Zootaxa 1141: 1–54 (2006)
www.mapress.com/zootaxa/

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

1141

A taxonomic review of the genus *Myrmelachista* (Hymenoptera: Formicidae) in Costa Rica

JOHN T. LONGINO
The Evergreen State College, Olympia, Washington 98505. E-mail: longinoj@evergreen.edu

Table of contents

Accepted by J. Pitts: 2 Feb. 2006; published: 8 Mar. 2006

Abstract

The Costa Rican fauna of the genus *Myrmelachista* is reviewed. *Myrmelachista* is a poorly-known lineage of Neotropical arboreal ants. Although a few are conspicuous surface foragers, the majority have cryptic habits, nesting in live stems of plants and rarely foraging on the surface. Fourteen species are reported, of which the following ten are described as new: *M. flavocotea, flavoguarea, haberi, joycei, lauroatlantica, lauropacifica, longiceps, meganaranja, nigrocotea,* and *osa*. *Myrmelachista costaricensis* Wheeler is synonymized under *M. plebecula* Menozzi, and *M. zeledoni thiemi* is synonymized under *zeledoni*. The enigmatic *M. cooperi*, previously known from a single alate queen, is rediscovered and the worker and male described. Keys to workers, queens, and males are provided. *Myrmelachista* species have either 9 or 10-segmented antennae, with most of the 9-segmented forms concentrated in Central America and the Caribbean, and the 10-segmented forms concentrated in South America. The taxonomic status of all the 9-segmented forms is discussed.

Key words: *Myrmelachista*, Costa Rica, Formicidae, key to species

Resumen

Se revisa la fauna Costaricense del genero *Myrmelachista*. *Myrmelachista* es un linaje poco conocido de hormigas neotropicales arborícolas. Aunque algunas especies forrajean en la superficie y son conspicuas, la mayoría presenta hábitos crípticos, anidando en tallos vivos y rara vez forrajeando en la superficie. Se informan 14 especies, con las siguientes 10 descritas como nuevas: *M. flavocotea, flavoguarea, haberi, joycei, lauroatlantica, lauropacifica, longiceps, meganaranja, nigrocotea,* y *osa*. *Myrmelachista costaricensis* Wheeler es sinonimizada bajo *M. plebecula* Menozzi, y *M. zeledoni thiemi* es sinonimizada bajo *zeledoni*. La enigmática especie *M. cooperi*, anteriormente conocida de una sola reina alada, es redescubierta y se describen la obrera y el macho. Se proveen claves para obreras, reinas, y machos. Especies de *Myrmelachista* tienen 9 o 10 segmentos antenales. Las formas con 9 segmentos son concentradas en America Central y El Caribe, y las formas con 10 segmentos son concentradas en Sudamérica. Se discuten la taxonomía de todas las especies de *Myrmelachista* con 9 segmentos antenales.

Introduction

Within the ants a number of lineages have developed exquisitely arboreal habits, nesting entirely within plant cavities and with specialized morphology and behavior for doing so. Species within these clades often show a range of specialization, being generalist inhabitants of dead stems, generalist inhabitants of live stems, or specialist inhabitants of live stems. The third group is often involved in obligate associations with particular lineages of plants and is particularly important in the study of mutualism (Davidson & McKey 1993). Species-level taxonomic work on stem-nesting ants can act in a synergistic way with studies of the community and evolutionary ecology of ant-plant associations and

is particularly important for this reason.

Among these stem-nesting ants is the formicine genus *Myrmelachista*. This group of ants is confined to the Neotropics and is exclusively arboreal. They are inconspicuous and have been little studied, but there are hints from the literature that they are far richer and with more complex plant associations than previously suspected. Early literature contained scattered reports of South American *Myrmelachista* inhabiting ant-plants (reviewed in Bequaert 1922, Wheeler 1942). *Myrmelachista nigella* Roger and *M. schumanni* Emery were reported in internodes of *Duroia hirsuta* (Rubiaceae) (Ule 1907–1908, Schumann 1889). More recent reports have described "devil's gardens" in South America, in which large polygynous colonies of *Myrmelachista* occupy monospecific patches of understory *Duroia* and *Tococa* (Melastomataceae) (Morawetz et al. 1992, Svoma & Morawetz 1992, Renner & Ricklefs 1998, Frederickson et al. 2005). These patches stand out in the typically dense and diverse understory vegetation as peculiar zones of a single plant species with bare earth beneath them and a ring of bare soil around the perimeter. These patches are created and maintained by the ants, which attack and kill foreign vegetation by spraying it with formic acid, which acts as an herbicide (Morawetz et al. 1992, Renner & Ricklefs 1998, Frederickson et al. 2005).

The first indication of something interesting in Central American *Myrmelachista* was Stout's (1979) observation of a tight association between an unidentified *Myrmelachista* and an understory tree species in the genus *Ocotea* (Lauraceae). She examined 50 plants of *Ocotea* "*pedalifolia*" (probably a mix of *O. atirrensis* and *O. dendrodaphne* [Hammel 1986]) at the La Selva Biological Station, and found the stems of 49 of them inhabited by *Myrmelachista*. Since then little has been written about the association, although floristic works on the Lauraceae recognize that various species are routinely occupied by ants (Hammel 1986, Burger & van der Werff 1990). Ibarra-Manríquez and Dirzo (1990) reported the same phenomenon at the Los Tuxtlas Biological Station in Veracruz, Mexico. My studies of *Myrmelachista* in Costa Rica reveal that these observations are just the beginning and that there is a largely overlooked community of Central American *Myrmelachista* and their associated plants.

Throughout Costa Rica the understory of mature wet forests have high densities of plants that are associated with multiple species of *Myrmelachista*. Cloud forests likewise have high densities of *Myrmelachista* living in live stems, but they are more abundant in the canopy than in the understory. Many of these species nest entirely inside of live stems and rarely venture out onto the surface, and the plants they inhabit show no external signs of specialization for ant occupation. There are no preformed domatia, no food bodies, and no extrafloral nectaries. The result is a lineage of ants that in spite of being species-rich and very abundant is almost never collected. Many of the species reported here had never been collected prior to my work in Costa Rica, much less receiving any formal taxonomic treatment.

This paper is a taxonomic review of the genus *Myrmelachista* in Costa Rica. This

regional taxonomy will (1) encourage and facilitate study of ant-plant relationships in the genus, (2) contribute to Costa Rica's national biodiversity inventory, and (3) inform and guide surveys of *Myrmelachista* in other parts of the Neotropics.

Generic placement and diagnosis

Bolton (2003) placed *Myrmelachista* in the tribe Plagiolepidini, in the lasiine tribe group. The diagnosis for the tribe group included (1) widely separated metacoxae and (2) the petiolar foramen long, extending to or beyond the anteriormost points of the metacoxal cavities. The diagnosis for the Plagiolepidini included (1) the petiolar node inclined anteriorly, or with a long posterior peduncle, or both; and (2) the base of abdominal segment III with complete tergosternal fusion on each side of the helcium, with the free tergite and sternite commencing some distance up the sclerite, well away from the helcium. Ants of the genus *Myrmelachista* can be distinguished from other plagiolepidines by having a 9 or 10-segmented antenna with a 3 or 4-segmented club. Other genera have the antenna with more than ten segments and/or the funiculus filiform or gradually thickening toward the apex (Bolton 2003). Other plagiolepidine genera with 9 or 10-segmented worker antenna are *Aphomomyrmex*, *Brachymyrmex*, and *Petalomyrmex*. Although Bolton (2003) listed 6,4 as the palpal formula for *Myrmelachista*, some of the species reported here have 5-segmented maxillary palpus.

The taxonomic history of the genus *Myrmelachista* is covered amply by Bolton (2003). Briefly, Roger (1863) described two genera, *Myrmelachista* and *Decamera*, that differed in number of antennal segments, nine in the former and ten in the latter. *Decamera* was a junior homonym and was changed to *Hincksidris* by Donisthorpe (1944). *Hincksidris* (earlier as *Decamera*) was placed as a subgenus of *Myrmelachista* by various authors and ultimately synonymized under *Myrmelachista* (Snelling & Hunt 1976).

There are 69 available names in the genus, of which only six are currently junior synonyms (Bolton 1995). Although it was recognized that the number of antennal segments could not be relied upon to reveal monophyletic taxa and that the division of *Myrmelachista* into two groups was artificial (Brown 1973, Snelling & Hunt 1976), number of antennal segments is stable within species and there is geographic patterning with respect to the abundance of one form versus the other. Among the 63 valid species-group taxa, 17 have workers with 9-segmented antenna and 46 have workers with 10-segmented antenna. The 9-segmented forms are mostly concentrated in Central America and the Caribbean, with only two known from South America. The 10-segmented forms are mostly from South America, with only 3 from Central America and Mexico.

Methods

Observations were made at 50x or 63x magnification with a dissecting microscope. Most measurements were made with a micrometer stage with digital output in increments of 0.0001mm. However, variation in specimen orientation, alignment of crosshairs with edges of structures, and interpretation of structure boundaries resulted in measurement accuracy to the nearest 0.01 to 0.005mm, depending on sharpness of the defined boundary. When measuring worker sizes, larger workers of a series were haphazardly selected. Only one worker from a colony series was measured, and when a species was known from multiple localities, workers were selected from different localities. All measurements are presented in mm.

The following terminology and abbreviations are used:

HL: head length in full face view; perpendicular distance from line tangent to rearmost point of vertex margin to line tangent to anterior most projection of clypeus (either laterally near mandibular insertion or median lobe, depending on which extends further), not including anteromedian denticle if present.

HW: head width; in full face view, maximum width of head capsule **above eyes** (not including eyes if they project beyond border of head capsule).

SL: scape length; length of scape shaft from apex to basal flange, not including basal condyle and neck.

EL: eye length, measured along maximum diameter.

OW: width of median ocellus.

OD: distance between inner margins of lateral ocelli.

CI: cephalic index; 100*HW/HL.

OI: ocular index; 100*EL/HW.

OcI: ocellar index, 100*OW/HL.

Collections are referred to by the following acronyms:

BMNH: The Natural History Museum, London, U.K.

INBC: Instituto Nacional de Biodiversidad, Costa Rica.

DEIC: Deutsches Entomologisches Institut, Eberswalde Finow, Germany.

JTLC: John T. Longino, personal collection, Olympia, WA, USA.

LACM: Los Angeles County Museum of Natural History, Los Angeles, CA, USA.

MCSN: Museo Civico de Storia Naturale "Giacomo Doria," Genoa, Italy.

MCZC: Museum of Comparative Zoology, Cambridge, MA, USA.

MHNG: Muséum d'Histoire Naturelle, Geneva, Switzerland.

UCDC: University of California, Davis, CA, USA.

USNM: National Museum of Natural History, Washington, DC, USA.

In lists of material examined, all specimens are deposited at JTLC unless otherwise

indicated. Specimens in the Longino collection will eventually be distributed to research collections, most likely INBio and LACM. Locality data are from a specimen database in which locality data may be inferred from label data and may not always be faithful renditions of the label (*e.g.*, inferred latitude and longitude; locality name variants, etc.).

All new species names in this work are nouns in apposition or genitive nouns and thus invariant (ICZN 1999, article 31). All holotypes and paratypes associated with the new species described here have unique specimen-level identifiers affixed to each pin, and these specimen codes are listed in each species description. These are not to be confused with collection codes, which are "lot numbers" associated with particular collection events. Many different specimens may share the same collection code. Species accounts are provided with a diagnosis. There are not separate diagnoses for workers, queens, and males; the diagnosis is the combination of worker, queen, and male characters that together most easily distinguish the species.

Worker characters

Workers show a great deal of plasticity and are not easily separated to species. There is inter- and intracolony size variation, and larger workers tend to exhibit more differences among species than small workers.

The only sharply defined character with two discrete states is the number of antennal segments: 9 or 10. All other characters are continuous, with each species showing a mean and a variance, overlapping with similar species, but not encompassing the entire range of variation. The maxillary palpus may be 5-segmented, 6-segmented, or both (Fig. 1). In some cases the terminal palpomere is elongate and there is a slight constriction in the middle, suggesting partial fusion of the terminal two palpomeres. In some cases within a species (e.g., *plebecula*) colonies with small workers have 5 segments, colonies with larger workers have 6. There are occasional individual specimens with one 5-segmented palpus and one 6-segmented palpus.

Mandible sculpture varies from smooth and shining to coarsely punctatorugose.

Pilosity patterns are quite variable but show trends within species. In full face view, pilosity on the side and rear margins may be sparse or abundant, very short or longer, about the length of the first funicular segment, fully appressed to suberect. Among the Costa Rican species pilosity on the scapes is always abundant and suberect to subdecumbent, and I have not found it useful for identification. The pilosity on the outer margin of the hind tibia is always present as a covering of short setae of relatively uniform length, with variable presence of longer setae projecting above them. The setae may look rather uniform and short, with length about 1/4 width of tibia, or they may be longer and somewhat more irregular, the longer setae being 1/2 to 3/4 tibia width. The setae may be fully appressed to suberect.

Color is a useful character (Fig. 2). A set of seven species that have become obligate inhabitants of live stems of particular species of Lauraceae and Meliaceae have a uniform light yellow orange color, with variable development of infuscated bands on the gastral

terga. Six species that are more generalized in their nesting habits and more often forage on the surface have largely brown coloration, with variable development of mottling of the mesosoma. Problematic cases are when workers are bicolored, with light colored head and mesosoma and dark colored gaster. *Myrmelachista plebecula*, one of the surface foraging species, can approach the coloration of the some of the yellow species.

I have rarely found useful characters in the shape of the mesosoma or petiole, although the species with 10-segmented antenna have a stronger hourglass shape, with strong constriction at the metanotal groove (Fig. 2).

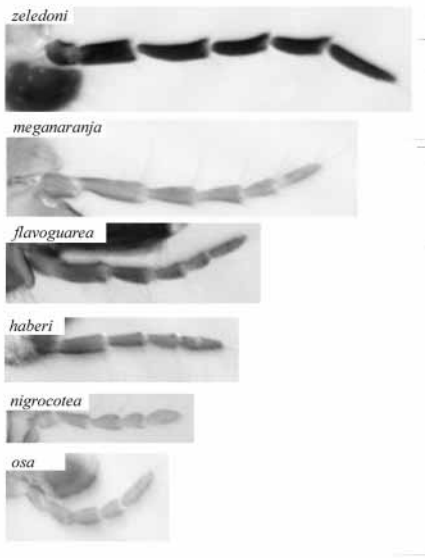

FIGURE 1. Examples of *Myrmelachista* worker maxillary palpi, showing reduction from 6 to 5 segments.

Queen characters

Queens are often more powerful differentiators of species than workers. The meristic, sculptural, and pilosity characters discussed for workers also apply to queens. Color is a valuable character, often sharply separating species when worker color does not. For example, the species that are specialist inhabitants of *Ocotea* and *Guarea* all have relatively uniform yellow workers, yet the queens differ dramatically in color, being either solid orange, solid black, or bicolored. Details of queen head size, head shape, and ocellus size are important for differentiating species.

Male characters

Males vary somewhat in the relative size of the ocelli, but the primary differences are in the genitalia (Fig. 3). Terminology follows Snodgrass (1941). The pygostyles are small setose papillae projecting from beneath the posterior margin of the 8th abdominal tergite. These may be present and easily visible or variously reduced to near invisibility or

absence. The basiparamere is always present and large. It usually has a pronounced dorsal lobe that is similar to but shorter than the paramere. It varies from broadly triangular and blunt to long, thin, and needle-like. In the smallest males the lobe may be very short or absent. The paramere is articulated to the basiparamere and is always present and elongate, sometimes broad at the base and tapering to a blunt point, or broad and parallel at the base and then tapering to a blunt point (looking like a seal head in profile), or long and thin with somewhat parallel sides, tapering to a point at the end. Internal to the paramere is the volsella, comprising two parts, the cuspis and the digitus. The cuspis is external to the digitus and closely applied to the inner wall of the paramere. The relationship of cuspis to digitus is somewhat like human thumb to clasped fingers. The cuspis is always shorter than the digitus and may be widely separated from it or with the apex converging on the dorsal margin of the digitus. The cuspis may be large, heavily sclerotized, and paddle shaped. From this state it shows reduction to a thin rectangular strip, to a small pointed needle-like structure, to a tiny triangular remnant fused to the inner margin of the paramere, and finally to completely absent. The digitus varies a great deal in shape, from a short, sharply down-turned triangle, to a long tapering blade, to a scimitar-shaped blade that becomes broader toward the apex before narrowing, to a blunt paddle-shaped structure. Internal to the volsella is the aedeagus, comprising two penial valves. The penial valve has an anterodorsal apodeme, a broad and elongate blade, and a posterior upturned tooth. The apodeme may meet the dorsal margin of the blade at nearly a right angle, resulting in a strongly upturned aedeagus relative to the main axis of the abdomen, or the apodeme may gently curve into the dorsal margin and project back at an obtuse angle, such that the aedeagus is not as strongly upturned in side view.

FIGURE 2. *Myrmelachista* workers. A. *zeledoni*. B. *joycei*. C. *flavocotea*. D. *plebecula*. Scale applies to entire figure.

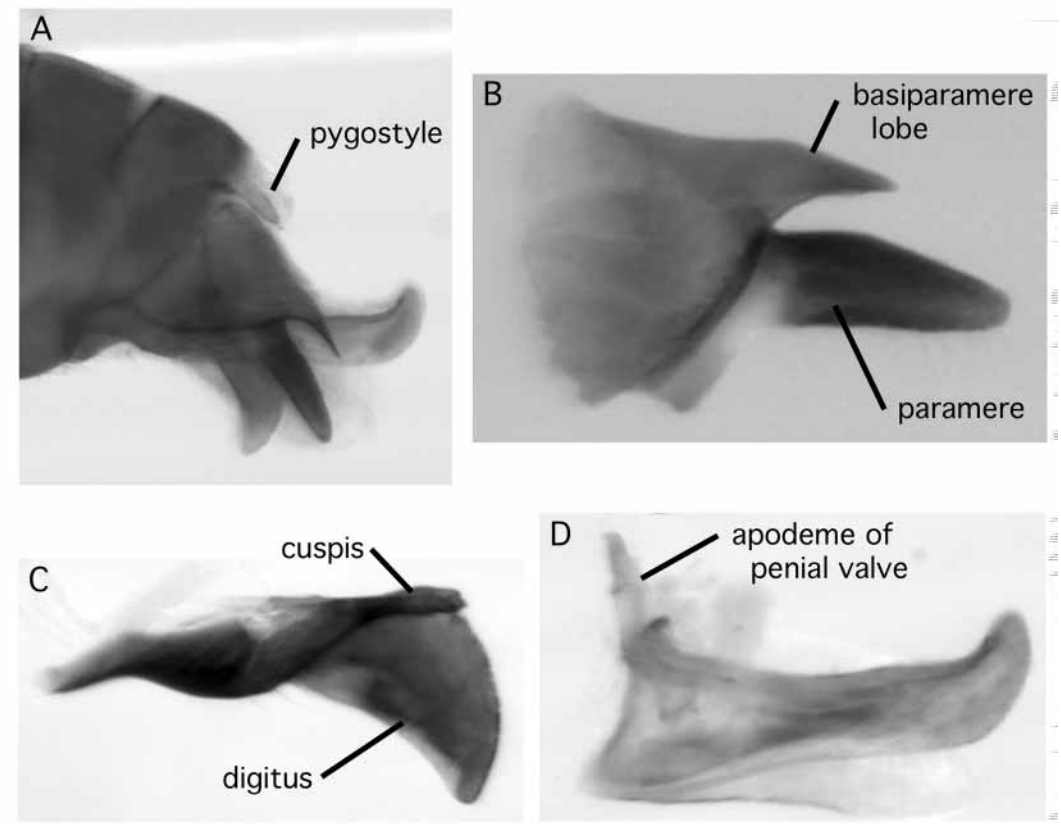

FIGURE 3. Male genitalia of *Myrmelachista*. A. Lateral view of male abdomen, showing undissected genitalia. B-D are dissected structure in same orientation and in order from outer to inner. B. Basiparamere and paramere. C. Volsella, a three-dimensional structure with cuspis external to digitus. D. Penial valve. A, B, D: *joycei*; C: *nigrocotea*.

Within species there is variation in degree of sclerotization of males, accompanied by variation in the size and robustness of genitalic elements. Less heavily sclerotized males also seem to have narrower and shorter basiparamere lobes, parameres, and volsellae. The variation is primarily among colonies and variation within colonies is low. The cause of high inter-colony variation is unknown. It could be due to ontogenetic changes in synchronous batches of males, intraspecific variation that is either genotypic or phenotypic, or evidence of cryptic species.

Taxonomic synopsis, Costa Rica fauna

M. cooperi (Gregg 1951). Costa Rica.
M. flavocotea **NEW SPECIES**. Costa Rica.
M. flavoguarea **NEW SPECIES**. Costa Rica.

M. haberi **NEW SPECIES**. Costa Rica.
M. joycei **NEW SPECIES**. Costa Rica.
M. lauroatlantica **NEW SPECIES**. Costa Rica.
M. lauropacifica **NEW SPECIES**. Costa Rica.
M. longiceps **NEW SPECIES**. Costa Rica.
M. meganaranja **NEW SPECIES**. Costa Rica.
M. mexicana Wheeler 1934. Mexico, Costa Rica.
M. nigrocotea **NEW SPECIES**. Costa Rica.
M. osa **NEW SPECIES**. Costa Rica.
M. plebecula Menozzi 1927. Costa Rica, Ecuador. = *costaricensis* Wheeler 1934. Costa Rica. **NEW SYNONYM**
M. zeledoni Emery 1896. Nicaragua, Costa Rica, Colombia, Venezuela, Peru. = *thieme* Emery 1906. Venezuela. **NEW SYNONYM**

Key to workers (costa rica)

1. Antenna with 10 segments; mesosoma strongly hourglass-shaped, with strong constriction at metanotal groove (Fig. 2); color dark brown to black 2
- Antenna with 9 segments; mesosoma not strongly hourglass-shaped, moderately constricted at metanotal groove; color variable, from yellow orange to red brown to black..... 3
2(1). Surface of head and mesosoma shagreened; HW greater than 0.50mm..... *zeledoni*
- Surface of head and much of mesosoma smooth and shiny; HW less than 0.48mm. ..... *mexicana*
3(1). Color nearly uniform light yellow orange or with some degree of infuscation on gaster (Fig. 2C); if clearly bicolored with orange head and mesosoma and dark gaster, pubescence on sides of head and on hind tibia usually abundant, suberect, OI usually less than 22..... ..4
- Color black to red brown, usually either uniform red brown or with dark head and gaster and mottled light and dark brown mesosoma (Fig. 2B); if clearly bicolored, pubescence on sides of head very sparse and fully appressed, pilosity on hind tibia fully appressed, and OI greater than 21 10
4(3). Maxillary palpus always 6-segmented; HW of larger workers usually greater than 0.65mm. 5
- Maxillary palpus always 5-segmented; HW of larger workers usually less than 0.65mm (the following set of species cannot be reliably distinguished with workers but can be differentiated with queens). 6
5(4). Infuscation of gastral tergites weak, confined to posterior third or less of tergites; nests in live stems of various plants in southern mountains of Costa Rica .... *meganaranja*

- Infuscation of gastral tergites more extensive, dark brown and covering 2/3 or more of tergite; nests in one species of understory *Guarea* in Cordillera de Tilarán, Costa Rica. ..*flavoguarea*

6(4). Gastral tergites completely yellow, without posterior band of infuscation; hind tibia with suberect pilosity ...7

- Gastral tergites with variably developed infuscated band posteriorly; hind tibia with suberect or appressed pilosity. ..8

7(6). Head of larger workers relatively broad (Fig. 4), CI 98–103; Atlantic slope ... *flavocotea*

- Head of larger workers relatively narrow, CI 87–95; southern Pacific slope ... *lauropacifica*

8(6). Hind tibia with pilosity fully appressed. ..*nigrocotea*

- Hind tibia with pilosity subdecumbent to suberect ...9

9(8). Side of head with projecting erect setae, the longest of which are similar in length to length of first funicular segment; Atlantic slope. ... *lauroatlantica*

- Side of head with projecting setae subdecumbent, very short, much shorter than length of first funicular segment; montane areas and southern Pacific lowlands ... *haberi* and *osa*

10(3). Color solid black; clypeus bulging; mandible with teeth 4 and 5 (counting from apex) separated by a wide diastema, teeth 1–4 more closely and evenly spaced; HW of larger workers 0.75mm or greater ... *cooperi*

- Color variable; clypeus not strongly bulging; mandible without diastema between teeth 4 and 5, all 5 teeth relatively evenly spaced; HW of larger workers usually less than about 0.70mm ...11

11(10). Head relatively elongate and subrectangular (Fig. 5), CI 89–95; mandible punctatorugose; sides of head with pubescence sparse and very short, subdecumbent to fully appressed ... *longiceps*

- Head relatively shorter, often somewhat cordate, CI 92–107; mandible usually smooth and shining; pubescence on side of head variable, from sparse and fully appressed to abundant and suberect (workers of *plebecula* and *joycei* cannot always be distinguished). ..12

12(11). Often bicolored, with light red brown head and mesosoma, dark gaster, but may have same coloration as *joycei*; pubescence on side of head usually sparse, short, fully appressed; pilosity on hind tibia usually appressed; eyes relatively larger, OI 22–25; HW of larger workers usually less than about 0.53mm (Fig. 5)..*plebecula*

- Never bicolored (except nanitics), head and gaster dark brown, mesosoma variably mottled light and dark red brown; pubescence on side of head and hind tibia subdecumbent; eyes relatively smaller, OI 19–21; HW of larger workers often greater than 0.53mm. ..*joycei*

Key to queens (Costa Rica)

1. Antenna with 10 segments; color dark brown to black.. 2
- Antenna with 9 segments; color variable, from yellow orange to red brown to black.. 4
2(1). Mandible strongly falcate; head dorsoventrally flattened.. ..... *.cooperi*
- Mandible subtriangular with differentiated basal and masticatory margin; head not strongly dorsoventrally flattened. 3
3(2). Face weakly roughened or sericeous, not strongly shining; HW greater than 0.8mm ..... *.zeledoni*
- Face smooth and shiny; HW less than 0.6mm..... *.mexicana*
4(1). Head orange.. 5
- Head dark red brown to black.. 9
5(4). HL greater than 1.2mm (Fig. 6). 6
- HL less than 1.2mm 7
6(5). Gaster solid dark brown; obligate inhabitant of understory *Guarea* in Cordillera de Tilarán.. ..... *flavoguarea*
- Gaster yellow orange with narrow infuscated bands medially; non-specialist inhabitant of live stems in Cordillera de Talamanca..... *.meganaranja*
7(5). Sides of head and hind tibia with pilosity (pubescence or longer setae) completely appressed; HL less than 0.85mm (Fig. 6); eyes relatively large, OI greater than 30; ocelli small, OcI 4–7; generalist inhabitant of live and dead stems .... *...plebecula* (also keys elsewhere due to variability in head color)
- Sides of head and hind tibia with subdecumbent to suberect pilosity; HL greater than 0.85mm; eye size variable, OI 27–37; ocelli larger, OcI 6–10; specialist inhabitant of understory *Ocotea*. 8
8(7). Eyes relatively small, OI 27–31; HW greater than 0.8mm (Fig. 6); Atlantic slope and central Cordilleras.. ..... *.flavocotea*
- Eyes larger, OI 33–37; HW less than 0.8mm; southern Pacific lowlands. .... *..lauropacifica*
9(4). HW less than 0.7mm (Fig. 7); generalist inhabitant of live and dead stems. .... *.plebecula*
- HW greater than 0.7mm; specialist or generalist inhabitant of live stems.. ..... .10
10(9). HL usually between 0.8–1.2mm (Fig. 7); head relatively broad, CI 87–98; eyes relatively small, OI less than 30, often around 27 (Fig. 8); ocelli very small, OW often less than 0.05mm; mandible smooth and shining or weakly rugose; maxillary palpus always 6–segmented (workers brown to mottled red brown; common cloud forest species nesting in many species of trees). ..... *.joycei*
- HL between 0.8–1.4mm; CI 79–93; OI 23–33; OW 0.04–0.10mm; mandible punctatorugose; maxillary palpus 5 or 6-segmented. 11
11(10). HW greater than 1.1mm (Fig. 7); head relatively broad, CI 88–93; eyes relatively

small, OI 23–27 (Fig. 8); much of face slightly roughened, dull, not strongly shining (Fig. 9A).. ..... *nigrocotea*

- HW less than 1.1mm, if approaching 1.1mm then head relatively elongate (CI less than 86); OI greater than 27; most of face smooth and strongly shining. 12

12(11). In full face view with long erect setae projecting from sides of head (Fig. 9D); maxillary palpus 5-segmented... *lauroatlantica*

- Sides of head with short appressed to suberect pubescence, no longer erect setae; maxillary palpus 5 or 6-segmented.. ..... .13

13(12). Workers dark red brown (*longiceps* queens bridge the morphological gap between *haberi* and *osa* and cannot be distinguished from either).. ..... *longiceps*

- Workers yellow orange... 14

14(13). Maxillary palpus 5-segmented; CI 83–89; HL 1.00–1.12; sides of head rounding more gradually into rear margin (Fig. 9B)..... *haberi*

- Maxillary palpus 6-segmented; CI 79–84; 1.18–1.23; head more sharply rectangular, sides flat and more abruptly rounding into flat rear margin (Fig. 9C) ..... *osa*

Key to males (Costa Rica)

The male of *M. osa* is unknown.

1. Antenna with 11 segments; apodeme of penial valve meeting dorsal margin of blade at nearly right angle (Fig. 10A)..... ...2

- Antenna with 10 segments; apodeme of penial valve rounding into dorsal margin at obtuse angle (Fig. 10B)...4

2(1). Pygostyles absent..... *mexicana*

- Pygostyles present. 3

3(2). Paramere broadly triangular ..... *cooperi*

- Paramere more elongate, with parallel sides before bluntly rounded apex .... *zeledoni*

4(1). Basiparamere lobe absent or reduced to short triangular tooth, much shorter than paramere; cuspis absent 5

- Basiparamere lobe well developed; cuspis present or absent..... ...6

5(4). Ocelli small, width of median ocellus less than distance between median and lateral ocellus (Fig. 11A); petiolar dorsum with few to no erect setae..... *plebecula*

- Ocelli large, width of median ocellus greater than distance between median and lateral ocellus (Fig. 11B); petiolar dorsum with conspicuous tuft of erect setae..... ..... *lauropacifica*

6(4). Pygostyles present; basiparamere lobes and parameres very long and thin (Fig. 12A, B) 7

- . Pygostyles absent or reduced to tiny unsclerotized remnants; basiparamere lobes and parameres thin or broad 8

7(6). Digitus evenly tapered to apex (Fig. 12B)..... *flavoguarea*
- Digitus broadening apically to paddle-shaped apex (Fig. 12A) ..... *meganaranja*
8(6). Digitus greatly expanded distally and with thickened posterodorsal and posterior margins, forming a bulla at apex (Fig. 12C, D)..... *longiceps*
- Digitus evenly tapered or scimitar-shaped, never forming a bulla at apex..... 9
9(8). Cuspis absent or reduced to sharply triangular or spine-like process, closely appressed to inner surface of paramere and distant from digitus 10
- Cuspis present and subrectangular, separated from inner surface of paramere, apex sometimes approaching or touching dorsal margin of digitus..... 12
10(9). Digitus scimitar-shaped (Fig. 10B); cuspis present as a spiniform tooth; maxillary palpus always 6-segmented ..... *joycei*
- Digitus more evenly tapered from base to apex; cuspis as above or absent; maxillary palpus 5 or 6-segmented..... 11
11(10). Maxillary palpus 5-segmented; cuspis present as a small triangular or spiniform tooth ..... *haberi*
- Maxillary palpus 6-segmented; cuspis absent ..... *lauropacifica*
12(9). Paramere thin and evenly tapered..... *lauroatlantica*
- Paramere scimitar-shaped, broadening apically 13
13(12). Basiparamere lobe and paramere very long and thin; digitus rounded apically..... *longiceps*
- Basiparamere lobe and paramere broad at the base, shorter; digitus tapering to a point at apex..... 14
14(13). Ocelli relatively large, width of median ocellus usually greater than distance between median and lateral ocellus; distance between lateral ocelli about equal to distance from lateral ocellus to compound eye (Fig. 11C)..... *flavocotea*
- Ocelli relatively small, width of median ocellus usually less than distance between median and lateral ocellus; distance between lateral ocelli less than distance from lateral ocellus to compound eye (Fig. 11D)..... *nigrocotea*

Species accounts

Myrmelachista cooperi (Gregg)

Figure 10

Camponotus (*Myrmostenus*) *cooperi* Gregg 1951:80. Holotype queen: Costa Rica, Turrialba (Cooper).
Aphomomyrmex (*Neaphomus*) *cooperi*: Gregg 1954:102.
Neaphomus cooperi: Kempf 1972:152.
Myrmelachista cooperi: Snelling and Hunt 1975:110.

Diagnosis

Worker antenna 9-segmented; maxillary palpus 6-segmented; color black. Queen black, antenna 10-segmented, head elongate and strongly flattened, mandible falcate.

Worker (previously unknown)

Antenna 9-segmented; maxillary palpus 6-segmented; mandible with teeth 4 and 5 (counting from apex) separated by a wide diastema, teeth 1-4 more closely and evenly spaced; dorsal surface of mandible striatopunctate near masticatory margin, grading to smooth and shining basally; clypeus strongly bulging medially, some workers with longitudinal median carina; face with superficial reticulate sculpture, becoming denser on clypeus and anterior malar spaces; in full face view, with abundant short erect setae projecting from rear margin of head, absent from sides of head; ventral surface of head with short sparse appressed pubescence, no erect setae; scapes with abundant erect to subdecumbent setae, longer setae subequal to width of scape; HW of large worker 0.76mm; outer surface of hind tibia with abundant erect setae, longer setae about 2/3 width of tibia; color black.

Measurements: HL 0.761–0.881, HW 0.750–0.853, SL 0.398–0.457, EL 0.157–0.178, CI 94–100 (n=3).

Queen

Antenna 10-segmented; maxillary palpus 6-segmented; labrum a large shiny plate that completely covers and closes the buccal cavity and other mouthparts (in other *Myrmelachista* the labrum is shorter, not covering the buccal cavity); mandible falcate, with three apical teeth and a series of small denticles; dorsal surface of mandible striatopunctate near apex, grading to smooth and shining basally; clypeus with large cone-like projection; face smooth and shining; in full face view, with abundant erect setae projecting from rear margin of head, much shorter erect setae on sides of head; ventral surface of head with long suberect pubescence; scapes with abundant erect to subdecumbent setae, longer setae subequal to width of scape; outer surface of hind tibia with abundant erect setae, longer setae about 2/3 width of tibia; petiole elongate, with very long, low node; color black. See also description of Gregg (1950).

Measurements: HL 1.684, HW 1.123, SL 0.613, EL 0.330, OW 0.081, OD 0.251, CI 67, OI 29, OcI 5 (n=1).

Male (previously unknown)

Antenna 11-segmented; maxillary palpus 6-segmented; pygostyles present, sclerotized, setose; basiparamere lobe and paramere short, robust, broadly triangular; cuspis robust, spatulate, with an apicodorsal field of small teeth at the apical contact point with the digitus; digitus short, dorsal margin forming an abrupt right angle, apex of digitus a ventrally directed triangular lobe; penial valve short and broad, apex blunt, with

dorsally-directed short triangular tooth, apodeme of penial valve strongly developed, at right angle to the rest of valve.

Range

Costa Rica. In Costa Rica it is known from two mid-elevation sites on the Atlantic slope.

Biology

Prior to this study *M. cooperi* was known only from the holotype queen, taken with no associated biological data near Turrialba. I rediscovered the species in the Peñas Blancas Valley, east of Monteverde in the Cordillera de Tilarán. The habitat was mature wet forest at 800m elevation. I found nests in live stems of a small lauraceous tree. A voucher specimen of this tree was obtained (William Haber collection #10708) but it has not been identified. At this field site *O. dendrodaphne* and *atirrensis* were common in the understory, inhabited by *M. flavocotea* and *M. nigrocotea* (see below). The tree species inhabited by *M. cooperi* was distinctly larger than these and much less common. I found several trees and they all contained *M. cooperi* in the live stems. One of the branches contained alate queens and males in addition to workers. One of the branches contained a dealate queen and workers.

Comments

The strongly falcate mandibles, the enlarged labrum covering the mouthparts, the shiny surface, and the diminutive thorax and abdomen in relation to the head are similar to other species known to be temporary social parasites (the parasite syndrome, see Hölldobler & Wilson 1990). The suite of characters suggests that queens of *cooperi* may use some form of social parasitism to establish colonies.

This is the only *Myrmelachista* species I know in which the workers and queens differ in number of antennal segments: workers with 9 and queens with 10 (based on examination of three queens and dozens of workers). The male genitalia are very similar to *zeledoni*, and very different from any of the other species with 9-segmented antenna. This suggests that *cooperi* is derived from a *zeledoni*-like ancestor, the 9-segmented antennal count in the workers may be independently derived relative to other 9-segmented species, and it may not be particularly closely related to the other Lauraceae-inhabiting species.

Material examined

COSTA RICA, *Alajuela*: Refugio Eladio, Rio Peñas Blancas, 10°19’N, 84°43’W, 800m (J. Longino, 4 collections)

Holotype alate queen: Costa Rica, Prov. Alajuela, Refugio Eladio, Rio Peñas Blancas, 10°19'N, 84°43'W, 800m, 23 Dec 1986 (J. Longino#1498) [INBC, specimen code JTLC000006174].

Paratypes: workers and queens, from same nest as holotype, specimen codes JTLC000006175-JTLC000006185, distributed to INBC, MCZC, USNM, UCDC, LACM, BMNH.

Diagnosis

Worker antenna 9-segmented, maxillary palpus 5-segmented, color yellow. Queen head orange, eyes relatively small (OI 27–31), HW greater than 0.8mm. Obligate inhabitant of understory Lauraceae.

Worker

Antenna 9-segmented; maxillary palpus 5-segmented; dorsal surface of mandible shiny, weakly striatopunctate; clypeus and face smooth and shining; in full face view, with abundant short subdecumbent setae projecting from rear margin and sides of head, cluster of longer setae on posterolateral vertex; ventral surface of head with abundant short subdecumbent setae; scapes with abundant erect to subdecumbent setae, longer setae subequal to width of scape; outer surface of hind tibia with abundant erect to subdecumbent setae, longer setae about 2/3 width of tibia; color uniformly yellow orange.

Measurements: HL 0.591–0.688, HW 0.585–0.700, SL 0.306–0.328, EL 0.105–0.133, CI 98–103 (n=5).

Queen

Antenna 9-segmented; maxillary palpus 5 or 6-segmented; labrum short, bilobed, not covering mouthparts; dorsal surface of mandible punctatorugose; face and clypeus smooth and shining; in full face view, with abundant short erect to suberect setae projecting from rear margin and sides of head; ventral surface of head with abundant short erect setae; scapes with abundant erect to suberect setae, longer setae subequal to width of scape; outer surface of hind tibia with abundant erect to subdecumbent setae, longer setae shorter than width of tibia; color light yellow orange with infuscated bands on gastral terga, these bands occasionally lacking, rarely (one collection from La Selva Biological Station) color light red.

Measurements: HL 0.965–1.167, HW 0.861–1.079, SL 0.420–0.507, EL 0.260–0.304, OW 0.058–0.112, OD 0.168–0.222, CI 86–96, OI 27–31, OcI 6–10 (n=13).

Male

Antenna 10-segmented; maxillary palpus 6-segmented; pygostyles minute, weakly

sclerotized; basiparamere lobe and paramere elongate, tapering; cuspis small, subrectangular, with series of about 3 tiny denticles at apex; digitus large, scimitar-shaped, broadly curved, with a series of tiny denticles on dorsal margin at contact point with apex of cuspis; apodeme of penial valve curving into dorsal margin at obtuse angle; ocelli relatively large; width of median ocellus about equal to or greater than distance from median to lateral ocellus; distance between lateral ocelli about equal to distance from lateral ocellus to compound eye.

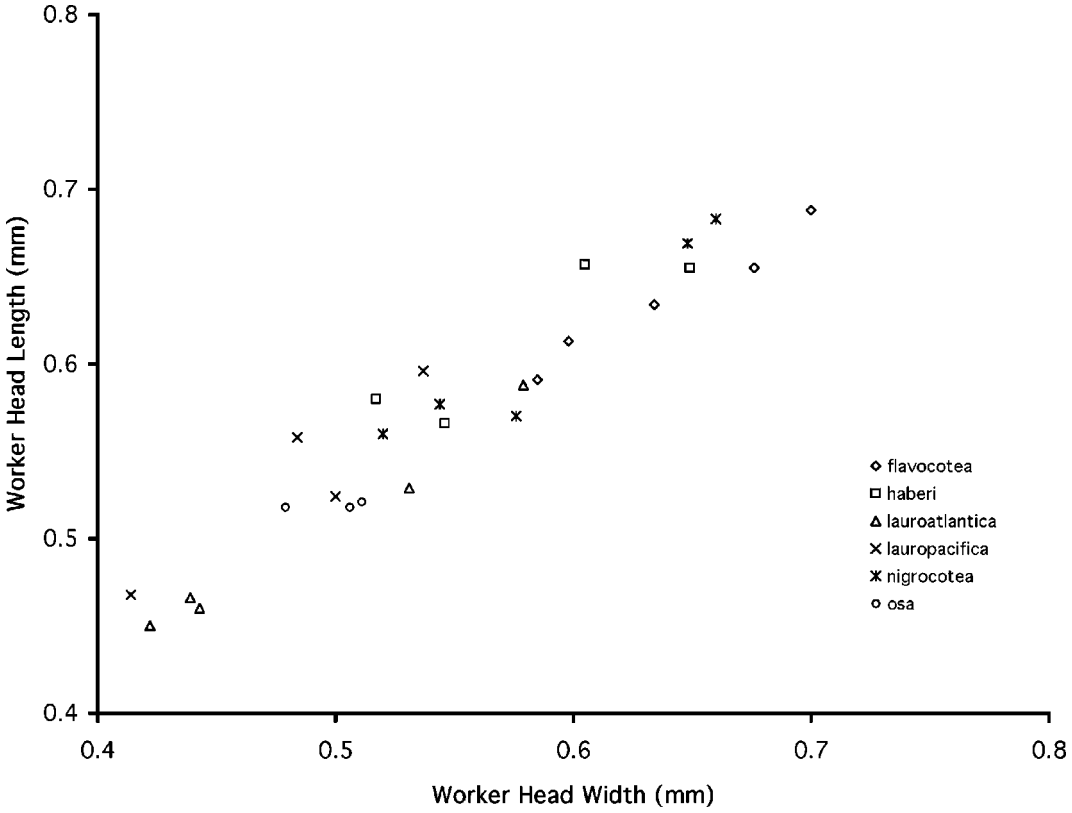

FIGURE 4. Head size measurements of *Myrmelachista* workers; specialist inhabitants of understory Lauraceae with yellow workers. One large worker per nest series chosen for measurement.

Etymology

Named for the yellow coloration of the queen and for the host association with plants in the genus *Ocotea*.

Range

Costa Rica. In Costa Rica it occurs throughout the Atlantic slope, from 50-1000m elevation. In Guanacaste Conservation Area it also occurs at 600m on the Pacific slope (Estación Maritza).

Biology

Myrmelachista flavocotea is an obligate inhabitant of understory treelets in the genus *Ocotea*. The first known collection of the species was by Nevermann in 1925, at Hamburg Farm, a site in Limón province. The specimens are at USNM and the label states "ex live stems with Coccoidea." An additional 43 records of the species have all been from live stems of Lauraceae. Most collections have been from *Ocotea atirrensis* and *O. dendrodaphne*, common understory species that are mature at 1-3m height. Although workers of *M. flavocotea* cannot be distinguished easily from workers of several other species, the collections made by Jean Stout at La Selva (Stout 1979) were probably this species. They were from "*Ocotea pedalifolia*," an early misidentification of La Selva plants later identified as *O. atirrensis* and *dendrodaphne* (Hammel 1986). Subsequent collections of *Myrmelachista* from understory *Ocotea* at La Selva have all been *M. flavocotea*. Less commonly colonies have been collected from *O. tenera*, another short-statured understory species.

Founding queens have been collected in stump sprouts of other Lauraceae that become large canopy trees, but no large trees have ever been found hosting a colony of *M. flavocotea*. Thus the species that become large trees must be unsuitable hosts for some reason and their colonization by founding queens accidental or an act of desperation resulting from unavailability of more suitable hosts.

Colonies are typically monogynous, although occasionally two physogastric queens occur in the same colony. All stem space of the treelets is occupied, from ground level to the tips of all the branches. Colonies contain hundreds to thousands of workers. New alate queens and males are produced gradually in the upper stems.

Low densities of Pseudococcidae are usually present in the stems.

Although referred to above as "colonies" in individual trees, the species may be unicolonial. Workers will fight and grapple with allospecific workers (e.g. *M. nigrocotea*) but not with conspecific workers, even if workers are mixed from trees up to a kilometer apart. In contrast, other *Myrmelachista* species show intraspecific aggression among nests in separate trees.

Material Examined

COSTA RICA, *Alajuela*: Refugio Eladio, Rio Peñas Blancas, 10°19’N, 84°43’W, 800m (J. Longino, 29 collections); Laguna Poco Sol, 10°21’N, 84°40’W, 800m (L. Elizalde, 2 collections); 3km S Vol. Arenal, 10°26’N, 84°42’W, 700m (J. Longino); *Cartago*: CATIE, nr. Turrialba, 9°54’N, 83°39’W, 550m (J. Longino); *Guanacaste*: Estacion Maritza, Guanacaste Conservation Area, 10°58’N, 85°30’W, 600m (J. Longino, 11 collections); north side Laguna Arenal, 10°30’N, 84°57’W, 640m (J. Longino, 2 collections); *Heredia*; Refugio EL Plastico, 17km S Pto. Viejo, 10°18’N, 84°02’W, 550m (J. Longino, 3 collections); 22km N Volcan Barba, 10°20’N, 84°04’W, 500m (J. Longino, 2 collections); Rara Avis, 17km S Pto. Viejo, 10°18’N, 84°03’W, 700m (J. Longino); La

Selva Biological Station, 10°26'N, 84°01'W, 50–100m (J. Longino, 4 collections); Virgen de Socorro, 10°16'N, 84°10'W, 1000m (J. Longino); 11km ESE La Virgen, 10°21'N, 84°03'W, 300m (J. Longino, 2 collections); 11km SE La Virgen, 10°20'N, 84°04'W, 500m (J. Longino); *Limon*: Hamburg Farm, 10°15'N, 83°27'W, 50m (F. Nevermann) [USNM]; 6km WNW Pto. Viejo, 9°40'N, 82°49'W, 50m (J. Longino).

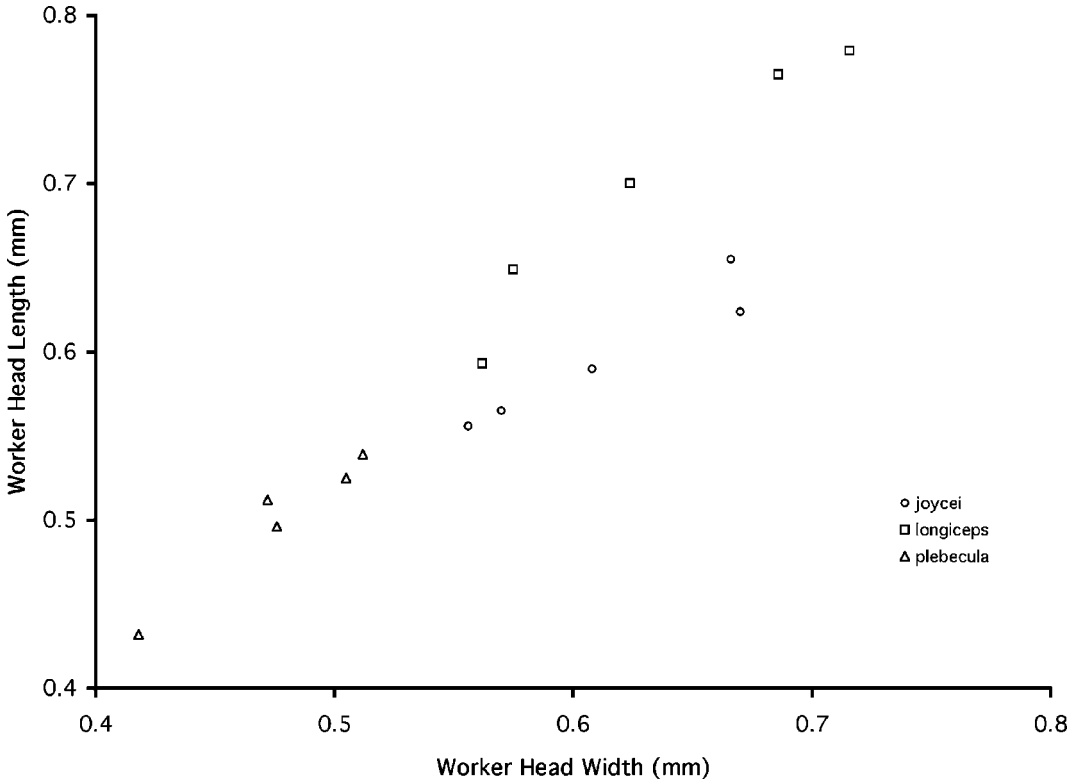

FIGURE 5. Head size measurements of *Myrmelachista* workers; species with 9-segmented antenna and dark-colored workers. One large worker per nest series chosen for measurement.

***Myrmelachista flavoguarea* NEW SPECIES**
Figures 1, 6, 12, 13

Holotype queen: Costa Rica, Alajuela, Refugio Eladio, Rio Peñas Blancas, 10°19'N, 84°43'W, 800m, 23 Dec 1986 (J. Longino#1501) [INBC, specimen code JTLC000002744].

Paratypes: all same locality as holotype, queens and workers; JTLC000002745, 27 Apr 1987 (J. Longino#1616) [MCZC]; JTLC000002746, 28 Apr 1987 (J. Longino#1624) [USNM]; JTLC000002747, 20 May 1987 (J. Longino#1678) [UCDC]; JTLC000006198, 22 May 1987 (J. Longino#1682) [LACM]; JTLC000006199, 30 Apr 1988 (J. Longino#2046) [BMNH].

Diagnosis

Worker antenna 9-segmented, maxillary palpus 6-segmented, color yellow with darker gaster. Queen head orange, HW 1.17–1.24mm. Male with pygostyles present, basiparamere lobes and parameres very long and thin, digitus evenly tapered to apex. Obligate inhabitant of understory *Guarea*.

Worker

Antenna 9-segmented; maxillary palpus 6-segmented; dorsal surface of mandible rugose; clypeus and face smooth; in full face view, with abundant short subdecumbent setae projecting from rear margin and sides of head, cluster of longer setae on posterolateral vertex; ventral surface of head with abundant short subdecumbent setae; scapes with abundant erect to subdecumbent setae, longer setae subequal to width of scape; outer surface of hind tibia with abundant short suberect setae, longer setae about half width of tibia; head and mesosoma yellow orange, gastral tergites with broad bands of infuscation.

Measurements: HL 0.636–0.865, HW 0.598–0.803, SL 0.308–0.376, EL 0.112–0.141, CI 93–99 (n=5).

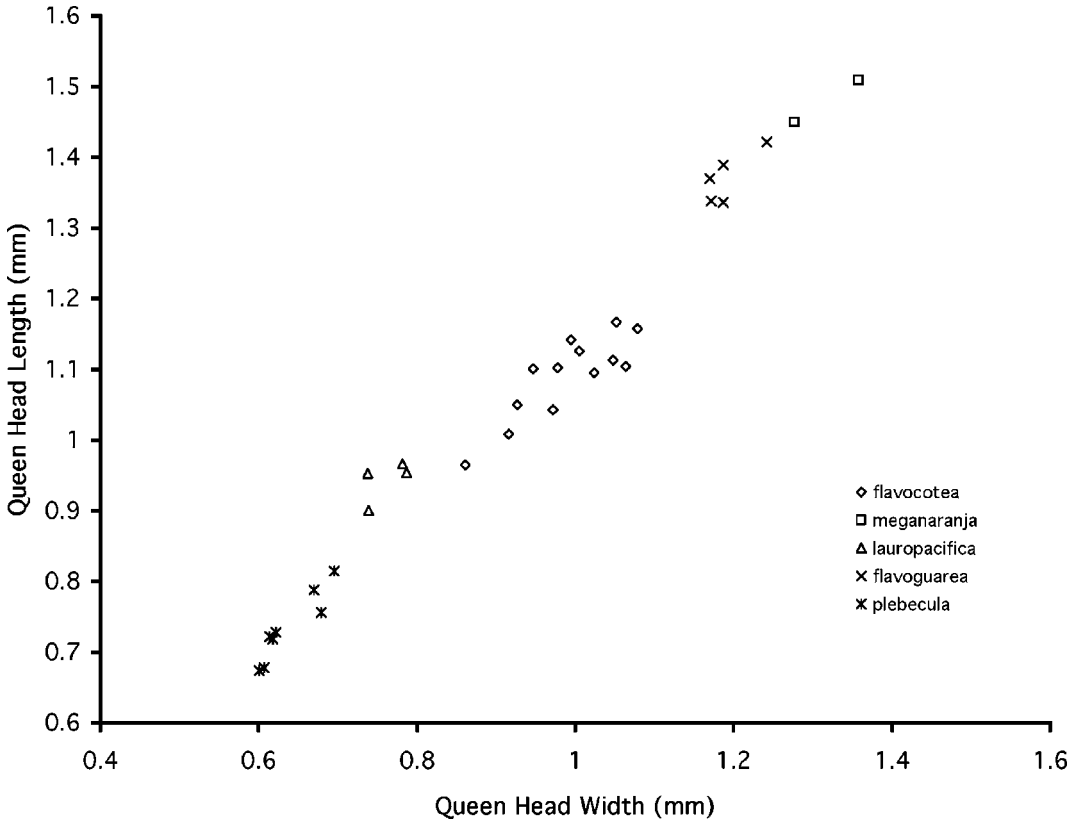

FIGURE 6. Head size measurements of *Myrmelachista* queens; species with orange heads.

Queen

Antenna 9-segmented; maxillary palpus 6-segmented; labrum short, bilobed, not covering mouthparts; dorsal surface of mandible punctatorugose; anterior face and clypeus faintly roughened, grading to smooth and shining posteriorly; in full face view, with abundant short subdecumbent setae projecting from rear margin and sides of head; ventral surface of head with abundant erect setae, many exceeding width of scape; scapes with abundant erect to suberect setae, longer setae subequal to width of scape; outer surface of hind tibia with abundant erect to subdecumbent setae, longer setae subequal to width of tibia; petiolar node broadly rounded in lateral view; head, and mesosoma including petiole yellow orange, gaster dark brown.

Measurements: HL 1.336–1.422, HW 1.170–1.242, SL 0.544–0.579, EL 0.289–0.321, OW 0.087–0.095, OD 0.161–0.185, CI 85–89, OI 25–27, OcI 6–7 (n=5).

Male

Antenna 10-segmented; maxillary palpus 5 or 6-segmented; pygostyles present, sclerotized, setose; basiparamere lobe thin, pointed, about half the length of the paramere; paramere long, thin, with parallel sides; cuspis small, subrectangular, with series of small denticles at apex; digitus long, narrow, curved, with a series of tiny denticles on dorsal margin at contact point with apex of cuspis; apodeme of penial valve curving into dorsal margin at obtuse angle.

Etymology

The name refers to the yellow color of the queen head and its association with the plant genus *Guarea.*

Range

Costa Rica. In Costa Rica it is known from one site, at 800m on the Rio Peñas Blancas in the Cordillera de Tilarán.

Biology

This species occurs in mature wet forest understory. It is an obligate inhabitant of an undescribed species of *Guarea* (Haber, pers. comm.). Most species of *Guarea* are large canopy trees; this species is an understory treelet, reaching reproductive maturity at 2–3m height. It is always a single stem from ground to shoot apex, with no lateral branches. Colonies of *Myrmelachista* occupy the entire stem, from ground level to the shoot apex. At Refugio Eladio in the Peñas Blancas Valley, the one site where I have collected *M. flavoguarea*, the tree is moderately common. Nearly every tree I have examined has contained *M. flavoguarea*, and I have never collected *M. flavoguarea* in any other situation. Thus, it appears to be an obligate inhabitant of this *Guarea* species.

There may be one or two physogastric colony queens. Occasional Coccoidea occur inside the stems. The only entrance holes are near the shoot apex. A few workers are

occasionally seen on the surface near the shoot apex, but inside the stems are densely packed with hundreds of workers.

The biology of this species appears very similar to *M. flavocotea*, *nigrocotea*, *lauroatlantica*, *lauropacifica*, *osa*, and *haberi*, which are all obligate inhabitants of understory Lauraceae.

Material Examined

COSTA RICA, *Alajuela*: Refugio Eladio, Rio Peñas Blancas, 10°19'N, 84°43'W, 800m (J. Longino, 15 collections).

***Myrmelachista haberi* NEW SPECIES**
Figures 1, 4, 7, 8, 9

Holotype queen: Costa Rica, Prov. Guanacaste, 3km N Santa Elena, 10°20'N, 84°50'W, 1500m, 26 Jun 1991 (J. Longino#2946-s) [INBC, specimen code INBIOCRI002281806].

Paratypes: all same locality as holotype; INBIOCRI002281803 (queen and workers), 26 Jun 1991 (J. Longino#2944) [LACM]; JTLC000006200, JTLC000006201, INBIOCRI002281805 (queens), 26 Jun 1991 (J. Longino#2946-s) [UCDC, MCZC, USNM]; INBIOCRI001282897, 2 Mar 1996 (J. Longino#3800) [BMNH].

Diagnosis

Worker with antenna 9-segmented, maxillary palpus 5-segmented, color yellow. Queen with black head, HW 0.85–0.98. Male with maxillary palpus 5-segmented; pygostyles absent; cuspis very small, thin, sharply pointed; digitus with more or less constant width, gently curved ventrally to a blunt apex. Obligate inhabitant of understory Lauraceae.

Worker

Same as *M. flavocotea* except for color of the gaster, which may be entirely brown or with posterior bands of infuscation on the tergites.
Measurements: HL 0.566–0.657, HW 0.517–0.649, SL 0.278–0.321, EL 0.107–0.128, CI 89–99 (n=4).

Queen

Antenna 9-segmented; maxillary palpus 5-segmented; labrum short, bilobed, not covering mouthparts; dorsal surface of mandible with large piligerous puncta, interspaces either smooth and shining or coarsely rugose; clypeus with large piligerous puncta; malar spaces with variable extent of weak punctatorugose sculpturing, grading to smooth and shining posteriorly; in full face view, with abundant short subdecumbent setae projecting from rear margin and sides of head; ventral surface of head with abundant short erect

setae; scapes with abundant erect to suberect setae, longer setae subequal to width of scape; outer surface of hind tibia with abundant erect to subdecumbent setae, longer setae shorter than width of tibia; color solid black.

Measurements: HL 0.996–1.115, HW 0.853–0.984, SL 0.430–0.488, EL 0.259–0.297, OW 0.076–0.087, OD 0.166–0.213, CI 83–89, OI 28–32, OcI 7–8 (n=7).

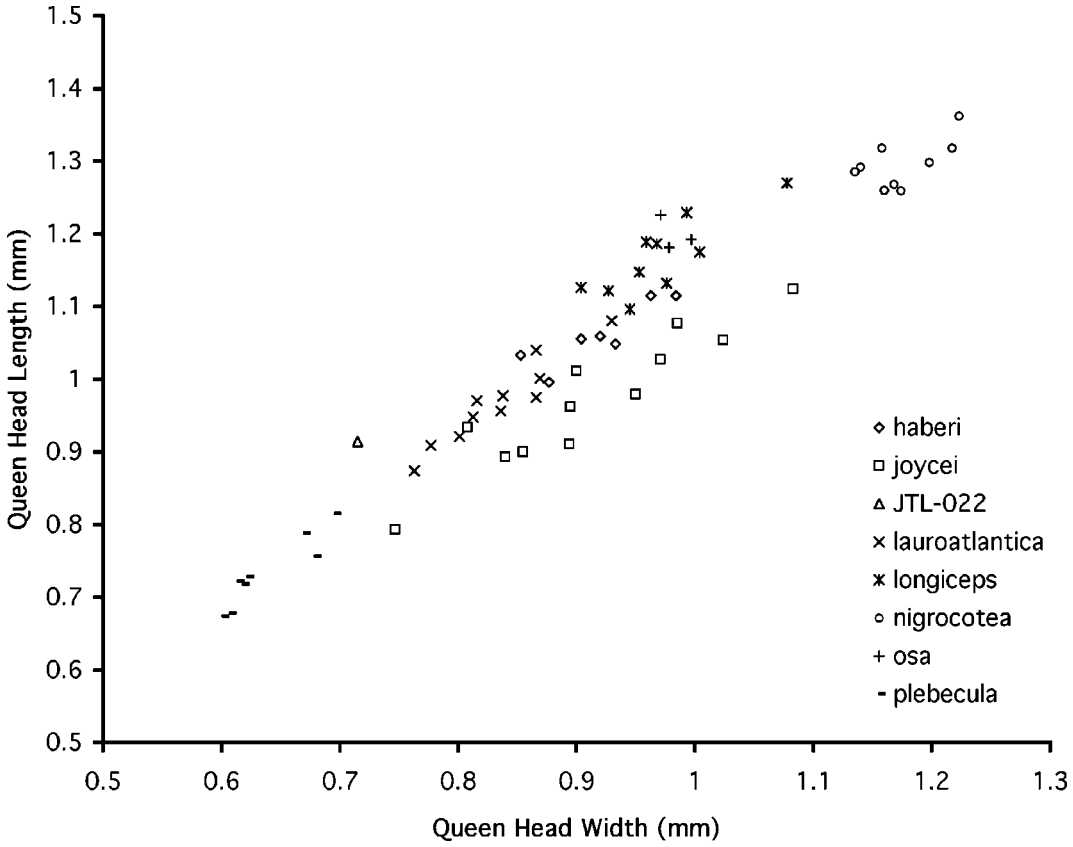

FIGURE 7. Head size measurements of *Myrmelachista* queens; species with 9-segmented antenna and black or dark brown heads.

Male

Antenna 10-segmented; maxillary palpus 5-segmented; pygostyles absent; basiparamere lobe thin, sharp, and spine-like, about half the length of the paramere; paramere long, thin, parallel-sided; cuspis very small, thin, sharply pointed; digitus with more or less constant width, gently curved ventrally to a blunt apex, dorsal margin smooth, with no denticles; apodeme of penial valve curving into dorsal margin at obtuse angle.

Etymology

The name refers to the Monteverde botanist and entomologist Bill Haber, who has helped with plant identifications for me and generations of tropical biology students.

Range

Costa Rica. In Costa Rica it occurs in mid-montane areas in the Cordillera de Tilarán and Cordillera Volcánica Central.

Biology

This species is known from two general areas in Costa Rica: (1) Cordillera de Tilarán, 1000–1500m elevation, in patches of moist forest on the Pacific slope near Santa Elena de Monteverde; and (2) Cordillera Volcánica Central, 1100m elevation, in mature wet forest on the Barva transect in Braulio Carrillo National Park.

The biology of this species is similar to *M. flavocotea*. In the forest patches near Santa Elena, colonies have been found in *Ocotea nicaraguensis*, an understory treelet. The one colony dissected in its entirety was monogynous, and founding queens were found alone in separate chambers in shoot tips from stump sprouts. On the Barva transect, a colony was found in *O. dendrodaphne* and an alate queen was captured in a Project ALAS Malaise trap.

Material Examined

COSTA RICA, *Guanacaste*: 3km N Santa Elena, 10°20’N, 84°50’W, 1500m (J. Longino, 4 collections); *Heredia*: 16km SSE La Virgen, 10°16’N, 84°05’W, 1100m (J. Longino); same data (ALAS); *Puntarenas*: Est. Biol. Los Llanos, near Santa Elena, 10°18’N, 84°50’W, 1150m (J. Longino).

***Myrmelachista joycei* NEW SPECIES**
Figures 2, 5, 7, 8, 10, 14

Holotype queen: Costa Rica, Prov. Puntarenas, Monteverde, 10°18’N, 84°48’W, 1500m, 29 May 1990 (J. Longino#2707) [INBC, specimen code JTLC000006202].

Paratypes: workers and queens, from same nest as holotype, specimen codes JTLC000002769, JTLC000006203-JTLC000006206, distributed to MCZC, USNM, UCDC, LACM, BMNH.

Diagnosis

Worker with antenna 9-segmented, color red brown. Queen with head black, mandible and clypeus usually smooth and shiny, HW 70.5–1.08mm, CI 87–98, OcI 3–6. Male with digitus elongate, curving, scimitar-shaped.

Worker

Antenna 9-segmented; maxillary palpus 5-segmented but terminal segment elongate, sometimes with partial constriction suggestion partial fusion of terminal two palpomeres; mandible, clypeus, and face smooth and shining; in full face view, side and rear margins of

head with sparse to abundant subdecumbent pubescence, sometimes with projecting setae on posterolateral vertex; ventral surface of head with very abundant short subdecumbent pubescence, no erect setae; scape with abundant suberect setae, longer setae about equal to width of scape; hind tibia with abundant appressed to suberect setae, relatively uniform length, about 1/4 to 1/2 width of tibia; typically with dark brown head and gaster, mottled dark and light brown mesosoma, sometimes uniformly dark brown, never strongly bicolored (nanitics may be bicolored).

Measurements: HL 0.556–0.655, HW 0.556–0.670, SL 0.302–0.352, EL 0.114–0.137, CI 100–107 (n=5).

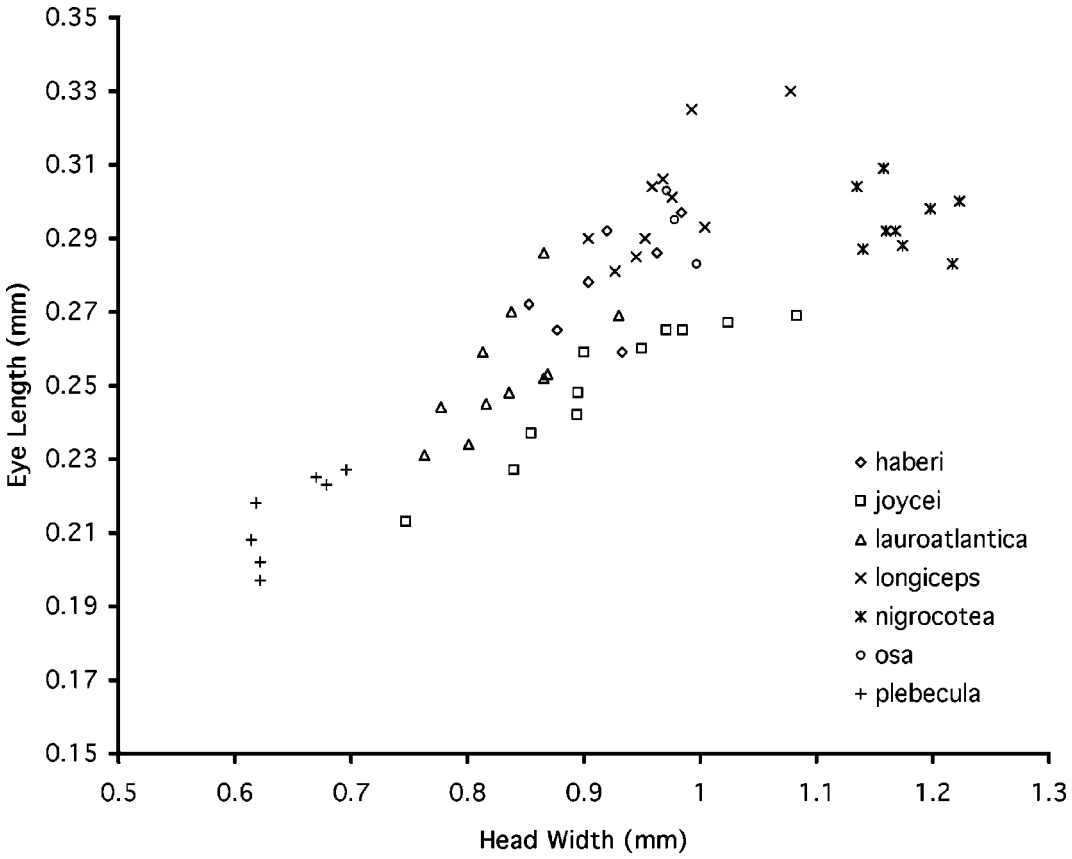

FIGURE 8. Head and eye size measurements of *Myrmelachista* queens; species with 9-segmented antenna and black or dark brown heads.

Queen

Antenna 9-segmented; maxillary palpus 6-segmented; dorsal surface of mandible smooth and shining with sparse piligerous puncta or weakly punctatorugose; clypeus and face largely smooth and shining with sparse small piligerous puncta; in full face view side and rear margins of head with abundant short appressed to suberect pubescence, without longer erect setae, sometimes with longer erect setae on posterolateral vertex; ventral

surface of head with abundant subdecumbent to suberect setae, these similar to or longer than setae on sides of head; scape with abundant suberect setae, longer setae about equal to width of scape; hind tibia with abundant appressed to suberect setae, relatively uniform length, about 1/4 to 1/2 width of tibia; color largely black, sometimes with some degree of lighter red color on anterior face.

Measurements: HL 0.793–1.124, HW 0.747–1.083, SL 0.395–0.531, EL 0.213–0.269, OW 0.024–0.069, OD 0.176–0.220, CI 87–98 (87 for specimen from northern Nicaragua, 89–98 for Costa Rican material), OI 25–29, OcI 3–6 (n=12).

Male

Antenna 10-segmented; maxillary palpus 6-segmented; pygostyles minute, in the form of weakly sclerotized papillae; basiparamere with elongate lobe; paramere elongate and linear, with parallel sides; cuspis a small, weakly sclerotized narrowly triangular tooth appressed to the inner surface of the paramere, distant from digitus; digitus elongate, curving, scimitar-shaped; apodeme of penial valve curving into dorsal margin at obtuse angle.

Etymology

The name refers to Frank Joyce, Monteverde biologist and teacher, indefatigable field naturalist, champion for the conservation of tropical biodiversity, and respected friend.

Range

Costa Rica, Nicaragua. In Costa Rica it occurs in cloud forest above 1000m, from the Cordillera de Tilarán south to the Cordillera de Talamanca. I have one record of a queen from cloud forest near Matagalpa, Nicaragua.

Biology

This species is very abundant in cloud forest. It nests in live branches of canopy trees, with columns extending out in galleries beneath epiphyte mats. It is one of the most common arboreal ants in the Monteverde cloud forest, occurring in a high frequency of tree crowns (Longino 2000) and common in canopy fogging samples (Schonberg et al. 2004). Active colony space occurs in hollow stems near shoot tips, but also extends far back in the centers of live branches, such that workers may be found in narrow chambers deep in the center of relatively thick branches, to 10cm diameter or more. Periodic larger chambers contain dense masses of workers, queens, and brood and may be well-protected deep in solid wood. Clusters of workers and brood also occur beneath epiphytes and in small bits of dead wood. Colonies are large and may occupy an entire tree crown. Large colonies are strongly polygynous, with clusters of physogastric queens scattered throughout the colony space. Pseudococcidae and Coccidae commonly occur in the nests and in the surface galleries beneath epiphytes. Colonies have been found in live branches

of *Sapium oligoneuron*, *Vismia*, *Clusia alata*, *Cecropia angustifolia* (formerly *polyphlebia*), *Ficus*, *Ocotea austinii*, hemiepiphytic Araleaceae, *Licaria*, and *Erythrina*. A founding queen was found in a live stem of an orchid.

Material Examined

COSTA RICA, *Alajuela*: Refugio El Aleman, Rio Peñas Blancas, 10°18'N, 84°45'W, 940m (J. Longino, 2 collections); *Cartago*: 10km SE Orosi, 9°45'N, 83°47'W, 1300m (J. Longino) *Guanacaste*: Cerro Cacao, 10°56'N, 85°28'W, 1100m (J. Longino); 3km N Santa Elena, 10°20'N, 84°50'W, 1500m (J. Longino); *Heredia*: 8km N Vol. Barba, 10°12'N, 84°06'W, 1830m (J. Longino); 16km SSE La Virgen, 10°16'N, 84°05'W, 1100m (ALAS, 12 collections); same data (R. Vargas C.); same data (D. Brenes, 3 collections); same data (Longino, 2 collections); 10km NE Vara Blanca, 10°14'N, 84°05'W, 1500m (J. Longino, 5 collections); *Puntarenas*: Monteverde, 10°18'N, 84°48'W, 1500m (J. Longino, 12 collections); same data (N. Nadkarni); same data (Yanoviak & Gering, multiple canopy fogging samples); San Luis Valley, 10°17'N, 84°47'W, 1100m (J. Longino); Estacion Biol. Pittier, 9°02'N, 82°58'W, 1670m (J. Longino); Fila Cruces, nr San Vito, 8°47'N, 83°03'W, 1200m (J. Longino); NICARAGUA, *Matagalpa*: Santa Maria de Ostuma, 1400m (N. L. H. Krauss) [USNM].

Myrmelachista lauroatlantica NEW SPECIES

Figures 4, 7, 8, 9

Holotype queen: Costa Rica, Prov. Limón, Casa Verde, Tortuguero, 10°35'N, 83°31'W, 5m, 24 Jun 1988 (J. Longino#2136) [INBC, specimen code JTLC000006207].

Paratypes: workers and queens, from same nest as holotype, specimen codes JTLC000006208-JTLC000006212, distributed to MCZC, USNM, UCDC, LACM, BMNH.

Diagnosis

Worker with antenna 9-segmented, maxillary palpus 5-segmented, color yellow. Queen black; in full face view, with abundant long erect setae projecting from rear margin and sides of head. Obligate inhabitant of Lauraceae.

Worker

Same as *M. flavocotea* except for color of the gaster, which has faint posterior bands of infuscation on the tergites.

Measurements: HL 0.450–0.588, HW 0.422–0.579, SL 0.217–0.295, EL 0.080–0.130, CI 94–100 (n=5).

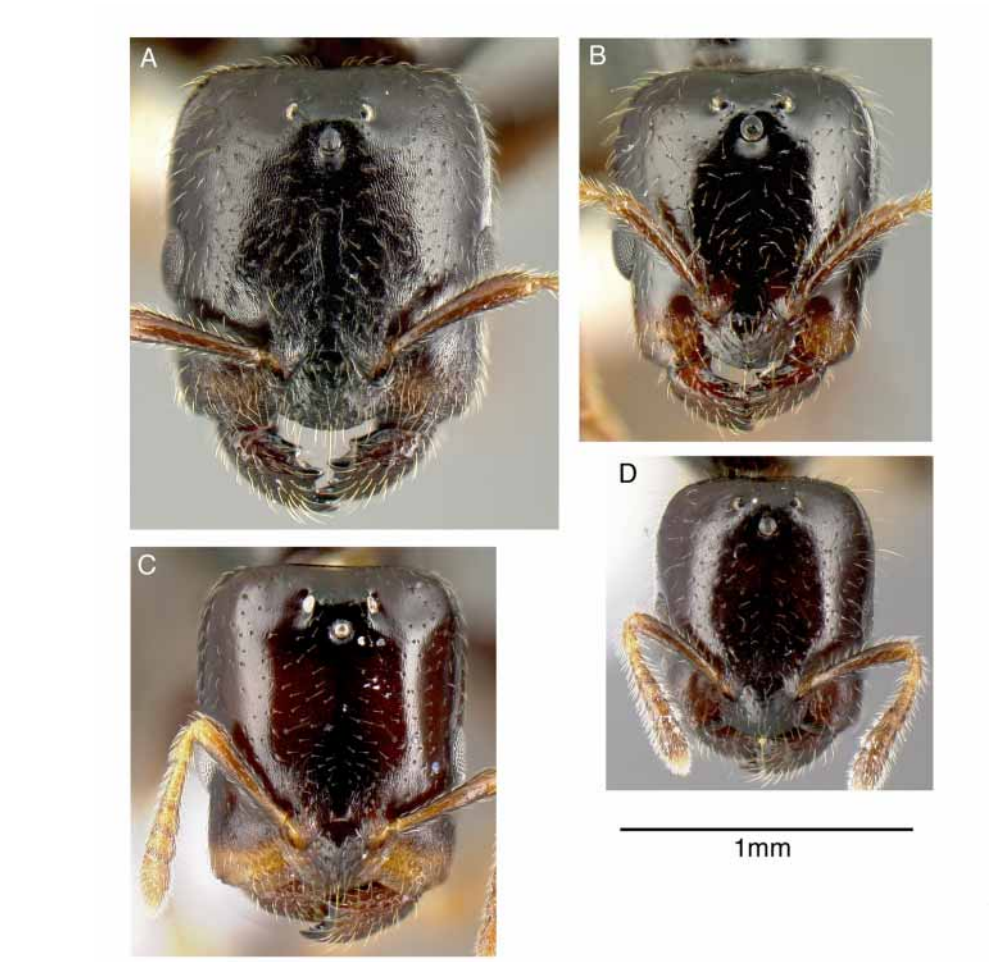

FIGURE 9. *Myrmelachista* queens, face view; species with 9-segmented antenna, orange workers, and black queens (not including *plebecula*). A. *nigrocotea*. B. *haberi*. C. *osa*. D. *lauroatlantica*. Images are of holotypes. Scale applies to entire figure.

Queen

Antenna 9-segmented; maxillary palpus 5-segmented; labrum short, bilobed, not covering mouthparts; dorsal surface of mandible punctate to coarsely punctatorugose; clypeus with large piligerous puncta; malar spaces with variable extent of weak punctatorugose sculpturing, grading to smooth and shining posteriorly; in full face view, with abundant long erect setae projecting from rear margin and sides of head; ventral surface of head with abundant short erect setae; scapes with abundant erect to suberect setae, longer setae subequal to width of scape; outer surface of hind tibia with abundant erect to subdecumbent setae, longer setae shorter than width of tibia; color solid black.

Measurements: HL 0.874–1.08, HW 0.763–0.930, SL 0.380–0.434, EL 0.231–0.286, OW 0.048–0.073, OD 0.170–0.227, CI 83–89, OI 29–33, OcI 5–8 (n=11).

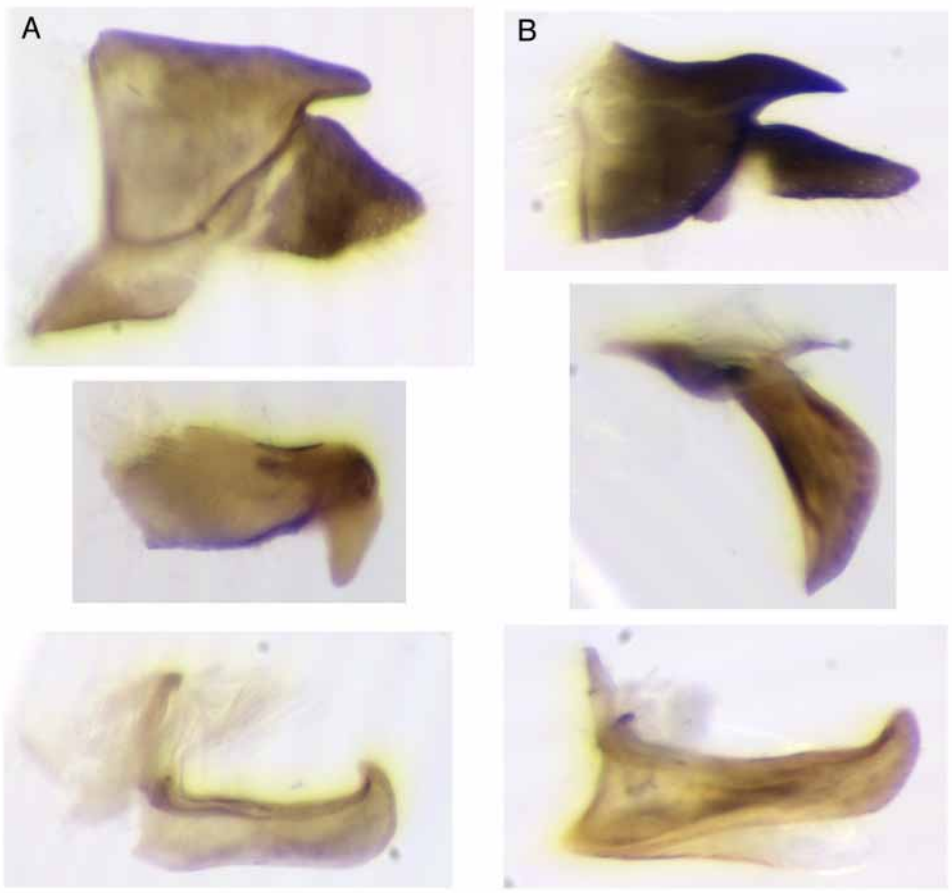

FIGURE 10. *Myrmelachista* male genitalia. A. *cooperi*. B. *joycei*. Top: basiparamere and paramere. Middle: volsella. Bottom: penial valve.

Male

Antenna 10-segmented; maxillary palpus 5 or 6-segmented; pygostyles nearly absent (tiny remnants visible at high magnification); basiparamere lobe pronounced, with broad base, about half the length of the paramere; paramere also with broad base; cuspis small, rectangular, with minute apical denticles; digitus evenly curved downward and tapering to blunt point; apodeme of penial valve curving into dorsal margin at obtuse angle.

Etymology

The name refers to its association with plants in the family Lauraceae and its geographic distribution in the Atlantic lowlands.

Range

Costa Rica. In Costa Rica it occurs in the Atlantic lowlands.

Biology

This species occurs in mature rainforest habitats in the Atlantic lowlands. It is a specialist inhabitant of live stems of Lauraceae, similar to *M. flavocotea*. In the forests around the community of Tortuguero on the north Atlantic coast understory *Ocotea dendrodaphne* and *Licaria* sp. are common, and nearly all are inhabited by *M. lauroatlantica*. I dissected numerous small plants with colonies, many of which were monogynous but some of which were polygynous. One small *Licaria* contained 25 dealate queens, along with workers, brood, and an adult male. One contained a cluster of 3 dealate queens in a colony with abundant workers and brood. A large *Licaria* tree that had fallen over and produced sucker shoots along its length was packed with a large polygynous colony, with clusters of dealate queens in many chambers. In a forest patch at C.A.T.I.E. near Turrialba colonies were common in *O. dendrodaphne* and *O. atirrensis.* A monogynous colony was found in an understory *Ocotea* (probably *dendrodaphne* or *atirrensis*) in Hitoy Cerere Biological Reserve.

Material Examined

COSTA RICA, *Cartago*: CATIE, nr. Turrialba, 9°54'N, 83°39'W, 550m (J. Longino, 6 collections); *Limón*: Tortuguero, 10°35'N, 83°31'W, 5–50m (J. Longino, 17 collections); Hitoy Cerere Biol. Reserve, 9°40'N, 83°02'W, 100m (J. Longino).

***Myrmelachista lauropacifica* NEW SPECIES**
Figures 4, 6, 11, 13

Holotype alate queen: Costa Rica, Prov. Puntarenas, Cedral, Corcovado National Park, 8°33'N, 83°33'W, 50m, 15 Jul 1982 (J. Longino) [INBC, specimen code JTLC000006213].

Paratypes: workers and queens, from same nest as holotype, specimen codes JTLC000006214-JTLC000006218, distributed to MCZC, USNM, UCDC, LACM, BMNH.

Diagnosis

Worker with antenna 9-segmented, maxillary palpus 5-segmented, color yellow. Queen with orange head, eyes relatively large (OI 33–37), HW less than 0.8mm. Obligate inhabitant of understory Lauraceae.

Worker

Same as *M. flavocotea*.

Measurements: HL 0.468–0.596, HW 0.414–0.537, SL 0.223–0.285, EL 0.098–0.110, CI 87–95 (n=4).

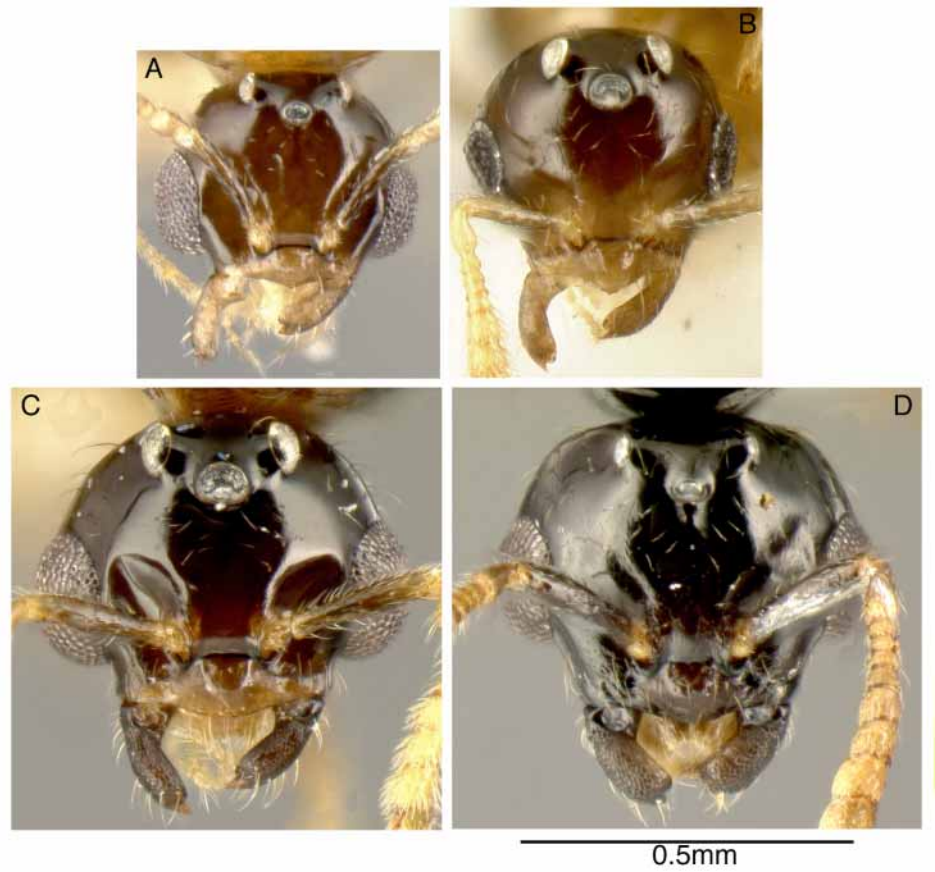

FIGURE 11. *Myrmelachista* males, face view. A. *plebecula*. B. *lauropacifica*. C. *flavocotea*. D. *nigrocotea*. Scale applies to entire figure.

Queen

Antenna 9-segmented; maxillary palpus 5 or 6-segmented; labrum short, bilobed, not covering mouthparts; dorsal surface of mandible with piligerous puncta, interspaces smooth or slightly roughened; face and clypeus smooth and shining; in full face view, with abundant long erect to suberect setae projecting from sides of head, setae on posterior margin shorter; ventral surface of head with abundant short erect setae; scapes with abundant erect to suberect setae, longer setae subequal to width of scape; outer surface of hind tibia with abundant erect to subdecumbent setae, longer setae shorter than width of tibia; color light yellow orange with infuscated bands on gastral terga.

Measurements: HL 0.900–0.966, HW 0.738–0.787, SL 0.363–0.402, EL 0.261–0.276, OW 0.076–0.089, OD 0.133–0.155, CI 77–82, OI 33–37, OcI 8–9 (n=4).

Male

Antenna 10-segmented; maxillary palpus 6-segmented; pygostyles absent; basiparamere lobe short, weakly sclerotized, half the length of paramere or less, in one

collection drawn out as thin, sharp point, in another reduced to short triangular tooth; paramere weakly sclerotized, parallel-sided with rounded apex; cuspis absent (at high magnification, barely visible as tiny remnant); digitus evenly curved downward, tapering to rounded point; apodeme of penial valve curving into dorsal margin at obtuse angle.

Etymology

The name refers to its association with plants in the family Lauraceae and its geographic distribution in the Pacific lowlands.

Range

Costa Rica. In Costa Rica it occurs in the southern Pacific lowlands.

Biology

This species occurs in mature wet forest in the southern Pacific lowlands. I have collected it in Corcovado National Park and Carara Biological Reserve. Colonies have been in live stems of Lauraceae, with a biology similar to *M. flavocotea*. I found nests in *O.* cf. *atirrensis* and *O. nicaraguensis*. In Carara, *O. nicaraguensis* was common along the Quebrada Bonita. Small plants in the forest understory all contained *M. lauropacifica*, while larger plants in more insolated areas along the stream edge contained *Azteca* cf. *pittieri* and *Pseudomyrmex viduus*.

Material Examined

COSTA RICA, *Puntarenas*: Cedral, Corcovado National Park, 8°33'N, 83°33'W, 50m (J. Longino); Bijagual, Carara Biol. Reserve, 9°47'N, 84°36'W, 500m (J. Longino); Carara Biological Reserve, Estación Quebrada Bonita, 9°47'N, 84°36'W, 30m (J. Longino, 2 collections).

***Myrmelachista longiceps* NEW SPECIES**
Figures 5, 7, 8, 12, 14

Holotype alate queen: Costa Rica, Prov. Puntarenas, Monteverde, 10°18'N, 84°48'W, 1400m, 24 Jan 1996 (J. Longino#3743) [INBC, specimen code JTLC000006219].

Paratypes: workers and queens, from same nest as holotype, specimen codes JTLC000006220-JTLC000006224, distributed to MCZC, USNM, UCDC, LACM, BMNH.

Diagnosis

Worker with antenna 9-segmented, color red brown. Queen with head black, elongate, CI 80–86. Male with digitus usually long and paddle-shaped with thickened posterodorsal margin.

Worker

Antenna 9-segmented; maxillary palpus 5-segmented but terminal segment elongate, sometimes with partial constriction suggestion partial fusion of terminal two palpomeres; dorsal surface of mandible weakly to strongly rugose or punctatorugose; clypeus and face smooth and shining with variable amount of roughening and larger puncta on anterior malar spaces and anterior clypeus; in full face view, side and rear margins of head with sparse to abundant appressed to subdecumbent pubescence, sometimes with a few projecting setae on posterolateral vertex; ventral surface of head with sparse to abundant short subdecumbent pubescence, no erect setae; scape with abundant suberect setae, longer setae about equal to width of scape; hind tibia with abundant appressed to subdecumbent setae, relatively uniform length, short, about 1/4 width of tibia; typically with dark brown head and gaster, mottled dark and light brown mesosoma, sometimes uniformly dark brown, never strongly bicolored.

Measurements: HL 0.593–0.779, HW 0.562–0.716, SL 0.312–0.384, EL 0.127–0.147, CI 89–95 (n=5).

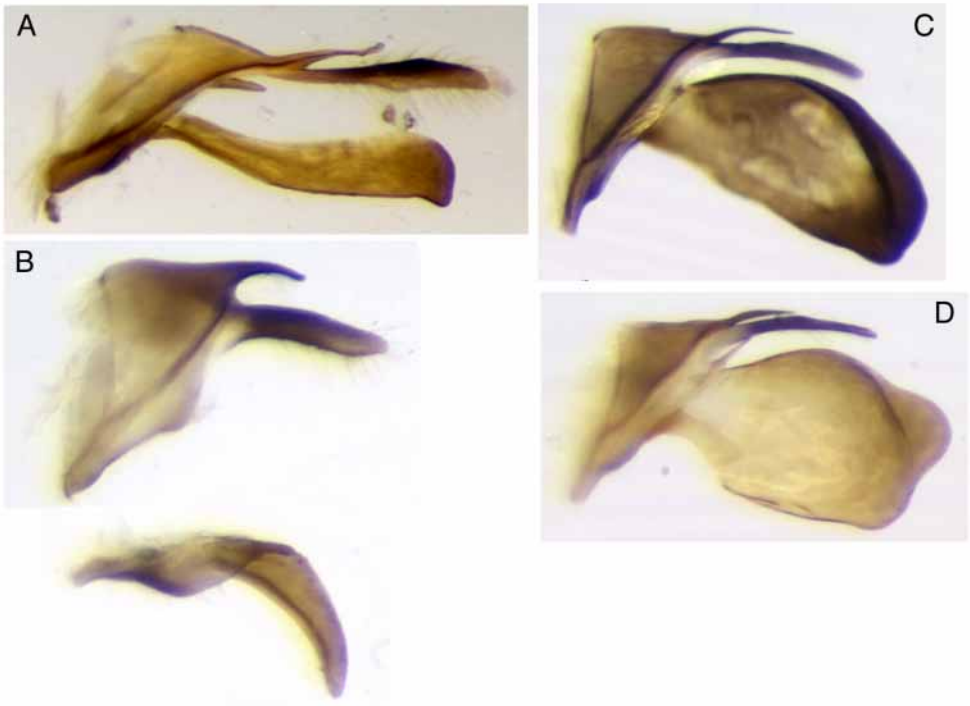

FIGURE 12. *Myrmelachista* male genitalia. A. *meganaranja*, basiparamere, paramere, and volsella. Note cuspis, small pointed structure beneath paramere and distant from digitus. B. *flavoguarea*, basiparamere and paramere above, volsella below. C. *longiceps*, combined basiparamere, paramere, and volsella. D. *longiceps*, showing variation in digitus.

Queen

Antenna 9-segmented; maxillary palpus 5 or 6-segmented; dorsal surface of mandible

moderately to strongly punctatorugose; clypeus and anterior malar spaces roughened and with large puncta, grading to smooth and shining with smaller puncta posteriorly; in full face view side and rear margins of head with abundant short appressed to suberect pubescence, without longer erect setae, sometimes with longer erect setae on posterolateral vertex; ventral surface of head with abundant subdecumbent to suberect setae, these similar to or longer than setae on sides of head; scape with abundant suberect setae, longer setae about equal to width of scape; hind tibia with abundant appressed to suberect setae, relatively uniform length, short, about 1/4 width of tibia; color largely black, sometimes with some degree of lighter red color on anterior face.

Measurements: HL 1.096–1.270, HW 0.904–1.078, SL 0.470–0.551, EL 0.281–0.330, OW 0.045–0.079, OD 0.187–0.232, CI 80–86, OI 29–33, OcI 4–7 (n=10).

Male

Antenna 10-segmented; maxillary palpus 5 or 6-segmented; pygostyles absent; basiparamere with long, needle-like lobe; paramere very elongate and linear, with parallel sides; apodeme of penial valve curving into dorsal margin at obtuse angle. Volsella variable as follows: (collection JTL2280) cuspis very short, closely applied to inner surface of paramere, paddle-shaped, apex with a row of small denticles, only apical row of denticles sclerotized; digitus with short, narrow, downcurved base where dorsal margin close to cuspis, then expanding into large paddle-shape structure, dorsal margin revolute and thickened, forming bulla, large lamina of digitus with several irregular thin spots; (JTL2696) cuspis very short and narrow, parallel sided, distant from digitus, digitus broadly and bluntly scimitar-shaped, but not as grossly expanded, without revolute margin or bulla, irregular thin spots small, faint; (JTL2620) cuspis like JTL2696; digitus like a shorter version of JTL2696, with apical margin greatly thickened and forming pair of bulla, shiny and cream-colored on dried specimen; lamina of digitus lacking thin spots.

Etymology

The name refers to the relatively elongate head of queen and worker.

Range

Costa Rica. In Costa Rica it occurs throughout the country in mature wet forest habitats, most commonly from 500–1500m elevation but occasionally lower.

Biology

This species occurs in mature wet forest habitats, most commonly in montane forests but occasionally lower. It nests in live stems of various plant species. Nests have been found in the live stems of a 2m tall shrub in the Rubiaceae, a large *Palicourea*-like shrub, *Guarea rhopalocarpa*, *Ocotea*, *Licaria*, *Ocotea whitei*, *Conostegia*, and *Ficus*. Founding queens have been found in *Guarea* (the undescribed species usually inhabited by *M.*

flavoguarea), in chambers in terminal shoots of sprouts from the base of a *G. rhopalocarpa* tree, in a small *Inga* sapling (adjacent to a large mature colony in a *Licaria* tree), and in a shrub in the Rubiaceae. Coccoidea often occur in the stems.

Comments

One collection is very similar to *longiceps* in many respects, but is an outlier with respect to queen size (Fig. 7). The queen is much smaller than any *longiceps* queen. It is currently assigned the morphospecies code JTL-022. It is based on one collection from Refugio Eladio in the Peñas Blancas Valley, Cordillera de Tilarán, Costa Rica. Workers and queens were collected from live branches of a *Lonchocarpus* tree that had been knocked over by a small landslide. The colony was polygynous, with many dealate queens. There were also Coccoidea with the ants in the stems. The measurements of a queen from this collection are: HL 0.914, HW 0.715, SL 0.416, EL 0.237, OW 0.040, OD 0.178, CI 78, OI 33, OcI 4 (n=1).

Material Examined

COSTA RICA, *Alajuela*: Refugio Eladio, Rio Peñas Blancas, 10°19'N, 84°43'W, 800m (J. Longino, 5 collections); Rio Agua Gota, 10°23'N, 84°42'W, 1100m (E. Bello); 2km N Volcan Arenal, 10°29'N, 84°42'W, 600m (J. Longino); *Guanacaste*: Estacion Cacao, 10°55'N, 85°30'W, 1100m (J. S. Noyes); *Heredia*: Refugio El Plastico, 17km S Pto. Viejo, 10°18'N, 84°02'W, 550m (J. Longino, 3 collections); 22km N Volcan Barba, 10°20'N, 84°04'W, 500m (J. Longino); La Selva Biological Station, 10°26'N, 84°01'W, 50m (ALAS); 16km SSE La Virgen, 10°16'N, 84°05'W, 1100m (ALAS, R. Vargas C., M. Paniagua, D. Brenes, J. Longino, multiple collections); *Puntarenas*: Monteverde, 10°18'N, 84°48'W, 1500m (Yanoviak & Gering, multiple canopy fogging samples); same data (J. Longino); Wilson Botanical Garden, 4km S San Vito, 8°47'N, 82°58'W, 1200m (J. Longino); 3km W Las Alturas, 8°56'N, 82°52'W, 1360m (J. Longino); Fila Cruces, nr San Vito, 8°47'N, 83°03'W, 1200m (J. Longino); *San José*: Carrillo, Braulio Carrillo Nat. Park, 10°09'N, 083°55'W, 500m (J. Longino).

Myrmelachista meganaranja **NEW SPECIES**

Figures 1, 6, 12, 13

Holotype alate queen: Costa Rica, Prov. Puntarenas, Wilson Botanical Garden, 4km S San Vito, 8°47'N, 82°58'W, 1200m, 23 Mar 1990 (J. Longino#2623) [INBC, specimen code JTLC000006225].

Paratypes: workers and queens, from same nest as holotype, specimen codes JTLC000006226-JTLC000006230, distributed to MCZC, USNM, UCDC, LACM, BMNH.

Diagnosis

Worker with antenna 9-segmented, maxillary palpus 6-segmented, color yellow orange. Queen with orange head, HW 1.28–1.36mm. Male with pygostyles present, basiparamere lobes and parameres very long and thin, digitus broadening apically to paddle-shaped apex.

Worker

Antenna 9-segmented; maxillary palpus 6-segmented; dorsal surface of mandible coarsely punctatorugose; clypeus and face smooth and shining; in full face view, with abundant short subdecumbent setae projecting from rear margin and sides of head; ventral surface of head with abundant short subdecumbent setae, occasional longer setae; scapes with abundant erect to subdecumbent setae, longer setae subequal to width of scape; outer surface of hind tibia with abundant subdecumbent short setae, occasional longer erect setae about 2/3 width of tibia; color uniformly orange.

Measurements: HL 0.830–0.970, HW 0.824–0.991, SL 0.457–0.527, EL 0.149–0.159, CI 99–102 (n=5).

Queen

Antenna 9-segmented; maxillary palpus 6-segmented; labrum short, bilobed, not covering mouthparts; dorsal surface of mandible with dense, large, piligerous puncta; face and clypeus smooth and shining, with some larger puncta on anterior malar spaces; in full face view, with abundant short subdecumbent setae projecting from rear margin and sides of head; ventral surface of head with abundant somewhat longer appressed to suberect setae; scapes with abundant erect to suberect setae, longer setae subequal to width of scape; outer surface of hind tibia with abundant erect to subdecumbent setae, longer setae about 1/2 to 2/3 width of tibia; color orange with infuscated bands on gastral terga.

Measurements: HL 1.450–1.509, HW 1.277–1.358, SL 0.646–0.673, EL 0.315–0.326, OW 0.092–0.094, OD 0.185–0.203, CI 88–90, OI 24–25, OcI 6–6 (n=2).

Male

Antenna 10-segmented; maxillary palpus 6-segmented; pygostyles small but present, distinctly sclerotized, setose; basiparamere lobe and paramere very elongate, thin; cuspis a thin spiniform processed fused to inner surface of paramere, distant from digitus; digitus elongate, paddle-shaped, broadening distally; apodeme of penial valve curving into dorsal margin at obtuse angle; ocelli relatively large.

Etymology

The name refers to the large size and orange coloration of the workers.

Range

Costa Rica. In Costa Rica it occurs in the southern highlands, at Wilson Botanical Gardens near San Vito and at Las Alturas.

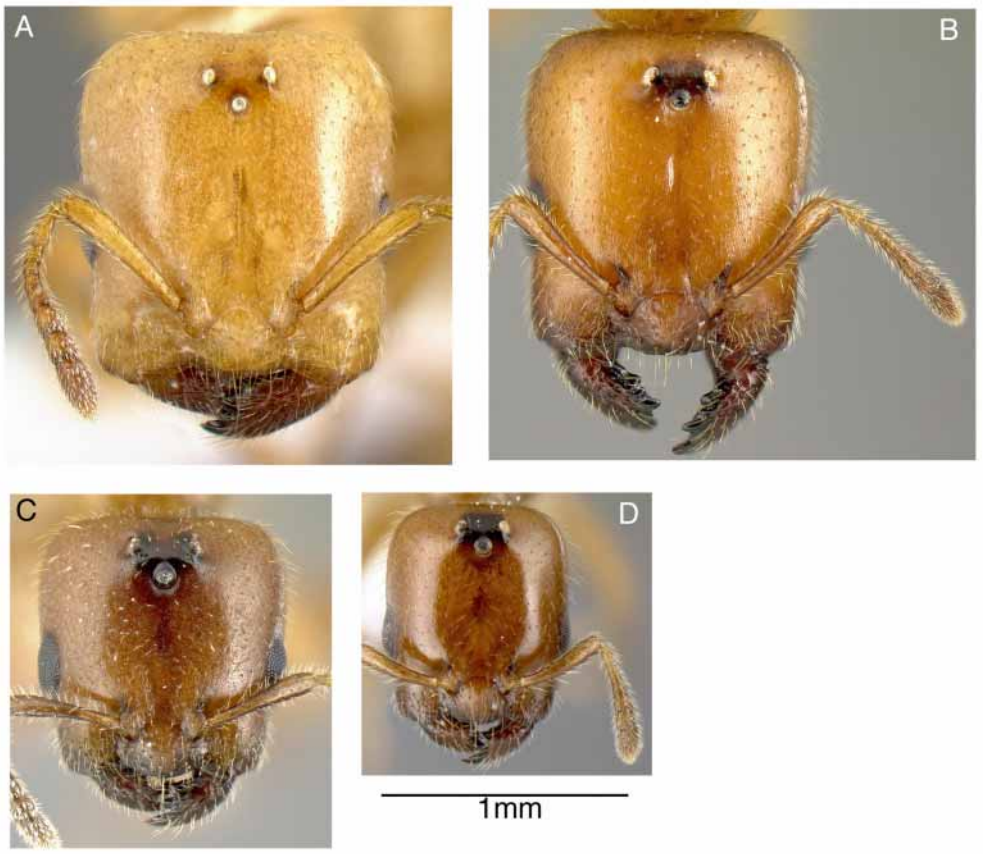

FIGURE 13. *Myrmelachista* queens, face view; species with 9-segmented antenna, orange workers, and orange queens (not including *plebecula*). A. *meganaranja*. B. *flavoguarea*. C. *flavocotea*. D. *lauropacifica*. Images are of holotypes. Scale applies to entire figure.

Biology

This species occurs in mature wet forest in the southern highlands of Costa Rica. At Wilson Botanical Gardens it occurs in a variety of plant species, nesting in live stems. I found a large aggregation of workers in the terminal two internodes of a *Cecropia insignis* sapling. A nest in a 2–3m tall *Ocotea* contained only workers, brood, and males, even though I entirely dissected the tree. A 10m tall *Guarea rhopalocarpa* tree contained a colony scattered in live stems throughout the crown. All the shoot tips contained cavities excavated by beetle larvae prior to entrance by ants. Many of the branches contained alate queens. The nests contained Pseudococcidae on the inner stem walls.

Material Examined

COSTA RICA, *Puntarenas*: Wilson Botanical Garden, 4km S San Vito, 8°47’N, 82°58’W, 1200m (J. Longino, 3 collections); same data (G. Hewson); 5km SW Las Alturas, 8°55’N, 82°52’W, 1240m (J. Longino).

Myrmelachista mexicana Wheeler

Myrmelachista mexicana Wheeler 1934:200. Syntype workers, queen, males: Mexico, Veracruz, Mirador (Skwarra #296), in hollow twigs [MCZC, USNM] (USNM syntype worker examined). Combination in *M.* (*Hincksidris*): Kempf, 1972:149.

Diagnosis

Worker with antenna 10-segmented, face shiny, HW less than 0.5mm.

Worker

Antenna 10-segmented; maxillary palpus 6-segmented; mandible, clypeus, and face smooth and shining; in full face view, sides of head with sparse, short, appressed pubescence, no erect setae; rear margin of head with longer erect setae; ventral surface of head with very sparse, very short appressed pubescence, no erect setae; hind tibia with abundant appressed to suberect setae, pilosity short, about 1/4 width of tibia; mesosoma strongly constricted at metanotal groove, hourglass-shaped; dorsal face of propodeum with faint to pronounced reticulate sculpture; petiole in side view with low, rounded node, short anterior peduncle and long posterior peduncle; bicolored, with light red brown head and mesosoma, dark brown gaster, or grading to more uniformly dark red brown coloration. Also see description of Wheeler (1934).

Measurements: HL 0.438–0.471, HW 0.389–0.423, SL 0.256–0.292, EL 0.093–0.100, CI 87–90 (n=5).

Queen

Similar to worker in meristic characters, patterns of sculpture, pilosity, coloration. Labrum short, bilobed. Also see description of Wheeler (1934).

Measurements: HL 0.570–0.599, HW 0.483–0.484, SL 0.285–0.297, EL 0.175–0.180, OW 0.032, OD 0.147–0.156, CI 81–85, OI 36–37, OcI 5–6 (n=2).

Male

See description of Wheeler (1934). Wheeler's figure of male genitalia show similarities to *zeledoni*, with blunt basiparamere lobe and paramere, and strongly upturned penial valve (suggesting that apodeme meets dorsal margin at right angle, like *zeledoni*). The volsella is not visible in the illustration, suggesting it is short and downturned, like *zeledoni*. Pygostyles are not shown, suggesting they are absent or minute.

Range

Mexico, Costa Rica, Panama. In Costa Rica it is known from La Selva Biological Station and Arenal National Park.

Biology

The types of *M. mexicana* were collected in hollow twigs in southern Mexico. A dealate queen at USNM was intercepted by Brownsville quarantine in an orchid stem from the Canal Zone in Panama. At La Selva Biological Station and on the Barva transect in Braulio Carrillo National Park it has been collected in several Project ALAS Malaise and canopy fogging samples, from 50 to 500m elevation.

At La Selva I found a colony in a small dead stem in the crown of a recently felled *Carapa guianensis*. The relict tree was somewhat isolated in low second growth vegetation, and there were abundant vines over the crown, mainly Marcgraviaceae. The colony was polygynous, with multiple dealate queens. In the field, the tiny workers looked like small *Solenopsis* or *Monomorium floricola*.

Material Examined

COSTA RICA, *Alajuela*: Par. Nac. Arenal, La Peninsula, 10°27'N, 84°45'W, 600m (J. S. Noyes); *Heredia*: La Selva Biological Station, 10°26'N, 84°01'W, 50m (ALAS); same data (J. Longino, 3 collections); MEXICO, *Veracruz*: Mirador, 19°13'N, 96°51'W (E. Skwarra) [USNM]; PANAMA, *Canal Zone*: Canal Zone (Brownsville Quarantine) [USNM].

Myrmelachista nigrocotea **NEW SPECIES**
Figures 1, 4, 7, 8, 9, 11

Holotype alate queen: Costa Rica, Prov. Alajuela, Casa Eladio, Rio Peñas Blancas, 10°19'N, 84°43'W, 800m, 30 Apr 1988 (J. Longino#2044) [INBC, specimen code JTLC000006186].
Paratypes: workers and queens, from same nest as holotype, specimen codes JTLC000006187-JTLC000006197, distributed to INBC, MCZC, USNM, UCDC, LACM, BMNH.

Diagnosis

Worker with antenna 9-segmented, maxillary palpus 5-segmented, color yellow. Queen black; mandible punctatorugose; HW greater than 1.1mm; head relatively broad (CI 88–93); eyes relatively small (OI 23–27); much of face slightly roughened, dull, not strongly shining.

Worker

Similar to *flavocotea*. Compared to *flavocotea*, there is a tendency for the pilosity on the side and ventral surface of head to be shorter, the pilosity on the hind tibia to be more fully appressed, and the gastral terga to develop faintly infuscated bands, but these differences are difficult to quantify.

Measurements: HL 0.560–0.683, HW 0.520–0.660, SL 0.274–0.345, EL 0.105–0.121, CI 93–101 (n=5).

Queen

Antenna 9-segmented; maxillary palpus 6-segmented; labrum short, bilobed, not covering mouthparts; dorsal surface of mandible punctatorugose; face and clypeus roughened, becoming somewhat smoother posteriorly; clypeus often coarsely rugose; in full face view, with short erect to appressed setae on rear and side margins of head; ventral surface of head with abundant short erect setae; scapes with abundant erect to suberect setae, longer setae subequal to width of scape; outer surface of hind tibia with abundant setae, suberect to fully appressed, longer setae shorter than width of tibia; color solid black.

Measurements: HL 1.259–1.362, HW 1.135–1.223, SL 0.532–0.575, EL 0.283–0.309, OW 0.063–0.096, OD 0.227–0.267, CI 88–93, OI 23–27, OcI 5–7 (n=9).

Male

Similar to *M. flavocotea*. Differing in generally heavier sclerotization, darker color, and smaller ocelli. Width of median ocellus usually less than distance between median and lateral ocellus; distance between lateral ocelli less than distance from lateral ocellus to compound eye.

Etymology

The name refers to the black color of the queen head and its frequent occurrence in the plant genus *Ocotea.*

Range

Costa Rica. In Costa Rica it occurs above 500m elevation in wet forest habitats of the Cordillera Volcánica Central, Cordillera de Tilarán, and Cordillera de Guanacaste.

Biology

This species occurs in mature wet forest habitats from 500–1100m elevation, where it nests in live stems of understory Lauraceae and Meliaceae. It has a biology similar to *M. flavocotea* but is more generalized in its host use. At Refugio Eladio in the Peñas Blancas Valley it occurs in *Ocotea dendrodaphne*, *O. atirrensis*, *O. tenera*, and the undescribed species of *Guarea* that is the host for *M. flavoguarea*. Cerro Pedregal, across from Estación Cacao in the Guanacaste Conservation Area, has a patch of understory *O. tenera* near the peak that is dominated by *M. nigrocotea*. Colonies can be monogynous or polygynous with 2–4 dealate queens. Stems often contain Pseudococcidae. Alate queens have been collected in Project ALAS Malaise traps on the Barva transect.

Material Examined

COSTA RICA, *Alajuela*: Refugio Eladio, Rio Peñas Blancas, 10°19'N, 84°43'W, 800m (J. Longino, 24 collections); *Guanacaste*: Cerro Cacao, 10°56'N, 85°28'W, 1100m (J. Longino, 4 collections); same data (J. S. Noyes); *Heredia*: Casa Plastico, 17km S Pto. Viejo, 10°18'N, 84°02'W, 550m (J. Longino); Virgen de Socorro, 10°16'N, 84°10'W, 1000m (J. Longino); 16km SSE La Virgen, 10°16'N, 84°05'W, 1100m (J. Longino); same data (ALAS, 2 collections); *San José*: Carrillo, Braulio Carrillo Nat. Park, 10°09'N, 83°57'W, 600m (J. Longino).

***Myrmelachista osa* NEW SPECIES**
Figures 1, 4, 7, 8, 9

Holotype alate queen: Costa Rica, Prov. Puntarenas, Rancho Quemado, Osa Peninsula, 8°42'N, 83°33'W, 200m, 15 Dec 1990 (J. Longino#2752) [INBC, specimen code JTLC000006231].

Paratypes: workers and queens, from same nest as holotype, specimen codes JTLC000006232-JTLC000006236, distributed to MCZC, USNM, UCDC, LACM, BMNH.

Diagnosis

Worker with antenna 9-segmented, maxillary palpus 5-segmented, color yellow. Queen black; mandible punctatorugose; face smooth and shining; sides of head with short appressed to suberect pubescence, no longer erect setae; maxillary palpus 6-segmented; CI 79–84.

Worker

Same as *M. flavocotea* but with tendency to develop faint infuscated bands on gastral tergites.

Measurements: HL 0.518–0.521, HW 0.479–0.511, SL 0.256–0.265, EL 0.097–0.105, CI 92–98 (n=3).

Queen

Antenna 9-segmented; maxillary palpus 6-segmented; labrum short, bilobed, not covering mouthparts; dorsal surface of mandible punctatorugose; face and clypeus largely smooth, variably roughened anteriorly; in full face view, with abundant short suberect setae on rear and side margins of head, longer setae on posterolateral vertex; ventral surface of head with abundant short erect setae; scapes with abundant erect to suberect setae, longer setae subequal to width of scape; outer surface of hind tibia with abundant short subdecumbent setae, longer setae shorter than width of tibia; color solid black.

Measurements: HL 1.181–1.226, HW 0.971–0.997, SL 0.491–0.507, EL 0.283–0.303, OW 0.062–0.081, OD 0.173–0.185, CI 79–84, OI 28–31, OcI 5–7 (n=3).

Male

Unknown.

Etymology

The name refers to the Osa Peninsula, which is the type locality.

Range

Costa Rica. In Costa Rica it occurs at Rancho Quemado on the Osa Peninsula.

Biology

This species is known from mature wet forest at Rancho Quemado on the Osa Peninsula. I collected it from three different *Ocotea nicaraguensis* trees, and it appears to have a biology similar to *M. flavocotea* and others.

Material Examined

COSTA RICA, *Puntarenas*: Rancho Quemado, Osa Peninsula, 8°42'N, 83°33'W, 200m (J. Longino, 3 collections).

***Myrmelachista plebecula* Menozzi**

Figures 2, 5, 6, 7, 8, 11, 14

Myrmelachista plebecula Menozzi 1927:338. Syntype workers: Costa Rica, San José (Schmidt) [DEIC] (examined).

Myrmelachista costaricensis Wheeler 1934:196. Syntype workers, males: Costa Rica, Alajuela, 28 Nov 1911 (Wheeler), in Tillandsia [MCZC] (examined). **NEW SYNONYM.**

Diagnosis

Worker and queen with 9 antennal segments; maxillary palpus of worker 5-segmented; queen mandible and clypeus largely smooth and shining; queen HL 0.67–0.82mm, CI 85–90; queen often sharply bicolored, with red orange head and mesosoma, dark gaster (occasionally uniform dark red brown); worker HW up to 0.6mm; worker in full face view with pilosity on side of head fully appressed, with no projecting setae or erect pubescence; basiparamere of male with very short, subtriangular lobe, or lobe absent; paramere elongate and linear, with parallel sides; cuspis completely absent; digitus elongate, curving, scimitar-shaped.

Worker

Antenna 9-segmented; maxillary palpus 5-segmented (may be 6-segmented in very

large workers); mandible, clypeus, and face smooth and shining (mandible may be weakly striate in very large workers); in full face view, side and rear margins of head with very sparse, very short, fully appressed to subdecumbent pubescence, no projecting erect setae; ventral surface of head with very sparse, very short subdecumbent pubescence, no erect setae; hind tibia usually with sparse, appressed pilosity, occasionally more abundant and subdecumbent, pilosity short, about 1/4 width of tibia; typically bicolored, with orange red head and mesosoma, dark brown gaster, but in montane wet forest areas may be completely dark red brown.

Measurements: HL 0.432–0.539, HW 0.418–0.512, SL 0.225–0.281, EL 0.102–0.119, CI 92–97 (n=5).

Queen (previously unknown)

Antenna 9-segmented; maxillary palpus 5 or 6-segmented, with varying degrees of fusion of terminal two palpomeres; mandible and clypeus largely smooth and shining with sparse small piligerous puncta; face entirely smooth and shining; face, sides of head, and ventral surface of head with sparse short appressed to subdecumbent pubescence, longer erect setae sparse, 6–8 across posterior margin of vertex, a pair at about mid-face, about 5 on clypeus; hind tibia usually with sparse, appressed pilosity, occasionally more abundant and subdecumbent, pilosity short, about 1/4 width of tibia; coloration often bicolored, with light red orange head and mesosoma, contrasting dark brown gaster; grading to forms with uniform red brown coloration.

Measurements: HL 0.674–0.815, HW 0.601–0.696, SL 0.330–0.385, EL 0.197–0.227, OW 0.032–0.056, OD 0.127–0.166, CI 85–90, OI 32–35, OcI 4–7 (n=9).

Male

Antenna 10-segmented; maxillary palpus 6-segmented; pygostyles minute, in the form of weakly sclerotized papillae without setae; basiparamere with very short, subtriangular lobe or lobe completely absent; paramere elongate and linear, with parallel sides; cuspis completely absent; digitus elongate, curving, scimitar-shaped; apodeme of penial valve curving into dorsal margin at obtuse angle.

Comments

Workers of *plebecula* and *joycei* cannot always be distinguished.

Range

Costa Rica, Ecuador. In Costa Rica it occurs throughout the country, from sea level to 1400m elevation cloud forest.

Biology

This species occurs in a wide variety of habitats, from moist to wet forest, lowlands to

mid-montane elevations, weedy roadside vegetation, second growth forest, or mature forest. It is nearly always in highly insolated areas, being relatively common near ground level in scrubby vegetation but restricted to the high canopy in mature forest.

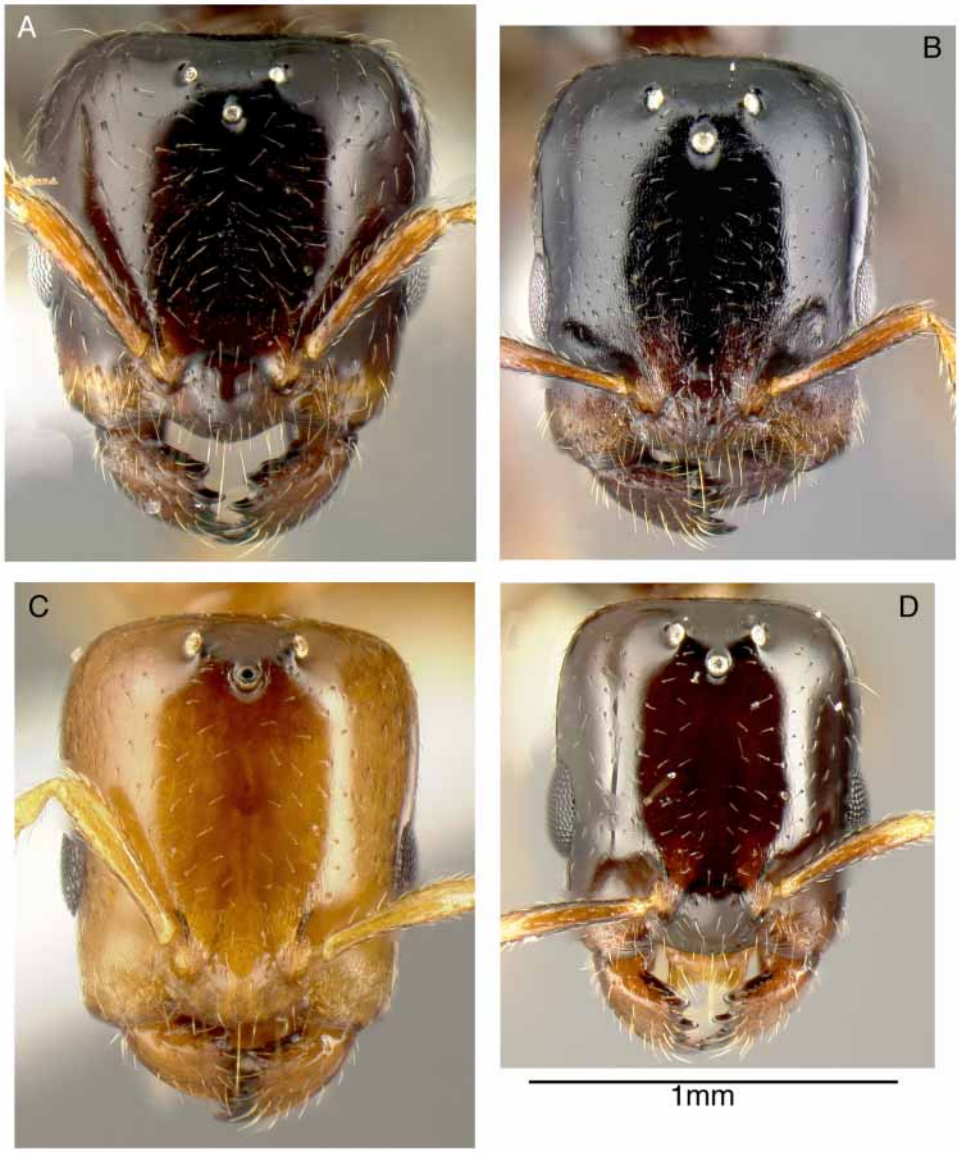

FIGURE 14. *Myrmelachista* queens, face view; species with 9-segmented antenna, brown workers, and brown queens (including *plebecula*, which is variable in color). A. *joycei*. B. *longiceps*. C. *plebecula* (light colored). D. *plebecula* (dark colored). Images of *joycei* and *longiceps* are of holotypes. Scale applies to entire figure.

Nests are in narrow galleries in dead or live stems of a variety of plant species. The dead stems are usually narrow gauge, hard, and woody, not fibrous. Colonies may be

polydomous, occupying multiple dead or live stems in a tree or shrub. I have found colonies nesting in live stems of *Cordia alliodora, Cecropia obtusifolia, Callophylum brasiliense, Sloanea,* and *Ficus.* It is unknown whether workers do any excavation of galleries on their own or just occupy preexisting chambers in myrmecophytes or chambers left by stem-boring insects.

Workers can be observed foraging on exposed stem and trunk surfaces in full sun, often moving in files. Pseudococcidae may occur in nest chambers in live stems (pers. obs.).

Alate queens may be in nests at any time of year. Alate queens have been collected in Malaise traps and one was collected at a blacklight sheet.

Material Examined

COSTA RICA, *province unknown*: no specific locality (San Francisco Quarantine) [USNM]; *Alajuela*: Alajuela, 10°01'N, 84°13'W, 1100m (W. M. Wheeler) [USNM, syntypes *costaricensis*]; Refugio Eladio, Rio Peñas Blancas, 10°19'N, 84°43'W, 800m (J. Longino, 2 collections); Refugio El Aleman, Rio Peñas Blancas, 10°18'N, 84°45'W, 940m (J. Longino); *Guanacaste*: Estacion Maritza, Guanacaste Conservation Area, 10°58'N, 85°30'W, 600m (J. Longino); Cerro Cacao, 10°56'N, 85°28'W, 1100m (J. Longino); Estacion Cacao, 10°55'N, 85°30'W, 1100m (J. S. Noyes); *Heredia*: Rara Avis, 17km S Pto. Viejo, 10°18'N, 84°03'W, 700m (J. Longino); 10km SE La Virgen, 10°20'N, 84°05'W, 500m (J. Longino); La Selva Biological Station, 10°26'N, 84°01'W, 50m (ALAS, 2 collections); 16km SSE La Virgen, 10°16'N, 84°05'W, 1100m (ALAS, D. Brenes, J. Longino, multiple collections); *Limón*: Hamburg Farm, 10°15'N, 83°27'W, 50m (F. Nevermann) [USNM]; *Puntarenas*: Sirena, Corcovado National Park, 8°29'N, 83°36'W, 50m (J. Longino, 2 collections); Monteverde, 10°18'N, 84°48'W, 1400m (J. Longino, 2 collections); Guacimal, rd to Monteverde, 10°14'N, 84°51'W, 500m (J. Longino, 2 collections); Guaria, rd to Monteverde, 10°15'N, 84°50'W, 700m (J. Longino); Ojo de Agua, rd to Monteverde, 10°16'N, 84°50'W, 800m (J. Longino, 2 collections); 5km SW Las Alturas, 8°55'N, 82°52'W, 1240m (J. Longino, 2 collections); same data (P. S. Ward); *San José*: San José, 9°56'N, 84°05'W (H. Schmidt) [MCSN, syntypes *plebecula*]; Carrillo, Braulio Carrillo Nat. Park, 10°09'N, 083°55'W, 500m (J. Longino); ECUADOR, *Guayas*: Cerro Blanco, 15km W Guayaquil, 2°10'S, 80°02'W, 400m (P. S. Ward).

Myrmelachista zeledoni **Emery**

Figures 1, 2

Myrmelachista zeledoni Emery 1896:102. Syntype workers: San José, Costa Rica (Alfaro) [MCSN] (examined). Description of male: Wheeler, W.M. 1934:203; description of larva: Wheeler, G.C. & Wheeler, J. 1953:138.

Myrmelachista zeledoni thiemi Emery 1906:185 (footnote). Syntype workers: Honda, Venezuela (Thieme) [MCSN] (examined). **NEW SYNONYM**.

Diagnosis

Worker black; antenna 10-segmented; face sericeous or shagreened, not shining.

Worker

Antenna 10-segmented; maxillary palpus 6-segmented; mandible smooth to feebly rugose; clypeus somewhat roughened; most of face with fine striate microsculpture giving a silky luster, grading to smooth and shiny on vertex margin; sides, rear margin and ventral surface of head with sparse, short, appressed pubescence, no erect setae; scapes with abundant suberect setae, longer setae about 1/2 scape width; hind tibia with abundant subdecumbent setae, longer setae about 1/4 width of tibia; mesosoma strongly constricted at metanotal groove, hourglass-shaped; entire mesosoma with reticulate microsculpture, matte; petiole in side view with compressed, scale-like node; color solid black. Also see description of Emery (1896).

Measurements: HL 0.521–0.720, HW 0.506–0.708, SL 0.364–0.472, EL 0.113–0.169, CI 92–100 (n=5).

Queen (previously unknown)

Similar to worker in meristic characters, patterns of sculpture, pilosity, coloration. Labrum short, bilobed.

Measurements: HL 0.904–1.031, HW 0.836–0.939, SL 0.465–0.534, EL 0.267–0.323, OW 0.061–0.080, OD 0.206–0.237, CI 90–92, OI 32–35, OcI 7–8 (n=5).

Male

See description of Wheeler (1934). Antenna 11-segmented; maxillary palpus 6-segmented; pygostyles present, sclerotized, setose; basiparamere lobe and paramere short, robust, broadly triangular; cuspis robust, spatulate, with an apicodorsal field of small teeth at the apical contact point with the digitus; digitus short, dorsal margin forming an abrupt right angle, apex of digitus a ventrally directed triangular lobe; penial valve short and broad, apex blunt, with dorsally-directed short triangular tooth, apodeme of penial valve strongly developed, at right angle to the rest of valve.

Range

Nicaragua, Costa Rica, Colombia, Venezuela, Peru. In Costa Rica it occurs throughout the country above 500m elevation.

Biology

This is a montane species that occurs at mid-elevation, from 600-1500m. It is most abundant in seasonally dry to moist forest habitat and less common in cloud forest and

very wet forest. It also seems more abundant in disturbed habitats than in mature forest. In Costa Rica it does well in synanthropic habitats, being common in the Central Valley and in scrubby forest on the Pacific slope in and below Monteverde.

Nests are usually in dead stems of trees, often in relatively hard wood, and usually high in the tree or otherwise highly insolated areas. Nests occasionally occur in live stems; I have collected nests from live stems of *Cecropia angustifolia*, *Hampea appendiculata*, and an unidentified lauraceous tree. It usually appears that they opportunistically use preexisting cavities rather than excavating their own. Colonies are often large and polydomous, occurring in many dead branches of multiple adjacent trees. Incipient colonies are monogynous in small dead or live stems.

Workers are diurnal foragers and may be found scattered on foliage and branch surfaces. In the field they look remarkably similar to *Crematogaster* and may even elevate the gaster when disturbed.

Material Examined

COSTA RICA, *province unknown*: Agua Caliente (W. M. Wheeler)[USNM]; *Cartago*: 8km ESE Moravia, 9°48'N, 83°23'W, 700m (J. Longino); Juan Vinas, 9°54'N, 83°45'W [USNM]; *Guanacaste*: 3km N Santa Elena, 10°20'N, 84°50'W, 1500m (J. Longino); Estacion Cacao, 10°55'N, 85°30'W, 1100m (J. S. Noyes); *Heredia*: 16km SSE La Virgen, 10°16'N, 84°05'W, 1100m (R. Vargas C.); same data (ALAS, 3 collections); *Puntarenas*: Monteverde, 10°18'N, 84°48'W, 1500m (J. Longino, 4 collections); same data (Yanoviak & Gering, multiple canopy fogging samples); Monteverde, 10°17'N, 84°49'W, 1100m (J. Longino); Santa Elena de Monteverde, 10°19'N, 84°50'W, 1300m (J. Longino); 2km SSE Monteverde, 10°17'N, 84°48'W, 1150m (J. Longino); Wilson Botanical Garden, 4km S San Vito, 8°47'N, 82°58'W, 1200m (J. Longino, 3 collections); Bajo Tigre, Monteverde, 10°18'N, 84°49'W, 1200m (D. W. Wagner); Cerro Plano de Monteverde, 10°18'N, 84°49'W, 1300m (J. S. Noyes); 5km SW Las Alturas, 8°55'N, 82°52'W, 1240m (P. S. Ward, 3 collections); same data (J. Longino, 2 collections); 2km SSW Las Alturas, 8°56'N, 82°51'W, 1380m (J. Longino); 3km W Las Alturas, 8°56'N, 82°52'W, 1360m (J. Longino, 2 collections); same data (P. S. Ward) 1 specimen; *San José*: San José, 9°56'N, 84°05'W (unknown) [MCSN, syntypes *zeledoni*]; same data (W. M. Wheeler) [USNM]; same data, 1100m (J. Longino); 15km S San Isidro, 9°17'N, 83°37'W, 600m (J. Longino); NICARAGUA, Jinotega (Sequeira) [USNM]; VENEZUELA, Honda (O. Thieme) [MCSN, syntypes *thiemei*].

Non-Costa Rican species with 9-segmented antenna

The majority of the available names in the genus *Myrmelachista* are for species with a 10-segmented antenna, and almost all of these are from South America. Only three, *longinoda*, *zeledoni* and *mexicana*, are known from Central America. There is little

question of the identity of *zeledoni* and *mexicana* in Costa Rica. *Myrmelachista longinoda* is known from a single queen from Panama, and it may be a species similar to but not conspecific with *cooperi*. There is no indication that there is a large undiscovered or complex community of 10-segmented forms in Central America.

In contrast, the species with 9-segmented antenna are more abundant and diverse in Central America and the Caribbean. The results from this study suggest there is a diverse and complex community and there will be many new species discovered with additional collecting in other parts of Central America. However, it is important to establish the identities of the existing available names, both for the correct assignment of names for the Costa Rican fauna and as a basis for further work on the Central American and Caribbean fauna. Below I review and discuss all the previously known forms with 9-segmented antenna.

Caribbean Taxa

Myrmelachista kraatzii Roger 1863:162. Syntype worker(s): Cuba [Matanzas, Cárdenas in Kempf 1972].

Myrmelachista rogeri Ern. André 1887:288. Holotype worker: Cuba. Description of queen, redescription of worker: Wheeler 1934:190.

Myrmelachista rogeri var. *manni* Wheeler 1934:190. Syntype workers: Cuba, Oriente, Saetia, workers on tree trunk (Mann) [USNM] (examined). (= *rogeri* in the sense of Mann 1920:434).

Myrmelachista rogeri var. *rubriceps* Mann 1920:434. Syntype workers: Cuba, Pinares, numerous workers from trunks of pine trees (Mann) [USNM] (examined).

Myrmelachista ambigua Forel 1893:350. Holotype worker: Lesser Antilles, Saint Vincent, Upper Richmond Valley (H. H. Smith).

Myrmelachista ambigua ramulorum Wheeler 1908:155. Syntype workers, queens, males: Puerto Rico, Culebra Island (Wheeler); Puerto Rico, Arecibo, Utuado (Wheeler) [MCZC, USNM] (USNM syntype worker examined). Raised to species: Wheeler 1934:189.

Myrmelachista ramulorum subsp. *fortior* Wheeler 1934:189. Syntype workers: Puerto Rico, Mona Island (Lutz). "...described from nine specimens ..., seven from Mona Island (type locality) and two from Porto Rico, without more precise locality." (Wheeler 1934).

Myrmelachista gagates Wheeler 1936:204. Holotype worker: Haiti, La Visite, 6000–7000 ft (Darlington).

The above are all the species and subspecies known from Caribbean islands. My knowledge of the Caribbean fauna is limited, but I have examined 20 collections of *ramulorum* from Puerto Rico, St. Croix, USA (Florida, possibly introduced and then extirpated, see Deyrup 2003), Santo Domingo, St. Thomas, and the Dominican Republic;

three collections of *rogeri* from Cuba; syntypes of *rogeri manni* from Cuba, and syntypes of *rogeri rubriceps* from Cuba. All appear to be similar to *plebecula*. All are bicolored or various shades of red brown. Unlike *plebecula*, all have long erect setae projecting from the sides of the head (workers and queens). Eight queens of *ramulorum* are very small with very narrow, rectangular heads. The largest of these have the narrowest heads, with HW around 0.70mm and CI around 74, a combination not found in any Costa Rican species except for the one small *longiceps*-like queen described under *longiceps*. Unlike *ramulorum*, the *longiceps*-like queen lacks erect setae on the sides of the head. The smallest *ramulorum* queens and the queens of *rogeri* are in the same size range as *plebecula* queens, but with relatively narrow heads. All measured queens of *plebecula* have CI 85 or greater. The highest CI among the *ramulorum* and *rogeri* queens is 82. *Myrmelachista kraatzii*, *ambigua*, *rogeri*, and *ramulorum* are all older names than *plebecula*, and if *plebecula* proves to be an allopatric variant of a widespread polytypic Caribbean species it will no doubt be a synonym of one of these older names.

It is not clear that *rogeri* and *ramulorum* are distinct. When two Cuban *rogeri* queens I have measured are compared to eight *ramulorum* queens from other islands, they are at the small end of a continuum of measurements.

Myrmelachista ambigua was described from a single worker from St. Vincent. Given the relative uniformity of workers, the published description and even examination of the type will be of little use. Queen and male-associated collections of *Myrmelachista* from St. Vincent will be needed to compare with material from other parts of the Caribbean. Wheeler (1908) considered the worker of *ramulorum* close to *ambigua*.

Myrmelachista gagates, from Haiti, was described as being close to *rogeri* but solid black.

It will be important to examine multiple collections of *Myrmelachista* from Cuba, to ascertain whether there are multiple sympatric species there. It is unknown whether *kraatzii* and the forms of *rogeri* are distinct or represent one variable species. *Myrmelachista kraatzii* from Cuba and *M. nigella* from Venezuela are the two oldest names in the genus, *kraatzii* being a 9-segmented form and *nigella* a 10-segmented form. Thus *kraatzii* would have priority among all the 9-segmented forms.

One collection from El Yunque, Puerto Rico, is indistinguishable from *M. longiceps*. It is a collection of workers and alate queens, collected by Juan Torres. I am reluctant to identify it as *longiceps* until more Puerto Rican material is obtained, but there is a large size gap between the queen of this El Yunque collection and the various queens of *ramulorum* from elsewhere in Puerto Rico.

From these observations it is clear that more collections are needed from the Caribbean to better understand species boundaries in this group.

Southern Mexico

Myrmelachista skwarrae Wheeler 1934:192. Syntype workers, queens, males: Mexico,

Morelos, Cuautla (Skwarra) [MCZC, USNM] (USNM syntype worker examined). "...described from numerous workers, seven females and six males (762) taken by Dr. Skwarra at Cuautla, Morelos (type-locality) in *Tillandsia circinata*, a number of workers belonging to several colonies (770, 771, 772, 777, 783a and 786) taken at Cuernavaca, Morelos in the same plant, and several workers (Z 208a) at Mirador, Vera Cruz in *T. valenzuelana*." (Wheeler 1934).

Myrmelachista skwarrae subsp. *picea* Wheeler 1934:194. Syntype workers: Mexico, Morelos, Cuernavaca (Skwarra 772, 773, 774, 787). Nesting in *Tillandsia circinata*.

Myrmelachista skwarrae subsp. *laeta* Wheeler 1934:195. Syntype workers: Mexico, Veracruz, Mirador (Skwarra). "...five workers (40) taken by Dr. Skwarra at Mirador Vera Cruz (type locality) in *Tillandsia balbisiana*, and one worker (762) taken at Cuautla, Morelos in *T. circinata*." (Wheeler 1934).

Myrmelachista amicta Wheeler 1934:195. Syntype workers: Mexico, Veracruz, Mirador (Skwarra: #618, in *Tillandsia balbisiana*; #296, in hollow stem of composite) [MCZC, USNM] (USNM syntype examined).

The above are a set of species described together by Wheeler from material collected by Elisabeth Skwarra in southern Mexico. They are all very similar to *plebecula* and *joycei*. I cannot distinguish workers of *amicta*, *skwarrae* (and its two subspecies *picea* and *laeta*), and *plebecula*. The males of *skwarrae* and *plebecula* are distinct. The male of *skwarrae* differs from *plebecula* in having a basiparamere lobe and distinct (though minute) setose pygostyles. *Myrmelachista skwarrae* males are more like *joycei*. They differ from *joycei* in the relatively thinner and more delicate basiparamere lobe and relatively larger ocelli.

If the Mexican forms prove to be geographic variants of *plebecula*, the latter has priority. On the other hand, *M. joycei* could prove to be a geographic variant of one of the previously named Mexican forms.

South America

Myrmelachista brevicornis Wheeler 1934:199. Syntype workers: Brazil, Santarem (Staudinger and Bang-Haas).

Myrmelachista guyanenesis Wheeler 1934:198. Syntype workers, queens: Guyana, Kartabo (Wheeler), inhabiting tenuous, anastomosing galleries in dead twigs and branches [MCZC, USNM] (USNM syntype worker examined).

From the descriptions of both species and my examination of workers of *guyanensis*, these two species are similar to and could be synonymous with *plebecula*. But further collections of South American *Myrmelachista* will be necessary to further understand their status.

It is tempting to speculate that the 10-segmented forms, widespread and diverse in

South America, have spawned one main radiation of 9-segmented forms in Central America and the Caribbean. In this scenario only *plebecula*, the "weediest" of 9-segmented forms, has spread into South America, and there is no diverse community of 9-segmented forms there. But the late discovery of a trove of 9-segmented *Myrmelachista* species in Costa Rica shows that this group may remain hidden from the general collector, even in the face of prolonged collecting effort. Thus we remain ignorant of extent of such forms in the South American hylea.

Acknowledgments

The results presented here are from 25 years of accumulated field collections in Costa Rica, and multiple Costa Rican institutions have been extremely supportive: The Servicio de Parques Nacionales, Instituto Nacional de Biodiversidad (INBio), Organizacion de Estudio Tropicales (OTS), the Monteverde Conservation League, and Monteverde Cloud Forest Reserve. I also thank the many undergraduate students who have worked with me in the field over the years. Bill Haber, Eladio Cruz, and Barry Hammel helped with plant identifications. Manuel Zumbado improved the Spanish abstract. The manuscript was improved by comments from Phil Ward and John LaPolla. This work was supported by National Science Foundation grant DEB-0072702 and National Geographic Society grant 7751-04.

Literature cited

André, E. (1887) Description de quelques fourmis nouvelles ou imparfaitement connues. *Revue d'E ntomologie (Caen),* 6, 280–298.

Bequaert, J. (1922) Ants in their diverse relations to the plant world. *Bulletin of the American Museum of Natural History,* 45, 333–584.

Bolton, B. (1995). *A New General Catalogue of the Ants of the World*. Cambridge, Mass., Harvard University Press.

Bolton, B. (2003) Synopsis and classification of Formicidae. *Memoirs of the American Entomological Institute* 71, 1–370.

Brown, W.L.,Jr. (1973) A comparison of the Hylean and Congo-West African rain forest ant faunas. *Tropical forest ecosystems in Africa and South America: a comparative review.* Meggers, B. J., Ayensu, E. S. & Duckworth, W. D. Washington, D.C., Smithsonian Institution Press, 161–185.

Burger, W. & van der Werff, H. (1990) Flora Costaricensis, Family #80 Lauraceae. *Fieldiana, Botany* 23, 1–129.

Davidson, D.E. & McKey, D. (1993) The evolutionary ecology of symbiotic ant-plant relationships. *Journal of Hymenoptera Research* 2, 13–83.

Deyrup, M. (2003) An updated list of Florida ants (Hymenoptera: Formicidae). *Florida Entomologist* 86, 43–48.

Donisthorpe, H. (1944) Notes arising out of Mr. W. D. Hincks's review of Mr. Donisthorpe's "A list of the type-species of the genera and subgenera of the Formicidae". *Entomologist's Monthly Magazine,* 80, 59.

Emery, C. (1896) Studi sulle formiche della fauna neotropica. XVII–XXV. *Bullettino della Società Entomologica Italiana* 28, 33–107.
Emery, C. (1906 "1905") Studi sulle formiche della fauna neotropica. XXVI. *Bullettino della Società Entomologica Italiana* 37, 107–194.
Emery, C. (1925). Hymenoptera. Fam. Formicidae. Subfam. Formicinae. *Genera Insectorum* 183, 1–302.
Forel, A. (1893) Formicides de l'Antille St. Vincent, récoltées par Mons. H. H. Smith. *Transactions of the Entomological Society of London* 1893, 333–418.
Frederickson, M.E., Greene, M.J. & Gordon, D.M. (2005) 'Devil's gardens' bedevilled by ants. *Nature*, 437, 495–496.
Gregg, R.E. (1951) Two new species of exotic ants. *Psyche* 58, 77–84.
Gregg, R.E. (1954 ("1953")) Taxonomic notes on the ant, *Camponotus cooperi* Gregg. *Psyche*, 60, 102–104.
Hammel, B.E. (1986) The vascular flora of La Selva Biological Station, Costa Rica - Lauraceae. *Selbyana*, 9, 218–233.
Hölldobler, B. & Wilson, E.O. (1990) *The Ants*. Harvard University Press, Cambridge, Massachusetts, USA, 732 pp.
Ibarra-Manríquez, G. & Dirzo, R. (1990) Arboreal myrmecophilous plants from Los Tuxtlas Biological Station, Veracruz. *Revista de Biologia Tropical*, 38, 79–82.
International Commission on Zoological Nomenclature (1999). *International Code of Zoological Nomenclature, Fourth Edition*. London, UK, The International Trust for Zoological Nomenclature.
Kempf, W.W. (1972) Catálogo abreviado das formigas da região Neotropical. *Studia Entomologica*, 15, 3–344.
Longino, J.T. (2000) The ants of Monteverde. *Monteverde: ecology and conservation of a tropical cloud forest*. Nadkarni, N. M. & Wheelwright, N. T. New York, New York, Oxford University Press**,** 132–136.
Mann, W.M. (1920) Additions to the ant fauna of the West Indies and Central America. *Bulletin of the American Museum of Natural History* 42, 403–439.
Menozzi, C. (1927) Formiche raccolte dal Sig. H. Schmidt nei dintorni di San José di Costa Rica (Schluss). *Entomologische Mitteilungen*, 16, 336–345.
Morawetz, W., Henzl, M. & Wallnöfer, B. (1992) Tree killing by herbicide producing ants for the establishment of pure *Tococa occidentalis* populations in the Peruvian Amazon. *Biodiversity and Conservation*, 1, 19–33.
Renner, S.S. & Ricklefs, R.E. (1998) Herbicidal activity of domatia-inhabiting ants in patches of *Tococa guianensis* and *Clidemia heterophylla*. *Biotropica*, 30, 324–327.
Roger, J. (1863). Die neu aufgeführten Gattungen und Arten meines Formiciden-Verzeichnisses nebst Ergänzung einiger früher gegebenen Beschreibungen. *Berliner Entomologische Zeitschrift*, 7, 131–214.
Schonberg, L., Longino, J.T., Nadkarni, N.M., Yanoviak, S.P. & Gering, J.C. (2004) Arboreal ant species richness in primary, secondary forest and pasture habitats of a tropical montane landscape. *Biotropica*, 36, 402–409.
Schumann, K. (1889) Ueber Ameisenpflanzen. *Sammlung gemeinverständlicher wissenschaftlicher Vorträge (Hamburg)*, 4 , 421–459.
Snelling, R.R. & Hunt, J.H. (1976 [1975]) The ants of Chile (Hymenoptera: Formicidae). *Revista Chilena de Entomología*, 9, 63–129.
Snodgrass, R.E. (1941) The male genitalia of Hymenoptera. *Smithsonian Miscellaneous Collections*, 99, 1–86.
Stout, J. (1979) An association of an ant, a mealy bug, and an understory tree from a Costa Rican rain forest. *Biotropica*, 11, 309–311.

Svoma, E. & Morawetz, W. (1992) Drüsenhaare, emergenzen und blattdomatien bei der ameisenpflanze *Tococa occidentalis* (Melastomataceae). *Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie*, 114, 185–200.

Ule, E. (1907–1908) Die Pflanzenformationen des Amazonas-Gebietes. Pflanzengeographische Ergebnisse meiner in den Jahren 1900–1903 unternommenen Reisen. *Botanische Jahrbucher für Systematik, Pflanzengeschichte und Pflanzengeographien*, 40, (1907) 114–172, (1908) 398–443, 8 plates.

Wheeler, G.C. & Wheeler, J. (1953) The ant larvae of the subfamily Formicinae. *Annals of the Entomological Society of America*, 46, 126–171.

Wheeler, W.M. (1908) The ants of Porto Rico and the Virgin Islands. *Bulletin of the American Museum of Natural History*, 24, 117–158.

Wheeler, W.M. (1934) Neotropical ants collected by Dr. Elisabeth Skwarra and others. *Bulletin of the Museum of Comparative Zoology*, 77, 157–240.

Wheeler, W.M. (1936) Ants from Hispaniola and Mona Island. *Bulletin of the Museum of Comparative Zoology*, 80, 195–211.

Wheeler, W.M. (1942) Studies of Neotropical ant-plants and their ants. *Bulletin of the Museum of Comparative Zoology*, 90, 1–262.

