

Two New Species of the *strigatus* Species Complex of the Ant Genus *Cyphomyrmex* (Hymenoptera: Formicidae) from Costa Rica and Panamá

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Abstract.—The *strigatus* species complex is defined as those workers and females of *Cyphomyrmex* in which the preocular carina extends back to the vertex, delimiting the lateral margin of a depressed concave scrobe. The mandibles have 6 or more teeth and there is a single medial pronotal tubercle. The complex was previously reported only in South America, especially southeastern Brasil and northern Argentina. Two **new species** were found in Central America: *C. andersoni* from Costa Rica, and *C. snellingi* from Panamá. *Cyphomyrmex andersoni* resembles *C. quebradae*, but can be separated as the hind femur is longer than the head capsule (shorter in *C. quebradae*). It can be differentiated from the similar *C. bruchi* as the mesosomal tubercles are distinct (indistinct in *C. bruchi*). *Cyphomyrmex snellingi* has the frontovertexal corners lobate and somewhat projecting posteriad. It is most similar to *C. faunulus*, but can be easily distinguished as the anterior mesonotal tubercle is not more developed than the other tubercles (much larger than the others in *C. faunulus*).

Resumen.—El complejo *strigatus* del género *Cyphomyrmex* se caracteriza porque las hembras y obreras presentan una carina preocular que se extiende posteriormente hasta el vertex y delimita la margen lateral de un escrobo antenal deprimido y cóncavo. Estas hormigas poseen mandíbulas con 6 o más dientes, y un sólo tubérculo pronotal mesial. El complejo *strigatus* se conocía solo de Suramérica, especialmente el sureste de Brasil y norte de Argentina. Dos **nuevas especies** fueron halladas en América Central: *C. andersoni* de Costa Rica, y *C. snellingi* de Panamá. *Cyphomyrmex andersoni* es similar a *C. quebradae*, pero se diferencia porque el fémur posterior es más largo que la cápsula cefálica (más corto en *C. quebradae*). A su vez, *C. andersoni* puede ser diferenciada de *C. bruchi* porque los tubérculos mesosomales son distinguibles (no distinguibles en *C. bruchi*). *Cyphomyrmex snellingi* tiene las esquinas frontovertexales lobosas y algo proyectadas posteriormente. Esta especie es más similar a *C. faunulus*, de la cual puede ser distinguida fácilmente por el tubérculo mesonotal anterior no tan desarrollado.

The ant genus *Cyphomyrmex* belongs to the New World fungus growing ants of the tribe Attini, and presently contains 40 species (Bolton et al. 2007). The genus is divided into two species complexes, the *strigatus* complex (Kempf 1964) and the *rimosus* complex (Kempf 1965; Snelling and Longino 1992). *Cyphomyrmex* workers and females are easily recognized, as the frontal carinae form a shield on the dorsum of the

head, which covers most of the head. The mesosoma has a series of pairs of blunt tubercles in nearly all species. The first opisthogastral tergum* (see glossary in Serna and Mackay 2010) lacks tubercles. Most surfaces are dull and without sculpture; the hairs are mostly limited to appressed, often scale-like setae that are nearly always restricted to the gaster and the head.

Most species nest in the soil, in rotten logs and stumps, or in hollow dead twigs. This genus also nests under bark, under moss, and within epiphytic pseudobulbs (Snelling and Longino 1992). Colonies are small, probably not exceeding 500 workers (Snelling and Longino 1992). All *Cyphomyrmex* species cultivate badisiomycete fungi in the tribe Leucocoprineae. In the *C. rimosus* group, these fungi grow in a yeast form (small masses of unicellular fungal cells) rather than in the multicellular mycelial form typical for all other attine ant gardens (Schultz et al. 2002; Schultz and Brady 2008).

Workers of the *strigatus* complex can be recognized by the closed antennal scrobe (sometimes with poorly defined margins), mandibles with six or more teeth, and with a single medial pronotal tubercle (apparently a fusion of two tubercles). The species of the *strigatus* complex were previously considered to be primarily southern South American in distribution, although *C. faunulus* occurs as far north as Venezuela (Mayhé Nunes and Jaffé 1998). An unidentified species is found in Colombia (Fernández and Palacio 1995) and an apparently new species was found in Ecuador (Tiputini) by Kari Ryder Wilkie (<http://people.bu.edu/karitr/genus/cyphomyrmex.html>).

In comparison, the workers of the *rimosus* complex have an open antennal scrobe (anteriorly), with the preocular carina curved mesially in front of the eye, and not directed to the posterior corner of the head, the mandibles have five teeth, and the pronotum lacks medial tubercles, or has a pair of tubercles. The species of the *rimosus* complex are widely distributed from the United States to South America.

Two new species of the *strigatus* species complex were found in Costa Rica and Panamá. These new species will be included in a key to the species of *Cyphomyrmex* that can be found at <http://www.utep.edu/leb/antgenera.htm>.

METHODS AND MATERIALS

The specimens were examined with a Zeiss stereoscope, at 64X, and were measured with an ocular micrometer. The abbreviations are as follows:

HL	Head length, measured in full frontal view, from anterior margin of medial lobe of clypeus to medial posterior margin of frons
HW	Head width, measured in full frontal view, maximum width excluding eyes (Measured near posterior point of head)
SL	Scape length, excluding condyle
EL	Eye length, maximum diameter of eye
EW	Eye width, maximum width of eye, perpendicular to EL
WL	Weber's length, a diagonal line from the top of the anterior edge of the pronotum to the posterior edge of the posteropropodeal lobes.
CI	Cephalic index, $HW/HL \times 100$
SI	Scape index, $SL/HL \times 100$
OI	Ocular index, $EW/EL \times 100$
MCZC	Museum of Comparative Zoology, Harvard University
CWEM	Collection of William and Emma Mackay, University of Texas at El Paso

Terms followed by an asterisk are defined at the end of this paper and explained in the glossary of Serna and Mackay (2010).

RESULTS

Cyphomyrmex andersoni new species (Figs 1–6)

Diagnosis.—The worker is a small (total length about 2.5 mm, $n=2$) reddish-brown ant. The mandibles have six teeth, the frontal carinae do not reach the dorsad ocular suture, the frontovertexal* corners

are barely extended into auricle-like structures; the pronotum has three angulate processes or teeth, including the medial process and two lateral processes, together with a pair of posterior swellings, and the mesonotum has a pair of conical processes; the propodeum has a pair of anterior, blunt processes and two well-developed angulate posterior processes; and the posterior 1/3 of the petiole is raised into a blunt process that appears bidentate when seen obliquely from above; the postpetiole has two parallel raised regions on the dorsal surface; and the gaster lacks longitudinal raised areas. The posterior femur has a distinctive ventral angulate process, followed distally by a poorly defined carina.

The female and male are unknown.

Distribution.—Known only from the states of Alajuela and Guanacaste, Costa Rica.

Worker measurements (mm).—HL 0.76–0.78, HW 0.64–0.66, SL 0.58–0.60, EL 0.13–0.14, EW 0.08–0.10 WL 0.90–0.93. Indices: CI 84–85, SI 74–79, OI 65–73. Mandible with 6 teeth; anteclypeus broadly rounded; paraclypeal teeth* spiniform, moderately developed; frontal lobes and frontal carinae relatively narrow, extending to frontovertexal corner*, forming carina that fuses with posterolateral margin of antennal scrobe, preocular carina continues posteriorly to form mesial margin of antennal scrobe; eyes relatively small, extending past sides of head; scape relatively short, barely reaches frontovertexal corner; pronotum with medial protuberance, 2 lateral, conical tubercles and 2 posterolateral lobate processes, anteroinfra angle of lateropronotum developed; 2 angulate conical tubercles on mesonotum (height approximately 0.05 mm); anterior margin of dorsopropodeum with 2 broad processes (height 0.03 mm), dorsopropodeum* relatively short (0.08 mm from notopropodeal groove to highest point of anterior tubercles) posteropropodeum* longer (0.25 mm, measured from anterior tubercles to metapleural lobe), propodeal spines small

(length 0.04 mm) and rounded; petiole enlarged posteriorly, forming dorsal tubercles as seen in lateral view (length 0.1 mm, height 0.07 mm) that appears to have two lateral tiny bumps; postpetiole with longitudinal medial depression flanked by two longitudinal ridges; all femora swollen, fore femur with poorly developed longitudinal carina along posteroventral margin, middle femur similar, but carina poorly developed, posterior femur with well-developed longitudinal carina forming distinct angle distad about one third length from body.

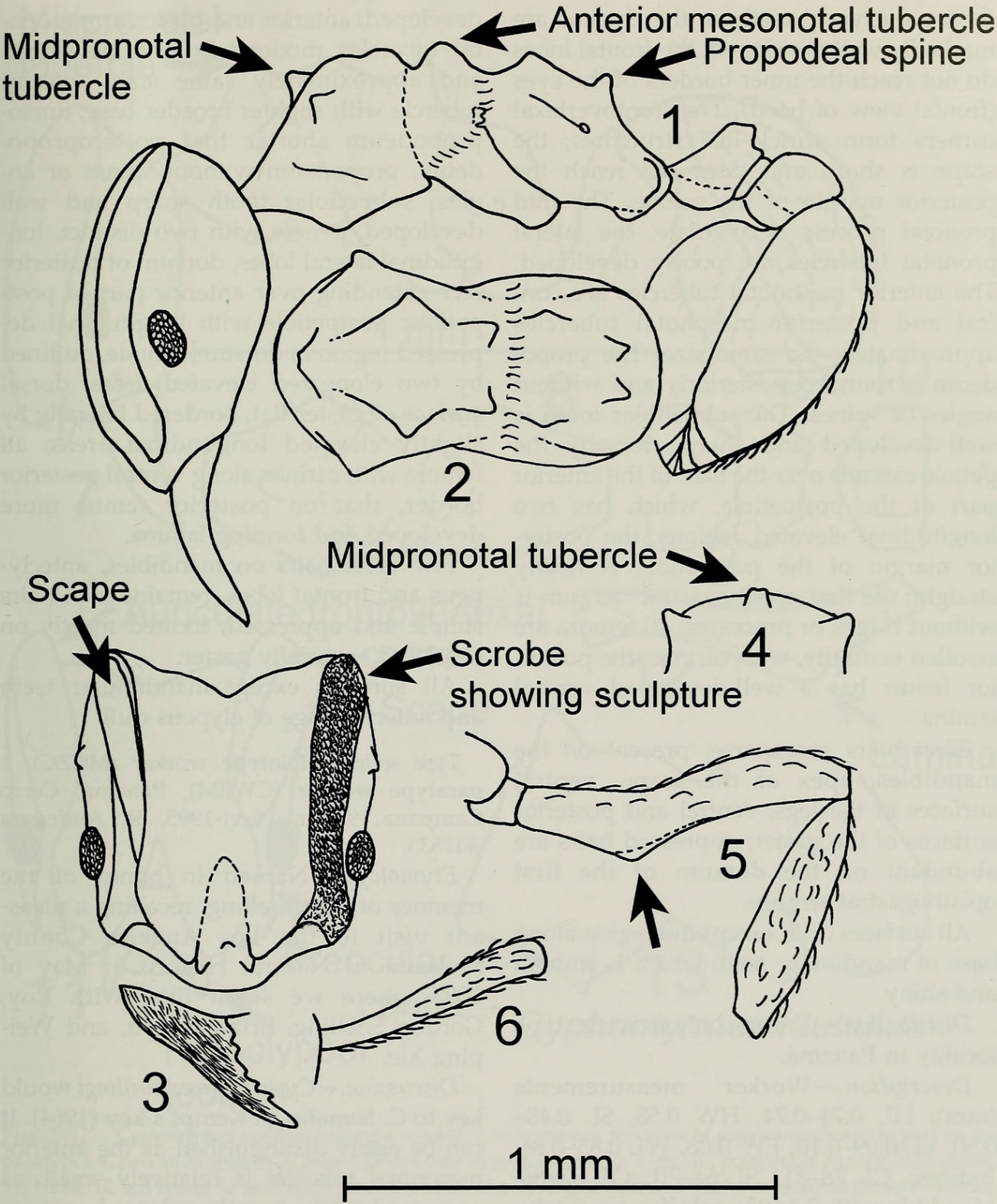
Erect hairs absent, except on mandible; hairs on scape and head appressed, hairs on ventral surface of head and anterior margin of procoxa subdecumbent, hairs on mesosoma, petiole, postpetiole, legs and gaster appressed.

Type series.—Holotype worker, Costa Rica, Alajuela, 27 km N and 8 km W west of San Ramón, 29-vi-6-vii-1999, R. Anderson # 19901, 99-109B, 10°13'30"N; 34°35'30"W (MCZC).

Additional material examined.—Costa Rica, Guanacaste, Cacao Field Station, 15-ii-1996, R. Anderson # 17682 (1 worker CWEM).

Etymology.—This new species is named in honor of Robert Anderson, who collected these specimens as well as thousands of other interesting specimens.

Discussion.—This species would key to *C. olitor* Forel in Kempf (1964), found in Brazil and Argentina. *Cyphomyrmex andersoni* is somewhat larger (HL of *C. olitor* 0.64, HW 0.56 from Kempf, 1964), has fewer mandibular teeth (7–8 in *C. olitor*), the midpronotal tubercle is approximately the same size as the lateral tubercles (midpronotal tubercle much smaller than lateral tubercles in *C. olitor*), and the propodeal spines are well developed (poorly developed in *C. olitor*). The mandibular teeth are worn and partially hidden by the clypeus in the holotype and badly worn in the mandible of the other specimen, but this species appears to be the only one of the *strigatus* species complex with six mandibular teeth (and as the members of the *rimosus* species complex



Figs 1–6. *Cyphomyrmex andersoni* holotype worker: 1, side view. 2, mesosoma as seen from above. 3, head and mandible, frontal views. 4, top of pronotum as seen from dorsoposterior view. 5, right posterior femur and tibia posterior aspect. 6, antennal scape.

all have five mandibular, it is apparently the only species in *Cyphomyrmex* with six teeth).

Biology.—The two specimens were collected in montane hardwood leaf litter at 1100–1200 m elevation and in wet montane forest litter.

Cyphomyrmex snellingi new species
(Figs 7–12)

Diagnosis.—The worker is a small (total length 2 mm) ferrugineous red specimen. The mandibles have seven teeth, the spini-

form paraclypeal teeth on the clypeus are markedly well developed; the frontal lobes do not reach the inner borders of the eyes (frontal view of head). The frontovertexal corners form auricle-like structures; the scape is short, and does not reach the posterior margin of the scrobe. The mid pronotal process is angulate, the lateral pronotal tubercles are poorly developed. The anterior mesonotal tubercles are conical and posterior mesonotal tubercles approximately the same size. The propodeum is rounded posteriorly and without angles or spines. The subpetiolar tooth is well-developed and sharp, dorsally the petiole extends over the base of the anterior part of the postpetiole, which has two longitudinal elevated regions, the posterior margin of the postpetiole is nearly straight; the first opisthogastral* tergum is without ridges or processes; all femora are swollen ventrally, with carinae, the posterior femur has a well-developed ventral lamina.

Erect hairs are sparse, present on the mandibles, apex of the scape, ventral surfaces of the legs, ventral and posterior surfaces of the gaster; appressed hairs are abundant on the dorsum of the first opisthogastral tergum.

All surfaces dull, except the region along base of mandibular teeth which is smooth and shiny.

Distribution.—Known only from the type locality in Panamá.

Description.—Worker measurements (mm): HL 0.71–0.74, HW 0.58, SL 0.48–0.50, EL 0.09–0.10, EW 0.08, WL 0.85–0.86. Indices: CI 78–81, SI 64–70, OI 82–86. Mandible with 7 teeth; spiniform paraclypeal teeth very well developed (length 0.07 mm), frontal carinae relatively narrowly spaced, not reaching preocular carina which forms mesiad margin of scrobe; eyes extending past sides of head, with about 20 ommatidia; scrobe greatly extending posteriorly, forming auricle-like structures; scapes not reaching posterior margin of scrobe; tubercles on pronotum poorly

developed; anterior and posterior mesonotal tubercles moderately well developed and approximately same size, anterior tubercle with slighter broader base; dorso-propodeum shorter than posteropropodeum, propodeum without spines or angles; subpetiolar tooth sharp and well developed, petiole with two distinct, longitudinal lateral lobes, dorsum of posterior face extending over anterior part of postpetiole; postpetiole with longitudinal depressed region in dorsum of node, outlined by two elongated elevated areas; dorsal surface of gaster flat, bordered laterally by slightly elevated longitudinal areas; all femora with carinae along ventral posterior border, that on posterior femur more developed and forming lamina.

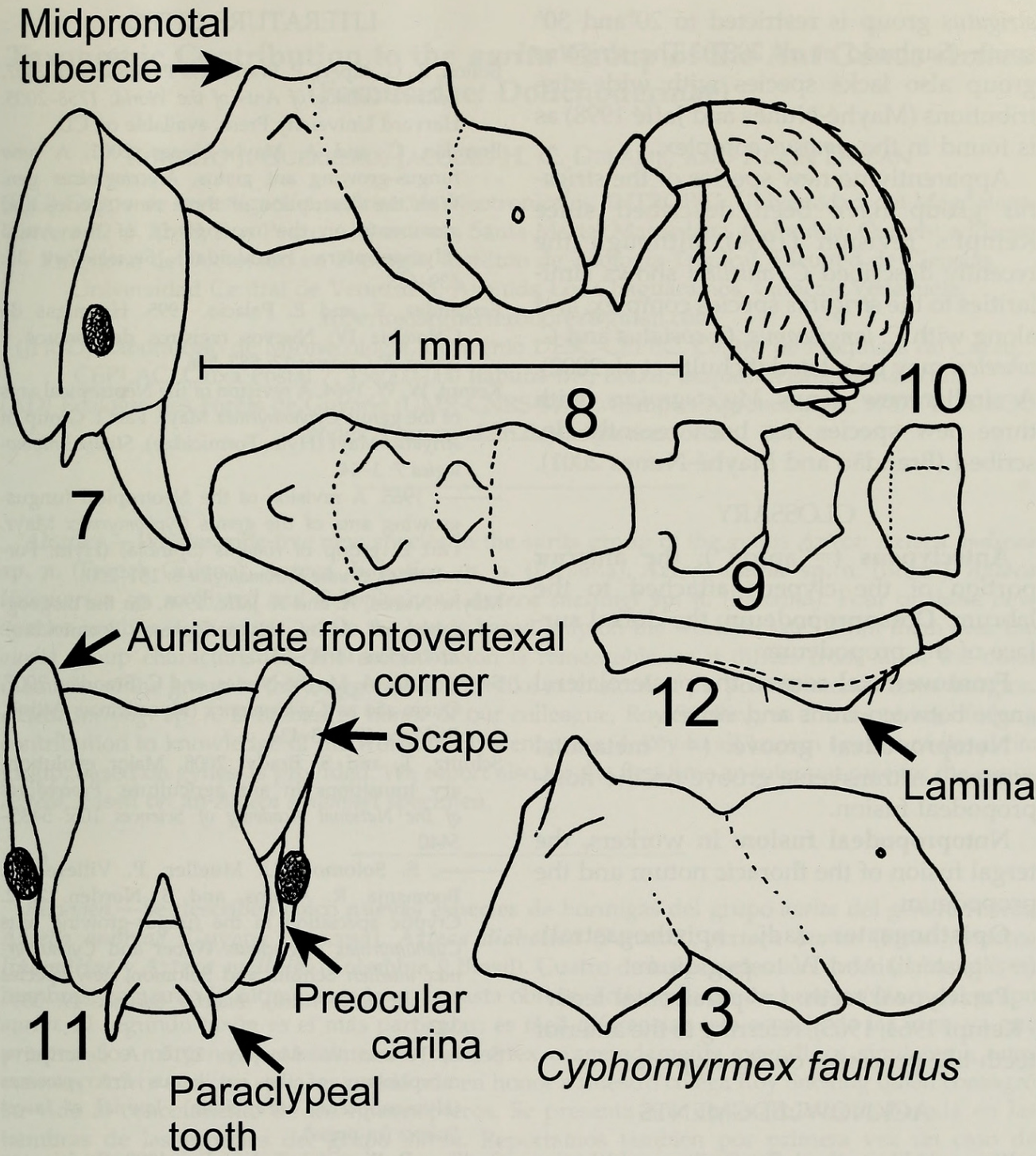
Few erect hairs on mandibles, anteclypeus and frontal lobes, remainder of hairs simple and appressed, located mostly on head and especially gaster.

All surfaces except mandibular teeth and anterior edge of clypeus dull.

Type series.—Holotype worker (MCZC), 1 paratype worker (CWEM), Panamá, Cerro Campana, 950 m, 5-vi-1995, R. Anderson #17833.

Etymology.—Named in honor of the memory of Roy Snelling, recalling a pleasant visit to the Los Angeles County Museum of Natural History in May of 2007 where we spent time with Roy, Gordon Snelling, Brian Brown, and Weiping Xie.

Discussion.—*Cyphomyrmex snellingi* would key to *C. faunulus* in Kempf's key (1964). It can be easily distinguished as the anterior mesonotal tubercle is relatively small, as compared to the greatly enlarged anterior mesonotal tubercle of *C. faunulus* (Fig. 13). Additionally, the posterodorsal edge of the petiole of *C. faunulus* does not extend over the anterior face of the petiole as it does in *C. snellingi*. *Cyphomyrmex faunulus* also lacks the erect hairs on the frontal lobes. Although it would key to *C. faunulus*, the two species do not appear to be morphologically similar.



Figs 7–12. *Cyphomyrmex snellingi* holotype worker: 7, side view. 8, top view of mesosoma (based in part on the paratype). 9, petiole as seen from above, postpetiole as seen in anterior view. 10, postpetiole as seen from above. 11, Head. 12, left femur as seen from posterior view. Fig. 13, *Cyphomyrmex faunulus* mesosoma (Reserva Ducke, near Manaus, Amazonas, Brasil, LACM).

Biology.—The type series was collected in a leaf litter extraction from a wet montane habitat.

DISCUSSION

The genus *Cyphomyrmex* is divided into two species complexes, the *rimosus* complex and the *strigatus* species complex. The

strigatus complex uses only mycelium cultivars and is probably plesiomorphic and paraphyletic to the *rimosus* complex (Schultz et al. 2002).

Cyphomyrmex has two centers of species richness: the *rimosus* group at about 10° north (Mayhé-Nunes and Jaffé 1998), whereas the majority of the species of the

strigatus group is restricted to 20° and 30° south (Sanhudo et al. 2007). The *strigatus* group also lacks species with wide distributions (Mayhé-Nunes and Jaffé 1998) as is found in the *rimosus* complex.

Apparently no new species of the *strigatus* group have been described since Kempf's revision (1964), although the recently described *C. muelleri* shows similarities to the *strigatus* species complex, and along with *C. longiscapus*, *C. costatus* and *C. wheeleri* may be related (Schultz et al. 2002). A similar new genus *Mycetagroicus*, with three new species has been recently described (Brandão and Mayhé-Nunes 2001).

GLOSSARY

Anteclypeus (= "apron"): the anterior portion of the clypeus attached to the labrum. **Dorsopropodeum**: the dorsal surface of the propodeum.

Frontovertexal corner: the posterolateral angle between frons and vertex.

Notopropodeal groove: (= "metanotal groove") a transverse groove on the notopropodeal fusion.

Notopropodeal fusion: In workers, the tergal fusion of the thoracic notum and the propodeum.

Opisthogaster (adj. opisthogastral): (= "gaster") Abd IV to pygidium.

Paraclypeal teeth: (= "parafrontal teeth" - Kempf 1964, 1965), referring to the anterior teeth-like processes on the clypeus.

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