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A revised key to the species of *Caenaugochlora* (*Ctenaugochlora*),
with the description of a new species from Costa Rica
(Hymenoptera: Apoidea: Augochlorini)

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ABSTRACT. A new species of *Caenaugochlora* MICHENER, subgenus *Ctenaugochlora* EICKWORT, is described and figured from a single female from central Costa Rica. *Caenaugochlora* (*Ctenaugochlora*) *perviridis*, new species, is distinguished from its congeners and a new key to the species of the subgenus is provided. New locality data are recorded for two other *Ctenaugochlora*, *C. algeri* ENGEL and *C. perpectinata* (MICHENER), both recorded from Costa Rica and the latter from Bolívia. Males of *C. perpectinata* were captured at flowers of *Clethra lanata* M. MARTENS & GALEOTTI (Ericales: Clethraceae). Comments on color variation in *C. algeri* and other augochlorines are provided.

Key words: entomology, taxonomy, Hymenoptera, Anthophila, Halictidae, Neotropical.

INTRODUCTION

The Augochlorini are conspicuous bees distributed principally in the Neotropical region and are very species rich and abundant in many ecosystems. Despite the wide and generally ubiquitous occurrence of the tribe in the New World tropics, many groups remain poorly known and recent descriptions of new taxa are regularly being made at the specific (e.g. GONÇALVES & MELO 2008; SANTOS & SILVEIRA 2009; SMITH-PARDO &

GONZALEZ 2009; ENGEL & GONZALEZ 2009; ENGEL 2009a, b, c, GONÇALVES and ENGEL in press) and generic levels (e.g. ENGEL 2007; GONÇALVES 2010). This ongoing effort toward documenting the fauna is a valuable endeavor and forms the foundation for natural history and synthetic studies on Augochlorini.

Within the tribe, the genus *Caenaugochlora* MICHENER is noteworthy for its compound eyes which usually bear minute setae and for the modified male sterna. The genus is distributed from northern South America to México, where it is quite diverse. A new Bolivian record reported herein extends the genus greatly South in South America. Species of the genus are divided into two subgenera, *Caenaugochlora* s.s. with 18 known species and *Ctenaugochlora* EICKWORT with four described species (ENGEL 2000, 2009c; MOURE 2007, GONÇALVES & ENGEL in press). *Ctenaugochlora* is easily distinguished from *Caenaugochlora* s.s. owing to the carinate preoccipital ridge, inner metatibial spur densely pectinate with more than 10 long branches (excluding the rachis, *sensu* ENGEL 2009a), and basal area of the propodeum (a combination of the metapostnotum and basal portions of the propodeum) with strong striae radiating from the basal margin to the apex (ENGEL 2000). Unfortunately, nothing is known about the nesting biology of this subgenus, and floral records are scarce.

The aim of the present contribution is to describe a new species of *Ctenaugochlora* with a quite distinctive brilliant coloration, to provide new records for some of the included species, and a revised identification key.

SYSTEMATICS

Genus *Caenaugochlora* MICHENER
Subgenus *Ctenaugochlora* EICKWORT

Caenaugochlora (Ctenaugochlora) perviridis n. sp.

(Figs. 1, 3–6)

DIAGNOSIS

The new species can be most easily recognized by its uniformly brilliant metallic green coloration with brown to amber legs which is unique among the species of *Ctenaugochlora*. In addition, the combination of subantennal sulci that are gently bent inward near toruli, the golden pubescence, the unmodified mesoscutellum (not bigibbous), and the fine golden setae of the metasoma serve to distinguish *C. perviridis* n. sp. from other species in the subgenus.

DESCRIPTION

Female. Total body length 9.63 mm; forewing length 6.92 mm. Head slightly longer than wide (length 2.30 mm, width 2.23 mm); distal two-thirds of clypeus below lower tangent of compound eyes; upper interorbital distance 1.09 mm, lower interorbital distance 0.96 mm; compound eyes without distinct setae; frontal line carinate between antennal toruli to nearly one-third distance from antennal toruli to median ocellus, impressed line from that point onward; subantennal sulci gently bent inward near antennal

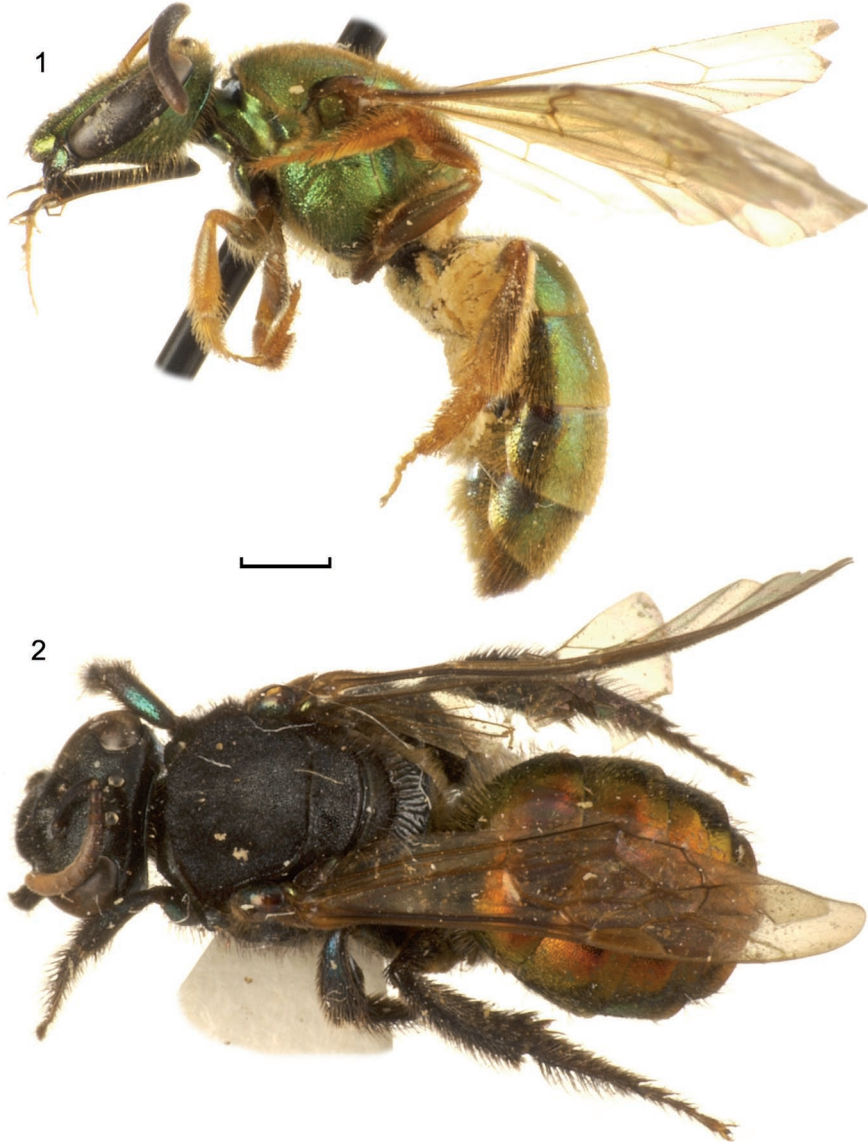
toruli. Mesoscutum with median and parapsidal lines strongly impressed; intertegular distance 1.90 mm; subpleural signum not tuberculate; mesoscutellum weakly and gently curved, not depressed medially or bigibbous. Forewing with basal vein distad cu-a by about four times vein width; 1rs-m confluent 1m-cu; 2rs-m distad 2m-cu by about 2.5 times crossvein width, 2rs-m weakly arched, not arcuate; first submarginal cell about as long as combined lengths of second and third submarginal cells as measured along posterior borders; first submarginal cell slightly narrowed anteriorly, anterior border of second submarginal cell along Rs slightly shorter than posterior border; anterior border of third submarginal cell along Rs about as long as anterior border of second submarginal cell, about 0.4 times as long as posterior border; distal hamuli arranged 3-1-1-2. Inner metatibial spur with 18 branches, not including apical portion of rachis.

Clypeus with coarse shallow punctures separated by less than a puncture width, integument between punctures colliculate blending to weakly imbricate apically; supraclypeal area with similar shallow punctures except faint (particularly medially and apically), separated by a puncture width, more dense along upper margin, nearly contiguous near antennal toruli, integument between punctures colliculate; integument of face bordering antennal toruli, supraclypeal area, and base of clypeus colliculate with shallow coarse punctures like those of supraclypeal area separated by a puncture width; remainder of face with small strong contiguous punctures, integument between (where evident) finely colliculate; punctures blending to colliculate in ocellocular area, upper parocular area, ocellocular area, and vertex with scattered shallow punctures separated by 1–3.5 times a puncture width, integument between finely colliculate; integument blending to finely imbricate on gena, with small punctures separated by 1–3 times a puncture width; integument blending to strongly imbricate ventrally on gena; postgena impunctate and strongly imbricate. Pronotum imbricate; mesoscutum and mesoscutellum with small contiguous punctures; metanotum weakly nodulate, between nodules integument colliculate; mesepisternum coarsely rugulose-punctate, integument strongly colliculate, punctures more well defined posteriorly and on anterior-facing surface of preepisternum; metepisternum with transverse striae on upper half, striae blending to finely imbricate ventrally, with small punctures separated by less than a puncture width; lateral and posterior surfaces of propodeum finely imbricate, basal area of propodeum with strong radiating striae that reach the apical border, integument between striae imbricate. Metasomal terga with minute punctures separated a puncture width, integument between punctures imbricate except punctures sparse and integument finely imbricate on anterior-facing surface of first metasomal tergum; metasomal sterna imbricate, with coarse shallow punctures separated by a puncture width or less on apical halves.

Head, mesosoma, and metasoma brilliant metallic green, with some golden highlights except mandible black; labrum and labiomaxillary complex dark brown except glossa and palpi light brown; scape amber brown ventrally and basally, otherwise remainder dark brown; pedicel and flagellum dark brown; tegula light brown except inner half brilliant metallic green; wing membranes hyaline, veins light brown except Sc+R dark brown; legs brown with metallic green highlights except procoxa brilliant metallic green and tarsi, protibia, and spurs amber; metasomal sterna dark brown with

strong metallic green highlights on apical halves although weaker on fifth sternum and faint on sixth sternum.

Pubescence typical for many Augochlorini, generally fine, scattered, and golden except fine, golden, subappressed to suberect setae of metasoma more numerous giving



1-2. Representative *Caenaugochlora* (*Ctenaugochlora*) species: 1 – lateral aspect of female holotype of *Caenaugochlora* (*Ctenaugochlora*) *perviridis* n. sp.; 2 – dorsal aspect of Costa Rican female of *C. (C.) algeri* ENGEL (SEMC); scale bar = 1.0 mm

the surface when viewed direct on a golden velvety appearance; some setae slightly more fuscous on apical metasomal terga and sterna.

Male. Unknown.



3-6. *Caenaugochlora* (*Ctenaugochlora*) *perviridis* n. sp., holotype female: 3 – facial aspect (scale bar = 1.0 mm); 4 – dorsal view of mesoscutum (scale bar = 0.5 mm); 5 – dorsal view of mesoscutellum, metanotum, propodeum, and anterior-facing surface of first metasomal tergum (scale bar = 0.5 mm); 6 – dorsal aspect of metasoma (scale bar = 1.0 mm)

HOLOTYPE

♀, Costa Rica: Cartago Prov., Refugio Nac. de Fauna Silvestre, Tapanti, 1 km E. Station, 1410m, 9°45.129' N, 83°46.936' W, 1 November 2001, R. Brooks, ex. on white flowers; deposited in the Division of Entomology, University of Kansas Natural History Museum, Lawrence, Kansas.

ETYMOLOGY

The specific epithet is a combination of the Latin terms *per* (meaning, “very”) and *viridis* (meaning, “green”) as a reference to the brilliant coloration.

***Caenaugochlora (Ctenaugochlora) algeri* ENGEL**

(Fig. 2)

Caenaugochlora (Ctenaugochlora) algeri ENGEL, 1995: 285.

NEW RECORDS

2♀♀, Costa Rica: La Virgen de Serapiquí, 20 May 1997 [one female with date reading only “1997”], Finca La Tirimbiria; deposited in the Division of Entomology, University of Kansas Natural History Museum, Lawrence, Kansas.

COMMENTS

The two females reported herein differ slightly in color from the original specimen. In both of the present specimens the metasomas are more strongly and uniformly golden and reddish-copper (with metallic golden-green highlights laterally) than that seen in the Panamanian holotype. In the holotype the metasoma is brilliant metallic gold with strong metallic green highlights laterally and metallic reddish-copper highlights apically. The metallic highlights of the head, mesosoma, and legs are largely identical to that of the holotype as are the structural and integumental details. Such minor color variation is unlikely to be of specific value as similar patterns are seen among other metallic bees where greenish-golden or bronzy specimens take on a more strongly reddish cast in some populations. For example, in *Euglossa gorgonensis* CHEESMAN and *E. bursigera* MOURE populations in Costa Rica are strikingly reddish in cast (subspecies *erythrophana* DRESSLER and *cupreicolor* MOURE, respectively) by comparison to those elsewhere which are more bronzy green (DRESSLER 1978). Similarly, in *E. villosa* MOURE Costa Rican and Panamanian populations are more distinctly reddish by comparison to populations in México (I.A. HINOJOSA-DÍAZ, pers. comm.).

Noticeable color variation exists elsewhere in *Caenaugochlora*. For example, the holotype of *C. (Ctenaugochlora) donnae* ENGEL is largely blue with strong purple and blue-green highlights while the American Museum of Natural History specimen reported by ENGEL (2000, pers. obs.) is more uniformly and more lightly blue, and the holotype of *C. (Caenaugochlora) elisabethae* ENGEL is strongly reddish purple while other specimens blend to more uniformly red (e.g., some of those in the Division of Entomology, University of Kansas and the American Museum of Natural History:

ENGEL 2000, pers. obs.). As more and more collecting is undertaken and larger series of these bees amassed over more localities it will be possible to fully characterize the ranges of color variation seen in several species of *Caenaugochlora* and other Augochlorini. Specimens of *Ariphanarthra palpalis* MOURE also show variation in color, with the mesosoma varying from metallic green to blue, and one nearly black individual collected by and in the collection of G.A.R. MELO (Brazil: Minas Gerais, Caratinga, 2 March 1993, Gabriel A.R. Melo // Faz. Montes Claros, 41°50'W, 19°45'S, em flor de *Solanum*; *visum* M.S.E. in 1996). Similarly, specimens of *Augochlorodes turrifaciens* MOURE from Minas Gerais are dark metallic green while the remainder has bluish highlights (GONÇALVES & MELO 2008). In *Pseudaugochlora*, *P. graminea* (FABRICIUS) specimens have an extreme color variation including bronzy, lilac, and reddish orange highlights (ALMEIDA 2008) and individuals of *P. sordicutis* (VACHAL) can be black or green even in the same nest as noted by EICKWORT (1967). For the present, the best known case of color variation for any augochlorine is the cline from brilliant metallic green to brilliant metallic blue observed in *Augochlora* (*Augochlora*) *pura* (SAY) along the eastern United States (e.g. MITCHELL 1960).

***Caenaugochlora* (*Ctenaugochlora*) *perpectinata* (MICHENER)**

Neocorynura perpectinata MICHENER, 1954: 83.

Caenaugochlora (*Ctenaugochlora*) *perpectinata* (MICHENER); EICKWORT 1969: 433.

NEW RECORDS

4♀, 1♂, Costa Rica: Cartago, P.N. Tapanti, 1150m, 9°45'41" N, 83°47'5" E [mislabelled, should be "W"], 18 July 2000, J. Ashe, R. Brooks, Z. Falin, ex: flowering tree; 3♂♂, Panamá: Panamá Prov., 8 km NW Capira, Cerro Campana, 1000m, on *Clethra lanata* [M. Martens & Galeotti (Ericales: Clethraceae)], 7 May 1981, R.W. Brooks; all deposited in the Division of Entomology, University of Kansas Natural History Museum, Lawrence, Kansas; 1♀, Bolivia, La Paz: \ Alto Río Beni, south \ of Río Inicua, 1100 m. \ January 15–18, 1976 \ L.E. Peña; deposited in the Division of Invertebrate Zoology, American Museum of Natural History.

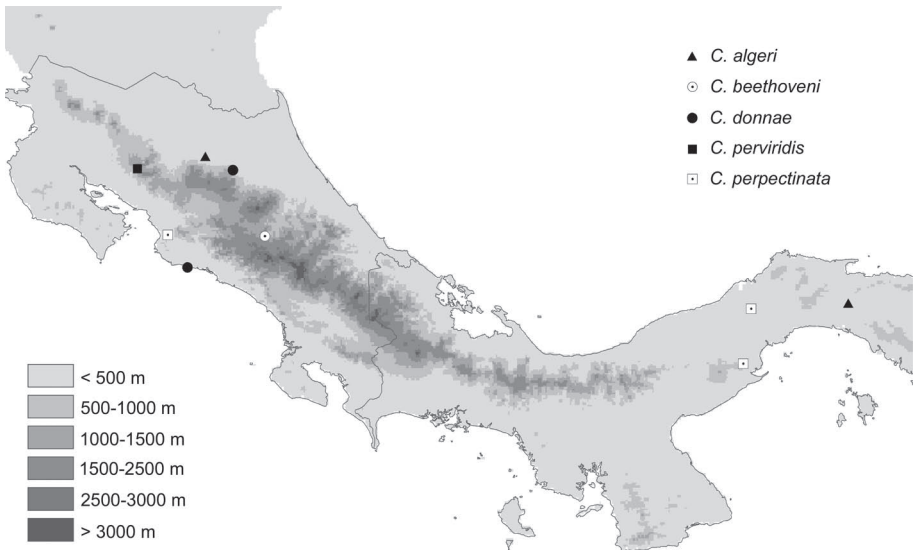
COMMENTS

The identity of the Bolivian specimen is certain and its conspecificity with the Costa Rican and Panamanian material is confirmed (GONÇALVES, pers. obs.). However, given the extreme distance between these localities (a distributional expansion of at least 2440 km!) and the placement of this specimen well outside of typical *Caenaugochlora* s.l. distribution, the possibility that it was mislabeled at some time in the past should be considered. For the present we accept this solitary record at face value, noting that future collecting in Bolivia and other South American countries will be needed in order to determine the veracity of this specimen and refine records for the group.

KEY TO SPECIES OF *CTENAUGOCHLORA*

The following key is modified from that of ENGEL (1995) and is for females only as males remain known only for *C. pectinata* and *C. donnae* (although for the latter the sole male specimen remains to be fully described and figured: specimen reported by ENGEL, 2000). Known countries of occurrence are summarized in parentheses for each species.

- 1. Head and mesosoma brilliant metallic in color 2.
- Head and mesosoma mainly black (sometimes with weak metallic highlights) ... 3.
- 2. Head and mesosoma brilliant metallic blue with strong metallic purple and blue-green highlights; metasoma dark reddish brown with strong metallic blue to purplish blue highlights; subpleural signum strongly tuberculate; mesoscutellum bigibbous (Costa Rica) *C. donnae* ENGEL
- Head and mesosoma metallic green; metasoma brilliant metallic green, with golden highlights; subpleural signum weakly tuberculate; mesoscutellum relatively flat, not bigibbous (Costa Rica) *C. perviridis* n. sp.
- 3. Metasoma black to dark reddish brown 4.
- Metasoma brilliant metallic gold with green-copper highlights to copper-red with green highlights (Costa Rica, Panamá) *C. algeri* ENGEL
- 4. Forewing with anterior margin darkly infumate, contrasting with remainder of wing membrane; integument between striae of basal area of propodeum shining and



7. Map of currently documented localities for species of *Caenaugochlora* (*Ctenaugochlora*) in Central America. A single record of *C. pectinata* (MICHENER) is also known from Bolivia (AMNH: refer to text)

- smooth to faintly imbricate; metasomal terga black, dorsal-facing surface of first metasomal tergum minutely and closely punctate (Bolivia, Costa Rica, Panamá)
 *C. perpectinata* (MICHENER)
- . Forewing uniformly hyaline to very faintly infumate; integument between striae of basal area of propodeum dull and coriaceous; metasomal terga dark reddish brown, dorsal-facing surface of first metasomal tergum strongly imbricate (Costa Rica)
 *C. beethoveni* ENGEL

NOTE

Dr. Matthias BUCK kindly informed the senior author while this paper was in proof stage of a single female of *C. perpectinata* in the collection of the Royal Alberta Museum, Edmonton. The locality information for this specimen is: Costa Rica: Alajuela, Cordillera Tilarán, Peñas Blancas, 700 m.

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