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Systematics, distribution and ecology of big headed ant, *Pheidole sharpi sharpi* Forel (Hymenoptera: Formicidae) of Kerala

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ABSTRACT
The genus *Pheidole* Westwood is generally known as "Big headed ants" and entitled as hyperdiverse. It is one of the most species rich genera that shows highest dispersal in terms of ecological dominance. The current study was carried out in 14 districts of Kerala to study the distribution as well as ecology of the species *Pheidole sharpi sharpi* Forel. This species was found to be diurnal and widely distributed throughout Kerala. Specimens were collected by mainly food bait, hand picking and by all out search method. Species were redescribed and compared with closely similar species.

Keywords: *Pheidole*, systematics, hyperdiverse, ecology, distribution.

1. Introduction
Ants contribute a conspicuous component of terrestrial biodiversity. So far many species of ants have been described. They are the most species divergent group among all groups of social insects. The ants occupy virtually all major terrestrial habitats, with the exception of tundra and cold ever-wet forests. They exhibit wide range of social behaviors', foraging habits and associations with other organisms.
The genus *Pheidole* was erected by Westwood [1], based on the type species *Atta providens* (Sykes) form India. *Pheidole* is the largest genus in the tribe Pheidolini, [2] Bingham [3] provided the description of *Pheidole* species and Wilson [4] published *Pheidole* Monograph of New World. Bharti [5, 6] added species to the Indian ants. Species of the genus *Pheidole* can be found in almost every habitat, occupying a large variety of ecological niches and functions. In India there are 54 valid species of *Pheidole* [7]. The present study aims to redescribe *Pheidole sharpi sharpi* Forel from Kerala. Distribution, ecology and comparison with closely related species was also carried out.

2. Materials and Methods
The specimens were collected by brush method, hand picking, all-out search method and food bait. The samples were collected during 2010 to 2013 from all districts of Kerala which include hilly areas, forests, marshy area, coastal regions, mid lands, wet lands and mid-arid regions. Species were analyzed using Leica MZ6 stereozoom microscope. Identification upto subfamily and genus level followed "The ants" [8] and "Identification guide to the ant genera of the world" [9]. Species level identification was carried out with the help of Bingham [3]. In addition to these, original descriptions from web resources (www.antweb.org) [10] were also used for the identification. For digital images, multi-focused montage images were produced using Leica S8APO Stereo microscope. Later, montage images, unnecessary parts (unfocused appendage), surrounding or covering target objects were erased and cleaned up. The backgrounds, colour balance, contrast and sharpness were adjusted using Adobe Photoshop CS3. Description format and morphological terminology for measurements and indices follow Longino [11] and Fischer [12] and include: HL = Head length; maximum distance from the mid-point of the anterior clypeal margin to the mid-point of the posterior margin of the head, measured in full-face view; in majors from midpoint of tangent between anterior most positions of clypeus to midpoint of tangent between posterior most projections of the vertex; SL = Scape length; maximum scape and neck; MDL = Mandible length; maximum length of mandible measured in oblique fronto-lateral view PW = Pronotal width; maximum width of

pronotum measured in dorsal view; WL = Webers length; diagonal length of mesosoma in lateral view from the anterior point of the pronotal slope and excluding the neck, to the posterio- ventral margin of the propodeum; PSL = Propodeal spine length; in dorso-caudal view, with the apex of the measured spine, its base, and the centre of the propodeal concavity between the spines in focus: measurement was taken from apex to base along the one axis of a dual-axis micrometer, aligned along the length of the spine, crossing the second axis at the base of the measured spine, and the latter connecting the base with the centre of the propodeal concavity; PTH = Petiole length; maximum height of petiolar node measured in lateral view from the highest (median) point of the node, orthogonally, to the ventral outline of the node; PTW = petiolar node width; maximum petiolar node width, measured in dorsal view; PPH= Post petiole height; maximum height of postpetiole in profile from uppermost to lowermost point, measured perpendicularly to tergosternal suture; PPL= Post petiole length; maximum length of post petiole in dorsal view between its visible anterior and posterior margin; PPW = Post petiole width; maximum width of post petiole from above/ in its dorsal view; CI = Cephalic index; HW / HL * 100; EI = Eye index; EL / HW x 100; SI = Scape index; SL / HW x100; MDI = Mandible index; MDL / HW x 100; PSLI = Propodeal spine index; PSL / HW x 100

2.1 Acronyms of depositories

SXC = St. Xavier's College for Women, Aluva, Kerala, India
ZSIWGRC = Zoological Survey of India Western Ghats Regional centre, Calicut, Kerala, India

3. Results and Discussion

Pheidole sharpi sharpi Forel
Pheidole sharpi Forel, 1902c: 169 (s.), 188 (w.) India (MHNG)
[Also described as new by Forel, 1902g: 540].

Material examined

(1 Major) India: Kerala, Ernakulam: Perumbavoor 10° 7' N, 7 6° E. 1. x. 2010, soil core; (2Major, 4Minors) India: Kerala, Thrissur: Horticultural College, 13° 32' N 76° 26' E. 17. vii. 2010, soil core; (1 Major, 5 Minors) India: Kerala, Ernakulam: Aluva 10° 6' N, 76° 21' E. 18. i. 2011; (1Minor) India: Kerala, Ernakulam: Valarpadam 9° 59' N, 76° 15' E. 22. i. 2011, leaf litter; (3 Major, 3 Minor) India: Kerala, Malappuram: Teak Museum 11° 18′ N, 76° 15′ E. 15. ii. 2011, hand picking; (1 Major, 2 Minor) India: Kerala, Calicut: Devagiri 19° 56‟ N, 75° 12‟ E. 17. ii. 2011, hand picking; (4 Major, 5 Minor) India: Kerala, Malappuram: Nedumkayam 11°1' N, 76° 3' E. 21. v. 2011, tree bark; (2 Major, 4 Minor) India: Kerala, Thrissur: Peechi 10° 31‟ N, 76° 22‟ E 23. v. 2011, brush method; (2 Minor) India: Kerala, Calicut: Chevayoor 11° 16' N, 75° 49' E. 16. ii. 2011, soil core; (3 Minor) India: Kerala, Thrissur: Ollukkara 10° 31' N, 76° 15' E. 22. ii. 2011, food bait; (9 Minor) India: Kerala, Malappuram: Canoly plot 11° 16' N, 76° 12' E. 24. ii. 2011, food bait; (3 Minor) India: Kerala, Malappuram: Nilambur 11° 16' N, 76° 13' E. 29. ii. 2011, soil; (1 Major, 2 Minor) India: Kerala, Wyanad: Kaniyampetta 11° 41' N, 76° 4' E04. v. 2012, brush mathod; (2 Major, 2 Minor) India: Kerala, Wyanad: Muthenga 11° 40' N, 76° 22' E. 03. v. 2012, hand picking; (1 Major, 1 Minor) India: Kerala, Wyanad: Kottiyoor 11° 52' N, 75° 51' E. 20. iv. 2012, hand picking; (1Major, 1 Minor) India: Kerala, Wyanad: Chekkady 11° 54' N, 76° 1' E. 19. iv. 2012, hand picking; (2 Major, 1Minor) India: Kerala, Calicut: Kakkavayal 11° 38' N, 76° 8' E. 03. iii. 2012, soil core; (2 Major, 1 Minor) India: Kerala, Palakkad: Pattambi 10° 48' N, 76° 11' E. 28. iii. 2012, leaf litter; (1 Major) India: Kerala, Pathanamthitta: Konni 9° 13' N, 76° 50' E. 14. x. 2011, hand picking; (1 Major) India: Kerala, Thrissur: Irijalakuda 10° 20' N, 76° 12' E. 12. xii. 2011, hand picking; (2 Major, 1 Minor) India: Kerala, Palakkad: Puthussery 11° 46' N, 75° 55' E. 14. i. 2012, hand picking; (5 Major, 1 Minor) India: Kerala, Kasargod: KAU peelicode 12° 11' N, 75° 9' E. 23. i. 2012, brush method; (1 Major, 1 Minor) India: Kerala, Kannur: Pazhassi dam 11° 59' N, 75° 39' E. 26. v 2012, hand picking; (1 Major, 1 Minor) India: Kerala, Kannur: Aralam 11° 43' N, 75° 41' E. 24. v. 2012, food bait; (1 Major, 1 Minor) India: Kerala, Kannur: St. Angelos Fort 11° 51' N, 75° 22' E. 23. v. 2012, food bait; (1 Major, 1 Minor) India: Kerala, Thrissur: Cheppara 8 ° 59' N, 76° 53' E. 18.v.2012; (1 Major, 2 Minor) India: Kerala, Thrissur: Vazhani 10° 38' N, 76° 18' E. 15. v. 2012, food bait; (1 Minor) India: Kerala, Kollam: Punalur 9° 1‟ N, 76° 55‟ E. 07. iv. 2011, food bait; (1Minor) India: Kerala, Thrissur: Athirapilly 10° 17' N, 76° 34' E. 26. i. 2011, food bait; (1Minor) India: Kerala, Trivandrum: Vizhijam 8° 24' N, 76° 59' E. 19. iv. 2011, brush method; (1Minor) Vagamon 9° 41' N, 76° 54' E. 30. xii. 2011, (Coll: Presty John). All specimens are at SXC and will eventually transfer to ZSIWGRC.

Redescription

Major worker (Fig. 1a- 1d)
Measurements and Indices (mm).
HW = 1.766, HL = 1.935, SL = 0.949, MDL = 0.755, EL = 0.225, PW = 0.837, WL = 1.507, PSL = 0.065, PPH = 0.424, PTH = 0.345, PTW = 0.0.435, PW = 0.753, CI = 91.266, EI = 12.784, SI = 53.92, MDI = 42.865, PSLI = 3.693, PWI = 47.557, Pp WI = 173.103, PeI = 51.971, PpI = 89.964.

Head

Longer (1.096x) than broad; lateral sides convex; vertex impressed in middle; occipital emargination broad (0.739 mm), shallow; clypeus medially carinated, anteriorly emarginated; fronto-clypeal suture distinct; frontal carina long (1.209 mm), parallel, posterior end 2.34x broader than anterior end; antennal grove distinct, shallow, partially covered by frontal lobe; antenna with 3 segmented club, terminal club CL3 longer than (0.214 mm) CL2 (0.164 mm) and CL1 (0.123 mm), shorter than CL2 + CL1 (1.3x), scape short (0.949 mm), cylindrical reach below the top of head by half the way from its insertion to top of the head; eyes small (0.225 mm) rounded, shorter than malar space; distance between mandibular insertion and anterior margin of eyes is 1.83x longer than the diameter of eye, 10–12 ommatidia along longitudinal axis; mandibles strong, broad (Fig: 1a), massive with obsolete dentition.

Mesosoma and pedicel

Pronotum convex (Fig: 1b), gibbous anteriorly, tubercle distinct, pronotum and mesonotum forming two convexities, pronotum broader than mesonotum and metanotum (Fig: 1b); pronotum forms a dome in profile with a distinct prominence on its posterior declivity; humeral area produced, laterally with obtuse cones; promesonotal furrow distinct, broad (0.288 mm) broader than mesometanotal suture (0.191 mm); metanotal spines short (0.065 mm), dentate (Fig: 1c), acute at apex; first node of pedicel with translucent rounded appendix beneath, triangular in profile, upper margin transverse, not emarginated;

second node rounded above, as broad as long, broader than first node (1.73x).

Gaster
Broadly oval (Fig: 1d), longer than broad (1.264x), opaque.

Sculpture
Head deeply longitudinally striated; mandibles finely striated at base; head laterally reticulated; pronotum above transversely striated; mesonotum and metanotum rugorecticulate; gaster striated from base to base, clypeus smooth.

Vestiture
Sparse semierect hairs present all over the body, more abundant on legs; antennae pubescent.

Colour
Head, mesosoma, mandibles, antennal scape chestnut red; legs, flagellum reddish brown; gaster black, shading lighter towards base; pilosity reddish yellow.

Minor Worker (Fig: 1e- 1h)
Measurements and Indices (mm):
HW = 0.733, HL = 0.850, SL = 1.144, MDL = 0.487, EL = 0.151, WL = 1.058, PW = 0.490, PSL = 0.013, PPH = 0.248, PTH = 0.248, PTW = 0.139, PPW = 0.312, CI = 86.235, EI = 20.600, SI = 196.99, MDI = 66.439, PSLI = 1.773, PWI = 66.848, PpWI = 224.460.

Head
Oval, longer (1.16x) than broad, narrowing anteriorly with distinct posterior and anterior margins (Fig: 1e, 1f) ; posterior margin of head rounded; occipital collar distinct; occipital emargination absent; no impression on vertex; clypeus not emarginated in middle, acarinate, convex; frontal carina short (0.294mm), reaching upto the base of eyes; antennal groove broad (Fig: 1e), long, distinct, frontal lobe inconspicuous; antennae wit 3 segmented club, CL3 longer (0.328 mm) than CL1 (0.118 mm) and CL2 (0.242 mm), 1.1x shorter than CL1 + CL2, funicular segment F3 = F6, scape cylindrical, extend beyond the top of head by two third from its insertion to the top of head (Fig: 1e); eyes rounded, located medially, nine to ten ommatidia along longitudinal axis; mandibles dentate.

Mesosoma and pedicel
Pronotum and mesonotum forming to different convexity, attenuated anteriorly (Fig: 1e) not forming a dome in profile; humeral area weakly produced; promesonotal groove shallow (0.148 mm) shorter than mesometanotal groove (0.185 mm); metanotal spines small (0.013 mm), stout, dentate (Fig: 1g); base of metanotum flat; legs cylindrical; first node of pedicel with no appendix beneath (Fig: 1g), subcuneiform, longer than second node; helicium obsolete; second node of pedicel broadly oval, 2.25x broader than first node, circular in profile.

Gaster
Oval (Fig: 1h), longer (1.43x), than broad opaque.

Sculpture
Head, pronotum, clypeus legs smooth, polished, shining; mandibles feebly striated at base; mesonotum and metanotum rugo-reticulate.

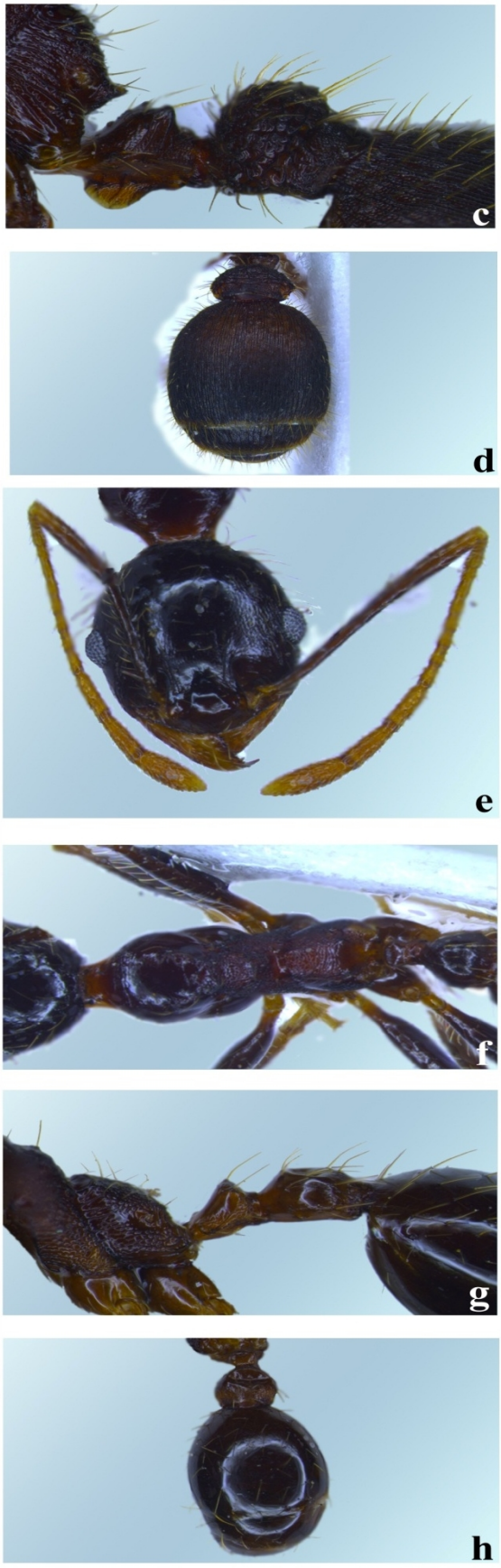
Vestiture
Pale, semierect sparse hairs present all over the body.

Colour
Head, gaster brownish black; mandibles, antennae, mesosoma, legs brownish yellow; pedicel brown.

Distribution.
India [Kerala: Thrissur, Ernakulam, Malappuram, Calicut, Wayanad, Palakkad, Pathanamthitta, Kasargod, Kannur, Kollam, Idukki, Trivandrum].

Ecology
Omnivorous, diurnal, more active during noon.

Remarks
Since the available description of this species is inadequate for easy identification, a redescription is provided here.
The major worker of *P. sharpi sharpi* Forel closely resembles *P. naoroji* Forel in having 1. Head anteriorly longitudinally striated; 2. Clypeus carinated in middle; 3. First node of pedicel with an appendix beneath. However *P. sharpi sharpi* differs from *P. naoroji* in having 1. Occipital emargination deep; (in *P. naoroji* occipital emargination not deep); 2. Pronotal tubercle distinct (in *P. naoroji* pronotal tubercle obtuse); 3. Gaster striated from end to end (in *P. naoroji* gaster not striated, smooth). The minor worker of *P. sharpi sharpi* closely resembles *P. naoroji* in having 1. Head oval with distinct posterior margin; 2. Pronotum convex; 3. Gaster smooth. However *P. sharpi sharpi* differs from *P. naoroji* in having 1. Scape extending beyond the top of head by two third from its insertion (in *P. naoroji* scape extends not by two third, but by one fourth from its insertion); 2. First node of pedicel subcuneiform (in *P. naoroji* first node of pedicel not subcuneiform but squamiform); 3. No small tubercles on pronotum (in *P. naoroji* minute tubercles are present on pronotum).



Pheidole sharpi sharpi Forel Major –a) Head dorsal view; b) Mesosoma and pedicel dorsal view; c) Nodes of pedicel lateral view; d) Gaster dorsal view. Minor –e) Head dorsal view; f) Mesosoma and pedicel dorsal view; g) Nodes of pedicel lateral view; h) Gaster dorsal view.

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