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Monograph

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Two new species of the genus *Camponotus* Mayr, 1861 (Hymenoptera: Formicidae) with five new records from India

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[1]urn:lsid:zoobank.org:author:1C870E60-5BC8-419E-AA6B-A5F558E8FEB6
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Abstract. Two new species, *Camponotus sholensis* sp. nov. and *Camponotus meghalayaensis* sp. nov. are described from India and redescriptions of four species (*C. habereri* Forel, 1911, *C. keihitoi* Forel, 1913, *C. quadrinotatus* Forel, 1886 and *C. simoni* Emery, 1893) new to India are provided. We also recorded and described an unidentified form '*Camponotus* sp. 101' that does not correspond to any species already known in India. An identification key supplemented with digital images of the known species of the genus is also provided.

Keywords. Formicinae, new species, new record, key, India, taxonomy.

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Introduction

Camponotus Mayr, 1861 is a globally distributed ant genus that belongs to the subfamily Formicinae Latreille, 1809. This subfamily includes several other genera and is known for its diversity. *Camponotus*, in particular, stands out due to its impressive number of species, with 1087 species and 410 subspecies recorded so far, which are further classified into 43 subgenera. As a result, it is considered one of the most species-rich ant genera in the world (Bolton 2022). The species of *Camponotus* display a wide range of physical and behavioral characteristics, which contribute to their ecological success. They can be found in various habitats, including forests, grasslands, and deserts, and often play important roles in their respective ecosystems. These ants are also known for their large size and defensive abilities, which they use to protect themselves and their colonies from predators. They have powerful mandibles used for crushing prey (Hölldobler & Wilson 1990; Fernandes *et al*. 2012; Souza *et al*. 2012).

Mayr (1861) described the genus based on the type species, *Formica ligniperda* Latreille, 1802. Emery (1896, 1925), Forel (1912b, 1914), Kempf (1972), Brandao (1991), Taylor & Brown (1985), Bolton (1995) and Shattuck (1999) have made noteworthy contributions in taxonomy of the species groups

and biogeography of the genus. The ant genus *Camponotus* is a taxonomically unstable constellation of lineages and has a complex taxonomic history due to variability of taxonomic characters. The morphology of the species complexes where the species are grouped is doubtful. Ward *et al*. (2016) revised the classification of the genus and raised the subgenus *Colobopsis* Mayr, 1861 and *Dinomyrmex* Ashmead, 1905 to the genus level and relegated the genera *Forelophilus* Kutter, 1931 and *Phasomyrmex* Stitz, 1910 to subgenera under *Camponotus*.

Given the backdrop, the taxonomy of the genus *Camponotus* remains chaotic in India, too. In India, this genus comprises the highest number of species among all Indian ants, with a total of 76 species (approximately one-tenth of the total known Indian ant fauna), which are a combination of lineages from diverse regions including Indo-Malaysia, the Palearctic, the Afrotropics, the Mediterranean, Central Asia, and temperate regions (Bharti *et al*. 2016; Dhadwal & Bharti 2021). These species are organized into different species complexes, which are sometimes disputed in terms of their monophyly. Moreover, species identification is often challenging due to the presence of polymorphic worker castes and subtle morphological differences. Unfortunately, the classification and identification process has become more complex due to the use of unreliable and ambiguous taxonomic characters that lack consistency over time in terms of the extent and range of variation within species, subspecies, and their geographically isolated populations. None of the contributors (Bingham 1903; Karmaly & Narendran 2006; Bharti & Wachkoo 2014) resolved the natural relationships of lineages occurring in the subcontinent. However, many ant species still need to be documented in India (Bharti *et al*. 2016). Hence, contributions in terms of new species and new records are significant. During the present study, we described two new species, *Camponotus sholensis* sp. nov. and *Camponotus meghalayaensis* sp. nov. Also, four species (*C. habereri* Forel, 1911, *C. keihitoi* Forel, 1913, *C. quadrinotatus* Forel, 1886 and *C. simoni* Emery, 1893) are recorded and redescribed along with an unidentified form *Camponotus* sp. 101 for the first time from India. An updated identification key supplemented with digital images of the known species of the genus is also provided.

Material and methods

Taxonomic analysis was conducted using a Nikon SMZ 1500 stereo zoom microscope with a maximum magnification of 112.5×. Digital images of the specimens were prepared using a Nikon SMZ 1500 stereo microscope fitted with an MP (Micro Publisher) digital camera and Auto Montage (syncroscopy, a division of Synoptics Ltd.) software. All the images were cleaned with Adobe Photoshop CS5 and Helicon Filter 5. A geographic map (Fig. 1) showing localities of the species is prepared by using ArcGIS software. Morphological measurements were recorded in millimetres with an oculometer fitted on a Nikon SMZ 1500 stereo microscope. Additional images were provided by https://www.antweb.org/. Morphological terminology and standard measurements (Fig. 2) follow Bharti & Wachkoo (2014) and Wachkoo & Akbar (2016).

Abbreviations

CI = Cephalic Index: HW/HL × 100
EL = Eye length: maximum diameter of the compound eye
GL = Gaster length: length of the gaster in profile from the anteriormost point of the first gastral segment to the posteriormost point
HL = Head length: the maximum median length of the head in full-face view, measured from the midpoint of the posterior margin of the head to the midpoint of the anterior margin of the clypeus
HTL = Maximum hind tibia length: straight line length of the hind tibia measured from the constriction immediately before its proximal insertion to its distal most point, excluding the bristles or spines

HW = Head width: the maximum width of the head capsule excluding the compound eyes
MTL = Maximum length of the mesotibia: maximum length of the mesotibia with full width and length positioned in visual plane, measured from the most distal point near the extensor profile to the proximal constriction point of flex or profile
PH = Petiolar node height: the maximum distance between the petiolar spiracle and the dorsal most point of the petiolar node
PL = Petiolar length: maximum length of the petiole in profile, measured in a straight horizontal line from immediately above the dorsal base of the anterior petiolar tubercle to the posterior margin
PrI = Pronotal index: PW/HW × 100
PW = Pronotum width: maximum width of the pronotum in dorsal view
SI = Scape index: SL/HW × 100
REL = Relative eye length index: EL/HL × 100
SL = Scape length: straight line length of the first antennal segment excluding the basal condyle
TL = Total length: HL + WL + PL + GL
WL = Weber's length: the longest anatomical line that connects the posteriormost point of the propodeal lobe with the anterior most point of the pronotal collar; preferentially measured in lateral view, but if one of the reference points is not visible, a dorsal view may help

Repository

PUAC = "Punjabi University Patiala Ant Collection" at Department of Zoology and Environmental Sciences, Punjabi University, Patiala, Punjab, India

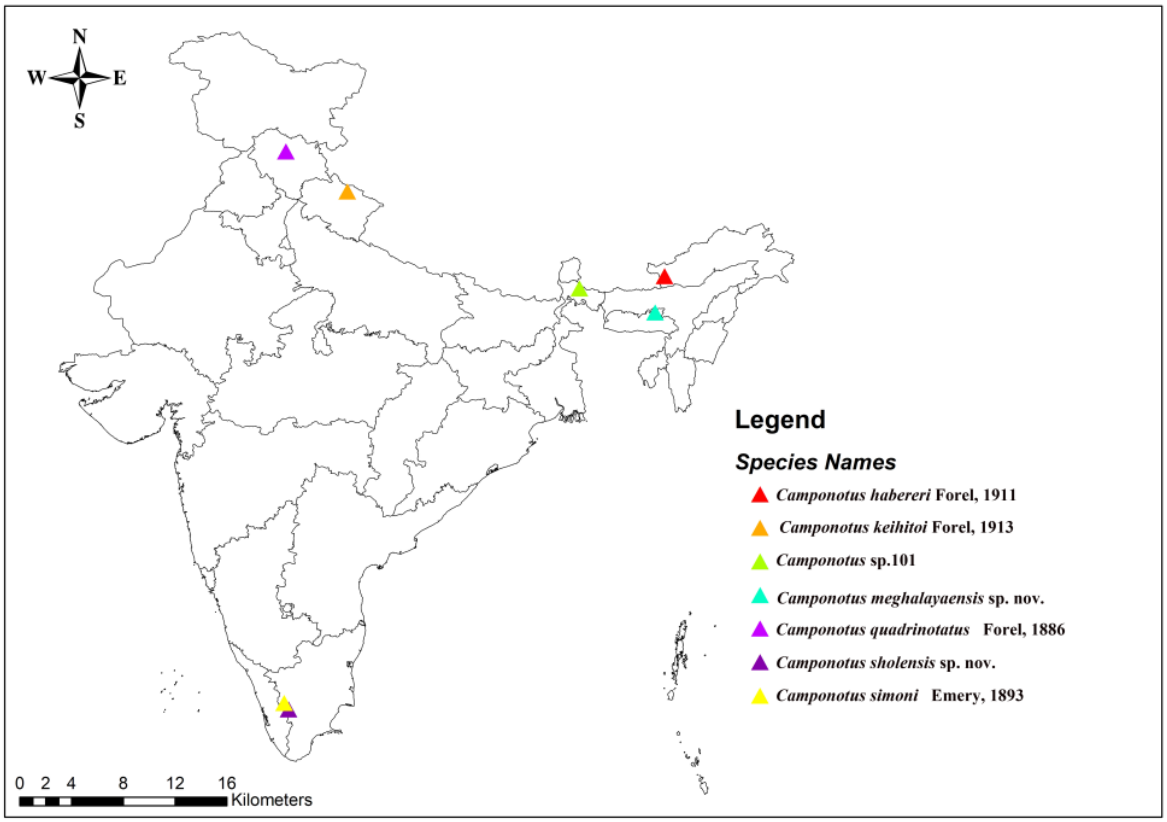

Fig. 1. Map showing type locality of the new species and localities of the new records from India.

Results

Morphological diagnosis of the worker castes of the genus Camponotus

The combination of the following features can be used to reliably diagnose worker caste:

Major worker

Head broad and massive or wider occipitally in full face view; lateral cephalic margins gradually narrowed or converging to the base of mandibles; posterior margin more or less straight; mandibles triangular or subtriangular with broad toothed masticatory margin; both palps and antennal scape short with respect to head size; antennal scape not surpassing posterior cephalic margin; anterior clypeal margin more or less straight; mesosoma gibbous in lateral view; body large size.

Minor worker

Minor workers are similar to major worker in all aspects except; in minor workers head small, longer than broad or narrow posteriorly; lateral cephalic margins more or less straight or some time converging to the base of mandibles; posterior margin more or less convex; clypeus with straight, broadly convex, or medially triangular anterior margin in full-face view; compound eye large, located posterior to the midline of the head in full face view; both palps and antennal scape long with respect to head size;

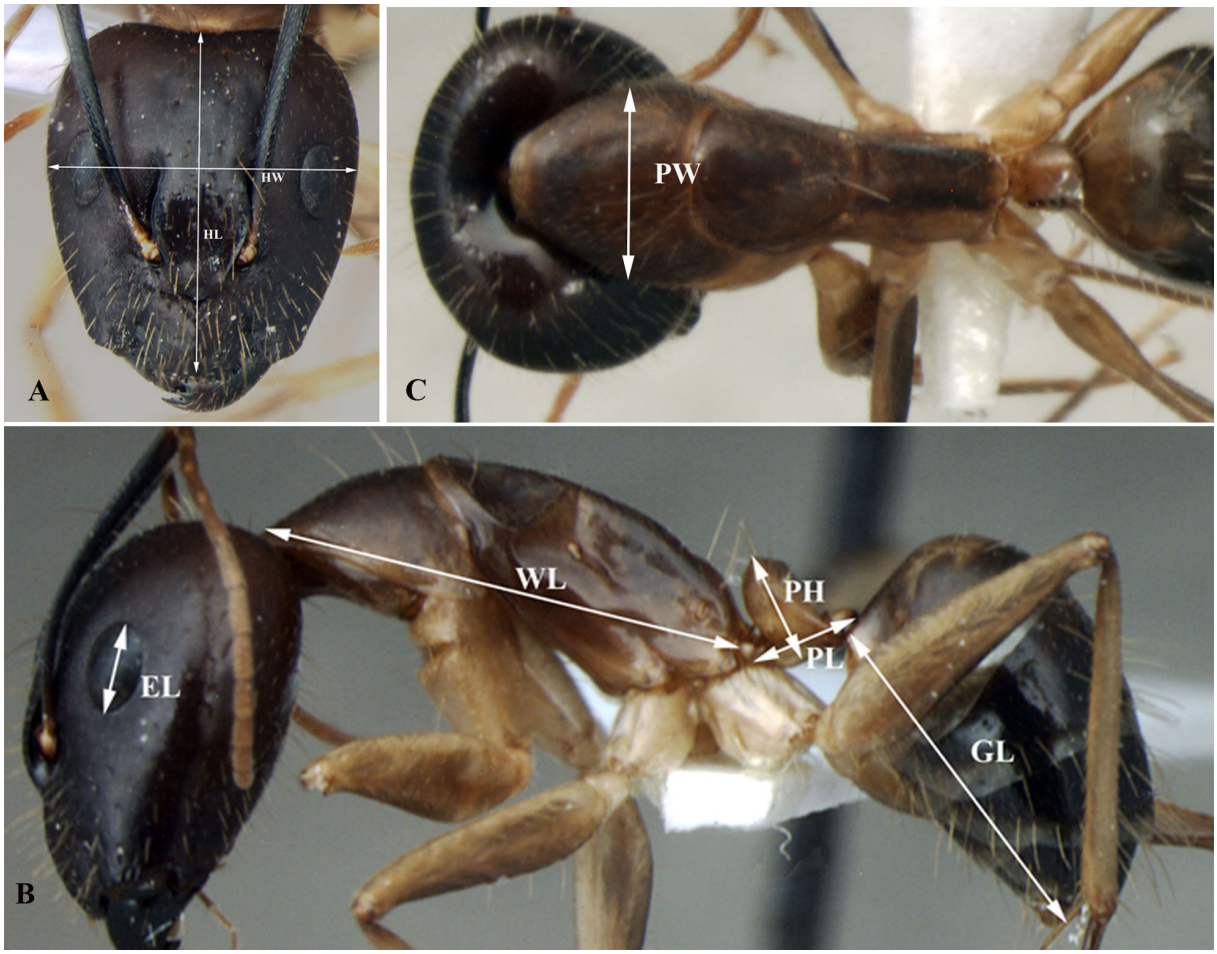

Fig. 2. Illustrations of measurements for species of *Camponotus* Mayr, 1861. **A**. Head in full-face view. **B**. Body in lateral view. **C**. Body in dorsal view. Abbreviations: see Material and methods.

antennal scape surpassing posterior cephalic margin of the head proportionally to its length; mesosoma not gibbous, comparatively narrow in lateral view; body size comparatively small.

Taxonomic account

Class Insecta Linnaeus, 1758
Order Hymenoptera Linnaeus, 1758
Family Formicidae Latreille, 1809
Subfamily Formicinae Latreille, 1809
Genus *Camponotus* Mayr, 1861
Subgenus *Tanaemyrmex* Ashmead, 1905

Camponotus sholensis sp. nov.
urn:lsid:zoobank.org:act:9616BD81-025B-4484-8390-074245286F80
Figs 3–5

Diagnosis

The distinguishing characteristics of *C. sholensis* sp. nov. are as follows: the head is as long as broad, mesosoma is broad and compact; petiole node is thin and anteriorly convex but flat posteriorly; tibiae are cylindrical and lack spines beneath them; the body is black and entirely microreticulate, gleaming and densely pilose, covered with long erect or suberect setae.

This species resembles *C. lamarckii* Forel, 1892 and can be distinguished by the following combination of characteristics: in *C. sholensis* sp. nov. (major worker), the head is as long as broad; the clypeal margin is straight; the tibiae are cylindrical; the vertex of the head has a few short erect or suberect hair and a row of hair present beneath the head; the mesosoma and the gaster are covered with few standing hairs. While in *C. lamarckii* (major worker), the head is longer than broad; the clypeal margin is medially carinate; the tibiae of the legs are compressed; the body is covered with very short and appressed pubescence; the mesosoma and the gaster are densely covered with yellow, erect, long setae.

Etymology

The species has been named after the Shola National Park.

Type material

Holotype

INDIA • major worker; Kerala, Pampadum Shola National Park; 10.1266° N, 77.2581° E; elev. 1700 m; 25 Jan. 2017; T. Dhadwal leg.; hand picking method; PUAC T27.

Paratypes

INDIA • 15 workers, 2 ♀♀; same collection data as for holotype; PUAC T30 to T46.

Measurements

Holotype major worker

HL 2.41; HW 2.05; EL 0.43; SL 2.14; PW 1.34; WL 2.86; MTL 1.55; HTL 2.29; PL 0.58; PH 0.69; GL 3.05; TL 8.90; CI 85; SI 99; REL 17; PrI 65.

Paratypes major workers (n = 5)

HL 2.21–2.62; HW 2.13–2.58; EL 0.41–0.45; SL 2.09–2.17; PW 1.43–1.47; WL 2.66–2.95; MTL 1.47–1.80; HTL 2.25–2.37; PL 0.57–0.61; PH 0.65–0.77; GL 2.25–3.36; TL 7.69–9.54; CI 96–98; SI 84–98; REL 17–18; PrI 56–67.

Paratypes minor workers (n = 5)
HL 1.34–1.51; HW 0.90–1.11; EL 0.40–0.41; SL 1.55–1.85; PW 1.02–1.21; WL 1.76–2.17; MTL 1.22–1.43; HTL 1.51–1.84; PL 0.45–0.49; PH 0.57–0.65; GL 1.27–1.96; TL 4.82–6.13; CI 67–73; SI 166–172; REL 27–29; PrI 109–113.

Paratypes gynes (n = 2)
HL 2.35–2.41; HW 2.10–2.17; EL 0.60–0.62; SL 1.98–2.23; WL 3.90–3.96; MTL 1.92–1.95; HTL 2.66–2.72; PL 0.80–0.86; PH 1.24–1.30; GL 4.52–4.65; TL 11.57–11.88; CI 89–90; SI 94–102; REL 25–25.

Description

Major worker (Fig. 3)
Habitus. In full-face view, head as long as broad (CI 96–98), posterior margin almost straight and shallowly concave in the middle, lateral sides of the head converging anteriorly; anterior margin of the clypeus virtually straight and feebly carinate; mandibles elongate, triangular and masticatory margin with 7 teeth; eyes are small, placed distinctly above the mid-length of the head; antennae short and 12-segmented; scape short (SI 166–172), almost reaching the posterior margin of the head. In dorsal view, mesosoma broad and compact, pronotum anteriorly narrow (PrI 56–67); pro mesonotal suture and metanotal groove distinct; mesosoma form a single convexity with mesonotum somewhat higher than the pronotum and propodeum in lateral view; propodeal declivity almost straight; propodeal spiracle is oval in shape and placed below the margin of propodeal declivity; petiole node thin, anteriorly convex and flat posteriorly; tibiae cylindrical; gaster elongated.

Sculpture. Head and mesosoma microreticulate and entire body gleaming; with gaster silky smooth.

Pilosity and pubescence. A few short erect or suberect hairs on the vertex of the head and a row of hair present on the ventral region of the head; clypeal margin with a row of setae, a few short setae present on the mandibles; pronotum and mesonotum coated with a few long erect setae; propodeum, petiole and gaster with a few standing hairs; hind tibia densely setose, without a row of spiny bristles on ventral margins in addition to 3–4 suberect setae close to the apical spurs.

Colouration. Head, mesosoma and gaster are black; legs reddish brown to dark brown, with a paler trochanter and tarsi.

Minor worker (Fig. 4)
With characteristics of a major worker except: comparatively smaller head, longer than broad (CI 67–73), rectangular in outline with posterior margin rounded and lateral sides are almost parallel; masticatory margin of mandibles with 6 teeth; scape distinctly long (SI 166–172) surpass posterior margin of head by more than half of its length; mesosoma short and form a smooth curve; legs of minor workers lighter in colour.

Gyne (Fig. 5)
Similar to the major worker with few modifications depicting the caste and the following differences: head smaller (CI 89–90) with lateral edges subparallel and posterior margin convex; cephalic dorsum with 3 prominent ocelli; mandibles with 7 teeth; parapsidal lines present; petiolar dorsum strongly emarginate; propodeal dorsum forming a right angle with propodeal declivity.

Male
Unknown.

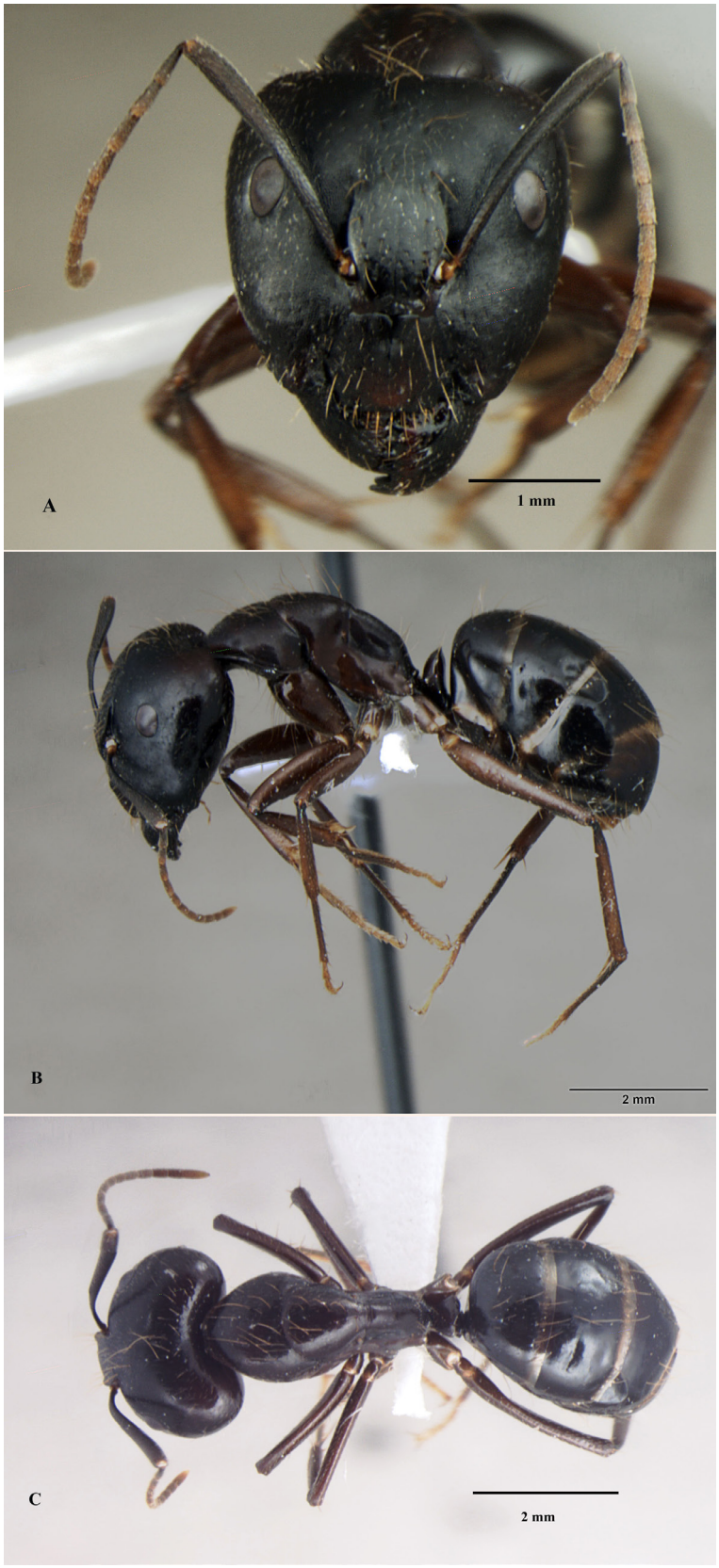

Fig. 3. *Camponotus sholensis* sp. nov., holotype, major worker (PUAC T27). **A**. Head in full face view. **B**. Body in profile view. **C**. Body in dorsal view.

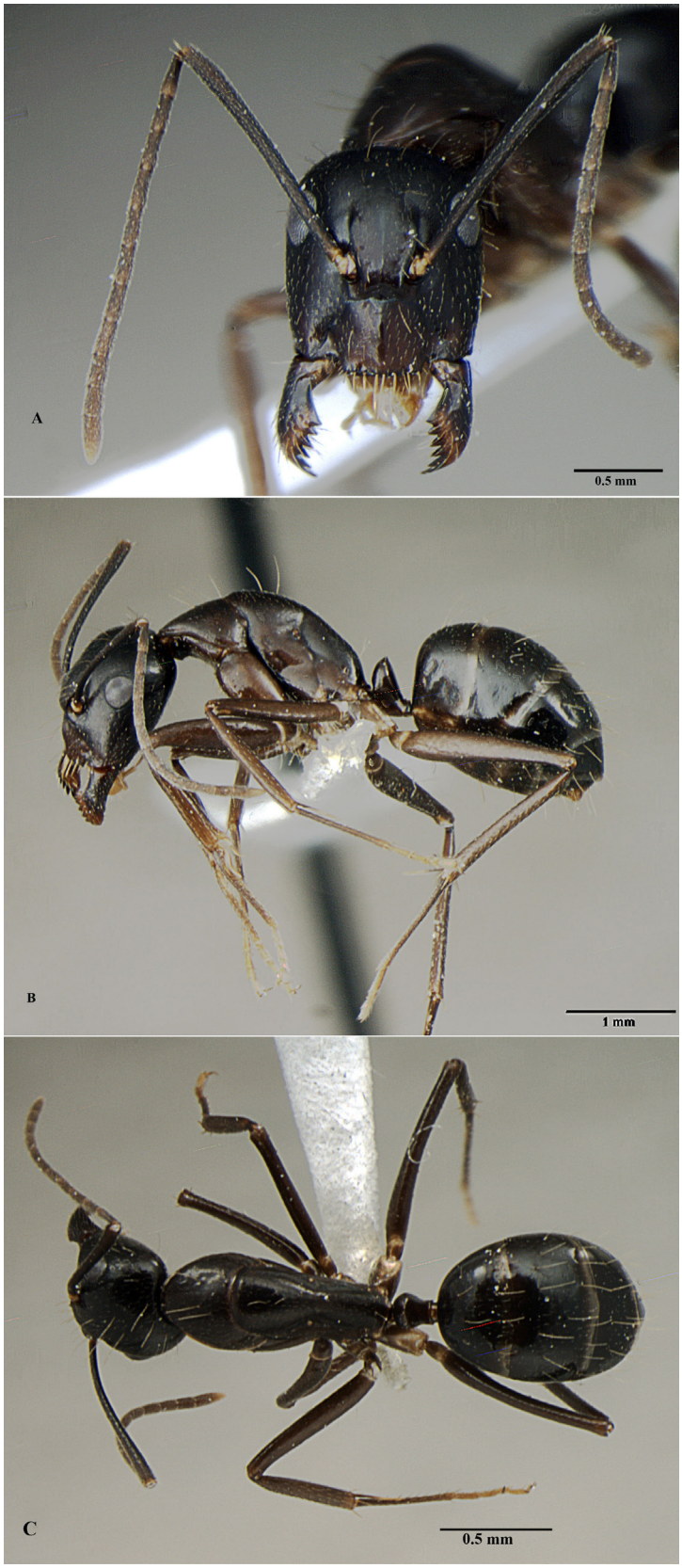

Fig. 4. *Camponotus sholensis* sp. nov., paratype, minor worker (PUAC T33). **A**. Head in full face view. **B**. Body in profile view. **C**. Body in dorsal view.

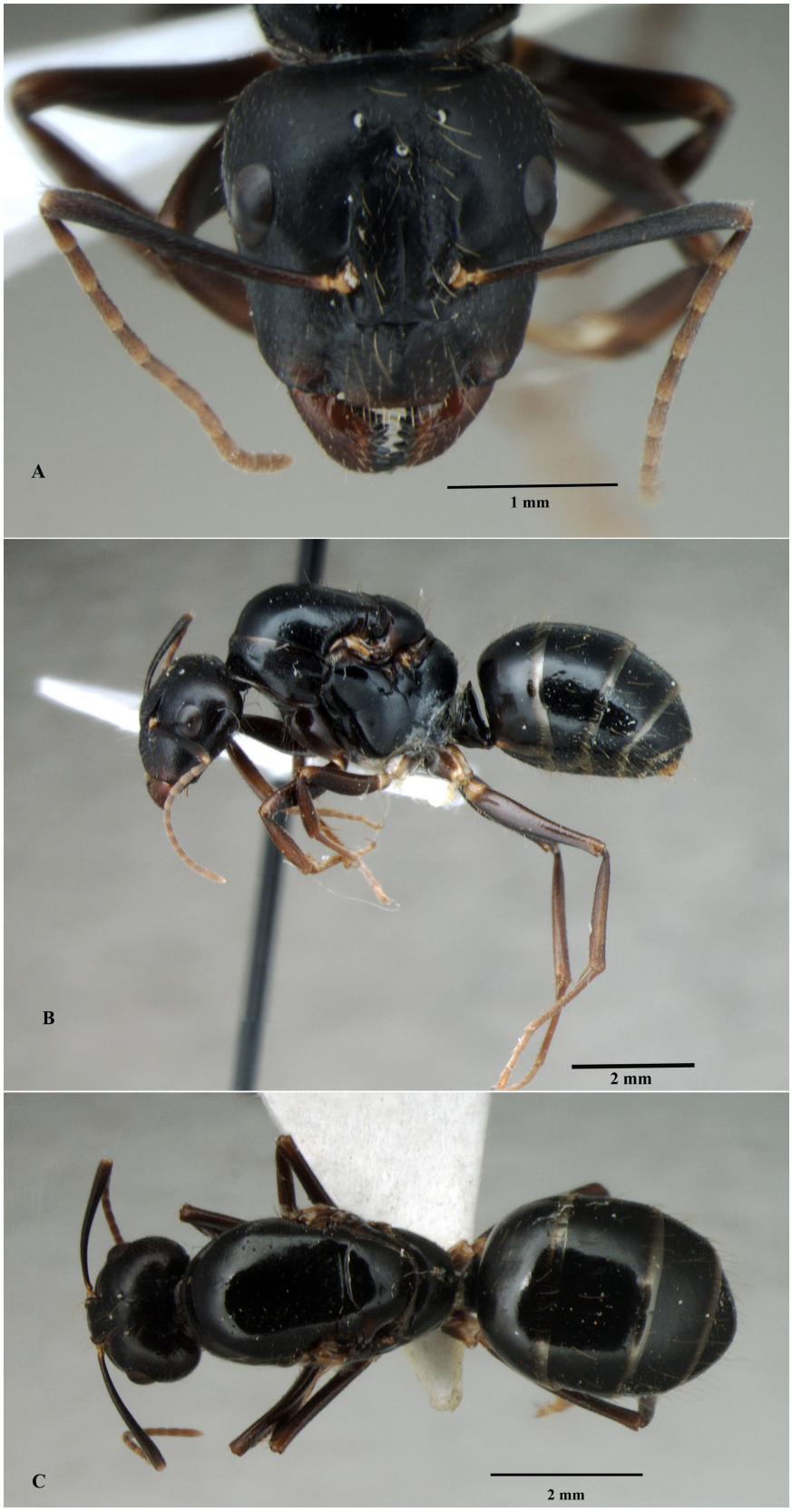

Fig. 5. *Camponotus sholensis* sp. nov., paratype, gyne (PUAC T 45). **A**. Head in full face view. **B**. Body in profile view. **C**. Body in dorsal view.

Habitat

The workers were collected from the forest area of Pampadum Shola forest, where a nest was found inside the wooden log covered with soil and grass. Workers started coming out after creating a disturbance as no worker had seen around the wooden log before it was disturbed or lifted. The region is characterized by thick evergreen forest and has an average daily temperature of 28°C.

Camponotus meghalayaensis sp. nov.
urn:lsid:zoobank.org:act:E9A32FD2-AA7B-4A8D-BF8D-F76F73B92C1A
Figs 6–7

Diagnosis

The distinguishing characteristics of the species are as follows: the head is longer than broad; the petiole node is thick and bluntly rounded; the tibiae are compressed without spined beneath; body is reticulate punctate, somewhat matte and sparsely pubescent.

This species resembles *C. mitis* (F. Smith, 1858) and can be distinguished by the following combination of characters; in *C. meghalayaensis* sp. nov. (major worker), the anterior clypeal margin is medially emarginated; the body is covered with sparse erect hairs or less pilose and the node of petiole is thick and bluntly rounded in shape. While in *C. mitis* (major worker), the anterior clypeal margin is not emarginated; the body is covered with erect dense pilosity and the node of the petiole is thin and scale-like.

Etymology

The species has been named after the state Meghalaya, from where it was discovered.

Type material

Holotype
INDIA • major worker; Meghalaya, Nongpoh; 25.9194° N, 91.8649° E; elev. 475 m; 13 Nov. 2019; T. Dhadwal leg.; hand picking method; PUAC T51.

Paratypes
INDIA • 6 workers; same collection data as for holotype; PUAC T55 to T60.

Measurements

Holotype major worker
HL 2.58; HW 2.34; EL 0.59; SL 2.25; PW 1.23; WL 3.07; MTL 1.47; HTL 2.54; PL 0.69; PH 0.70; GL 2.33; TL 8.67; CI 83; SI 96; REL 22; PrI 52.

Paratype major worker (n = 1)
HL 2.66; HW 2.48; EL 0.61; SL 2.37; PW 1.35; WL 3.36; MTL 2.11; HTL 2.82; PL 0.77; PH 0.73; GL 2.46; TL 9.25; CI 107; SI 95; REL 22; PrI 54.

Paratypes minor workers (n = 5)
HL 1.76–1.88; HW 1.02–1.11; EL 0.45–0.49; SL 2.29–2.41; PW 1.02–1.06; WL 2.66–2.82; MTL 1.80–1.96; HTL 2.25–2.54; PL 0.57–0.65; PH 0.61–0.65; GL 2.29–2.58; TL 7.28–7.93; CI 57–59; SI 217–224; REL 25–26; PrI 95–100.

Description

Major worker (Fig. 6)
Habitus. In full-face view, head longer than broad (CI 83–107), posterior margin of the head rounded and shallowly concave in the middle, lateral margins slightly converging towards the anterior side; anterior

Fig. 6. *Camponotus meghalayaensis* sp. nov., holotype, major worker (PUAC T51). **A**. Head in full face view. **B**. Body in profile view. **C**. Body in dorsal view.

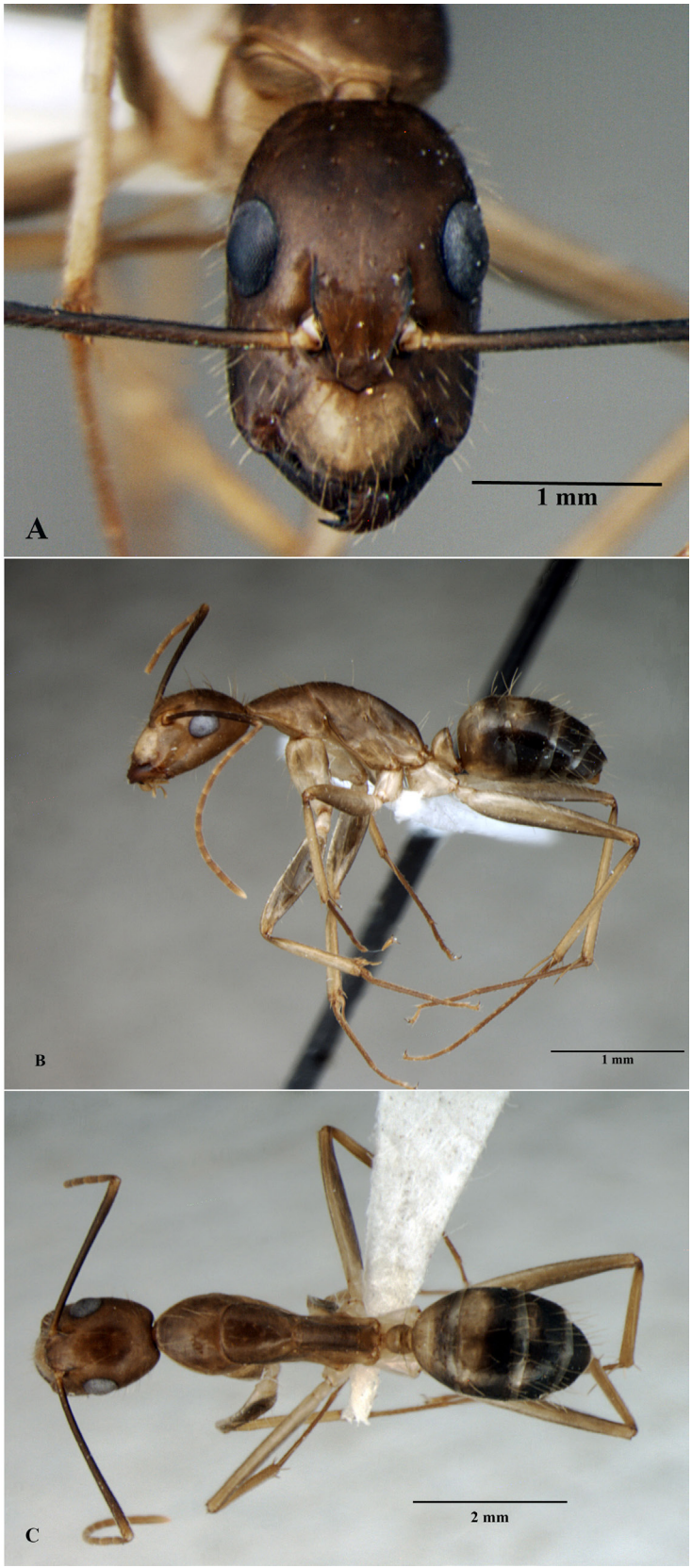

Fig. 7. *Camponotus meghalayaensis* sp. nov., paratype, minor worker (PUAC T57). **A**. Head in full face view. **B**. Body in profile view. **C**. Body in dorsal view.

clypeal margin medially emarginated; mandibles with 7 teeth; eyes large placed near the midlength of the head; antennae long, slender and 12-segmented; scape short (SI 95–96) surpassing posterior margin of the head by ¼ of its length. In dorsal view, mesosoma broad and elongated, pronotum anteriorly narrow (PrI 54); pro-mesonotal suture and metanotal groove distinct; mesosoma form a single convexity with mesonotum somewhat higher than the pronotum and propodeum in lateral view; propodeal declivity almost straight; propodeal spiracle oval in shape placed below the margin of propodeal declivity; petiole node is thick and bluntly rounded; tibiae compressed; gaster elongated.

Sculpture. Head and mesosoma reticulate punctate; head somewhat matte, whereas mesosoma and gaster are gleaming.

Pilosity and pubescence. Pubescence sparse, with a few setae present on the vertex and anterior margin of the clypeus; lateral sides of the head covered with sparse short erect hair; hind tibia densely setose, without a row of spiny bristles on ventral margin in addition to 3–4 suberect setae close to the apical spur.

Colouration. Head and gaster dark brown; mesosoma yellowish brown to reddish brown; legs lighter brown.

Minor worker (Fig. 7)

Differs from the major worker in the following characteristics: head smaller and elongated (CI 57–59), longer than broad and narrower posteriorly than in the fornt, with the posterior margin almost rounded and sub-parallel lateral margins; anterior clypeal margin straight; eyes comparatively large touching the lateral sides of the head; mandibles with 6 teeth; scape distinctly long (SI 217–224) surpassing posterior margin of head by half of its length; mesosoma is shorter than the one of major worker.

Habitat

The workers were collected moving around the house at the type locality (Nongpoh) and were observed entering a crack in the floor. The region has an average temperature of 30°C and has residential areas surrounded by forest.

New records

Camponotus habereri Forel, 1911
Figs 8–9

Camponotus habereri Forel, 1911: 293.

Camponotus habereri – Forel 1912a: 76; 1913a: 200.
Camponotus (*Myrmoturba*) *habereri* – Forel 1913a: 200. — Emery 1920: 255.
Camponotus (*Myrmothrix*) *habereri* – Forel 1914: 269.
Camponotus (*Tanaemyrmex*) *habereri* – Emery 1925: 93.

Diagnosis

This species resembles *C. nicobarensis* Mayr, 1865 but can be easily separated from the latter by following a combination of characteristics: in *C. nicobarensis* (major worker), the masticatory margin is armed with 5 teeth; the dorsal surface of the gaster is marked with black and yellowish alternate bands; the body is covered with very sparse and erect or sub-erect hairs. While in *C. nicobarensis* (major worker), the masticatory margin of the mandibles are armed with 7 teeth; the gaster is brownish with a blackish edge of the proceeding tergite; the head, mesosoma, and gaster are all covered with very long, dense, and erect or sub-erect hairs on their dorsal surfaces.

Material examined

INDIA • 14 workers; Arunachal Pradesh, Dirang; 27.3605° N, 92.2473° E; elev. 1560 m; 3 Nov. 2019; T. Dhadwal leg.; hand picking method; PUAC T71 to T84.

Measurements

Major worker (n = 7)
HL 2.97–3.16; HW 2.72–3.03; EL 0.60–0.62; SL 2.70–2.85; PW 1.36–1.72; WL 3.41–3.65; MTL 2.35–2.54; HTL 3.03–3.22; PL 0.80–0.93; PH 0.93–1.05; GL 2.66–3.41; TL 9.84–11.15; CI 91–95; SI 94–99; REL 19–20; PrI 50–56.

Minor worker (n = 7)
HL 1.64–2.01; HW 0.94–1.06; EL 0.45–0.48; SL 2.37–2.54; PW 0.86–0.94; WL 2.74–3.03; MTL 2.05–2.09; HTL 2.33–2.66; PL 0.61–0.69; PH 0.61–0.69; GL 2.25–2.47; TL 7.24–8.20; CI 39–53; SI 239–252; REL 24–27; PrI 88–91.

Description

Major worker (Fig. 8)
Habitus. In full-face view, head subtriangular, longer than broad (CI 91–95), with posterior margin emarginated medially, occipital corners rounded, lateral sides convex and converging anteriorly; clypeus broad and flat with a transverse anterior margin and pointed lateral angles; mandibles massive and triangular, with 5 teeth; eyes large, placed dorsally, slightly above the mid-length of head; antennae long, slender and 12-segmented, scape long (SI 94–99) surpasses the posterior head margin by ¼ of its length. In dorsal view, mesosoma anteriorly broad (PrI 50–56) and progressively narrow posteriorly; promesonotal suture and metanotal groove distinct; pronotum broader than rest of mesosoma; mesosoma forming a single convexity in lateral view; propodeal declivity slightly concave; propodeal spiracle elongated or slit-like placed below the margin of the propodeal declivity; anterior face of petiole convex and posterior face straight, dorsally convex and slightly emarginated; tibiae compressed; gaster large and oval.

Sculpture. Head, mesosoma, petiole and gaster microreticulated; clypeus, genae and antennal scape punctured; mandibles with scattered punctures. Except for the anterior region of the head and the gaster, the body is gleaming.

Pilosity and pubescence. Entire body covered with sparse, pale yellow and erect hairs; dense erect hairs present on anterior clypeal margin and on apex of the gaster; ventral margin of the hind tibia lacking a row of spiny bristles, but bearing 3–4 suberect setae close to apical spurs; body covered with short dense decumbent hairs.

Colouration. Mandibles, genae, antennal scape and appendages reddish brown; vertex with dark brownish band; posterior to the genae, mesosoma and petiole light brownish; dorsal surface of the gaster with alternating black and yellowish bands.

Minor worker (Fig. 9)
Same characteristics as of the major worker, except: head relatively small (CI 39–53), elongated and subrectangular with parallel lateral sides, posterior margin of the head convex; scape long (SI 239–252), surpassing the posterior head margin by more than half of its length.

Global distribution

Japan (type locality) and Taiwan.

Fig. 8. *Camponotus habereri* Forel, 1911, major worker (PUAC T73). **A**. Head in full face view. **B**. Body in profile view. **C**. Body in dorsal view.

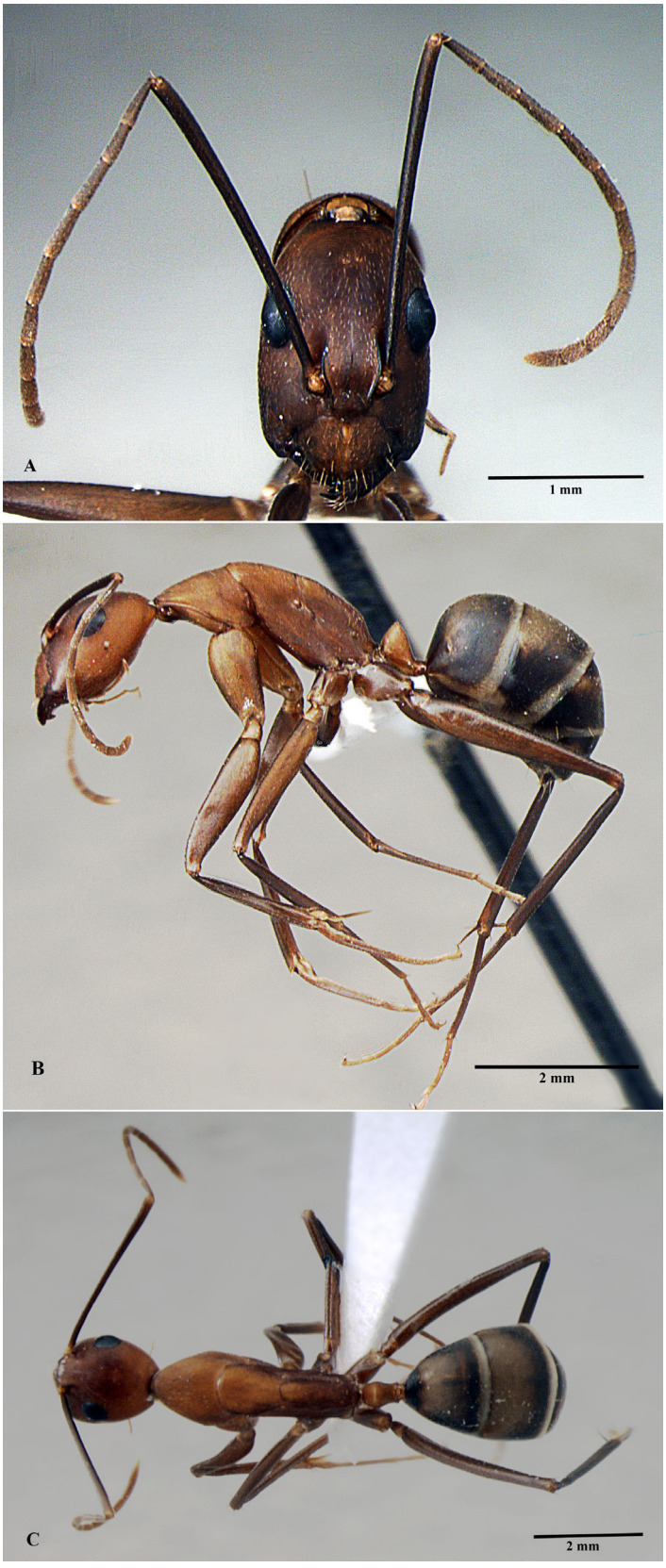

Fig. 9. *Camponotus habereri* Forel, 1911, minor worker (PUAC T75). **A**. Head in full face view. **B**. Body in profile view. **C**. Body in dorsal view.

Habitat

The nest was found inside the trunk of a tree. The workers were collected from both the grass and tree branches. The average daily temperature of the region was 28°C and it primarily consists of residential areas.

Relevance

Camponotus habereri Forel, 1911 represents a new record for India. Previously, this species was reported in Japan and Taiwan.

Camponotus keihitoi Forel, 1913
Figs 10–13

Camponotus fallax var. *keihitoi* Forel, 1913b: 663
Camponotus tokyoensis Teranishi, 1915: 137 (synonymized by Terayama & Satoh 1990: 532).

Diagnosis

Camponotus keihitoi Forel, 1913 is allied to *C. quarinotatus* Forel, 1886, however, both species can be fairly distinguished by the following combination of characteristics: in *C. keihitoi* (major worker), the metanotal depression is distinct; pilosity is absent on the mesosoma and the petiole; and the anterior clypeal margin is transverse. While in *C. quarinotatus* (major worker), the metanotal depression is indistinct; the mesosoma and the petiole are pilose; the clypeal margin is convex anteriorly.

Material examined

INDIA • 14 workers, 2 ♀♀, 2 ♂♂; Uttarakhand, Flower Valley (Nanda Devi National Park); 30.7280° N, 79.6053° E; elev. 3600 m; 4 Jul. 2019; T. Dhadwal leg.; hand picking method; PUAC T81 to T98.

Measurements

Major worker (n = 7)
HL 1.56–1.70; HW 1.26–1.44; EL 0.42–0.45; SL 1.47–1.59; PW 0.96–1.05; WL 2.07–2.19; MTL 1.35–1.68; HTL 1.59–1.84; PL 0.51–0.57; PH 0.57–0.75; GL 1.81–2.64; TL 5.95–7.10; CI 80–84; SI 110–116; REL 26–27; PrI 72–76.

Minor worker (n = 7)
HL 1.35–1.38; HW 1.14–1.20; EL 0.36–0.39; SL 1.38–1.44; PW 0.91–0.93; WL 1.95–2.01; MTL 1.17–1.23; HTL 1.51–1.56; PL 0.45–0.54; PH 0.54–0.57; GL 1.71–2.04; TL 5.46–5.97; CI 84–86; SI 120–121; REL 26–28; PrI 77–79.

Gyne (n = 2)
HL 1.59–1.72; HW 1.47–1.51; EL 0.49–0.57; SL 1.59–1.63; WL 2.54–2.66; MTL 1.41–1.43; HTL 1.80–1.96; PL 0.57–0.65; PH 0.82–0.90; GL 2.74–2.82; TL 7.44–7.85; CI 87–92; SI 107–108; REL 30–33.

Male (n = 2)
HL 1.02–1.11; HW 1.08–1.10; EL 0.39–0.42; SL 1.41–1.43; WL 2.01–2.13; MTL 1.33–1.35; HTL 1.72–1.74; PL 0.51–0.53; PH 0.45–0.48; GL 2.37–2.54; TL 5.91–6.31; CI 99–105; SI 130–131; REL 37–38.

Fig. 10. *Camponotus keihitoi* Forel, 1913, major worker (PUAC T82). **A**. Head in full face view. **B**. Body in profile view. **C**. Body in dorsal view.

Fig. 11. *Camponotus keihitoi* Forel, 1913, minor worker (PUAC T85). **A**. Head in full face view. **B**. Body in profile view. **C**. Body in dorsal view.

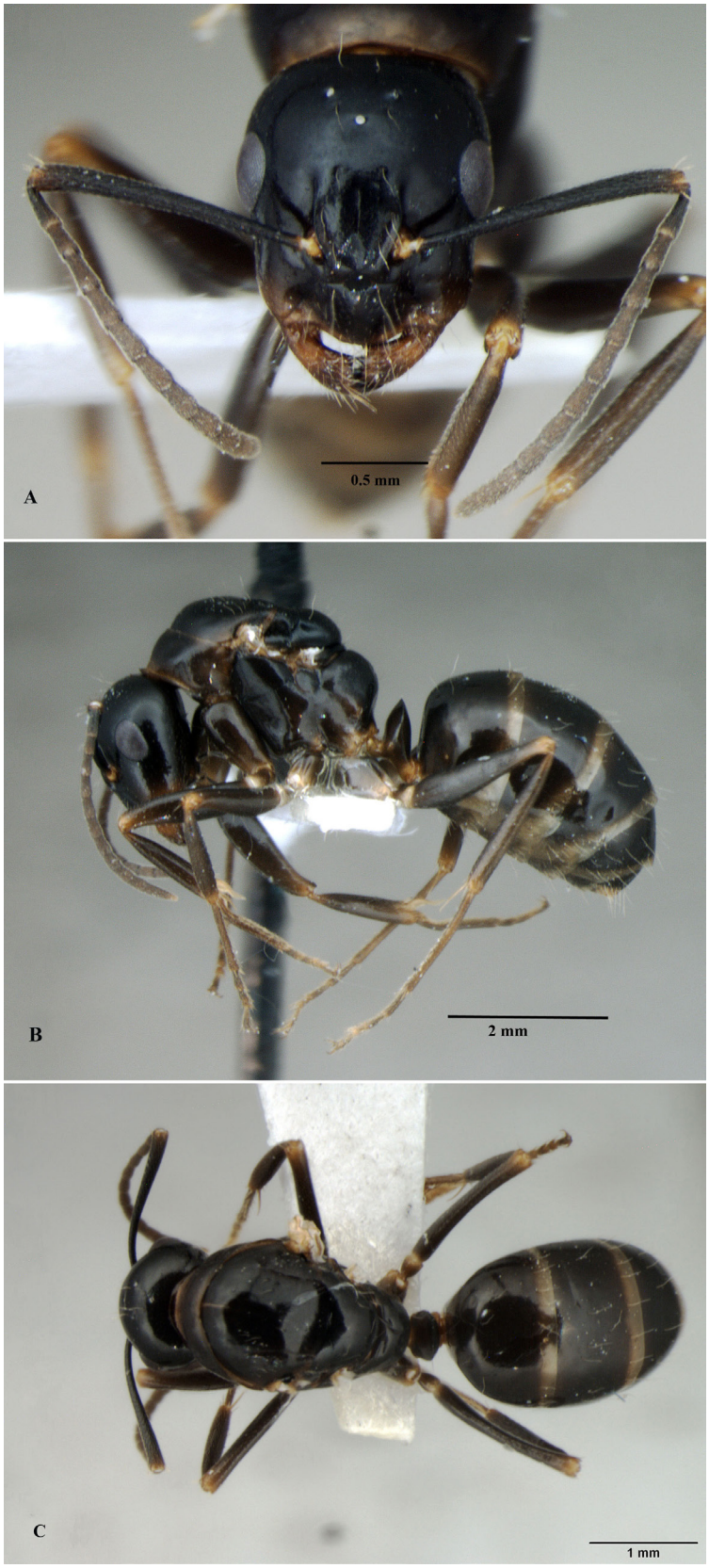

Fig. 12. *Camponotus keihitoi* Forel, 1913, gyne (PUAC T89). **A**. Head in full face view. **B**. Body in profile view. **C**. Body in dorsal view.

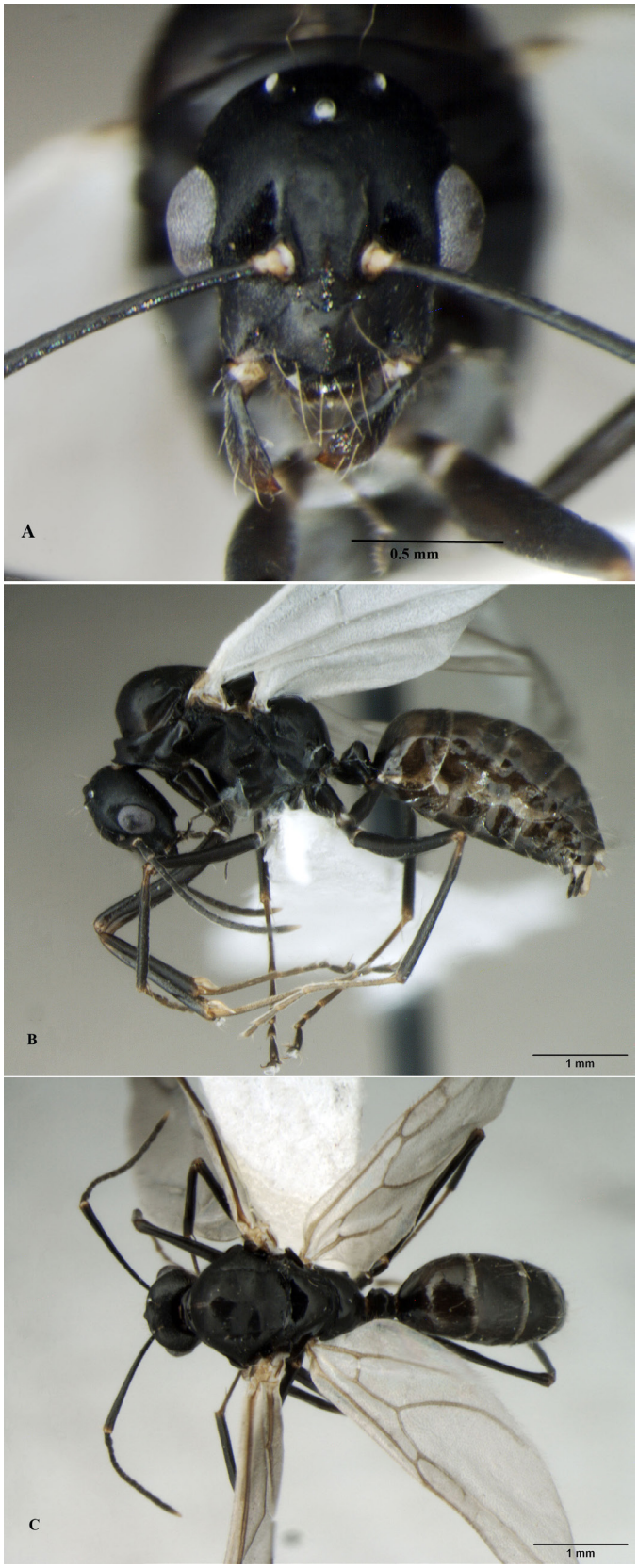

Fig. 13. *Camponotus keihitoi* Forel, 1913, ♂ (PUAC T90). **A**. Head in full face view. **B**. Body in profile view. **C**. Body in dorsal view.

Description

Major worker (Fig. 10):

Habitus. In full-face view, head as long as broad or slightly longer than broad (CI 80–84), posterior head margin convex, occipital corners broadly rounded and lateral sides convex; clypeus broad, anterior margin transverse; mandibles subtriangular and masticatory margin with 5 teeth; antennae slender with 12 segments, scape long (SI 107–108), exceeds posterior head margin by ¼ of its length; eyes moderate in size placed laterally above the mid-length of the head. In dorsal view, mesosoma anteriorly broad (PrI 72–76) and narrow posteriorly; pronotum broader than long; pro-mesonotal suture and metanotal groove distinct; propodeum slightly impressed behind the metanotal groove; propodeum laterally compressed behind the mesonotum; propodeal declivity steep; mesosoma does not form a single convexity, convexity interrupted at propodeum being truncate; propodeal declivity concave; propodeal spiracle oval in shape, placed below the propodeal declivity; petiole anteriorly convex and posteriorly flat; tibiae cylindrical; gaster elongate and subglobose.

Sculpture. Head, mesosoma, petiole and gaster all glossy; rest of body is reticulate-rugulose; clypeus with a median keel and scattered punctures; mandibles longitudinally rugulose with sparse pits.

Pilosity and pubescence. Body coated in appressed hairs; pale yellow erect or sub-erect hairs plentiful on clypeus and mandibles; gaster covered in long hairs and hind tibia of the legs with dispersed setae underneath as well as 3–4 suberect setae close to the apical spurs.

Colouration. Body blackish; mandibles reddish brown and antennae and appendages dark brown.

Minor worker (Fig. 11)

All characteristics are the same as of major worker except: in minor worker head is comparatively small (CI 84–86) and oval with a convex posterior margin and sub-parallel lateral margins; the anterior clypeal margin is slightly convex; scape long (SI 120–121), surpassing posterior margin of head by half of its length.

Gyne (Fig. 12)

Similar to the major worker with few modifications depicting the caste and the following differences: head narrower (CI 87–92) with subparallel lateral margins and convex posterior margin; cephalic dorsum with 3 prominent ocelli; mandibles with 5 teeth; scape of antennae surpassing posterior margin of head by $^{1}/_{6}$ of its length (SI 107–108); scutum and scutellum minutely reticulated; dorsal surface of petiole transverse; propodeal declivity almost straight slightly convex.

Male (Fig. 13)

Habitus. In full-face view, head as long as broad (CI 99–105), posterior margin of the head slightly concave; cephalic dorsum with 3 prominent ocelli; clypeus carinate in the middle; mandibles slender, curved strap like apical tooth acute, remainder without any teeth or denticles, when closed their tips overlap; eyes subglobose, convex, large and bulging, breaking lateral cephalic head outline; antennae 13-segmented and filiform, scape long (SI 130–131), surpassing posterior margin of head by about half of their length. Mesosoma enlarged, pronotum transverse, narrow and convex; scutum large, rounded anteriorly and transverse posteriorly; dorsally without notauli; parapsidal lines prominent and diverging anteriorly; scutellum pentagonal in shape; mesepimeron with a posterodorsal (epimeral) lobe that covers mesothoracic spiracle and forms a seemingly isolated plate; jugal lobe of hind wing present; petiole triangular, dorsal margin convex; propodeal declivity smoothly rounded; propodeal spiracle round. Pygostyles tubular, projecting outward; parameres elongated; cuspi small bent toward digiti, shorter than digiti; digiti long with short peg-like teeth bent toward parameres; penis valves projecting.

Pilosity and pubescence. Clypeus and posterior margin of head with a few thin setae, scutum and scutellum with sparse erect short setae; gaster with adpressed short hairs; pygostyles and distal part of parameres setose; hind tibia without a row of spiny bristles on ventral margins.

Colouration. Colour and sculpture as of worker caste.

Global distribution

China and Japan (type locality).

Habitat

During the field survey, the species was documented in Uttarakhand. The nest was found under the boulder. Some of the workers were also collected moving on the grass. The area is mostly surrounded by short grass and flowers with an average daily temperature of 22°C. The habitat is mostly open grassland type.

Relevance

Camponotus keihitoi Forel, 1913 represents a new record for India. Previously, this species was reported from China and Japan. The male of the species is described for the first time.

Camponotus sp. 101
Fig. 14

Diagnosis

This species is remarkably distinct from other Indian species by the following combination of characters: petiole nodiform; in dorsal view, first and second gastral tergite with two white bands; half of the coxal margin, trochanter and distal margin of the femur with white bands; head, mesosoma, petiole and gaster very feebly striated; clypeus with a median keel; mandibles feebly longitudinally rugulose and densely punctated; whole body shiny.

Material examined

INDIA • 1 worker; West Bengal, Chapramari Wild Life Sanctuary; 26.8746° N, 88.8550° E; elev. 200 m; 28 Jul. 2019; J. Singh leg.; Winkler extraction; PUAC T101.

Measurements

Minor worker (n = 1)
HL 1.11; HW 0.96; EL 0.27; SL 0.87; PW 0.69; WL 1.35; MTL 0,72; HTL 0.87; PL 0.30; PH 0.27; GL 1.44; TL 2.85; CI 86; SI 90; REL 24; PrI 71.

Description

Minor worker (Fig. 14)
Habitus. In full-face view, head oval, distinctly longer than broad (CI 86) with subparallel lateral sides and convex posterior margin of the head; clypeus broad and convex, anterior clypeal margin rounded; mandibles triangular; palp formula 5:3; eyes large and convex, placed laterally at mid-length of the head; antennae 12-segmented, scape long (SI 90), surpassing posterior margin of head by ¼ of its length. In dorsal view, mesosoma trapezoidal; promesonotal suture distinct; metanotal groove indistinct or feebly developed; pronotum broader (PrI 71) than rest of mesosoma; mesosoma convex in lateral view; propodeal declivity concave, propodeal spiracle small and circular; petiolar node longer than high, anterior and posterior faces parallel, dorsal surface rounded; tibia cylindrical; gaster large and oval.

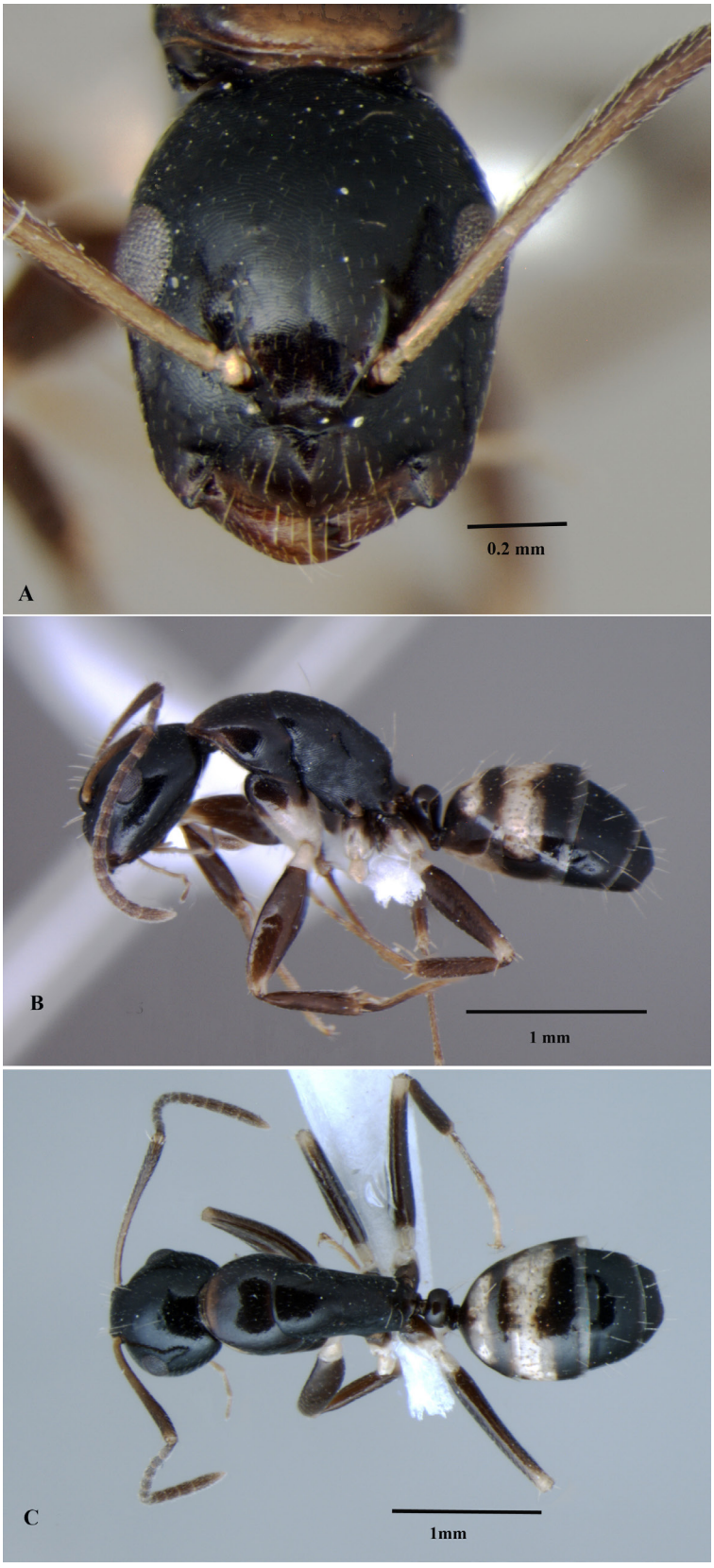

Fig. 14. *Camponotus* sp. 101, minor worker (PUAC T101). **A**. Head in full face view. **B**. Body in profile view. **C**. Body in dorsal view.

Sculpture. Head, mesosoma, petiole and gaster very feebly striated; clypeus with a median keel; mandibles feebly longitudinally rugulose and densely punctated; whole body shiny.

Pilosity and pubescence. Body covered with very sparse, long, erect and sub-erect hairs; dense erect hairs present on anterior clypeal margin, mandibles and apex of gaster; appressed pubescence almost wanting or very sparse on the body but dense on antennae; ventral side of the hind tibia without spiny bristles, in addition to bristles, 4–5 short spines present near the apical spur.

Colouration. Head, mesosoma and petiole brownish to dark brown; dorsal surface of first and second gastral tergite have alternate white or black bands, remaining gastral tergites blackish in colour; half of the coxal margin, trochanter and distal margin of the femur with white bands, remaining appendages brownish in colour and antennae light brownish.

Habitat

The species was collected by Winkler extraction. The ground in the collection area was almost dry and covered with leaf litter. The average daily temperature was 32°C.

Relevance

Under this name, we record and describe an unidentified form that closely resembles the Malagasy *C. maculiventris* Emery, 1985 and does not correspond to any species already known in India. We collected a single worker belonging to this form, whose full identification and naming will require further investigation beyond this paper.

Camponotus quadrinotatus Forel, 1886
Fig. 15

Camponotus marginatus var. *quadrinotatus* Forel, 1886: 142.
Camponotus marginatus rubicolor Ruzsky, 1925: 42 (synonymized by Radchenko 1997: 704).
Camponotus quadrinotatus nigricolor Ruzsky, 1926: 109 (synonymized by Kuznetsov-Ugamsky 1928: 18; Bolton 1995: 119; Radchenko 1997: 704).

Camponotus marginatus quadrinotatus Dalla Torre 1893: 242.
Camponotus fallax quadrinotatus – Forel 1907: 19.
Camponotus caryae quadrinotatus – Wheeler 1917: 29.
Camponotus quadrinotatus – Santschi 1925: 89 (m.)
Camponotus (*Myrmentoma*) *quadrinotatus* – Emery 1925: 118.

Diagnosis

Camponotus quarinotatus Forel, 1886 resembles *C. keihitoi* Forel, 1913, but both species can be easily distinguished by the following combination of characters: in *C. keihitoi* (minor worker), the metanotal depression is distinct; pilosity is absent on the mesosoma and the petiole; the clypeal margin is transverse anteriorly. While in *C. quarinotatus* (minor worker), the metanotal depression is indistinct; the mesosoma and the petiole are pilose; the clypeal margin is convex anteriorly.

Material examined

INDIA • 10 workers; Himachal Pradesh, Solang; 32.3219° N, 77.1496° E; elev. 3000 m; 15 Aug. 2019; T. Dhadwal leg.; hand picking method; PUAC T105 to T114.

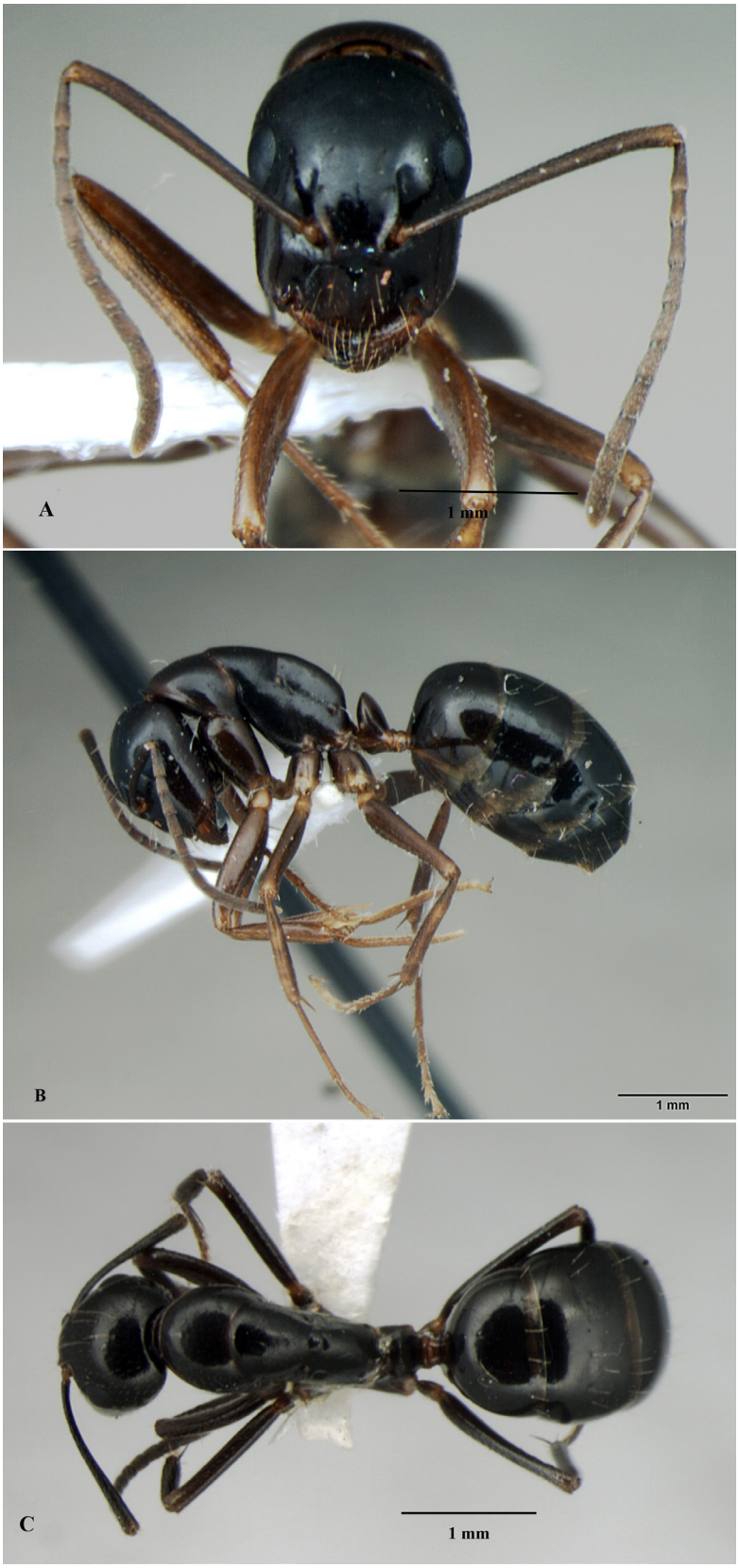

Fig. 15. *Camponotus quadrinotatus* Forel, 1886, minor worker (PUAC T107). **A**. Head in full face view. **B**. Body in profile view. **C**. Body in dorsal view.

Measurements

Minor worker (n = 4)

HL 1.35–1.62; HW 1.14–1.26; EL 0.33–0.39; SL 1.35–1.59; PW 0.96–1.05; WL 1.95–2.25; MTL 1.20–1.25; HTL 1.53–1.62; PL 0.48–0.60; PH 0.58–0.66; GL 2.01–2.43; TL 5.79–6.90; CI 77–84; SI 118–126; REL 24–25; PrI 83–84.

Description

Minor worker (Fig. 15)

Habitus. In full-face view, head subrectangular, longer than broad (CI 77–84) with convex posterior margin and subparallel lateral margins; clypeus carinate in the middle, clypeus margin anteriorly convex; mandibles with 5 teeth; eyes moderate in size, placed laterally over the mid-length of the head; antennae long, slender and 12-segmented, scape long (SI 118–126), surpassing posterior head margin by half of its length. In dorsal view, mesosoma broad and pronotum narrow (PrI 83–84) anteriorly; pro-mesonotal suture distinct and metanotal groove absent; mesonotum and propodeum compressed laterally; mesosoma does not form a single convexity in lateral view, convexity interrupted at propodeum being truncate; propodeal declivity steep and slightly concave; propodeal spiracle slit-like, placed below the level of propodeal declivity; petiole thick and biconvex; tibiae cylindrical; gaster subglobose.

Sculpture. Head, mesosoma and gaster minutely reticulated and shiny; mandibles rugose.

Pilosity and pubescence. Body sparsely pilose, with a few erect hairs on the vertex of the head, mesosoma, petiole and gaster; tibiae lacking a row of spiny bristles on the ventral edge, and with 3–4 suberect setae near apical spurs.

Colouration. Head, mesosoma and gaster black; in some workers 1st and 2nd gastral tergites having each a pair of yellowish or whitish markings, and the rest completely black.

Global distribution

China, Democratic People's Republic of Korea, Japan (type locality), Republic of Korea and Russian Federation.

Habitat

During the field survey, the species was collected from Solang, Himachal Pradesh. The nest was found under the stone, the colony was small and having few minor workers only. The area is mostly surrounded by Deodar and Pine trees, with an average daily temperature of 28°C.

Relevance

Camponotus quarinotatus Forel, 1886 represents a new record for India. Previously, this species was reported from China, North and South Korea, Japan and the Russian Federation.

Camponotus simoni Emery, 1893
Figs 16–18

Camponotus simoni Emery, 1893: 250.

Camponotus dorycus simoni – Forel 1902: 288; 1908: 6.
Camponotus (*Tanaemyrmex*) *simoni* – Emery 1925: 90.

Diagnosis

This species resembles *C. mitis* (Smith, 1858) (major worker) but can be distinguished by its elongated head; the clypeal margin is shaped as a short lobe anteriorly truncate; the masticatory margin of mandibles with 6 teeth; the head and gaster are dark reddish-brown, with yellowish markings on the dorsal surface of the gaster; mesosoma, antennal flagella and legs are yellowish brown. While in *C. mitis* (major worker), the head is subtriangular in shape; the clypeal margin is shaped as a short lobe anteriorly transverse; the masticatory margin of mandibles bears 7 teeth; the head and scape are dark brown to black; the mesosoma, petiolar and gastral colouration is variable from yellow-brown to dark brown; the tibiae and tarsi are usually darker.

Material examined

INDIA • 14 workers, 1 ♀; Kerala, Parambikulum National Park; 10.3834° N, 77.0831° E; elev. 600 m; 30 Jan. 2017; T. Dhadwal leg.; hand picking method; PUAC T121 to T135.

Measurements

Major worker (n = 7)
HL 2.52–2.70; HW 2.05–2.13; EL 0.45–0.49; SL 2.74–2.87; PW 1.43–1.47; WL 3.07–3.19; MTL 2.13–2.46; HTL 3.09–3.19; PL 0.65–0.69; PH 0.63–0.65; GL 2.46–2.58; TL 8.70–9.16; CI 78–81; SI 133–134; REL 17–18; PrI 69–70.

Minor worker (n = 7)
HL 1.76–1.92; HW 0.77–0.94; EL 0.41–0.45; SL 3.07–3.15; PW 1.21–1.33; WL 2.95–3.11; MTL 2.21–2.58; HTL 3.23–3.29; PL 0.57–0.61; PH 0.61–0.65; GL 2.13–2.27; TL 7.41–7.91; CI 43–48; SI 335–398; REL 23; PrI 141–157.

Gyne (n = 1)
HL 2.79; HW 1.98; EL 0.68; SL 4.15; WL 4.46; MTL 2.41; HTL 3.03; PL 0.80; PH 1.05; GL 3.34; TL 11.39; CI 70; SI 209; REL 24.

Description

Major worker (Fig. 16)
Habitus. In full-face view, head elongated, longer than broad (CI 78–81), posterior margin emarginated in the middle, occipital corners round, lateral margins convex anteriorly; clypeus carinate in the middle, clypeal margin produced as a short lobe anteriorly truncate; mandibles moderately broad with 6 teeth; eyes moderate in size, placed in front over the mid-length of the head; antennae long, slender and 12-segmented, scape long (SI 133–134), surpassing the posterior margin of head by 1/5 of its length. In dorsal view, mesosoma elongated, pronotum anteriorly narrow (PrI 69–70) pro-mesonotal suture and metanotal groove distinct; mesonotum and propodeum compressed laterally; mesosoma strongly convex in lateral view; propodeal declivity slightly concave, propodeal spiracle round placed below the margin of propodeal declivity; petiole node thick, convex anteriorly and flat posteriorly, tapering towards the tip; tibiae compressed; gaster oval.

Sculpture. Head, mesosoma and gaster minutely reticulated and matte; mandibles smooth and shiny with scattered.

Pilosity and pubescence. Body pilose, long erect abundant yellowish hair on the vertex of head, mesosoma and gaster, a few short hairs present on anterior of head and clypeus; hind tibia without a row of spiny bristles on the ventral margin, but with 3–4 erect setae close to apical spurs.

Colouration. Head and gaster dark reddish brown, with yellowish stripes on the dorsal side of the gaster; mesosoma, antennomeres and legs yellowish brown.

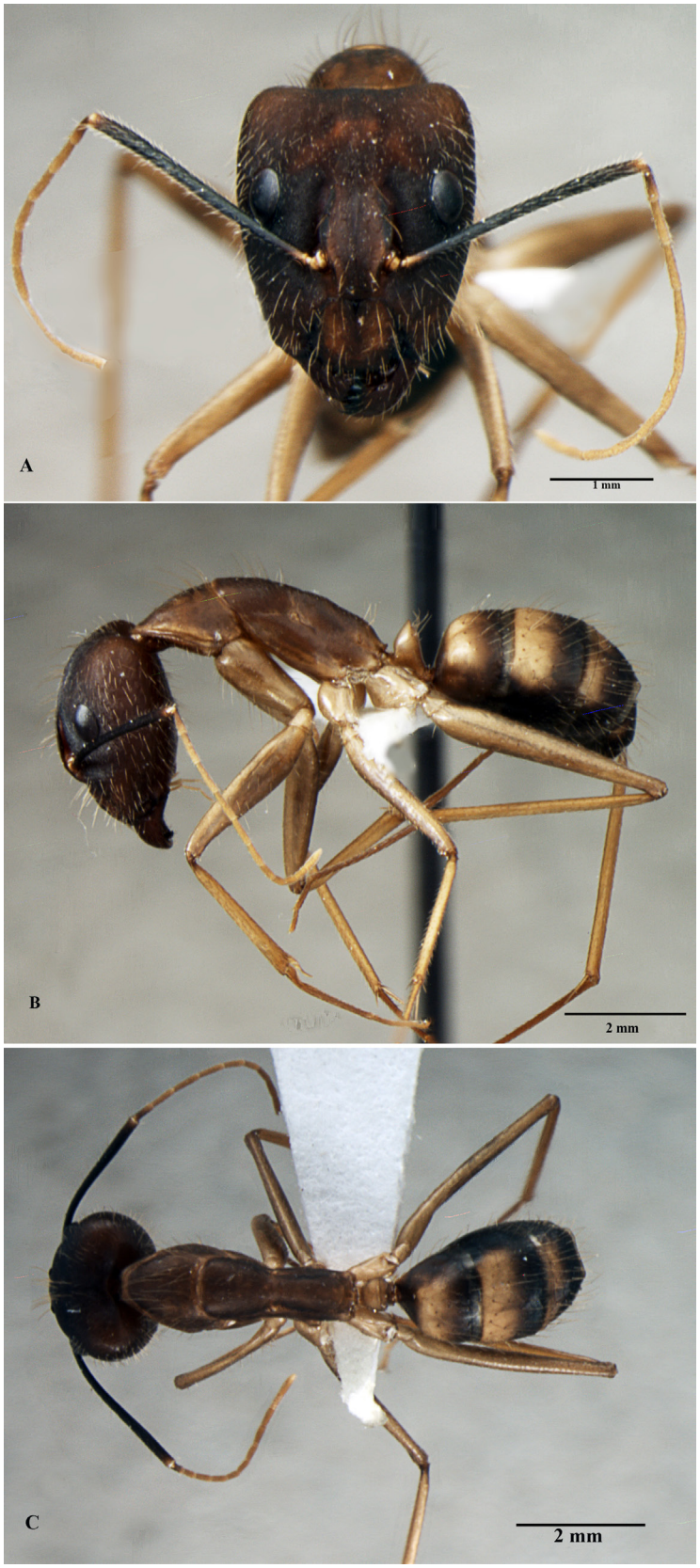

Fig. 16. *Camponotus simoni* Emery, 1893, major worker (PUAC T123). **A**. Head in full face view. **B**. Body in profile view. **C**. Body in dorsal view.

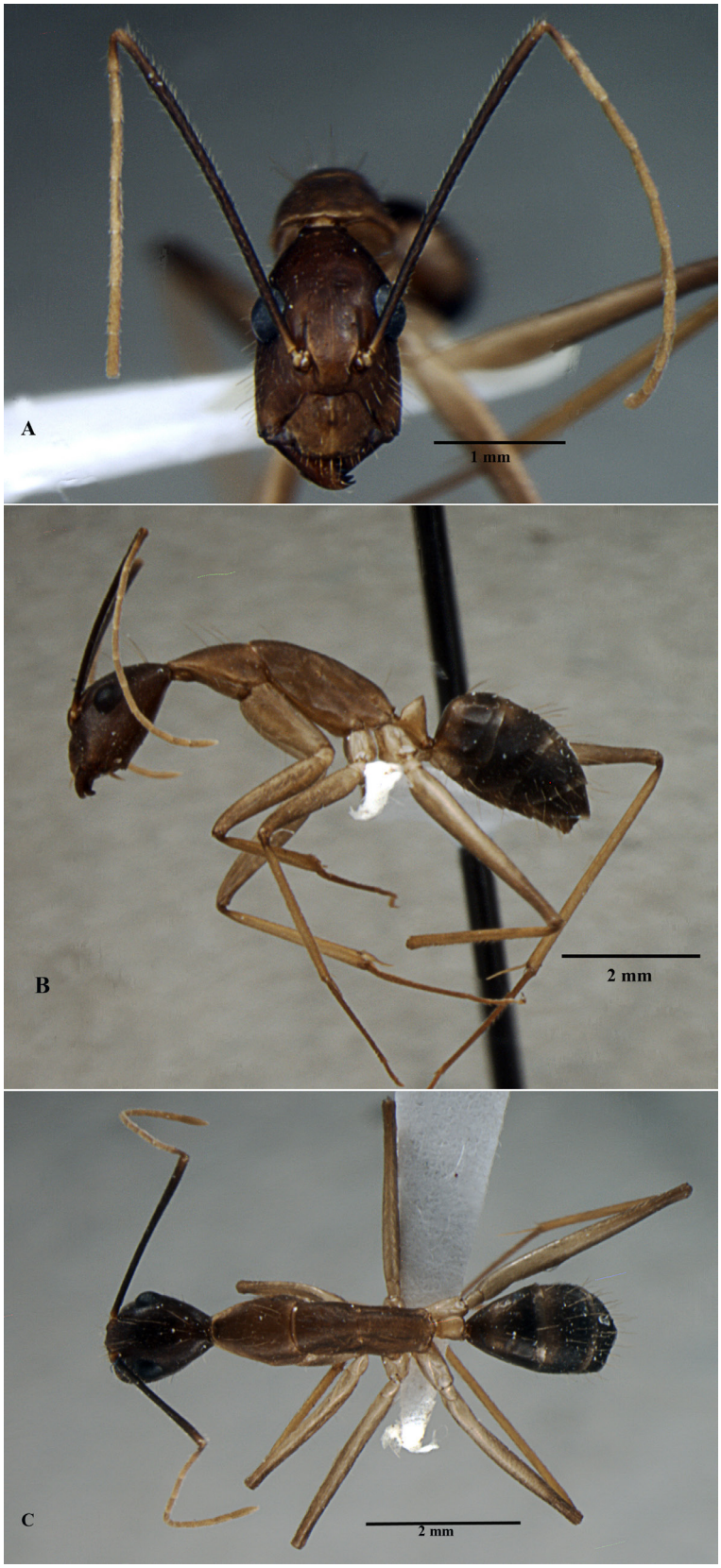

Fig. 17. *Camponotus simoni* Emery, 1893, minor worker (PUAC T127). **A**. Head in full face view. **B**. Body in profile view. **C**. Body in dorsal view.

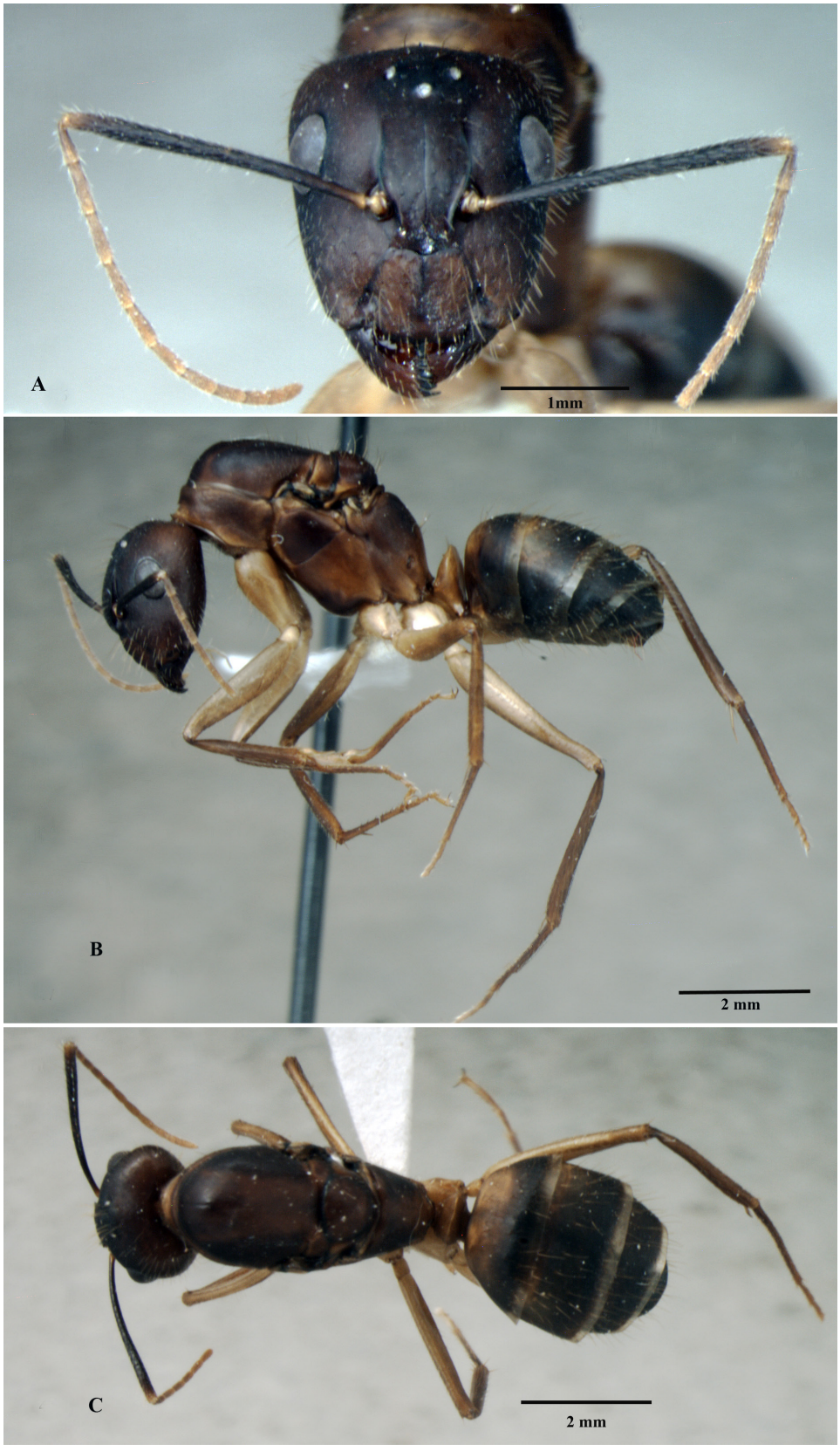

Fig. 18. *Camponotus simoni* Emery, 1893, gyne (PUAC T133). **A**. Head in full face view. **B**. Body in profile view. **C**. Body in dorsal view.

Minor worker (Fig. 17)

All characteristics as of major worker except: in minor worker head is comparatively small (CI 43–48) with round posterior margin and subparallel lateral margins converging anteriorly; clypeus margin anteriorly produced as a short round lobe; mandibles with 5 teeth; eyes moderate in size, placed laterally over the mid-length of the head; scape distinctly long (SI 335–398), surpassing posterior margin of head by half of its length; mesosoma short as compared to the major worker.

Gyne (Fig.18)

Similar to the major worker with few modifications indicating the caste and the following differences: head narrower (CI 70) with subparallel lateral margins, posterior margin straight; cephalic dorsum with 3 prominent ocelli; mandibles with 6 teeth; scapes surpassing the posterior margin of head by half of their length (SI 209); propodeal declivity smoothly convex; head, scutellum and gaster with erect or suberect hairs.

Global distribution

Sri Lanka (type locality).

Habitat

During the field survey, the species was collected from Karianchola (Parambikulam National Park), Kerala. The nest was located in the deep forest. It was mound type located above the ground shared by termites also. The association is not determined yet. On disturbing, the workers started coming out, otherwise, no foraging worker was observed. The region has an average daily temperature of 32°C and is comprised of intact tropical wet evergreen forest.

Relevance

This species represents a new record for India. Formerly it was reported from Sri Lanka. The gyne of the species is described for the first time

Identification key to the known species of genus Camponotus from India based on the worker caste

1. Mesosoma viewed from the side forming a regular arch without interruption by propodeum (Fig. 19A) 2
– Mesosoma viewed from the side interrupted by the propodeum, not forming a regular arch (Fig. 19B–D) 53

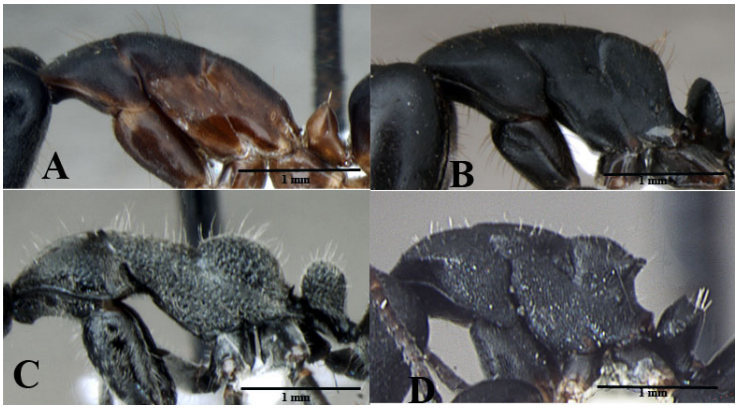

Fig. 19. Body in profile view. **A**. *Camponotus arrogans* (Smith, 1858). **B**. *Camponotus socrates* Forel, 1904. **C**. *Camponotus holosericeus* Forel, 1889. **D**. *Camponotus selene* (Forel, 1889). Scale bars = 1 mm.

2. Head with lateral and ventral setae abundant, long and suberect, providing a 'bearded' appeareance (Fig. 20A) 3
– Head with lateral and ventral setae absent to short, and never abundant (Fig. 20B) 4

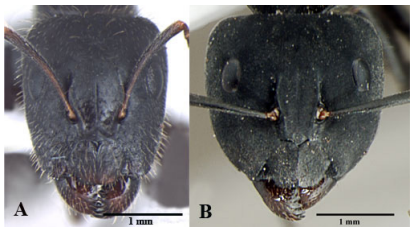

Fig. 20. Head in full face view. **A**. *Camponotus parabarbatus* Bharti & Wachkoo, 2014. **B**. *Camponotus dolendus* Forel, 1892. Scale bars = 1 mm.

3. Head subtriangular with a shallowly concave posterior margin, body uniformly jet-black (Fig. 21A) ..... ***C. parabarbatus*** Bharti & Wachkoo, 2014
– Head subrectangular, with gently convex posterior margin, body red brown in color (Fig. 21B) ..... ***C. barbatus*** Roger, 1863

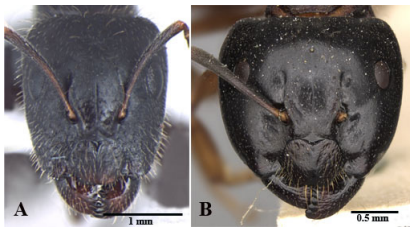

Fig. 21. Head in full face view. **A**. *Camponotus parabarbatus* Bharti & Wachkoo, 2014. **B**. *Camponotus barbatus* Roger, 1863. Scale bars: A = 1 mm; B = 0.5 mm.

4. Metatibia spined beneath 5
– Metatibia without spined beneath 27

5. Head, mesosoma and gaster concealed with sericeous pubescence or erect hairs (Fig. 22) 6
– Head, mesosoma and gaster lacking pubescence (Fig. 22B) ..... ***C. dolendus*** Forel, 1892

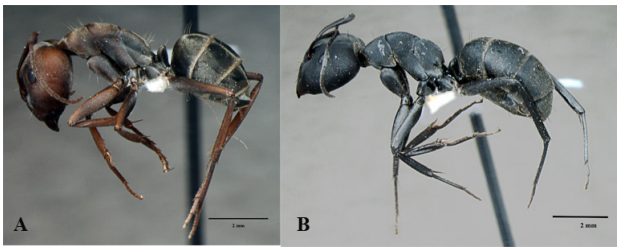

Fig. 22. Body in profile view. **A**. *Camponotus rufoglaucus* (Jerdon, 1851). **B**. *Camponotus dolendus* Forel, 1892. Scale bars: A = 1 mm; B = 2 mm.

6. Gaster completely covered with sericeous pubescence (Fig. 23A) 7
– Gaster not covered with sericeous pubescence, but with either erect or decumbent setae (Fig. 23B) 12

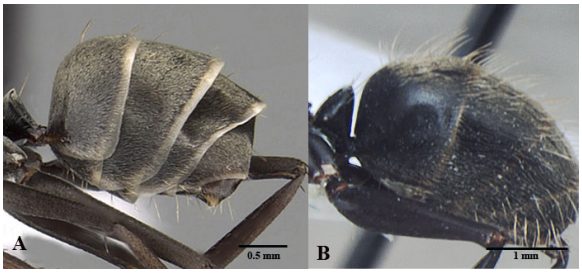

Fig. 23. Gaster in lateral view. **A**. *Camponotus parius* Forel, 1889. **B**. *Camponotus japonicus* Mayr, 1866. Scale bars: A = 0.5 mm; B = 1 mm.

7. Clypeus with a median lobe produced anteriorly (Fig. 24A) 8
– Clypeus lacking a median lobe (Fig. 24B) ..... ***C. mendax*** Forel, 1895

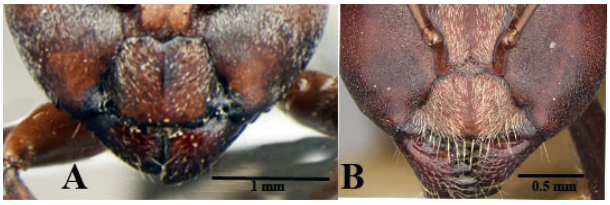

Fig. 24. Clypeus in full face view. **A**. *Camponotus rufoglaucus* (Jerdon, 1851). **B**. *Camponotus mendax* Forel, 1895. Scale bars: A = 1 mm; B = 0.5 mm.

8. Clypeal lobe anteriorly transverse 9
– Clypeal lobe anteriorly emarginated medially 10

9. Body with grey pubescence (Fig. 25A) ..... ***C. binghamii*** Forel, 1894
– Body with yellow pubescence (Fig. 25B) ..... ***C. parius*** Emery, 1889

Fig. 25. Body in profile view. **A**. *Camponotus binghamii* Forel, 1894. **B**. *Camponotus parius* Forel, 1889. Scale bars = 0.5 mm.

10. Petiolar node thin, slightly convex anteriorly and flat posteriorly 11
– Petiolar node thick and strongly convex anteriorly ..... ***C. rufoglaucus tenuis*** Forel, 1907

11. Mesosoma smooth; gaster black with a green ash-grey strip in the middle .....
.....***C. cinerascens*** (Fabricius, 1787)
– Mesosoma finely microreticulate; gaster reddish brown with no ash-grey strip in middle .....
..... ***C. rufoglaucus*** (Jerdon, 1851)

12. Gaster is covered in long, reclining yellowish setae (Fig. 26A) 13
– Gaster with short, sparse erect setae (Fig. 26B) 14

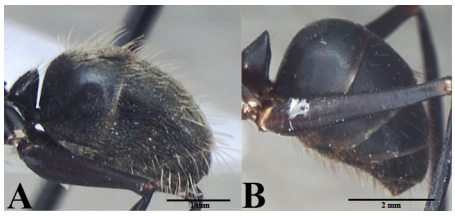

Fig. 26. Gaster in lateral view. **A**. *Camponotus japonicus* Mayr, 1866. **B**. *Camponotus angusticollis* (Jerdon, 1851). Scale bars: A = 1 mm; B = 2 mm.

13. Pronotum angled anterolaterally; head with triangular shape widest occipitally (Fig. 27A–B) .....
.....***C. fulvopilosus*** (De Geer, 1778)
– Pronotum rounded anterolaterally; head with rectangular shape, widest at the middle (Fig. 27C–D)
..... ***C. japonicus*** Mayr, 1866

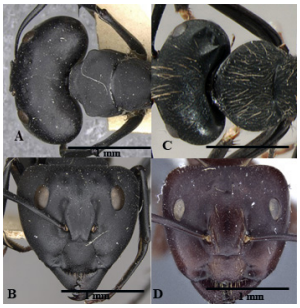

Fig. 27. Pronotum and head in full face view. **A–B**. *Camponotus fulvopilosus* (De Geer, 1778). **C–D**. *Camponotus japonicus* Mayr, 1866. Scale bars = 1 mm.

14. Pronotum tightly constricted in the front, forming a neck (Fig. 28A) 15
– Pronotum not tightly constricted in front, not forming a neck (Fig. 28B) 17

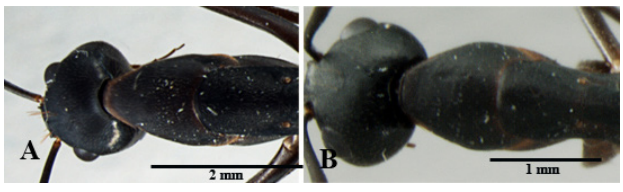

Fig. 28. Pronotum. **A**. *Camponotus angusticollis* (Jerdon, 1851). **B**. *Camponotus compressus* (Fabricius, 1787). Scale bars: A = 2 mm; B = 1 mm.

15. Anterior margin of clypeus transverse and dentate 16
– Anterior margin of clypeus convex and feebly dentate .... ***C. ashokai*** Karmaly & Narenderan, 2006

16. Head as long as broad with lateral sides converging anteriorly (Fig. 29A) .... ***C. angusticollis*** (Jerdon, 1851)
– Head distinctly longer than broad with lateral sides parallel (Fig. 29B) .... ***C. angusticollis sanguinolentus*** Forel, 1895

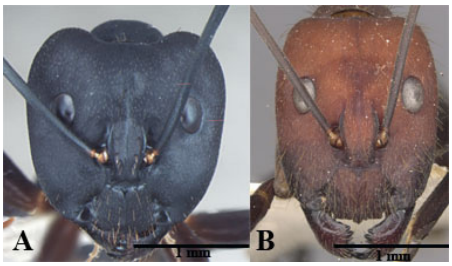

Fig. 29. Head in full face view. **A**. *Camponotus angusticollis* (Jerdon, 1851). **B**. *Camponotus angusticollis sanguinolentus* Forel, 1895. Scale bars = 1 mm.

17. Head, mesosoma and gaster black ..... ***C. compressus*** (Fabricius, 1787)
– Head, mesosoma and gaster never all black 18

18. Scape flat ..... ***C. misturus fornaronis*** Forel, 1892
– Scape cylindrical 19

19. Metatibia compressed (Fig. 30A) 20
– Metatibia cylindrical (Fig. 30B) 26

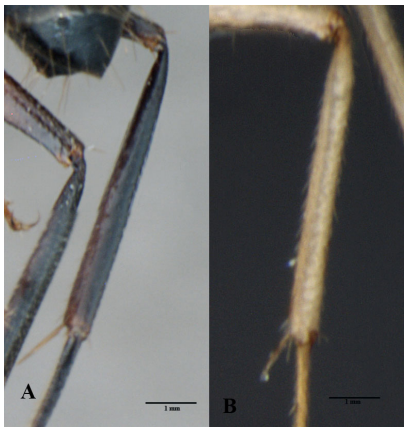

Fig. 30. Tibia. **A**. *Camponotus arrogans* (Smith, 1858). **B**. *Camponotus buddhae* Forel, 1892. Scale bars = 1 mm.

20. Body unicoloured, castaneous red in colour 21
– Head and gaster black or castaneous red, mesosoma varying from yellow to brown in colour 22

21. In major worker body length over 15 mm and in minor worker body length over 10 mm .... ***C. festinus*** (Smith, 1857)
– In major worker, body length not over than 8 mm; in minor worker body length 5 mm .... ***C. arrogans*** (Smith, 1858)

22. Median lobe of clypeus long and rectangular (Fig. 31A) 23
– Median lobe of clypeus short and round (Fig. 31B) 25

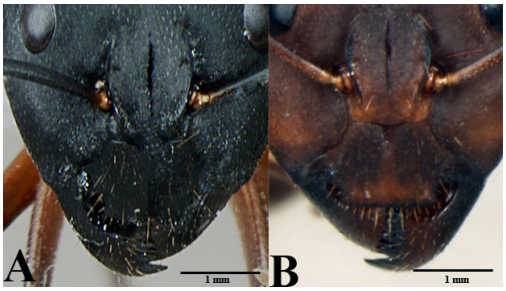

Fig. 31. Clypeus in full face view. **A**. *Camponotus sylvaticus basalis* Smith, 1878. **B**. *Camponotus irritans* (Smith, 1857). Scale bars = 1 mm.

23. Head, mesosoma and legs ferruginous-red to reddish-brown; gaster reddish-brown or blackish-brown ..... ***C. sylvaticus basalis*** Smith, 1878
– Head black; mesosoma, gaster and legs partly yellow brown 24

24. Head much broader posteriorly than anteriorly, petiole node thin in profile and convex anteriorly .. .. ***C. sylvaticus paradichrous*** Emery, 1925
– Head as broad posteriorly as anteriorly, petiole node remarkably thick and convex anteriorly .... ***C. kattensis*** Bingham, 1903

25. Head and mesosoma reddish brown with gaster black; occipital margin widely emarginated in major workers ..... ***C. irritans*** (Smith, 1857)
– Head and mesosoma yellowish brown with gaster somewhat dark in colour; occipital margin feebly emarginated in major workers ..... ***C. irritans carensis*** Emery, 1920

26. Head and mesosoma finely sculptured, shiny (Fig. 32A) ..... ***C. oblongus*** (Smith, 1858)
– Head and mesosoma coarsely reticulate-punctate, matte (Fig. 32B) .... ***C. oblongus binominatus*** Forel, 1916

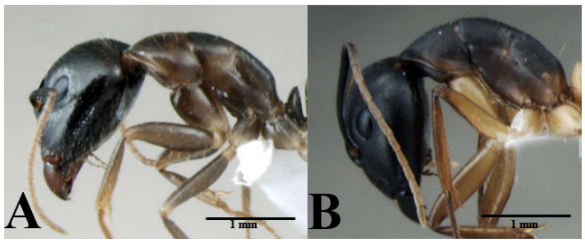

Fig. 32. Head and mesosoma. **A**. *Camponotus oblongus* (Smith, 1858). **B**. *Camponotus oblongus binominatus* Forel, 1916. Scale bars = 1 mm.

27. Tibiae covered with long erect setae ..... ***C. buddhae*** Forel, 1892
– Tibiae covered with very widely spaced, adpressed setae 28

28. Head, mesosoma and gaster unicoloured, black 29
– Head, mesosoma and gaster bicoloured, never all black 31

29. Petiole node thick in profile, trapezoidal with rounded top (Fig. 33A) .... ***C. crassisquamis*** Forel, 1902
– Petiole node is thin in profile and tapered towards the top (Fig. 33B) 30

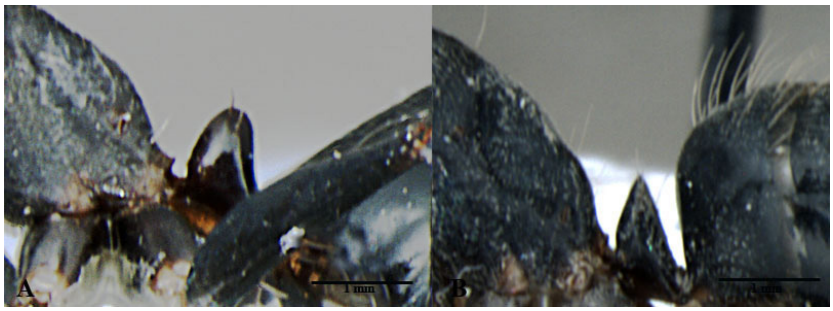

Fig. 33. Petiole in lateral view. **A**. *Camponotus crassisquamis* Forel, 1902. **B**. *Camponotus lamarckii* Forel, 1892. Scale bars = 1 mm.

30. Clypeus vertically carinate, tibiae prismatic (Fig. 34A) .....***C. lamarckii*** Forel, 1892
– Clypeus not vertically carinate, tibiae cylindrical (Fig. 34B) ..... ***C. sholensis*** sp. nov.

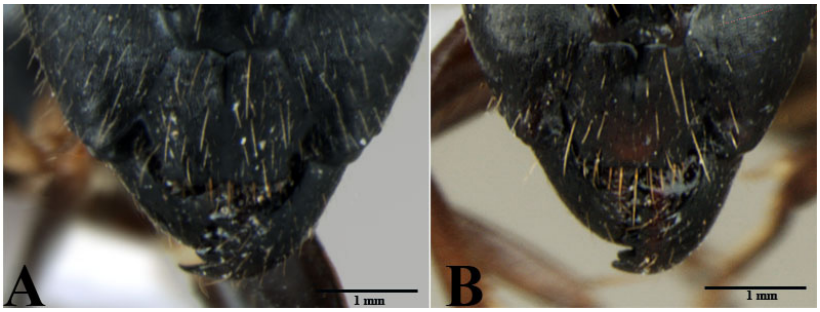

Fig. 34. Clypeus in full face view. **A**. *Camponotus lamarckii* Forel, 1892. **B**. *Camponotus sholensis* sp. nov. Scale bars = 1 mm.

31. Mesosoma strongly convex anteriorly, forming a high shouldered look to the body .... ***C. invidus*** Forel, 1892
– Mesosoma moderately convex 32

32. Tibiae cylindrical 33
– Tibiae compressed 40

33. Median lobe of clypeus anteriorly convex ..... ***C. wroughtonii*** Forel, 1893
– Median lobe of clypeus anteriorly transverse, straight 34

34. Head triangular, lateral occipital angles prominent (Fig. 35A); legs covered with sparse decumbent hairs 35
– Head subtriangular, lateral occipital angles not prominent (Fig. 35B); legs covered with dense recumbent hairs 36

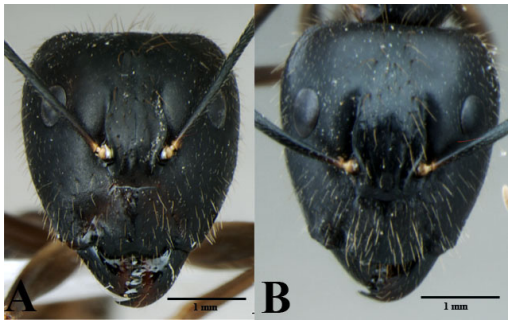

Fig. 35. Head in full face view. **A**. *Camponotus variegatus infuscus* Forel, 1892. **B**. *Camponotus barbatus taylori* Forel, 1892. Scale bars = 1 mm.

35. Head, mesosoma and gaster dark brown or black ..... ***C. variegatus infuscus*** Forel, 1892
– Head, mesosoma and gaster entirely pale yellowish in colour ..... ***C. variegatus dulcis*** Dalla Torre, 1893

36. Major worker: length under 8 mm, minor worker under 6 mm 37
– Major worker: length over 8 mm, minor worker: over 6 mm 38

37. Gaster without yellow spots on first and second abdominal tergites (Fig. 36A) ..... ***C. barbatus taylori*** Forel, 1892
– Gaster with yellow spots on first and second abdominal tergites (Fig. 36B) ..... ***C. albosparsus*** Bingham, 1903

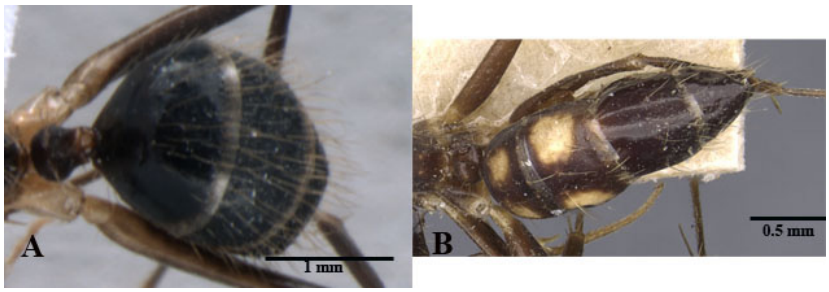

Fig. 36. Gaster in dorsal view. **A**. *Camponotus barbatus taylori* Forel, 1892. **B**. *Camponotus albosparsus* Bingham, 1903. Scale bars: A = 1 mm; b = 0.5 mm.

38. Node of petiole thick in profile and biconvex in shape 39
– Node of petiole thin in profile, convex anteriorly and flat posteriorly ..... ***C. variegatus somnificus*** Forel, 1902

39. Clypeus tectiform with short median lobe; mesosoma generally yellowish red, head and gaster brownish in colour (Fig. 37A) ..... ***C. variegatus*** (Smith, 1858)
– Clypeus subcarinate without median lobe; mesosoma generally black, head and mesosoma brownish black (Fig. 37B) ..... ***C. variegatus bacchus*** (Smith, 1858)

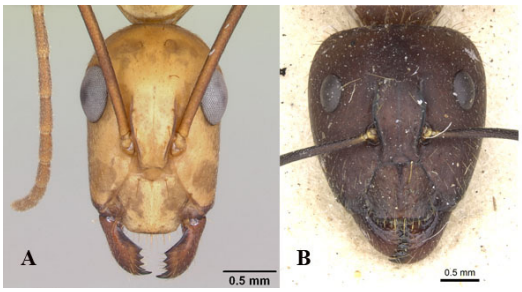

Fig. 37. Head in full face view. **A**. *Camponotus variegatus* (Smith, 1858). **B**. *Camponotus variegatus bacchus* (Smith, 1858). Scale bars = 0.5 mm.

40. Head, mesosoma and gaster finely rugulose and matte 41
– Head, mesosoma and gaster sparsely punctured, shining not matte 45

41. Petiole node thick in profile, oval anteriorly convex and flat posteriorly ..... ***C. sklarus*** Bolton, 1995
– Petiole node thin slightly, rounded above, convex anteriorly and concave posteriorly 42

42. Mandibles with 7 teeth, body covered with dense long pilosity (Fig. 38A) 43
– Mandibles with 5 teeth, body with sparse long pilosity (Fig. 38B) 44

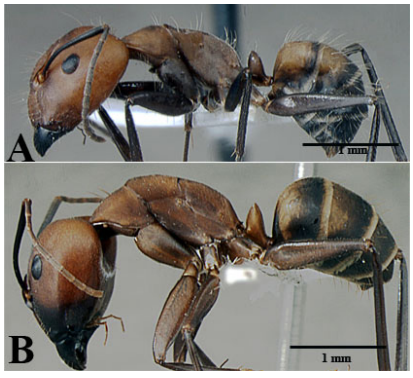

Fig. 38. Head in full face view. **A**. *Camponotus nicobarensis* Mayr, 1865. **B**. *Camponotus exiguoguttatus* Forel, 1886. Scale bars = 1 mm.

43. Clypeus weakly carinate and clypeal lobe anteriorly convex (Fig. 39A) ..... ***C. nicobarensis*** Mayr, 1865
– Clypeus distinctly carinate and clypeal lobe anteriorly transverse (Fig. 39B) ..... ***C. exiguoguttatus*** Forel, 1886

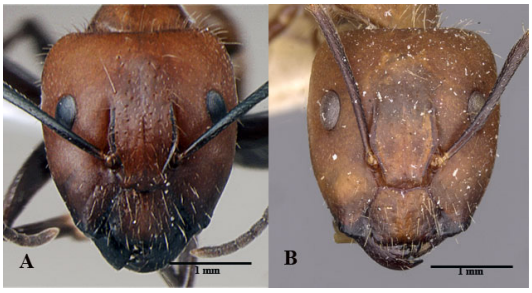

Fig. 39. Head in full face view. **A**. *Camponotus nicobarensis* Mayr, 1865. **B**. *Camponotus exiguoguttatus* Forel, 1886. Scale bars = 1 mm.

44. Petiole nodiform; In dorsal view first and second gastral tergite with two white bands; half of coxal margin, trochanter and distal margin of femur with white bands (Fig. 40A) .... ***Camponotus*** sp. 101
– Petiole scale like ; In dorsal view, whole gaster with black and yellowish alternate bands; half of coxal margin, trochanter and distal margin of femur without white bands (Fig. 40B) .... ***C. habereri*** Forel, 1911

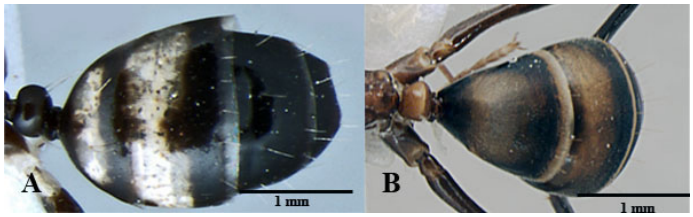

Fig. 40. Gaster in dorsal view. **A**. *Camponotus* sp. 101. **B**. *Camponotus habereri* Forel, 1911. Scale bars = 1 mm.

45. Unicolored, head, mesosoma and gaster dark castaneous brown 46
– Bicoloured, head and gaster fuscous brown, mesosoma variable from yellow-brown to dark brown 48

46. Pronotum longer than mesonotum, strongly constricted anteriorly forming a distinct neck (Fig. 41A) ..... ***C. carin*** Emery, 1889
– Pronotum almost equal in length to mesonotum, only slightly constricted in front not forming a distinct neck (Fig. 41B) 47

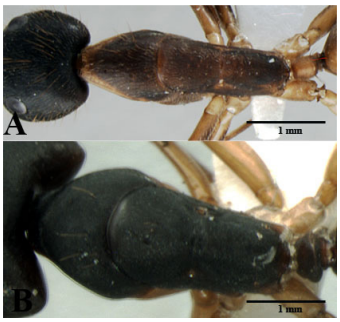

Fig. 41. Mesosoma in dorsal view. **A**. *Camponotus carin* Forel, 1889. **B**. *Camponotus thraso* Forel, 1893. Scale bars = 1 mm.

47. Meso-metanotal suture indistinct ..... ***C. thraso*** Forel, 1893
– Meso-metanotal suture distinct ..... ***C. keralensis*** Karmaly & Narendran, 2006

48. Distance between frontal carinae equal to the distance between eyes and frontal carinae (Fig. 42A) 49
– Distance between frontal carinae distinctly greater than the distance between eyes and frontal carinae (Fig. 42B) ..... ***C. irritans pallidus*** (Smith, 1857)

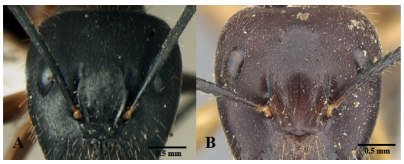

Fig. 42. Median portion of head. **A**. *Camponotus variegatus fuscithorax* Dalla Torre, 1893. **B**. *Camponotus irritans pallidus* (Smith, 1857). Scale bars = 0.5 mm.

49. Coxae and base of femora yellow, without any trace of brown ..... ***C. variegatus fuscithorax*** Dalla Torre, 1893
– Coxae and base of femora yellowish brown 50

50. Body covered with erect dense pubescence, node of petiole thin and scale like (Fig. 43A) 51
– Body covered with sparse erect pubescence, node of petiole thick and bluntly rounded in shape (Fig. 43B) ..... ***C. meghalayaensis*** sp. nov.

Fig. 43. Body in profile view. **A**. *Camponotus mitis* (Smith, 1858). **B**. *Camponotus meghalayaensis* sp. nov. Scale bars: A = 1 mm; B = 2 mm.

51. Head distinctly longer than wide with parallel lateral sides and mandibles with 6 teeth (Fig. 44A) ..... ***C. simoni*** Emery, 1893
– Head subtriangular, longer than wide with arched lateral sides and mandibles with 7 teeth (Fig. 44B) 52

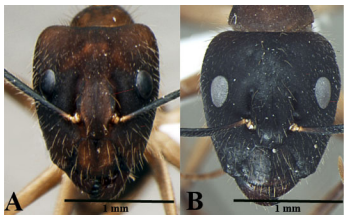

Fig. 44. Head in full face view. **A**. *Camponotus simoni* Forel, 1893. **B**. *Camponotus mitis* (Smith, 1858). Scale bars = 1 mm.

52. Eyes large, placed up in position to the median line of the head ..... ***C. timidus*** (Jerdon, 1851)
– Eyes small, frontal rather than lateral .....***C. mitis*** (Smith, 1858)

53. The propodeum not elevated above metanotum, forming a continous line (Fig. 45A) 54
– The propodeum is raised gibbous or forms an angle with the mesonotum, interrupting the regular arch of the mesosoma (Fig. 45B) 63

Fig. 45. Mesosoma in profile view. **A**. *Camponotus socrates* Forel, 1904. **B**. *Camponotus opaciventris* Mayr, 1879. **C**. *Camponotus mutilarius* Forel, 1893. Scale bars = 1 mm.

54. Clypeus anteriorly emarginated in the middle (Fig. 46A) 55
– Clypeus anteriorly not emarginated in the middle (Fig. 46B) 56

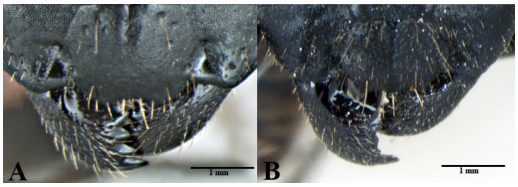

Fig. 46. Clypeus. **A**. *Camponotus himalayanus* Forel, 1893. **B**. *Camponotus socrates* Forel, 1904. Scale bars = 1 mm.

55. Head, mesosoma and gaster covered with long erect or suberect hair (Fig. 47A) .....
..... ***C. rufifemur*** Emery, 1900
– Body with very short and very sparse appressed pubescence (Fig. 47B) .....
..... ***C. himalayanus*** Forel, 1893

Fig. 47. Body in profile view. **A**. *Camponotus rufifemur* Forel, 1900. **B**. *Camponotus himalayanus* Forel, 1893. Scale bars = 0.5 mm.

56. Scape flattened ..... ***C. radiates*** Forel, 1892
– Scape cylindrical 57

57. Larger species, with a body length of more than 10 mm in major worker and 7 mm in minor worker 58
– Smaller species, with body length less than 7 mm, even in major workers 60

58. Clypeus broad and slightly tectiform, with a transverse anterior edge 59
– Clypeus subcarinate, trapeziform and with a subcrenulate anterior border .... ***C. socrates*** Forel, 1904

59. Body with abundant brown or yellow pilosity, especially in head and gaster (Fig. 48A) .... ***C. aethiops cachmiriensis*** Emery, 1925

Fig. 48. Body in profile view. **A**. *Camponotus aethiops cachmiriensis* Forel, 1925. **B**. *Camponotus siemsseni* Forel, 1901. Not to scale.

– Body with a few grey scattered hairs (Fig. 48B) ..... ***C. siemsseni*** Forel, 1901

60. Head, mesosoma and gaster black 61
– Head, mesosoma and gaster reddish brown 62

61. Mesosomal dorsum and petiole without standing hairs; metanotal depression distinct .... ***C. keihitoi*** Forel, 1913
– Mesosomal dorsum and petiole with standing hairs; metanotal depression absent .... ***C. quadrinotatus*** Forel, 1886

62. Head longer than broad, subtruncate anteriorly and occipital margin transverse; mandibles large ... . ***C. reticulatus latitans*** Forel, 1893
– Head as long as broad, not subtruncate anteriorly, occipital margin round; mandibles small .... ***C. indeflexus*** (Walker, 1859)

63. Propodeum elevated, rounded above and gibbous (Fig. 49A) 64
– Propodeum forming an angle with the mesonotum at the meso-metanotal suture; basal portion of propodeum horizontal, flat, or slightly concave; apical portion excavate (Fig. 49B) 69

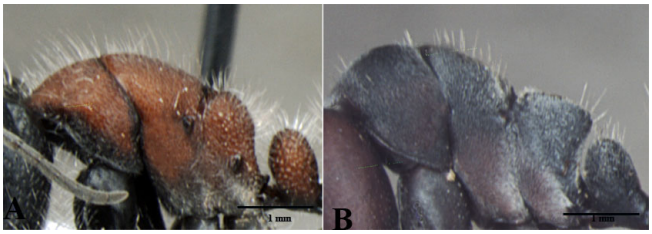

Fig. 49. Mesosoma in profile view. **A**. *Camponotus mutilarius* Forel, 1893. **B**. *Camponotus opaciventris* Mayr, 1879. Scale bars = 1 mm.

64. Humeri angulated (Fig. 50A) 65
– Humeri rounded (Fig. 50B) 66

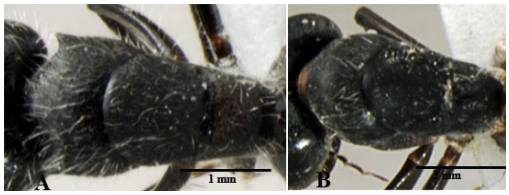

Fig. 50. Mesosoma in dorsal view. **A**. *Camponotus wasmanni* Forel, 1893. **B**. *Camponotus confucii* Forel, 1894. Scale bars = 1 mm.

65. Body completely black (Fig. 51A) ..... ***C. wasmanni*** Emery, 1893
– Head black, mesosoma, petiole and first gastral tergite reddish in colour (Fig. 51B) .....
..... ***C. mutilarius*** Emery, 1893

Fig. 51. Body in profile view. **A**. *Camponotus wasmanni* Forel, 1893. **B**. *Camponotus mutilarius* Forel, 1893. Not to scale.

66. Body length above 9 mm 67
– Body length below 9 mm ..... ***C. confucii*** Forel, 1894

67. Mesosoma and petiole finely reticulate punctate and rugulose (Fig. 52A) 68
– Mesosoma and petiole coarsely punctured (Fig. 52B) ..... ***C. holosericeus*** Emery, 1889

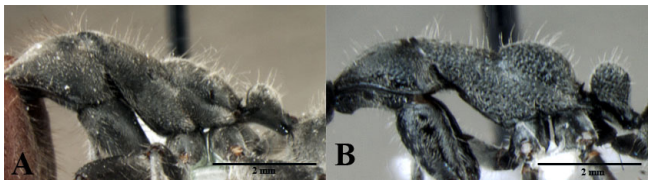

Fig. 52. Body in profile view. **A**. *Camponotus camelinus* (Smith, 1857). **B**. *Camponotus holosericeus* Forel, 1889. Scale bars = 2 mm.

68. Bicoloured, head blood-red; mesosoma, petiole and gaster blackish in colour .....
..... ***C. singularis*** (Smith, 1858)
– Unicoloured, head, mesosoma, petiole and gaster dark blackish ..... ***C. camelinus*** (Smith, 1857)

69. Hind tibia spined beneath 70
– Hind tibia without spined benath 74

70. Clypeus tectiform (Fig. 53A) ..... ***C. varians*** Roger, 1863
– Clypeus convex (Fig. 53B) 71

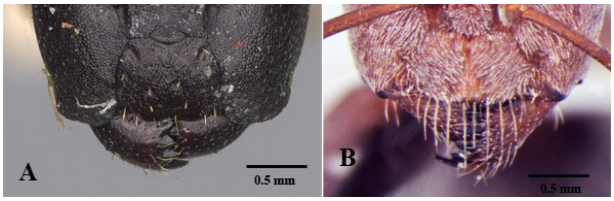

Fig. 53. Clypeus. **A**. *Camponotus varians* Roge, 1863. **B**. *Camponotus puniceps* Donisthorpe, 1942. Scale bars = 0.5 mm.

71. Petiole rounded and knob like, body black (Fig. 54A) 72
– Petiole scale like with narrow apex, anterior surface slightly concave and sloping, posterior surface upright, body reddish (Fig. 54B) ..... ***C. puniceps*** Donisthorpe, 1942

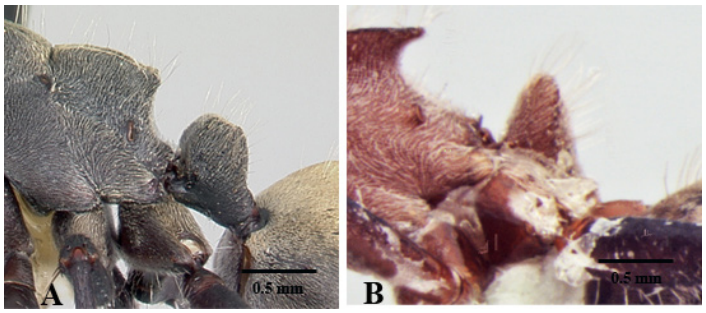

Fig. 54. Petiole in lateral view. **A**. *Camponotus sericeus* (Fabricius, 1798). **B**. *Camponotus puniceps* Donisthorpe, 1942. Scale bars = 0.5 mm.

72. Body covered with dense pubescence, sculpture not distinct 73
– Body without dense pubescence, sculpture distinct ..... ***C. opaciventris*** Mayr, 1879

73. Head, mesosoma without pubescence and gaster covered with dense golden pubescence (Fig. 55A) .....***C. sericeus*** (Fabricius, 1798)
– Head, mesosoma and gaster covered with dense greyish pubescence (Fig. 55B) ....***C. sericeus peguensis*** Emery, 1895

Fig. 55. Body in profile view. **A**. *Camponotus sericeus* (Fabricius, 1798). **B**. *Camponotus sericeus peguensis* Forel, 1895. Scale bars: A = 2 mm; B = 0.5 mm.

74. Propodeum with a pair of lamellate spines; dorsal surface transversely grooved (Fig. 56A) 75
– Propodeum without spines; dorsal surface of petiole is smooth (Fig. 56B) 76

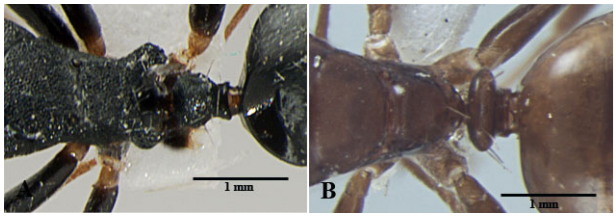

Fig. 56. Propodeum in dorsal view. **A**. *Camponotus selene* (Forel, 1889). **B**. *Camponotus nirvanae* Forel, 1893. Scale bars = 1 mm.

75. Petiole dorsally transversely grooved; head and mesosoma densely reticulate punctate and matte .....***C. selene*** (Emery, 1889)
– Petiole with obtuse tip, not grooved; head and mesosoma densely punctuated not matte ....***C. selene obtusatus*** (Emery, 1895)

76. Petiole emarginated above; body entirely black (Fig. 57A) .... ***C. horseshoetus*** Datta & Ray Chaudhury, 1985
– Petiole rounded above; head and mesosoma reddish, gaster somewhat dark (Fig. 57B) 77

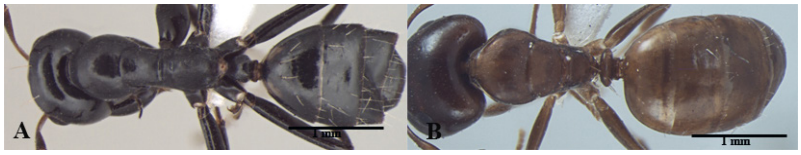

Fig. 57. Body in dorsal view. **A**. *Camponotus horseshoetus* Datta & Ray Chaudhury, 1985. **B**. *Camponotus nirvanae* Forel, 1893. Scale bars = 1 mm.

77. Mandibles triangular; clypeus is large and convex with anterior border rounded medially and sinuate at sides ..... ***C. varius*** Donisthorpe, 1943
– Mandibles sub triangular; clypeus sub truncate anteriorly and anterolateral corners broadly rounded ..... **C. *nirvanae*** Forel, 1893

Note

Camponotus gretae Forel, 1902 and *Camponotus luteus* (Smith, 1858) are excluded from the key as their description is based on reproductive caste. *Camponotus velox* (Jerdon, 1851) is not included in the key because the identity of this taxon is obscure.

Discussion

The genus *Camponotus* is a large and varied group of ants that has many different types of species within it. Despite this diversity, the way in which the different lineages are classified does not accurately reflect their natural relationships. In other words, relying solely on morphological taxonomy may not be enough to accurately determine how these species are related to one another. There are several reasons for this. One of the main factors is that certain morphological features have evolved similarly in different species over time. This means that when looking at two different species that are distantly related, they may appear to have very similar physical features. This can make it challenging to distinguish between these species and accurately classify them. As a result of these similarities, several species within the *Camponotus* genus have been misidentified. This makes it even more challenging to reconstruct the evolutionary relationships between different lineages within the genus.

Considering these recent discoveries, it is evident that the genus has a huge diversity that still needs to be explored and will require a large amount of taxonomy and inventory work in the future from India. In this regard, recent research has identified 83 species of *Camponotus* in India, which is the highest number of species for any ant genus in the country. However, the relationships among these species are yet to be fully resolved through a combination of morphological and molecular methods. Unfortunately, there is currently a lack of sequenced taxa available to represent the *Camponotus* genus in a larger molecular phylogenetic analysis. This highlights the need for further research to explore the diversity of the genus and its relationships, using a combination of traditional morphological approaches and molecular analysis.

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Supplementary material

Supp. file 1. Coordinates of species locality in the map. https://doi.org/10.5852/ejt.2023.901.2317.10053

Supp. file 2. Morphometric measuremments of the studied species of *Camponotus* Mayr, 1861. https://doi.org/10.5852/ejt.2023.901.2317.10055