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Two new species of *Pseudolasius* (Hymenoptera: Formicidae) from India

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Abstract
Descriptions of two new species of *Pseudolasius* based on worker caste and sexuals are provided from India. With addition of these two species collected in lower Shivalik range of Northwest Himalaya, four species signify the genus *Pseudolasius* from India. An identification key to the workers of Indian *Pseudolasius* species is provided.

Introduction

Pseudolasius ants are mainly restricted to southern Asia, from India to China, stretching southwards to northern Australia and seem to be restricted to tropical localities (LaPolla et al., 2010). They are currently represented by 47 extant species, 15 subspecies and 1 fossil species across the globe (Ward, 2014). Although, *Pseudolasius* is in serious need of taxonomic revision, some important taxonomic contributions to this genus include: Emery (1911); Wheeler (1922); Menozzi (1924); Wu and Wang (1995); Xu (1997); Zhou (2001) and LaPolla (2004).

Pseudolasius are perhaps best known for possessing a polymorphic worker caste, with most species possessing complete dimorphism, characterized by major and minor workers (Holldobler & Wilson, 1990; LaPolla, 2004). Although there are clear size differences between the extremes among workers, blending of the major and minor castes occurs; this fact has caused confusion when elucidating species boundaries, and in the past has led to specimens being described several times as representing separate, distinct species (LaPolla, 2004).

Here we present descriptions of two new species, *Pseudolasius diversus* sp. n. and *Pseudolasius polymorphicus* sp. n., collected in foothills of Northwest Himalaya, the Shivalik range. Prior to this study, the genus *Pseudolasius* from India was represented by only two species, *P. familiaris* (Smith, F., 1860) and *P. machhediensis* Bharti et al., 2012 restricted to upper Himalaya.

Materials and Methods

The specimens were hand collected and their taxonomic analysis was conducted on Nikon SMZ 1500 stereo zoom microscope. For digital images, MP evolution digital camera was used on same microscope with Auto-Montage (Syncroscopy, Division of Synoptics, Ltd.) software. Later, images were cleaned with Adobe Photoshop CS5. Holotype and paratypes of both the species have been deposited in PUPAC, Punjabi University Patiala Ant Collection, Patiala. Some paratypes of both species will be deposited in BMNH, Natural History Museum, London, U.K. and California Academy of Sciences, San Francisco, United States of America. Measurements were recorded in micrometers between 80

× and 225 × with measuring accuracies of ±1 µm for small measures like eye length, such of ±2 µm for medium sized measures like head width, such of ±5 µm for larger measures like Weber's length. Morphological terminology for measurements and indices are as follows:

HL Maximum length of head in full-face view (maximum length and width of head present in the same focal level), measured in straight line from the anterior most point of the median clypeal margin to a line drawn across the posterior margin from its highest points by first measuring median length and then adding the depth of concavity.

HW Maximum width of head in full-face view (excluding the portion of eyes that extends past the lateral margins of the head) exclusive of any defined anteroposterior level.

HS Head Size, arithmetic mean of HL and HW.

EL Maximum length of eye as measured normally in oblique view of the head to show full surface of eye.

SL Maximum length of the scape excluding the basal neck and condyle.

PW Maximum width of the pronotum in dorsal view.

WL Weber's length measured from the anterior surface of the pronotum proper (excluding the collar) to the posteriormost point of the propodeal lobes.

FL Maximum length of the femur of foreleg from its margin with the trochanter to its margin with the tibia.

FW Maximum width of the femur of foreleg.

GL Maximum length of the gaster in lateral view from the anteriormost point of first gastral segment to the posteriormost point of the last segment.

TL Total length: HL + WL + GL.

CI Cephalic index: HW/HL.

SI Scape index: SL/HW.

REL Relative eye length index: EL/HL.

Results

Descriptions of new species

Pseudolasius diversus sp. n. (Figures 1-16)

Type material

Holotype **(**Major worker): India, Uttarakhand, Rajaji Forest Area, 30.2483°N 77.9878°E, 660m.a.s.l., 11.viii.2009, hand collecting (coll. Aijaz A. Wachkoo). Paratypes: 24 workes, 2 gynes and 6 males, with same data as holotype; 7 workers, 5.viii.2009; 55 workers 6.viii.2009; 30 workers 13.viii.2009; 62 workers 6.ix.2010, same data as holotype.

Workers (Figures 1-9)

Morphometric data of the holotype: HL 1126; HW 1108; HS 1117; EL 118; SL 681; PW 678; WL 1082; FL 743; FW 227; GL 1446; TL 3654. Indices: CI 0.98; SI 0.61; REL 0.10.

Morphometric data of the paratype workers: HL 656-1134; HW 629-1103; HS 638-1112; EL 78-118; SL 549-722; PW 454-713; WL 795-1136; FL 512-740; FW 150-234; GL 1054-1466; TL 2505-3722. Indices: CI 0.82-1.00; SI 0.61-0.88; REL 0.07-0.14 (n=29).

Head roughly heart-like in major worker, subrectangular in media and subquadrate in minor, as long as wide in major and minor workers, distinctly elongate in media workers. Posterior margin with a strong "v" shaped impression medially in major and media, weakly concave in minor; posterolateral corners rounded; sides parallel in media and minor, in major convex anteriorly, subparallel and gently converging posteriorly. Frontal carinae, nearly parallel with sides of head, not extending past posterior margin of eyes. Anterolateral corner of clypeus bluntly toothed; scape just reaches posterolateral corner in minor worker, shorter in media reaching four-fifths and even short in major worker reaching three-fourths of posterolateral corner; antennal segments 3-9 longer than wide; mandible with five teeth, fifth one mostly reduced.

In lateral view, promesonotum convex in minor and media relatively flat in major; metanotal groove strongly developed; metanotal area short but distinct. Propodeum low, nearly flat above with sides diverging basally; propodeal spiracle rounded; declivity steep. Petiole low triangular, inclined forward with posterior face longer than anterior face, dorsum mostly emarginate, transverse in some minor workers. First gastral segment with concave anterior face, receives the petiole.

Head and gaster with abundant appressed pubescence, mesosoma sparsely pubescent; head, scape, legs and gaster with abundant short erect setae, denser on gaster; relatively longer erect setae cover clypeus and mesosoma. Mandibles with short, curved setae near masticatory borders; anterior clypeal margin with a few, longer, anteriorly directed setae medially and fringe of short setae towards mandibular bases.

Full-grown workers yellowish brown, fairly microreticulate with dull and opaque cuticle; nanitic workers light yellow with superficial sculpturing and relatively shiny cuticle.

Gyne (Figures 10-12)

Morphometric data of the gynes: HL 958-987; HW 918-938; HS 938-962; EL 259-279; SL 842-861; WL 1700-1762; FL 768-782; FW 198-220; GL 2748-2791; TL 5406-5540. Indices: CI 0.95-0.96; SI 0.92; REL 0.27-0.28 (n=2).

Gyne similar to worker with usual differences indicating caste, including three ocelli, complete thoracic structure and wings. Head similar to minor worker, subquadrate with broadly emarginate posterior margin. Scape surpasses the posterior margin of head by about one-fifth its length. Propodeum indistinct. Body light yellow colored with feebler sculpture. Pubescence abundant on body including mesosoma, erect setae shorter and sparser than in conspecific worker caste.

Male (Figures 13-16)

Morphometric data of the males: HL 525-552; HW 508-531; HS 516-540; EL 228-240; SL 528-550; WL 972-1095; FL 637-661; FW 130-142; GL 1122-1181; TL 2620-2824. Indices: CI 0.95-0.96; SI 1.04-1.05; REL 0.43-0.44 (n=5).

Head oval, as long as wide excluding large compound eyes; eyes subglobulose, bulging, projecting well beyond head outline in full-face view; three prominent ocelli present. Antennae 13 segmented, filiform, scapes long, surpass posterior margin by about three-tenths their length. Anterolateral corner of clypeus bluntly toothed. Mandibles slender, armed with three teeth, apical one prominent, large and pointed, basal tooth small, blending seamlessly into inner mandibular margin.

Mesosoma modified for presence of wing; in lateral view scutum and scutellum flat; propodeum indistinct, not higher than remainder of notum with very short dorsal face and long declivitous face. Petiole as in worker; gaster elongated.

Parameres paddle-shaped, turning slightly inward toward midline of body posteriorly; long setae extending off parameres. Cuspi long and tubular, bent toward digiti; digiti weakly anvil-shaped; curved outward and covered with short peg-like teeth. Penis valves projecting.

Body mostly smooth and shiny; erect setae shorter and sparser but pubescence as in worker caste. Color light yellow, head mostly brownish.

Etymology: The species is named for its morphologically diverse worker caste.

Distribution and habitat: This species seems to be rare in Shivalik range of Northwest Himalaya and was found mostly under stones in a primary, subtropical, semi-evergreen forest with relatively high annual precipitation. It was encountered in a single locality of a reserved forest area (Rajaji Forest Area), in Uttarakhand during the intensive surveys.

Comparative notes: *Pseudolasius diversus* mostly resembles Chinese, *Pseudolasius bidenticlypeus* Xu, 1997 but can be easily separated from it by 5-toothed mandible whilst latter possess 6-toothed mandible. Scapes are longer in *P. bidenticlypeus* almost reaching posterior margin of head in major and easily surpassing posterior margin in minor and media whereas in *Pseudolasius diversus* scapes reach only up to three-fourths of posterior margin in major and never surpass the posterior margin in media and minor.

Pseudolasius polymorphicus sp. n. (Figures 17-32)

Type material

Holotype (Major worker): India, Himachal Pradesh, Andretta, 32.0744°N 76.5856°E, 940m.a.s.l., 11.vi.2010, hand collecting (coll. Aijaz A. Wachkoo). Paratypes: 45 workers, 1 gyne and 6 males, with same data as holotype.

Workers (Figures 17-25)

Morphometric data of the holotype: HL 920; HW 800; HS 860; EL 72; SL 502; PW 521; WL 864; FL 498; FW 168; GL 1282; TL 3066. Indices: CI 0.87; SI 0.63; REL 0.08.

Morphometric data of the paratype workers: HL 515-926; HW 468-804; HS 502-864; EL 27-62; SL 360-506; PW 360-532; WL 570-874; FL 350-502; FW 110-174; GL 759-1034; TL 1850-3094. Indices: CI 0.86-0.92; SI 0.61-0.80; REL 0.04-0.08 (n=24).

Head subrectangular in major worker, subquadrate in media and minor, relatively longer than wide in major as in media and minor workers. Posterior margin medially strongly impressed in major and media, only weakly so in minor; posterolateral corners rounded; sides subparallel in media, convex in minor and major, converging anteroposteriorly. Frontal carinae, divergent posteriorly, do not extend past posterior margin of eyes. Anterolateral corner of clypeus bluntly toothed; scape barely reaches posterolateral corner in minor worker, shorter in media reaching four-fifths and even short in major worker reaching two-thirds of posterolateral corner; antennal segments 3-9 wider than long; mandible with five teeth, fifth one mostly reduced.

In lateral view, promesonotum convex; metanotal groove strongly developed; metanotal area short but distinct. Propodeum low, nearly flat above with sides diverging basally; propodeal spiracle rounded; declivity steep. Petiole low triangular, inclined forward with posterior face longer than anterior face, dorsal margin weakly emarginate to transverse. First gastral segment with concave anterior face, receives the petiole.

Head and gaster covered with abundant appressed pubescence, mesosoma only sparsely pubescent; head, scape, legs and gaster with abundant short erect setae, denser on gaster; relatively longer erect setae cover clypeus and mesosoma. Mandibles with numerous, curved setae near masticatory borders; anterior clypeal margin with a few, longer, anteriorly directed setae medially and few short setae fringing margin laterally.

Full-grown workers yellow, with head and gaster usually yellowish brown, feebly microreticulate with smooth and feebly shiny cuticle; nanitic workers light yellow with superficial sculpturing and relatively shinier cuticle.

Gyne (Figures 26-28)

Morphometric data of the gyne: HL 782; HW 831; HS 806; EL 229; SL 622; WL 775; FL 661; FW 180; GL 2462; TL 4019. Indices: CI 1.06; SI 0.75; REL 0.30 (n=1).

Gyne similar to worker with usual differences indicating caste, including three ocelli, complete thoracic structure and wings. Head, trapezoidal with transverse posterior margin. Scape surpasses the posterior margin of head by about one-tenth its length. Propodeum indistinct. Head, mesosomal dorsum and gaster dark brown, antennae, legs and lateral mesosoma, brownish yellow; sculpture superficially microreticulate. Pubescence on body abundant and longer including

mesosoma, erect setae shorter and sparser than in conspecific worker caste.

Male (Figures 29-32)

Morphometric data of the males: HL 436-462; HW 441-462; HS 440-464; EL 170-202; SL 350-390; WL 752-828; FL 450-512; FW 81-92; GL 841-904; TL 2027-2194. Indices: CI 1.00-1.03; SI 0.80-0.84; REL 0.38-0.44 (n=6).

Head broadly oval, as long as wide excluding large compound eyes; eyes subglobulose, bulging, projecting beyond head outline in full-face view; three prominent ocelli present. Antennae 13 segmented, filiform, scapes long, surpass posterior margin by about three-tenths their length. Anterolateral corner of clypeus bluntly toothed. Mandibles curved strap like, with acute pointed apical tooth, remainder of masticatory margin smooth, without any teeth or denticles; basal angle rounded, indistinct and seamlessly blends into inner mandibular margin; when closed their tips meet or overlap and the entire blades are tucked away under the clypeus in such a way that only their external margins show externally along the anterior clypeal border.

Mesosoma enlarged to accommodate flight muscles; in lateral view scutum and scutellum flat; propodeum indistinct, lower than remainder of notum with very short dorsal face and long declivitous face. Petiole as in worker; gaster elongated.

Parameres broad paddle-shaped, turning slightly inward toward midline of body posteriorly; long setae extending off parameres. Cuspi smaller, covered under parameres weakly paddle-shaped, slightly bent toward digiti; digiti as long as penis valves, weakly anvil-shaped; curved outward and covered with short peg-like teeth. Penis valves projecting.

Overall, body mostly smooth and shiny; erect setae shorter and sparser but pubescence as in worker caste. Head dark brown, mesosoma and gaster brown, antennae and legs yellowish brownish.

Etymology. The species is named for its polymorphic worker caste.

Distribution and habitat. Andretta, the type locality of this species falls within the Shivalik range of Northwest Himalaya and is devoid of leaf litter; surrounded on all sides by tea gardens and pine forests before they merge with the Dhauladhar ranges (a southern branch of the main Outer Himalayan chain of mountains). This species seems rare in Shivalik range of Northwest Himalaya and was encountered only once during the intensive surveys, found nesting under a stone below a shady tree.

Comparative notes. *Pseudolasius polymorphicus* most resembles Chinese, *Pseudolasius cibdelus* Wu & Wang, 1992 but can be easily distinguished from the latter. In *P. polymorphicus* scapes are short reaching only two-thirds of posterior margin of head in major and barely reaches posterior margin in minor whereas in *P. cibdelus* scapes are longer reaching three-fourths of posterior margin of head in major and surpassing the posterior margin in minor workers. Sides of head are subparallel in major of *P. polymorphicus* with head equally broad anteroposteriorly, and minor worker has only feebly emarginate posterior margin whilst, sides of head are strongly converging anteriorly in *P. cibdelus* with head distinctly narrowing in front and posterior margin of head is fairly emarginate in minor worker.

Key to species of Pseudolasius of India based on worker caste

1. Antennal segments 3-9 longer than wide; frontal carinae parallel.....2
— Antennal segments 3-9 wider than long; frontal carinae divergent posteriorly……. *P. polymorphicus* sp. n.
2. Scapes easily surpass the posterior margin of head …..……..……..…….…….....3
— Scapes never surpass the posterior margin of head …..…….....…..*P. diversus* sp. n.
3. Mandibles armed with 8 teeth……*P. familiaris* (Smith, F., 1860)
— Mandibles armed with 6 teeth.....*P. machhediensis* Bharti *et al.,* 2012

Discussion

At times the distinction of castes among worker specimens is difficult to make. LaPolla (2004) defines, "the major as an individual worker that possesses a much wider head proportionate to the mesosoma than is otherwise observed in minor workers". In this study, with regards to shape *P. diversus* sp. n. major and minor workers can be easily differentiated from media workers by squarer head, whilst media workers distinctly have rectangular head, but in *P. polymorphicus* sp. n. minor and media workers have squarer head in comparison to rectangular head in major workers. Most of the body parts are isometric but a few are always allometric in both species i.e., they increase or decrease in relative size as total body is enlarged. Head grows wider, and the antennae become relatively shorter in major workers, whereas pronotal width etc are isometric with regard to most of the remaining body. The conclusion renders us safe to define in relativity major as worker with widest head and shortest scapes; minor as worker with narrowest head and longest scapes while media as intermediate between them.

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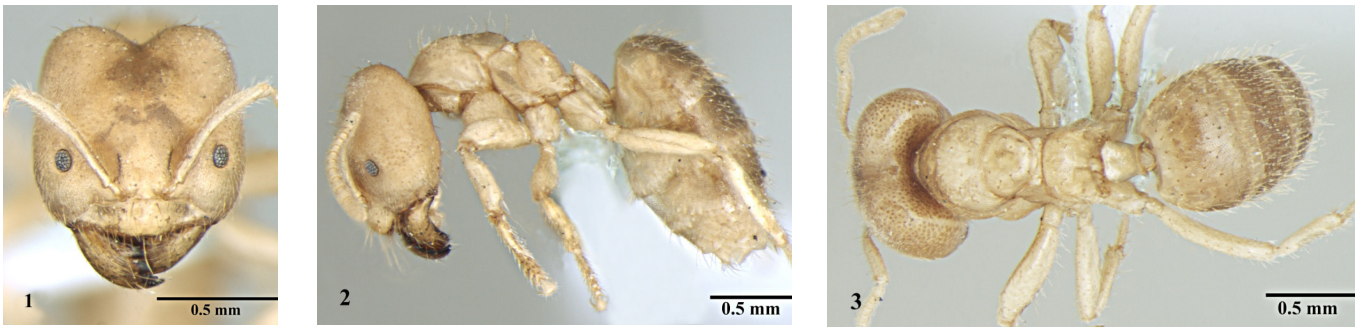

Fig. 1-3. *Pseudolasius diversus* sp. n**.,** major worker 1) head, full face view; 2) Body, lateral view; 3) body, dorsal view.

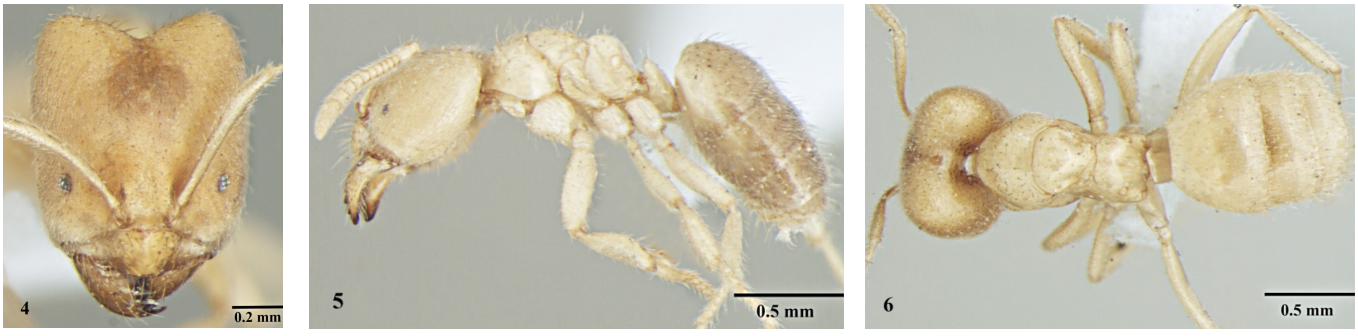

Fig. 4-6. *Pseudolasius diversus* sp. n**.**, media worker 4) head, full face view; 5) body lateral view; 6) body, dorsal view.

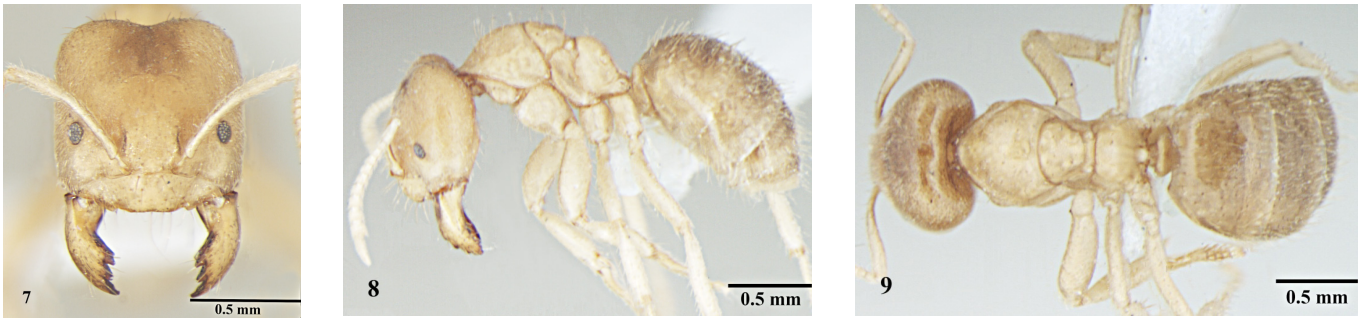

Fig. 7-9. *Pseudolasius diversus* sp. n**.,** minor worker 7) head, full face view; 8) body, lateral view; 9) Body, dorsal view.

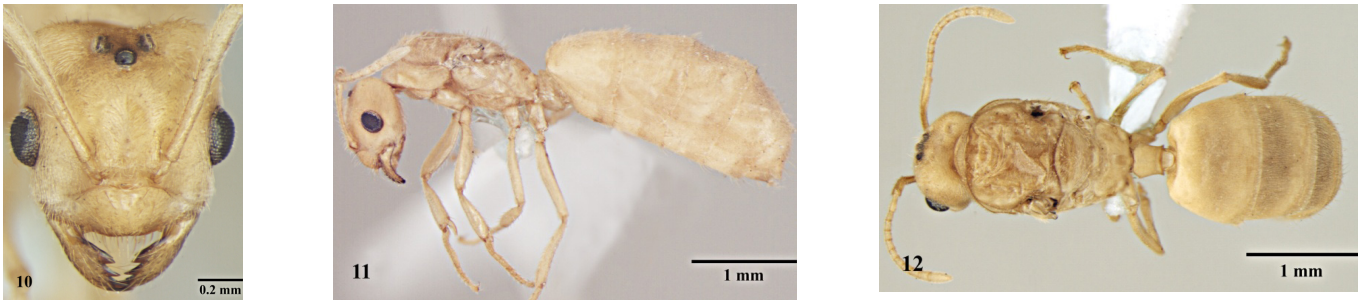

Fig. 10-12. *Pseudolasius diversus* sp. n**.,** gyne 10) head, full face view; 11) body, lateral view; 12) body, dorsal view.

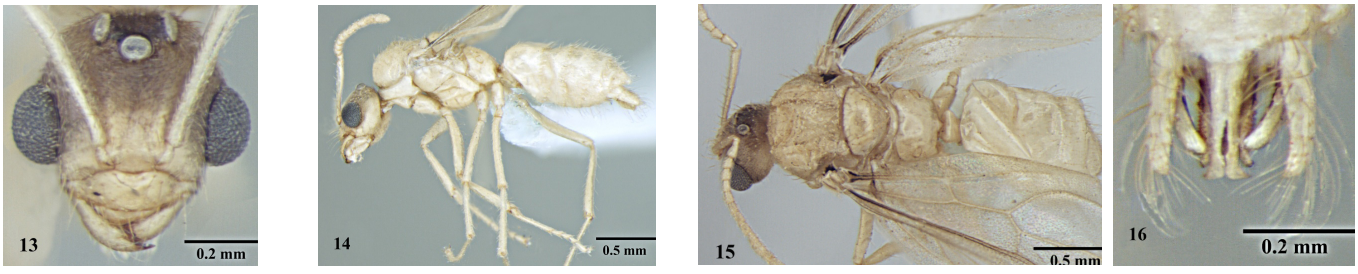

Fig. 13-16. *Pseudolasius diversus* sp. n**.,** male 13) head, full face view; 14) body, lateral view; 15) body, dorsal view; 16) genetalia, dorsal view.

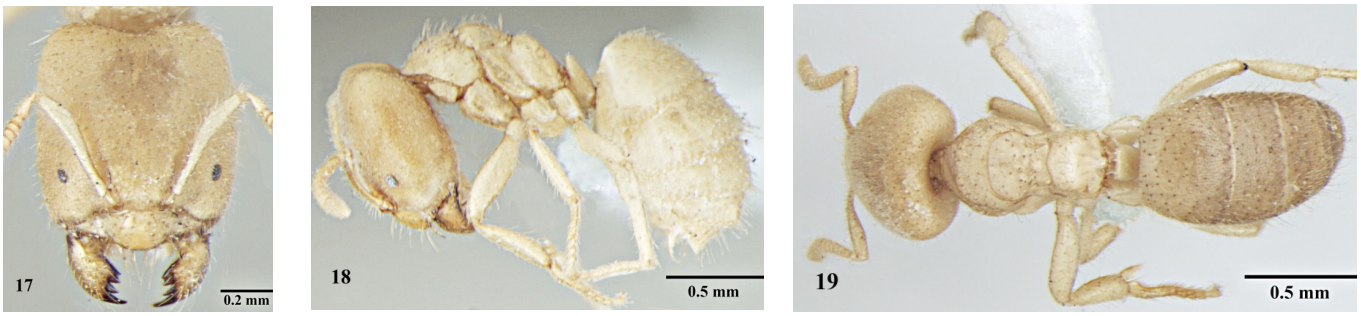

Fig. 17-19. *Pseudolasius polymorphicus* sp. n**.,** major worker 17) head, full face view; 18) body, lateral view; 19) body, dorsal view.

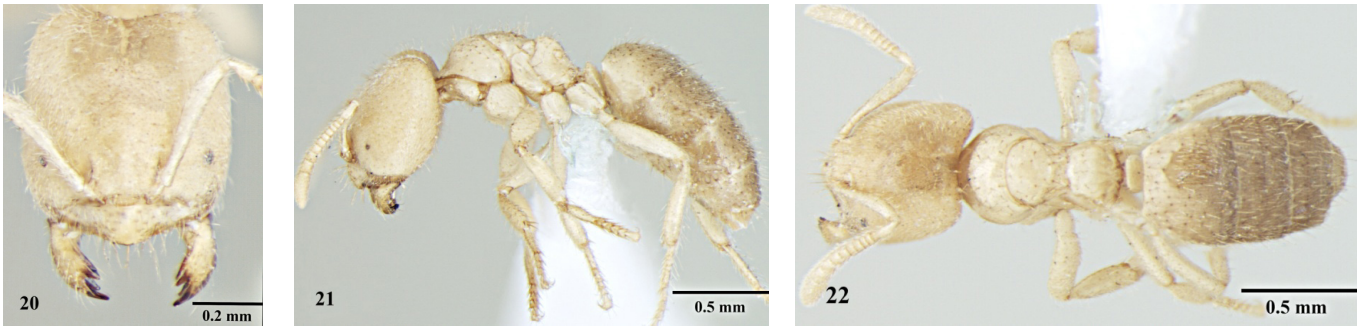

Fig. 20-22. *Pseudolasius polymorphicus* sp. n**.**, media worker 20) head, full face view; 21) body lateral view; 22) body, dorsal view.

Fig. 23-25. *Pseudolasius polymorphicus* sp. n**.,** minor worker 23) head, full face view; 23) body, lateral view; 25) body, dorsal view.

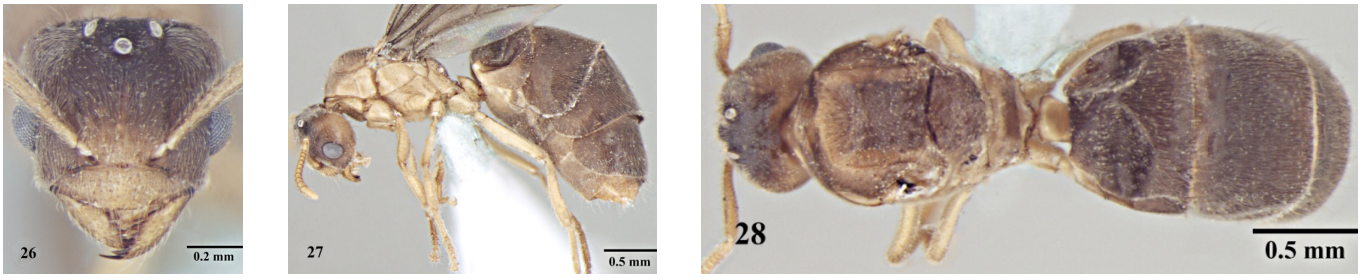

Fig. 26-28. *Pseudolasius polymorphicus* sp. n**.,** gyne 26) head, full face view; 27) body, lateral view; 28) body, dorsal view.

Fig. 29-32. *Pseudolasius polymorphicus* sp. n**.,** male 29) head, full face view; 30) body, lateral view; 31) body, dorsal view; 32) genetalia, dorsal view.