and the notauli are deeply impressed (shallow)." Contrary to these comments, the ramellus, or 2RS2 vein of the fore wing, is present in the holotype of *D. subfasciata*. The notauli of the Thai and Vietnamese specimens are deeply impressed and smooth exactly as in the holotype of *D. subfasciata*. The remaining difference is the presence of some yellow on the scape of the holotype of *D. subfasciata* which is absent in the Thai and Vietnamese specimens. In light of the fact that many specimens from India also lack this yellow coloration, and are otherwise identical to the type, we believe it to represent intraspecific variation.

GenBank accession. *H1862:* #JF506257

Distribution. Thailand, India and Vietnam. Distribution map of the Thai specimens can be found at http://purl.org/thaimaps/sybfaciata.

Besides the types, identified specimens are in HIC and QSBG.

***Earinus aurantius* van Achterberg & Long**
http://species-id.net/wiki/Earinus_aurantius
Fig. 50

Earinus aurantius van Achterberg and Long 2010 [RMNH, type examined]

Diagnosis. This species is very similar to *Earinus longensis* Sharkey 1996. The coloration of the Thai specimens match specimens of *E. longensis* (China, Japan and Far East Russia) almost exactly, however specimens of *E. aurantius* are more gracile and their ovipositor sheaths are wider.

Notes. The Thai specimens differ from those described from Vietnam in that the former have less orange brown color on the mesosoma. In the Thai specimens this color is restricted to the apex of the scutellum.

GenBank accession. *H041:* #HQ667972

Distribution. Thailand and Vietnam. Distribution map of the Thai specimens which are deposited in HIC and QSBG can be found at http://purl.org/thaimaps/aurantius.

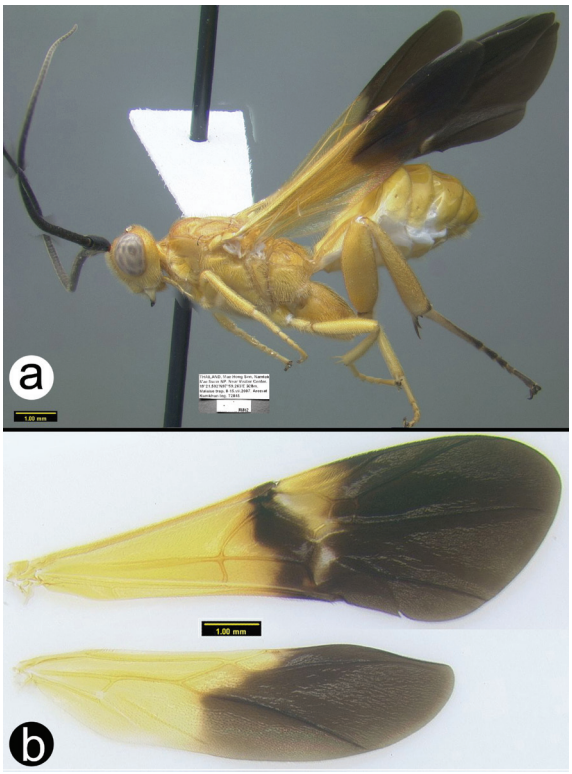


Figure 48. *Disophrys subfasciata* **a** lateral habitus **b** wings.

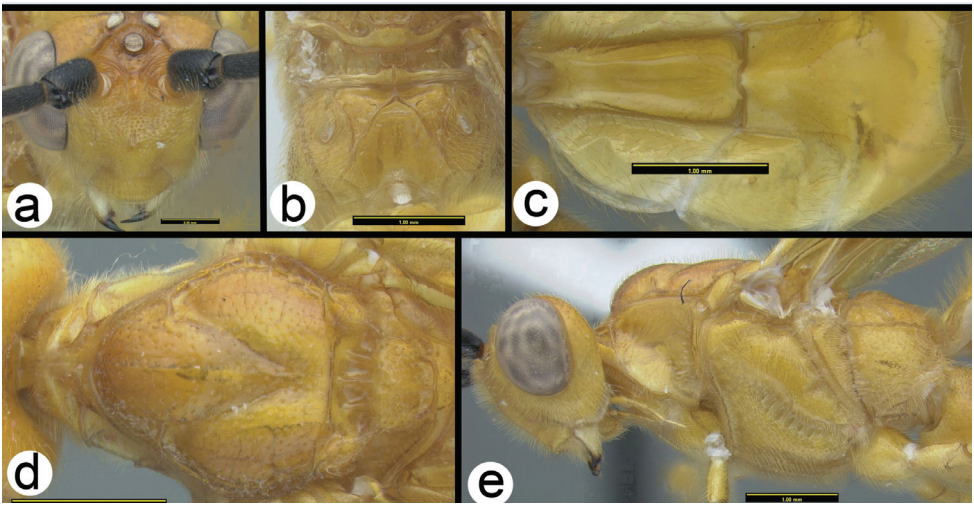


Figure 49. *Disophrys subfasciata* **a** anterodorsal head **b** dorsal metasoma and propodeum **c** dorsal metasomal terga 1–3 **d** dorsal thorax **e** lateral head and mesosoma.

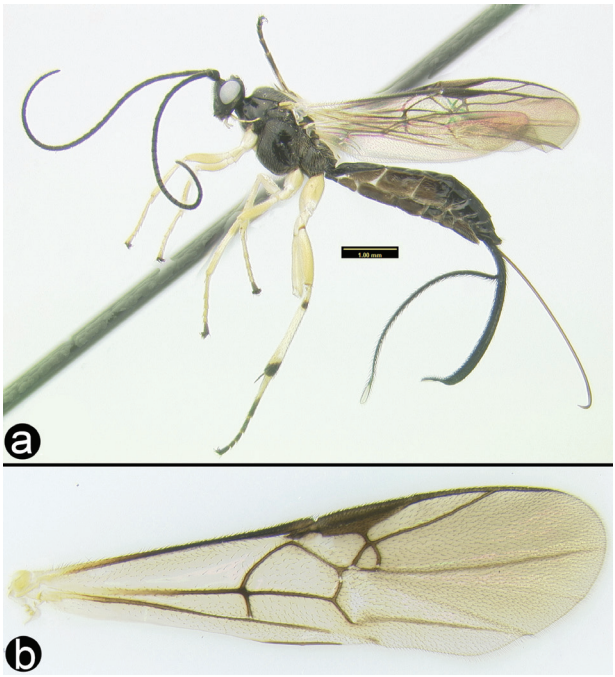


Figure 50. *Earinus aurantius* **a** lateral habitus **b** fore wing.

***Gyrochus yunnanensis* Wang**
http://species-id.net/wiki/Gyrochus_yunnanensis
Fig. 51

Gyrochus yunnanensis Wang 1984 [IZCAS] China.

Diagnosis. The light color of the metasoma combined with the color pattern of the wings is sufficient to distinguish this species. *Gyrochus nigripennis* Enderlein 1920 and *G. sumatransis* Enderlein 1920, both from Indonesia (Sumatra), are similar and differ in the presence of more extensive melanic color especially on the metasoma. *Gyrochus ornatipennis* (Cameron 1905) (New Combination for *Disophrys ornatipennis* Cameron 1905), from Borneo also has more melanic color. *Gyrochus flavipennis* (Brullé 1846) (New Combination for *Agathis flavipennis* Brullé 1846), from Papua New Guinea, has fore wings that are completely yellow.

Gyrochus helvus Enderlein 1920, from Sumatra, has a similar pale body but the fore wing is completely yellow except some very weak infuscation restricted to the apex. *Gyrochus guangensis* Wang, from China also has the fore wing completely yellow.

Notes. The five nominal species of *Gyrochus* differ almost exclusively in color pattern, particularly in the wings. Van Achterberg and Long (2010) illustrated a specimen from Vietnam with much darker wings than that of the holotype; however they have

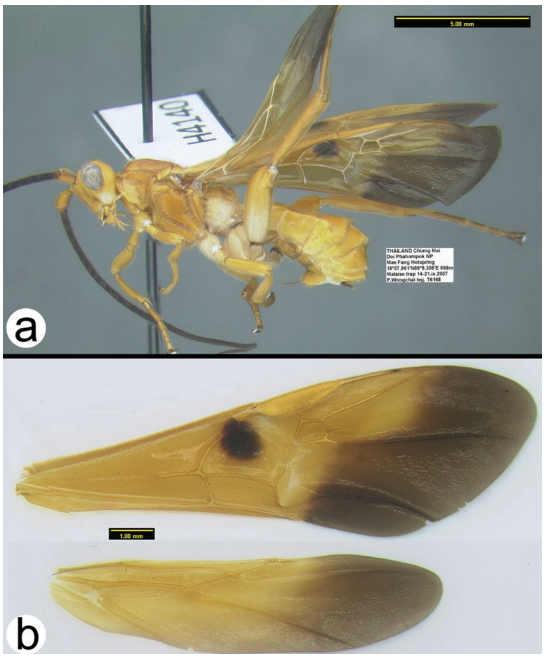


Figure 51. *Gyrochus yunnanensis* **a** lateral habitus **b** wings.

correctly identified the specimen. The specimen illustrated here from Thailand conforms much more closely to the coloration of the holotype.

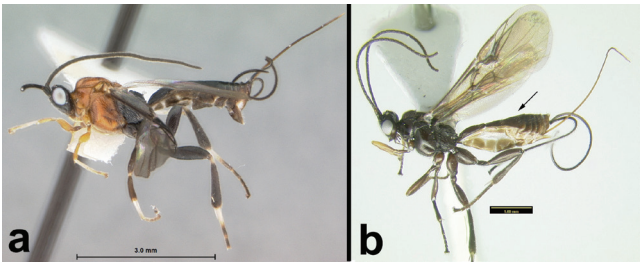
GenBank accession. *H543:* # HQ667973

Distribution. China (Yunnan), Vietnam, Thailand. Distribution map of the Thai specimens which are deposited in HIC and QSBG can be found at http://purl.org/thaimaps/yunnanensis.

Key to species of Thai *Lytopylus*

1a Pro and mesothorax orange, mid and hind basitarsomeres milky white..... ..... ***L. ebulus*** **(Nixon)**

1b Pro and mesothorax mostly or entirely melanic, mid and hind basitarsomeres mostly melanic.....***L. romani*** **(Shestakov)**



***Lytopylus ebulus* (Nixon), stat. n.**
http://species-id.net/wiki/Lytophylus_ebulus
Fig. 52

Agathis ebula Nixon 1950. [BMNH, type examined]
Previously synonymized under *Lytopylus romani* by Sharkey (1998).
Agathis burmensis Bhat & Gupta, 1977. syn. n.

Diagnosis. The orange pro- and mesothorax combined with milky white mid and hind basitarsomeres distinguish this species.

Notes. Here we synonymize *Agathis burmensis* Bhat and Gupta (1997). It differs from the holotype of *Lytopylus ebulus* only in minor color variation and the degree of sculpture on metasomal tergum three, which is somewhat reduced in *A. burmensis.*

Distribution. Examined specimens are from India, Taiwan, Burma, and Thailand. The pale specimen figured in van Achterberg and Long (2010, Fig. 217) identified as *L. romani* appears to be a representative of this species. Distribution map of the Thai specimens which are deposited in QSBG can be found on http://purl.org/thaimaps/ebulus.

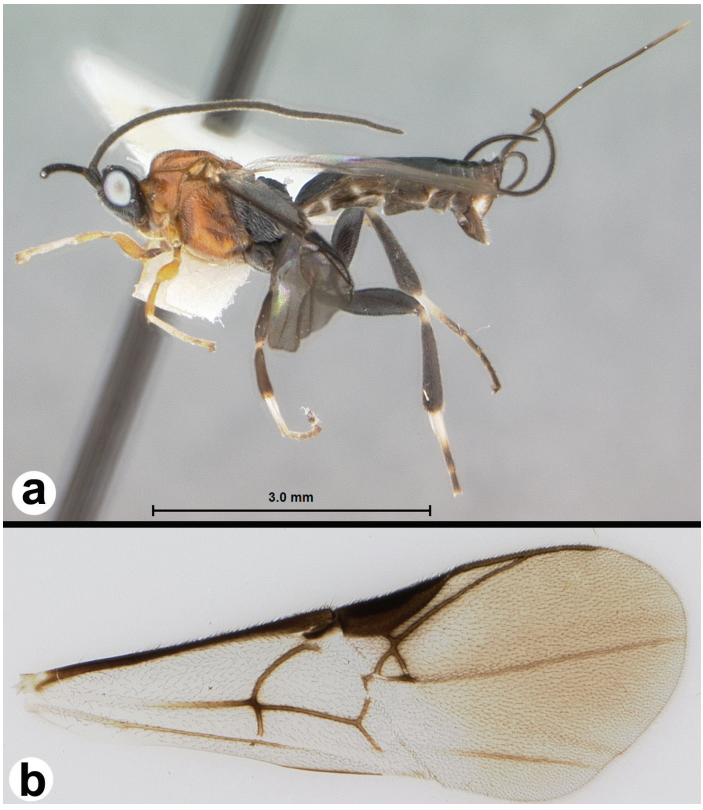


Figure 52. *Lytopylus ebulus* **a** lateral habitus **b** fore wing.

***Lytopylus romani* (Shestakov)**
http://species-id.net/wiki/Lytopylus_romani
Fig. 53

Microdus romani Shestakov1940. [NHRS examined]
Bassus ater Chou & Sharkey1989 (synonymized by Sharkey 1998)

Diagnosis. The melanic mesothorax combined with melanic mid and hind basitarsomeres distinguish this species in this geographic area.

Notes. *Lytopylus romani* may be an uncommonly widespread and variable species or it may represent a complex of species. We suspect that the latter is more likely. The length of the ovipositor varies considerably within the "species" with some specimens from Far East Russia possessing particularly long ovipositors. A molecular approach may be necessary to resolve species limits.

Distribution. Taiwan, India, Japan, Korea, Russia, Far East Russia, Thailand. Distribution map of the Thai specimens which are deposited in QSBG can be found at http://purl.org/thaimaps/romani.

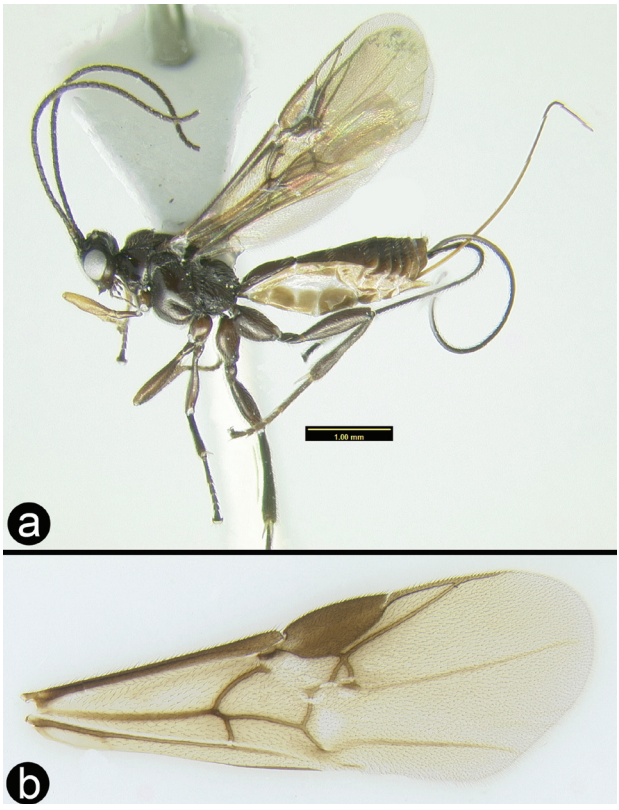


Figure 53. *Lytopylus romani* **a** lateral habitus **b** fore wing.

***Troticus alloflavus* van Achterberg & Long**
http://species-id.net/wiki/Troticus_alloflavus
Fig. 54

Troticus alloflavus van Achterberg and Long 2010 [RMNH, type examined] Vietnam

Diagnosis. There is one other Oriental species. *Troticus giganteus* van Achterberg and Long (2010), has much more extensive melanic color on the fore wing. It is illustrated and described in van Achterberg and Long (2010).

Distribution. Thailand and Vietnam. Distribution map of the sole Thai specimen can be found at http://purl.org/thaimaps/alloflavus.

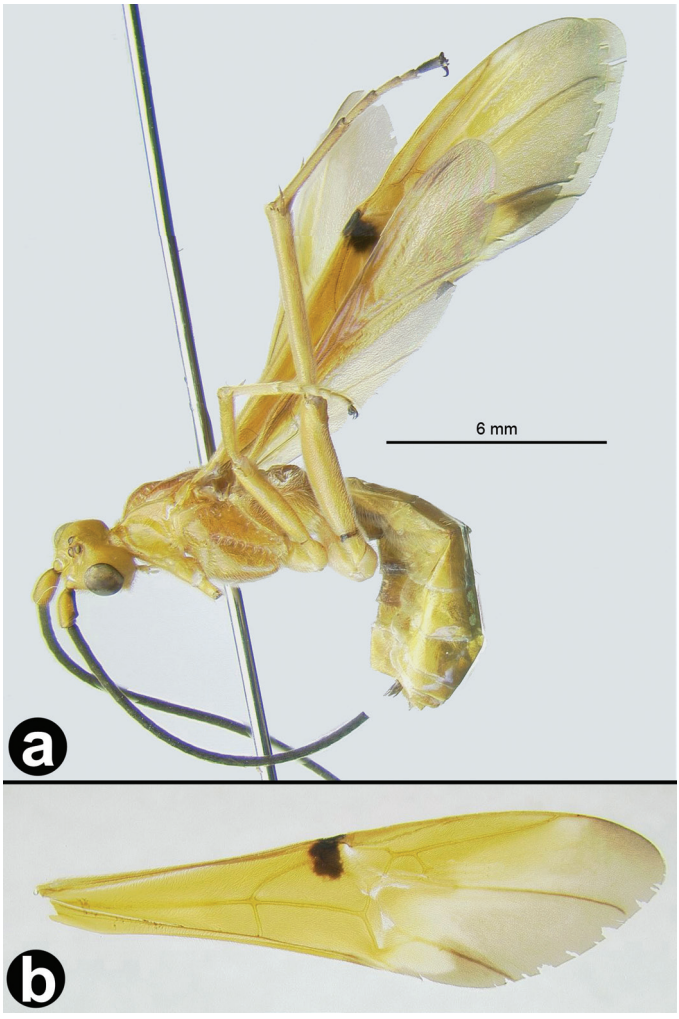


Figure 54. *Troticus alloflavus* **a** lateral habitus **b** fore wing.

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We thank all of the staff at Queen Sirikit Botanic Garden in Chaing Mai for sorting the many hundreds of samples and for the Thai park staff for running Malaise traps and other collection devices. A special thanks to Chaweewan Hutacharern for managing the Thai end of the TIGER project. Also many thanks to the curators around the world (London, Oxford, Warsaw, Leiden, Gainesville, Budapest, Beijing, Paris, Stockholm, Washington) for lending specimens and hosting MJS on visits. Special thanks to Kees van Achterberg for lending specimens and types from Vietnam. Funding was provided by NSF grants DEB-0542864 and EF-0337220.

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Appendix 1

DELTA data matrix, images, and other files to the key of the Oriental genera of Agathidinae (Hymenoptera, Braconidae). (doi: 10.3897/JHR.22.1299.app1)

Citation: Sharkey MJ, Clutts SA (2011) A revision of Thai Agathidinae (Hymenoptera, Braconidae), with descriptions of six new species. Journal of Hymenoptera Research 22: 69–132. doi: 10.3897/JHR.22.1299.app.1

Appendix 2

Interactive key, in IntKey format, to the genera of Oriental Agathidinae (Hymenoptera, Braconidae). (doi: 10.3897/JHR.22.1299.app2)

Note: To run the identification key, you will need Windows 95/NT or a later version. You also need to download Intkey software and reboot your computer, if it is not already installed. The software package, Intkey, can be downloaded from http://delta-intkey.com/www/programs.htm. Once Intkey is installed you need only click on the .ink file (below) and the key will open. Click on any character on the left to begin.

More details on how to use Intkey efficiently are found at http://florabase.calm.wa.gov.au/help/keys/intkey_tutorial.pdf.

Citation: Sharkey MJ, Clutts SA (2011) A revision of Thai Agathidinae (Hymenoptera, Braconidae), with descriptions of six new species. Journal of Hymenoptera Research 22: 69–132. doi: 10.3897/JHR.22.1299.app.2

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RESEARCH ARTICLE

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Description of two techniques to increase efficiency in processing and curating minute arthropods, with special reference to parasitic Hymenoptera

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Abstract

We describe and illustrate two techniques for enhancing curatorial and processing efficiency as it pertains to parasitic Hymenoptera (Chalcidoidea, Cynipoidea). These techniques were developed in response not only to the massive number of parasitoids that have been acquired through various biodiversity studies, but also the difficulty in mobilizing the human resources to curate this material. The first technique uses small, crystal polystyrene boxes with tight-fitting lids to store dehydrated specimens prior to mounting. Locality information is affixed to the box and specimens are spread in a layer for ease of examination by researchers. Solutions for managing static electricity within the specimen boxes are discussed. The second involves a vacuum pump connected to a funnel with a filtration membrane and flask apparatus to rapidly dehydrate hard-bodied parasitoids (Figitidae) that are not subject to collapse during air-drying.

Keywords

Chalcidoidea, Cynipoidea, crystal polystyrene, vacuum pump, curation, dehydration

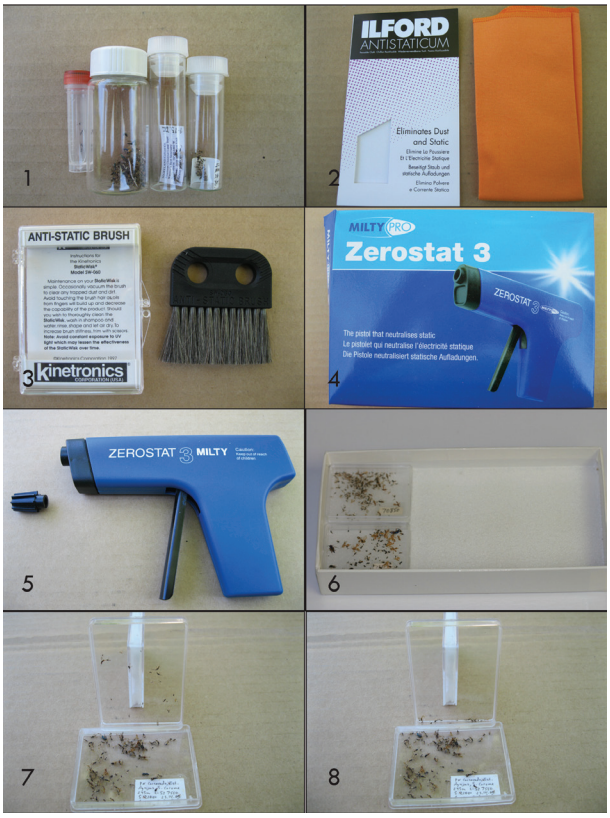
Introduction

Participation in large-scale biodiversity studies and other ecological research projects (Delabie et al. 2000; Droege et al. 2010; Fisher 2005; LaPolla et al. 2007) involving the collection of arthropods with passive collection techniques (Darling and Packer 1988;

Fraser et al. 2008; Noyes 1989; Townes 1962) generates not only a massive biomass of interest to the conducting researcher, but also a large volume of non-target material, or 'by-catch.' Both of these fractions must be dealt with in an efficacious manner to ensure maximal preservation of the morphological and genomic information of the specimens (Quicke et al. 1999). By using novel, inexpensive separation techniques (Buffington and Gates 2008), and volunteer labor (where possible), samples can be processed and made available for research. Here we illustrate our techniques for processing sorted samples of parasitic Hymenoptera (Chalcidoidea and Cynipoidea). These combined techniques can be considered a model to be applied to organisms of similar size that fit the criteria described herein.

After amassing a large volume of raw insect residues from biodiversity studies from which parasitic Hymenoptera must be separated, we employ an aqueous technique using mesh colanders, plastic tubs, and an orbital shaker to separate each raw residue into a macro and a micro fraction (Buffington and Gates 2008). We then focus on the micro fraction, sorting higher parasitic Hymenoptera taxa into ethanol for distribution to specialists or further processing at the National Museum of Natural History (USNM). In the interim, micro (and subfractions thereof) fractions are stored in –10° explosion-proof freezers (Kelvinator Scientific BT-30C-EXPR) or in our dedicated alcohol sample storage range. Unfortunately, there is insufficient freezer space to properly store our volume of aqueous fractions and the alcohol range is too warm to sufficiently inhibit degradation of aqueous fractions (Vink et al. 2005). An additional constraint to ethanol storage of microhymenoptera is one of handling. Many microhymenoptera are extremely small, making accurate identification difficult while in ethanol; specimens can be difficult to hold in position, and the optical index of ethanol is less than ideal for high magnification examination. Thus, we strive to store many of our micro subfractions in a dehydrated state until resources may be directed for mounting and labeling.

For many taxa (e.g. Chalcidoidea), hexamethyldisilazane (HMDS) is used as part of a chemical dehydration process required to prevent specimen collapse while air drying; we follow the protocols of Heraty and Hawks (1998) for our HMDS processing. For those specimens that can withstand air drying without collapse (e.g., Cynipoidea: Figitidae; Platygastroidea: Platygastridae), we detail a rapid process for specimen dehydration. In either case, the ultimate storage of dried specimens poses problems, and our current method employing a multitude of vials and jars (varying in volume and transparency) is insufficient for the task: examination of specimens ranges from difficult to impossible, storage is non-standard and haphazard, and specimens are periodically at risk of damage during examination (Fig. 1). We summarize here a novel method for storing large numbers of unmounted micro Hymenoptera that maximizes efficient use of space, allows for rapid examination, and protects the specimens from the rigors of handling during examination.

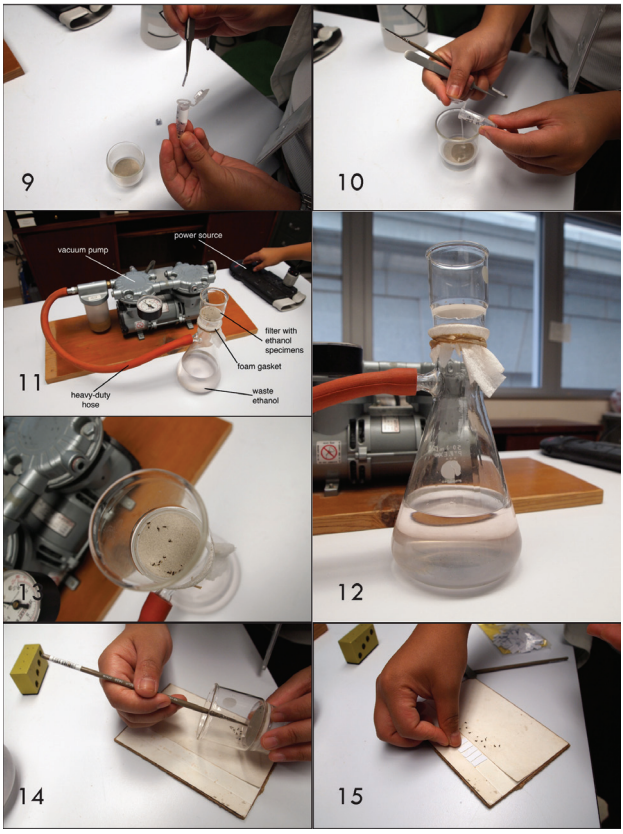


Figures 1–8. 1 Miscellaneous vials for specimen storage **2** Ilford antistatic cloth. **3** Kinetronics antistatic brush. **4** Zerostat 3 product box. **5** Zerostat 3 gun with cap. **6** USNM ½ unit tray with plastic specimen boxes. **7** Specimens attracted to box lid by static. **8** Specimens at bottom of box lid after static dissipated.

Materials and methods

Images of supplies, equipment and specimens were taken with either an Olympus PEN EP-1L (Figs 9–15) or a Canon Powershot A3100 digital cameras (Figs 1–8). The crystal polystyrene specimen storage boxes (rectangular cases) are manufactured by Caubère (http://www.caubere.fr/en/produits/carres_rectangulaires/carre_rectangulaire02.htm) and the size we use most frequently is the 56 × 41 × 6 mm. The antistatic cloth (13 × 13" Ilford Antistaticum), antistatic brush (Kinetronics Corp., Model SW-060), and antistatic gun (Zerostat, MiltyPro Zerostat 3) are inexpensive and available online (Table 1).

The vacuum pump is Gast LAA-V104-NQ, a model of oilless miniature rocking piston pump/vacuum; glassware associated with the pump are an Erlenmeyer flask, geological filter, styrofoam padding (for a gasket), and high-density hose. Another filter



Figures 9–15. **9** Collection labels are removed from the sample. **10** Specimens in ethanol are poured into the filter. **11** Complete vacuum pump system. **12** Filter under vacuum. **13** Specimens dried after running the pump. **14** Specimens removed from the filter onto a mounting board. **15** Glue boards are arranged.

apparatus tested with success was a GE Disposable 'All-in-one Vacuum Filtration Unit' available from Fisher Scientific. The abbreviation for our collection is USNM (National Museum of Natural History, Smithsonian Institution, Washington, D.C., USA).

Results

Clear Box Specimen Storage. 1) Arrange workspace so that it is clean and lay down an antistatic cloth (Fig. 2) on which to work with specimens and boxes. 2) Brush the inner surfaces of the empty boxes (depending on local static electricity conditions, this may be unnecessary) with the antistatic brush (Fig. 3) to eliminate residual static. The blend of natural hairs and conductive synthetic fibers and conductive nature of the brush dissipate static effectively. 3) If static remains an issue, the Zerostat gun may be used (Figs 4, 5). We typically need to use it only on the inner surface of the lid in these

Table 1. Cost of supplies.

Item	Cost	Source
Milty Zerostat 3	$100	http://www.buy.com/
Ilford Antistatic Cloth	$8.00	http:// www.amazon.com
Polystyrene box (#546)	~$100/500	http://www.caubere.fr/en/produits/ (must contact for current pricing)
Kinetronics 60 Antistatic Brush	$19.95	http://www.buy.com/
FJC 6909 3.0 CFM Twin Port Vacuum Pump	$115	http://www.amazon.com
Filtration kit w/ 70mm w/ buchner funnel, flask and filter paper	$18.95	http://www.amazon.com

conditions, especially if specimens "jump" onto the lid. To test, static was deliberately generated by rubbing the closed box with specimens on carpeting until specimens were attracted to the lid (Fig. 7). The box was opened with specimens on the lid (Fig. 7), the Zerostat was held approximately six inches away from the lid and activated. The specimens from the lid fell off as the static was dissipated. The gun contains two piezoelectric crystals and compression trigger which, by slowly squeezing the trigger, generates a stream of positive ions, and upon slowly releasing the trigger, releases a negative stream of ions. It requires no batteries and is durable (expect 10,000 trigger pulls). 4) The locality label is affixed with clear tape underneath the bottom of the box (Fig. 7), the specimens are deposited into the box, and the lid is placed on the bottom. 5) The specimens are ready for storage in unit trays in drawers (Fig. 6). Based upon the box size used most frequently, 18 boxes easily fit in a standard USNM ½ unit tray for a total of 128 boxes per USNM drawer. Many sizes are available to fit different taxa.

Crystal polystyrene boxes possess several attributes that are favorable for dry storage: 1) transparency; 2) tight-fitting lids; and 3) high stiffness and dimensional stability. These attributes offer several advantages: 1) labels may be affixed to the bottom and can be viewed while simultaneously examining specimens under stereoscope; 2) enables rapid sorting of specimens not yet available as mounted and labeled material; 3) specimens may be removed for use in research projects as needed with minimal disturbance to non-target specimens; 4) specimens may be easily mailed to other researchers, avoiding disadvantages associated with shipping ethanol-preserved specimens (e.g. hazardous materials packaging, package preparation training, restrictions imposed by shipping companies).

Vacuum Dehydration. 1) Remove collection labels from the sample (Fig. 9). 2) Pour ethanol-preserved specimens into the filter (Fig. 10). For samples with an abundance of debris in the ethanol (e.g. lepidopteran scales), additional clean ethanol can be added to float off debris from the specimens. 3) The complete vacuum pump system is illustrated in Figure 11. In this example, the pump motor is always 'on', so the power strip also functions as the 'on/off' switch. Note the heavy-duty hose; this is critical because a weaker hose will collapse under vacuum. The foam gasket insures a firm seal between the filter and the flask below. 4) Filter under vacuum; ethanol is pulled through the membrane, specimens remain in filter (Fig. 12). Recycle or discard waste

ethanol. 5) Dry specimens by running the pump for 30 seconds (Fig. 13). 6) Remove specimens from the filter onto a mounting board (Fig. 14). In cases where there are greater than 50 specimens, the majority can be removed by inverting the filter. Some specimens will remain on the filter membrane, and these can be removed using a micro paintbrush. 7) Arrange glue boards in preparation for affixing wasps (Fig. 15).

Discussion

Researchers attempting to examine dried, unsorted material stored in miscellaneous transparent or translucent vials face the challenge of searching for specimens of interest through the vial wall and within a specimen bolus of various sizes (e.g., Fig. 1). The alternative is the more time-consuming process of emptying the specimens on a tray and sorting through them under the stereoscope, before placing them back into the vial. Clear boxes solve both issues and allow the sorter to open a box, remove the specimens of interest, and mount them immediately for use or put them in a gelatin capsule. Advantages over long-term cold storage include no electrical requirements or storage issues related to flammable liquids. Previously, dried material was stored in a variety of vials of different sizes, making it difficult to efficiently sort specimens. If static is a problem, the Zerostat gun can be used for spot treatments.

Advantages for using the vacuum pump system for drying hard-bodied micro Hymenoptera include: 1) speed of curation dramatically increased (uninterrupted drying and mounting can achieve 500 specimens/day); 2) no need for hazadous chemical handling (including a fume hood, gloves, lab coat, and goggles); 3) low cost; once the vacuum pump system is assembled, there is no further investment required. Further, many laboratories are equipped with 'lab-vac' alongside compressed gas for burners. A lab equipped with such vacuum does not require the acquisition of a vacuum pump. In conjunction with the polystyrene boxes, thousands of specimens per day can be taken from ethanol and stored dried, awaiting examination at a later date.

Success using the vacuum pump drying technique can be influenced by the size of the arthropod being dried. In our experience, larger cynipoids that have thick cuticle (e.g. Liopteridae) tend to take longer to dry. In some instances, a specimen that appeared to look dry upon initial inspection clearly was not done drying when examined under a microscope while mounting. In these cases, ethanol could still be seen evaporating from setae. If this occurs, the specimens are returned to the vacuum apparatus and dried for a longer period of time.

Although the vacuum pump rapidly air-dries specimens, there exists the potentially deleterious side effect of damaging DNA due to the extended contact of specimen tissues with residual water (i.e. enzymatic cleavage in presence of water and oxidation) (Junqueira et al. 2002), particularly in the meso- and metasoma (see comments above). Drying times to ensure tissues are not decomposing any further, yielding a specimen for dissection and/or tissue DNA extraction, are currently unknown. However, the presence of residual water at the drying stage depends in large part on how the speci-

mens were killed (Dillon et al. 1996), subsequently preserved, and stored (Eglinton and Logan 1991). Thus, specimen preservation is more important than other factors (e.g. specimen age, dehydration technique) for DNA recovery (Junqueira et al. 2002). Nevertheless, the speed at which the internal tissues dry can affect the ultimate state of preservation of DNA for subsequent genomic extraction (Quicke et al. 1999; Nagy 2010). The HMDS dehydration method, along with other chemical-based techniques, is demonstrated to yield high quality genomic DNA (Austin and Dillon 1997); some DNA sequence data in Buffington et al. (2007), using the chelex extraction protocol, was generated from cynipoid specimens that were vacuum dried in the manner summarized here, but no quantification of success vs. failure of DNA amplification was documented. Many of the arguments concerning dessication rate are marginalized when one considers recent improvements made to the sensitivity/specificity of DNA extraction and amplification protocols applied to degraded samples (Junqueira et al. 2002). We must underscore that the methods summarized here have been developed in response to biodiversity surveys yielding tens of thousands of specimens, the vast majority of which require mounting to determine morphospecies. We feel the vacuum pump technique helps remove one more barrier in the often difficult process of collection building and generating species inventories.

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