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Two new dolichoderine ant genera from Madagascar: *Aptinoma* gen. n. and *Ravavy* gen. n. (Hymenoptera: Formicidae)

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Abstract

The Malagasy dolichoderine ant genera *Aptinoma* and *Ravavy* and the following species are newly described: *Aptinoma mangabe* **sp. n.** (type species), *Aptinoma antongil* **sp. n.**, and *Ravavy miafina* **sp. n.** (type species). A key to the five dolichoderine genera of the Malagasy region based on workers is presented.

Key words: Afrotropical, Malagasy endemics, arthropods, ants, *Ravavy*, *Aptinoma*, taxonomy, Dolichoderinae

Introduction

Field collecting in Madagascar over the last 15 years has provided a comprehensive overview of ants and other arthropods from the island (Fisher 2005, Fisher & Penny 2008). Fieldwork included sampling from the full range of vegetation, climate, elevation, and geological substrates found across Madagascar. Diverse collecting methods were used including leaf litter sifting, light traps, Malaise traps, pitfall traps, and manual hand collecting.

These efforts have revealed an estimated 1,000 new ant species. However, a number of these new taxa cannot be placed in existing genera. A separate study on the phylogenetic relationships within the Dolichoderinae provided the opportunity to evaluate the Malagasy dolichoderine lineages (Ward, Brady, Fisher & Schultz 2009). The phylogenetic study revealed two new lineages described here as *Aptinoma* and *Ravavy. Ravavy* is sister to *Loweriella*, within a newly defined Bothriomyrmecini, but at considerable depth within the tree, justifying its treatment as a separate genus. *Aptinoma* was recovered as sister to *Tapinoma*, within the tribe Tapinomini, again at considerable depth in the tree, making it unlikely that *Tapinoma* is paraphyletic with respect to *Aptinoma*. The purpose of this paper is to provide names for these two new lineages and describe the species that occur in Madagascar.

Methods

This revision is primarily based on arthropod surveys carried out in Madagascar from 1992 to 2008 that included over 6,000 leaf litter samples, 4,000 pitfall traps, and 9,000 additional hand collecting events (see Fisher 2005 for additional details).

Specimens of *Aptinoma* and *Ravavy* were examined from the following collections:

CASC	California Academy of Sciences, San Francisco, CA, USA
PSWC	P. S. Ward Collection, University of California at Davis, CA, USA

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All species and type material examined in this study have been imaged and are available on AntWeb (www.antweb.org). Material was deposited at the California Academy of Sciences, San Francisco (CASC); British Museum of Natural History, London (BMNH); Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts (MCZC), and the Madagascar Biodiversity Center (MBCC), Antananarivo, Madagascar.

New specific names in this work are nouns in apposition to the generic name and thus invariant. Each specimen discussed below is uniquely identified with a specimen-level code (e.g., CASENT0003099) affixed to each pin. In addition, each specimen may include a collection code, which is a field number that uniquely identifies collecting events (e.g. BLF01652). Collection codes, when available, are associated with a collector and follow the collector's initials.

Digital color images were created using a JVC KY-F75 digital camera and Syncroscopy Auto-Montage (v 5.0) software. All measurements were taken at 80× power with a Leica MZ APO microscope using an orthogonal pair of micrometers, recorded to the nearest 0.001 mm, and rounded to two decimal places for presentation. When more than one specimen was measured, minimum and maximum measurements and indices are presented. Measurements follow those used by Bolton 2007. Abdominal segments are noted by "A" and the segment number, such as A2 for the petiole and A3 for the first gastral segment. In Dolichoderinae "gaster" refers to abdominal segments A3–A8 in the workers and females, and A3–A9 in males (apex of abdomen). Antenna segment count is as follows: scape refers to segment 1, pedicel to segment 2, and flagellum to segments 3–12 in females or 3–13 in males. Palp formula (e.g., 6:3) is the number of maxillary and labial palp segments separated by a colon.

Abbreviations used

HL Head length, excluding mandibles: the maximum longitudinal length from the mid-point of the anterior clypeal margin to the mid-point of the posterior margin, measured in full-face view (male: including ocelli).

HW Head width: the maximum width of the head behind the eyes, measured in full-face view (male: including eyes).

ED Eye diameter: maximum diameter of eye as measured normally in oblique lateral view of the head to show full surface of eye.

SL Scape length: maximum chord length excluding basal condyle and neck.

WL Weber's length (mesosoma length): in lateral view of the mesosoma, diagonal length from posteroventral corner of propodeum to the farthest point on anterior face of pronotum, excluding the neck.

PW Pronotum width: in dorsal view, maximum width of pronotum.

FL Femur length: maximum length of hind femur.

CI Cephalic index: HW/HL × 100.

SI Scape index: SL/HW × 100.

Genus *Aptinoma*

Aptinoma Fisher gen. n.

Figures 1–5, 7a

Type-species: *Aptinoma mangabe* **sp. n.**, by present designation.

Diagnosis of worker. Dimorphic, with distinct minor and major workers. Major workers polymorphic. Lateral and anterior corner of hypostoma reduced to a thin sclerite, without expanded flange. Mandible with

4–6 teeth apically on masticatory margin; counting from the apex, third tooth smaller than fourth, fifth smaller than sixth. Teeth followed by a fine series of 4–8 denticles (effaced in some major workers); basal angle blunt, with a relatively uninterrupted curve between the masticatory and basal margins; basal margin with minute serrations. Antennae with 12 segments. Palpal formula 6:3 (confirmed with dissection of *A. mangabe*). Fourth maxillary palp segment subequal in length to segment 5. Fifth maxillary palp segment at the apical extreme of segment 4. Metanotal groove impressed but often weak. Propodeum unarmed, without any acute angle. Propodeal declivity almost straight in profile. Petiolar scale present, in the form of a node with low standing forward face. Gaster with only four plates on upper surface; fifth tergite (abdominal tergite 7) reflexed ventrally, and visible in ventral view where it forms a transverse plate abutting the fifth sternite. Mesosoma lacking erect hairs.

Diagnosis of queen. Based on one specimen of *A. mangabe*. Ergatoid with diagnostic characters of workers. Ocelli present. Scutellum distinct. Petiolar scale present, in the form of a node with a low standing forward face.

Diagnosis of male. Based on *A. mangabe*. Scape not reaching or surpassing posterior lateral margin of head in full-face view; scape length shorter than the length of segments 3 + 4. Second antenatal segment (pedicle) cone-shaped. Compound eyes relatively anterior on head. Anterior clypeal margin with a broad, shallow concavity. Posterior clypeal margin between the anterior and posterior surfaces of the antennal condyle. Palpal formula 6:3 (not confirmed with dissection). Mandible with single apical tooth followed by series of serrate teeth or denticles (> 20) along masticatory margin; basal angle of mandible indistinct, with a relatively uninterrupted curve between the two margins. Petiole with distinct scale, angled dorsally and strongly inclined anteriorly, with anterior face shorter than posterior face. First gastral segment in dorsal view with a groove for reception of entire height of petiole.

Discussion of characters. In many respects *Aptinoma* workers are similar to *Tapinoma* workers. Both genera share a number of traits, including the shape of the clypeus, position of eyes, and shape and number of mandibular teeth and denticles. *Aptinoma* differs from *Tapinoma* in palpal formula (6:3 in *Aptinoma*, 6:4 in *Tapinoma* (confirmed with dissection; Fig. 7c). *Aptinoma* also differs in having a more developed petiole node. The petiolar node in *Tapinoma* is flat, with almost no visible rise in the anterior face. In *Aptinoma*, a visible face is present. The face is more pronounced in major workers. The combination of palpal formula and form of petiolar node form an inclusive diagnosis that isolates *Aptinoma* from all other genera within the subfamily. Within the Malagasy region, the presence of dimorphic workers (with majors and minors), distinguish *Aptinoma* from all other dolichoderine genera. In males, the length of scape (shorter than the length of antennal segments 3 + 4), the presence of a petiole scale, and palpal formula 6:3 form an inclusive diagnosis.

Key to workers of Malagasy *Aptinoma*

1 In profile, metanotal groove distinct and set in shallow V-shaped impression (Figs 1a, e). Propodeal dorsum more or less convex, meeting steeply sloped declivity in blunt, narrowly rounded curve. In dorsal view, lateral margin of pronotum evenly convex, without blunt angle at widest point (Figs 1c, 2c). Body light to dark brown. ..... *Aptinoma antongil*

- In profile, metanotal groove not set in a V-shaped impression (Figs 3a, 4a). Propodeum in absolute profile without differentiated dorsal and declivitous surfaces, forming single evenly rounded surface. In dorsal view, lateral margin of pronotum with blunt angle at widest point (Figs 3c, g). Body yellow to orange. ..... *Aptinoma mangabe*

***Aptinoma antongil* Fisher sp. n.**
Figures: **worker** 1, 2

Type material: *Holotype*: major worker, MADAGASCAR, Province Toamasina, Parc National de Masoala, 39.4 km 150° SSE Maroantsetra, 15.71°S, 49.97°E, 200m, 1 December 2001, under canopy moss and leaf litter, rainforest (coll. B.L.Fisher & H.J.Ratsirarson) collection code: BLF04719, pin code: CASENT0418269 (CASC). *Paratypes*: 5 workers with same data as holotype but pins coded CASENT0418267, CASENT0418268, CASENT0418270 (BMNH, CASC, MBCC, MCZC).

Major Worker measurements: maximum and minimum based on all specimens, n=10: HL 0.47–0.63 , HW 0.48–0.63, CI 93–102, ED 0.10–0.13, SL 0.34–0.40, SI 63–73, WL 0.50–0.70, FL 0.39–0.49, PW 0.29–0.39.

Minor Worker measurements: maximum and minimum based on all specimens, n=2: HL 0.40–0.42 , HW 0.39, CI 94–98, ED 0.09, SL 0.30–0.32 , SI 77–80, WL 0.46, FL 0.34, PW 0.22–0.26.

With characters described in the genus diagnosis for major and minor workers: Anterior clypeal margin without a distinct shallow impression; medial clypeal margin with two or more pairs of setae directed anteriorly; additional pair of setae, slightly anterior of clypeal margin, directed anterodorsally. Scape not surpassing posterior margin of the head in full-face view in both major and minor. In dorsal view, lateral margin of pronotum evenly convex, without blunt angle at widest point. Metanotal groove in profile distinct and impressed. Dorsum of propodeum more or less convex, meeting the steeply sloped declivity in a blunt, narrowly rounded curve. In profile, propodeal spiracle along margin of declivitous face. Body light to dark brown.

Major workers are variable in size and are distinguished from the minor workers by shorter scapes relative to head width (SI 63–73). Since only two minor workers were collected, further samples are needed to evaluate if there is a continuum of worker sizes from minors to the larger majors.

A. antongil can be separated from *A. mangabe* by color and shape of propodeum and metanotal groove as outlined in the key to species. Minor workers of *A. antongil* are easily distinguished from minor workers of *A. mangabe* by length of scape. The scape surpasses the posterior margin of the head in minor workers in *A. mangabe* while in *A. antongil* it does not reach the margin.

QUEEN and MALE: unknown.

Distribution and biology. The distribution is limited to forests around Antongil Bay, Madagascar. Specimens have been collected from canopy habitat on the Masoala Peninsula and on low vegetation near the summit of Montagne d'Anjanaharibe (1100 m) just north of Maroansetra. Like *A. mangabe*, this species is arboreal. However, it may not nest in dead twigs as does *A. mangabe*. Collections suggest that the species nests under canopy litter and moss. The collections in Masoala were made by exploring the canopy using ropes. *A. antongil* workers were found foraging under moss and litter at the junction of branches.

Additional material examined for *Aptinoma antongil*: In addition to the type material, specimens from five additional collecting events from the following two localities were examined in this study. MADAGASCAR, Province Toamasina: Parc National de Masoala, 39.4 km 150° SSE Maroantsetra, 200 m, 15.71°S, 49.97°E, (B.L.Fisher & H.J.Ratsirarson), 1 December 2001, rainforest, canopy moss and leaf litter collection codes: BLF04716, BLF04717, BLF04718 BLF04721. Montagne d'Anjanaharibe, 19.5 km 27° NNE Ambinanitelo, 1100 m, 15.17833°S, 49.635°E, (Fisher *et al.*), 14 March 2003, montane rainforest, beating low vegetation, collection code: BLF08151.

***Aptinoma mangabe* Fisher sp. n.**
Figures: **worker** 3, 7a, **queen** 4, **male** 5

Type Material: *Holotype*: major worker, MADAGASCAR, Province Toamasina, Nosy Mangabe, 7.43 km S Maroantsetra, 15.4973°S, 49.76223°E, 5 m. 27 July 2007, ex dead twig above ground, littoral rainforest edge

(coll. J.J. Rafanomezantsoa.) collection code: BLF17925, pin code: CASENT0130146 (CASC). *Paratypes*: 1 minor worker, 1 major worker, ergatoid queen, male with same data as holotype but pins coded CASENT0130148, CASENT0192285, CASENT0175008, CASENT0130147, respectively (BMNH, CASC, MCZC).

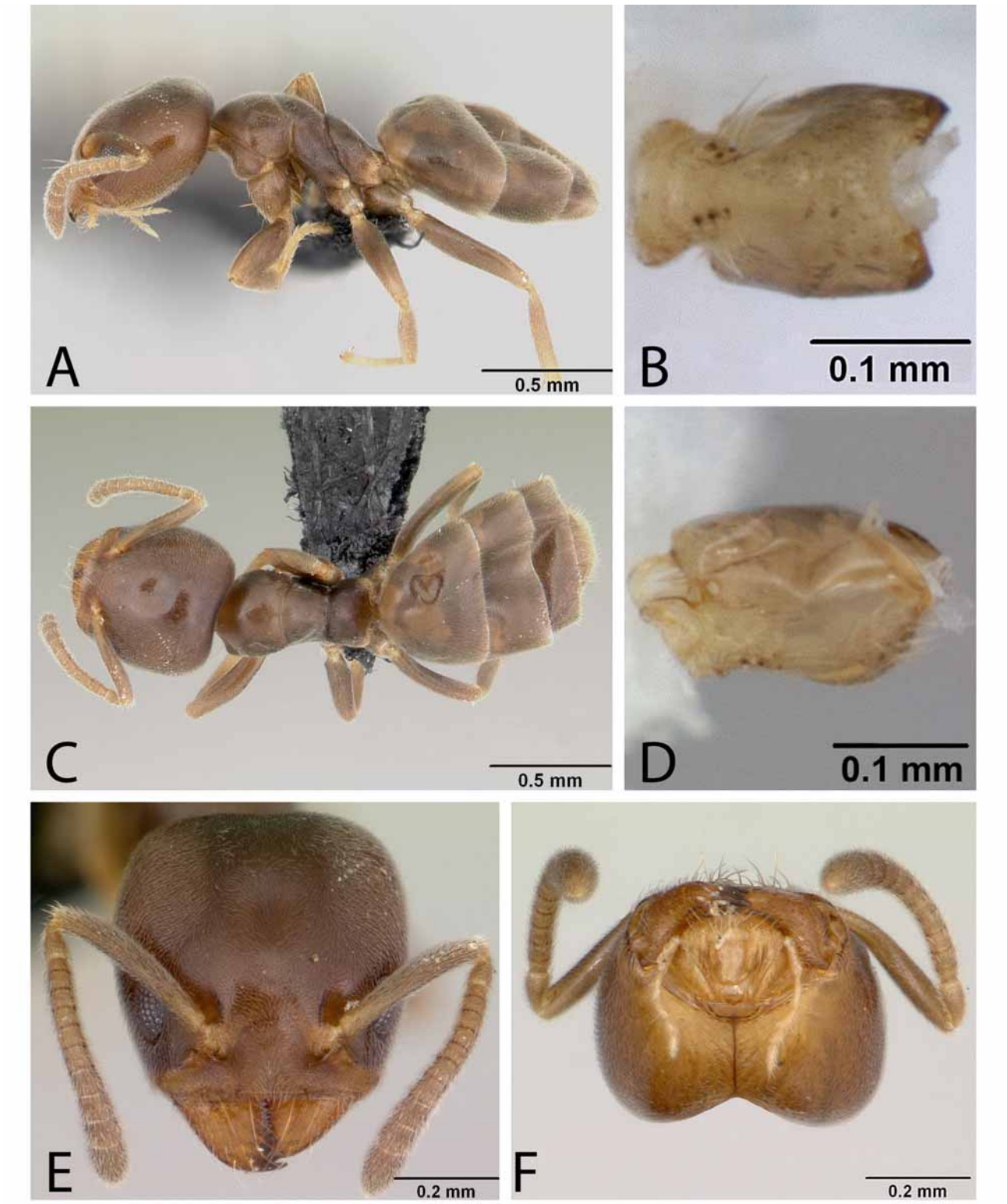

FIGURE 1. *Aptinoma antongil* major worker CASENT0489161. A, profile; B, petiole in ventral view (anterior to left); C, dorsum; D, petiole in profile (anterior to left); E, full face; F, buccal cavity.

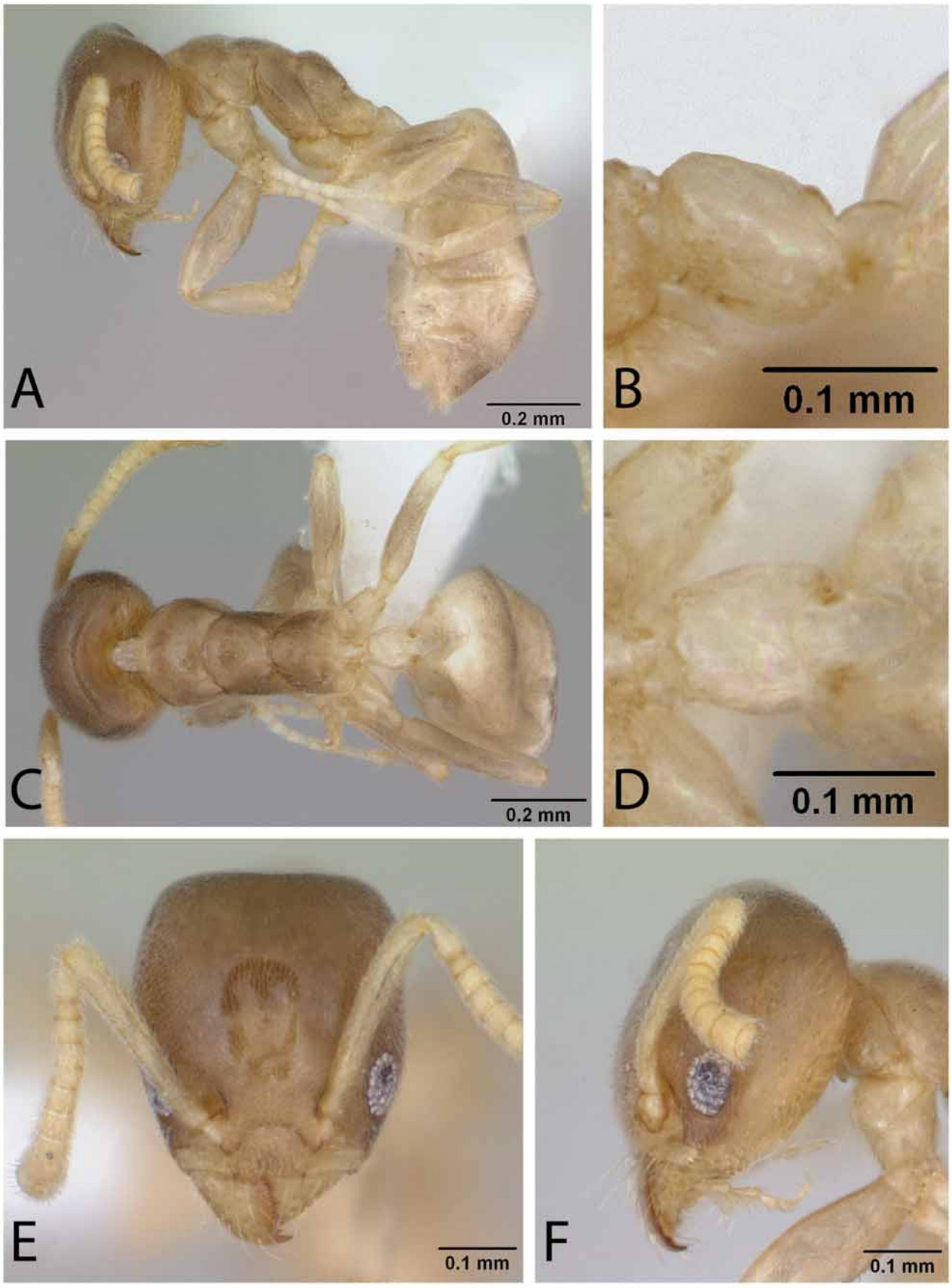

FIGURE 2. *Aptinoma antongil* minor worker CASENT0418267. A, profile; B, petiole in profile (anterior to left); C, dorsum; D, petiole in dorsal view; E, full face; F, head in profile.

Major worker measurements: maximum and minimum based on all specimens, n=5, HL 0.54–0.57 , HW 0.53–0.56, CI 99–102, ED 0.10–0.11, SL 0.39–0.41, SI 70–75, WL 0.57–0.64, FL 0.47–0.49, PW 0.34–0.37.

Minor worker measurements: maximum and minimum based on all specimens, n=5, HL 0.42–0.46 , HW 0.37–0.42, CI 86–96, ED 0.09, SL 0.38–0.41, SI 97–103, WL 0.48–0.54, FL 0.41–0.45, PW 0.22–0.29.

With characters described in the genus diagnosis for major and minor workers: Apical teeth on mandible followed by 4–6 denticles; basal margin with minute, serrate teeth. Anterior clypeal margin with distinct shallow median impression; medial clypeal margin with three pairs of setae arched anteriorly over mandibles; additional pair of setae on clypeus, posterior of clypeal margin, directed anterodorsally. Scape surpassing posterior margin of head in full-face view in minors, not surpassing margin in majors. In dorsal view, lateral margin of pronotum with blunt angle at widest point. Metanotal groove in profile not impressed; propodeum in profile with dorsal and declivitous surfaces not differentiated, forming single evenly rounded surface without trace of angle at junction with declivity. Body yellow to orange.

A. mangabe can be separated from *A. antongil* by color and shape of propodeum and metanotal groove as outlined in the key to species. Differences in minor workers are discussed under *antongil*.

Queen (ergatoid) measurements: n=1. HL 0.61, HW 0.59, CI 97, ED 0.15, SL 0.44, SI 75, WL 0.82, FL 0.57, PW 0.44.

All main morphological characters of the major worker are duplicated in the queen caste. In the ergatoid queen, ocelli are present and the mesoscutellum is distinct. Metanotum indistinguishable, but metanotal groove distinctly wider than that of workers.

Male measurements: maximum and minimum based on n=3: HL 0.40–0.43, HW 0.54–0.57, CI 127–137, ED 0.22–0.25, SL 0.21, SI 37–39, WL 0.74–0.78, FL 0.52–0.55.

In profile, inner margin of eye convex, not flat. Antenna with 13 articles. Scape not reaching posterior margin of head, shorter than flagellar segments 1+2+3. Pedicel conical. First flagellar article cylindrical, straight, articles 1 and 2 twice as long as broad. Anteromedial clypeal margin with central concavity. Anterior clypeal margin with several pairs of straight setae projecting anteriorly, central pair longer than the setae at lateral margins. Just posterior to anterior margin, a single pair of suberect setae projecting anterodorsally. Posterior clypeal margin convex between antennal socket cavities. Palpal formula 6:3 (not confirmed with dissection). Mandible with apical tooth followed by a series of 15 or more minute denticles that decrease in size towards the basal margin. An uninterrupted curve between masticatory and basal margins. Propodeal angle indistinct; declivitous and dorsal faces of propodeum forming a single convexity. Petiole in profile with distinct scale, angled dorsally and strongly inclined anteriorly with anterior margin shorter than posterior margin. Venter of petiole with weakly developed lobe. Pygostyles present.

Distribution and biology. Distribution is limited to forests around Antongil Bay including the island of Nosy Mangabe and the adjacent forest of the Masoala Peninsula. Specimens were collected from dead twigs or vines, or foraging in the canopy. Males were collected in colonies in April and July. The only queen collected was an ergatoid.

Additional material examined for *Aptinoma mangabe*: In addition to the type material, specimens from 8 additional collecting events from the following 4 localities were examined in this study. MADAGASCAR, Province Toamasina:

P.N. Masoala, 40 km 154° SSE Maroantsetra, 150 m, 15.72667°S, 49.95667°E, (A. Dejean & B. Rajemison), 14 October 2001, rainforest, canopy. Tampolo, Masoala Peninsula, 40.4 km 154° SSE Maroantsetra, 30 m, 15.73°S, 49.96°E, (B.L.Fisher, & H.J.Ratsirarson), 28 November 2001, rainforest, canopy collection codes: BLF04698 BLF04713, BLF04717. Nosy Mangabe, 7.43 km S Maroantsetra, 5 m, 15.4973°S, 49.76223°E, (C. Ranaivo & C. E. Randrianandrasana), littoral rainforest edge, collection codes: BLF17931, 27 July 2007, on low vegetation; BLF18015, 31 August 2007, ex dead twig above ground. Nosy Mangabe, <5 m, 15.5°S, 49.76667°E, (P.S.Ward), collection code: PSW10346, 20 April 1989, rainforest edge, ex dead twig of vine.

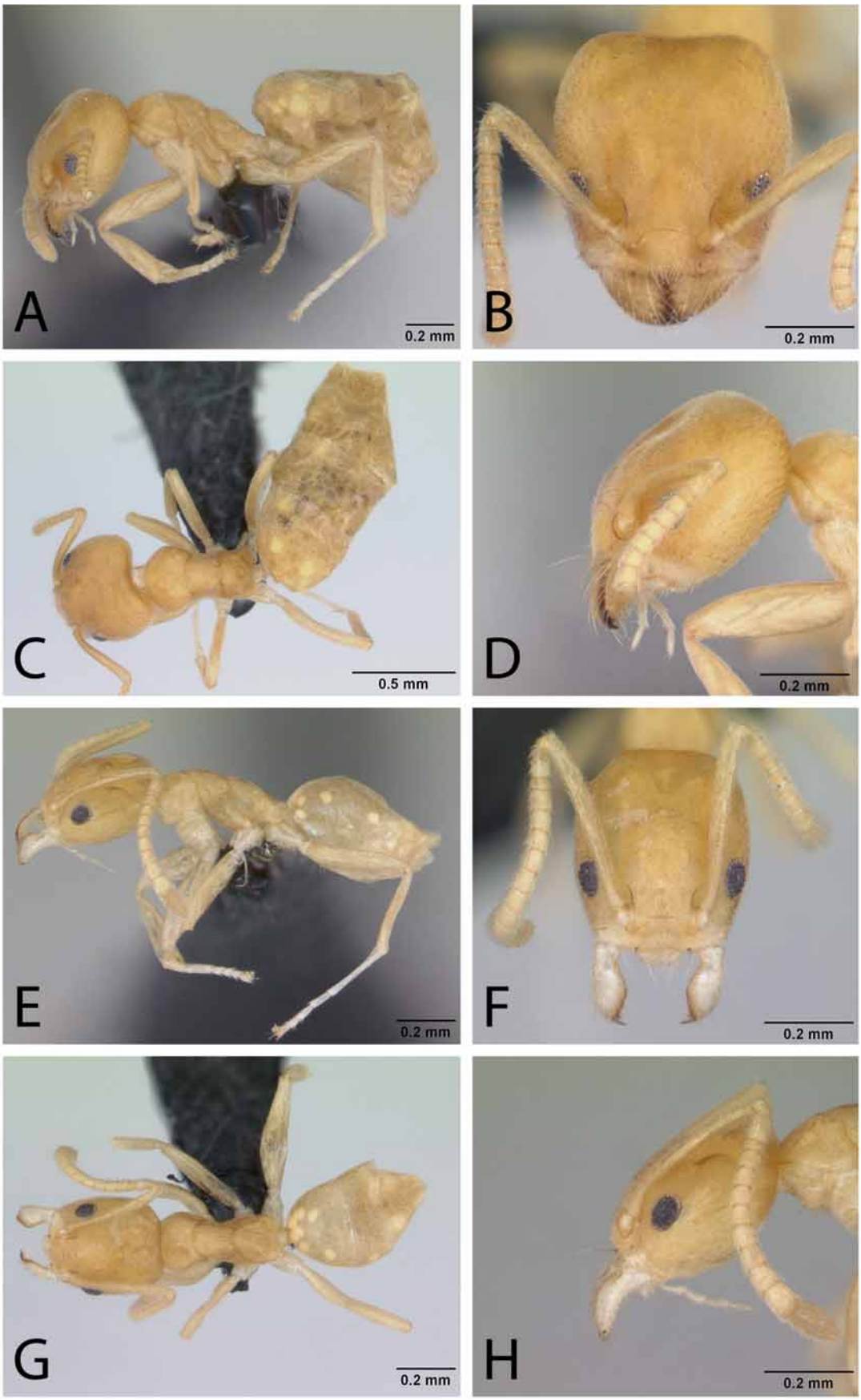

FIGURE 3. *Aptinoma mangabe* major worker holotype CASENT0130146 (major) A–D; minor worker paratype CASENT0130148 E–H. A, profile; B, full face; C, dorsum; D, head in profile; E, profile; F, full face; G, dorsum; H, head in profile.

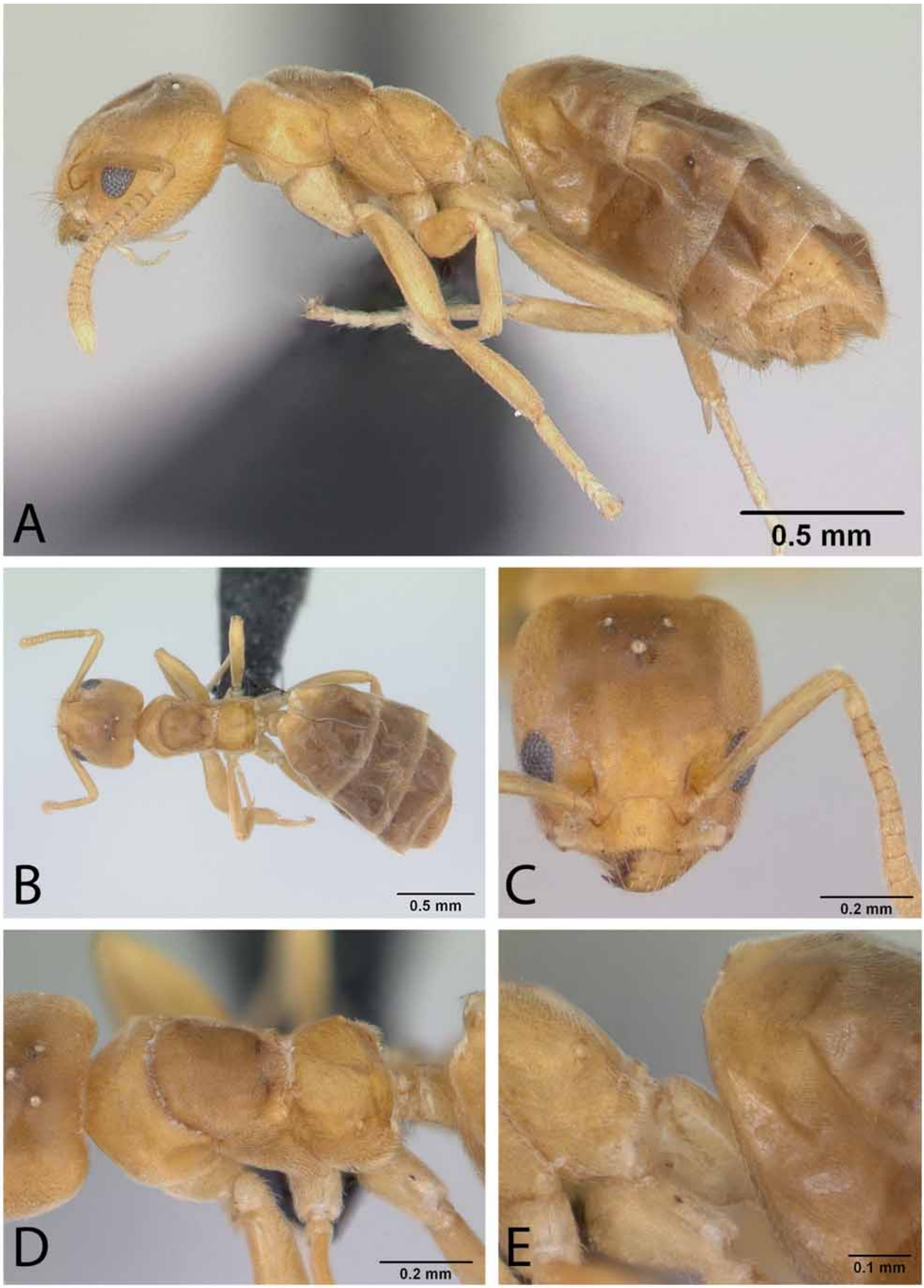

FIGURE 4. *Aptinoma mangabe* queen CASENT0175008. A, profile; B, dorsum; C, full face; D, dorsum of mesosoma, oblique view; E, petiole in oblique lateral view.

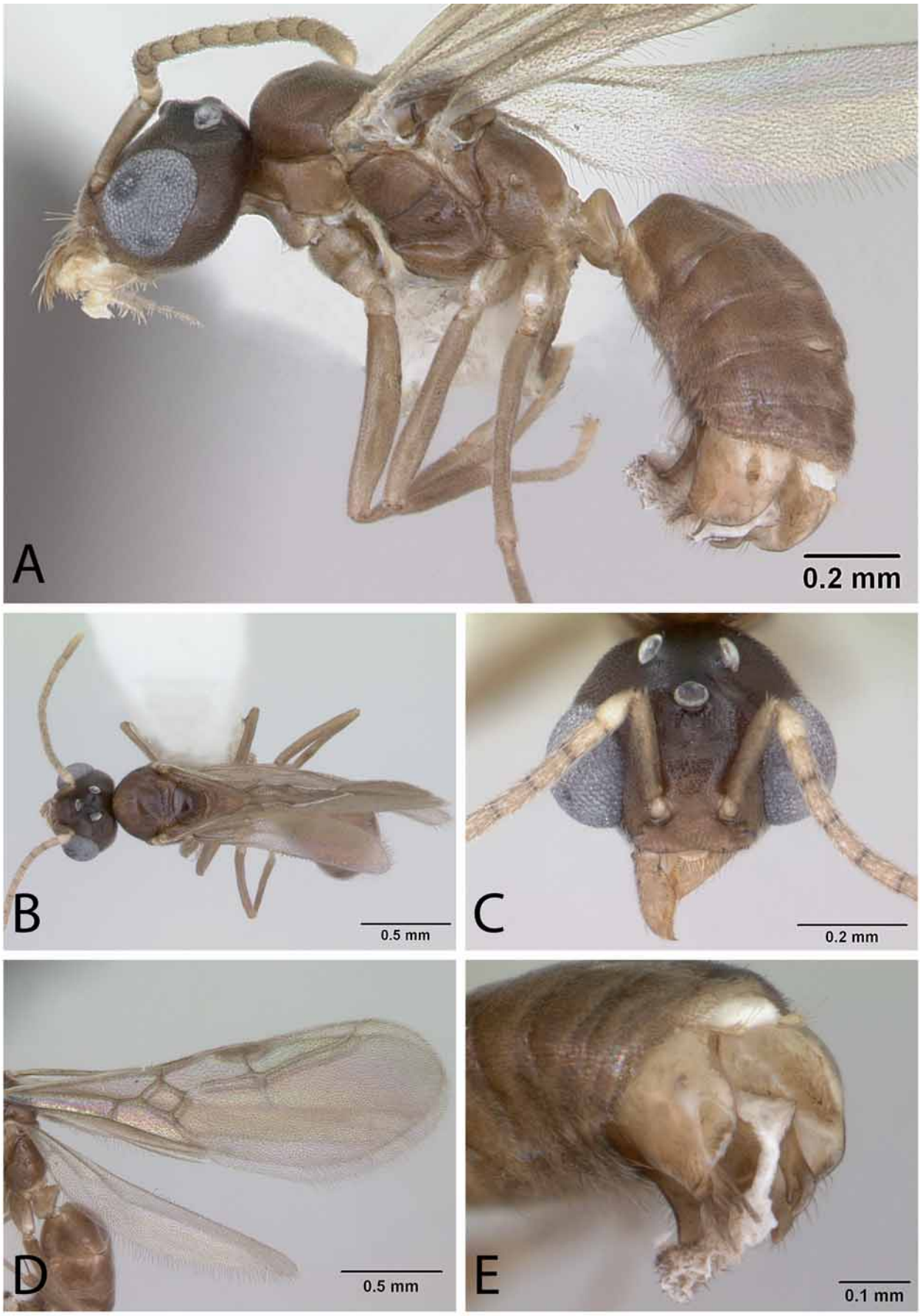

FIGURE 5. *Aptinoma mangabe* male CASENT0173594. A, profile; B, dorsum; C, full face; D, hindwing and forewing; E, genitalia in oblique lateral view.

Genus *Ravavy*

***Ravavy* Fisher gen. n.**
Figures 6, 7b

Type species ***Ravavy miafina*, sp. n.**, by present designation.

WORKER and QUEEN: unknown.

Diagnosis of male. Based on specimens of *Ravavy miafina*. Head longer than wide. Ventral margin of eye more or less flat. Antennae with 13 articles. Scape length twice that of flagellar segment 1. Scape not reaching posterior margin of head. Pedicel conical. First flagellar segment cylindrical, straight. Flagellar segments 1 and 2 three times as long as broad. Anteromedian clypeal margin entire, without central concavity. Posterior clypeal margin straight, not projecting between antennal socket cavities. Palpal formula 6:3 (confirmed with dissection). Mandible with single narrow apical tooth, located at tip of mandible; without series of serrate denticles or teeth along margin. Masticatory margin meeting basal margin in abrupt angle. Basal margin elongate, greater than twice length of masticatory margin. Propodeal angle indistinct; declivitous and dorsal faces of propodeum convex. In profile, petiole with distinct node; anterior and posterior margin subequal in height, dorsum evenly convex. Attachment to gaster broad. First gastral segment in dorsal view without grove for the reception of the entire height of the petiole.

Discussion of male characters. *Ravavy* is distinguished from all other described males in the dolichoderine genera by its unique mandibular shape. The elongate basal margin and reduced masticatory margin is considered apomorphic for the genus. The shape of the clypeus, length of scape and form of petiole, together form an inclusive diagnosis that isolates *Ravavy* from all other genera in the subfamily. No other described male is even superficially similar to *Ravavy.* The shape of the mandible in *Bothriomyrmex* Emery (see images on AntWeb CASENT0103279), however, is reminiscent in some respects. The mandible in *Bothriomyrmex* is not triangular as in *Tapinoma* for example, but like *Ravavy,* has a short masticatory margin compared to the basal margin. In *Bothriomyrmex,* however, the masticatory margin includes at least three teeth, while in *Ravavy* a single tooth is present.

***Ravavy miafina* Fisher sp. n.**
Figures: **male** 6, 7b

Type material: *Holotype*: male, MADAGASCAR, Province Antsiranana, Ampasindava, Forêt d'Ambilanivy, 3.9 km 181° S Ambaliha, 13.79861°S, 48.16167°E, 600m, 4–9 March 2001, Malaise trap, rainforest (coll. B.L. Fisher *et al.*) collection code: BLF03251, pin code: CASENT0081523 (CASC). *Paratypes*: 6 males with same data as holotype but pins coded CASENT0476953, CASENT0476983, CASENT0476947, CASENT0081525 (BMNH, CASC, MBCC, MCZC).

WORKER and QUEEN: unknown.

Male measurements: maximum and minimum based on n=10: HL 0.46–0.50, HW 0.43–0.47, CI 91–98, ED 0.20–0.23, SL 0.17–0.21, SI 39–47, WL 0.78–0.84, FL 0.60–0.70.

With characters of the genus, and the following. Head longer than wide, CI 91–98. Clypeus prominent; width of clypeus from posterior margin at antennal sockets to anterior margin equal in length to antennal segment 3 (flagellar segment 1). Anteromedial clypeal margin with single pair of setae projecting in line with the mandibles, posterior to this pair and more distal, single pair of suberect setae project anterodorsally above mandibles. Pair of erect setae posterior of clypeus between antennal sockets. Clypeus and head with short appressed setae. Mandibles smooth under dense matte of appressed setae. Dorsum of mesosoma, and gaster with dense pubescence. Mesosoma without erect setae; abdominal tergites A5–8 with at least one pair of erect

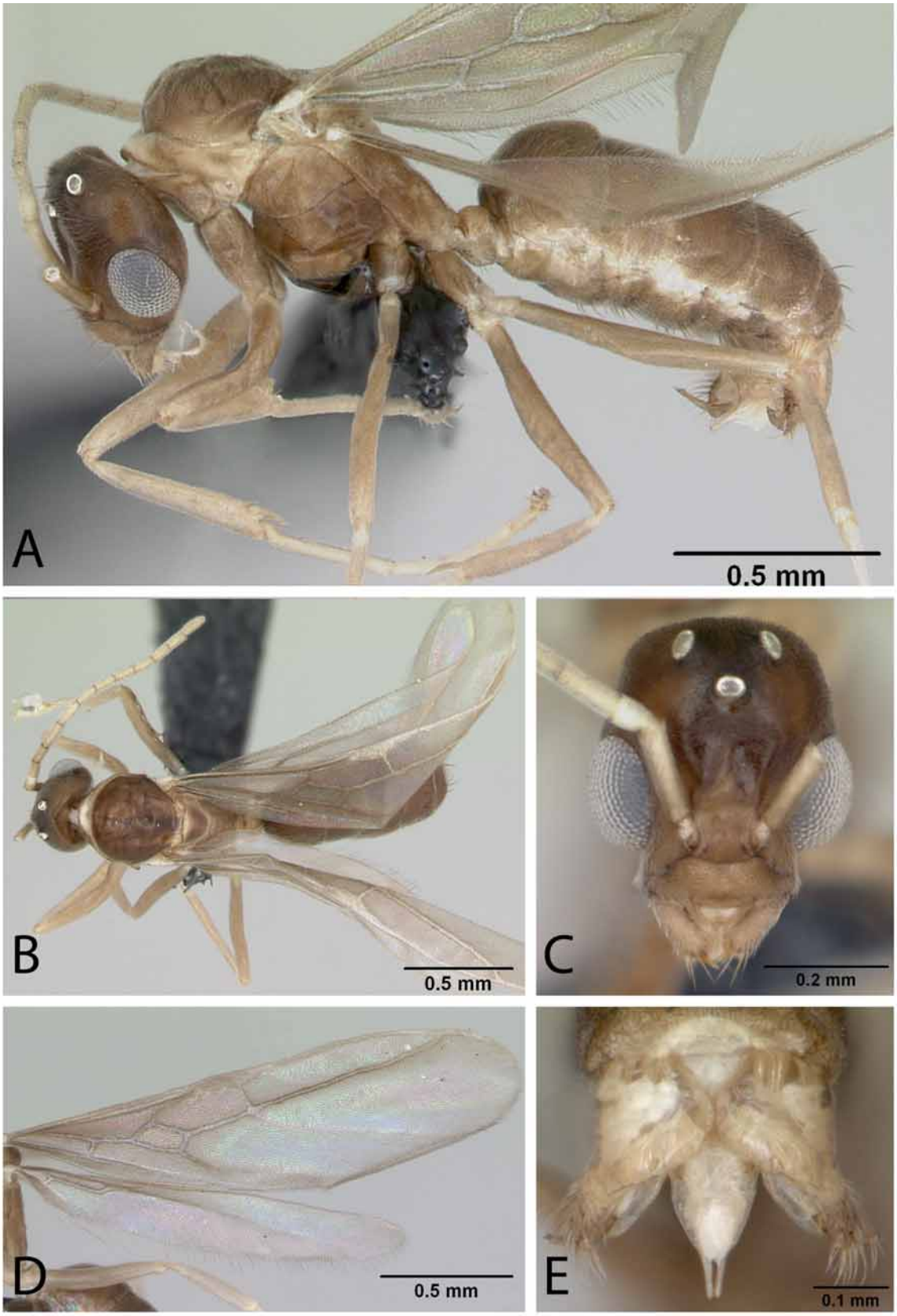

FIGURE 6. *Ravavy miafina* male CASENT0115570. A, profile; B, dorsum; C, full face; D, hindwing and forewing; E, genitalia in dorsal view.

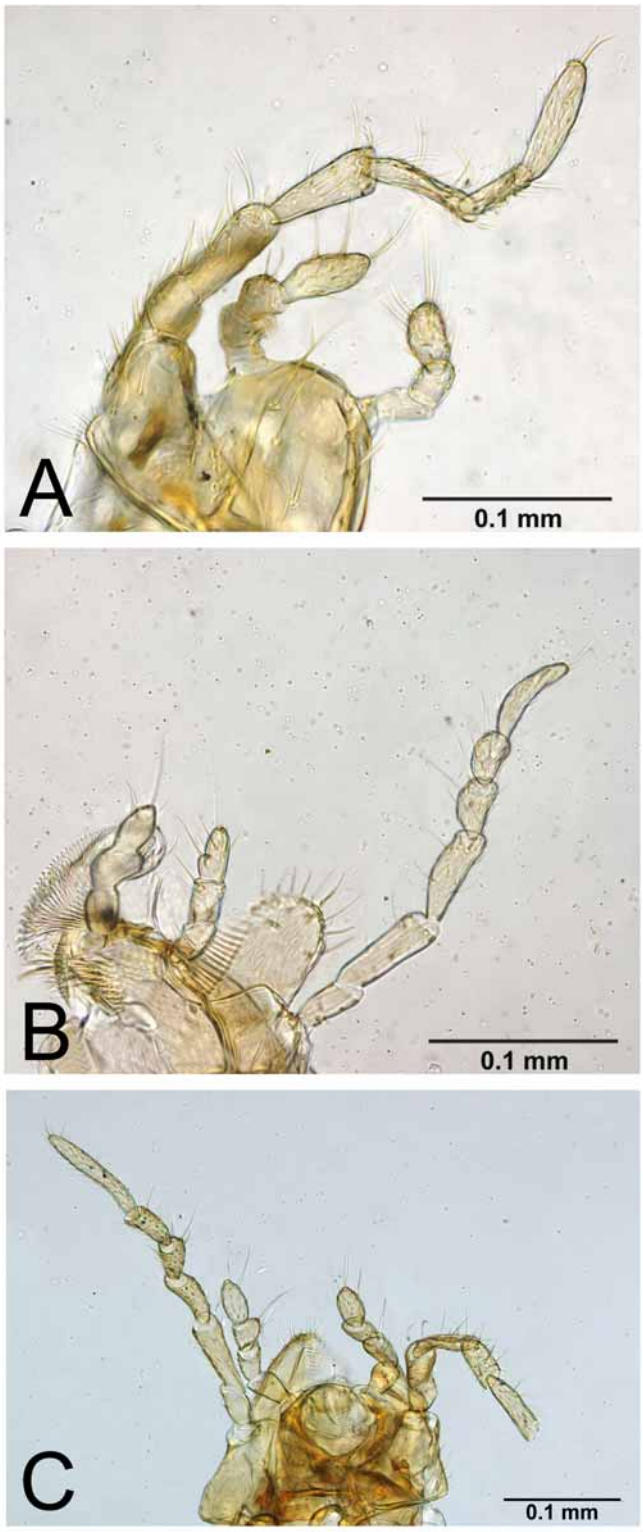

FIGURE 7. Maxillary and labial palp segments. A, *Aptinoma mangabe* worker; B, *Ravavy miafina* male; C, *Tapinoma* MG07 worker.

setae. Petiolar node smooth and shiny, without pubescence. Venter of petiole with well-developed lobe. Propodeum elongate, dorsal and declivitous faces continuous without angle. Pygostyles present.

Distribution and biology. Males have been collected in Malaise traps sampled from January through August across western Madagascar. Habitats in which this species was collected include the spiny bush near

Fort Dauphin, dry forest in Kirindy near Morandava, rainforest in the Sambirano region on the Ampasindava Peninsula, and coastal scrub on sand dunes near Antiranana in the northeastern tip of Madagascar.

The nesting habits of *Ravavy* are not known.

Additional material examined for *Ravavy miafina*: In addition to the type material, specimens from 9 additional collecting events from five localities were examined in this study. MADAGASCAR, Province **Toliara**: Forêt de Kirindy, 15.5 km 64° ENE Marofandilia, 100 m, 20.045°S, 44.66222°E, (Fisher *et al.*), tropical dry forest, Malaise trap collection code: BLF04601, 28 November 2001–03 December 2001, Malaise trap; PN Andohaela, 60 m, 24.83083°S, 46.53617°E, (Rin'Ha, Irwin), dry forest spiny forest, Malaise trap, collection code: MG-21-42, 17, December 2003–19 December 2003. Province **Antsiranana:** Parc National Montagne d'Ambre [Petit Lac road], 1125 m, 12.52028°S, 49.17917°E, (R. Harin'Hala): rainforest, Malaise trap, collection code MA-01-01D-05, 04 March 2001–19 March 2001; collection code: MA-01-01D-05, 04 March 2001–19 March 2001, collection code: MA-01-01D-12, 30 May 2001–06 June 2001. Sakalava Beach [vegetated beach dunes], 10 m, 12.26278 °S, 49.3975°E, (R. Harin'Hala), across sandy trail in dwarf littoral forest, Malaise trap, collection code: MA-01-04B-10, 16 May 2001–31 May 2001; collection code: MA-01-04B-17, 13 August 2001–20 August 2001; 7 km N Joffreville , 360 m, 12.33333°S, 49.25°E, (M.E. Irwin), in dry forest, hand netted, collection code: MA-01-07-03, 26 January 2001; (R. Harin'Hala) collection code: MA-01-07-06, 29 January 2001–15 February 2001.

Discussion

Shattuck (1992) provided a seminal overview of the Dolichoderinae genera that set the stage for subsequent phylogenetic and taxonomic studies by Shattuck (1995), Chiotis *et al*. (2000), Dubovikov (2004, 2005), Fisher and Bolton (2007), and Bolton (2007). Based on these works, it is now possible to summarize the overall dolichoderine fauna of Madagascar, combining both published species accounts and unpublished records on Antweb (www.antweb.org).

Five dolichoderine genera and 25 species are present in the Malagasy region:

***Aptinoma*:** two species, both endemic to Madagascar.

Ochetellus: one introduced *glaber*-like species found in Réunion and Mauritius.

Ravavy: one species, endemic to Madagascar.

***Tapinoma*:** nine species, including one tramp species (*melanocephalum*) and seven undescribed species.

Technomyrmex: 12 species including four tramp species (*albipes*, *difficilis*, *pallipes*, and *vitiensis*).

With the description of two new genera, Madagascar and Africa each have four dolichoderine genera with native species. These two biogeographic regions have the least dolichoderine diversity in the world.

Aptinoma is distinguished from *Tapinoma* by a more developed petiolar node and dimorphic caste. Major workers are also known in three species of *Tapinoma*, *annandalei* (Wheeler 1928), *wheeleri* (Mann 1935) and *williamsi* (Wheeler1935), that were initially described in the genus *Zatapinoma*. The males of these three species, however, have the unique elongate scape found only in *Tapinoma* males and absent in *Aptinoma* (see image of *T. annandalei* male CASENT0172852 on AntWeb). And unlike the major workers of *Aptinoma*, the major workers in these three species are phragmotic. To further evaluate the phylogenetic placement of these phragmotic species and to test the morphological hypothesis that major workers evolved independently in these two lineages, fresh samples for molecular work are needed. Though these three species were collected and described in rapid succession from 1928 to 1935, there appear to have been no collections since. Ant collectors in India, Philippines and Samoa (type localities of "*Zatapinoma*" species) should be on the lookout for *Tapinoma* with a phragmotic solder caste.

The only known queen in *Aptinoma* is ergatoid. A surprising number of genera of the southwest Indian Ocean islands have endemic ant species with wingless queens, including species in *Technomyrmex*. Wingless queens have not been recorded in Malagasy *Tapinoma*. Winged queens are clearly an advantage for dispersing to an island. But what explains the loss of wings in the Madagascar lineage? Winged queens may become a

drawback once a species becomes established on an island, since winged queens are more likely to be blown offshore and into the ocean. It would be interesting to test within genera with both wingless and winged queen species, if the wingless lineages arrived earlier in Madagascar than those lineages with winged queens.

Across the subfamily, maxillary and labial palp segment counts for workers, queens and males include 6:4, 5:3, 4:3, 4:2, 3:4, 2:3 and 2:2 (Shattuck 1992). In both workers and males of *Aptinoma* and *Ravavy*, the number of maxillary palp segments is clearly 6 (Figs 7a, b). However, the number of labial palps is more difficult to discern. Dissections of workers of *A. mangabe* and males of *R. miafina*, revealed only 3 distinct labial palp segments (Figs 7a, b), while in *Tapinoma* MG07, 4 labial palp segments are clearly visible (Fig. 7c). In *Aptinoma* and *Ravavy*, the apparent number is three but it could be a small reduced segment at the base or a partially fused apical segment that is not apparent without using an electron microscope.

In Dolichoderinae, as in other subfamilies, only a few genera are widespread and found across biogeographic regions, (e.g. *Tapinoma*, *Technomyrmex*) while most genera are highly restricted in distribution. Not surprisingly, recently-described dolichoderine genera such as *Gracilidris* (Wild & Cuezzo 2006), *Nebothriomyrmex* (Dubovikov 2004), *Aptinoma* and *Ravavy* are restricted in distribution. *Aptinoma* is restricted to two species found only around the Antongil Bay in the Northeast of Madagascar. *Ravavy* is much more widespread in Madagascar but appears to have a restricted habitat. Despite numerous collecting expeditions, the female castes and nesting location of this species have yet to be uncovered. One explanation for why leaf litter techniques, beating low vegetation, breaking dead twigs in the canopy, and hand searching have failed to uncover the workers and queens of *Ravavy* is that the colonies are subterranean and rarely forage above ground.

If the collecting effort required to uncover these restricted taxa in Madagascar is typical, then other tropical and subtropical regions where far less sampling has occurred must hold new genera to be discovered. The recent descriptions of *Feroponera* (Bolton & Fisher 2008), and *Martialis* (Rabeling *et al*. 2008) further point to the extreme rarity or difficulty of sampling of new genera. These new genera are known from only one collection each, and one specimen only for *Martialis*. Traditional techniques such as Malaise trap and leaf litter sampling are essential tools in discovering these restricted taxa but new methods to sample subterranean and canopy habitats should also be explored.

Appendix 1. Revised key to genera of Malagasy Dolichoderinae (workers)
(workers of *Ravavy* are unknown and not included).

This key is based on Bolton (1994).

1 In profile, declivitous face of propodeum distinctly concave. Petiole in profile with a conspicuous, high standing scale with distinct forward and rearward faces; not concealed by the gaster (known from Mauritius, Réunion). ..... *Ochetellus*

- In profile rear face of propodeum more or less flat or convex. Petiole in profile not forming distinct high standing scale; petiole reduced and often concealed by the gaster. 2

2 Gaster with four plates on upper surface; fifth tergite reflexed below the fourth and visible in ventral view where it forms a transverse plate abutting fifth sternite; anal and associated orifices thus situated ventrally. Mesosoma lacking erect setae. 3

- Gaster with five plates on upper surface; fifth tergite small but forming continuing line along dorsum of gaster and not reflexed below fourth tergite; anal and associated orifices thus situated at apex of gaster. Pronotum commonly with 2–10 erect setae. ..... *Technomyrmex*

3 Dimorphic, with majors and minors. In profile, petiole in form of node with low standing forward face. Palp formula 6,3. ..... *Aptinoma*

- Not dimorphic; in profile, petiole narrow and subcylindrical, without forward face Palp formula. Palp formula 6,4. ..... *Tapinoma*

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