



RESEARCH ARTICLE - ANTS

Taxonomy of *Temnothorax simlensis* stat. nov. (Hymenoptera: Formicidae) with first description of sexual castes along with a mention of its plesiobiotic association with Himalayan species of genus *Myrmica*

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urn:lsid:zoobank.org:pub:BCF46A5E-5031-471D-89E8-E0CD24889AF9

Article History

Edited by

Gilberto M. M. Santos, UEFS, Brazil

Received 22 July 2015

Initial acceptance 10 April 2016

Final acceptance 28 April 2016

Publication date 20 July 2016

Keywords

Temnothorax, Myrmicinae, Himalaya, plesiobiotic association, *Myrmica*.

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Abstract

The subspecies *Temnothorax rothneyi simlensis* (Forel) is raised to species rank as *Temnothorax simlensis* stat. nov. All three castes are recorded, with the queen and male castes described for the first time. This revision is based on the comparative data from morphometry, descriptions, digital images and distribution. In addition, we provide first-hand information about the plesiobiotic association of this species with Himalayan species of genus *Myrmica*. A revised key to the worker caste of known Indian species of *Temnothorax* is also provided.

Introduction

The genus *Temnothorax* Mayr is represented globally by 388 extant species and 47 extant subspecies (Bolton, 2016). From India, 10 species and 2 subspecies have been reported so far (Bharti et al., 2016) and a comprehensive outline of the Indian *Temnothorax* was provided by Bharti et al. (2012) along with the description of three new species from Himalaya. *Temnothorax rothneyi simlensis* was described by Forel (1904) as a subspecies of *Temnothorax rothneyi* (Forel, 1902) based on the worker caste. The queen and male castes were unknown till date. Here *Temnothorax rothneyi simlensis* (Forel) is accorded species status, with reports of hitherto un-described queen and male caste. In addition, we provide first-hand information about the plesiobiotic association of this species with Himalayan species of genus *Myrmica*. A revised key to the worker caste of known Indian species of *Temnothorax* is also provided.

Materials and Methods

The specimens were collected by the handpicking method. Taxonomic analysis was carried on a Nikon SMZ 1500 stereo zoom microscope. For the digital images, a MP evolution digital camera was used on same microscope with subsequent use of Auto-Montage software (Syncroscopy, Division of Synoptics, Ltd.). Later, images were cleaned as per requirement with Adobe Photoshop CS5.

Abbreviations of the specimen depositories are:

MHNG - Museum of Natural History, Geneva, Switzerland
PUAC - Punjabi University Patiala Ant Collection, Patiala, India
 The figures of measurements have been given as proposed by Bharti (2012) and Matthew (2015). The taxonomic study of the species is supported by the digital images of each caste showing the specimen in three different views, i.e. Head in full face view, Body in lateral view (profile) and Body in dorsal view.



Morphological terminology for measurements and indices are given in millimeters and includes:

HL - Length of the head measured in full face view in a straight line from the middle of the anterior clypeal margin to the middle of the occipital margin. The head has to be carefully tilted to the position of the real maximum (Fig A).

HW - Maximum width of the head in full face view, behind the eyes (Fig A).

SL - Maximum straight-line length of the scape excluding the basal neck and the condyle (Fig B).

WL - (Weber's length) The length of mesosoma in profile, from the margin of neck shield to the posterior margin of propodeal lobes (Fig B).

PNW - Maximum width of the pronotum in dorsal view (Fig C).

PL - Maximum length of the petiole from above, in dorsal view (Fig C).

PPL - Maximum length of the postpetiole from above, in dorsal view (Fig C).

PH - Maximum height of the petiole in profile (Fig B).

GL - The length of the gaster in lateral view from the anterior most point of first gastral segment to the posterior most point (excluding sting if present) (Fig B).

PSL - Maximum length of the propodeal spine in profile (Fig B).

TL - The total outstretched length in profile from anterior clypeal margin to the posterior most point of gaster excluding sting.

Indices

Cephalic Index- $CI = HL/HW \times 100$

Scape Index - $SI_1 = SL/HL \times 100$

Scape Index - $SI_2 = SL/HW \times 100$

Spine-length Index - $PSLI = PSL/HW \times 100$

Results and discussion

Temnothorax simlensis stat. nov.

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(Figs 1-9)

Leptothorax rothneyi var. *simlensis* Forel, 1904: 22 (w.) India.

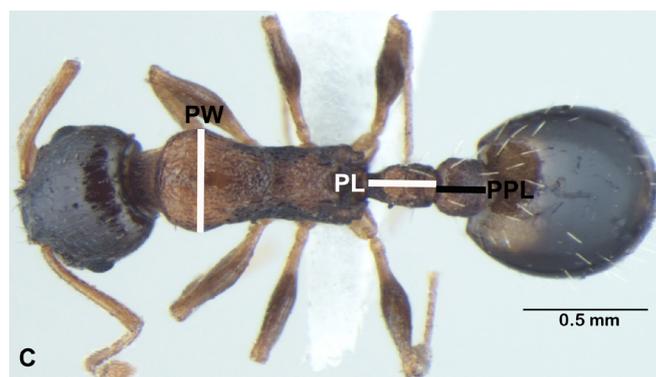
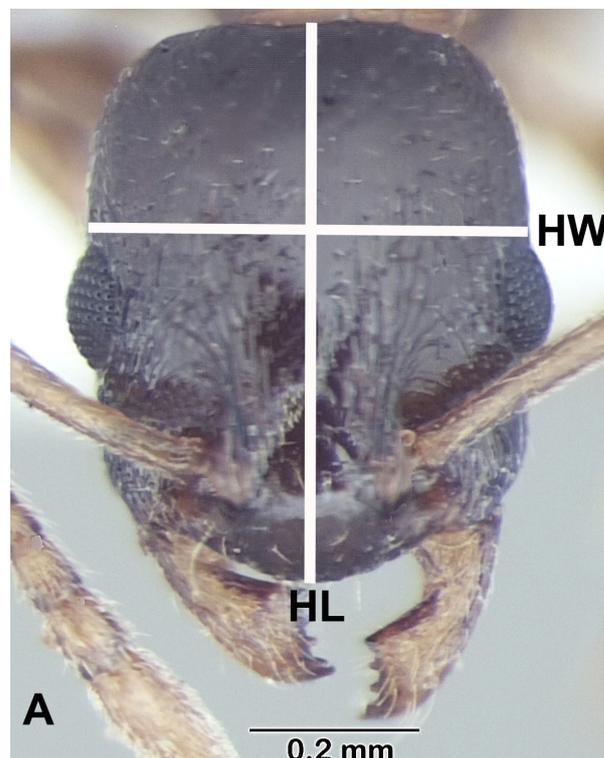
Diagnosis: The following character combination distinguishes the species from the other Indian *Temnothorax*:

The presence of small dentate (triangular) propodeal spines ($PSLI = 9-10$) is a distinctive character of this species; propodeal spines small, triangular in worker and queen and indistinct in male; absence of dense sculpture on head (distinct longitudinal rugae) and yellowish brown to brown colouration of the body.

Description

Worker: (Figs 1-3)

Measurements, HL 0.69-0.75; HW 0.55-0.59; SL 0.51-0.57; WL 0.74-0.80; PNW 0.41-0.47; PL 0.41-0.47; PPL



Figs A-C. Measurements of different body parts.

0.21-0.24; PH 0.17-0.21; GL 0.90-0.96; PSL 0.054-0.06; CI 125-130; SI_1 71-75; SI_2 93-98; $PSLI$ 9-10; TL 2.86-3.04. $n=9$

Head: Head subrectangular in full face view; posterior margin of head slightly convex; narrowly round posterolateral corners; lateral sides almost parallel; anterior clypeal margin broadly rounded; eyes situated about the middle on the sides of the head; mandibles triangular, the masticatory margin with 5 prominent teeth; antennae 12 segmented, scape short, barely reaching posterior margin of head.



Figs 1-3. Worker *Temnothorax simlensis* stat. nov.: 1- Head, full face view; 2- Body, lateral view; 3- Body, dorsal view

Mesosoma, petiole and postpetiole: Mesosoma with slightly convex dorsum anteriorly, posteriorly fairly straight; metanotal groove shallow but distinct; humeri in dorsal view rounded; propodeal spines short, dentate, as long as 1/4 the range of their bases; petiolar node longer than high with short anterior peduncle; petiolar node in profile with steep and very slightly concave anterior face and somewhat rounded, thicker dorsum; postpetiolar node as high as petiolar node, with the rounded dorsum and wider than petiolar node; gaster somewhat ovate, smooth and shiny.

Sculpture and pilosity: Head rugulose and reticulated except for the space in between frontal carinae up to posterior side of frons and the median clypeus which are smooth; mandibles with distinct rugosity; clypeus longitudinally rugose except for the median portion; Mesosoma rugulose and reticulated all over; petiolar and postpetiolar nodes finely

reticulated; head and Mesosoma punctulate; gaster smooth and shiny; suberect to erect hairs scattered over the whole body; decumbent pubescent hairs on antennae and legs, more dense on antennal funiculus.

Colour: The front of the mesosoma, mandibles, antennae, legs, petiole, postpetiole and anterior 1/5 of the gaster yellowish brown; rest of the body dark brown to black in colour; pilosity pale white.

Queen: (Figs 4-6)

Measurements, HL 0.79; HW 0.66; SL 0.56; WL 1.32; PNW 0.84; PL 0.42; PPL 0.29; PH 0.25; GL 1.62; PSL 0.054; CI 119; SI₁ 71; SI₂ 85; PSLI 8; TL 4.4. n=1.



Figs 4-6. Queen *Temnothorax simlensis* stat. nov.: 4- Head, full face view; 5- Body, lateral view; 6- Body, dorsal view.

Resembles the worker, with modifications expected for caste and with the following differences: Body massive, hairy; scattered longitudinal rugae covering the head except for the frons and antennal hollows which are smooth with a few indistinct rugulae; eyes large and bulging; three prominent ocelli positioned as making a triangle on frons; mesosomal dorsum weakly rugulose anteriorly, posteriorly smooth; rugulose on sides and around propodeal spines with some patches smooth on sides; propodeal spines dentate; petiolar, postpetiolar nodes dull due to weak sculpture on the nodes; hairs of varying lengths cover entire body; mesosoma without any constriction, very robust, with raised scutellum interrupting the regular convexity above; propodeal declivity very steep; petiolar node broadly round, postpetiolar node very broad; gaster long and gibbous; colour dark brown to black all over with a yellowish patch on anterior segment of gaster and on the middle of mesosoma; legs and antennae yellow except for the femori which are brown.

Male: (Figs 7-9)

Measurements, HL 0.53; HW 0.51; SL 0.20; WL 1.12; PNW 0.72; PL 0.28; PPL 0.26; PH 0.16; GL 1.15; PSL 0; CI 103; SI₁ 38; SI₂ 39; PSLI 0; TL 3.34. n=1

Head broadly oval and converging posterior to eyes in full face view; posterolateral corners rounded; eyes very large, bulging beyond head outline in full-face view; three prominent ocelli present on frons; antennae 13 segmented, filiform, scapes short, failing to reach the posterior margin of head; clypeus broadly rounded anteriorly; mandibles with 5 teeth; mesosoma enlarged to accommodate flight muscles; pronotum small; scutum smooth; scutellum raised, declivity steep; propodeal spines indistinct; petiolar node indistinct, very low, postpetiolar node, broad, low; gaster lengthened; colour black all over; antennae and legs yellowish brown; wings transparent with a creamish glare; body shiny, head with microreticulation; clypeus smooth with a few carinae; mandibles with indistinct rugosity; petiolar and postpetiolar nodes finely reticulated; mesosoma and gaster smooth and shiny.

Material examined: India: *Himachal Pradesh*: Kothi, 2600m, 9(w), 1(q), 1(m), 23.vi.2010 (collected by Irfan Gul), 5(w), 27.vi.2014, 4(w), 16.vi.2015 (collected by Sishal Sasi) in PUAC. Syntypes (MHNG): Shimla, casent 0909055- *T. rothneyi similensis*; Mussorie, casent 0909054- *T. rothneyi*.

Distribution: India (Himalaya).

Ecology: The nests of this species were located on a hill slope covered with grasses and stones, in a temperate forest, which comprises mostly of *Pinus* and *Cedrus* trees. The nests were small, usually 4 to 5 inches deep with low abundance of workers. The recorded nest temperature ranged from 14°C to 28°C and relative humidity from 42% to 91%. This species

has been observed to share a plesio-biotic association with two of the *Myrmica* species (*M. aimmonissabaudiae* and *M. cachmiriensis*) distributed in the region, where these different ant species nest very close to each other under the stones, but are not engaged in direct communication, unless their nest chambers are broken open, in which case fighting and brood capturing have been observed.

Remarks: Both *T. rothneyi* and *T. rothneyi similensis* have been found to be sympatric, and are endemic to Himalaya (see map). Additionally, based on morphometry and consistency of morphological characters (as outlined in the key) in workers & gyne, which distinguish the taxa under question, *T. rothneyi similensis* has been raised to species rank.



Figs 7-9. Male *Temnothorax similensis* stat. nov.: 7- Head, full face view; 8- Body, lateral view; 9- Body, dorsal view.



Figs 10-12. Worker *Temnothorax rothneyi* (Forel, 1902): 10-Head, full face view; 11- Body, lateral view; 12- Body, dorsal view.

A revised key to the known Indian species of *Temnothorax* based on worker caste (modified after Bharti et al., 2012)

1. Propodeum without any teeth or spines; pilosity very sparse; head and mesosoma shiny, very slightly longitudinally rugose, rest of the body smooth and shiny..... *T. inermis* (Forel)
- Propodeum with variously developed teeth or spines; pilosity more dense; head and mesosoma smooth or with different surface sculpture but never with only slightly longitudinally rugose sculpture.....2
2. Dorsal outline of mesosoma in profile without any impression, mesometanotal groove absent3
- Dorsal outline of mesosoma in profile more or less impressed at the mesometanotal groove or behind.....4
3. Mesosoma, the base of the first gastral segment, petiole, postpetiole, legs and antennae testaceous yellow to yellowish brown; head and rest of gaster brown; CI=122-124; SI₁=75-

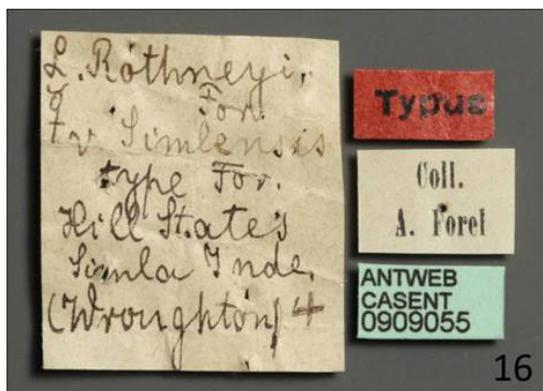
- 78.6; (length 2.2-2.9mm).....*T. desioi* (Menozzi)
- The color is uniformly brown; CI= 127-128; SI₁= 73-75; (length 2.4-3.0mm)*T. desioi melanicus* (Menozzi)
4. Either head and mesosoma distinctly sculptured or the head is smooth and mesosoma distinctly sculptured.....5
- Head and mesosoma smooth and shining with a few rugulae...10
5. Head smooth, mesosoma distinctly sculptured; the species is bicolored, with light to dark brown head and gaster and yellowish to reddish yellow mesosoma; (length 2.5-3.3mm)...
.....*T. kashmirensis* Bharti et al.
- Head and thorax distinctly sculptured; color combination different but never as in above6
6. Whole body black; head distinctly longitudinally rugose; PS LI= 18-23; CI= 117-123; SI₁= 72-73; SI₂= 85-90; (length 2.8-3.2mm).*T. schurri* (Forel)
- Whole body light yellow to dark brown, never black; head distinctly rugulose and microreticulated7
7. The color of head distinctly brown8
- The color of head distinctly yellow9
8. Propodeal spines as long as is the interval between their bases; PS LI= 11-20; (length 2.5-3.9mm)...*T. rothneyi* (Forel)
- Propodeal spines small, triangular, more or less dentate; PS LI=9-10; (length 2.8-3.1mm).....*T. simlensis* stat. nov.
9. Scape reaches beyond the posterior margin of head by 1/6 of its total length; the color of body is uniformly pale yellow; propodeal spines very long (Spine length PSL: 0.20-0.23mm).
.....*T. nordmeyer*i (Schulz)
- Scape somewhat short not reaching the posterior margin of head; gaster with a brown patch in the middle; propodeal spines short (Spine length PSL: 0.09-0.11mm); (length 2.8-3.4mm)..
.....*T. microreticulatus* Bharti et al.
10. Propodeal spines very short, appearing as two small blunt denticles (tubercles) in dorsal view; node of petiole rounded in profile.....*T. wroughtonii* (Forel)
- Propodeal spines much longer, as long as 2/3 the range of their bases; node of petiole more or less angular in profile..... 11
11. Head more or less chestnut brown; mesosoma, legs, antennae, petiole and postpetiole more or less yellowish brown; gaster dark brown; CI=120-139; SI₁=77-79; SI₂=94-108; (length 2.4-3.1mm).....*T. fultonii* (Forel)
- Head light yellow to dark yellow with a brownish tinge; mesosoma light to dark yellow; gaster light yellow to dark yellow most often with a brownish patch dorsally in the middle; CI=113-122; SI₁=70-76; SI₂=81-95; (length 2.35-2.79mm)...
.....*T. himachalensis* Bharti et al.

Key characters to separate queens of *Temnothorax simlensis* stat. nov. and *Temnothorax rothneyi* (Forel, 1902)

- Propodeal spines long, almost as long as is the interval between their bases; PS LI = 17; (length 4.26 mm) (Fig 14)
.....*T. rothneyi* (Forel)
- Propodeal spines short and triangular; PS LI= 8; (length 4.40 mm) (Fig 5).....*T. simlensis* stat. nov.



Figs 13-15. Queen *Temnothorax rothneyi* (Forel, 1902): 13-Head, full face view; 14- Body, lateral view; 15- Body, dorsal view.



Figs 16, 17. 16- casent 0909055-*T. rothneyi simlensis*; 17- casent 0909054- *T. rothneyi*.

Acknowledgements

The authors are sincerely thankful to Dr Adam Cronin for language correction of the manuscript and Matthew Prebus for suggestions. Financial assistance rendered by Department of Science and Technology (Grant No. SR/SO/AS-65/2007 and SR/SO/AS-68/2011), Govt. of India, New Delhi is gratefully acknowledged.

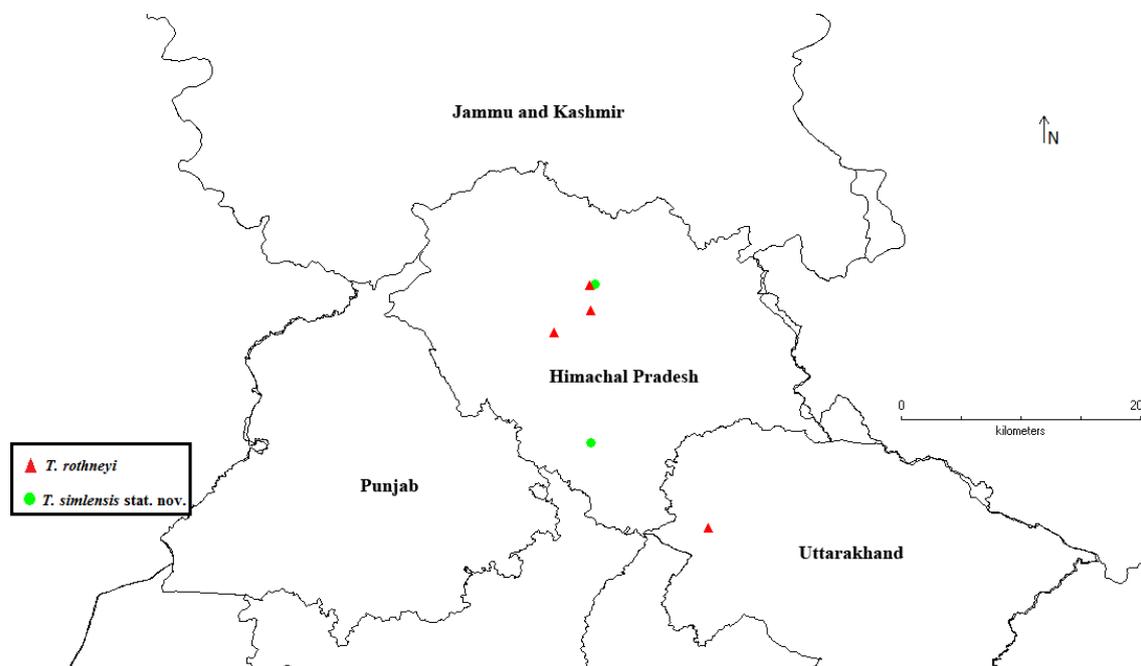


Fig 18. Map showing the distribution of *Temnothorax simlensis* and *Temnothorax rothneyi*.

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