

Integrative taxonomic studies on
Rinacapritermes Amina & Rajmohana n. gen.
(Blattodea: Isoptera: Termitidae)
with two new species from India

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Integrative taxonomic studies on *Rinacapritermes* Amina & Rajmohana, n. gen. (Blattodea: Isoptera: Termitidae) with two new species from India

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ABSTRACT

The new genus *Rinacapritermes* Amina & Rajmohana, n. gen. (Blattodea: Isoptera: Termitidae) and two new species *Rinacapritermes silvius* Amina & Rajmohana, n. gen., n. sp. and *Rinacapritermes abundans* Amina & Rajmohana, n. gen., n. sp. are described here based on the distinct morphological characters of the soldier and the worker castes. The new genus and the new species are supported by distinct monophyletic groups based on the preliminary mt COI gene tree. The gut morphology of the worker caste along with the enteric valve armature of the type species, *R. silvius* Amina & Rajmohana, n. gen., n. sp. are detailed. A dichotomous key to soldiers of all genera under *Pericapritermes*-group found in the Oriental Region is provided to distinguish the proposed new genus. Additionally for the first time DNA barcodes for the mt COI gene based on worker caste were generated for the 12 species under nine genera for the samples from the Western Ghats. An attempt has been made in the studies to build single gene tree using mt COI gene at the generic level for the subfamily Termitinae Latreille, 1802.

KEY WORDS

Gut morphology,
dichotomous key,
Pericapritermes-group,
mt DNA COI gene
phylogeny,
new genus,
new species.

RÉSUMÉ

Études taxonomiques intégratives de Rinacapritermes Amina & Rajmohana, n. gen. (Blattodea: Isoptera: Termitidae) avec deux nouvelles espèces d'Inde.

Le nouveau genre *Rinacapritermes* Amina & Rajmohana, n. gen. (Blattodea: Isoptera: Termitidae) et deux nouvelles espèces *Rinacapritermes silvius* Amina & Rajmohana, n. gen., n. sp. et *Rinacapritermes abundans* Amina & Rajmohana, n. gen., n. sp. sont décrits ici sur la base des caractères morphologiques distincts des castes de soldats et d'ouvriers. Le nouveau genre et les nouvelles espèces sont étayés par des groupes monophylétiques distincts basés sur l'arbre préliminaire du gène mt COI. La morphologie de l'intestin de la caste des ouvriers ainsi que l'armature de la valve entérique de l'espèce type, *R. silvius* Amina & Rajmohana, n. gen., n. sp., sont détaillées. Une clé dichotomique des soldats de tous les genres du groupe *Pericapritermes* trouvés dans la région orientale est fournie pour distinguer le nouveau genre proposé. En outre, pour la première fois, des codes-barres d'ADN pour le gène mt COI basé sur la caste des ouvriers ont été générés pour les 12 espèces (neuf genres) pour les échantillons des Ghâts occidentaux. Nous proposons, dans cette étude, un essai de reconstruction d'un arbre à partir du seul mt COI au niveau générique pour la sous-famille des Termitinae Latreille, 1802.

MOTS CLÉS
Morphologie de l'intestin,
clé dichotomique,
groupe *Pericapritermes*,
gène COI de l'ADN mt
phylogeny,
espèces nouvelles,
genre nouveau.

INTRODUCTION

Among the nine extant families of termites, the family Termitidae Latreille, 1802 is the most speciose and accounts for 71% of the total termites (Krishna *et al.* 2013). They are widely distributed, but are dominant in tropical regions, particularly in the rain forests and savannas (Eggleton 2011). Of the four subfamilies, Macrotermitinae Kemner, 1934, Apicotermitinae Grassé & Noirot, 1955, Nasutitermitinae Hare, 1937 and Termitinae Latreille, 1802 reported from India, Termitinae is the richest in species diversity.

In Oriental Region, *Pericapritermes*-group of subfamily Termitinae comprises 13 genera, eight of which are known from India and has a very high endemism. Of the 13 genera, only genus *Pericapritermes* Silvestri, 1914 is distributed outside the Oriental Region, the remaining 12 are restricted to the Oriental Region. However, three genera, *Indocapritermes* Chhotani, 1997, *Krishnacapritermes* Chhotani, 1997 and *Labiocapritermes* Krishna, 1968 are endemic to India (Krishna *et al.* 2013).

During the course of our studies on termites of the Western Ghats part of the South Indian state of Kerala, including a few Sri Lankan endemic taxa and a few new species (Amina & Rajmohana 2013; Amina *et al.* 2013, 2019) from 2012 to 2015, a large scale sampling was carried out. Initially all the samples were sorted based on morphological characters, a few termite samples with unusual characters were noted. The worker mandibular structure and their gut morphological studies revealed them as members of the *Pericapritermes*-group. Considering the distinct morphological characters data set and the single gene (mt COI) based phylogenetic tree showing monophyletic group, a new genus *Rinacapritermes* Amina & Rajmohana, n. gen., is established with two new species *Rinacapritermes silvius* Amina & Rajmohana, n. gen., n. sp. and *Rinacapritermes abundans* Amina & Rajmohana, n. gen., n. sp. A dichotomous key to soldiers of the genera of *Pericapritermes*-group of the Oriental Region is also provided. With the mt DNA COI gene barcode data, a phylogenetic tree has been generated.

MATERIAL AND METHODS

All specimens were collected from the forest floor of the southern Western Ghats underneath boulders and were preserved in 100% alcohol. Dissections and measurements were also made in the same preservative, under Leica EZ4HD stereozoom microscope, at magnifications between 8–35×. Taxonomic descriptions were made for soldiers and worker caste. Mandibles of the worker caste specimens were removed on to glass slides and mounted in Canada balsam and then examined for diagnostic characters. Photographs were taken using a Leica 205-A stereomicroscope fitted with DFC 500 camera, and processed with the help of extended focus software, LAS version 3.6. The photograph of the enteric armature was taken by using Leica DM 2000 compound microscope at 40× magnification.

Morphometric characters follow Chhotani (1997), terminologies of worker mandibles are after Fontes (1987) and also Gathorne-Hardy (2001). The digestive tube morphology follows Sands (1998) and Noirot (2001).

All specimens including the holotype and paratypes are deposited in the National Zoological Collections of the Zoological Survey of India (ZSI), at Calicut (Kozhikode), Kerala, India.

DNA EXTRACTION, PCR AMPLIFICATION AND SEQUENCING
Protocols for DNA extraction, PCR amplification and sequencing followed the termite studies of Amina *et al.* (2019) from the Western Ghats. For the species of *Rinacapritermes* Amina & Rajmohana, n. gen. mt COI gene sequences of worker caste were generated for the few endemic genera of the Western Ghats. The genera for which mt COI gene sequences were generated belong to the morphological *Pericapritermes*-group namely, *Indocapritermes* Chhotani, 1997, *Krishnacapritermes* Chhotani, 1997, *Labiocapritermes* Krishna, 1968, *Pericapritermes* Silvestri, 1914, *Procapritermes* Holmgren, 1912, *Pseudocapritermes* Kemner, 1934, *Dicuspiditermes* Krishna, 1968, *Homallotermites* John, 1925 and *Odontotermites* Holmgren, 1910 as outgroup (Appendix 1).

PHYLOGENETIC ANALYSIS

For the phylogenetic analysis, mt COI gene sequences of species were downloaded from GenBank (Appendix 1). They belong to the following genera *Amitermes* Silvestri, 1901, *Cylindrotermes* Holmgren, 1906, *Drepanotermes* Silvestri, 1909, *Genuotermes* Emerson, 1950, *Inquilinitermes* Mathews, 1977, *Neocapritermes* Holmgren, 1912, *Pericapritermes*, *Planicapritermes* Emerson, 1949, *Microcerotermes* Silvestri, 1901 and *Termes* Linnaeus, 1758.

With our sequences for mt COI and the sequences downloaded from GenBank (Appendix 1) alignment was done manually using MEGA version 5.2 (Tamura *et al.* 2011). Uncorrected pairwise genetic distances (p-distances, Appendix 2) were computed in MEGA version 5.2 to delineate the new species from their congeneric sister taxon using mt COI gene data. Maximum Likelihood (ML) tree was generated using raxmlGUI v1.3 (Silvestro & Michalak 2012). The ML tree was obtained with 1000 thorough bootstrap replicates under GTR+GAMMA+I model. The RaxML output tree was viewed using FigTree v1.4.0 (Fig. 4) with *Odontotermes* as outgroup (Amina *et al.* 2019).

ABBREVIATION

ZSI Zoological Survey of India, Calicut (Kozhikode).

RESULT

Family TERMITIDAE Latreille, 1802
Subfamily TERMITINAE Latreille, 1802

Genus *Rinacapritermes*
Amina & Rajmohana, n. gen.

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TYPE-SPECIES. — *Rinacapritermes silvius* Amina & Rajmohana, n. sp.

MORPHOLOGICAL DIAGNOSIS. — **Soldier.** Soldiers with antennae 15 segmented, labrum with substraight anterior margin equipped with broad-based, robust and long antero-lateral points. Frons sharply inclining in front, fontanelle transverse and frontal gland large, postmentum club-shaped, pronotum saddle-shaped, anterior margin convex, without notch.

Worker. Worker caste with 14-15 segmented antennae and mandibles with apical tooth slightly larger than first marginal. Second marginal of left mandible not distinct, third marginal rudimentary or just as an impression of tooth, not separated from first marginal by any cut or notch; small, tooth-like process partially visible on the underside of the left molar plate. Digestive tube characterised by the presence of a mixed segment and the absence of malpighian nodule, with both pairs of malpighian tubules united at common base. Enteric valve cushions acutely triangulate and median longitudinal area of each cushion with uniformly distributed small spine-like protrusions (Fig. 3E).

DNA BARCODE DIAGNOSIS. — A total of 28 mt COI sequences were generated from the Western Ghats representing multiple species under nine genera for the first time (Appendix 1). On the preliminary phylogenetic tree multiple sequences of monophyletic group representing at least two species is treated as a new genus

Rinacapritermes Amina & Rajmohana, n. gen. with an unresolved sister relationship among the other genera of the larger 'Termitinae clade' (Fig. 4). Members of the *Rinacapritermes* Amina & Rajmohana, n. gen. is genetically distinct from the morphologically similar genus *Indocapritermes* (Fig. 4). The new genus exhibited a high-level genetic divergence of 10.7% to 13.7%, for mt COI with the genus *Indocapritermes* (Appendix 3).

ETYMOLOGY. — The genus name 'Rinacapritermes', is the combination of name 'Rina' and 'capritermes'. 'Rina' refers to the first author's daughter and 'capritermes' refers to the morphological similarity with *Capritermes* Wasmann, 1897 group.

GEOGRAPHICAL DISTRIBUTION (Fig. 5). — The Western Ghats from Wayanad, Kozhikode, Ernakulam, Idukki and Kottayam districts (Kerala state, India).

BIOECOLOGY. — *Rinacapritermes* Amina & Rajmohana, n. gen. species are soil dwellers. All samples in the present study were collected from underneath small boulders. The concavity and the rudimentary ridges of the molar plate of right mandible of worker caste (Figs 1F; 2F) indicate their humus/organic rich soil feeding habit of type III feeding group (De Souza & Brown 1994). The soldier abdomen has a hyaline appearance, indicating that they are fed with salivary secretions only (Scheffrahn *et al.* 2017). Since they are not wood feeders, they are not categorised as pests. Their presence in multiple localities ranging from low (26 m asl.) to high elevations (910 m asl) indicates that they do not have any strict elevational preferences. Among the two species, the samples of *R. silvius* Amina & Rajmohana, n. gen., n. sp. were collected from the forest area while *R. abundans* Amina & Rajmohana, n. gen., n. sp. from tea and rubber plantations.

DESCRIPTION

Imago

Not known.

Soldier

Head capsule. Monomorphic, small; head moderately and body fairly hairy. In dorsal view head subrectangular; broad; antero-lateral corners of head rounded, without any tubercle-like process. Frontal gland large and median arm of Y-suture distinct only at posterior part of head capsule; in profile, frons sharply inclining in front; fontanelle transverse. Antennae with 15 segments. Labrum not swollen; asymmetrical, anterior margin substraight with broad based, robust and long antero-lateral points or spine-like processes. Mandibles asymmetrical and thick; left mandible strongly twisted at middle, with blunt apex, tip without any hook, not beak-like; basal projection sharply pointed. Right mandible blade-like with pointed apex, facing upwards; inner margin of right mandible incurved at middle region and with a deep cut at basal half; postmentum club-shaped.

Pronotum. Saddle-shaped; anterior lobe raised, narrower and smaller than posterior lobe; anterior margin convex; posterior margin substraight; anterior and posterior margin without any notch. Mesonotum and metanotum narrower than pronotum. Legs with 3:2:2 apical tibial spurs; dorsal spur of foretibia sometimes indistinct; tarsi 4-segmented.

Worker

Head capsule. Monomorphic; head and body densely hairy. In dorsal view head subcircular, maximum width of head capsule at base of antennae. Fontanelle plate translucent and round. Antennae with 14–15 segments. Postclypeus swollen.

Left mandible. Apical tooth slightly larger than first marginal. Posterior margin of apical tooth concave; second marginal not distinct (M2); third marginal rudimentary (M3) or just as an impression of tooth, not separated from first marginal by any cut or notch; small, tooth-like process partially visible on the underside of the left molar plate; molar plate large and extending upto first marginal.

Right mandible. Apical tooth finger-like and larger than first marginal (M1); posterior margin of first marginal a little longer than anterior margin; second marginal (M2) short and with incurved posterior margin; molar plate longer than posterior margin of second marginal, without any ridges; cockroach notch present.

Pronotum. Saddle-shaped. Legs with 3:2:2 apical tibial spurs, dorsal spur sometimes absent or indistinct; fore tibia swollen.

Digestive tube (Fig. 3A–D). Crop (C) globose, voluminous and partially visible in dorsal view in coiled condition, funnelling into a poorly sclerotized gizzard. Mixed segment (MS) present. Both pairs of malpighian tubules united at common base; malpighian nodule absent. First part of proctodeal segment (P1) starting from the right side of abdomen, tubular and short. Posterior part narrow and running into paunch (P3) through narrow enteric valve (P2). P2 inserted into paunch (P3). Paunch J-shaped, composed of 2 parts. Region of attachment of enteric valve remaining separated by constriction. Posterior part of paunch narrowing progressively and opening into long and narrow tube-like colon with a U-turn at anterior side and P4 leading to very large bulbous rectum (P5).

Enteric valve armature (Fig. 3E). Thin, composed of six acutely triangulate cushions; acute points of cushions directed to posterior. Median longitudinal area of each cushion covered with uniformly distributed and small spine-like protrusions. Each cushion separated by cuticular lining having similar but larger and more widely spaced protrusions.

REMARKS

In the key to Indian genera of Termitinae (Chhotani 1997), the proposed new genus runs to serial number 17, leading to *Indocapritermes*. In the key to common genera of Termitidae found in South India (Kalleshwaraswamy *et al.* 2013), this genus also keys to *Indocapritermes*, at serial number 9. However, it does not fit the description of *Indocapritermes*. The soldiers of *Rinacapritermes* Amina & Rajmohana, n. gen. have antennae with 15 segments vs 14 segments in *Indocapritermes*; anterior margin of labrum is substraight with broad based, robust and long, antero-lateral points in the new genus vs labrum with narrow based, short, thin and minute lateral points in the

latter; comparing to head length, left mandible of new genus is somewhat longer, thinner and tip not broadly rounded vs shorter, thick with broadly rounded tip; apical blade of right mandible pointed and facing upwards in *Rinacapritermes* Amina & Rajmohana, n. gen. (Fig. 7C) vs not much pointed and substraight in *Indocapritermes* (Fig. 7D). Anterior lobe of pronotum in new genus is slightly raised with strongly convex anterior margin and without any notch vs anterior lobe not raised with slightly convex to substraight anterior margin and with a weak median notch in latter; posterior margin substraight, not emarginate and without any notch in proposed new genus vs slightly convex, faintly emarginate and with a weak notch. The workers also differ in having antennae with 14–15 segments in the new genus vs 13–14 segments in *Indocapritermes*; a small, tooth-like process partially visible on the underside of the left molar plate in new genus, while this tooth-like process is absent in *Indocapritermes*. The shape of the antero-lateral points of labrum in soldier caste also help to separate this genus from the rest of other genera under *Pericapritermes*-group found in India (Fig. 6)

The proposed new genus has the posterior margin of the right second marginal of the worker mandible (M2) incurved (Figs 1F; 2F), the digestive gut without a malpighian nodule and P1 is short and tubular, as seen in *Pericapritermes*-group (Noirot 2001; Krishna *et al.* 2013). Hence based on the worker mandible structure and the gut morphology, *Rinacapritermes* Amina & Rajmohana, n. gen. is placed in *Pericapritermes*-group, though their soldiers are with 15 segmented antennae, in spite of their usual 14 segments.

Rinacapritermes silvius

Amina & Rajmohana n. sp.

(Figs 1; 3; 7A; Table 1)

urn:lsid:zoobank.org:act:8C629647-1999-45D7-BAB7-F16A1C792D1C

TYPE MATERIAL. — **Holotype** (Soldier). **India** • Kerala, Ernakulam, Urulanthanni (Thattekadu Bird Sanctuary); 10°7'41"N, 76°45'18"E; 5.I.2015; Amina Poovoli leg.; Colony code: ZSI/WGRC/IR/INV/4610. **Paratypes** (12 soldiers, 10 workers). **India** • 10 soldiers, same data as for holotype • 10 workers; same data as for holotype • 2 soldiers; Kerala, Idukki (Thekkady, in Periyar Tiger Reserve); 9°27'43"N, 77°14'12"E; 6.IV.2013; K. Rajmohana & party leg.; Colony code: ZSI/WGRC/IR/INV/4611.

Sequenced specimens. Same as paratypes.

ETYMOLOGY. — The species epithet name is derived from the latin term 'silvius' meaning forest as the new species was predominant in forested habitat.

DNA BARCODE. — *Rinacapritermes silvius* Amina & Rajmohana, n. gen., n. sp. is showing sister relationship with *Rinacapritermes abundans* n. sp. exhibiting genetic divergence of 7.3% to 8.3% for COI gene (Fig. 4). Both the species can easily be distinguished morphologically (see key below) and both the species type localities are isolated in range of distribution (Fig. 5).

DISTRIBUTION IN INDIA. — From two adjoining districts of Kerala (Ernakulam and Idukki); could be a limited-range endemic species restricted to south of Palghat Gap.

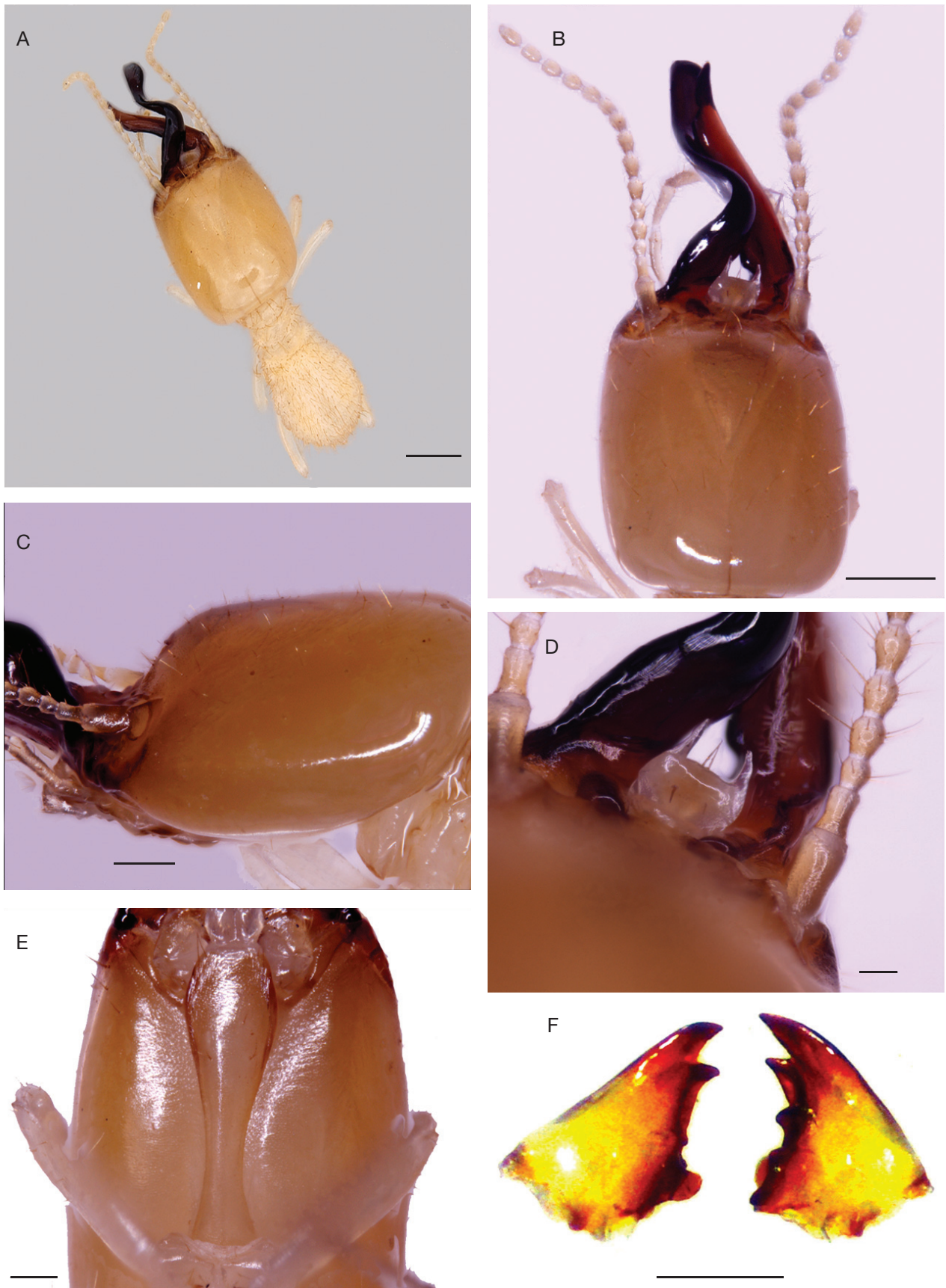


FIG. 1. — *Rinacapritermes silvius* Amina & Rajmohana, n. gen., n. sp.: **A**, soldier body dorsal view; **B**, soldier head dorsal view; **C**, soldier head profile; **D**, soldier's labrum; **E**, soldier's postmentum; **F**, worker left and right mandible. Scale bars: A, B, 0.5 mm; C, F, 0.3 mm; D, 0.1 mm; E, 0.2 mm.

TABLE 1. — Measurements (in mm) of soldiers of *Rinacapritermes silvius* Amina & Rajmohana, n. gen., n. sp. (n = 6).

Body parts	Range	Mean	Holotype
Head length with mandibles	2.9-3.02	2.98	2.99
Head length to base of mandibles	1.60-1.66	1.64	1.66
Maximum head width	1.17-1.24	1.20	1.22
Maximum head height	0.84-0.90	0.88	0.90
Occipito- fontanelle distance	1.37-1.50	1.42	1.45
Head index (maximum head width/ head length to base of mandible)	0.70-0.76	0.74	0.74
Fontanelle head index (fontanelle distance/ head length to base of mandibles)	0.85-0.90	0.87	0.87
Length of labrum	0.23-0.28	0.25	0.24
Width of labrum	0.22-0.24	0.23	0.23
Left mandible length	1.28-1.36	1.32	1.33
Right mandible length	1.23-1.28	1.26	1.28
Mandible head length index (left mandible length/head length to base of mandibles)	0.80-0.82	0.81	0.80
Length of postmentum	0.85-0.89	0.87	0.87
Maximum width of Postmentum	0.32-0.35	0.33	0.33
Width of postmentum at waist	0.138-0.142	0.14	0.13
Postmentum-head length index (postmentum length/head length to base of mandible)	0.51-0.54	0.53	0.52
Postmentum contraction index (Width at waist/ maximum width)	0.39-0.45	0.43	0.39
Pronotum length	0.25-0.30	0.27	0.30
Pronotum width	0.64-0.69	0.67	0.69
Total body length	4.25-5.15	4.67	4.50

DESCRIPTION

Imago

Not known

Soldier (Fig. 1A-E; Table 1)

Monomorphic. Head capsule pale yellowish brown; fontanelle gland area pale yellow; antennae paler than head; labrum translucent at arterial and lateral part and pale yellow on rest; left mandible blackish brown; right mandible reddish brown; legs and body whitish yellow.

Head Capsule. Moderately hairy with long and a few short hairs. Antennal segments with long and short hairs on entire surface; labrum with a few hairs on anterior part; postmentum with a very few short hairs at distal third. Anterior margin of pronotum with 5-8 long hairs. Body densely hairy with long hairs; legs covered with long hairs, more concentrated at last tarsal segments.

Head capsule in dorsal view. Subrectangular; sides substraight, slightly narrowing at anterior end; minimum width being at base of mandibles; posterior margin rounded. Frons sharply inclining in front; median suture of head short, extending up to ¼ of head-length from posterior margin; fontanelle transverse, situated anteriorly at distal ½ of head; fontanelle gland large, extending beyond middle of head. Antennae with 15 segments; segment 2 longer than 3; segment 4 slightly longer than or sometimes subequal to 3; segment 3 sometimes shortest; 5-10 gradually increasing in length and remaining segments subequal. Labrum slightly asymmetrical;

anterior margin substraight with broad based, robust and long antero-lateral points. Mandibles strongly asymmetrical; left mandible strongly twisted at middle; with blunt apex. Right mandible blade-like with sharp, pointed apex, facing upward; inner margin of right mandible incurved at middle region; apical blade substraight. Postmentum club-shaped; length more than ½ of head length; with a narrow waist lying posteriorly.

Title. Pronotum saddle-shaped, anterior and posterior margin without any notch. Legs with 3:2:2 apical tibial spurs; outer spur not very distinct.

Abdomen. Elongated; cerci short; 2 segmented.

Worker (n = 5)

Monomorphic. Head capsule, antennae, postclypeus whitish yellow; thorax and legs paler than head; abdomen translucent with intestinal contents showing through. Head capsule moderately hairy with many long and short hairs, post clypeus with long hairs and body sparsely hairy with a few long hairs and very short hairs. Total body length 3.9-4.40 mm.

Head. Subcircular; length to tip of labrum 1.13-1.23 mm, length to base of mandible 0.68-0.76 mm and maximum width 0.88-0.92 mm; width of head capsule widest at base of mandibles. Epicranial suture slightly distinct; fontanelle plate translucent and oval. Antennae with 14-15 segments; segment 3 shortest; segment 2 longer than 3 and 4. Postclypeus swollen; almost straight anteriorly and rounded posteriorly; length less than half of width (length 0.19-0.22 mm; width 0.45-0.47 mm).

Mandible (Fig. 1F). As for genus.

Digestive tube. As for genus.

Pronotum. Saddle-shaped (length 0.24-0.26 mm; width 0.48-0.53 mm); anterior and posterior lobe without notch. Legs with 3:2:2 apical tibial spurs; dorsal spur of foretibia at times indistinct; foretibia somewhat swollen.

REMARKS

Dorsal spur of fore tibia is sometimes indistinct. So both the 3:2:2 and 2:2:2 conditions are seen in the soldiers as well as the workers of the same colony.

Rinacapritermes abundans

Amina & Rajmohana, n. sp.

(Figs 2; 7C; Table 2)

urn:lsid:zoobank.org:act:976E00D3-6BC8-4B67-83A3-90778E454A45

TYPE MATERIAL. — **Holotype** (soldier). **India** • Kerala, Kottayam (Changanasseri- Kadamanchira); 9°35'29"N, 76°31'19"E; 13.III.2015; Amina Poovoli leg.; Colony code: ZSI/WGRC/IR/INV/4612.

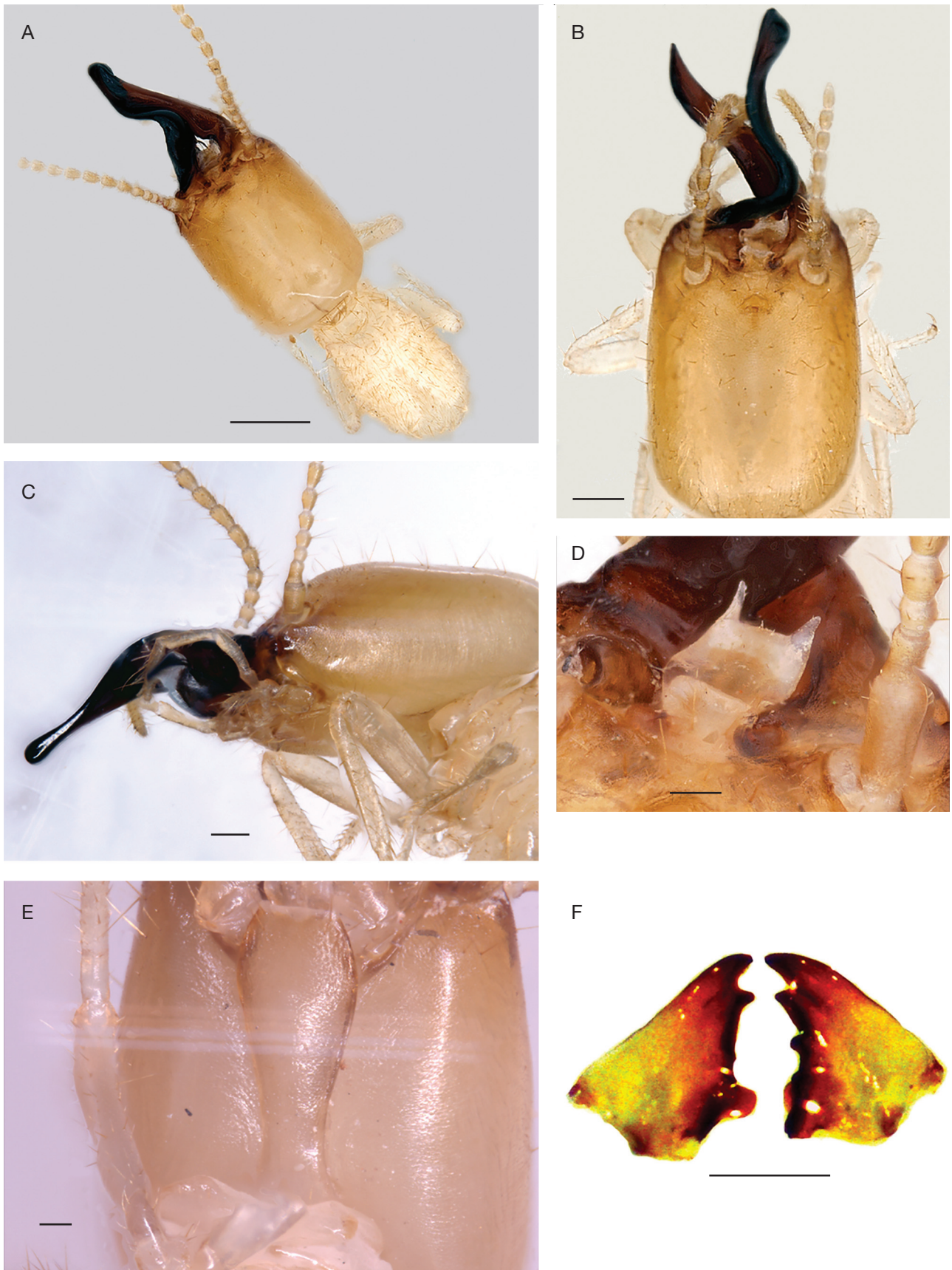


FIG. 2. — *Rinacapritermes abundans* Amina & Rajmohana, n. gen., n. sp.: **A**, soldier body dorsal view; **B**, soldier head dorsal view; **C**, soldier head profile; **D**, soldier's labrum; **E**, soldier's Postmentum; **F**, worker left and right mandible. Scale bars: A, 0.5 mm; B, F, 0.3 mm; C, 0.2 mm; D, E, 0.1 mm.

TABLE 2. — Measurements (in mm) of soldiers of *Rinacapritermes abundans* Amina & Rajmohana, n. gen., n. sp. (n = 6).

Body parts	Range	Mean	Holotype
Head length with mandibles	2.76-2.86	2.82	2.85
Head length to base of mandibles	1.48-1.55	1.51	1.52
Maximum head width	1.06-1.10	1.07	1.07
Maximum head height	0.79-0.85	0.83	0.85
Occipito- fontanelle distance	1.22-1.31	1.26	1.26
Head index (maximum head width/ head length to base of mandible)	0.68-0.72	0.71	0.70
Fontanelle head index (fontanelle distance/ head length to base of mandibles)	0.83-0.85	0.83	0.83
Length of labrum	0.19-0.22	0.20	0.21
Width of labrum	0.18-0.213	0.20	0.20
Left mandible length	1.24-1.30	1.28	1.30
Right mandible length	1.21-1.27	1.24	1.27
Mandible head length index (left mandible length/head length to base of mandibles)	0.83-0.88	0.85	0.86
Length of postmentum	0.71-0.79	0.74	0.75
Maximum width of postmentum	0.295-0.303	0.30	0.30
Width of postmentum at waist	0.14-0.17	0.16	0.15
Postmentum-head length index (postmentum length/head length to base of mandible)	0.45-0.49	0.48	0.49
Postmentum contraction index (Width at waist/ maximum width)	0.48-0.54	0.52	0.51
Pronotum length	0.27-0.32	0.29	0.27
Pronotum width	0.56-0.62	0.59	0.56
Total body length	4.00-4.27	4.15	4.10

Paratypes. India • 10 workers, 6 soldiers; with same data as for holotype • 4 soldiers, 10 workers; Kerala, Kozhikode (Balussery-Narayankulam); 11°30'14"N, 75°48'58"E; 2.I.2015; Amina Poovoli leg.; Colony code: ZSI/WGRC/IR/INV/4613 • 4 soldiers, 8 workers; Kerala, Wayanad (Vythiri); 11°33'6"N, 76°2'25"E; 1.VIII.2015; Shilimol; Colony code: ZSI/WGRC/IR/INV/4944 • 3 soldiers, 5 workers; Kerala, Wayanad (Thalappuzha); 11°50'25"N, 75°56'57"E; 29.VII.2015; Shilimol; Colony code: ZSI/WGRC/IR/INV/4945. **Sequenced specimens.** Same as paratypes.

ETYMOLOGY. — The species epithet name is derived from the latin term ‘abundans’ meaning abundant, as the population of the new species is seen to be abundant across the known range of distribution.

DNA BARCODE. — *Rinacapritermes abundans* Amina & Rajmohana, n. gen., n. sp. is a member of the larger ‘*Rinacapritermes* clade’ showing sister relationship with *Rinacapritermes silvius* Amina & Rajmohana, n. gen., n. sp. exhibiting medium to high genetic divergence of 7.3% to 8.3% for COI gene (Fig. 4). Both species can easily be distinguished morphologically (see key below) and the type localities of both species are isolated in range of distribution (Fig. 5).

DISTRIBUTION IN INDIA. — Could be a narrow-range endemic species, known from central as well as southern Western Ghats of Kerala (Wayanad, Kozhikode and Kottayam).

DESCRIPTION

Imago

Not known

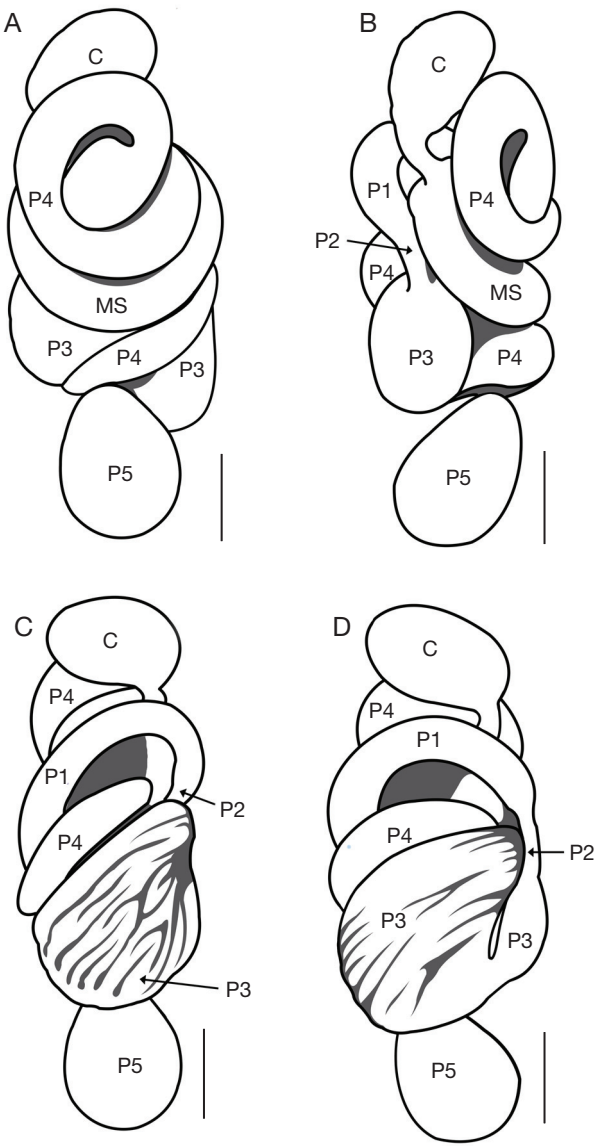


FIG. 3. — Digestive tube of *Rinacapritermes silvius* Amina & Rajmohana, n. gen., n. sp. worker: **A**, dorsal view; **B**, left lateral view; **C**, right lateral view; **D**, ventral view; **E**, worker's enteric valve armature. Scale bars: A-D, 0.5 mm; E, 20 µm.

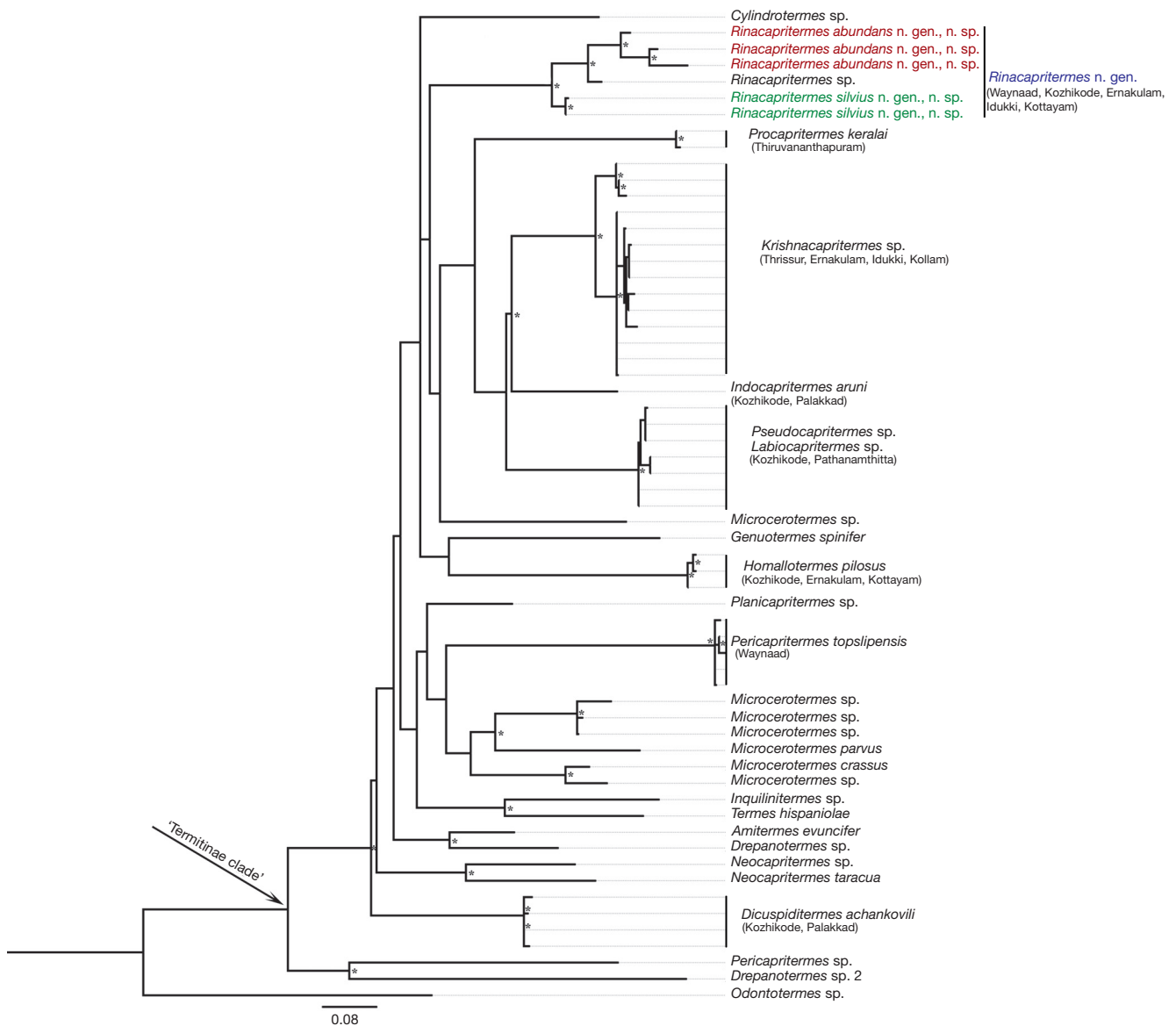


Fig. 4. — Maximum likelihood tree based on 663 bp of mitochondrial COI gene (*represents the bootstrap values above 50%).

Soldier (Fig. 2; Table 2).

Monomorphic. Head capsule yellow; fontanelle gland area pale yellow; antennae paler brown; labrum translucent; left mandible blackish brown; right mandible reddish brown; legs and body whitish yellow.

Head capsule. Moderately hairy with many long and a few short hairs. Antennal segments with long and short hairs on entire surface; labrum with a few hairs on anterior part; postmentum with a very few hairs on entire surface. Anterior margin of pronotum with 5-8 long hairs. Body densely hairy with long hairs; legs covered with long hairs, more concentrated at last tarsal segments.

Head subrectangular. Sides substraight; posterior margin rounded. Frons sharply inclining in front; median suture of head very short, only at posterior margin of head capsule; fontanelle transverse, situated anteriorly at distal 1/3 of head; fontanelle gland large, extending beyond middle of head. Antenna 15 segmented; segment 2 longer than 3; segment 4 shorter than 2 and slightly longer than 3; segment 3 shortest; 5-10 gradually increasing in length and remaining segments subequal. Labrum slightly asymmetrical; anterior margin substraight with broad based, robust and long antero-lateral points. Mandibles strongly asymmetrical; left mandible strongly twisted at middle; with blunt apex. Right mandible blade-like with sharp, pointed apex, facing upward; inner

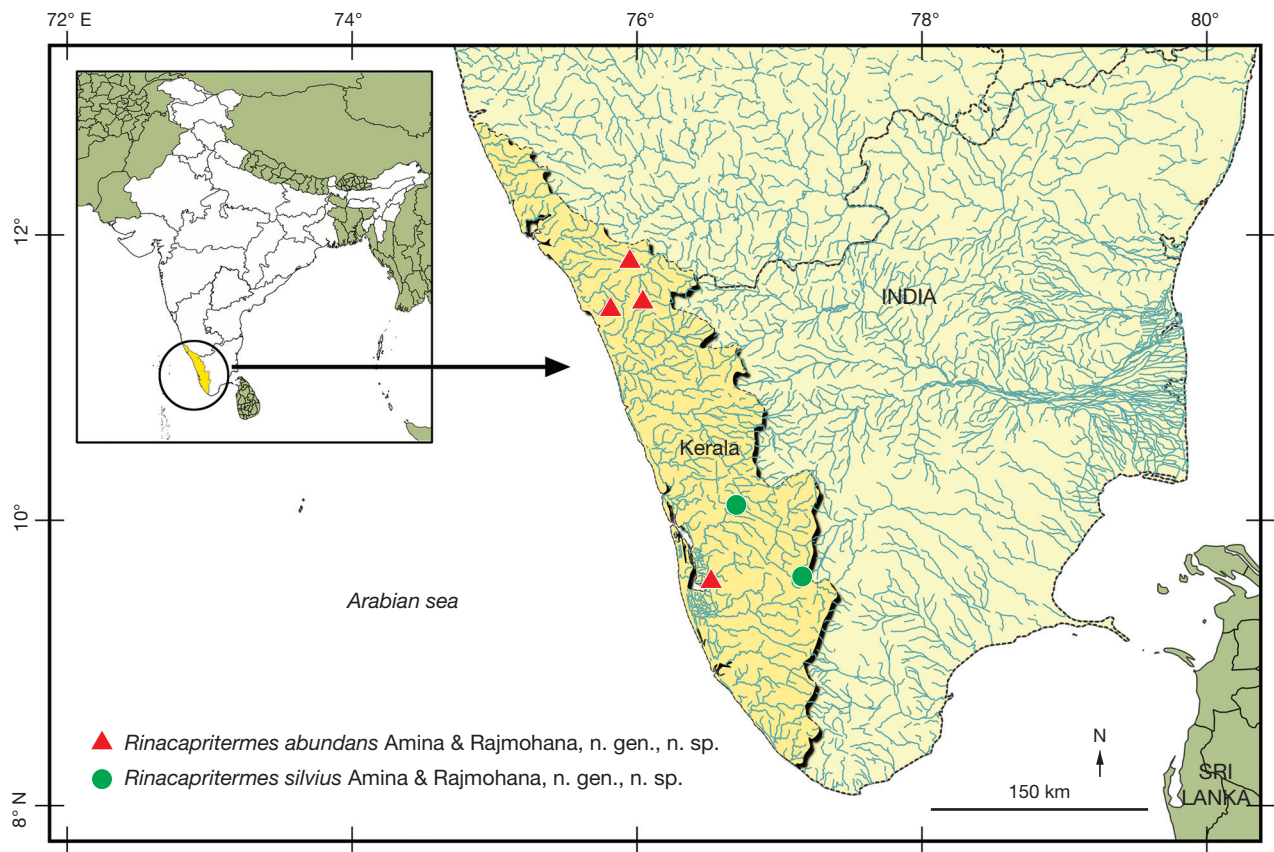


FIG. 5. — Distribution map of *Rinacapritermes* Amina & Rajmohana, n. gen. species.

margin of right mandible incurved at middle region; apical blade substraight. Postmentum club-shaped; with a narrow waist lying posteriorly.

Pronotum. Saddle-shaped, anterior and posterior margin without any notch. Legs with 3:2:2 apical tibial spurs. Abdomen oblong; cerci short; 2 segmented.

Worker ($n = 5$)

Monomorphic. Head capsule, antennae whitish yellow; postclypeus pale brown, thorax and legs paler than head; abdomen translucent with intestinal contents showing through. Head capsule moderately hairy with many long and short hairs, postclypeus with long hairs and body sparsely hairy with a few long hairs and very short hairs. Total body length 3.70–4.20 mm.

Head capsule. Length to tip of labrum 1.17–1.21 mm, length to base of mandible 0.75–0.79 mm and maximum width 0.92–0.95 mm; width of head capsule widest at base of mandibles. Epicranial suture slightly distinct; fontanelle plate translucent and oval. Antennae with 15 segments, segment 2 longer than 3 and 4; segment 3 shortest. Postclypeus swollen; almost straight anteriorly and rounded posteriorly; length less than half of width (length 0.20–0.224; width 0.46–0.48 mm).

Mandible (Fig. 2F). As for genus.

Digestive tube. As for genus.

Pronotum. Saddle-shaped (length 0.22–0.24 mm; width 0.47–0.50 mm); anterior and posterior lobe without notch. Legs with 3:2:2 apical tibial spurs; dorsal spur of foretibia indistinct; foretibia somewhat swollen.

REMARKS

In *R. abundans* Amina & Rajmohana, n. gen., n. sp., all soldiers are with apical tibial spur 3:2:2. In workers the dorsal spur is sometimes indistinct.

R. silvius Amina & Rajmohana, n. gen., n. sp. is comparatively a larger species than *R. abundans* Amina & Rajmohana, n. gen., n. sp. In addition to the keyed characters, they can be differentiated also by the following features. In *R. silvius* Amina & Rajmohana, n. gen., n. sp. soldiers, the median suture is present a little above the posterior part of the head capsule and workers have 14–15 antennal segments. But in *R. abundans* Amina & Rajmohana, n. gen., n. sp. soldiers, the median suture is seen only at a very basal region of the head capsule and workers have 15 segmented antennae.

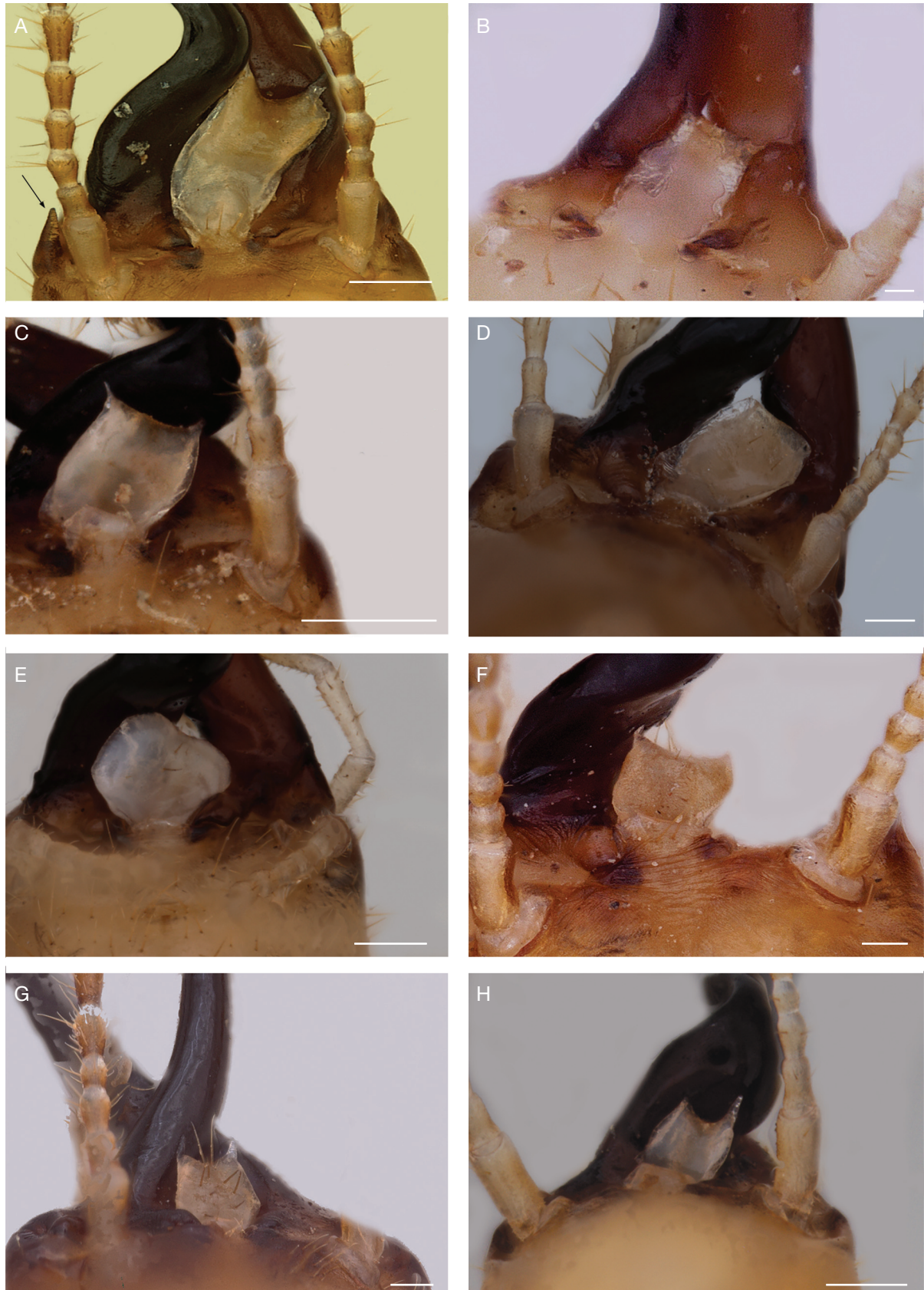


FIG. 6. — Labrum of genera under *Pericapritermes*-group; **A**, *Dicuspiditermes incola* (Wasmann, 1893); **B**, *Homallotermes pilosus* (Mathur & Thapa, 1962); **C**, *Indocapritermes aruni* Chhotani, 1997; **D**, *Krishnacapritermes maitii* Chhotani, 1997; **E**, *Labiocapritermes distortus* (Silvestri, 1922); **F**, *Pericapritermes dunensis* (Roonwal & Sen-Sarma, 1960); **G**, *Procapritermes keralai* (Chhotani & Ferry, 1995); **H**, *Pseudocapritermes fletcheri* (Holmgren & Holmgren, 1917). Scale bars: A-C, 0.3 mm; D, E, H, 0.2 mm; F, G, 0.1 mm.

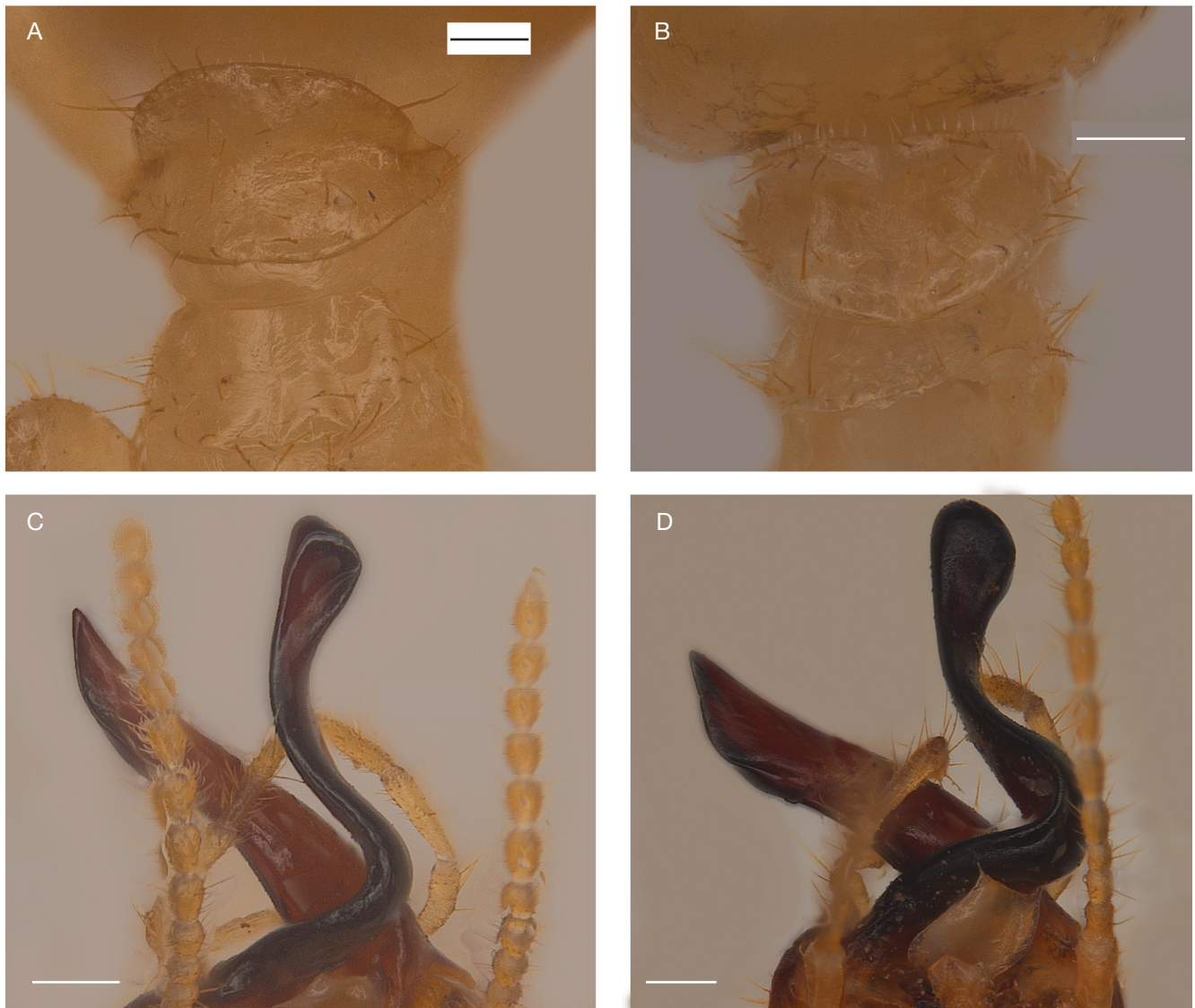


FIG. 7. — **A**, pronotum of *Rinacapritermes silvius* Amina & Rajmohana, n. gen., n. sp. soldier; **B**, pronotum of *Indocapritermes aruni* Chhotani, 1997 soldier **C**, mandible of *Rinacapritermes abundans* Amina & Rajmohana, n. gen., n. sp. soldier **D**, mandible of *Indocapritermes aruni* soldier. Scale bars: 0.2 mm.

DISCUSSION

The nine genera for which the mt COI DNA Barcodes were generated for the Western Ghats include *Dicuspidermes* (1 sp.), *Homallotermes* (1 sp.), *Indocapritermes* (1 sp.), *Krishnacapritermes* (2 sp.), *Labioapritermes* (1 sp.), *Pericapritermes* (1 sp.), *Procapritermes* (1 sp.), *Pseudocapritermes* (1 sp.) and *Rinacapritermes* Amina & Rajmohana, n. gen. (2 sp.). Of the above nine genera, only *Pericapritermes* is distributed outside the region, the remaining eight are restricted to the Oriental Region.

Initial search for the mt COI gene sequences for the members of the subfamily Termitinae from GenBank yielded 18 sequences falling under 10 genera (Appendix 1). In the present study 58 sequences (under nine genera) were generated from the samples of the Western Ghats and are deposited in GenBank (Appendix 1). All the above 76 sequences were used for the generation of single gene Maximum Likeli-

hood (ML) tree (Fig. 4). The resultant topology shows the monophyly of the new genus and the sistership relation of the new taxa described.

Among the new sequences generated from the Western Ghats, monophyletic groups were obtained only for the members of the genera *Dicuspidermes*, *Pericapritermes*, *Homallotermes*, *Indocapritermes*, *Krishnacapritermes*, *Procapritermes* and *Rinacapritermes* Amina & Rajmohana, n. gen. (without strong bootstrap values among the sister clades; Fig. 4).

Based on the unique combination of morphological characters, like soldier caste having a 15-segmented antennae, large frontal gland and transverse fontanelle, anterior margin of labrum with broad-based, robust and long antero-lateral points, anterior lobe of pronotum strongly convex and without notch and also its monophyly, a new genus *Rinacapritermes* Amina & Rajmohana, n. gen. is established here with two species new to science.

KEY TO THE SOLDIERS OF GENERA UNDER *PERICAPRITERMES*-GROUP
FOUND IN THE ORIENTAL REGION

1. Head with highly sclerotized frontal ridge, head somewhat phragmotic *Kemneritermes* Ahmad & Akhtar, 1981
— Head without frontal ridge and not phragmotic 2
2. Antero-lateral corners of head produced into a distinct tubercle-like projection (Fig. 6A arrowed part) *Dicuspiditermes* Krishna, 1968.
— Antero-lateral corners of head rounded, not produced into tubercle-like projection 3
3. Left mandible moderately twisted at middle, sharply pointed at tip or forming a beak or bent like a hook 4
— Left mandible strongly twisted at middle, blunt at tip 8
4. Antennae with 13 segments; mandibles thin, slender and weakly bent at middle *Homallotermes* John, 1925.
— Antennae with 14 segments, mandibles thick, moderately to strongly bent at middle 5
5. Head with frontal projection, left mandible moderately bent at middle *Mirocapritermes* Holmgren, 1914
— Head without frontal projection, left mandible strongly bent at middle 6
6. Distal tip of left mandible bent like a beak *Pseudocapritermes* Kemner, 1934.
— Distal tip of left mandible slightly incurved and bent in form of hook 7
7. Mandibles thin and slender. Apical tibial spur formula 3: 2: 2 *Procapritermes* Holmgren, 1912.
— Mandibles comparatively thick and stouter. Apical tibial spur formula 2: 2: 2 *Sinocapritermes* Ping & Xu, 1986.
8. Labrum greatly swollen *Labiocapritermes* Krishna, 1968.
— Labrum not much swollen 9
9. Head moderately hairy; frons sharply inclining in front 10
— Head sparsely hairy; frons gradually inclining in front 11
10. Antero-lateral points of labrum minute, thin and with a narrow base (Fig. 6C); anterior lobe of pronotum slightly convex and weakly notched (Fig. 7B). Antennae 14 segmented *Indocapritermes* Chhotani, 1997.
— Antero-lateral points of labrum long, robust and with broad base (Figs 1D; 2D); anterior lobe of pronotum strongly convex and without notch (Fig. 7A). Antennae 15 segmented *Rinacapritermes* Amina & Rajmohana, n. gen.
11. Fontanelle transverse, fontanelle gland large *Krishnacapritermes* Chhotani, 1997.
— Fontanelle small, circular, fontanelle gland small 12
12. Left mandible without lower basal projection, sometime a minute pimple-like tubercle present. Labrum short, thick, broader than long *Pericapritermes* Silvestri, 1914.
— Left mandible with well developed indented lower basal projection. Labrum long, as long as or longer than wide 13
13. Labrum anteriorly deeply concave, as long as wide, antero-lateral processes with points at bases *Oriencapritermes* Ahmad & Akhtar, 1981.
— Labrum anteriorly shallowly concave, longer than wide, antero-lateral processes without points at bases *Syncapritermes* Ahmad & Akhtar, 1981.

KEY TO THE SPECIES OF *RINACAPRITERMES*
AMINA & RAJMOHANA, N. GEN.

- Comparatively smaller: Head length to the base of mandibles 1.48-1.55 mm; maximum head width 1.06-1.10 mm. Postmentum short and a little wider at waist (postmentum length 0.71-0.79 mm; postmentum contraction index 0.48-0.54 mm) *Rinacapritermes abundans* Amina & Rajmohana, n. gen., n. sp.
- Comparatively larger: Head length to the base of mandibles 1.60-1.66 mm; maximum head width 1.17-1.24 mm. Postmentum long and a little narrower at waist (postmentum length 0.85-0.89 mm; postmentum contraction index 0.39-0.45 mm) *Rinacapritermes silvius* Amina & Rajmohana, n. gen., n. sp.

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APPENDICES

APPENDIX 1. — GenBank accession number details for the sequences used in the construction of single gene tree phylogenetic studies. Symbol: *, newly generated sequence through present study.

COI sequences for	GenBank Accession number	Collection locality
<i>Amitermes evuncifer</i> (Silvestri, 1912)	AY127718.1	Asia
<i>Cylindrotermes</i> sp.	MG813823.1	Guyana
<i>Dicuspitermes achankovili</i> Verma, 1985*	MT272760.1	Kozhikode, Kerala, India
<i>Dicuspitermes achankovili</i> Verma, 1985*	MT272750.1	Kozhikode, Kerala, India
<i>Dicuspitermes</i> sp.*	MT272755.1	Kozhikode, Kerala, India
<i>Dicuspitermes</i> sp.*	MN511306.1	Ernakulam, Kerala, India
<i>Drepanotermes</i> sp. 1	JQ412150.1	China
<i>Drepanotermes</i> sp. 2	JQ412149.1	China
<i>Genuotermes spinifer</i> Emerson, 1950	KY379279.1	Brazil
<i>Homalotermes pilosus</i> (Mathur & Thapa, 1962)*	MT272758.1	Kottayam, Kerala, India
<i>Homalotermes pilosus</i> (Mathur & Thapa, 1962)*	MT272753.1	Kozhikode, Kerala, India
<i>Homalotermes pilosus</i> (Mathur & Thapa, 1962)*	MT272747.1	Ernakulam, Kerala, India
<i>Indocapritermes aruni</i> Chhotani, 1997*	MT272742.1	Kozhikode; Kerala, India
<i>Inquilinitermes</i> sp.	EU253866.1	NA
<i>Krishnacapritermes dineshan</i> Amina & Rajmohana, 2019*	MN507711.1	Idukki, Kerala, India
<i>Krishnacapritermes dineshan</i> Amina & Rajmohana, 2019*	MN507710.1	Idukki, Kerala, India
<i>Krishnacapritermes dineshan</i> Amina & Rajmohana, 2019*	MN507709.1	Idukki, Kerala, India
<i>Krishnacapritermes thakuri</i> Chhotani, 1997*	MN507714.1	Kollam, Kerala, India
<i>Krishnacapritermes thakuri</i> Chhotani, 1997*	MN507726.1	Thrissur, Kerala, India
<i>Krishnacapritermes thakuri</i> Chhotani, 1997*	MN507720.1	Ernakulam, Kerala, India
<i>Krishnacapritermes thakuri</i> Chhotani, 1997*	MN507724.1	Kollam, Kerala, India
<i>Krishnacapritermes thakuri</i> Chhotani, 1997*	MN507717.1	Ernakulam, Kerala, India
<i>Krishnacapritermes thakuri</i> Chhotani, 1997*	MN507729.1	Thrissur, Kerala, India
<i>Krishnacapritermes thakuri</i> Chhotani, 1997*	MN507727.1	Thrissur, Kerala, India
<i>Krishnacapritermes thakuri</i> Chhotani, 1997*	MN507728.1	Thrissur, Kerala, India
<i>Krishnacapritermes thakuri</i> Chhotani, 1997*	MN507721.1	Kollam, Kerala, India
<i>Krishnacapritermes thakuri</i> Chhotani, 1997*	MN507713.1	Kollam, Kerala, India
<i>Krishnacapritermes thakuri</i> Chhotani, 1997*	MN507716.1	Kollam, Kerala, India
<i>Labiocapritermes distortus</i> (Silvestri, 1922)*	MT272752.1	Thiruvananthapuram, Kerala, India
<i>Labiocapritermes distortus</i> (Silvestri, 1922)*	MT272744.1	Kozhikode, Kerala, India
<i>Labiocapritermes distortus</i> (Silvestri, 1922)*	MT272756.1	Kozhikode, Kerala, India
<i>Labiocapritermes distortus</i> (Silvestri, 1922)*	MT272743.1	Thiruvananthapuram, Kerala, India
<i>Microcerotermes crassus</i> Snyder, 1934	MH645300.1	Guam
<i>Microcerotermes parvus</i> (Haviland, 1898)	AY127721.1	NA
<i>Microcerotermes</i> sp. 1	JF923260.1	Africa
<i>Microcerotermes</i> sp. 2	JF923259.1	Africa
<i>Microcerotermes</i> sp. 3	MF804714.1	Myanmar
<i>Microcerotermes</i> sp. 4	MF804713.1	Myanmar
<i>Microcerotermes</i> sp. 5	JF923261.1	Africa
<i>Neocapritermes</i> sp.	MG813860.1	Guyana
<i>Neocapritermes taracua</i> Krishna & Araujo, 1968	KF430193.1	NA
<i>Odontotermes</i> sp.*	MN511308.1	Kozhikode, Kerala, India
<i>Pericapritermes</i> sp.	MF804751.1	Myanmar
<i>Pericapritermes topslipensis</i> Thakur, 1976*	MT272741.1	Wayanad, Kerala, India
<i>Pericapritermes topslipensis</i> Thakur, 1976*	MT272745.1	Wayanad, Kerala, India
<i>Pericapritermes topslipensis</i> Thakur, 1976*	MT272749.1	Wayanad, Kerala, India
<i>Pericapritermes topslipensis</i> Thakur, 1976*	MT272761.1	Wayanad, Kerala, India
<i>Pericapritermes topslipensis</i> Thakur, 1976*	MT272762.1	Kozhikode, Kerala, India
<i>Planicapritermes</i> sp.	MG813828.1	NA
<i>Procapritermes keralai</i> (Chhotani & Ferry, 1995)*	MT272757.1	Thiruvananthapuram, Kerala, India
<i>Procapritermes keralai</i> (Chhotani & Ferry, 1995)*	MT272748.1	Thiruvananthapuram, Kerala, India
<i>Pseudocapritermes fletcheri</i> (Holmgren & Holmgren, 1917)*	MT272754.1	Pathanamthitta, Kerala, India
<i>Pseudocapritermes fletcheri</i> (Holmgren & Holmgren, 1917)*	MT272746.1	Kozhikode, Kerala, India
<i>Pseudocapritermes fletcheri</i> (Holmgren & Holmgren, 1917)*	MT272751.1	Thiruvananthapuram, Kerala, India
<i>Rinacapritermes abundans</i> Amina & Rajmohana, n. gen., n. sp.*	MT274291.1	Wayanad, Kerala, India
<i>Rinacapritermes abundans</i> Amina & Rajmohana, n. gen., n. sp.*	MT274292.1	Wayanad, Kerala, India
<i>Rinacapritermes abundans</i> Amina & Rajmohana, n. gen., n. sp.*	MT274296.1	Wayanad, Kerala, India
<i>Rinacapritermes silvius</i> Amina & Rajmohana, n. gen., n. sp.*	MT274294.1	Pathanamthitta, Kerala, India
<i>Rinacapritermes silvius</i> Amina & Rajmohana, n. gen., n. sp.*	MT274293.1	Ernakulam, Kerala, India
<i>Rinacapritermes</i> sp.*	MT274295.1	Wayanad, Kerala, India
<i>Termes hispaniolae</i> (Banks, 1918)	FJ802753.1	NA

APPENDIX 2. — Raw uncorrected genetic distances (p) in percentage for the mt COI gene among the species of *Rinacapritermes* from different locations of the Western Ghats (see Table 1).

	<i>R. abundans</i>	<i>R. abundans</i>	<i>R. abundans</i>	<i>R. abundans</i>	<i>R. silvius</i>	<i>R. silvius</i>
<i>R. abundans</i> Amina & Rajmohana, n. gen., n. sp.	0	—	—	—	—	—
<i>R. abundans</i> Amina & Rajmohana, n. gen., n. sp.	3.0	0	—	—	—	—
<i>R. abundans</i> Amina & Rajmohana, n. gen., n. sp.	4.3	3.0	0	—	—	—
<i>R. abundans</i> Amina & Rajmohana, n. gen., n. sp.	3.4	4.3	7.1	0	—	—
<i>R. silvius</i> Amina & Rajmohana, n. gen., n. sp.	5.5	7.3	8.3	4.1	0	—
<i>R. silvius</i> Amina & Rajmohana, n. gen., n. sp.	5.2	7.1	8.0	3.9	2.0	0

APPENDIX 3. — Raw uncorrected genetic distances (p) in percentage for the mt COI gene among the 19 genera used for the construction of single gene tree phylogenetic tree. Abbreviations: **CYL**, *Cylindrotermes*; **RHI**, *Rhinacapritermes*; **PRO**, *Procapritermes*; **KRI**, *Krishnacapritermes*; **IND**, *Indocapritermes*; **PSE**, *Pseudocapritermes*; **LAB**, *Labiocapritermes*; **MIC**, *Microcerotermes*; **GEN**, *Genuotermes*; **HOM**, *Homallotermes*; **PLA**, *Planicapritermes*; **PER**, *Pericapritermes*; **INQ**, *Inquillinitermes*; **TER**, *Termes*; **AMI**, *Amitermes*; **DRE**, *Drepanotermes*; **NEO**, *Neocapritermes*; **DIC**, *Dicuspitermes*; **ODO**, *Odontotermes*.

	CYL	RHI	PRO	KRI	IND	PSE	LAB	MIC	GEN	HOM	PLA	PER	INQ	TER	AMI	DRE	NEO	DIC	ODO
CYL	0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
RHI	13.9	0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
PRO	14.1	14.4	0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
KRI	12.3	13.6	15.1	0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
IND	12.8	11.0	14.7	9.9	0	—	—	—	—	—	—	—	—	—	—	—	—	—	—
PSE	16.2	16.2	15.9	12.8	11.0	0	—	—	—	—	—	—	—	—	—	—	—	—	—
LAB	16.2	16.2	15.9	12.8	11.0	0	0	—	—	—	—	—	—	—	—	—	—	—	—
MIC	15.6	18.6	17.8	14.8	18.1	16.1	16.1	0	—	—	—	—	—	—	—	—	—	—	—
GEN	14.5	12.5	16.7	14.5	15.5	16.6	16.6	17.0	0	—	—	—	—	—	—	—	—	—	—
HOM	18.3	17.8	18.8	18.0	15.2	15.5	15.5	18.4	16.8	0	—	—	—	—	—	—	—	—	—
PLA	13.6	15.7	14.6	13.9	14.2	14.7	14.7	12.8	14.0	18.5	0	—	—	—	—	—	—	—	—
PER	19.3	20.9	17.7	18.1	18.7	17.9	17.9	16.3	22.8	21.6	16.1	0	—	—	—	—	—	—	—
INQ	17.9	18.6	19.4	15.8	16.6	19.2	19.2	15.7	17.5	19.2	13.1	20.5	0	—	—	—	—	—	—
TER	14.8	17.8	16.6	15.7	16.0	17.6	17.6	15.3	15.0	16.5	11.7	18.3	12.9	0	—	—	—	—	—
AMI	14.0	11.5	13.0	11.2	13.5	14.1	14.1	14.0	12.2	15.9	10.3	17.9	14.8	12.9	0	—	—	—	—
DRE	23.4	21.2	23.4	21.2	20.3	22.2	22.2	27.1	21.0	22.3	24.8	31.7	26.1	22.4	18.7	0	—	—	—
NEO	14.7	17.4	13.4	16.4	15.9	17.5	17.5	19.1	16.8	21.2	11.8	19.5	18.3	16.0	13.0	26.5	0	—	—
DIC	13.6	15.3	15.8	11.1	12.8	15.5	15.5	17.2	16.7	17.4	13.1	17.7	20.5	15.6	11.7	21.7	16.6	0	—
ODO	18.4	23.8	20.5	23.1	22.8	24.6	24.6	22.2	25.0	24.5	20.0	20.0	21.7	20.5	20.0	24.4	23.4	22.1	0