Zootaxa 4985 (3): 403–413
https://www.mapress.com/j/zt/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

https://doi.org/10.11646/zootaxa.4985.3.7
http://zoobank.org/urn:lsid:zoobank.org:pub:2BDD3B3F-9A50-45FF-BE75-0082571F756F

First record of the myrmicine ant genus *Syllophopsis* Santschi, 1915 (Hymenoptera: Formicidae) from India with description of a new species

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Abstract

Here we describe and illustrate *Syllophopsis peetersi* **sp. nov.** from Silent Valley National Park, a biodiversity hotspot region of the Western Ghats of India. The discovery also marks a first native report of the genus from the Indian subcontinent. Scanning Electron Microscopy (SEM) analysis was carried out to elucidate the general morphology and sensilla of the new species. The new species is similar to congeners from Madagascar, but with larger differences from species that occur elsewhere.

Key words: *Syllophopsis*, ants, new species, worker caste, Western Ghats, India

Introduction

The myrmicine ant genus *Syllophopsis* was established by Santschi (1915) for the species *Syllophopsis modesta* (Santschi, 1914). Bolton (1987) synonymized the genus *Syllophopsis* under *Monomorium* Mayr, 1855. Although monophyly of the genus was weakly supported, Ward *et al.* (2015) resurrected *Syllophopsis* as a valid genus. In the same paper the genus *Monomorium* was split into other valid genera including *Epelysidris*, *Erromyrma*, and *Trichomyrmex*. It remains highly suggestive that the genus *Monomorium* is still paraphyletic with embedded genus-level taxa and probably will see further changes with time (Heterick 2006; Ward *et al.* 2015; Sharaf *et al*. 2020, 2021). Most of the taxonomic research that involves *Syllophopsis* species was conducted on what were thought to be *Monomorium* species, e.g. Bolton's (1987) description of ten *Syllophopsis* species and Heterick's (2001, 2006) revision of the *Monomorium* of Australia and the Malagasy region. The *hildebrandti* group, as created by Heterick (2006), are all *Syllophopsis* species. Recent studies on the genus include those of Sharaf (2007), Sharaf & Aldawood (2013), Aldawood (2016) and Wetterer (2020). The genus currently includes 22 valid species globally (AntWeb 2021), out of which 17 species are reported from the greater Afrotropical region (Wetterer 2020). *Syllophopsis sechellensis* is the only known widespread species of the genus, reported across Afrotropics, Indomalaya, Australasia, Oceania, Palearctic, and Neotropic regions (Wetterer & Sharaf 2017).

The genus *Syllophopsis* has no strong diagnosis, and the members are very similar in appearance to members of the genus *Monomorium*. Some of the distinguishing characters among the two genera are: anteromedian seta on the clypeus situated under a protruding ledge, compared to the seta being on or just above the anterior margin in *Monomorium*; mandibles five-toothed, compared to more often three- or four-toothed in *Monomorium*; the propodeum is strongly angulate, compared to more often rounded or smoothly angulate in *Monomorium* (however, strongly angulate in some African *Monomorium* species). Species belonging to the genus *Solenopsis* also resemble *Syllophopsis*, but can be differentiated by a 2-segmented terminal antennal club compared with 3-segmented antennal

Accepted by J. Longino: 21 May 2021; published: 15 Jun. 2021

club in *Syllophopsis*. The generic diagnosis of the genus *Syllophopsis*, as provided in Bolton (1987) and Aldawood (2016) and slightly modified here, is: monomorphic; body mostly smooth and shiny (except for *S. aureorugosa* and *S. infusca*); unsculptured, strongly oblique 4–5 toothed mandibles (striate only in *S. peetersi* sp. nov.); antennae 12-segmented, terminating with a 3-segmented club; median clypeal portion distinctly longitudinally bicarinate, projecting anteriorly as a pair of blunt teeth; eyes tiny with few ommatidia in the longest row (except for Madagascar species); promesonotal suture absent; metanotal groove mostly impressed with distinct cross-ribs; propodeal dorsum smoothly rounded to strongly angulate; petiole pedunculate, with a high and rounded node; postpetiole node smaller and lower than petiolar node in profile; body pilosity variable but always distinct.

Here we describe a new *Syllophopsis* species from the Western Ghats of India. This is the first record of a native species of the genus from the Indian subcontinent and the 23rd species to be described globally. Way & Bolton (1997) recorded *S. australica* (Forel, 1907) in coconut plantations in Sri Lanka (as *Monomorium talpa* Emery, 1911, a junior synonym of *S. australica* (Forel, 1907)), where it is likely exotic and may not be permanently established (Dias *et al.* 2020). With the present discovery, the occurrence of native *Syllophopsis* is confirmed for the Indian subcontinent, a region coincident with the Indian subregion. *i.e.*, the area south of the Himalayas bounded by Afghanistan, Burma, and the Chagos archipelago (Wachkoo *et al.* 2019).

Materials and methods

Taxonomic analysis was conducted using a Nikon SMZ 1500 stereo zoom microscope with a MP evolution digital camera. Digital stacked images were processed using Auto-Montage (Syncroscopy, Division of Synoptics, Ltd.) software and Adobe Photoshop CS6. The global distribution map for the genus *Syllophopsis* was prepared by plotting representative country coordinates (accessed from https://www.antweb.org.) in Google maps (Fig 1). Terminology, measurements and indices follow Aldawood (2006), Heterick (2006) and Keller (2011) and are:

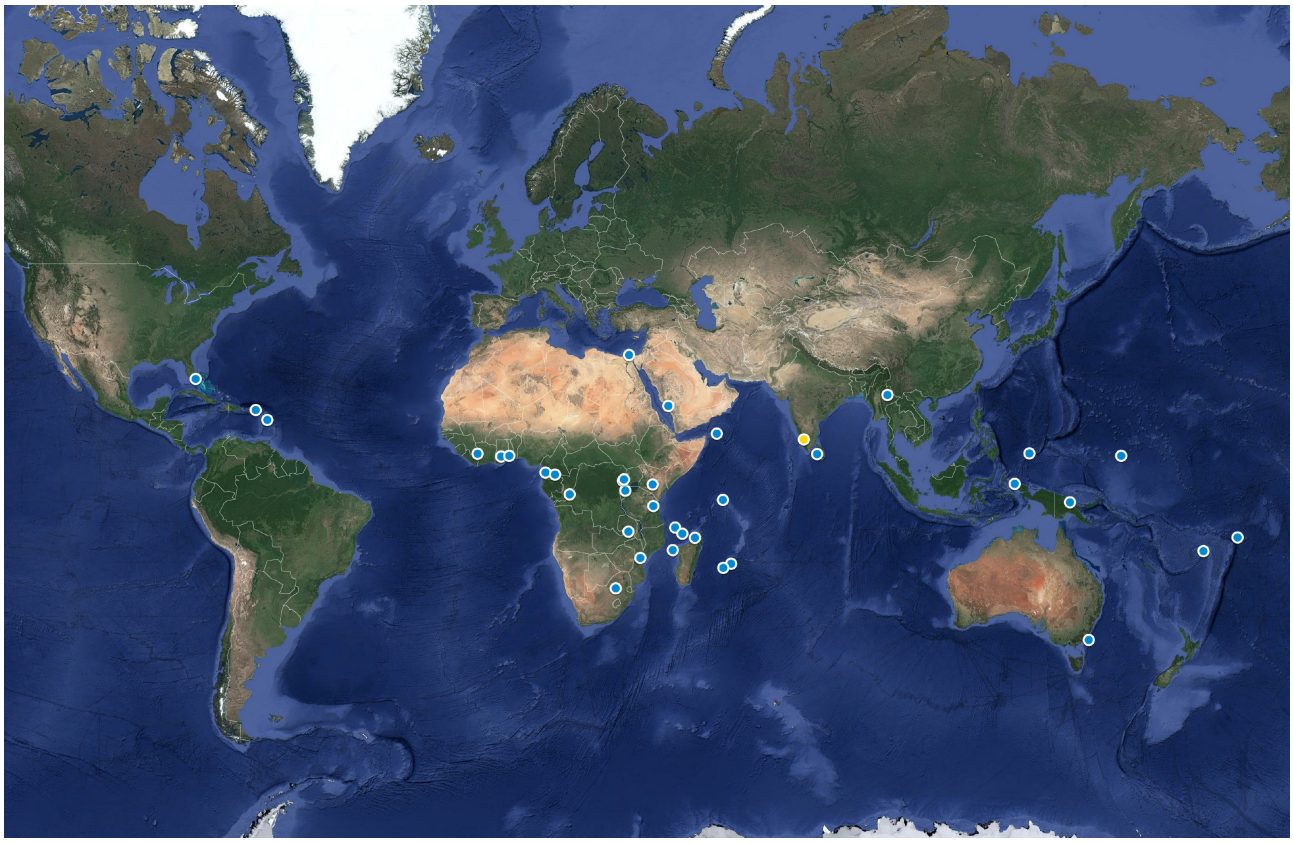

FIGURE 1. Global distribution map of the extant valid species of the genus *Syllophopsis* (blue circles for known country records, yellow for India).

EL: Eye Length (maximum diameter of eye).
HL: Head Length (maximum length of head from anterior clypeal margin to posterior margin of head).
HW: Head Width (maximum width of head behind eyes in full face view).
ML: Mesosoma Length (maximum length of mesosoma from the point where the pronotum meets the cervical shield to the posterior edge of the propodeal lobes in lateral view).
PL: Petiole Length (maximum length of petiole from anterior margin to posterior margin in dorsal view).
PPL: Postpetiole Length (maximum length of postpetiole in dorsal view).
PPW: Postpetiole Width (maximum width of postpetiole in dorsal view).
PH: Maximum height of petiole in lateral view.
PPH: Maximum height of postpetiole in lateral view.
PRW: Pronotal Width (maximum width of pronotum in dorsal view).
PW: Petiole Width (maximum width of petiole in dorsal view).
SL: Scape Length (maximum length of scape excluding basal neck).

Indices:

CI: Cephalic Index (HW/HL × 100).
SI: Scape Index (SL/HW × 100).

Specimens for SEM analyses were preserved in 70% ethanol for several days. From ethanol, the specimens were transferred into 6% phosphotungstic acid (PTA) solution in 70% ethanol for 24 hours. Dehydration was provided by ethanol series of 80, 90, 96% and two changes of absolute ethanol for 10 minutes each. Some of the dehydrated specimens were treated with chloroform for 24 h. Dehydrated and cleaned specimens were dried using the Leica EM CPD 300 auto critical point dryer (Leica Microsystems, Vienna, Austria). Dry samples were mounted on aluminium stubs with double-sided adhesive carbon tape and sputter-coated with 30 nm layer of chromium in a Quorum 150 T ES Plus sputter coater (Quorum Technologies Ltd, Laughton, East Sussex, UK). The specimens were imaged by the Hitachi SU8010 field emission scanning electron microscope FESEM (Hitachi High-Technologies Corporation, Tokyo, Japan) at 5 and 7 kV accelerating voltage with a secondary electron detector (ESD) in the SEM laboratory of the Institute of Biology, Biotechnology and Environmental Protection, University of Silesia in Katowice (Katowice, Poland).

The collected material is deposited in the following collections:

NHMUK Natural History Museum, London, United Kingdom.
NMNH National Museum of Natural History, Smithsonian Institution, Washington, USA.
PSAA Private collection, Shahid Ali Akbar, Srinagar, India.
PUAC Punjabi University Patiala, Ant Collection, Punjab, India.
USKP University of Silesia Katowice, Poland.

Taxonomy

Syllophopsis peetersi sp. nov.

(Figures 2–6)

Types. Holotype worker: India, Kerala, Silent Valley National Park, 11.0939N, 76.4462E, Kerala, India, 900 m.a.s.l., 25.ix.2011, Winkler extraction method, leg. S.A. Akbar (unique specimen identifier PUAC5001). Paratypes: 6 workers with same data as holotype (PUAC5002–PUAC5007). Additional material examined: 14 workers, Silent Valley National park near Badriya Juma Masjid, Mukkali, 11.0618N, 76.5390E, Kerala, India, 700 m.a.s.l., 20.xii.2016, Winkler extraction method; 8 workers (PSAA0001–PSAA0008); 2 workers (PSAA0009–PSAA0010 for molecular analysis, NMNH); 2 workers (PSAA00011–PSAA0012 for SEM studies, USKP); 2 workers, same data except: 21.xii.2016 (PSAA00013–PSAA0014 NHMUK), leg. S.A. Akbar.

Worker measurements (n=11; range with holotype in brackets): EL 0.11–0.13 (0.11), HL 0.68–0.73 (0.71), HW 0.58–0.61 (0.60), SL 0.50–0.52 (0.51), ML 0.65–0.77 (0.74), PRW 0.51–0.53 (0.52), PL 0.25–0.27 (0.26), PPL 0.22–0.24 (0.23), PPW 0.24–0.26 (0.25), PW 0.25–0.28 (0.27), PH 0.28–0.29 (0.29), PPH 0.25–0.26 (0.26) mm. Indices: CI 83–85 (84), SI 82–86 (85).

Worker Description. Head longer than wide (CI 83–85); vertex planar to slightly concave; frons shining and smooth with sparse piliferous pits and a few striolae around antennal sockets; frons with incurved and semierect setae (Figs 2a, 3a–b). Eye distinct, well developed, consisting of more than 9 ommatidia, eye width 1–2× greatest width of antennal scape, eyes set about midpoint of head capsule, more-or-less circular with curvature of inner eye margin slightly more pronounced than that of its outer margin, ommatidia of compound eyes are loosely and regular deployed having few curved sensilla in-between (Figs 3c–d). The frontal lobes are well-separated and the anteromedian seta is situated well under a protrusive ledge (Fig 3e). Clypeal carinae weakly defined with anteromedian clypeal margin narrowly convex between weakly ridged clypeal carinae; paraclypeal setae moderately long and fine, curved; posteromedian clypeal margin ending slightly anterior to antennal fossae. Mandibles with 4–5 teeth and one denticle (on second basal tooth); mandibles linear-triangular with few piliferous pits and distinctly striate; masticatory margin of mandibles strongly oblique (Figs 3f–g); anterior tentorial pit is situated far away from the antennal sockets (Fig 3h). The torulus appears as circular sclerites with a well marked torular lobe; placed within is antennal bulbus having series of sensilla trichodea (Figs 3i–m). Antennae consist of 12 segments with a 3-segmented distinct club; scape, pedicel and flagellum are well separable (Fig 4a). Compared with the rest of the antennal segments, the scape consists of fewer but longer pilosity (Figs 4b–c). Pedicel and rest of the antennal segments mainly consist of curved sensilla trichodea, with some of them having grooved surfaces (Figs 4d–i). The apical antennal segments which form the club also have few sensilla trichodea curvata (tc) along lateral sides (Figs 4j–k). Most of the sensilla are concentrated along the apical flagellomere (Fig 4l). The terminal flagellomere has a dense covering of sensilla trichodea curvata (tc), few sensilla basiconica (b) and some sensilla trichodea (t) (Figs 4m–p). Most of the basiconica and sensilla trichodea appear paired (Fig 4o). On the tip of terminal flagellomere there are also few small pores in the cuticle representing the openings of the sensilla ampullacea (a) and sensilla coeloconica (c) (Figs 4p–q). The very tip of the flagellomere is characterised by very granulated or porous surface (Fig 4r). The general surface of head consists of regularly placed sensilla trichodea throughout with gena mostly devoid of any distinct pilosity (Figs 4s–t). The sensilla are strongly curved at the base and their sockets are quite tight (Fig. 4u). Head cuticle is more or less ribbed (Figs 4v–w). Pilosity near tentorial pits consists of short curved hairs (Fig 4x).

Mesosomal outline in profile broadly convex and smoothly rounded, promesonotum slightly raised compared to propodeum (Figs 2b–c, 5a–b). Metanotal groove strongly impressed, with distinct transverse costulae (Figs 5c–d). Mesosoma shining and smooth with faintly striolate mesopleuron posteriad. Promesonotal setae a mixture of incurved, semierect setae, slightly shorter decumbent setae, and sparse appressed setulae. Propodeum with dorsum longer than the posterior (declivitous) face; mostly smooth and shining with dorsum having few weak striolae; propodeum with erect to decumbent setae along dorsum and entire declivitous face; propodeal spiracle nearer to declivitous face of propodeum than metanotal groove; vestibule of propodeal spiracle distinct; propodeal lobes present as rounded flanges, metapleural gland with a distinct circular opening (Figs 5e–g). Petiolar node cuboidal, shining and smooth throughout without any ventral rugae on the petiolar peduncle; petiolar spiracle situated anteriad of petiolar node (Fig 5h); postpetiole shining and smooth; postpetiolar sternite depressed, anterior carina inconspicuous (Fig 5i). Four distinct gastral tergites with sharp pointed sting; the terminal gastral segment has a circular stigma opening (Figs 5j–m); gastral tergites, with a mixture of incurved, semierect setae and slightly shorter decumbent setae.

The legs with strongly swollen femur and a stout tibia, calcar, basitarsus, five tarsomeres and sharply pointed claws (Fig 6a). The surface of leg shows presence of scattered sensilla trichodea (t). The protibial spur of forelegs (calcar of strigil) appears distinct with grooved squamiform and spatulate setae (Figs 6b–j). Claws with long setae and arolium between the pointed claws in all the legs (Figs 6k–m). The tarsomeres also have a dense covering of long sensilla trichodea (Figs 6n–o).

Color yellowish to very light brown.

Distribution. Western Ghats, India.

Ecology. The specimens were collected by Winkler sampling carried out at Silent Valley National Park, a primary tropical rainforest in Kerala. Located in the Nilgiri hills of Western Ghats of India, the park represents one of the last undisturbed tracts of tropical moist evergreen forest in India (2d). The region has a mean annual rainfall of 6,066 mm and a mean annual temperature of 20.2°C. The litter samples were taken from thick leaf litter and

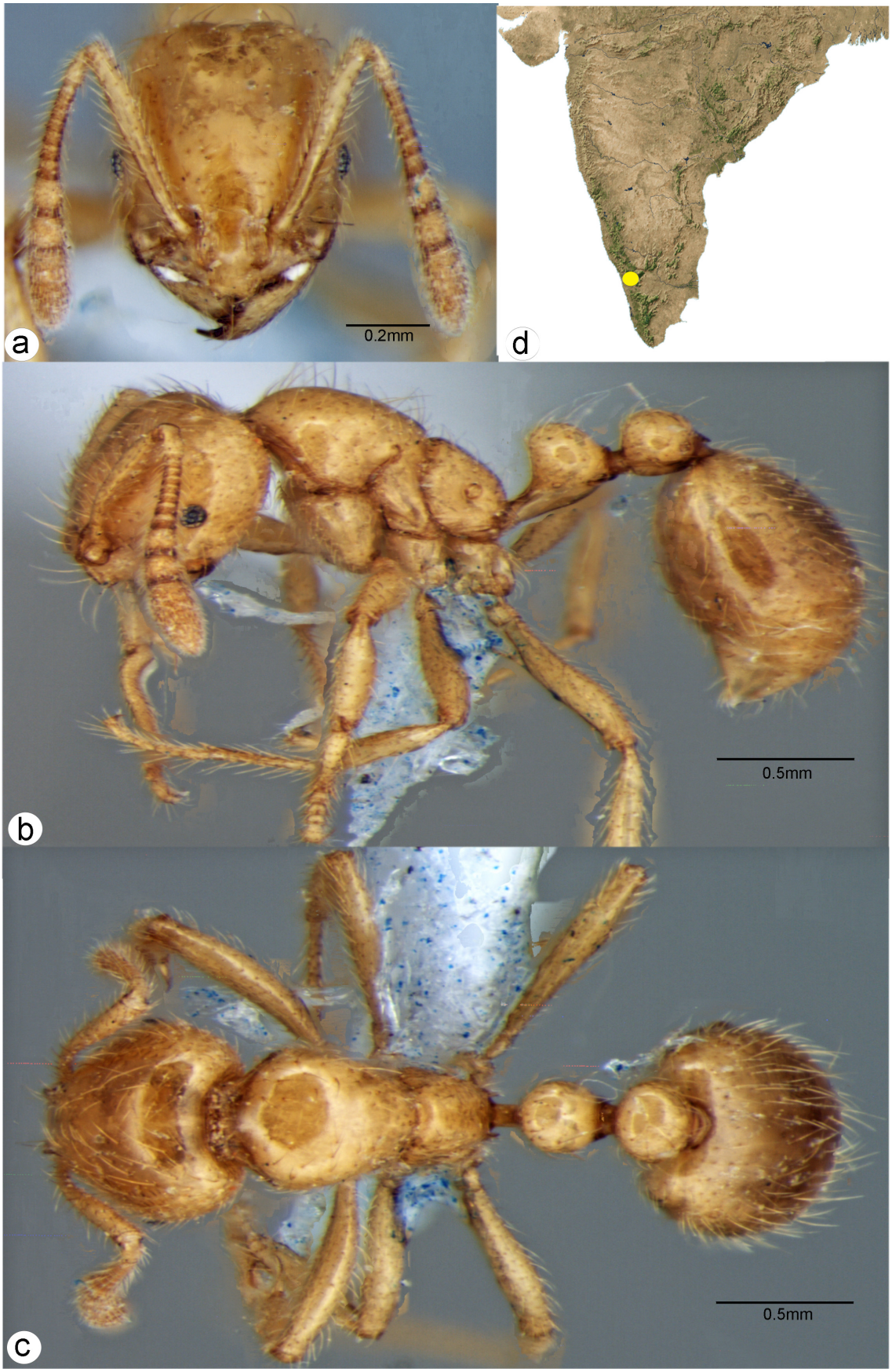

FIGURE 2. *Syllophopsis peetersi* **sp. nov.** Holotype worker. (**a**) Head, full-face view; (**b**) Body, lateral view; (**c**) Body, dorsal view; (**d**) Type locality of new species.

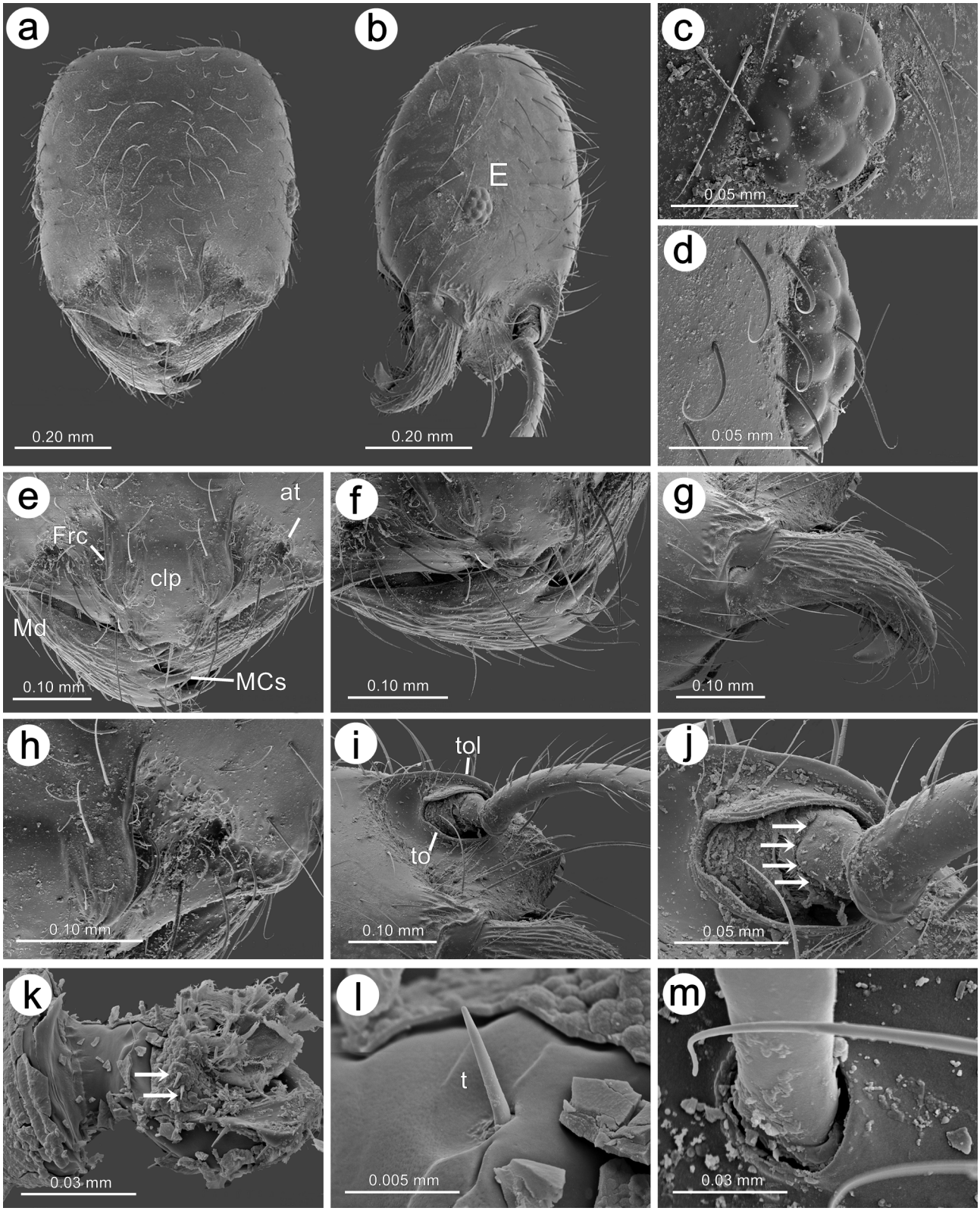

FIGURE 3. SEM of *Syllophopsis peetersi* **sp. nov.** (worker), Head. (**a**) full face-view; (**b**) lateral-view, eye (E); (**c**) eyes with 9-ommatidia; (**d**) curved sensilla in-between eye ommatidia; (**e**) median clypeus with two teeth, anteromedian seta (MCS), anterior tentorial pit (at), frontal carina (Frc), clypeus (Clp), mandible (Md); (**f–g**) sculptured mandibles with 4-teeth and one denticle on second basal tooth; (**h**) anterior tentorial pit, enlarged; (**i**) antennal basal socket, torulus (to), torular lobe (tol); (**j–k**) enlarged basal socket with antennal bulbus having series of sensilla trichodea; (**l–m**) enlarged sensilla trichodea and its basal socket.

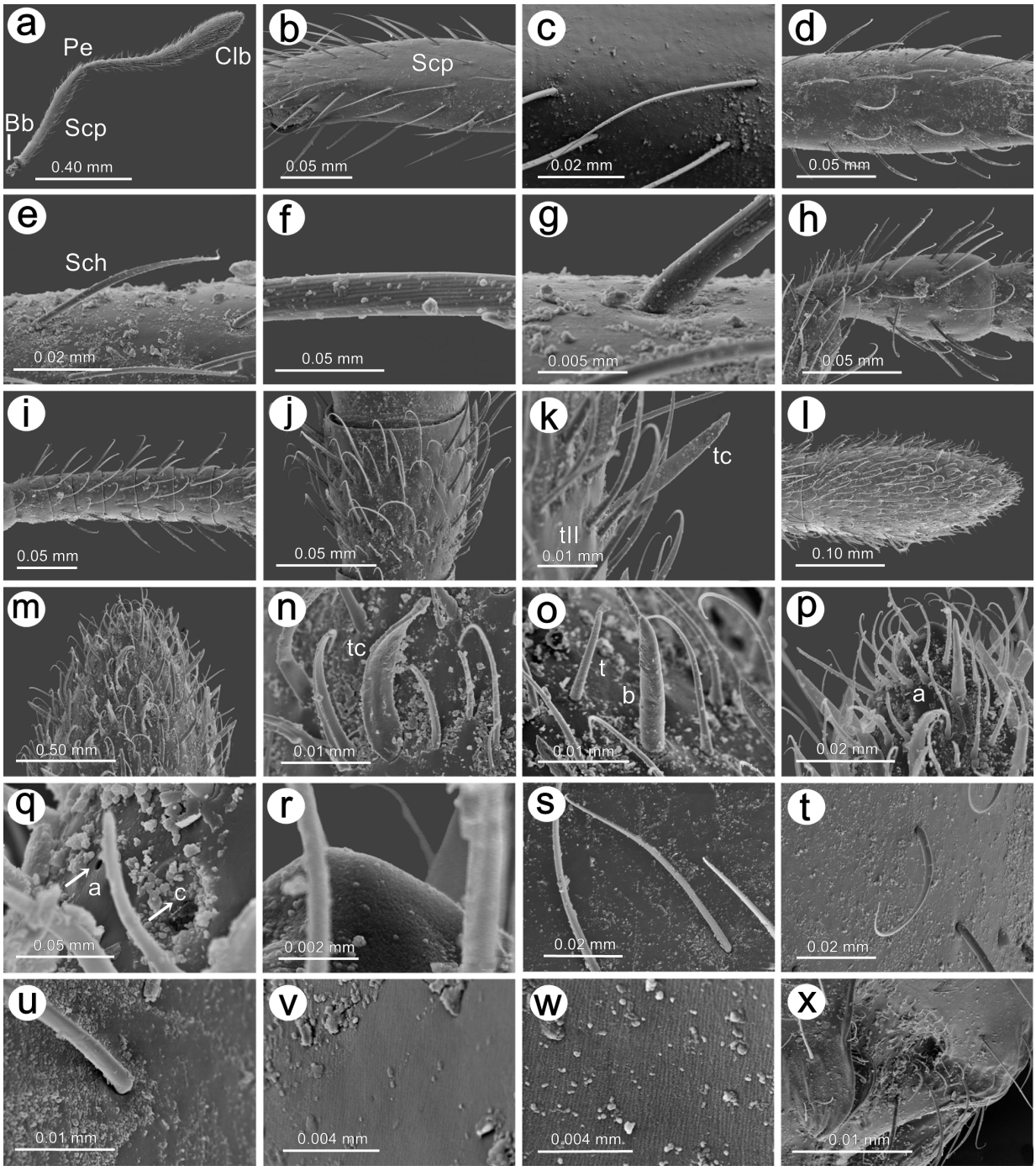

FIGURE 4. SEM of *Syllophopsis peetersi* **sp. nov.** Antenna. (**a**) bulbus (Bb), scape (Scp), pedicel (pe), 3-segmented antennal club (Clb); (**b–c**) scape (Scp) with long sensilla chaetica (Sch); (**d–g**) few curved sensilla trichodea with some of them having grooved surfaces; (**h–j**) pedicel and other flagellomere mostly with sensilla trichodea; (**k**) sensilla trichodea curvata (tc) and sensilla trichodea II (tII) of apical antennal segment; (**l–m**) dense sensilla concentration on terminal flagellomere; (**n–r**) sensilla trichodea curvata (tc), sensilla basiconica (b) sensilla trichodea (t), sensilla trichodea II (tII), sensilla ampullacea (a) and sensilla coeloconica (c); (**n**) sensilla trichodea curvata (tc); (**o**) basiconica and sensilla trichodea mostly occur as paired; (**p–q**) small pores of sensilla ampullacea (a) and sensilla coeloconica (c); (**r**) granulated or porous surface of terminal antennal segment**;** (**s–t**) head surface with sensilla trichodea and sclerotic microtrichia; (**u**) fine structure of the sensillum trichodea basal part; (**v–w**) general cuticle surface; (**x**) short curved hairs of tentorial pits.

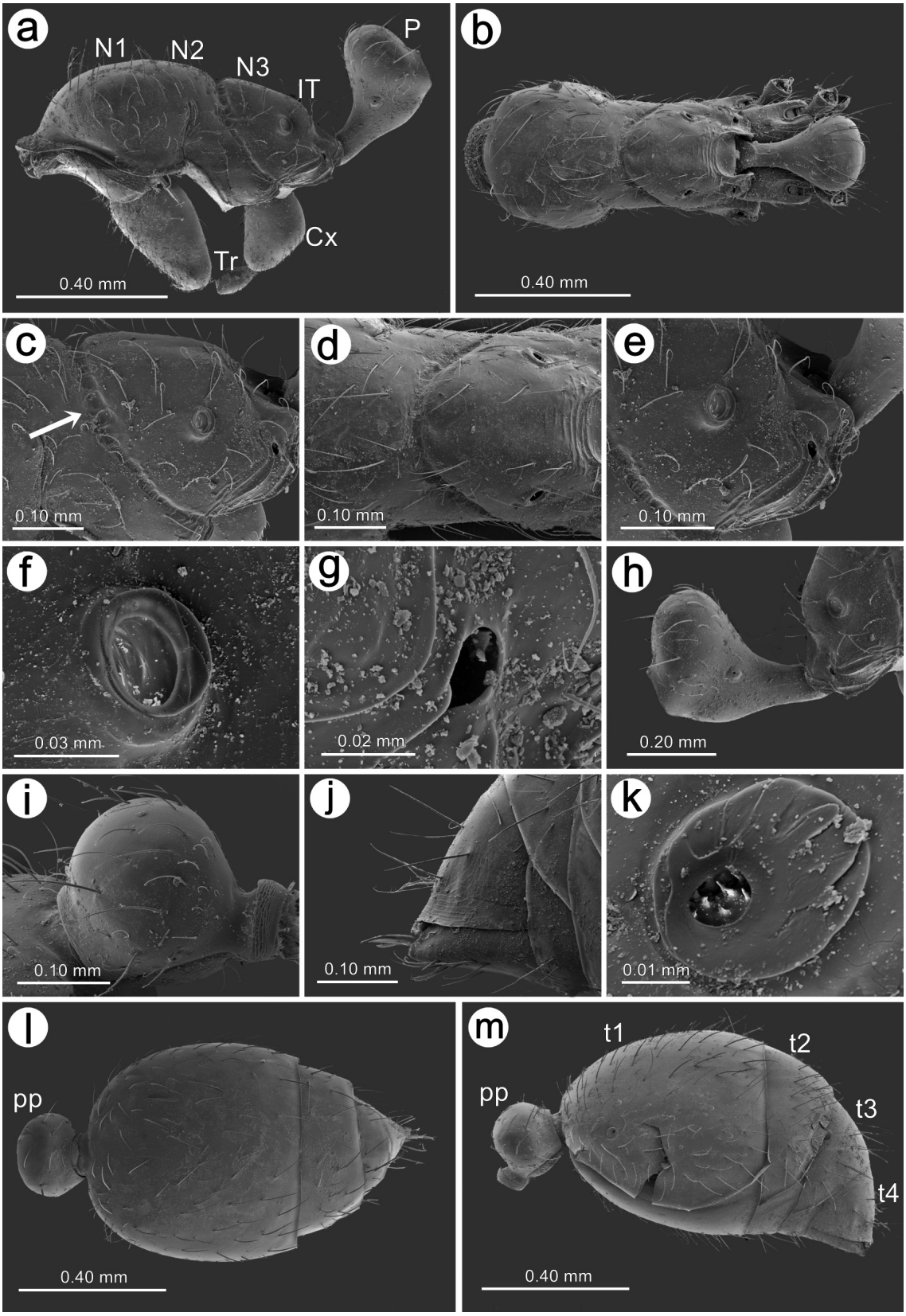

FIGURE 5. SEM of *Syllophopsis peetersi* **sp. nov.** meso- and metasoma. (**a**) Lateral view of mesosoma with, pronotum (NI), mesonotum (N2), metanotum (N3), propodeum (IT), petiole (P), coxa (Cx), and trochanter (Tr); (**b**) dorsal view of mesosoma; (**c–d**) striolate metanotal groove; (**e–g**) propodeal spiracle and metapleural gland opening; (**f**) propodeal spiracle (enlarged); (**g**) metapleural gland opening (enlarged); (**h–i**) petiole and postpetiole; (**j**) gastral tergites and sting; (**k**) terminal gastral segment opening; (**l–m**) dorsal and lateral view of metasoma, postpetiole (PP), first to fourth tergite (t1–t4).

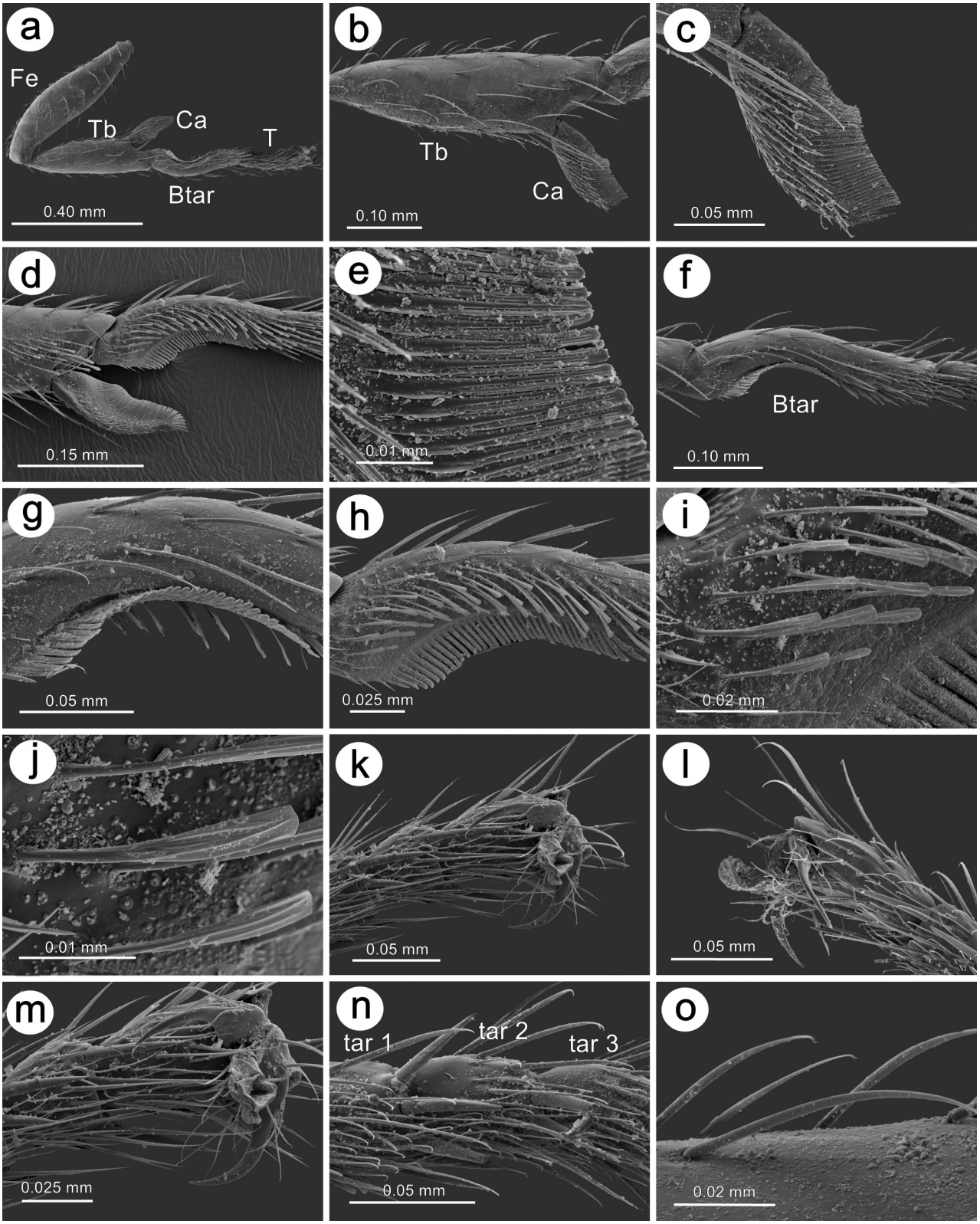

FIGURE 6. SEM of *Syllophopsis peetersi* **sp. nov.** Legs. (**a**) femur (Fe), tibia (Tb), calcar of strigil (Ca), basitarsus (Btar), tarsus (T); (**b**–**c**) tibia (Tb), calcar (Ca); (**d**–**e**) calcar enlarged surface with groves; (**f**) basitarsus (Btar); (**g**–**j**) enlarged basitarsus with notch and modified spatulate setae; (**k**–**m**) claws with arolium and long curved setae; (**n**–**o**) tarsomere (tar 1–tar 3) with stout sensilla trichodea.

moisture laden soil near tree trunks, from two sites along the banks of the river Kunthi (Kunthipuzha). One site was in the buffer zone (Mukkali) and one in the core region (Sairandhri). The Sairandhri region forms the gateway of Silent Valley. The type locality of the new species is known for its ancient history and relict ant taxa (Bharti & Akbar 2013a, b, c, 2015; Dad *et al.* 2019).

The majority of the species in the genus have been collected via Winkler sampling, inhabiting leaf litter from the tropical rainforests (AntWeb 2021), and same holds true for the new species described here. The species appears rare, with a restricted distribution. However, it is quite possible that the species occurs elsewhere in southern India and Sri Lanka, in areas with similar habitat.

Etymology. The species epithet honours the late Professor Christian Peeters and is a masculine genitive noun. The name 'Peeters' is derived from the Greek root word Petrus ('rock' or 'stone') which also appropriately symbolises the foundational stature of Prof. Christian Peeters' work in the study of ants.

Discussion

The genus *Syllophopsis* was reinstated in Ward *et al.* (2015) for the members of the *Monomorium hildebrandti*-group. Molecular data weakly supported monophyly, but distinctive morphological features further supported monophyly. The new species also exhibits the usual features of *Syllophopsis*. The placement within *Syllophopsis*is is also supported by preliminary results obtained with phylogenomic data (Ultraconserved Elements, UCEs) (Gotzek, pers comm.).

The new species is distinct from all congeners in having striate mandibles, a character shared with members of the closely related genus *Trichomyrmex*. The new species is quite similar in appearance to members of the radiation in Madagascar, but not to the species that occur elsewhere. The *Syllophopsis* that occur outside of Madagascar are more-or-less uniform in appearance. They are all characterized by a single faceted eye (more than five ommatidia in *S. peetersi*), a relatively narrower head and closely approximated frontal lobes (frontal lobes well-separated in *S. peetersi*). Most of the bulkier and larger-eyed species in Madagascar have ventral rugae on the petiolar peduncle, but these are lacking in *S. peetersi*. The new species is somewhat similar to *S. hildebrandti* (Forel, 1892). The two species can be differentiated based on following characters. In *S. peetersi* the eyes consist of more than five ommatidia, there is dense body pilosity, the metanotal groove is strongly impressed and in profile view the promesonotum is higher than the propodeum. In contrast, *S. hildebrandti* has eyes consisting of a single ommatidium, the body pilosity is less distinct, the metanotal groove is indistinct and, in profile, the promesonotum forms a continuous arch that includes and is not raised above the propodeum. The *S. sechellensis* differs from the new species in smaller eyes, and the entire mesopleuron is matte and reticulate punctate. Likewise, *S. australica*, reported from Sri Lanka, has reduced eyes and closely approximated antennal insertions.

Acknowledgments

We are highly thankful to Ted Schultz and Dietrich Gotzek (Department of Entomology, National Museum of Natural History, Smithsonian Institution) for sharing preliminary results. We thank Brian Heterick (Western Australian Museum) and Benoit Guénard (Hong Kong University) for their valuable input. We are appreciative of AntWeb (https://www.antweb.org/) and Antmaps (http://antmaps.org) for their immensely useful work. The first author would like to thank various forest officials of Western Ghats division for their multifold help during the surveys carried out in this region. Sincere thanks are due to David Lubertazzi (Harvard University) for language editing and other helpful comments and suggestions about the manuscript. We would also like to thank the subject editor, John T. Longino and the reviewers Brian Fisher and Francisco Hita Garcia for immensely improving the manuscript.

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