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DESCRIPTION OF THE MALE, HOST ASSOCIATIONS, AND NEW DISTRIBUTION RECORDS FOR *LOPHOSTIGMA CINCTA* (DU BUYSSON) (HYMENOPTERA: MUTILLIDAE)

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Abstract.—The male of the mutillid wasp genus *Lophostigma* Mickel is described for the first time based on specimens of *Lophostigma cincta* (du Buysson). The sex association for *L. cincta* is based on individuals reared from nests of nocturnal sweat bees, *Megalopta genalis* (Meade-Waldo) and *M. ecuadoria* Friese (Hymenoptera: Halictidae). These bees are the first confirmed hosts for *Lophostigma.* We summarize the geographical distribution of *L. cincta.*

Key Words: Sphaeropthalminae, parasitism, Halictidae, *Megalopta*

Wasps in the family Mutillidae (Hymenoptera) are parasitic on the prepupae and pupae of other insects, including beetles (Coleoptera), flies (Diptera), and wasps and bees (Hymenoptera) (summarized in Mickel 1928; Brothers 1972, 1995). Although mutillid wasps are often vividly colored and conspicuous, and therefore well-represented in collections, the biology of most (>95%) of the ~8,000 described species is unknown (Brothers 1972, 1995). Here we describe parasite-host associations for the Neotropical sphaeropthalmine genus *Lophostigma* Mickel, based on rearing the parasites from nests of nocturnal sweat bees, *Megalopta genalis* (Meade-Waldo) and *M. ecuadoria* Friese (Hymenoptera: Halictidae). The males of this mutillid genus were unknown, so we describe the generic characters of male *Lophostigma* based on *Lophostigma cincta* (du Buysson) specimens. We summarize the geographical distribution for *L. cincta* in Central America.

MATERIALS AND METHODS

Megalopta nests were collected periodically in the Barro Colorado Nature Monument [9°09′N, 79°51′W; for description of Barro Colorado Island (BCI), see Leigh 1999], Republic of Panama, from January 1999 through November 2001. Nests were sealed with a cotton plug and transported to the laboratory where they were then split open and the cell contents examined; the contents were preserved or transferred to plastic tissue culture trays for rearing.

Morphological descriptions follow Mickel (1928, 1952), except for the mesoscutal terminology that follows Menke (1993). Photographs were made using a scanning

electron microscope (JEOL model JSM 5300LV). The abbreviations T and S are used for metasomal tergum and metasomal sternum, respectively. *Lophostigma cincta* specimens are deposited in the Museo de Invertebrados "G. B. Fairchild," Universidad de Panamá (MIUP) and the Dry Reference Collection of the Smithsonian Tropical Research Institute (STRI). Voucher specimens of the host bees are deposited at STRI and the Natural History Museum, University of Kansas.

Synopsis of Host Biology

Megalopta genalis and *M. ecuadoria* are medium-sized bees that nest in dead, broken branches in the understory of primary and secondary forests in central Panamá (Wcislo et al. 2004). Females establish nests and provision them throughout the dry season (approximately mid-December through May) and the first half of the wet season. Nests contain a series of cells, usually adjacent to a single tunnel. Nests contain 1–11 adult females per nest. If two or more bees live together in a nest, then that nest is regularly guarded by one of the bees. Each cell is mass provisioned with pollen, which females collect during foraging trips in the early evening and pre-dawn morning. After feeding, larvae develop into prepupae and then pupae without spinning cocoons.

Taxonomy

Lophostigma Mickel (Figs. 1–4, 8)

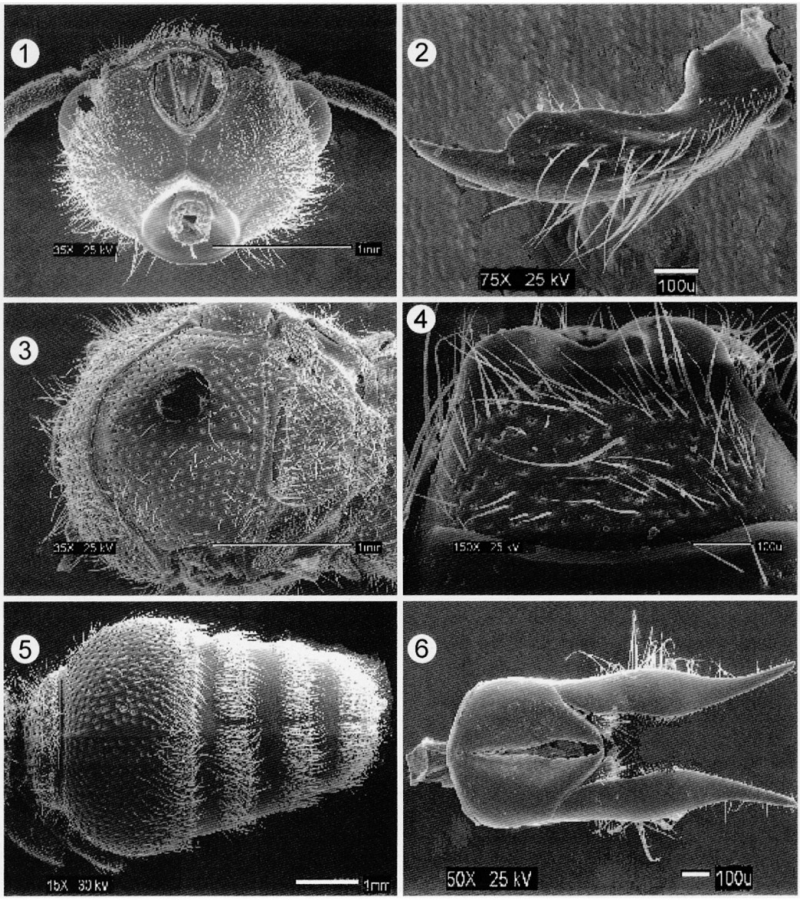
Lophostigma Mickel 1952: 146. Type species: *Mutilla iracunda* Cresson, 1902, original designation.

Generic diagnosis of male.—Proboscidal fossa moderate in size (Fig. 1); genal carina absent; mandible suddenly narrowed near tip, angle formed on inner margin by sudden narrowing, rounded (Fig. 2); mandible without ventral, basal tooth; scape with single sharp carina beneath; antennal scrobe not carinate above, but with small, median tubercle; lateral surface of pronotum with anterior, strong transverse carina terminating at humeral angle in blunt tubercle (Fig. 3); notauli absent; parapsidal lines faint, present in posterior third of mesoscutum; scutellum flat in dorsal view; dorsum of propodeum rounded onto posterior surface; mesosternum simple, without teeth or projections, with arcuate carina in front of mesocoxa; mesosternal lamellate process with medial, emargination at apex, ending posteriorly as spine in front of metacoxa; first metasomal segment slightly disciform, with narrow, dorsal surface and large, subcircular anterior surface; T2 with felt lines; S2 without felt lines; S7 (hypopygium) posteriorly with broad, medial emargination (Fig. 4); tibial spurs pale; forewing with marginal cell subacute at tip, two submarginal cells (Fig. 8); seta simple, not plumose.

Lophostigma cincta (du Buysson)

Mutilla cincta du Buysson 1892: 58.

Description.—Male. Length: 10.6 mm. Integument black, clothed with long erect and recumbent white pubescence, except last metasomal segment with black setae. Head transversely ovate-rectangular, width slightly less than width of thorax; clypeus with transverse, arcuate ridge; eye strongly convex, shortly ovate, maximum diameter 1.0× distance from postero-lateral ocellus to inner eye margin; front, vertex and gena with dense, close, punctures; occipital region and postgena not coarsely punctured, nearly smooth; front with median, impressed, longitudinal line extending from anterior margin between antennal tubercles posteriorly about half distance to anterior ocellus; ocellus small, maximum diameter 0.2× distance from postero-lateral ocellus to inner eye margin; anterior margin clypeus with inconspicuous tooth below antennal tubercle; pedicel short, length 0.62× flagellomere I; flagellomeres I and II approximately equal length. Mesosoma with dense, close, punctures (Fig. 3), except metapleuron, smooth; dorsum of propodeum reticulate throughout; scutellum with me-



Figs. 1–6. *Lophostigma cincta,* male. 1, Head, ventral view. 2, Mandible (dorsal face), lateral view. 3, Thorax, dorsal view. 4, Apical emargination of S7. 5, Metasoma, T1–T4 (dorsal view). 6, Genitalia (dorsal view).

dian, impressed, longitudinal sulcus in posterior half; mesosternum with deep, broad median sulcus, anterior to arcuate carina in front of middle coxa; axilla small, without tooth or spine (Fig. 3). Metasoma with T1, T2 (Fig. 5) and S2 with median close punctures, T2 with discal, narrow, longitudinal smooth area; S1 mostly smooth, with distinct, median, longitudinal carina, strongly elevated anteriorly into conspicuous tooth; S and T3–7 with dense, small, close punctures; forewing infuscated, except basal cell, mostly clear; hindwing with basal half mostly clear, apical half infuscated. Para-

mere as in Fig. 6, penis valve as in Fig. 7; cuspis, digitus, short, cuspis reduced to rounded lobe much shorter than digitus.

Holotype.—Female, VENEZUELA, Carabobo State: San Esteban, M. E. Simon col. In the Muséum National d'Histoire Naturelle, Paris.

Distribution.—El Salvador, Costa Rica, Panama, Colombia, Venezuela, Ecuador (see Cambra and Quintero 1996).

Material examined.—EL SALVADOR: Dpto. La Paz, campo experimental de la Fac. de Ciencias Agronómicas, Universidad de El Salvador (CAPREX), 2 Nov 1997, J. Sermeño, 1 ♀ (MIUP) [new distribution record]. PANAMA: Veraguas Prov., Sta. Fe, Alto de Piedra, 23–24 Mar 1999, A. Santos, 1 ♀ (MIUP); Colón Prov., Donoso, 21–26 Jul 2001, P. González, 1 ♀ (MIUP); Barro Colorado Island: 26 April 2001-4, Wcislo & Gonzalez, ex nest *M. genalis*, 5 ♀, 3 ♂ (STRI, MIUP); 10 Jan 2001-7, Wcislo & Gonzalez, ex nest *M. genalis*, 1 ♀ (MIUP); Adam Smith, emerged on May 9, into trap from nest code AS-20-4-2001-6, ex nest *M. ecuadoria*, 1 ♀ (STRI); 10 Jan 2001-2, Wcislo & Gonzalez, ex nest *M. ecuadoria*, 1 ♀ (STRI); 1 June 2001-7, Wcislo & Gonzalez, ex nest *M. ecuadoria*, 1 ♀ (STRI); 26 Apr 2001-3, Wcislo & Gonzalez, ex nest *M. ecuadoria*, 1 ♀ (STRI).

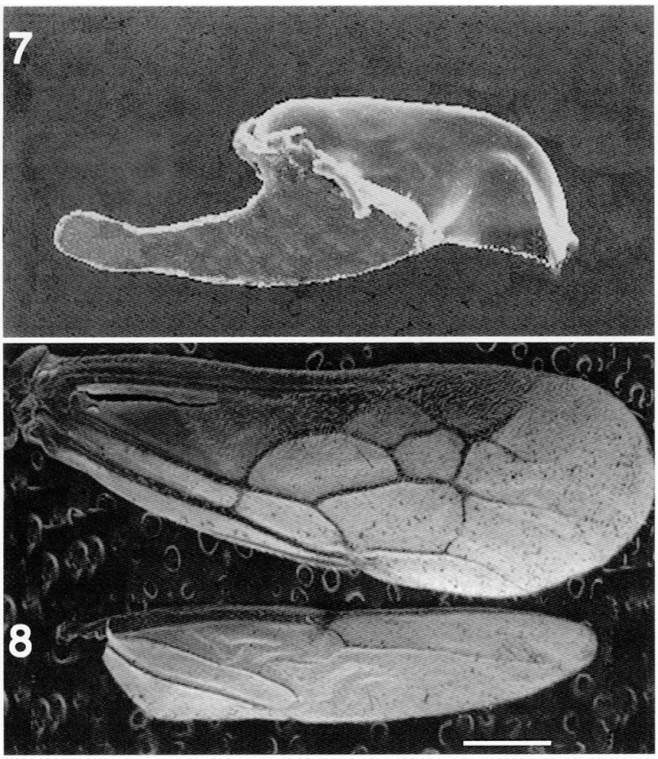
Nest Parasitism

No immature or adult mutillid wasps were observed in any cells from nests collected prior to January 2001 (N ~350 nests). Between January and November 2001, 4 mutillid wasps were reared from 4 of 66 *M. ecuadoria* nests (2.5% of 160 provisioned cells). Parasitized nests contained 2–4 sealed cells, and a single adult female bee; the percentage of parasitized cells per nest for the 4 nests ranged from 25–50% ($\bar{X}$ = 36, SD = 0.1). Similarly, ~2.1% of *M. genalis* cells were parasitized by *L. cincta* during this time (8 of 388 cells examined from 119 different nests). An adult female mutillid was found within a *M. genalis* nest that contained one old cell and four sealed cells, each of which had a hole in the cell closure; subsequently adult mutillids emerged from sealed cells, confirming the host association. Parasitized *M. genalis* nests had from 1–5 sealed cells, and 0–2 adult female bees; the percentage of parasitized cells per nest for these nests ranged from 20–100% ($\bar{X}$ = 52%, SD = 0.34). *Lophomutilla cincta* emerged from a brownish paper-like cocoon that occupied almost the entire volume of the cell, and was attached to the wall via fine pillars that appeared to be extensions of the cocoon material. Emergence holes of *L. cincta* were located near the cell entrance, and were roughly circular and ranged from 2.8–4.3 mm in diameter.

Discussion

The genera *Lophostigma* and *Lophomutilla* Mickel may be related, because in both genera the shape of the male mandible (Fig. 2) is unique for any known New World genera. Males of *Lophostigma* and *Lophomutilla* key to couplet 34 (Quintero and Cambra 1996: 352). However, characters that they used to separate males of these genera are unreliable. Males of the two genera differ in the shape of the seventh sternite, mesosternal lamellate process, and scutellum (in *Lophomutilla* the mesosternal process and the S7 lacks medioapical emarginations, and the scutellum is convex).

The percentage of *Megalopta* cells parasitized by *L. cincta* is extremely low (2.1–2.5% within a season when parasitism was observed, and $\ll$1% overall), as are parasitism rates for *Megalopta* in general (Falin et al. 2000, Smith et al. 2003, Wcislo et al. 2004). Nevertheless, the fact that *L. cincta* was reared from various nests of two different species suggests that *Megalopta* bees are not an accidental host for this species. Adult males of *L. cincta* exhibit no morphological features typically associated with nocturnal activity, such as enlarged ocelli or pale body coloration, as known for genera such as *Photopsis* Blake, *Odonto-*



Figs. 7–8. *Lophostigma cincta,* male. 7, Penis valve. 8, Forewing and hindwing (scale bar = 1 mm).

photopis Viereck, and *Limaytilla* Casal (RACT, personal observation). In fact, females of this species are frequently observed during the day on the forest floor or walking up plant stems (RACT and WTW, personal observation). No host-parasite interactions were observed, however, and further studies are needed to determine when *L. cincta* females attack hosts, as well as other details of their biology.

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