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Taxonomy of the ant genus *Nesomyrmex* Wheeler (Formicidae, Myrmicinae) in the Afrotropical region, with a review of current species groups and description of a new species of the *N. angulatus* group from Mozambique

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Abstract. This study reviews the taxonomy of the ant genus *Nesomyrmex* Wheeler, 1910 in the Afrotropical region. Previous revisionary studies are discussed and four species groups are proposed on the basis of external morphology. The *N. angulatus* group contains seven species that are widely distributed throughout the whole Afrotropical region, with one species also occurring in the Palaearctic and Malagasy regions. The *N. cataulacoides* group is monotypic, with one morphologically bizarre species found in Equatorial rain forests. The *N. humerosus* group is also monotypic and occurs in East Africa. The last and by far most species-rich group is the *N. simoni* group that contains 17 species, all of which are endemic to South Africa. The four groups are defined for the first time for the region, and an illustrated identification key is provided. Furthermore, the *N. angulatus* group is more thoroughly reviewed. One new species from Mozambique is described, *N. inhaca* sp. nov., and species accounts for the other six are provided. Also, an illustrated identification key to the species of the *N. angulatus* group is presented.

Keywords. Ant taxonomy, identification key, Inhaca Island, new species, systematics.

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Introduction

Nesomyrmex Wheeler, 1910 is a moderately-sized genus of myrmicine ants distributed in the tropics and subtropics of the Neotropical, Afrotropical and Malagasy regions (Guénard & Economo 2016). It was traditionally grouped within the tribes Leptothoracini or Formicoxenini, but the most recent phylogeny of the Myrmicinae revealed it to be a member of the Crematogastrini (Ward *et al*. 2015). At present, *Nesomyrmex* contains 55 valid species (Bolton 2016), of which 21 are Neotropical, 25 Afrotropical, and nine Malagasy (Kempf 1959; Brandão 1991; Bolton 2003; Mbanyana & Robertson 2008; Csősz & Fisher 2015). Two extinct species are known from Dominican Amber (De Andrade *et al*. 1999). For most of its existence *Nesomyrmex* was treated by most authorities as either a subgenus or junior synonym of the much more diverse and widespread genus *Leptothorax* Mayr, 1855 (e.g., Wheeler 1922; Kempf 1959; Bolton 1982). Relatively recently, Bolton (2003) revived it from synonymy with *Leptothorax* and raised it to full genus status by providing a thorough generic diagnosis and distinguishing it from other closely related genera. The most recent multi-locus molecular phylogeny of the subfamily Myrmicinae strongly supports the monophyly of the genus (Ward *et al*. 2015). The alpha taxonomy of the genus in the Afrotropical region is in reasonably good condition. Bolton (1982) revised the genus (as part of *Leptothorax*), recognised nine species, and gave a species level key to the then known species. Later, Snelling (1992) described the morphologically bizarre *N. cataulacoides* from Cameroon as a tenth Afrotropical species. More recently, Mbanyana & Robertson (2008) provided an extensive revision of the *Nesomyrmex* of southern Africa. They recognised 20 species from South Africa, of which they described 15 as new, leading to a total of 25 *Nesomyrmex* species for the whole Afrotropical region.

During a recent taxonomic survey of the *Tetramorium* Mayr, 1855 fauna of Mozambique hosted in the ant collection of the Museum of Comparative Zoology, Harvard University Cambridge, the first author encountered a strange looking series from Inhaca Island. After a closer look it became apparent that this series was accidentally mislabelled as *Tetramorium*, but clearly belonged to the genus *Nesomyrmex*. While the genus identity was easily assessed, it was impossible to identify the species on the basis of the currently available taxonomic identification keys (Bolton 1982; Mbanyana & Robertson 2008). A more thorough examination and comparison with reference material revealed that the material belonged to a new, undescribed species. In this study we review the *Nesomyrmex* species groups found in the Afrotropical region and provide an identification key to the four proposed groups herein: *N. angulatus* group, *N. cataulacoides* group, *N. humerosus* group and *N. simoni* group. In addition, we review the *N. angulatus* group and describe the new species as *N. inhaca* sp. nov. In order to aid in identification we also provide an illustrated key to all species of the *N. angulatus* group.

Abbreviations of depositories

The collection abbreviations given below follow Evenhuis (2016). The material upon which this study is based on is located and/or was examined at the following institutions:

BMNH = The Natural History Museum, London, U.K.
HLMD = State Museum of Hesse Darmstadt, Darmstadt, Germany
MCZC = Museum of Comparative Zoology, Harvard University, Cambridge, U.S.A.
KSMA = Museum of Arthropods, King Saud University, Riyadh, Kingdom of Saudi Arabia
SAMC = Iziko Museum of Cape Town, Cape Town, South Africa
ZFMK = Zoological Research Museum Alexander Koenig, Bonn, Germany

Material and methods

All new type material and all imaged specimens can be uniquely identified by specimen-level codes affixed to each pin (e.g., CASENT0493062). Digital colour montage images were created using a JVC KY-F75 digital camera and Syncroscopy Auto-Montage software (version 5.0), or a Leica DFC 425 camera in combination with the Leica Application Suite software (version 3.8), or a Canon EOS 7D in

combination with Helicon Focus (version 6.5). All images used in this publication are available online and can be seen on AntWeb (http://www.antweb.org). General terminology for ant morphology is based on Bolton (1982, 1994), and for the description of degrees of inclination of pilosity we follow Wilson (1955). When referring to the terminology for the description of surface sculpturing we follow Harris (1979) and Bolton (1982). Morphometric measurements were performed with a Leica M165 equipped with an orthogonal pair of micrometres at magnifications ranging from 63× to 120×. Measurements and indices are presented as minimum and maximum values with arithmetic means in parentheses, and all measurements are expressed in mm to two decimal places. The measurements and indices used in this study follow Hita Garcia & Fisher (2015).

Measurements:

EL = Eye length: maximum diameter of compound eye measured in oblique lateral view
HL = Head length: maximum distance from the midpoint of the anterior clypeal margin to the midpoint of the posterior margin of the head, measured in full-face view. Impressions on the anterior clypeal margin and the posterior head margin reduce head length
HW = Head width: width of the head directly behind the eyes measured in full-face view
PH = Pronotal height: maximum height of the pronotum measured in lateral view
PPH = Postpetiole height: maximum height of the postpetiole measured in lateral view
PPL = Postpetiole length: maximum length of the postpetiole measured in dorsal view
PPW = Postpetiole width: maximum width of the postpetiole measured in dorsal view
PSL = Propodeal spine length: in dorsofrontal view the tip of the measured spine, its base, and the centre of the propodeal concavity between the spines must all be in focus. Using a dual-axis micrometre the spine length is measured from the tip of the spine to a virtual point at its base where the spine axis meets orthogonally with a line leading to the median point of the concavity.
PTH = Petiolar node height: maximum height of the petiolar node measured in lateral view from the highest (median) point of the node to the ventral outline. The measuring line is placed at an orthogonal angle to the ventral outline of the node
PTL = Petiolar node length: maximum length of the dorsal face of the petiolar node from the anterodorsal to the posterodorsal angle, measured in dorsal view excluding the peduncle
PTW = Petiolar node width: maximum width of the dorsal face of the petiolar node measured in dorsal view
PW = Pronotal width: maximum width of the pronotum measured in dorsal view
SL = Scape length: maximum scape length excluding basal condyle and neck
WL = Weber's length: diagonal length of the mesosoma in lateral view from the posteroventral margin of propodeal lobe to the anterior-most point of pronotal slope, excluding the neck

Indices:

OI = Ocular index: EL / HW × 100
CI = Cephalic index: HW / HL × 100
SI = Scape index: SL / HW × 100
DMI = Dorsal mesosoma index: PW / WL × 100
LMI = Lateral mesosoma index: PH / WL × 100
PSLI = Propodeal spine index: PSL / HL × 100
LPeI = Lateral petiole index: PTL / PTH × 100
DPeI = Dorsal petiole index: PTW / PTL × 100
LPpI = Lateral postpetiole index: PPL / PPH × 100
DPpI = Dorsal postpetiole index: PPW / PPL × 100
PPI = Postpetiole index: PPW / PTW × 100

The distribution data given below is based on the previous revisions or treatments of the genus for the Afrotropical region (Bolton 1982; Snelling 1992; Mbanyana & Robertson 2008), as well as on data mined from AntWeb and other online databases (Bolton 2016; Guénard & Economo 2016).

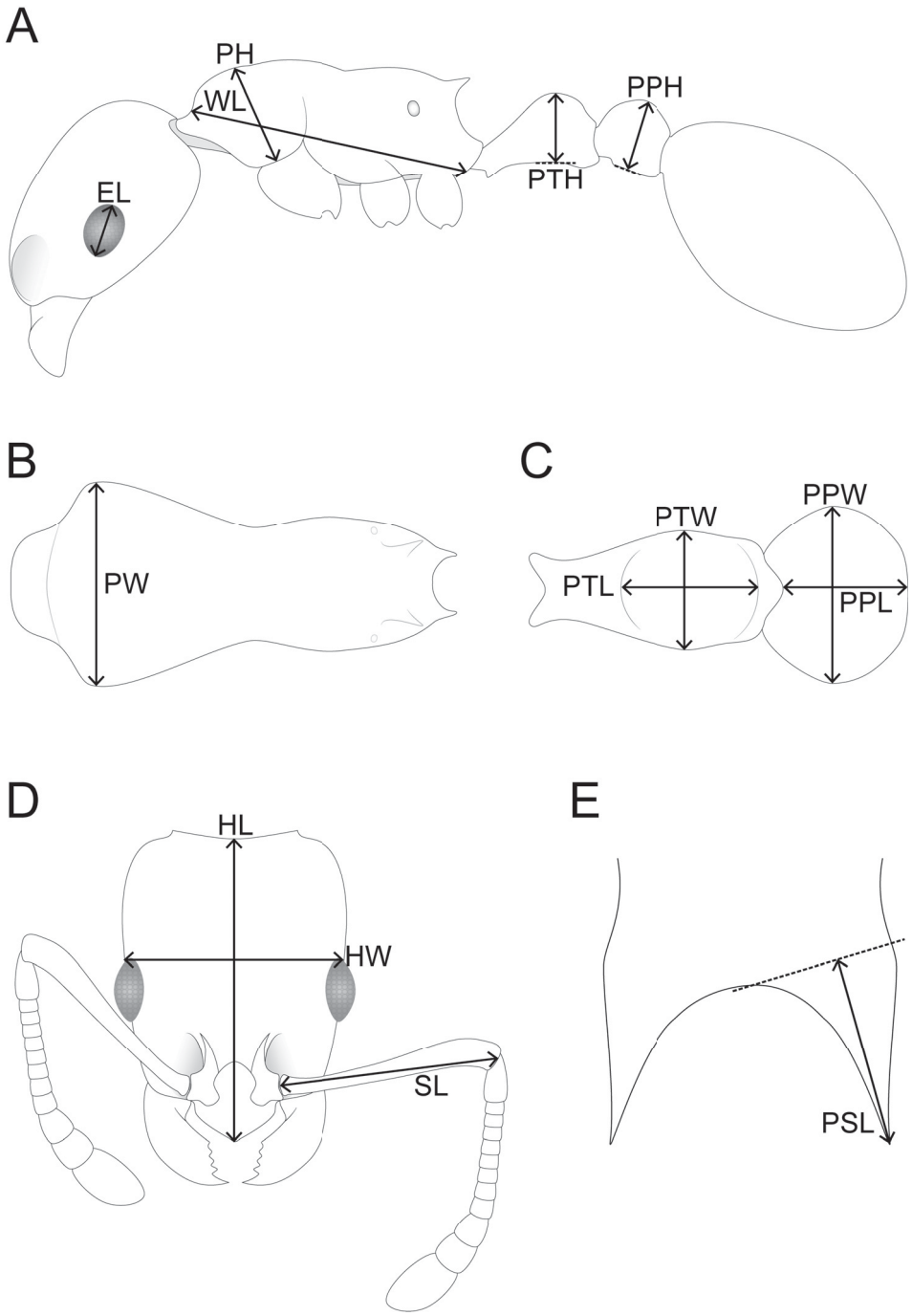

Fig. 1. Schematic line drawings of *Nesomyrmex inhaca* sp. nov., illustrating the measurements used. **A**. Body in profile with measuring lines for EL, WL, PH, PTH and PPH. **B**. Mesosoma in dorsal view with measuring line for PW. **C**. Petiole and postpetiole in dorsal view with measuring lines for PTL, PTW, PPL and PPW. **D**. Head in full-face view with measuring lines for HL, HW and SL. **E**. Dorsocaudal view of the propodeum with measuring line for PSL.

Results

Class Hexapoda Blainville, 1816
Order Hymenoptera Linnaeus, 1758
Suborder Apocrita Latreille, 1810
Infraorder Aculeata Latreille, 1802
Superfamily Formicoidea Latreille, 1804
Family Formicidae Latreille, 1809
Subfamily Myrmicinae Lepeletier de Saint-Fargeau, 1835
Tribe Crematogastrini Forel, 1893

Genus ***Nesomyrmex*** Wheeler, 1910

Review of Afrotropical *Nesomyrmex* species groups

Synoptic list of Afrotropical Nesomyrmex *species*

***Nesomyrmex angulatus* species group**

Nesomyrmex angulatus (Mayr, 1862) [Algeria, Botswana, Comoros, Djibouti, Egypt, Eritrea, Ethiopia, Ghana, Kenya, Libya, Madagascar, Malawi, Mozambique, Niger, Nigeria, Oman, Saudi Arabia, Seychelles, South Africa, Sudan, Uganda, Tanzania, Tunisia, Yemen, Zimbabwe]
= *Nesomyrmex angulatus ilgii* (Forel, 1894)
= *Nesomyrmex latinodis* (Mayr, 1895)
= *Nesomyrmex angulatus concolor* (Santschi, 1914)
Nesomyrmex denticulatus (Mayr, 1901) [South Africa]
Nesomyrmex evelynae (Forel, 1916) [Burkina Faso, Central African Republic, Ghana, D.R. Congo, Kenya, Uganda]
Nesomyrmex grisoni (Forel, 1916*)* [Central African Republic, D.R. Congo, Ghana]
Nesomyrmex inhaca sp. nov. [Mozambique]
Nesomyrmex innocens (Forel, 1913) [D.R. Congo, Kenya]
Nesomyrmex stramineus (Arnold, 1948) [South Africa, Swaziland]

***Nesomyrmex cataulacoides* species group**

Nesomyrmex cataulacoides (Snelling, 1992) [Cameroon, Kenya]

***Nesomyrmex humerosus* species group**

Nesomyrmex humerosus (Emery, 1896) [Kenya, Tanzania, Yemen]

***Nesomyrmex simoni* species group**

Nesomyrmex antoinetteae Mbanyana & Robertson, 2008 [South Africa]
Nesomyrmex braunsi (Forel, 1912) [South Africa]
Nesomyrmex cederbergensis Mbanyana & Robertson, 2008 [South Africa]
Nesomyrmex entabeni Mbanyana & Robertson, 2008 [South Africa]
Nesomyrmex ezantsi Mbanyana & Robertson, 2008 [South Africa]
Nesomyrmex inye Mbanyana & Robertson, 2008 [South Africa]
Nesomyrmex karooensis Mbanyana & Robertson, 2008 [South Africa]
Nesomyrmex koebergensis Mbanyana & Robertson, 2008 [South Africa]
Nesomyrmex larsenae Mbanyana & Robertson, 2008 [South Africa]
Nesomyrmex mcgregori Mbanyana & Robertson, 2008 [South Africa]
Nesomyrmex nanniae Mbanyana & Robertson, 2008 [South Africa]
Nesomyrmex njengelanga Mbanyana & Robertson, 2008 [South Africa]
Nesomyrmex ruani Mbanyana & Robertson, 2008 [South Africa]
Nesomyrmex saasveldensis Mbanyana & Robertson, 2008 [South Africa]

Nesomyrmex simoni (Emery, 1895) [South Africa]
Nesomyrmex tshiguvhoae Mbanyana & Robertson, 2008 [South Africa]
Nesomyrmex vannoorti Mbanyana & Robertson, 2008 [South Africa]

Identification key to Afrotropical *Nesomyrmex* species groups (workers)

The following newly developed identification key to species groups is loosely based on Bolton (1982) and Mbanyana & Robertson (2008), and also incorporates ideas from Snelling (1992).

1. Antennae with 11 segments (Fig. 2A); petiolar node and postpetiole with conspicuous and very well developed lateral spines (Fig. 2B) ……***N. cataulacoides*** group
– Antennae with 12 segments (Fig. 2D); petiolar node and postpetiole never with conspicuous and very well developed lateral spines as above, at most petiolar node with small, lateral denticles (Fig. 2C, E–F) ……2

2. Anterior clypeal lobe short, flat-margined, and never convex, lobe with a small median triangular projection (Fig. 3A); pronotum anterodorsally sharply marginate, with sharp, dentate corners (Fig. 2C); petiole barrel-shaped with very weakly developed, short and triangular petiolar node (Fig. 3B) ……***N. humerosus*** group
– Anterior clypeal lobe always conspicuously developed, usually convex and variably rounded, sometimes flat, but never with a small median triangular projection (Fig. 3C); pronotum anterodorsally either rounded or weakly marginate but without sharp, dentate corners (Fig. 2E–F); petiole variably shaped, but never as above, usually with very well developed petiolar node (Fig. 3D) ……3

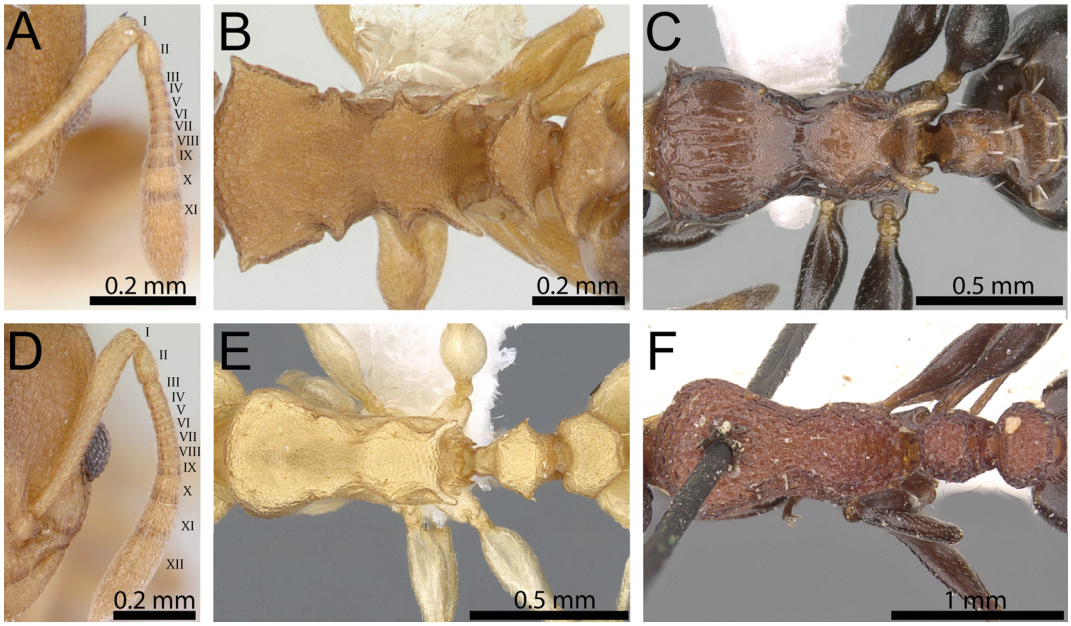

Fig. 2. Part of head in full-face view showing the antennae (antennal segments are counted in Roman numerals) and dorsum of mesosoma. **A–B**. *Nesomyrmex cataulacoides* (Snelling, 1992) (CASENT0172593, CASENT0178301). **C**. *N. humerosus* (Emery, 1896) (CASENT0906196). **D**. *N. evelynae* (Forel, 1916) (CASENT0178298). **E**. *N. stramineus* (Arnold, 1948) (CASENT0922011). **F**. *N. braunsi* (Forel, 1912) (CASENT0909209).

3. Propodeal spines present and conspicuous, usually long and narrow, in profile distinctly longer than their basal width (Fig. 4A–B); hairs on dorsum of mesosoma always present, short, and blunt (Fig. 4A–B) ……***N. angulatus*** group
– Propodeal spines usually absent (Fig. 4D), if present, then very short and broad, in profile no longer than their basal width (Fig. 4C); hairs on dorsum of mesosoma variably developed: usually long, fine and acute, sometimes absent, and only very rarely short and blunt …… ……***N. simoni*** group

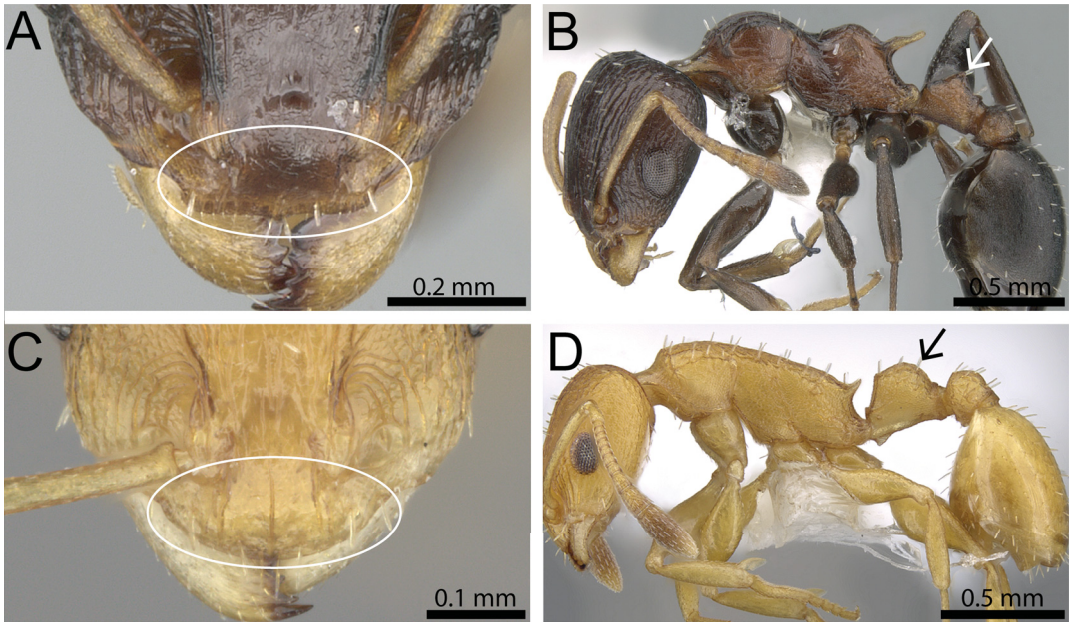

Fig. 3. Anterior cephalic dorsum (white ellipse around anterior clypeus) and body in profile. **A–B**. *N. humerosus* (Emery, 1896) (CASENT0906196). **C**. *N. angulatus* (Mayr, 1862) (CASENT 0235552). **D**. *N. angulatus* (Mayr, 1862) (CASENT0922010).

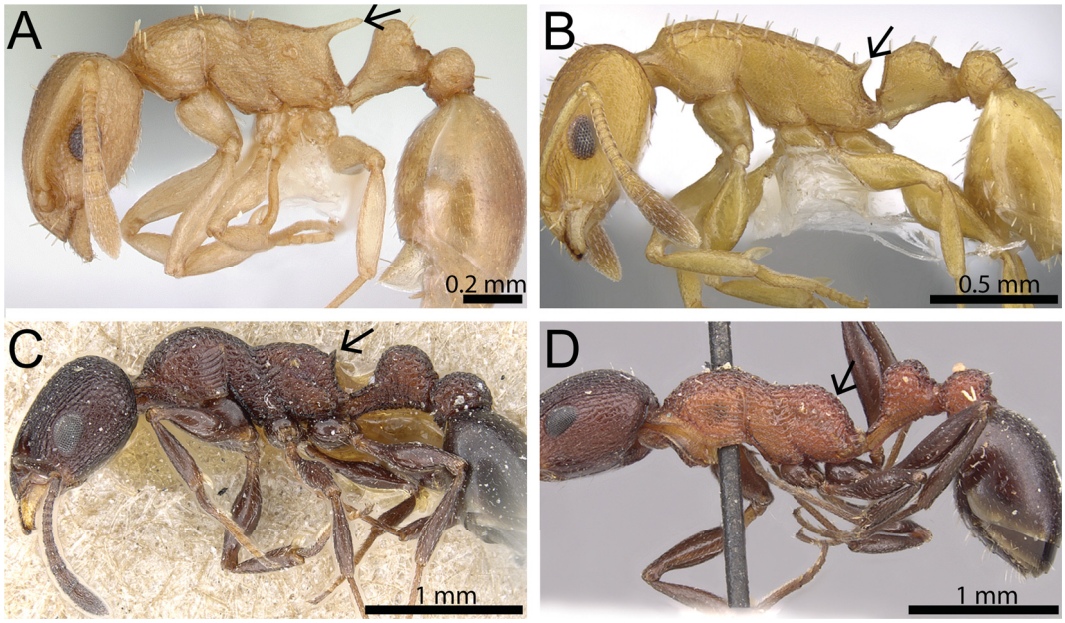

Fig. 4. Body in profile. **A**. *Nesomyrmex evelynae* (Forel, 1916) (CASENT0178298). **B**. *N. angulatus* (Mayr, 1862) (CASENT0922010). **C**. *N. simoni* (Emery, 1895) (CASENT0904790). **D**. *N. braunsi* (Forel, 1912) (CASENT0909209).

Nesomyrmex angulatus species group

Definition

Antennae with 12 segments; anterior clypeal lobe conspicuously convex, rounded and without a small median triangular projection; frontal carinae absent; propodeum always with moderately long to long spines, in profile distinctly longer than their basal width; petiole and postpetiole without large lateral spines, petiole sometimes with small denticles; all dorsal surfaces of body with short, blunt pilosity (with the exception of *N. evelynae*, which lacks standing hairs on most of first gastral tergite).

Comments

This group contains seven species that are widely distributed in the Afrotropical region, with one species extending into the Palaearctic and Malagasy regions. All species appear to be arboreal or subarboreal. Species accounts for all group members are provided below in the review of the group. The alpha taxonomy of the group appears straightforward based on the literature (Bolton 1982; Mbanyana & Robertson 2008). However, we find some species delimitations quite problematic (see species accounts below) and it might be necessary to revise the *N. angulatus* species group in the future after the accumulation of more material from additional Afrotropical localities.

Nesomyrmex cataulacoides species group

Definition

Antennae with 11 segments; anterior clypeal lobe conspicuously convex and rounded, without a small median triangular projection; frontal carinae absent; propodeal spines very well developed, long and spiniform; petiole and postpetiole each with a pair of large and conspicuous lateral spines; all dorsal surfaces of body without standing pilosity.

Comments

The *N. cataulacoides* species group holds only one morphologically bizarre and extraordinary species, which is impossible to confuse with any other *Nesomyrmex* species from the Afrotropical or any other region. The 11-segmented antennae, lack of standing pilosity on all dorsal surfaces, and the extreme spinosity render *N. cataulacoides* immediately recognizable. The possession of spines/teeth on the anterior pronotal corners, the anterior and posterior propodeum, and on both waist segments is unique within the genus. The affinities of *N. cataulacoides* to other *Nesomyrmex* are difficult to ascertain, mostly due to the extreme morphological specializations. So far it is not possible to associate it closely with any other *Nesomyrmex* species or species group. Currently, the species is known only from Cameroon and Kenya. Based on the few collections available, this species is strictly arboreal. The observed disjunctive distribution is most likely a sampling artefact due to the scarcity of collecting in Central African canopies, and we expect that *N. cataulacoides* will be collected in intermediate countries in the future.

Nesomyrmex humerosus species group

Definition

Antennae with 12 segments; anterior clypeal lobe short, flat-margined, and never convex, with small median triangular projection; frontal carinae present, but weakly developed; propodeal spines very well developed, long and spiniform; petiole and postpetiole without lateral spines; all dorsal surfaces of body with short, blunt pilosity.

Comments

This group contains only one species, which is morphologically quite unique in the Afrotropical region. Of special importance are the short, flat-margined anterior clypeal lobe with a small median triangular projection and the barrel-shaped petiolar node with its small, triangular node. These characters are in slightly modified ways also seen in several Neotropical and Malagasy species, while they are absent in

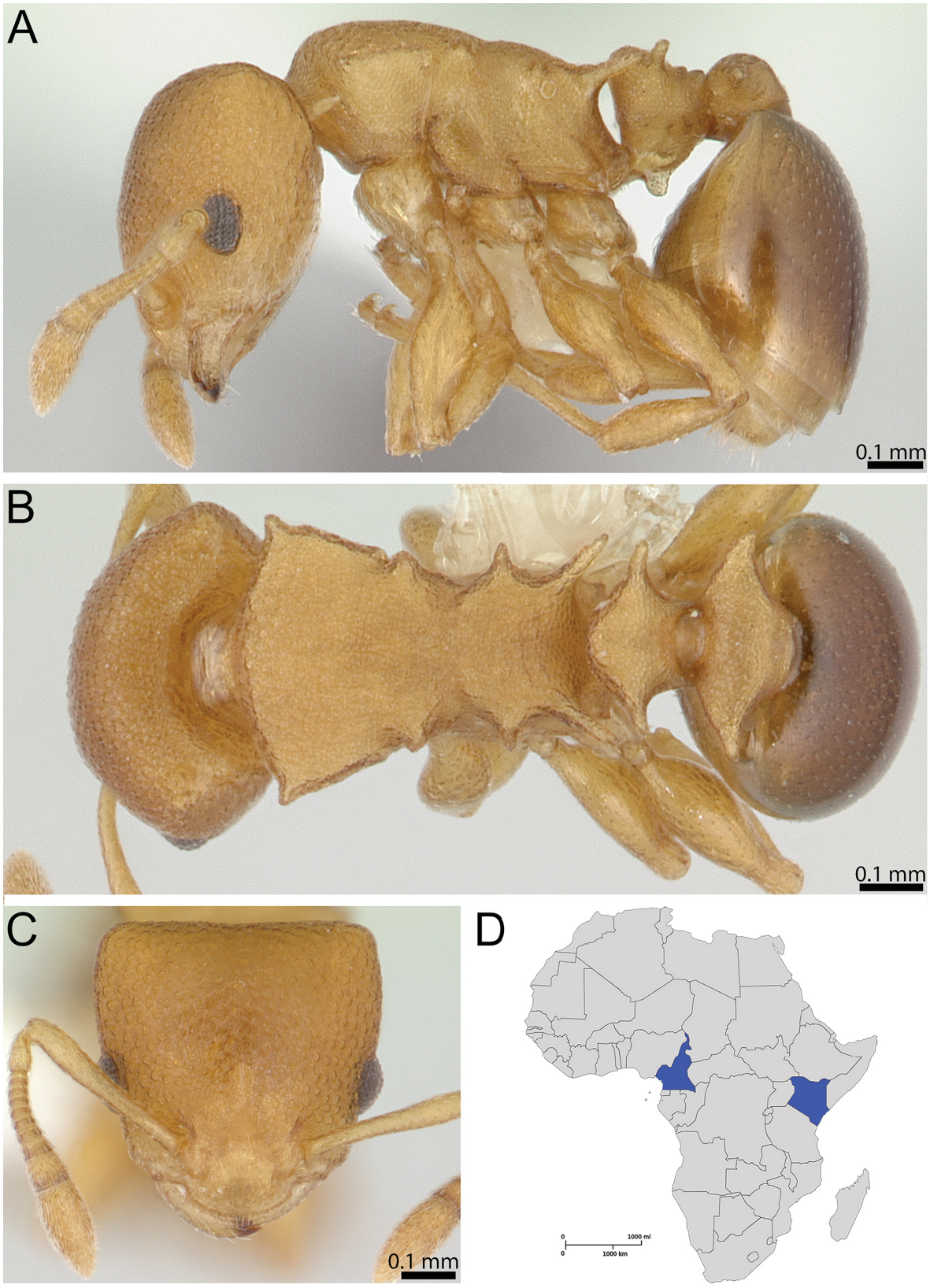

Fig. 5. *Nesomyrmex cataulacoides* (Snelling, 1992) (CASENT0178300). **A**. Body in profile view. **B**. Body in dorsal view. **C**. Head in full-face view. **D**. Map of Africa and Madagascar showing currently known distribution.

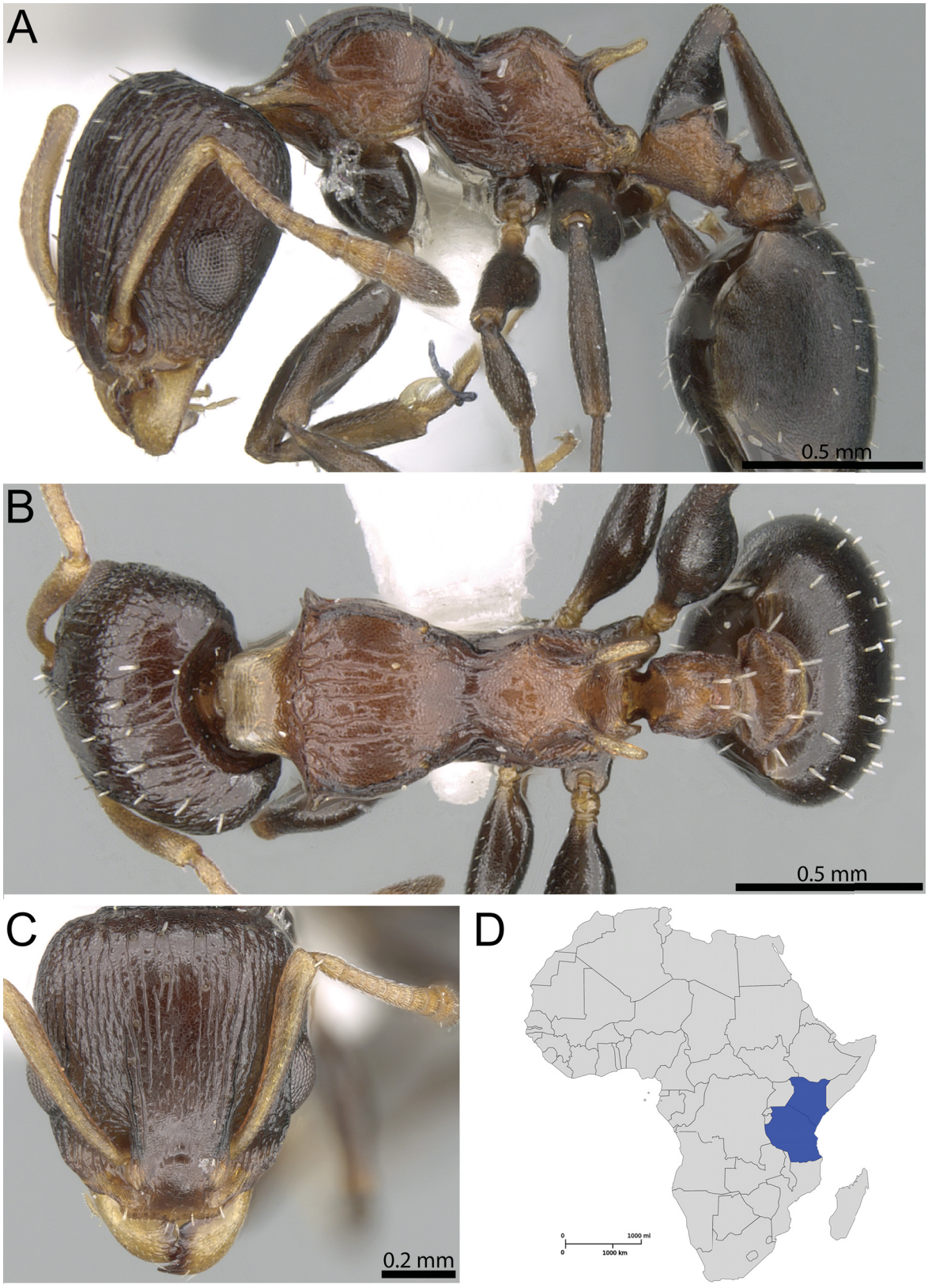

Fig. 6. *Nesomyrmex humerosus* (Emery, 1896) (CASENT0906196). **A**. Body in profile view. **B**. Body in dorsal view. **C**. Head in full-face view. **D.** Map of Africa and Madagascar showing currently known distribution.

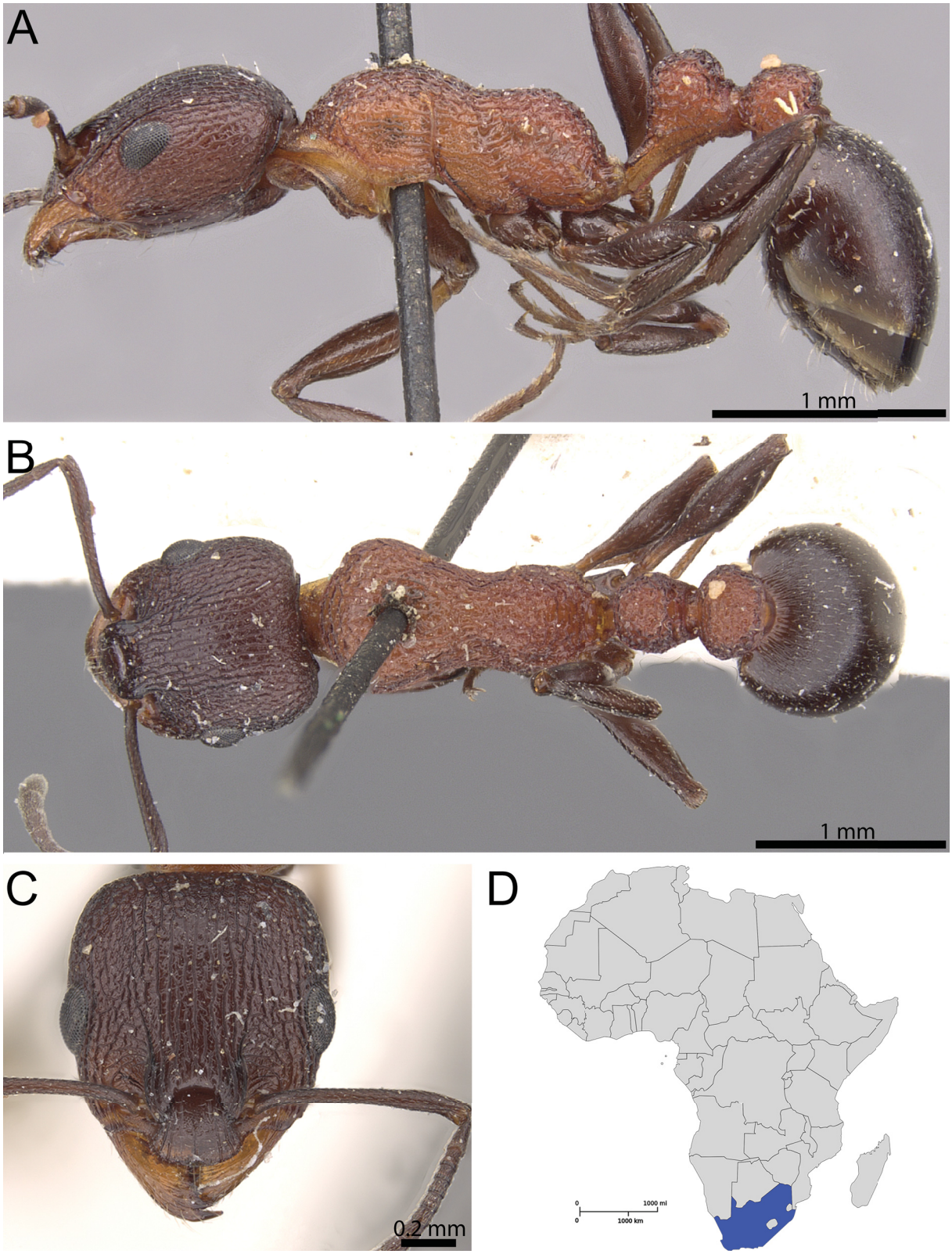

Fig. 7. *Nesomyrmex braunsi* (Forel, 1912) (CASENT0909209). **A**. Body in profile view. **B**. Body in dorsal view. **C**. Head in full-face view. **D**. Map of Africa and Madagascar showing currently known distribution.

the other Afrotropical species groups. However, the fact that *N. humerosus* shares these characters with species from other regions does not necessarily mean that *N. humerosus* is more closely related to them. It could also be an independent African lineage and similarities with species from other regions might be based on convergence. Despite the fact that *N. humerosus* does not resemble most species from the *N. simoni* group, it still shares characters with some species, such as the large eyes and the shape of the dorsal mesosomal outline, and it could be that *N. humerosus* is just an aberrant *N. simoni* group member. At present, it is not possible to deduce the biogeographical and phylogenetic affinities of this peculiar species. Currently, *N. humerosus* is known to occur in Kenya, Tanzania and Yemen. It is a rather rarely collected species and our scarce knowledge is based on just four collection events. Based on a sample collected in Kenya by the first author, it seems to live on vegetation, but it was also sampled from the ground in Tanzania and Yemen. It is possible that the species also occurs in other East African countries, such as Somalia and Mozambique, which are greatly under-sampled.

***Nesomyrmex simoni* species group**

Definition

Antennae with 12 segments; anterior clypeal lobe conspicuously convex and rounded, without a small median triangular projection; frontal carinae absent; propodeum usually unarmed, rarely with short teeth, in profile no longer than their basal width; petiole and postpetiole without lateral spines; usually all dorsal surfaces of body with (mostly) long, fine or (rarely) short, blunt standing pilosity, sometimes pilosity reduced on a few body parts, but never completely absent from all dorsal surfaces.

Comments

The 17 species of this group are all endemic to South Africa. In contrast to the members of most other Afrotropical groups, all *N. simoni* group species nest and live on the ground. Mbanyana & Robertson (2008) revised this group extensively, provided a sound and functional species identification key, and presented detailed descriptions of all species. Consequently, in this study we do not go into further details concerning the *N. simoni* group and refer to Mbanyana & Robertson (2008).

Review of the *Nesomyrmex angulatus* species group

Identification key to Afrotropical species of the *N. angulatus* species group (workers)

The following key is partly based on Bolton (1982) and Mbanyana & Robertson (2008).

1. In profile mesosomal dorsum forming a single, uninterrupted flat surface without any trace of metanotal groove; petiolar peduncle short (Fig. 8A) ……2
– In profile mesosomal dorsum always with conspicuously impressed metanotal groove; petiolar peduncle long (Fig. 8B) ……3

2. Body colour yellow to very light brown (Fig. 9A) ……***N. angulatus*** (Mayr, 1862)
– Body colour very dark brown to black (Fig. 9B) ……***N. grisoni*** (Forel, 1916)

3. First gastral tergite lacking standing hairs except for single transverse row on posterior end of tergite (Fig. 10A) ……***N. evelynae*** (Forel, 1916)
– First gastral tergite with standing hairs evenly distributed throughout (Fig. 10B) ……4

4. Antennal scapes conspicuously longer (SI 95–98); in dorsal view sides of petiolar node straight to weakly rounded, not laterally denticulate (Fig. 11A); dorsum of propodeum without standing hairs (Fig. 11B) ……***N. inhaca*** sp. nov.
– Antennal scapes conspicuously shorter (SI 67–77); in dorsal view petiolar node laterally denticulate (Fig. 11C); dorsum of propodeum with short standing hairs (Fig. 11D) ……5

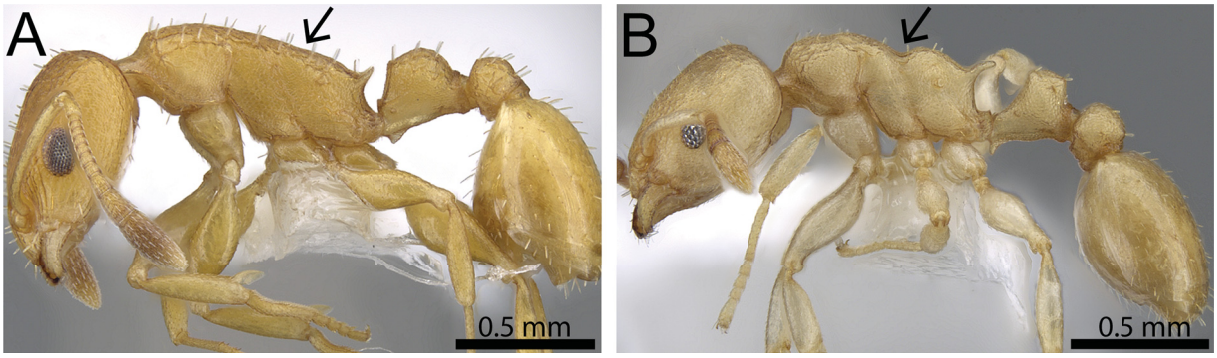

Fig. 8. Body in profile. **A**. *Nesomyrmex angulatus* (Mayr, 1862) (CASENT0922010). **B**. *N. stramineus* (Arnold, 1948) (CASENT0922011).

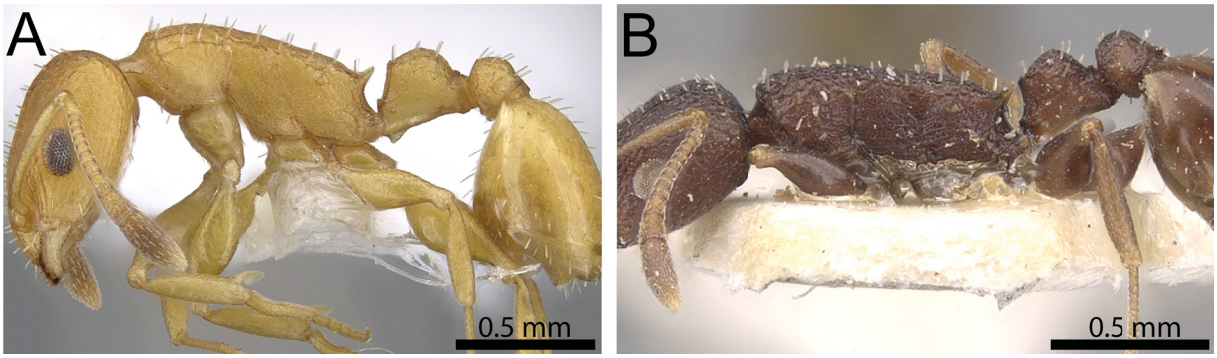

Fig. 9. Body in profile. **A**. *Nesomyrmex angulatus* (Mayr, 1862) (CASENT0922010). **B**. *N. grisoni* (Forel, 1916) (CASENT0908994).

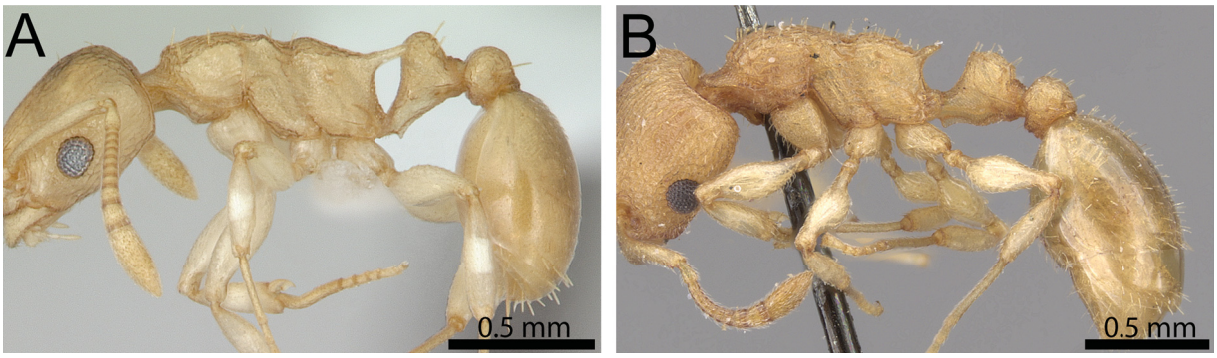

Fig. 10. Body in profile. **A**. *Nesomyrmex evelynae* (Forel, 1916) (CASENT0413068). **B**. *N. denticulatus* (Mayr, 1901) (CASENT0908992).

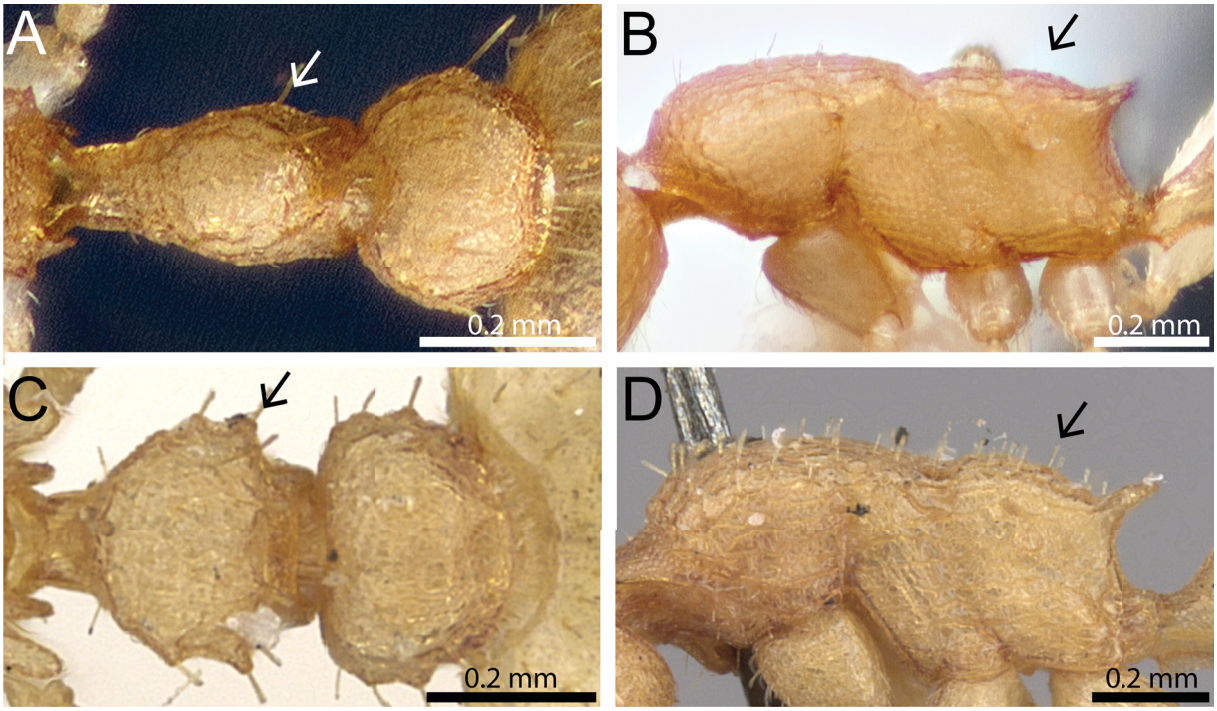

Fig. 11. Waist segments in dorsal view and mesosoma in profile. **A**–**B**. *Nesomyrmex inhaca* sp. nov. (CASENT0790016). **C**. *N. denticulatus* (Mayr, 1901) (CASENT0914923). **D**. *N. denticulatus* (Mayr, 1901) (CASENT0908992).

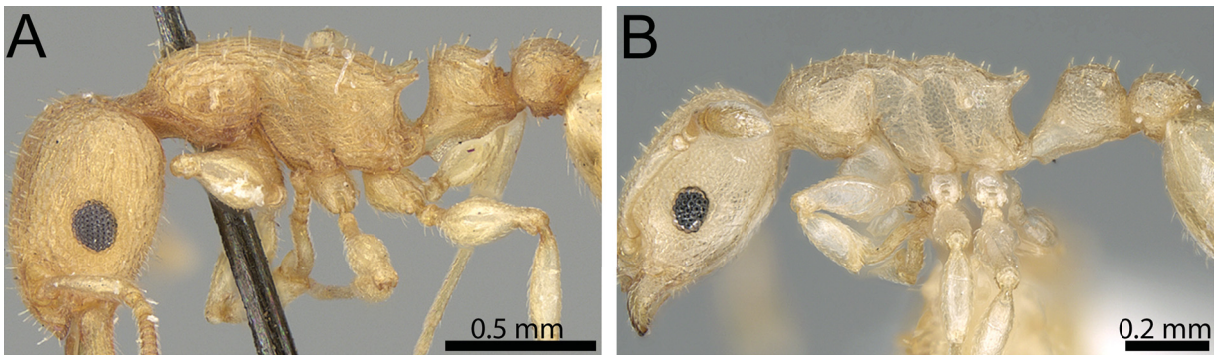

Fig. 12. Head, mesosoma, and waist segments in profile. **A**. *Nesomyrmex denticulatus* (Mayr, 1901) (CASENT0914923). **B**. *N. innocens* (Forel, 1913) (CASENT0906195).

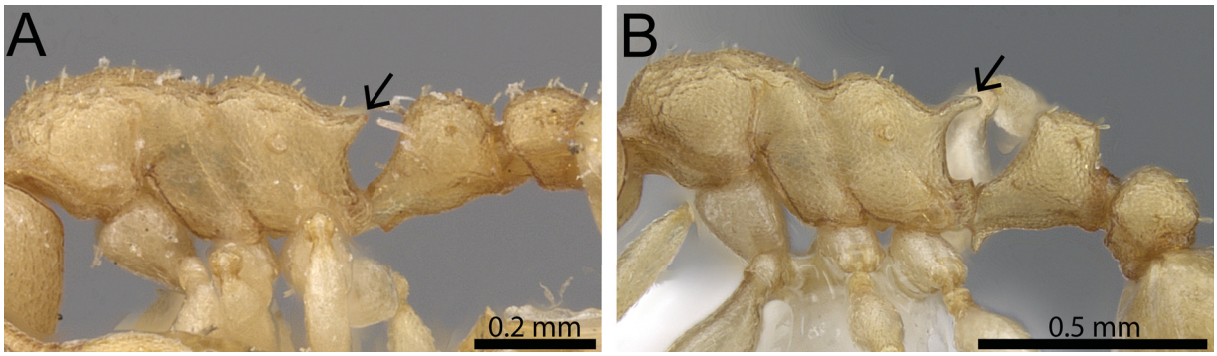

Fig. 13. Mesosoma and waist segments in profile. **A**. *Nesomyrmex innocens* (Forel, 1913) (CASENT0908995). **B**. *N. stramineus* (Arnold, 1948) (CASENT0922011).

5. Eyes larger, with 10–12 ommatidia in longest row (Fig. 12A); subpetiolar process with a conspicuous tooth anteriorly, followed by a long cuticular flange running back to the postpetiolar junction (Fig. 12A) ……***N. denticulatus*** (Mayr, 1901)
– Eyes smaller, with 7–9 ommatidia in longest row (Fig. 12B); subpetiolar process with or without a conspicuously developed tooth anteriorly, but without a long cuticular flange running back to the postpetiolar junction (Fig. 12B) ……6

6. Propodeal spines shorter and thicker, elongate-triangular and only weakly longer than their basal width; in profile petiolar node nodiform, appearing approximately as long as high (Fig. 13A) ……***N. innocens*** (Forel, 1913)
– Propodeal spines longer and thinner, several times longer than their basal width; in profile petiolar node high, rectangular nodiform, appearing around twice as high as long (Fig. 13B) ……***N. stramineus*** (Arnold, 1948)

Nesomyrmex angulatus (Mayr 1862)
Figs 3C–D, 4B, 8A, 9A, 14

Leptothorax angulatus Mayr, 1862: 739 (w.), Egypt.
Leptothorax angulatus var. *concolor* Santschi, 1914: 107, fig. 15 (w.), Kenya.
Leptothorax angulatus r. *ilgii* Forel, 1894: 82 (w.), Ethiopia.
Leptothorax latinodis Mayr, 1895: 130 (w.), Mozambique.

Leptothorax angulatus – Santschi 1914: 107 (q.).
Leptothorax (Goniothorax) angulatus – Emery 1896: 58 (footnote).
Nesomyrmex angulatus – Bolton 2003: 272. See also: Mbanyana & Robertson 2008: 38. (Current subspecies: nominal plus *lybica*.)
Leptothorax (Goniothorax) angulatus r. *ilgii* – Santschi 1912: 148 (q.). — W.M. Wheeler 1922: 891. (Junior synonym of *angulatus*: Bolton 1982: 324.)
Leptothorax (Goniothorax) latinodis – Emery 1896: 58 (footnote). (Junior synonym of *angulatus*: Bolton 1982: 324.)
Leptothorax angulatus var. *concolor* – Emery 1915: 16 (q.m.). (Junior synonym of *angulatus*: Bolton 1982: 324.)

Diagnosis

The following character combination distinguishes *N. angulatus* from the other members of the group: in profile mesosomal dorsum forming a single, uninterrupted flat surface without any trace of metanotal groove; petiolar peduncle short; body colour yellow to very light brown.

Diagnostic comments

Nesomyrmex angulatus together with *N. grisoni* are easily separable from the other members of the group on the basis of the dorsal mesosomal outline, which is an uninterrupted, flat surface without any trace of a metanotal groove. The separation of *N. angulatus* from *N. grisoni* is less clear though. As Bolton (1982) stated in his revision, the only differentiating character is body colour, which is yellowish in *N. angulatus* and dark brown to black in *N. grisoni*. In general, body coloration is a rather weak diagnostic character and extremely variable in many ant species, and it is likely that both species are actually conspecific and the differently coloured forms represent geographic or ecological variants. The latter seems probable if one considers that *N. angulatus* is predominantly an arid-adapted species, while *N. grisoni* appears to prefer humid rain forests. Nevertheless, at the moment we hesitate to synonymise the two species and prefer to keep them separate for the following reasons. First, while there is a lot of material of *N. angulatus* in many museums, there is not much of *N. grisoni*, making comparative

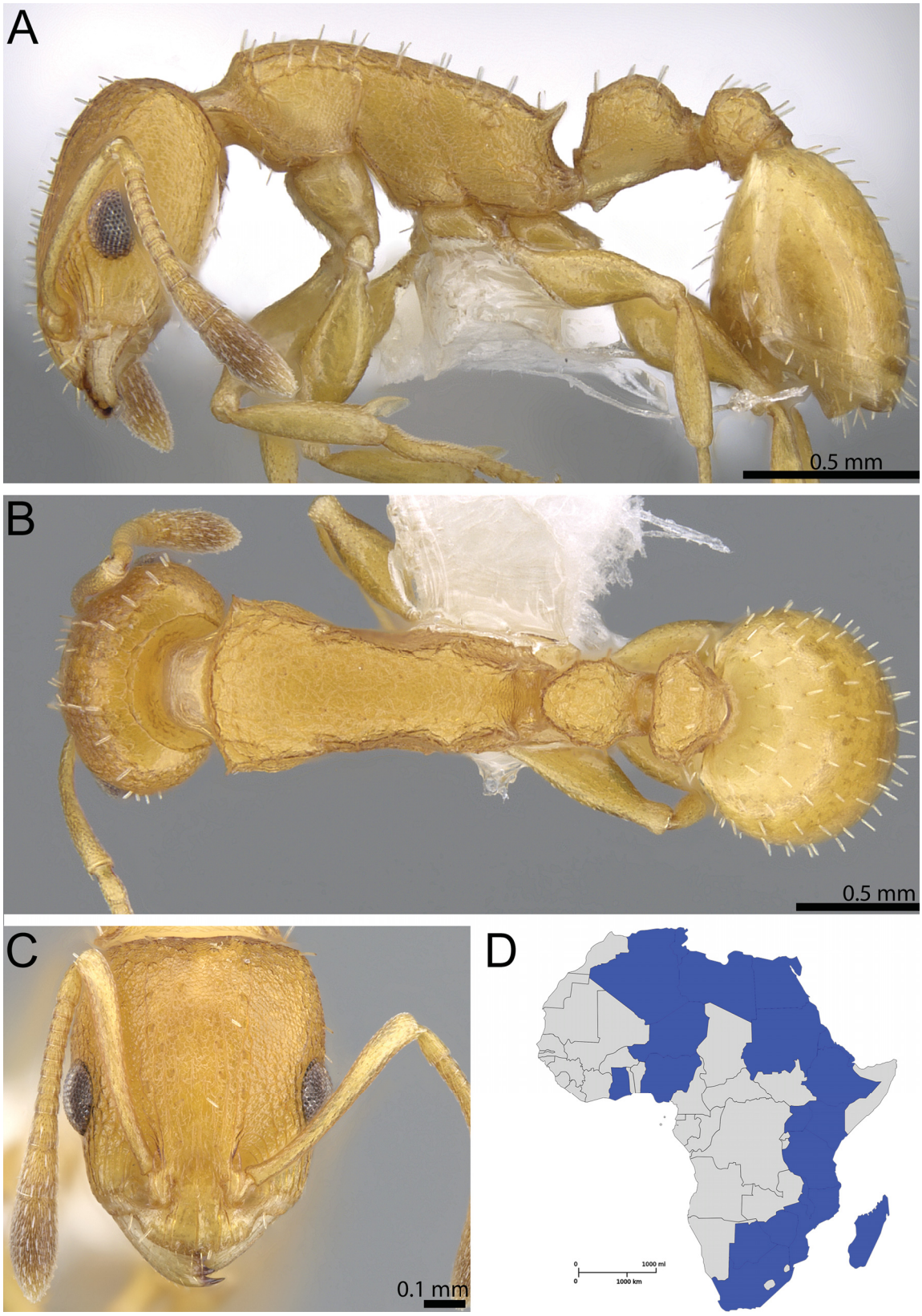

Fig. 14. *Nesomyrmex angulatus* (Mayr, 1862) (CASENT0922010). **A**. Body in profile view. **B**. Body in dorsal view. **C**. Head in full-face view. **D**. Map of Africa and Madagascar showing currently known distribution.

analyses challenging. Secondly, and more importantly, we are not fully convinced that all the material currently listed and identified as *N. angulatus* represents the same species. On the basis of some recent collections from Kenya and Mozambique we were able to observe a lot of morphological variation within and between localities. As already noted by Bolton (1982), the shape of the petiolar node seems to be especially variable. Consequently, we cannot rule out the possibility of dealing with a complex of more or less cryptic species. At the same time it is possible that *N. angulatus* is not only a very successful and widespread, but also an extremely variable species. The solution to this problem is not the aim of this study, since it requires the accumulation of an extensive amount of material from all over Africa, the Arabian Peninsula, and the Malagasy region.

Biology

Nesomyrmex angulatus was collected from a variety of habitat types, such as tropical dry forest, coastal scrub, mangrove forest, savannah, and Acacia woodland. In general it seems as if the species prefers comparatively arid environments. In addition, it is predominantly found on the trunk of trees or the lower vegetation, rarely on the ground, and it nests in pre-existing cavities of dead wood (Bolton 1982; Mbanyana & Robertson 2008).

Distribution

This species has by far the widest distribution range within the *N. angulatus* group, and likely represents the most widespread *Nesomyrmex* species on a global scale. It is found in the majority of African countries, as well as on the Arabian Peninsula and in most of the Malagasy region.

Nesomyrmex denticulatus (Mayr, 1901)
Figs 10B, 11C–D, 12A, 15

Leptothorax denticulatus Mayr, 1901: 5 (w.q.), South Africa.

Leptothorax (*Goniothorax*) *denticulatus* – W.M. Wheeler 1922: 891.
Nesomyrmex denticulatus – Bolton 2003: 272 (see also Bolton 1982: 328; Mbanyana & Robertson 2008: 38).

Diagnosis

The following character combination separates *N. denticulatus* from the remainder of the group: eyes with 10–12 ommatidia in longest row; in profile mesosomal dorsum with conspicuously impressed metanotal groove; in dorsal view petiolar node laterally denticulate; subpetiolar process with a conspicuous tooth anteriorly followed by a long cuticular flange which runs back to the postpetiolar junction; dorsum of propodeum with standing hairs; first gastral tergite with standing hairs evenly distributed throughout.

Diagnostic comments

The three species, *N. denticulatus*, *N. innocens* and *N. stramineus*, are morphologically very similar and can be well separated from the other species by the laterally denticulate petiolar node. The separation of these three can be challenging though. *Nesomyrmex denticulatus* is larger in general body size, has larger eyes with more ommatidia, and a subpetiolar process with a conspicuous tooth anteriorly, followed by a long cuticular flange which runs back to the postpetiolar junction, and slightly denser pilosity.

Biology

This species usually nests in cavities of branches on trees and bushes previously excavated by wood-boring beetles, lepidopteran larvae or termites (Mbanyana & Robertson 2008). It is found in a variety

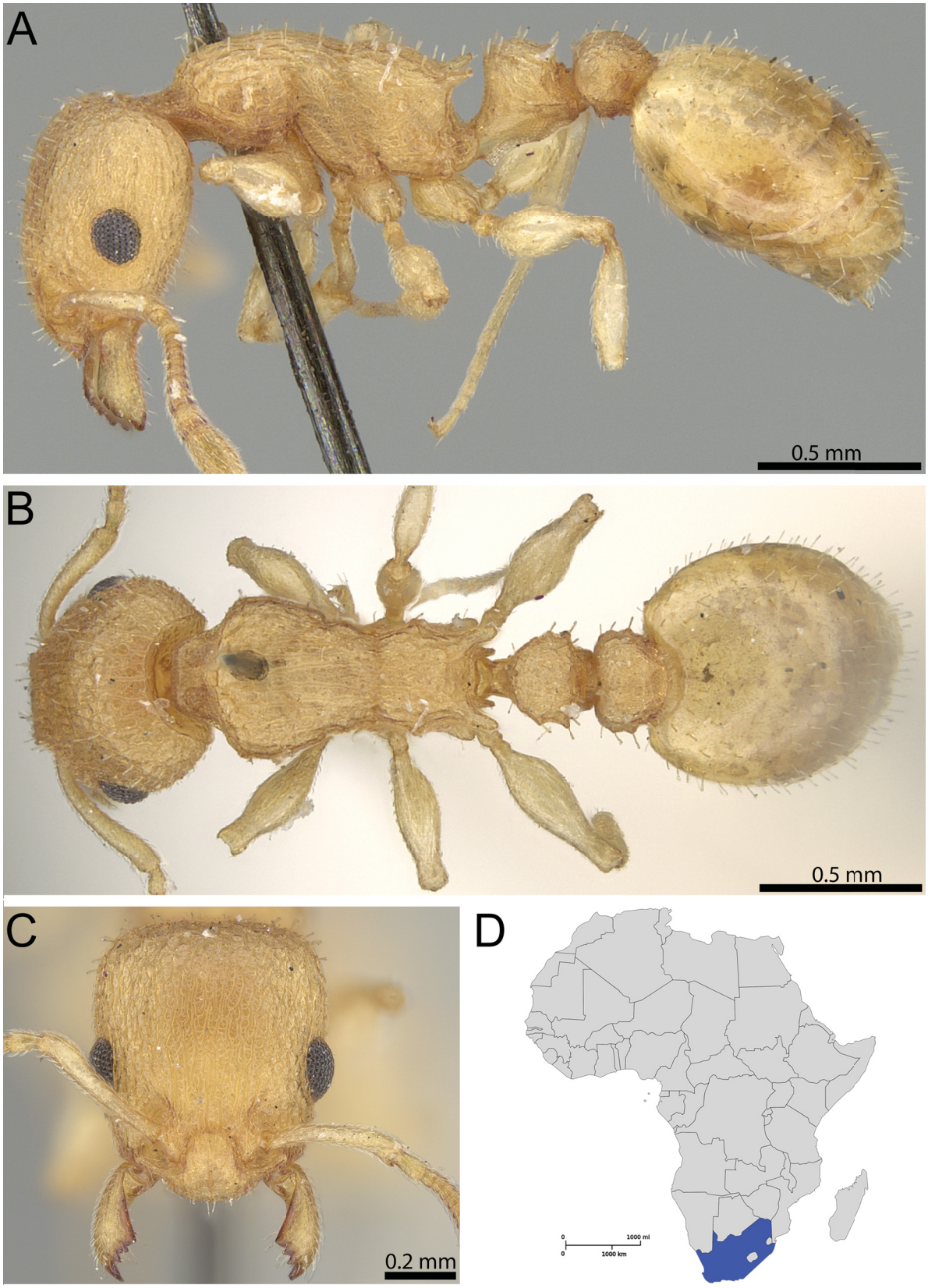

Fig. 15. *Nesomyrmex denticulatus* (Mayr, 1901) (CASENT0914923). **A**. Body in profile view. **B**. Body in dorsal view. **C**. Head in full-face view. **D**. Map of Africa and Madagascar showing currently known distribution.

of more arid habitats, such as late succession Fynbos, Succulent Karoo with large bushes, along edges of Southern Afrotemperate Forest, and possibly also Albany Thicket (Mbanyana & Robertson 2008).

Distribution

Nesomyrmex denticulatus is only known from South Africa, where it seems to be relatively common in the Western and Eastern Cape regions.

Nesomyrmex evelynae (Forel, 1916)
Figs 2D, 4A, 10A, 16

Leptothorax (*Goniothorax*) *evelynae* Forel, 1916: 423 (w.q.), D.R. Congo.

Nesomyrmex evelynae – Bolton 2003: 272 (see also Bolton 1982: 328).

Diagnosis

The following character combination distinguishes *N. evelynae* from the other species of the group: in profile mesosomal dorsum with conspicuously impressed metanotal groove; petiolar peduncle long; dorsum of propodeum without standing hairs; first gastral tergite lacking standing hairs except for single transverse row on posterior end of tergite.

Diagnostic comments

The recognition of this species within the *N. angulatus* group is fairly straightforward, since it is the only one that lacks standing hairs on most of the first gastral tergite while all other group species have standing hairs evenly distributed throughout this tergite. It also lacks standing hairs on the propodeum, a character shared only with *N. inhaca* sp. nov., whereas the other five species have short, standing pilosity on the propodeum.

Biology

It prefers rain forests where it lives in the canopy stratum. Based on canopy fogging samples from Kenya available to the first author, it appears that this species is found commonly on trees, even though in small individual numbers, suggesting smaller colony sizes.

Distribution

Nesomyrmex evelynae is found in Equatorial Africa ranging from Burkina Faso and Ghana in the west through the Central African Republic and the D.R. Congo to Uganda and Kenya in the east. The known distribution is disjunctive since *N. evelynae* is not known from the countries between Ghana and the Central African Republic and the D.R. Congo. We consider this more of a sampling artefact though, and expect the species to be collected from the countries in between in future sampling projects.

Nesomyrmex grisoni (Forel, 1916)
Figs 9B, 17

Leptothorax (*Goniothorax*) *grisoni* Forel, 1916: 425 (w.q.). D.R. Congo.

Nesomyrmex grisoni – Bolton 2003: 272 (see also Bolton 1982: 329).

Diagnosis

The following character combination distinguishes *N. grisoni* from the other species of the group: in profile mesosomal dorsum forming a single, uninterrupted flat surface without any trace of metanotal groove; petiolar peduncle short; body colour dark brown to black.

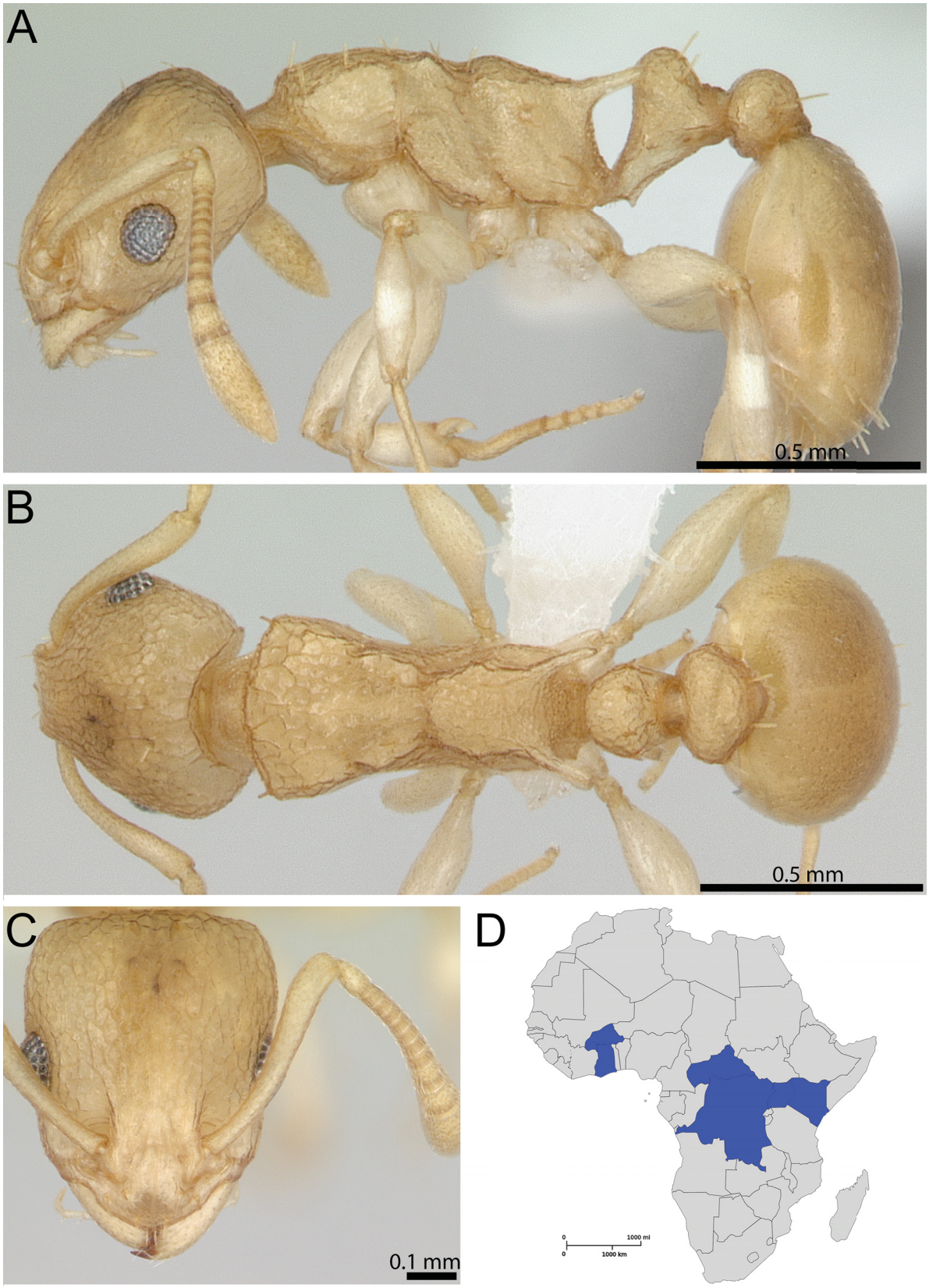

Fig. 16. *Nesomyrmex evelynae* (Forel, 1916) (CASENT0413068). **A**. Body in profile view. **B**. Body in dorsal view. **C**. Head in full-face view. **D**. Map of Africa and Madagascar showing currently known distribution.

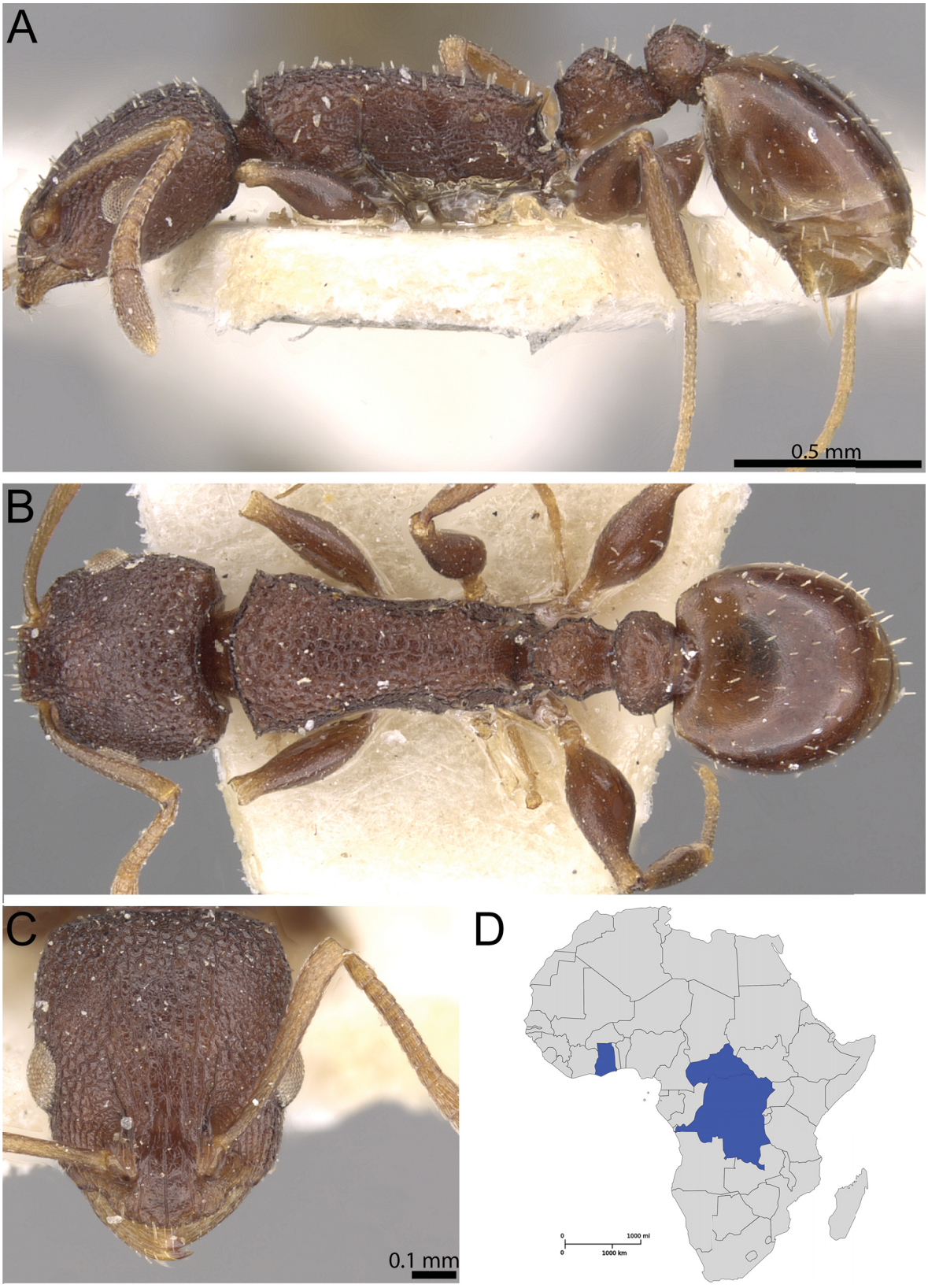

Fig. 17. *Nesomyrmex grisoni* (Forel, 1916) (CASENT0908994). **A**. Body in profile view. **B**. Body in dorsal view. **C**. Head in full-face view. **D**. Map of Africa and Madagascar showing currently known distribution.

Diagnostic comments

As mentioned above, *N. grisoni* and *N. angulatus* are straightforwardly distinguishable from the remainder of the group. At the same time they are morphologically very close to each other and only separable on the basis of body colour. For a more in-depth discussion we refer to the species account of *N. angulatus*.

Biology

Very little information about the natural history of this species is available. It seems to live on vegetation in rain forest habitats.

Distribution

Nesomyrmex grisoni is only known from the Central African Republic, the D.R. Congo and Ghana.

Nesomyrmex inhaca sp. nov.
urn:lsid:zoobank.org:act:C33B5A40-C3C0-4860-BD38-C99AC2D774A3
Figs 11A–B, 18

Diagnosis

The following character combination distinguishes *N. inhaca* sp. nov. from the other members of the *N. angulatus* group: in profile mesosomal dorsum with conspicuously impressed metanotal groove; in dorsal view petiolar node not laterally denticulate; dorsum of propodeum without standing hairs; first gastral tergite with standing hairs evenly distributed throughout.

Etymology

The new species is named after the type locality, Inhaca Island, to the southeast of Mozambique. The species epithet is a noun in apposition and thus invariant.

Type material

Holotype

MOZAMBIQUE: pinned worker, Maputo, Inhaca Island, 26°2′9″ S, 32°54′17″ E, 1 m, secondary forest, low vegetation, 21 Jun. 1992, G.D. Alpert leg. (MCZC: MCZ-ENT00593557).

Paratypes

MOZAMBIQUE: 6 pinned workers, same collection data as holotype (BMNH: CASENT0790018; HLMD: HLMD-Hym-2395; KSMA: CASENT0790019; MCZC**:** CASENT0790017; SAMC: CASENT0790022; ZFMK: CASENT0790020).

Worker measurements (n=7)

HL 0.69–0.73 (0.71); HW 0.50–0.53 (0.51); SL 0.47–0.51 (0.50); EL 0.16–0.17 (0.17); PH 0.26–0.28 (0.27); PW 0.41–0.42 (0.41); WL 0.85–0.88 (0.87); PSL 0.12–0.13 (0.12); PTL 0.14–0.16 (0.15); PTH 0.21–0.22 (0.22); PTW 0.19–0.20 (0.19); PPL 0.18–0.20 (0.19); PPH 0.21–0.22 (0.21); PPW 0.27–0.28 (0.28); CI 71–73 (72); SI 95–98 (96); OI 30–33 (32); DMI 47–49 (48); LMI 31–32 (32); PSLI 16–18 (17); LPeI 64–70 (69); DPeI 127–141 (131); LPpI 86–93 (89); DPpI 140–147 (145); PPI 138–147 (143).

Worker description

Head. Masticatory margin of mandible with five teeth, decreasing in size from largest, acute apical tooth to smallest basal denticle; clypeus arched-convex to almost triangular, anterior margin with slightly darker, lamellate, flattened ridge all-around; head in full-face view appearing relatively narrow, much

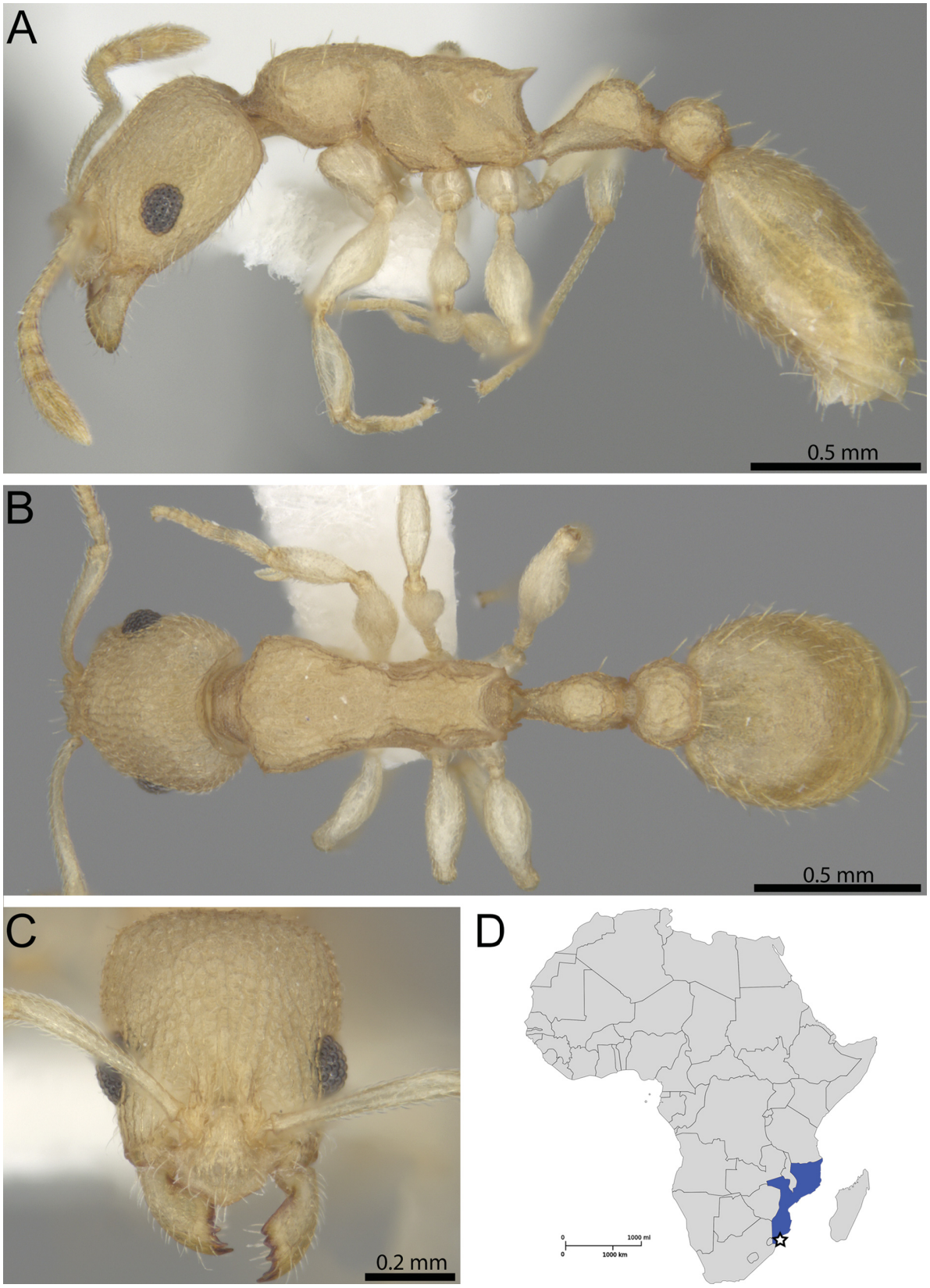

Fig. 18. *Nesomyrmex inhaca* sp. nov., holotype (MCZ-ENT00593557). **A**. Body in profile view. **B**. Body in dorsal view. **C**. Head in full-face view. **D**. Map of Africa and Madagascar showing currently known distribution and type locality (black and white star symbol).

longer than broad (CI 71–73), sides of head approximately straight, gently broadening behind eye level, narrowest directly behind posterior eye margin, and widest halfway between posterior eye margin and posterior head margin; posterior head margin concave medially; frontal carinae and antennal scrobes absent; antennal scapes moderately long, not reaching posterior head margin (SI 95–98). Eyes relatively large (OI 29–33), with eight to nine ommatidia in the longest row.

Mesosoma. In lateral view mesosomal outline relatively low (LMI 31–32) and flat with conspicuously impressed metanotal groove; promesonotal suture present laterally and completely absent dorsally; pronotum moderately marginate between lateral and dorsal mesosoma, anterodorsal corners not denticulate; propodeum armed with short to moderately long propodeal spines (PSLI 16–18), in profile spines distinctly longer than their basal width; propodeal lobes low and rounded.

Waist segments and gaster. Petiolar peduncle long, anteriorly with a small tooth-like subpetiolar process; in profile petiolar node relatively low and globular, between 1.4 and 1.5 times as high as long (LPeI 64–70); anterior face smoothly merging with peduncle and petiolar dorsum without any angles, posterior face slightly better developed; node in dorsal view about 1.3 to 1.4 times as wide as long (DPeI 127–141); in dorsal view petiolar node not laterally denticulate; in profile postpetiole globular, about 1.1 to 1.2 times as high as long (LPpI 86–93); in dorsal view about 1.4 and 1.5 times as wide as long (DPpI 140–147); postpetiole in dorsal view around 1.4 to 1.5 times as wide as petiolar node (PPI 138–147).

Sculpture. Mandibles shagreened to partly smooth and shiny, sometimes with very weak, superficial, irregular, longitudinal rugulae; median clypeal carina present and conspicuous, usually accompanied by one or two lateral, longitudinal, and slightly weaker rugae on each side; cephalic dorsum posteriorly and laterally strongly reticulate-rugose, medially more irregularly longitudinally rugose, ground sculpture conspicuously reticulate-punctulate; mesosoma laterally and dorsally with distinct reticulate-punctulate ground sculpture, lateral mesosoma conspicuously reticulate-rugose, dorsum reticulate-rugose with some irregular, longitudinal elements medially; legs unsculptured, smooth and shining; petiole and postpetiole with irregular reticulate-rugose sculpture superimposed on reticulate-punctulate ground sculpture; sculpture of first gastral tergite variable, some specimens only with reticulate-punctulate ground sculpture, other specimens irregularly rugose/rugulose on top of reticulate-punctulate ground sculpture.

Pilosity and pubescence. Head, mesosoma, waist segments and gaster dorsally with sparse, erect, blunt, and moderately long pilosity, hairs shorter on head and mesosoma than on waist segments and gaster; head laterally and ventrally with short appressed to decumbent pubescence; pubescence on mesosoma and waist segments sparse to absent; first gastral tergite with short to moderately long, appressed to decumbent pubescence.

Coloration. Body uniformly yellowish to light brown, in a few specimens legs slightly lighter yellow, almost white.

Diagnostic comments

Within the members of the *N. angulatus* species group, *N. inhaca* sp. nov. cannot be mistaken for *N. evelynae* since the latter is devoid of standing hairs on the first gastral tergite except for a single transverse row on the posterior end of the tergite, and also has very long propodeal spines and a relatively high petiolar node. *Nesomyrmex inhaca* sp. nov. has short, standing hairs evenly distributed throughout the first gastral tergite, shorter propodeal spines and a much lower petiolar node. The species pair *N. angulatus* and *N. grisoni* both do not possess a trace of a metanotal groove, which is obviously present in *N. inhaca* sp. nov. and thus it is not likely these species will be confused. Nevertheless, *N. inhaca* sp. nov. is morphologically closer to the trio of species *N. denticulatus*, *N. innocens* and *N. stramineus*. These

three are, however, easily separable since they possess a petiolar node with distinct lateral denticles and have standing hairs on the propodeal dorsum, while *N. inhaca* sp. nov. lacks both the lateral petiolar denticles and the standing hairs on the propodeum. Moreover, *N. inhaca* sp. nov. has apparently longer antennal scapes based on the much higher SI (94–95) compared to the other three species (SI 67–77). This is partly due to the fact that *N. inhaca* sp. nov. has indeed relatively longer antennal scapes, but the comparatively narrow head with low values of HW contributes to these high SI values. Therefore, we suggest being cautious with scape length as the single diagnostic character.

Intraspecific variation

Since the description is based on just one collection event, the observed intraspecific variation seen in the worker caste is very low. However, the sculpture on the first gastral tergite shows some variability, as described above.

Biology

Nesomyrmex inhaca sp. nov. was sampled from low vegetation in secondary forest at an elevation of 1 m. Apart from this, nothing is known of its natural history.

Distribution

The new species is so far only known from one collection event on Inhaca Island in the southeast of Mozambique. Despite this apparently restricted distribution to just one island, we are reluctant to declare *N. inhaca* sp. nov. as endemic to Inhaca Island. With the noticeable exception of the area around Gorongosa, most of Mozambique remains severely under-sampled and our knowledge of local ant communities and species distributions is very poor to non-existent. Consequently, it is possible that *N. inhaca* sp. nov. will also be found on the mainland.

Nesomyrmex innocens (Forel, 1913)
Figs 12B, 13A, 19

Tetramorium (*Leptothorax*) *innocens* Forel, 1913: 317 (w.), D.R. Congo.

Leptothorax innocens – Forel 1916: 425.
Nesomyrmex innocens – Bolton 2003: 272 (see also Bolton 1982: 330).

Diagnosis

The following character combination distinguishes *N. innocens* from the other members of the group: eyes with 7–9 ommatidia in longest row; in profile mesosomal dorsum with conspicuously impressed metanotal groove; propodeal spines short and thick, elongate-triangular and only weakly longer than their basal width; in profile petiolar node nodiform, appearing approximately as long as high; in dorsal view petiolar node laterally denticulate; subpetiolar process without a long cuticular flange running back to the postpetiolar junction; dorsum of propodeum with standing hairs; first gastral tergite with standing hairs evenly distributed throughout.

Diagnostic comments

As noted in the description of *N. denticulatus*, the latter, *N. innocens* and *N. stramineus* are morphologically relatively close. *Nesomyrmex innocens* and *N. stramineus* differ from *N. denticulatus* by generally smaller body size, smaller eyes with less ommatidia, and a subpetiolar process without a long cuticular flange running back to the postpetiolar junction. The separation of *N. innocens* and *N. stramineus* is a bit more difficult, as already mentioned by Bolton (1982). *Nesomyrmex innocens* has shorter and thicker propodeal spines and a lower and thicker petiolar node compared to *N. stramineus*. It is not clear at the

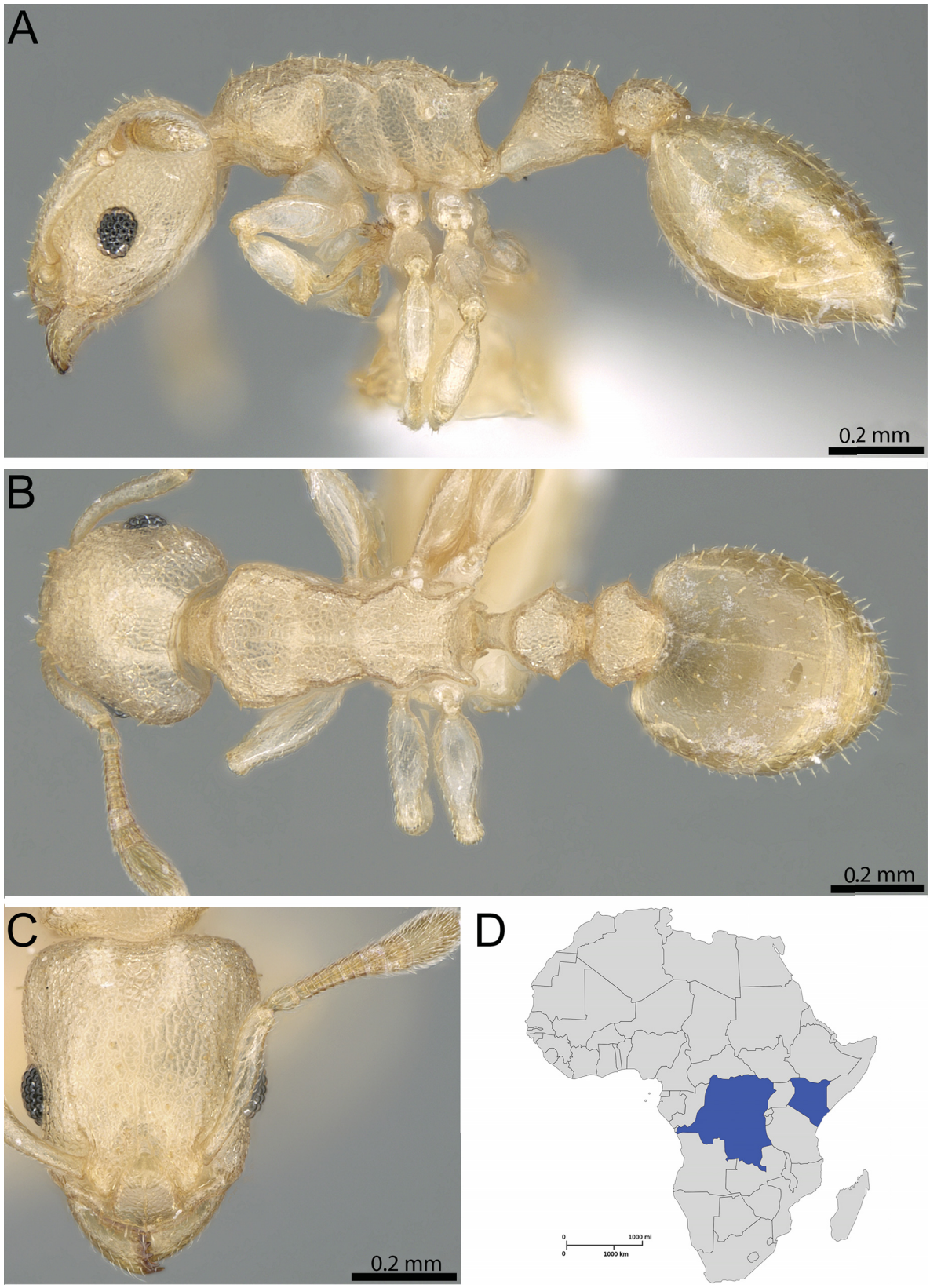

Fig. 19. *Nesomyrmex innocens* (Forel, 1913) (CASENT0906195). **A**. Body in profile view. **B**. Body in dorsal view. **C**. Head in full-face view. **D**. Map of Africa and Madagascar showing currently known distribution.

moment whether or not these character states are sufficient to maintain their heterospecificity in the long term. Bolton (1982) had some doubts about this, too, and it is possible that they represent geographical varieties of the same species. However, at present, based on the scarcity of the material, especially of *N. innocens*, we treat them as two different species.

Biology

Based on the limited data available, *N. innocens* nests in the stem of trees.

Distribution and biology

This species is only known from very few specimens, collected from the D.R. Congo and Kenya.

Nesomyrmex stramineus (Arnold, 1948)
Figs 2D, 8B, 13B, 20

Limnomyrmex stramineus Arnold, 1948: 223 (w.), South Africa.

Leptothorax stramineus – Brown 1971: 4.
Nesomyrmex stramineus – Bolton 2003: 272 (see also Bolton 1982: 332; Mbanyana & Robertson 2008: 38).

Diagnosis

The following character combination distinguishes *N. stramineus* from the other species of the group: eyes with 7–9 ommatidia in longest row; in profile mesosomal dorsum with conspicuously impressed metanotal groove; propodeal spines relatively long and thin, several times longer than their basal width; in profile petiolar node high, rectangular nodiform, appearing around twice as high as long; in dorsal view petiolar node laterally denticulate; subpetiolar process without a long cuticular flange running back to the postpetiolar junction; dorsum of propodeum with standing hairs; first gastral tergite with standing hairs evenly distributed throughout.

Diagnostic comments

As pointed out above, *N. stramineus* is very close to *N. denticulatus* and *N. innocens*. For more details on its differentiation from them we refer to the species account of *N. innocens*.

Biology

Nesomyrmex stramineus was sampled in savannah woodlands and Afromontane forests, where it lives in dead wood on trees (Mbanyana & Robertson 2008).

Distribution

This species occurs only in South Africa and Swaziland. It seems to be rather rare since it is only known from a few collection events.

Discussion

As already mentioned above, initially Bolton (1982) revised the Afrotropical *Nesomyrmex* fauna for the whole region, and more recently Mbanyana & Robertson (2008) for South Africa. Despite the existence of these revisions, there were no clear delimitations of *Nesomyrmex* species groups for the region prior to this study. Bolton (1982) discussed several assemblages of species that shared some morphological characters, but he did not formally define any groups or complexes. In their revision of South African *Nesomyrmex*, Mbanyana & Robertson (2008) provide brief species group definitions for the two groups encountered in South Africa: the *N. angulatus* and *N. simoni* groups. However, they only cover the South African species and omit the remainder of the Afrotropical fauna. In this study, we provide a first

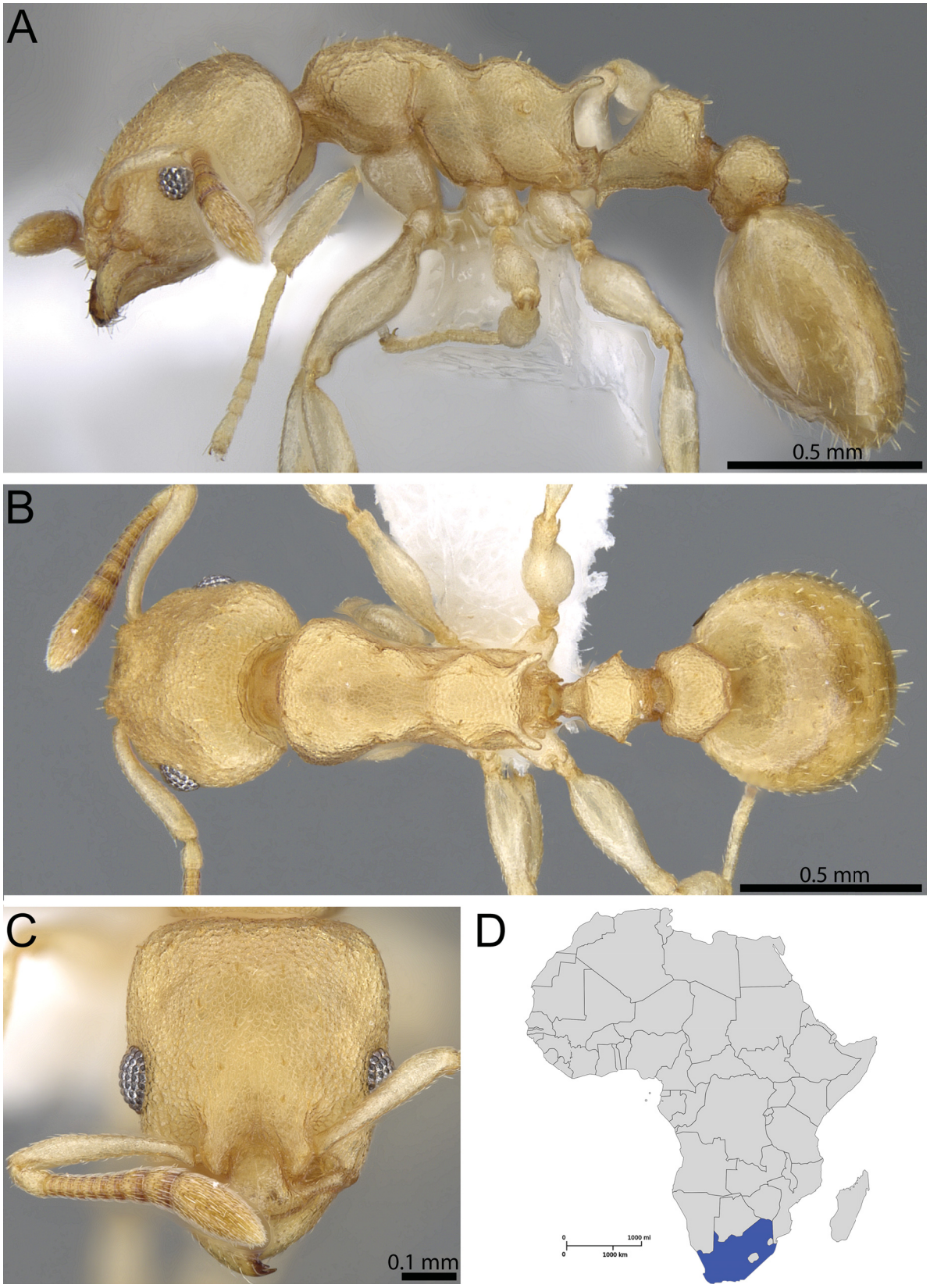

Fig. 20. *Nesomyrmex stramineus* (Arnold, 1948) (CASENT0922011). **A**. Body in profile view. **B**. Body in dorsal view. **C**. Head in full-face view. **D**. Map of Africa and Madagascar showing currently known distribution.

assessment of the entire Afrotropical fauna, propose species groups, and provide illustrated identification tools for all groups and most species with the exception of the species of the *N. simoni* group, which was extensively revised in Mbanyana & Robertson (2008). Nevertheless, the species groups proposed here are based on morphology alone, and should be treated as taxonomic convenience groups rather than phylogenetic entities. It is still likely that some or all represent monophyletic clades, but this can only be assessed in detail through a thorough comprehensive phylogenetic study that combines morphological with molecular data.

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