

Taxonomic notes on *Ponera guangxiensis* Zhou, 2001 (Hymenoptera: Formicidae: Ponerinae), with a new distribution record from Vietnam and the first description of queen, male, and larva

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Abstract: *Ponera guangxiensis* Zhou, 2001 was originally described from Guangxi Province, China, based on workers only. Since then, no further information on this species became available. Recently, we successfully retrieved a complete colony series of *P. guangxiensis* in the northernmost part of Vietnam, close to Guangxi Province. We herein redescribe the worker of *P. guangxiensis* and describe the queen, male, pupa, and larvae for the first time. Furthermore, the utility of using male genitalia morphology for discriminating *Ponera* species is discussed.

Keywords: Ant - taxonomy - dissection - male genitalia - external morphology.

INTRODUCTION

The ant genus *Ponera* Latreille, 1804 was recently assigned by Schmidt & Shattuck (2014) to the *Ponera* genus group of the tribe Ponerini, in the subfamily Ponerinae. A total of 57 accepted species are currently known (AntCat, 2017), and the center of species-richness is found in the Oriental region with 26 species (AntCat, 2017; antmaps.org 2017). Because of the subterranean and cryptobiotic habits (Taylor, 1967), it is hard to find intact nests of *Ponera* and to retrieve a complete colony containing all castes and sexes. Therefore, until now there are only three *Ponera* species (*P. incerta* Wheeler, 1933, *P. pennsylvanica* Buckley, 1866, and *P. woodwardi* Taylor, 1967; see Taylor, 1967 and AntCat, 2017) of which all castes and sexes have been documented completely.

In Vietnam, a core area of the Indo-Burma biodiversity hotspot (Myers *et al.*, 2000; Sterling *et al.*, 2006), Eguchi *et al.* (2014) recognized five morphospecies of *Ponera* for which the species-level status and their identification is currently being reconsidered by the present authors, this partly due to the lack of complete colony series. Recently, the first author recognized two complete colonies and one

incomplete colony of *Ponera guangxiensis* Zhou, 2001 in our most recent collection made near Mount Mau Son (Lang Son Province, Vietnam), which is located near the type locality of *P. guangxiensis*, i.e., Guangxi Province, southern China.

In the present paper, based on the newly obtained colony series and the images of the type specimens provided by Dr Shan-Yi Zhou, we hereby redescribe the worker of *P. guangxiensis* and describe the queen, male, pupa, and larvae for the first time. Furthermore, we discuss the utility male genitalia morphology for discriminating *Ponera* species.

MATERIAL & METHODS

Photography

Specimens were examined under a stereomicroscope (Leica Z16 APO, Wetzlar, Germany) and photographed using digital cameras (Leica DFC490, Wetzlar, Germany). For scanning electron microscopic observation, specimens were sputter-coated with a SPI Module and imaged with a JSEM-5600, JEOL.

Abbreviations of institutions/collections

- IEBR Institute of Ecology and Biological Resources, Vietnam Academy of Science and Technology, 18 Hoang Quoc Viet Road, Nghia Do, Cau Giay, Hanoi, Vietnam.
- MHNG Muséum d'histoire naturelle Genève, 1 route de Malagnou, 1208 Genève, Switzerland.
- NMNS National Museum of Natural Science, Taichung, Taiwan.
- OMNH Osaka Museum of Natural History, Osaka, Japan.

Terminology

Morphological terminology follows those in Taylor (1967) and Keller (2011) for the worker and queen, Boudinot (2013, 2015) for the male, and Wheeler & Wheeler (1976) for the larva. The measurements and indices follow those in Taylor (1967). All measurements are given in millimeters.

- HL** Head length. Maximum length of head in full-face view, measured from posterior most points of head to anterior most point of median clypeus in full-face view of head.
- HW** Head width. Maximum width of head in full-face view (excluding the eyes in female, but including the eyes in male).
- SL** Scape length. Maximum length of scape in external view (excluding the basal neck and condyle).
- PrW** Pronotum width. Maximum width of pronotum in dorsal view.
- PeNL** Petiolar node length. Maximum length of petiolar node in lateral view, measured between of the inflections of petiole peduncle.
- PeW** Petiolar node width. Maximum width of petiolar node in dorsal view.
- CI** Cephalic Index, $(HW/HL) \times 100$.
- SI** Scape Index, $(SL/HW) \times 100$.

TAXONOMY

Ponera guangxiensis Zhou, 2001

Figs 1-13

Ponera guangxiensis Zhou, 2001: 37-18, figs 33-34.

Type locality: Huashuichong Natural Protection Area, Guangxi Province, China.

Images of type material examined: 1 paratype worker, 31 VIII 1998, Huashuichong Natural Protection Area (ca. 24.4246°N, 111.2276°E), Guangxi, China, SY Zhou leg.

Non-type material examined: 1 worker, 1 alate queen, 1 male (colony: CML12ix17-Col.22; OMNH: LCM00052_1 alate queen, LCM00053_1 male, LCM00054_1 worker), Vietnam, Lạng Sơn Province,

Mount Mau Son, 21.8370°N, 106.9139°E, ca. 990 m alt., 12 IX 2017, CM Leong leg. – 9 workers, 1 dealate queen, 1 alate queen, 9 pupae, 2 larvae (CML13ix17-Col.21; NMNS: LCM00055_1 worker, LCM00056_1 worker), Vietnam, Lạng Sơn Province, Mount Mau Son, 21.8417°N, 106.9419°E, ca. 904 m alt., 13 IX 2017, CM Leong leg. – 5 workers, 1 dealate queen, 9 alate queens, 1 male, 13 pupae (CML15ix17-Col.07; MHNG: LCM00058_1 worker, LCM00057_1 worker; IEBR: LCM00059_1 alate queen, LCM00060_1 dealate queen; OMNH: LCM00061_1 male, LCM00062_1 pupa, LCM00063_1 larva), Vietnam, Lạng Sơn Province, Mount Mau Son, 21.8525°N, 106.9454°E, ca. 866 m alt., 15 IX 2017, CM Leong leg.

Species diagnosis: *Ponera guangxiensis* Zhou, 2001 can be distinguished from the other congeners by a combination of the following characteristics in the worker: masticatory margin of mandible edentate except for the apical and two preapical teeth; antennal scape, when laid backward, not reaching the posterior corner of head, with the remaining distance of head to posterior corner of head about 5% of the scape length; antennal club five-merous; metanotal groove distinct and thin; petiolar node in dorsal view semicircular, with strongly and roundly convex anterior margin, and almost straight and roundly concave posterior margin, in lateral view with posteromedian portion of the dorsum slightly sloping posteroventrad; petiolar node in lateral view slightly higher at the anterodorsal corner than at the posterodorsal corner; subpetiolar process with distinct posteroventral teeth.

Description of the worker

Measurements and indices: Workers (n = 5): HL 0.55-0.57; HW 0.45-0.52; SL 0.36-0.38; PrW 0.38-0.41; WL 0.75-0.82; PeH 0.39-0.41; PeNL 0.19-0.21; PeW 0.32-0.34; CI 81-92; SI 72-83.

Head: Head in full-face view with posterior margin straight to slightly convex; lateral margin weakly convex (Fig. 1). Eye small; the longest axis having 5-7 minute ommatidia. Anterior clypeal margin with median blunt tooth (Fig. 2A). Masticatory margin of mandible edentate, except for three large teeth in the apical part (one apical and two preapical teeth; Fig. 2B). Antennal scape, when laid backward, not reaching the posterior corner of head, with remaining distance of head to posterior corner about 5% of scape length; ratio of the length of antennal segment VI-X approximately 1.00: 1.25: 1.67: 2.64: 3.07 (n = 5).

Mesosoma: Dorsum of mesosoma slightly convex in lateral view (Fig. 3A). Pronotal disc in dorsal view with broadly convex anterior margin (Fig. 2C). Promesonotal articulation distinct but weakly incised (Figs 2E, 3A). Metanotal groove distinct and forming a narrow suture (Fig. 2C, E). Propodeal dorsum in dorsal view moderately broad; posterodorsal corner of propodeum broadly round in lateral view.

Metasoma: Petiolar node in dorsal view semicircular, ca.



Fig. 1. *Ponera guangxiensis*, worker (colony: CM-L12ix17-Col.22; specimen: LCM00054), head, full-face view.

0.5 times as long as wide, with roundly convex anterior margin and almost straight posterior margin (Figs 2D, 3B), with posteromedian portion of the dorsum slightly sloping posteroventrad. Petiolar node in lateral view with straight anterior margin, slightly convex posterolateral margin and convex dorsal margin, with its anterodorsal corner slightly higher than posterodorsal corner (Figs 2F, 3A). Subpetiolar process in lateral view with medium-sized posteroventral teeth (Fig. 2F), medium-sized fenestra, and very weakly concave ventral margin. Abdominal tergum III in dorsal view distinctly broader than length (the ratio = 77-83%; $n = 5$).

Sculpture: Body sculpture as shown in Figs 1, 2 and 3. Dorsum of head capsule strongly and densely punctate (Fig. 2A); the intervals between punctures (ca. 0.010 mm; $n = 5$) much greater than the diameter of punctures (ca. 0.005-0.007 mm; $n = 5$). Mandible smooth and shining with a few superficial hair pits on the lateral surface. Mesosomal dorsum weakly punctate; the density sparser in mesosomal dorsum than in dorsum of head capsule; intervals between punctures ca. 0.013 mm and diameter of punctures ca. 0.005-0.007 mm in pronotal disc ($n = 5$), and intervals between punctures ca. 0.015 mm and diameter of punctures 0.006-0.008 mm in mesonotum and propodeal dorsum ($n = 5$). Lateral face of pronotum very weakly punctate but shining. Mesopleuron with punctate upper portion and weakly striate lower portion. Metapleuron with smooth upper portion, and punctate lower portion. Most portion of propodeum sparsely punctate. Propodeal declivity smooth and shining. Anterior and lateral faces of petiolar node sparsely and very weakly punctate; dorsal face smooth and shining

with a few superficial hair pits; posterior face shining and smooth. Abdominal tergum III weakly and sparsely punctate (interval ca. 0.018 mm; diameter = 0.011 mm). **Setation:** Body densely covered with short pubescence (Figs 1-3). Each antennomere with many decumbent long hairs which increase in number through the apex. Anterior clypeal margin with a series of erect hairs including two very long erect hairs (Fig. 2B). Ventral face of mandible with many long and erect hairs. Petiolar dorsum with several long and erect hairs (Fig. 3A); subpetiolar process with few long erect hairs (Fig. 2F). Gastral sterna and gastral terga V-VII with many long erect hairs (Fig. 3B).

Color: Body brown; antenna, mandible, clypeus, legs and posterior half of gaster yellowish orange (Figs 1, 3).

Description of the gyne

Measurements and indices: Gynes ($n = 3$): HL 0.60-61; HW 0.54-0.57; SL 0.40-0.43; PrW 0.50-0.52; WL 0.93-1.02; PeH 0.46-0.47; PeNL 0.22; PeW 0.37-0.38; CI 91-93; SI 71-78.

Body: In overall morphology similar to the worker (Figs 4-5). Antennal scape, when laid backward, not reaching the posterior corner of head, with the remaining distance about 5% of the scape length; ratio of the length of antennal segments VI-X approximately 1.00: 1.23: 1.51: 2.33: 2.96 ($n = 3$). Pronotal disc in dorsal view with broadly convex anterior margin. Mesoscutum well developed and large (Figs 4B, 5B), with moderately broad and deep scutoscuteellar sulcus from which transscutal line runs laterad. Mesoscutellar disc suboval with moderately convex anterior and posterior margins. Oblique mesopleural sulcus in lateral view almost straight and incised (Figs 4A, 5A). Upper metapleuron suboval and narrowed ventrad, weakly separated from lower metapleuron by a sulcus. Propodeal corner in lateral view broadly round. Petiolar node in dorsal view semicircular, ca. 0.5 times as long as wide, with strongly and roundly convex anterior margin, and roundly concave posterior margin (Figs 4B, 5B), with posteromedian portion of the dorsum slightly sloping posteroventrad. Petiolar node in lateral view with straight anterior and posterior margins; blunt apex; anterodorsal corner little higher than posterodorsal corner (Figs 4A, 5B). Subpetiolar process with medium-sized teeth, small fenestra, straight ventral margin. Abdominal tergum III in dorsal view distinctly broader than length (the ratio = 78-82%; $n = 3$).

Wings: Forewing (Fig. 6A) Rsfl short and forming a blunt angle with Mf1; Mf1 straight and 3 times as long as Rsfl. Mf2 very short, 0.20 times as long as Rs+M; Rs+M running almost at right angle to 1m-cu; dc1 cell subrectangular, with Cu a little longer than Mf1; 2rs-m and 2r-rs oriented at slightly different angles and diverging; Rsf4 and Rsf2-3 forming an blunt angle; the junction of Mf1 and Cu present distad to the junction of M+Cu and cu-a; cell smc2 narrowing toward Mf2, with bluntly angulate distal corner formed by Rsf4 and 2rs-m; smc2 cell 0.5 times as long as cell mc1. Hindwing

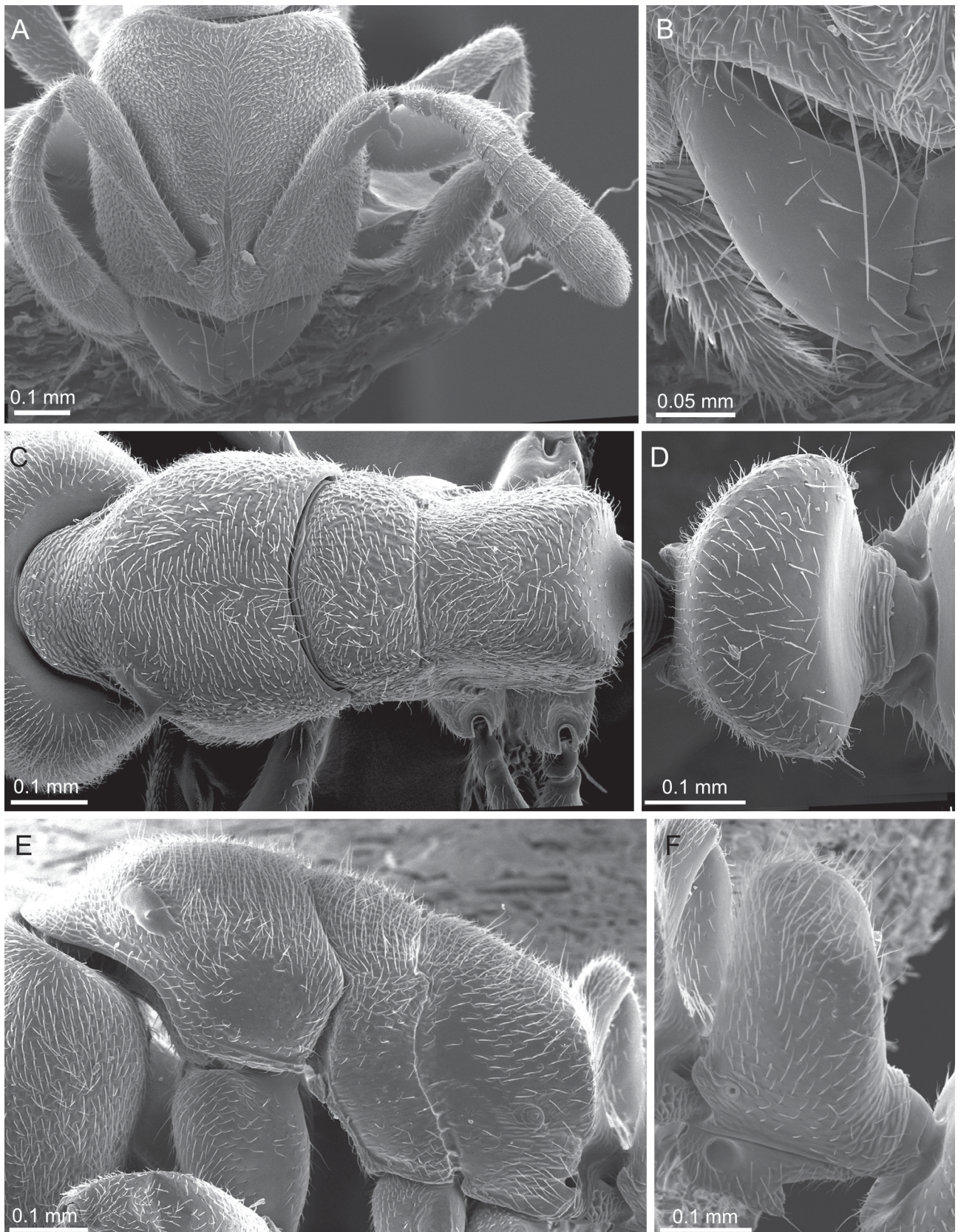


Fig. 2. *Ponera guangxiensis*, worker (colony: CML15ix17-Col.07; specimen: LCM00056). (A) Head, full-face view. (B) Mandible. (C) Mesosoma, dorsal view. (D) Petiole, dorsal view. (E) Mesosoma, lateral view. (F) Petiole, lateral view.

(Fig. 6B): Vein A reaching wing outer margin of wing, but Rsf, Cuf, Mf almost reaching outer margin.

Description of the male

Measurements and indices: Male (n = 1): HL 0.49; HW 0.51; SL 0.06; PrW 0.56; WL 0.98; PeH 0.33; PeNL 0.18; PeW 0.22; CI 106; SI 11.

Head: In full-face view of head (Fig. 7) suboval, broader than long (CI: 106). Gena and lateral portion of clypeus forming a distinctly angulate corner. Median portion of clypeus convex, weakly raised dorsad and forming a diamond-shaped mound; anterior clypeal margin straight. Compound eye large; the longest axis about



Fig. 3. *Ponera guangxiensis*, worker (colony: CML12ix17-Col.22; specimen: LCM00054). (A) Body, lateral view. (B) Body, dorsal view.

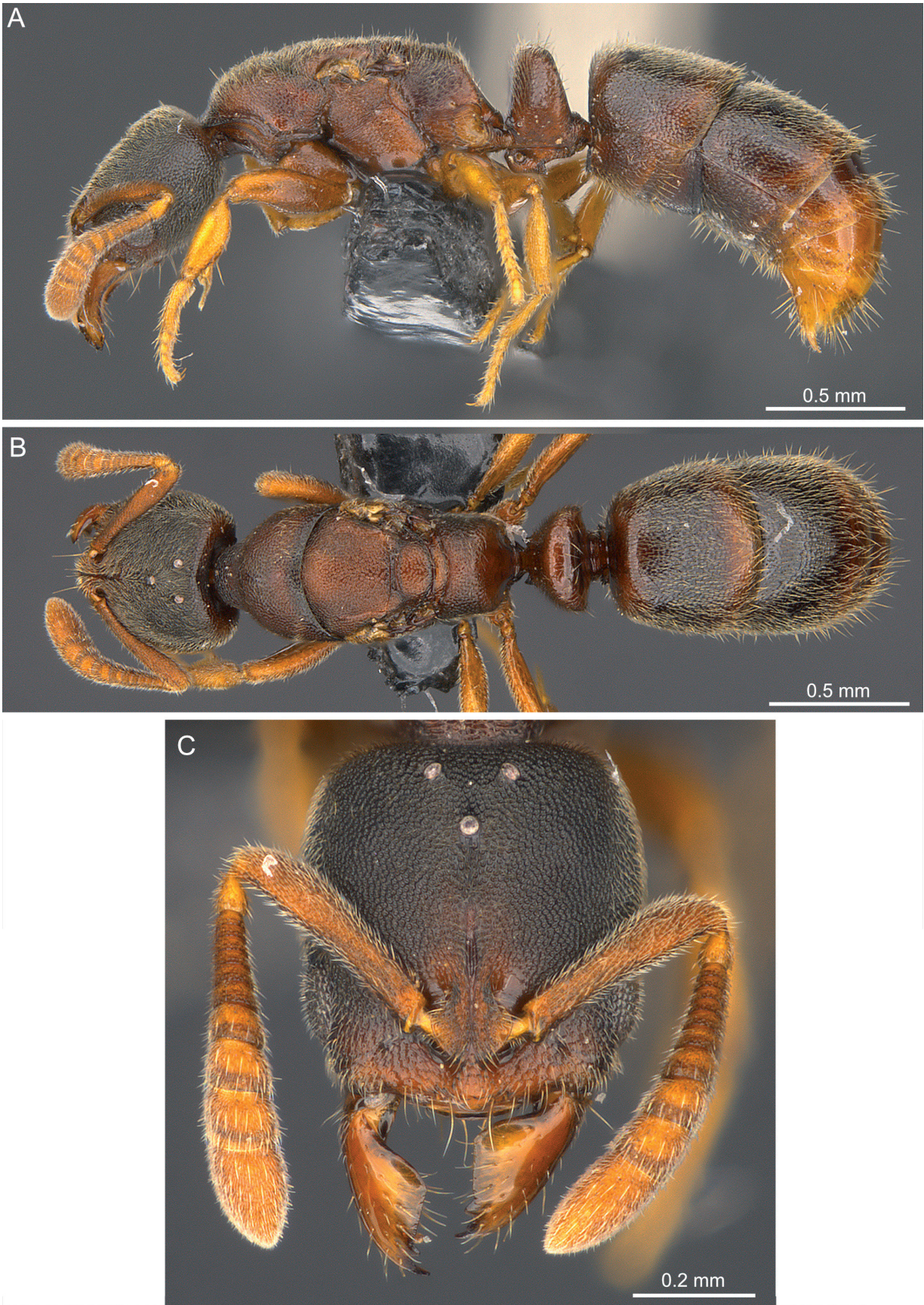


Fig. 4. *Ponera guangxiensis*, dealate queen (colony: CML15ix17-Col.07; specimen: LCM00060). (A) Body, lateral view. (B) Body, dorsal view. (C) Head, full-face view.

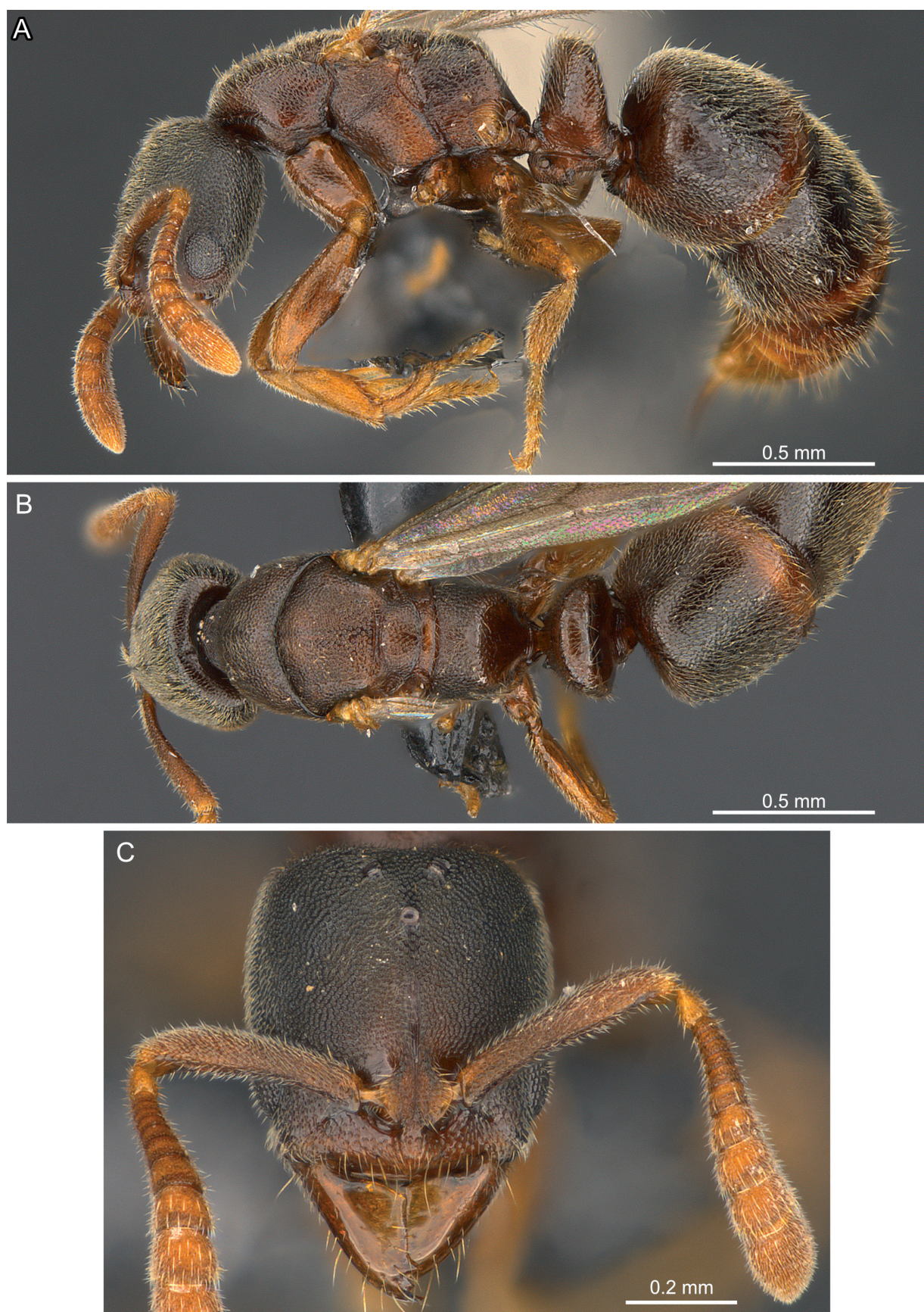


Fig. 5. *Ponera guangxiensis*, alate queen (colony: CML12ix17-Col.22; specimen: LCM00052). (A) Body, lateral view. (B) Body, dorsal view. (C) Head, full-face view.

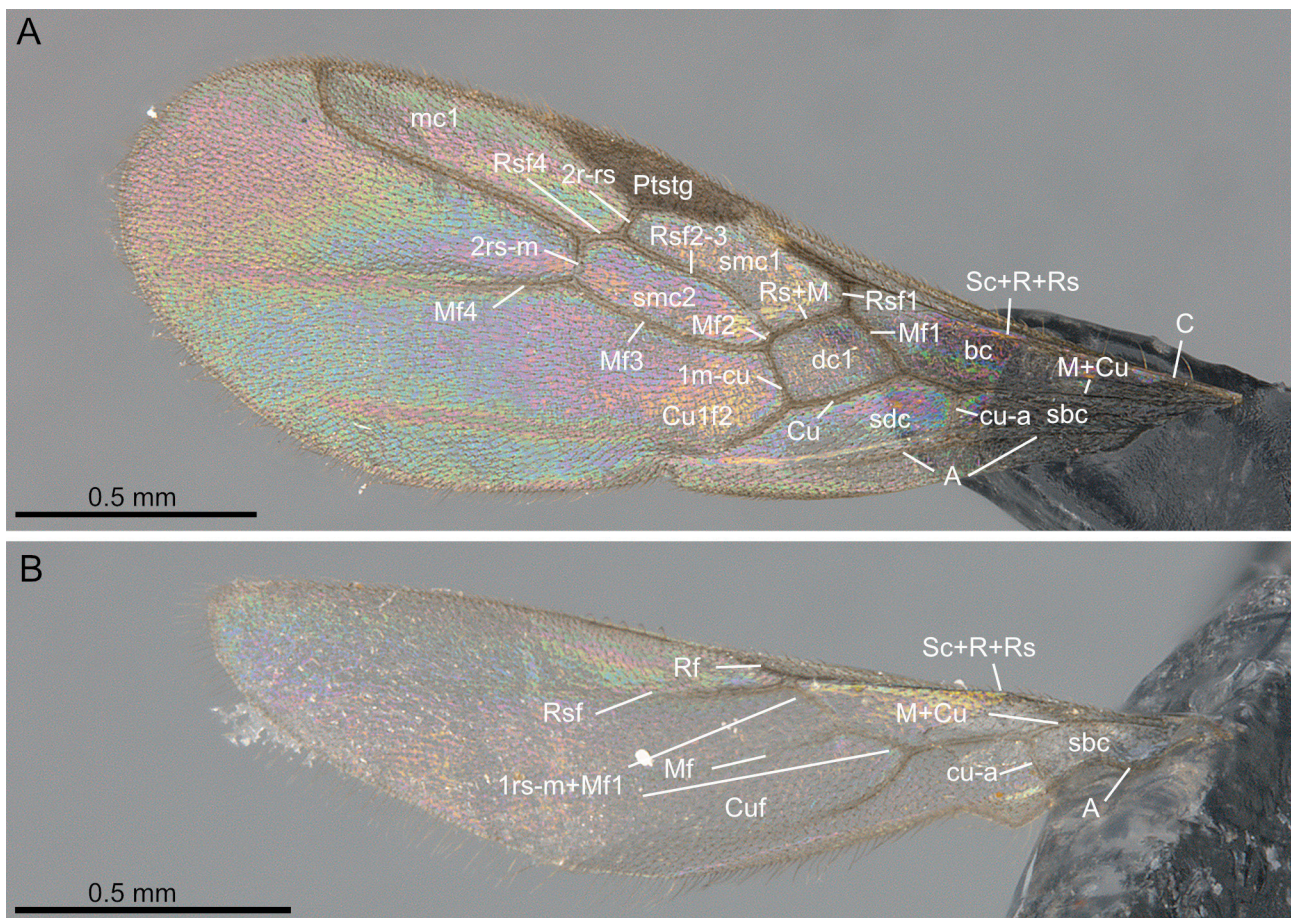


Fig. 6. *Ponera guangxiensis*, alate queen. (A) Front wing. (B) Hind wing.



Fig. 7. *Ponera guangxiensis*, male (colony: CM-L12ix17-Col.22; specimen: LCM00053), head, full-face view.

0.23 mm, with 25 ommatidia. Median ocellus circular, about 0.06 mm in maximum diameter; lateral ocelli subcircular, about 0.06 mm in maximum diameter. Mandible reduced, triangular with sharp apex; mandulus large and subcircular. Palp formula: 4, 2. Antennal scape very short; the ratio of the length of antennal segments I–XIII approximately 1.0: 1.1: 2.7: 2.8: 2.6: 2.7: 2.6: 2.8: 2.7: 3.70: 3.1: 2.8: 3.1: 5.1 ($n = 1$).

Mesosoma: Mesoscutum well developed and large (Fig. 8B), with broad and deep scutoscuteellar sulcus from which transscutal line runs laterad. Mesoscutellar disc sub-trapezoidal with straight anterior margin. Oblique mesopleural sulcus distinct in lateral view. Upper metapleuron suboval, distinctly separated from lower metapleuron by a sulcus. Propodeal corner in lateral view broadly round.

Metasoma: Petiolar node cone-like (Fig. 8A), with steeply sloping anterior margin and ventral posterior margin, in dorsal view oval, broader than long. Subpetiolar process triangular, with indistinct fenestra, with acute anteroventral and round posteroventral corners. Abdominal sternum III prora in lateral view blunt. Posteromedian portion of abdominal tergum VIII acutely

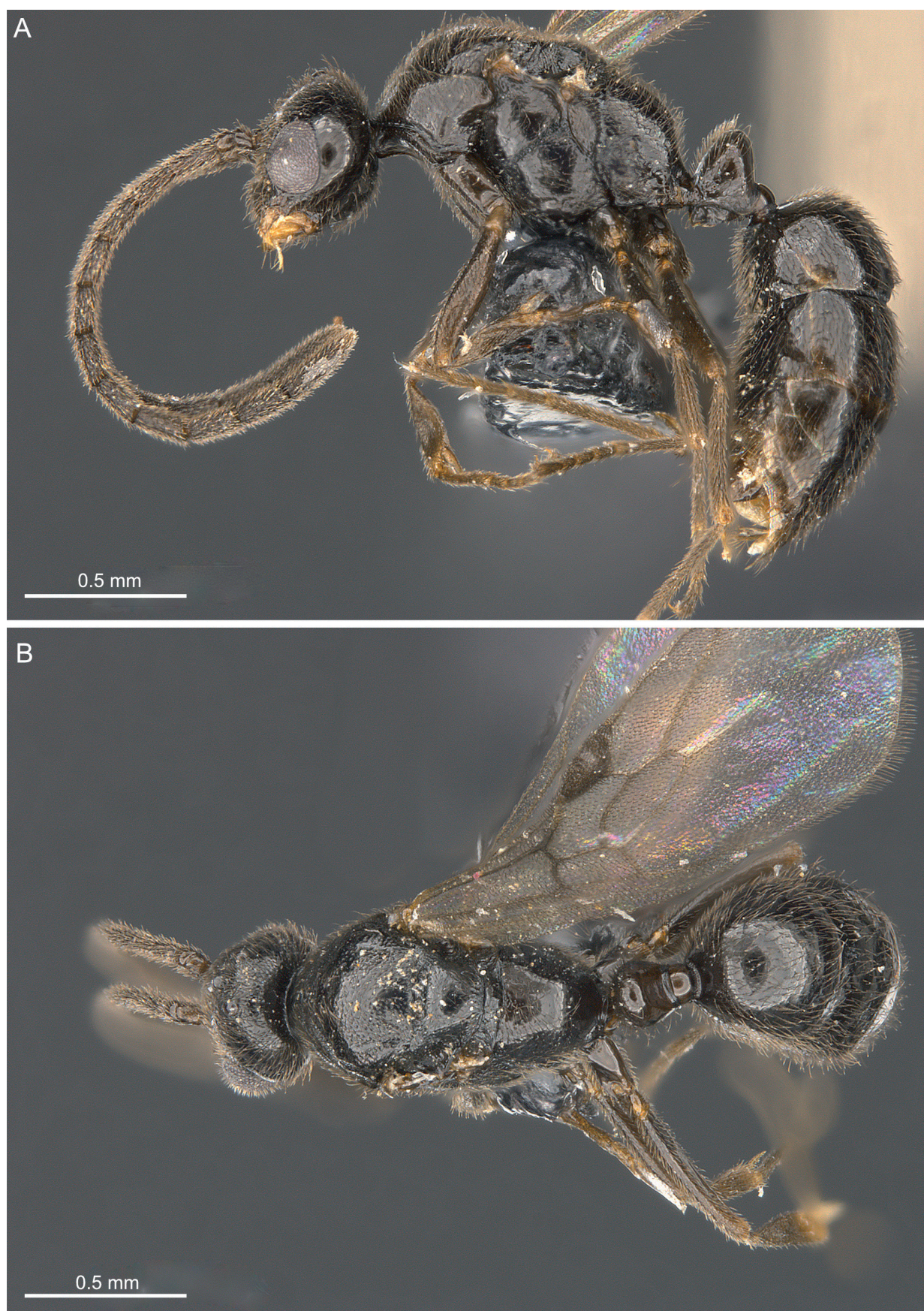


Fig. 8. *Ponera guangxiensis*, male (colony: CML12ix17-Col.22; specimen: LCM00053), body. (A) Lateral view. (B) Dorsal view.

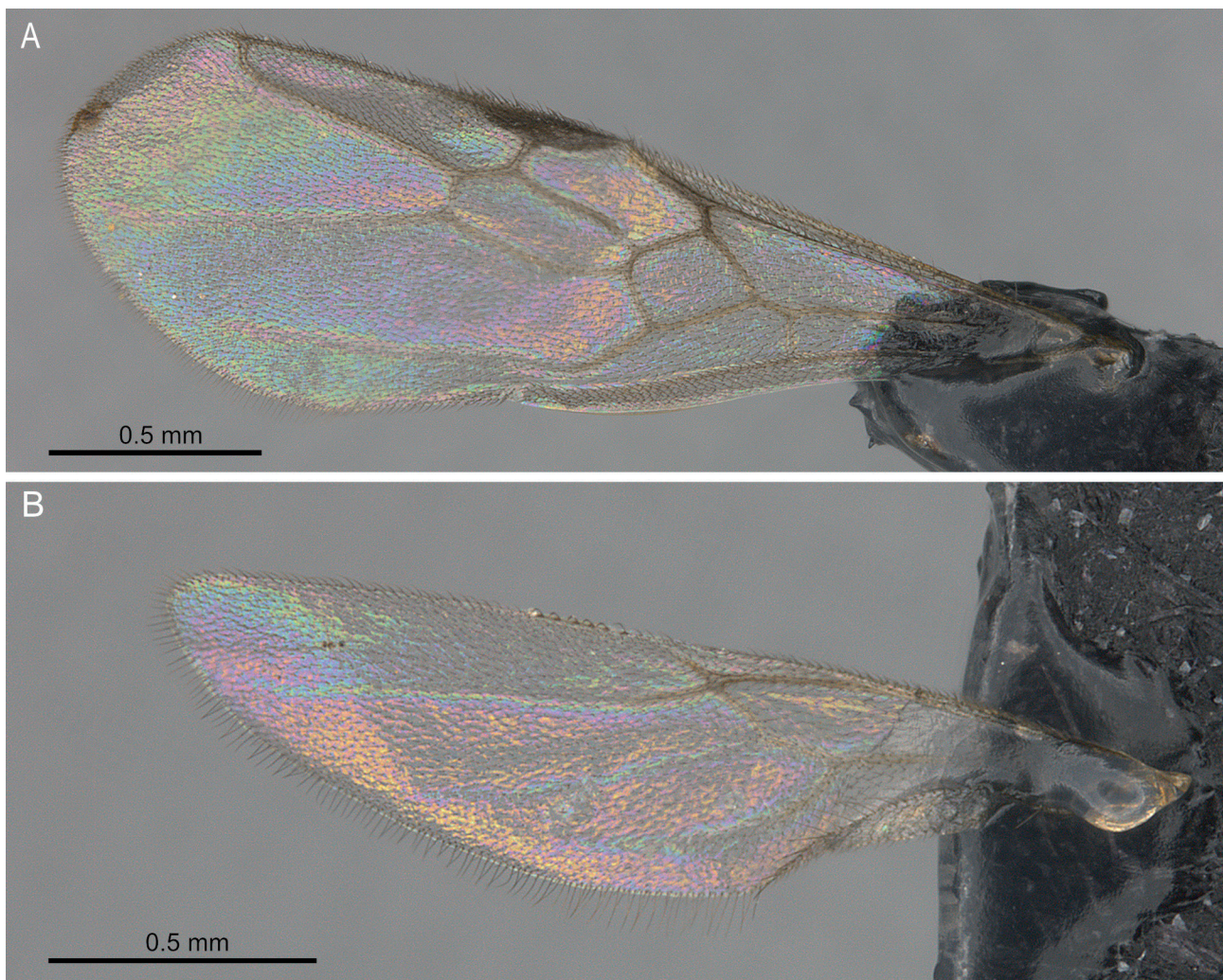


Fig. 9. *Ponera guangxiensis*, male (colony: CML12ix17-Col.22; specimen: LCM00053). (A) Front wing. (B) Hind wing.

sharpened, forming median spine as long as its nearby erect hairs. Fore, middle and hind legs each with a single pectinate tibial spur; middle tibial spur approximately 3 times as large as those of fore and hind legs.

Sculpture: Head weakly and evenly punctate; clypeus evenly punctate. Pronotal dorsum and mesonotum with relatively sparse punctures. Propodeal dorsum smooth. Mesosoma in lateral view with very scattered punctures. Propodeal declivity smooth. Petiolar node with dorsal and posterior faces smooth and shiny, and lateral face with few punctures. Abdominal tergum III evenly punctate.

Setation: Head covered densely with short sub-erect hairs; clypeus with a few long and decumbent hairs. Compound eyes with dense and very short erect hairs (Fig. 6). Mesosoma, petiole and gaster covered densely with short and decumbent/suberect background hairs; petiolar node hairy in anterior face, and propodeal declivity and posterior face of petiole glabrous.

Wings: Similar to those of gyne, as shown in Fig. 9.

Color: Body color blackish brown (Figs 7, 8); antennae and legs dark brown; mandibles blackish yellow.

Genitalia (dissected): Pygostyle digitiform, with 7-8 long erect hairs (Fig. 10A). Apical part of abdominal sternum IX (Fig. 10B) triangular, with angulate apex, ventrally with sparse hairs. Genital capsule almost as long as broad, broadest at the midlength of basimere (Fig. 10C, D), in lateral view subtriangular, distinctly longer than high (Fig. 10E); parameral process in lateral view subtrapezoidal with well protruding posterodorsal corner; telomere in lateral view forming an obtuse dorsomedial process (Fig. 10E), then tapering apicad, with the apex blunt and round (Fig. 10E). Volsella with well developed cuspis and digitus; digitus in mesal view thick at the base, narrowed and bent ventrad in the apical 2/3; cuspis elongate and spatulate (Fig. 10F, G). Valviceps subdivided into distinct apical and ventral lobes by a deep and round apicoventral notch (Fig. 10H); apical lobe broadly and roundly produced apicad; ventral

margin of ventral lobe weakly and roundly convex, with ca. 10 small denticles; valvura weakly curved.

Description of the pupa (worker)

Pupa enclosed by a cocoon. Cocoon yellowish brown, with a dark-brown circular meconium in the anal area. Diameter of cocoon largest around the thorax of pupa, about 0.44 mm (Fig. 11A-B).

Description of the larva (expectedly final instar; but sex and caste unknown)

Body shape pogonomymecoid (*sensu* Wheeler & Wheeler, 1976). Head subtrapezoidal (Fig. 12C), with posterior margin straight, with lateral margin well convex. Tentorial pit weakly incised. Labrum thin, with straight anterior margin. Labium well developed, subtrapezoidal, with a pair of labial palps. Each maxilla with 2 palps.

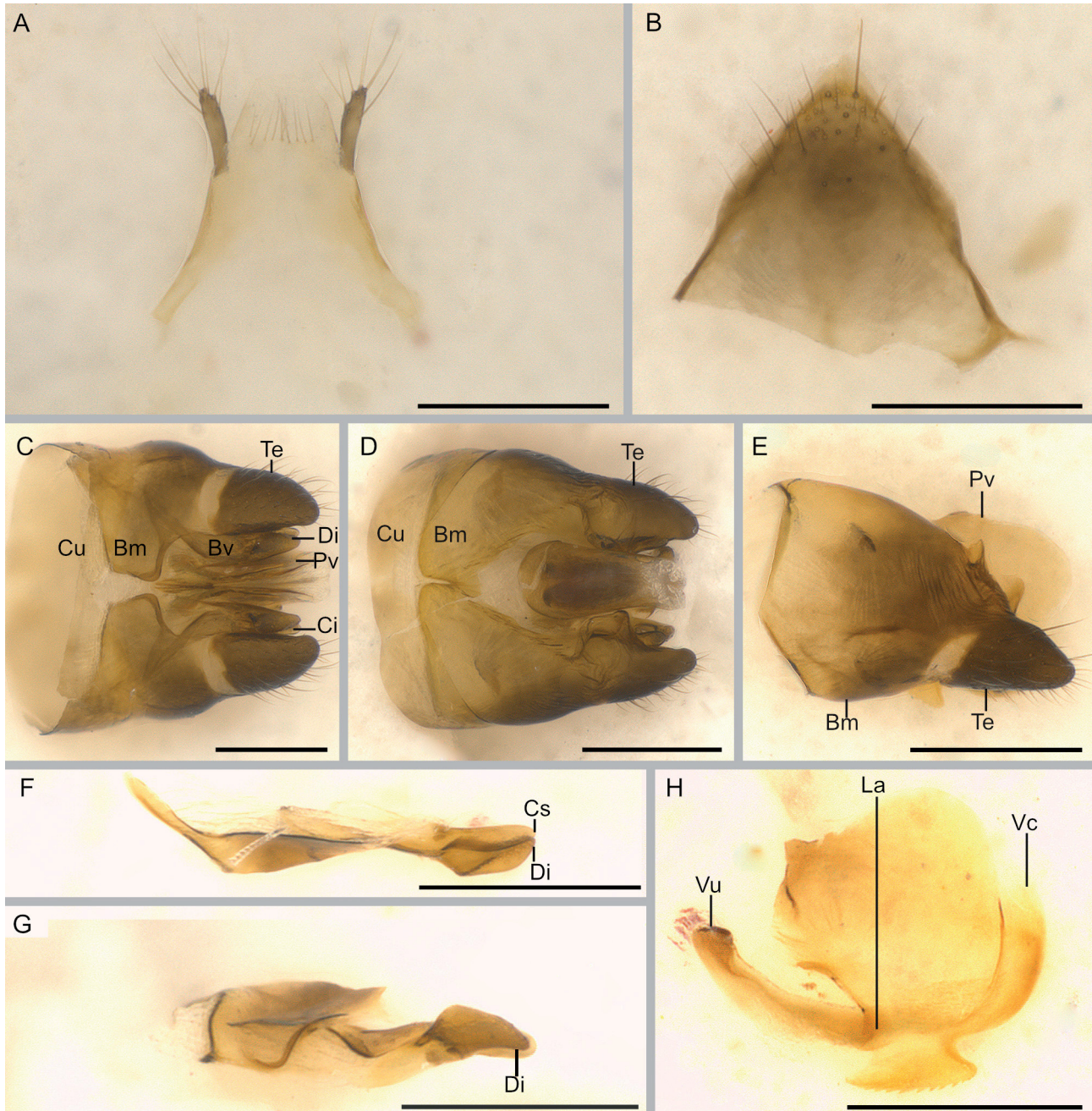


Fig. 10. *Ponera guangxiensis*, male genitalia (colony: CML15ix17-Col.07; specimen: LCM00061). (A) Pygostyle. (B) Abdominal sternum IX. (C) Whole, ventral view. (D) Whole, dorsal view. (E) Left half, lateral view. (F) Left volsella, ventral view. (G) Left volsella, dorsal view. (H) Left penisvalva, lateral view. Abbreviations: Bm basimere, Bv basivolsella, Cs cuspis, Cu cucula, Di digitus, La lateral apodeme, Pv penisvalva, Te telomere, Vc valviceps, Vu valvura. Scale bars = 0.2 mm.

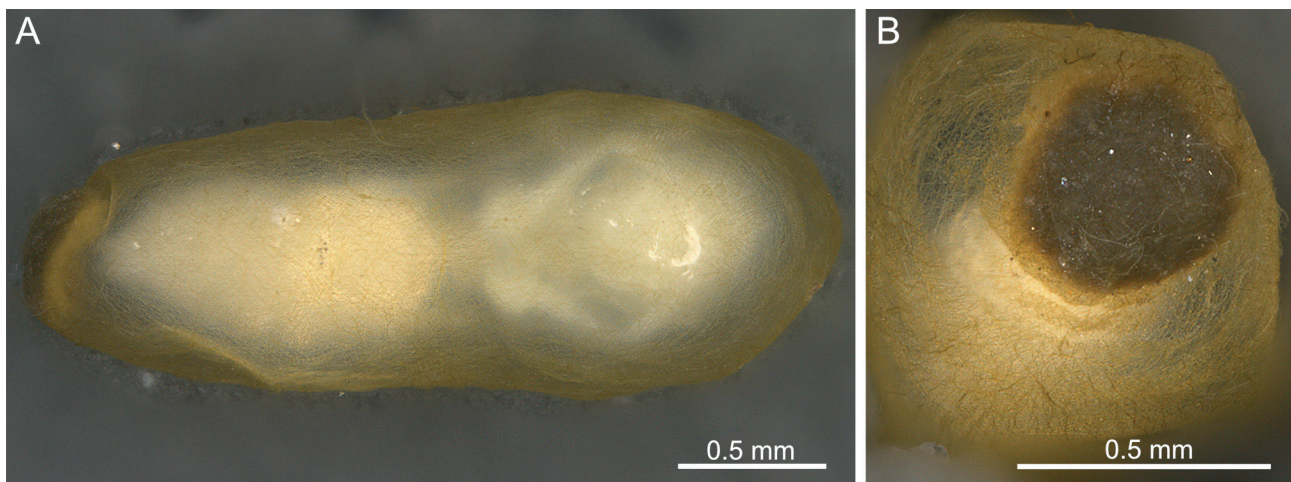


Fig. 11. *Ponera guangxiensis*, pupa of worker (colony: CML15ix-17-Col.07; specimen: LCM00062). (A) Ventral view. (B) Posterior view.

Mandible well sclerotized, pogonomymecoid (*sensu* Wheeler & Wheeler, 1976), with a total of 3 teeth. Antenna with base weakly raised. Thoracic segment I (TI) with ca. 12 slender and simple subcones which are arranged as a single whorled series. Each of TII-TIII and AI-AVII with ca. 20 slender and simple subcones which are arranged as double whorled series dorsally and a single whorled series ventrally. Each of AVI-AVII additionally with a pair of glutinous tubercles. The remainder of abdominal segments (after AVII) with increasing numbers of slender and simple subcones. Head with a few erect hairs (ca. 30 hairs). Body color yellowish white.

Distribution and nesting sites: Guangxi Province, China and Lạng Sơn Province, Vietnam (new record). The nests of *P. guangxiensis* were found inside the rotten wood, under the moss or under the stone in humid environments (Fig. 14).

DISCUSSION

In the previous studies, the male genitalia in the genus *Ponera* have so far been documented with illustration only from a European species, *P. pennsylvanica* Buckley, 1866 by Taylor (1967), and a Japanese species, *P. scabra* Wheeler, 1928, by Ogata (1987), respectively. In the present study, the examined male genitalia of *P. guangxiensis* are clearly distinguishable from those of *P. pennsylvanica* and *P. scabra* as shown in Fig. 14:

1. the valviceps is subdivided into distinct apical and ventral lobes by a deep and round apicoventral notch, and the apical lobe broadly and roundly produced apicad in *P. guangxiensis*, but not subdivided into distinct apical and ventral lobes in *P. pennsylvanica*, or weakly subdivided by a shallow and broad concavity in *P. scabra* (see Fig. 14A-C);
2. the relative length of the ventral lobe to valviceps

is much smaller in *P. guangxiensis* than in *P. pennsylvanica* and *P. scabra* (arrow in Fig. 14A-C);

3. the telomere in lateral view has broadly and roundly concave distidorsal margin in *P. pennsylvanica* and *P. scabra* (Fig. 14E-F), but slightly convex distidorsal margin in *P. guangxiensis* (see Fig. 14D);
4. the genital capsule in lateral view has a distinct posterodorsal corner in *P. pennsylvanica* (Fig. 14B) or a large projection in *P. scabra* (Fig. 14F), but a small projection in *P. guangxiensis* (see Fig. 14D).

Given the degree of interspecific differences described above, male genitalia appear thus as a promising character for discriminating *Ponera* species, especially for species with workers having a similar external morphology, as in the case of many Ponerinae (see Satria *et al.*, 2015, 2017).

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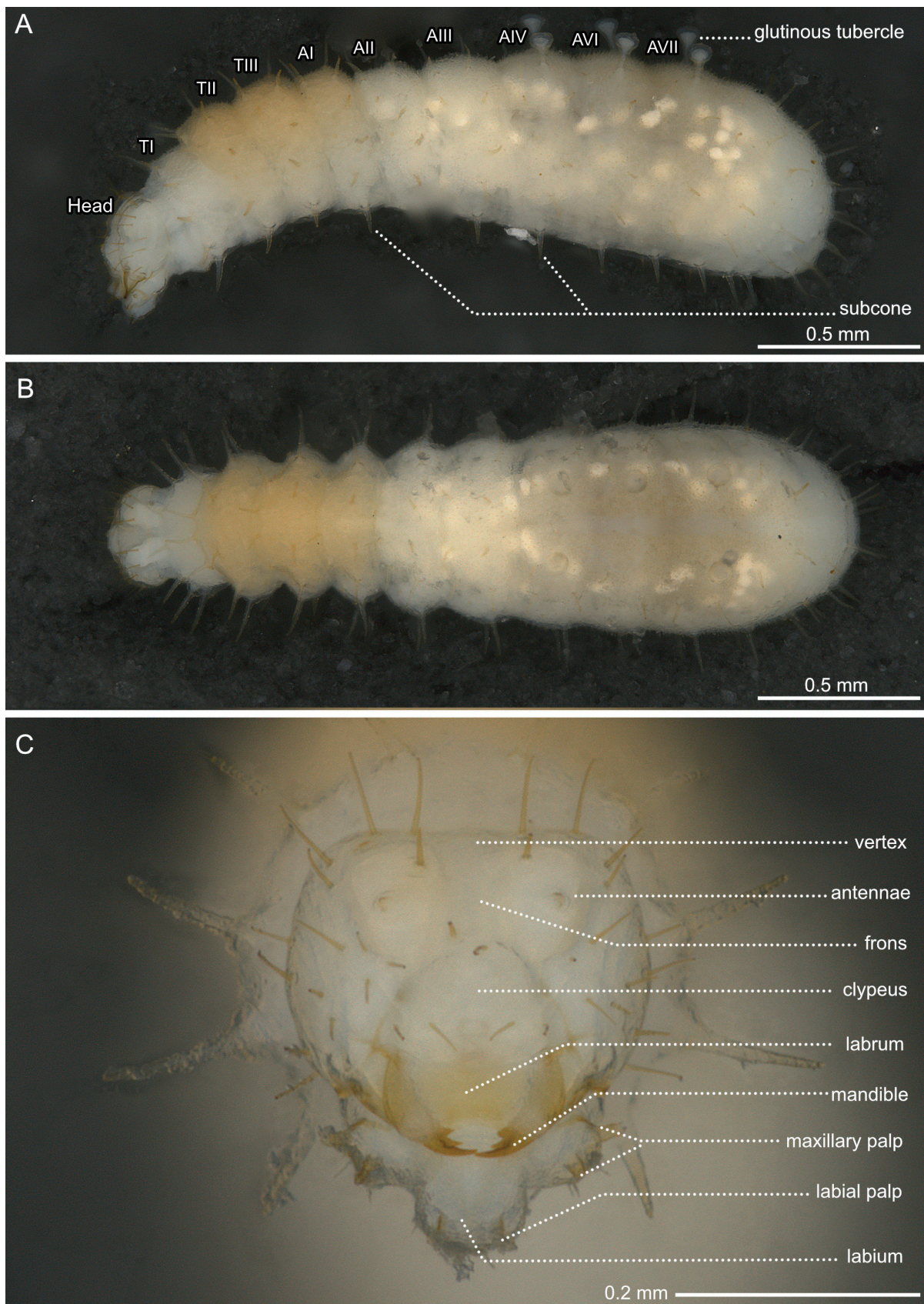


Fig. 12. *Ponera guangxiensis*, larva (colony: CML15ix-17-Col.07; specimen: LCM00063). (A) Body, lateral view. (B) Body, dorsal view. (C) Head, full-face view.



Fig. 13. *Ponera guangxiensis* (colony: CML12ix17-Col.22). Left: rocky cliff covered by moss, uncovered nesting site indicated in a white square. Right: enlarged view of the white square (10:35 UTC+8, 12/09/2017).

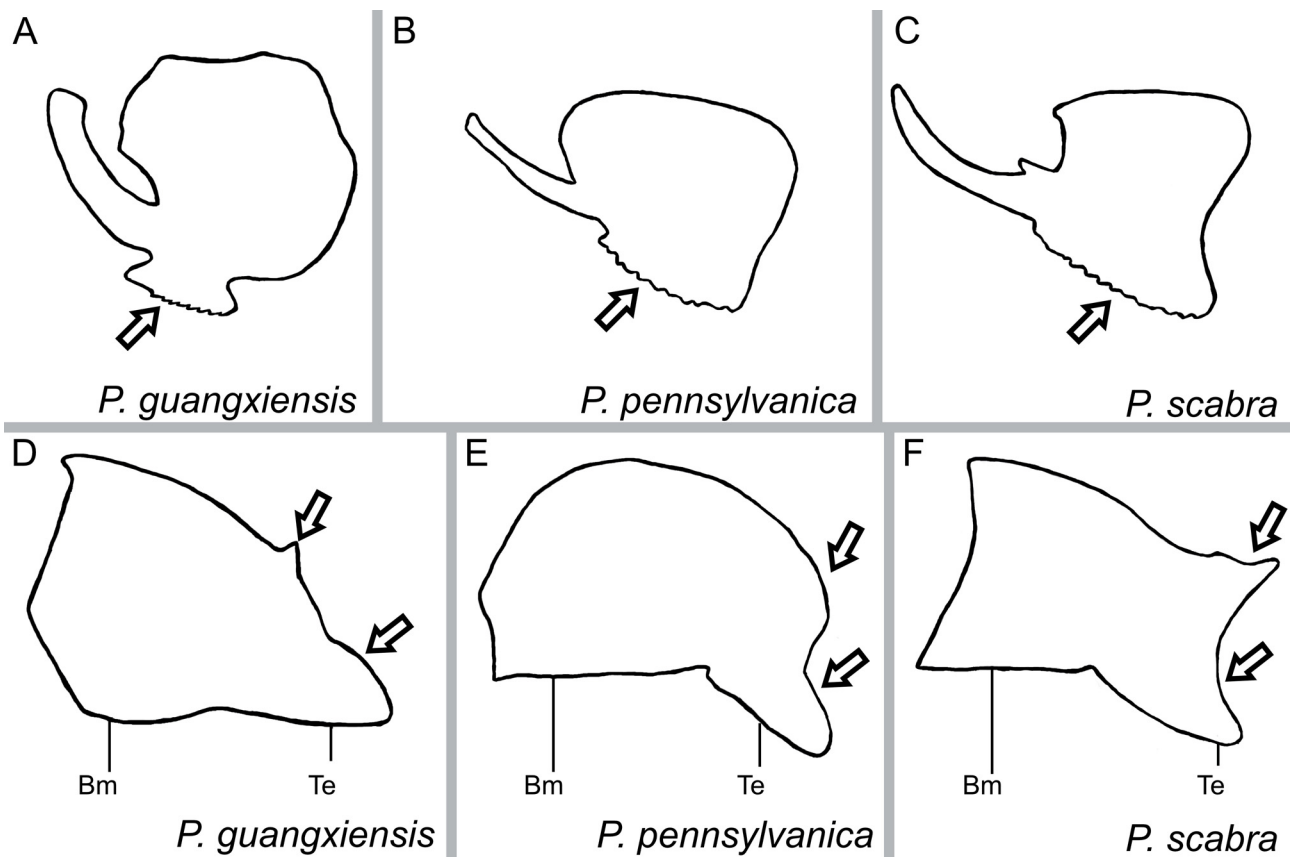


Fig. 14. (A-C) Left penisvalva, lateral view. (A) *Ponera guangxiensis*. (B) *P. pennsylvanica* (redrawn from Taylor, 1967). (C) *P. scabra* (redrawn from Ogata, 1987). (D-F) Left half of genital capsule, lateral view. (D) *Ponera guangxiensis*. (E) *P. pennsylvanica* (redrawn from Taylor, 1967). (F) *P. scabra* (redrawn from Ogata, 1987). Abbreviations: Bm basimere, Te telomere.

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