Revision of the Ant Genus Bothroponera (Hymenoptera: Formicidae: Ponerinae) From the African Continent

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REVISION OF THE ANT GENUS *BOTHROPONERA* (HYMENOPTERA: FORMICIDAE: PONERINAE) FROM THE AFRICAN CONTINENT

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Dedication

I dedicate this dissertation to my family, to my parents Mohamed Alnour and Khadija Mohamed Ali, who raised me and encouraged me throughout my life to be able to achieve the highest level of education. To my wife Hawa Algatroni and children Rawan and Mustafa, who always supported me wherever my study took me, filling my life with love and patience. To my brothers: Abdalrahman, Mahmoud, Abdalnour, Ali, Ibrahim and my sisters: Aisha, Fatima, Zainab, Zohra, Imbarka, Mouna, who did not neglect any opportunity to encourage me to continue my scientific journey at all times.

A special dedication goes to my supervisor, Professor William Mackay, who transferred his experience in the field of myrmecology to me, opened his laboratory for my use to complete my research and supported me during my time at UTEP.
REVISION OF THE ANT GENUS *BOTHROPONERA* (HYMENOPTERA: FORMICIDAE: PONERINAE) FROM THE AFRICAN CONTINENT

by

Abdulmeneem M. Alnour Joma, BSc, MSc

DISSEPTION

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Chapter 1. Revision of the African ants of the *Bothroponera pumicosa* species complex (Hymenoptera: Formicidae: Ponerinae)

**Abstract**

The Afrotropical ants in the genus *Bothroponera* include the *pumicosa*, *talpa*, and *sulcata* species complexes. Species in the *Bothroponera pumicosa* species complex are mainly distributed in the southern part of Africa. This group of ants is characterized by having coarsely foveolate sculpture and by having either a raised a “v” or “u” shaped anterior medial area of the clypeus (anteclypeus), with or without a carina. The mandibles have 7 teeth in the majority of species and 8 teeth in the others. The eyes are relatively large. The scapes usually do not reach the posterior lateral corner of the head, but in some species they reach or slightly exceed the posterior corner. Members of this complex lack the metatibial gland on the anterior side of the metatibia. The African members of this complex include: *Bothroponera aspera* (stat. nov.), *B. berthoudi* (= variolosa syn. nov.), *B. cariosa*, *B. cavernosa*, *B. granosa*, *B. laevissima*, *B. montivaga* (stat. nov.), *B. pumicosa*, *B. strigulosa*, and *B. umgodikulula*. Several morphological characters distinguish members of the *Bothroponera pumicosa* complex, such as sculpture pattern, gastral segment form, scape length, and form of the anterior border and disc of the clypeus. A key to the workers with diagnoses and comparisons is provided, together with illustrations of each species as well as the distributions and information about the material examined and colored photographs of the species.
Introduction

The genus *Pachycondyla* was described by Frederick Smith in 1858 when he introduced ten species of *Pachycondyla* including *P. crassinoda, P. simillima, P. striata, P. rufipes, P. tridentata, P. piliventris, P. bispinosa, P. astuta, P. punctata* and *P. montezumia* from throughout the world. The genus *Pachycondyla* (family Formicidae, subfamily Ponerinae, tribe Ponerini) comprises a large heterogeneous group of ants; classified in more than 17 genera (Schmidt and Shattuck, 2014). In 1862, Mayr introduced the subgenera *Paltothyreus, Megaponera, Bothroponera*, and in 1867 he also recognized *Ectomomyrmex* to be a new subgenus of *Pachycondyla*. Forel added the genus *Ophthalmopone* in 1890, the subgenus *Euponera* in 1891 and Emery in 1893 added *Cryptopone* to be new subgenus of *Pachycondyla*. Taxonomists continued describing new subgenera in *Pachycondyla*. For example, in 1900, Emery added three subgenera including *Brachyponera, Mesoponera* and *Pseudoponera*; moreover, he added *Neoponera* in 1901 and in 1901 Forel (1901a) added *Eumecopone* and *Hagensia* as new subgenera of *Pachycondyla*. Others described new subgenera considered part of *Pachycondyla* including *Trachymesopus* Emery (1911a), *Xiphopelta* Forel (1913), *Syntermitopone* and *Termitopone* W. M. Wheeler (1936), *Wadeura* Weber (1939) and *Pseudoneoponera* Donisthorpe (1943). The above history reflects the vast diversity of this group. By considering the wide range distribution of tropical and subtropical ants, Brown, (1973) Snelling, (1981), Hölldobler and Wilson, (1990) Brown in Bolton, (1994) and Bolton, (2003) included all of the above subgenera as synonyms of *Pachycondyla*. The subgenera were in a state of taxonomic confusion (Mackay & Mackay, 2006; Mackay & Mackay, 2010; Joma and Mackay, 2013) and the genus is not monophyletic (Schmidt, 2013). Recently, *Pachycondyla* and *Bothroponera* along with other genera of the subfamily Ponerinae received modern molecular attention that made huge adjustments in their classification (Schmidt and Shattuck, 2014), and confirmed our conclusions (Joma and Mackay, 2013) that *Bothroponera* should be considered as a genus. The new classification information included only two tribes for the subfamily Ponerinae. Tribe Platythreini with one genus (*Platythyrea*) and Tribe Ponerini with 46 genera included in six genus groups (*Harpegnathos* genus group, *Hypoponera* genus group, *Odontomachus* genus group, *Pachycondyla* genus group, *Plectroctena* genus group and *Ponera* genus group). According to Schmidt and Shattuck (2014) the genus *Bothroponera* is placed in the *Odontomachus* genus group.

The distribution of *Bothroponera* includes the African tropics, as well as the Oriental Region (India and Southern Asia). The ancestor of *Bothroponera* apparently evolved after the separation of the Neotropical Region from Afrotropical Region (more than 100 million years ago) because they are not found in the Nearctic, Palearctic and Neotropical Regions. They are also not found in Mesoamerica,
North Africa, the Arabian Peninsula, Australian region and Iran (based on maps from antwiki accessed 10/2014).

The genus *Bothroponera* is characterized by the narrowed, convex, medially raised clypeus with the anterior medial margin “u” or “v” shaped in the *Bothroponera pumicosa* species complex, straight or slightly concave in the *B. talpa* species complete and broadly convex in the *B. sulcata* species complex. The carina is present or absent on the anterior medial longitudinal raised area of the clypeus. The mandibles are triangular or narrowed with 6 - 9 teeth. The frontal lobes are rounded or semi-oval shaped in the *B. pumicosa* and *B. talpa* species complexes and subquadrate in the *B. sulcata* species complex, divided by a well-developed frontal furrow. The pronotum of the worker lacks any evidence of a carina or shelf. The lateropronotum has straight lower margins with a rounded or angled inferior pronotal process and anteroinferior pronotal process. The mesopleuron is not divided by an anapleural suture, and is well separated from the metapleuron by the mesometapleural suture. A toothed epicnemial process is present on the ventral side of the pronotum. The basalar sclerite is oval, semi-oval or rounded in shape. The mesonotum is completely fused with the propodeum and the notopropodeal suture is completely absent. The propodeum is strongly curved posteriorly to form a semi-vertical posteropropodeum with or without angled lateral margins. In some species, the propodeum slightly slopes posteriorly (evenly rounded) to form a poorly distinguished posteropropodeum separated from the dorsopropodeum. The propodeal spiracle is slit shaped and situated (diagonal or oblique), vertically or horizontally on the lower part of the lateropropodeum. The petiole is thick, sub-rectangular. The anterior petiolar face is vertical, the apex is rounded. The posterior petiolar face is vertical and slightly concave (seen from the side). The apex of the petiolar node is with or without a medial depression (seen from above). The sternopetiolar process is present with or without an anterior tooth. The anterior face of the postpetiole is vertical with a developed anterior sternopostpetiolar process. The 4th to 7th abdominal segments (2nd to 5th gastral segments) often have different sculpture from the other surfaces.

There are numerous previous studies on the ecology and surveys of Afrotropical ants where the identifications of some specimens were not available. For example, Belshaw and Bolton, (1994) conducted a survey of the African ant fauna in Ghana. They collected approximately 183 individuals (representing eight different species of *Pachycondyla*), recognized species including *Pachycondyla ambiguа, P. brunoі, P. caffraria, P. fugaх, P. pachyderma*, and *P. sorоr* whereas two species were unidentified or new species. Recently, the classification of these taxa has changed to become *Mesoponera ambiguа, Euponera brunoі, Mesoponera caffraria, Bothroponera fugaх, B. pachyderma*, and *B. sorоr*. Dejean *et al.*, (1996) studied ant colonies in 10 forests of southern Cameroon; they
collected about 14 species of *Pachycondyla*, which were occupying *Cubitermes termitaries* nests. In fact, five were *Bothroponera* species including *B. talpa*, *B. fugax*, *B. silvestrii*, *B. soror* and *B. pachyderma*. Another five species were distributed into different genera including *Euponera brunoi*, *Mesoponera ambigua*, *M. caffraria*, *Loboponera nasica*, and *Paltothyreus tarsatus*, whereas four species were unidentified or new. Schoeman and Foord, (2012) studied the ant species richness of the Marakele National Park in South Africa as one of the most important studies involving conservation plans. They found about three species, including *Bothroponera granosa*, which was found in two different sites that were characterized by ecotone ranges between mountains and open area, a second species was *Paltothyreus tarsatus* whereas the third species was unidentified. Fisher, (2004) conducted one of the most important studies on diversity patterns of ants in southwestern Gabon, where he collected 5 species, including *Mesoponera ambigua*, *M. cattvaria* [*M. caffraria*], *P. cf. sharpi*, *Paltothyreus tarsatus*, *Euponera sjostedti* and *Bothroponera talpa*, whereas four species were unknown.

In this project, I will focus on the members of *Bothroponera* from Africa to reorganize the genus at the species level. This chapter presents a revision of the Afrotropical *Bothroponera* of the *pumicosa* species complex, which is part of a revision of this conspicuous and ecologically important group of ants to improve the knowledge of African *Bothroponera* and provide keys for the identification of species.
Materials and Methods

Museums and Collections:

The specimens of the African Bothroponera species complexes were obtained from the following museums:

- Naturhistorisches Museum, Basel, Switzerland (NHMB).
- Iziko South African Museum, South Africa (SAM).
- Dr. William Mackay’s collection (CWEM) the University of Texas at El Paso, USA.
- British Natural History Museum, London, UK (BMNH).
- Museum für Naturkunde, Berlin, Germany (ZMHU).
- Museo Civico di Storia Naturale, Genova, Italy (MCSN).
- American Museum of Natural History, New York, USA (AMNH).
- Los Angeles County Museum of Natural History, California, USA (LACM).
- Museum of Comparative Zoology, Cambridge, Massachusetts, USA (MCZC).

Measurements and Abbreviations used:

The specimens were examined with a Zeiss binocular microscope with an ocular micrometer. All measurements are in millimeters.

- Head Length (HL), in full face view, the maximum length of the head excluding the mandibles, from the mid-point of the anterior clypeal margin to the mid-point of the posterior margin of the head.
- Head Width (HW), in full face view, the maximum width of the head from the extreme side of head to the other extreme side excluding the eyes.
- Mandible length (ML), the distance from the mandible’s base to the apex of the apical tooth.
- Eye Length (EL), the maximum diameter of the eye as seen from the side.
- Eye Width (EW), the maximum distance of the eye from the anterior edge to the posterior edge as seen from the side.
- Scape Length (SL), the maximum length of the scape from the proximal to the distal extremes, excluding the basal constriction.
- Funiculus Length (FL), the measurement of the distal 11 segments of the antenna including the club and all of the funicular segments.
Weber Length (WL), the length in lateral view, from the anterior edge of the pronotum to the end of posterior margin of the propodeal lobes.

Petiole Length (PL), in lateral view, the maximum distance of the petiole from the anterior face to the posterior edge, excluding the helcium.

Petiole Width (PW), in dorsal view, the maximum side to side thickness of the petiole, generally at the posterior edge since it has the largest width.

Petiole Height (PH), in lateral view, the maximum length from the lower point of the sternopetiolar process excluding the petiolar teeth, to the highest point at the apex of the petiolar node.

Further Measurements and Descriptions:

In each specimen I measured the hair length, the total body length, the malar space length (from lower edge of the eye to the base of the mandible), and the length of the side of the head from the upper margin of the eye to the highest point of the posterior lateral corner of the head (side view). In some cases, I measured the frontal lobe width and the gaster length. There are other characters that are taken into account including the shape of the head, size of the eyes (large or small), pronotum, mesopleuron, propodeum, petiole and postpetiole. The shape of the pronotal shoulder, lower margin of the pronotum, basalar sclerite, and propodeal spiracle are also important. The entire body color including the antennae, clypeus, mandibles and legs were described as well.

Indices used:

Cephalic Index (CI), HW/HL x 100.
Ocular Index (OI), EL/HW x 100.
Mandible Index (MandI), ML/HL x 100.
Scape Index (SI), SL/HW x 100.
Petiole Index (PetI), PW/PL x 100.

Illustrations, photos and maps:

The morphological terms are from Serna and Mackay (2010) and Keller (2011). Illustrations were completed using the typical methods such as compound microscope, microscopic grids, and a micrometer.
Photos were taken in the Museum of Comparative Zoology (MCZC) using an automontage photosystem provided with computer software (LEICA MZ 7.5 stereomicroscope, Canon Camera EOS 7D 18 megapixel digital SLR, Helicon focus software and Photoshop). The Ant website was the alternative source to obtain ant photos.

Maps of the distribution of African *Bothroponera* were completed using Golden Software MapViewer version 3.0. The longitudes and latitudes of the specimen localities were determined using fuzzy gazetteer (isodp.hof-university.de/fuzzyg/query/). Google Earth was used to identify the ant localities.

Lectotypes and paralectotypes were named in order to establish the identity of the species.
Genus description
Family Formicidae
Genus Bothroponera Mayr, 1862

Worker:

Specimens characterized as large ants, with maximum total length 5 - 16 mm; head subquadrate in most species (excluding mandibles), suborbicular in some species, posterior border generally concave; mandibles narrowed or triangular-shaped in most species, shorter than head length with teeth number ranging from 6 to 9; anterior medial margin of clypeus convex, often sharply angled or straight to slightly concave with medial raised area; frontal lobes divided by well-developed frontal furrow; scape shorter, nearly reaches or extends past posterior border of head; compound eyes vary from relatively small to large; sculpture smooth or slightly rough to punctate or foveolate; pronotal shoulder squared or rounded, but without lateral margin or carina in all species of Bothroponera; mesonotum and propodeum poorly separated by notopropodeal groove; mesopleural suture well developed; propodeum rounded between faces, mesonotal basalar sclerite rounded or oval-shaped, propodeal spiracle elongate or slightly oval-elongate; petiole subquadrate, rounded antero-posteriorly, usually wide with definite dorsal face; stridulatory file present on second acrotergite of gaster; hairs scarce on body and usually short; color mostly dark brown or black.

Female:

Head subquadrate or suborbiculate; pronotum rounded anteriorly, pronotal shoulder lacking carina or lateral margins; scutum wide anteriorly, reaches same width as pronotum, narrowed posteriorly to same width as scutellum; metanotum slightly elevated, narrowed, well separated from propodeum and scutellum; mesopleuron divided by anapleural sulcus to form ventral katepisternum and dorsal anepisternum; mesopleural suture well defined; mesonotal basalar sclerite oval or round shaped, propodeal spiracles elongate or subrectangular in some species; petiole rounded anteriorly, vertical with slightly concave posterior face in some species; postpetiole rounded or subquadrate anteriorly; postpetiole and remainder of gaster larger than mesosoma; short to moderately long (up to 0.40 mm) erect golden hairs scattered on dorsum of pronotum, scutum, scutellum, metanotum, propodeum, petiole
and postpetiole; short (up to 0.15 mm) erect golden hairs on head; surfaces mostly brown, dark brown or black.

**Male:**

Head excluding mandibles rounded or elongated; eyes large, cover most of side of head; scape shorter and thicker than second segment of funiculus; pronotum triangular, scutum usually with notauli; scutellum elevated, triangular in dorsal view, metanotum slightly raised between scutellum and propodeum, mesopleuron divided by anapleural sulcus into ventral katepisternum and dorsal anepisternum; propodeum gradually sloping downward posteriorly to reach insertion of petiole; petiole small, apex rounded, width and height less than those of propodeum and postpetiole; postpetiole rounded or squared anteriorly; color mostly black or dark brownish.
Comparison of Bothroponera with Pachycondyla and similar genera

Worker:

There are some of important differences between Bothroponera and Pachycondyla (sensu lato). For example, the head of Bothroponera is usually suborbicular or subquadrate, whereas it ranges from elongate, subrectangular, subquadrate or suborbicular to subtriangular in Pachycondyla. The pronotal shoulder never has a shelf or carina in Bothroponera as it often does in Pachycondyla. The mesonotum is completely fused with the propodeum in Bothroponera species while they are divided by notopropodeal groove in Pachycondyla and other similar genera. The propodeal spiracle is slit slide shaped in all Bothroponera and vertical in all Bothroponera species complexes except in B. umgodikulula where the propodeal spiracle is positioned horizontally on the lateropropodeum; in contrast, the propodeal spiracle is slit shaped to rounded in Pachycondyla and similar genera. The petiole is thick and subquadrate, slightly rounded anteriorly, vertical and slightly concave posteriorly in Bothroponera; conversely, in Pachycondyla and similar genera it is rarely square-shaped and is often compressed antero-posteriorly with a pointed apex in many species or thicker and larger than Bothroponera in other species. The sculpture ranges from slightly rough, rough, punctate to smooth and moderately shiny in Pachycondyla, while it is rough, coarsely rough, punctate and nearly always foveolate in Bothroponera. The sculpture varies among the Bothroponera species complexes as well.

Female:

The characteristics that separate females of Bothroponera from the remainder of Pachycondyla are similar to those of the worker, except for the structure of the mesopleuron, metanotum and abdominal segments. The mesopleuron is divided by the anapleural sulcus into the upper anepisternum and lower katepisternum in females of both Bothroponera and Pachycondyla and similar genera. The metanotum is narrowed and slightly elevated between the scutellum and the propodeum in both genera. The postpetiole and the fourth-seventh abdominal segments are nearly twice as large as the mesosoma in both genera. The meso-metanotal suture and the metanotal-propodeal grooves are deeply impressed in the queen caste of Bothroponera and other genera.
Male:

The males of *Pachycondyla* and *Bothroponera* are basically similar. The only males of *Bothroponera* seen in this study include those of *B. pachyderma*, *B. crassa*, *B. crassior*, *B. kruegeri*, *B. kenyensis*, *B. soror*, *B. notaula* and *B. ryderae*. The characterization and comparison of the males of both *Pachycondyla* and *Bothroponera* is as follows: The head is suborbicular in most species, elongate in others. The eyes cover most of the sides of the head. The scape is shorter and thicker than the second funicular segment. The anterior margin of the clypeus is convex in most species, straight to slightly concave in others. The pronotum is narrow, rounded anteriorly, and widened posteriorly on the sides. The mesopleuron is large and divided into upper anepisternum and lower katepisternum. The scutum is slightly elevated, widened and rounded anteriorly, narrowed and straight posteriorly in dorsal view. The notauli are present or absent in different species. The scutellum is as wide anteriorly as the posterior width of the scutum, narrowed posteriorly and bounded posteriorly by the metanotum. The metanotum is elevated higher than the dorsopropodeum, but lower than the scutellum. The propodeum slopes gradually posteriorly to reach the attachment point of the petiole. The dorsopropodeum is wide (slightly elongate antero-posteriorly) in some *Pachycondyla* species, narrow in others. The metapleuron forms two parts: a distinctive upper metanepisternum and poorly defined or fused lower metakatepisternum. The petiole is small with a mostly rounded apex and is with a well-developed ventral process in some species, poorly developed in others. The length of the postpetiole with the remaining abdominal segments is slightly larger or similar to the length of the mesosoma in most of the species. The entire body is smooth, or slightly roughened in some species that are similar to *Pachycondyla* species. The males of *Bothroponera* are similar, but the mesosomal surface is rough, punctate or foveolate in others while the petiole, postpetiole, 4th to 7th abdominal segments are smooth or slightly rough and shining.
**Bothroponera pumicosa** species complex description

**Worker:**

The workers of the *B. pumicosa* species complex are very similar to each other. Workers large, head shape excluding mandibles subquadrate or suborbiculate, slightly narrowed anteriorly; posterior border concave; mandibles triangular, shorter than head length, with 7 - 8 teeth, smooth, coarsely punctate or covered with fine striae in some species; anterior medial margin of clypeus convex, with single medial longitudinal carina (clypeal carina) in some species, “v” or “u” shaped anteriorly, sharp or blunt; frontal carinal lobe rounded, divided by longitudinal frontal furrow, lower margins of frontal lobes smooth and shiny; scape barely reaches or slightly passes posterior lateral corner of head; compound eyes relatively large; pronotal shoulder rounded anteriorly; basalar sclerite oval or rounded; mesonotum and propodeum fused (dorsal view); meso-metapleural suture well developed; propodeum angulate, quadrate or rounded posteriorly, propodeal spiracle elongated; petiole well developed with petiolar spiracles and a developed sternopetiolar process; sternopostpetiolar process well developed; metatibial gland absent; generally; head punctate or coarsely foveolate; edges and bottom of frontal lobes shiny; head, body, legs, antennae, mandibles shiny or weakly striated; dorsum of pronotum, mesonotum, propodeum, petiole, postpetiole mostly more coarsely sculptured than sides; entire body covered with scattered or moderately abundant short or long erect golden hairs, denser on dorsum than on sides and longer on mesosoma than on head; frontal lobes covered with fine hairs; color mostly black or dark brown.

The females and males are unknown.
Key to the Afrotropical *Bothroponera* species complexes

1. Metatibial gland present; scape extends at least length of first funicular segment past posterior lateral corner of head; lower margin of anterior medial area of clypeus convex; frontal lobes subquadrate
   ............................ ......................................................................................... *B. sulcata* species complex
   - Metatibial gland absent; scape shorter, barely reaches posterior lateral corner of head or extends past less than length of first funicular segment; lower margin of anterior medial area of clypeus convex, straight or slightly concave; frontal lobes rounded ................................................................. 2

2(1). Anterior margin of anterior medial area of clypeus convex, “u” or “v” shaped; eyes relatively large
   ........................................................................................................................................... *B. pumicosa* species complex
   - Anterior margin of clypeus straight or slightly concave or convex but not “v” or “u” shaped; eyes relatively small (EW and EL 0.15 - 0.40 mm) .............................................. *B. talpa* species complex
Key to the *Bothroponera punicosa* species complex
based on the workers.

1. Hairs on entire mesosoma and gaster long (up to 0.55 mm) curly, the anterior medial raised area of clypeus “u” shaped without carina ................................................................. *punicosa*
- Hairs on entire surface relatively short (0.10 – 0.25 mm) erect moderately long, straight (not curly); anterior medial raised area of clypeus “u” or “v” shaped with or without carina ................................................................. 2

2(1). Anterior border of clypeus “u” shaped, broadly rounded ........................................... 3
- Anterior border of clypeus “v” shaped with sharp anterior medial point ......................... 6

3(2). Anterior medial area of clypeus raised from surface (best seen in side view) to form sharp carina, which extends from between frontal lobes to anterior border of clypeus ......................... 4
- Anterior medial area raised but does not form sharp carina, if carina partially present, not complete as described above or not sharp ................................................................. 5

4(3). Posterior border of petiolar node (seen from above) with deep medial depression; mandibles with several deep coarse grooves ................................................................. *cariosa*
- Posterior border of petiolar node with little evidence of impression; with smooth shiny mandibles ................................................................................................................. *strigulosa*

5(3). Body smooth, shiny, black, fourth abdominal segment smooth, shiny ....................... *laevissima*
- Body strongly sculptured by dense foveolae, fourth abdominal segment foveolate ...................................................................................................................... *berthoudi*

6(2). Anterior medial area of clypeus raised to form sharp carina ........................................ *granosa*
- Anterior medial area raised but does not form carina .................................................... 7

7(4). Propodeal spiracle nearly horizontal; fourth abdominal segment smooth, partially glossy ........
................................................................. *umgodikulula*
- Propodeal spiracle nearly vertical, usually nearly parallel with posteropropodeum; fourth abdominal segment smooth to slightly rough or sculptured .................................................. 8
8(7). Head and mesosoma with sparse punctures, moderately shiny, black …………………… *aspera*
   - Head and mesosoma sculptured with dense foveolae ………………………………………. 9

9(8). Scapes longer, extending slightly past posterior lateral corner of head (SI 78), short (0.10 up to 0.20 mm) erect golden hairs cover entire surface ………………………………………. *cavernosa*
   - Scapes barely reaching posterior lateral corner of head (SI 79.59 – 81.25), short (0.10 – 0.15 mm) erect silver hairs cover entire surface ……………………………………………. *montivaga*
Species accounts of members of the Afrotropical Bothroponera pumicosa species complex

Bothroponera aspera Arnold, stat. nov.
Figures 1.1, 2.1 and Plate 1.1; Map 1.1


Diagnosis:
Worker:

The worker of Bothroponera aspera is large (total length 12 - 13 mm). The mandibles are triangular, shorter than the head length, and smooth. The anterior medial margin of the clypeus is convex, with a single raised medial carina, the anterior margin of the clypeus is “v” shaped. The scape reaches the posterior lateral corner of head or surpasses it by a short distance.

The lower margin of the pronotum is straight, rounded anteriorly (anteroinferior pronotal process) and posteriorly (inferior pronotal process). The propodeal mesopleural suture is poorly developed. The propodeum is rounded posteriorly.

In general, the head is shiny, but rough with dense, shallow punctures; the edges and the bottom of the frontal lobes are shiny. The pronotum, mesonotum, propodeum, mesopleuron, petiole, and postpetiole are shiny, but rough with dense, shallow punctures. The terga of the fourth - seventh abdominal segments are mostly smooth and glossy while the entire remainder of the body is sculptured.

The entire body, head, petiole and postpetiole are covered with scattered and moderately abundant short (0.07 mm on the head and up to 0.15 mm on the body) erect silver hairs.

The female and male are unknown.

Description:
Worker Measurements: (n=2)

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Worker Description:

Total length 12 - 13 mm; head suborbiculate; mandibles smooth, with 7 teeth; anterior medial margin of clypeus convex, without carina, lower margin of clypeus “v” shaped, maximum clypeal length 2.15 mm; maximum frontal lobe width in full face view 1.00 mm; malar space from side 0.55 mm, length from upper margin of eye to upper margin of occipital lobe 1.25 - 1.30 mm; scape slightly exceeds posterior lateral corner of head; meso-metapleural suture well developed; basalar sclerite oval shaped; propodeum rounded posteriorly; propodeal spiracle elongated, obliquely vertical; petiole rounded anteriorly, posterior face vertical, slightly concave posteriorly; head shiny with dense punctae, edges and bottom of frontal lobes shiny; pronotum, mesonotum, propodeum, mesopleuron, petiole, postpetiole shiny, densely punctulate; tergum of second gastral segment mostly smooth, glossy, entire remainder of body sculptured; entire body and head covered with scattered or moderately abundant short erect silver hairs (0.07 - 0.10 mm), erect hairs on petiole and postpetiole range from 0.10 - 0.15 mm, denser on dorsum than on sides, longer than on head, scape covered with short erect silver hairs (up to 0.07 mm); body color black; legs, antennae, mandibles brownish.

Comparison:

The worker of *B. aspera* is similar to the worker of *B. laevissima*; however, there are two main differences between them. The first difference is the body sculpturing, which is partially sculptured in *B. aspera* while it is less sculptured and glossy in *B. laevissima*. The head of *B. aspera* is shiny with dense punctures whereas it is shiny with few scattered shallow punctures in *B. laevissima*. The pronotum, mesonotum, propodeum, mesopleuron, petiole and postpetiole are shiny and densely punctulate in *B. aspera*. On the other hand, in *B. laevissima*, the pronotum, mesonotum, propodeum, mesopleuron, and petiole are rough and shiny with a few scattered punctures, but the postpetiole and the 4th abdominal segment along with 5th to 7th abdominal segments are smooth and glossy. The tergum of the second gastric segment is mostly smooth and glossy in *B. aspera* as well. Secondly, the clypeal structure is different in the two species. The clypeus is “v” shaped in *B. aspera* and does not form a carina on the medial raised area, which is sculptured on the sides and without a grooved beak on the lower medial margin of the posteroclypeus whereas the clypeus in *B. laevissima* is “u” shaped. The lower margin of the medial raised area of the clypeus of *B. laevissima* does not form a carina, but the grooved beak on the lower margin of clypeus is present. Other than that, it is easy to distinguish both *B. aspera* and *B. laevissima* from the rest of the *B. pumicosa* species complex members. The black, smooth, and shiny
surface with punctures is found only in *B. aspera* and *B. laevissima*. The other *B. cavernosa* species are characterized by having coarse foveolae on the body surface; however, the 4\(^{th}\) abdominal segment is similar in some species to that of *B. aspera* and *B. laevissima*, such as *B. umgodikulula, B. cavernosa* and *B. montivaga*.

There is a specimen from the South Africa Museum that was identified as *Bothroponera aspera* which is quite similar to the paratype specimen of *B. aspera*. This specimen and the paratype of *B. aspera* are from the same locality (Ysterfontein area), but the labels do not indicate if they are from the same nest. I distinguished it from the paratype specimen of *B. aspera* because it does not have the typical clypeal shape. This excluded specimen is more likely to be a new species of *Bothroponera* that belongs to *B. pumicosa* species complex. It has broad and slightly convex lower margin of the clypeus. The anterior medial area of the clypeus is completely lacking the “V” and “U” shapes of the anterior medial area of the clypeus that were obvious in all of the other *B. pumicosa* complex members. However, further specimens are needed to recognize this taxon as a new species.

**Material examined:**

**Type material.**

**SOUTH AFRICA: Western Cape Province**, Ysterfontein, farmstead, 33°1'0" S; 18°9'0" E, Dr. A. J. Hesse and Mr. Thom; *Bothroponera laevissima* var. *aspera*, Det. G. Arnold, South Africa museum ex. national museum Bulawayo 1981; SAM-ENT, 9:60 (1 w #11519, Paratype [designator not specified] SAM).

**Non-type material.**

**SOUTH AFRICA: Western Cape Province**, Ysterfontein, 33°1'0" S; 18°9'0" E; *Bothroponera laevissima* var. *aspera*, Det. G. Arnold; S. A. M. 9:60, possible new species (1 w #COO11519, SAM).

**Distribution:**

*Bothroponera aspera* is known only from Saldanha Bay, South Africa.
**Biology and habitat:**

*Bothroponera aspera* has been collected from Saldanha Bay area, Western Cape Province. The individuals were living in holes in the ground at Ysterfontein (Yzerfontein), in the southern part of the Saldanha Bay area (Arnold, 1962). The habitat is characterized by Fynbos biome vegetation. The Bay is one of the richest areas in biodiversity in the Western Cape Province. There are assemblages of several groups of organisms including benthic, intertidal, marine and plant species (Anchor Environmental Consultants, 2006, 2010). This habitat has unique, distinct flora and fauna that are identified as endemic species to the area, as well as organisms in need of conservation (Schils et al., 2001; Anchor Environmental Consultants, 2006, 2010). The other members of the *B. pumicosa* species complex that can be found in this province include *B. laevissima, B. cavernosa, B. granosa* and *B. montivaga*.

![Map 1.1: The distribution of *B. aspera*.](image)
Figures. 1.1-4.1

Fig. 1.1: The lateral view of a paratype worker of *Bothroponera aspera*.

Fig. 2.1: The head of the paratype worker of *B. aspera*.

Fig. 3.1: The head of the worker of *B. berthoudi* from South Africa, Eastern Cape Province, Algoa-Bay (ZMHU).

Fig. 4.1: The lateral view of a worker of *B. berthoudi* from South Africa, Eastern Cape Province (ZMHU).

The sculpturing of the head is shown only on one side “right or left side”, to allow the illustration of the hairs on the other side “left or right side” of the head.
Bothroponera berthoudi (Forel) revived status
Figures 3.1, 4.1 and Plate 2.1; Map 2.1

Pachycondyla (Bothroponera) berthoudi Forel, 1901b: 344 (w), South Africa, Valdezia, Transvaal; Emery 1911b: 76; Forel, 1913c: 306 (m), Willowmore, colonie du Cap; Pachycondyla (Bothroponera) pumicosa berthoudi: Forel, 1913b:109 (w), Willowmore, Cap; Bothroponera pumicosa race berthoudi: Arnold, 1952a: 460, considered berthoudi to be a junior synonym of strigulosa; Pachycondyla berthoudi: Brown in Bolton, 1995: 303; Bothroponera berthoudi: Joma and Mackay: 2013: 3.


Diagnosis:
Worker:

The worker of Bothroponera berthoudi is a relatively large ant (total length 9.60 – 12.00 mm). The mandibles are hairy and coarsely covered with punctures. The anterior medial margin of the clypeus is convex and “u” shaped and slightly bent ventrally, with an anterior medial longitudinal raised smooth and striated area. The upper part of the raised area, between the frontal lobes is rough with a few punctules, but with a small clypeal carinae. The clypeal wings are punctulate and obliquely striate. The frontal lobes are smooth and shiny. The scape barely reaches the posterior lateral corner of the head.

The dorsal surface of the head is coarsely foveolate. The surface of the pronotum, mesonotum, propodeum, mesopleuron, lateropropodeum and metapleuron are densely foveolate and moderately shiny. The cheek, sides of the head posterior to the eyes and the frons are covered with weakly defined striae. The petiolar and postpetiolar surfaces are densely covered with deep and large foveolae with striae finer than those of the mesosoma and head. The dorsum of the postpetiole is partially covered with striae. The dorsum of the fourth segment of the abdomen (2nd gastral tergite) is densely covered with shallow foveolae and striae. The remainders of the gastral segments are smooth and moderately shiny, covered with fine striae. The posteropropodeum is rough and slightly concave.

The head, dorsum of the pronotum, mesonotum and propodeum of the B. berthoudi worker is covered with fine erect moderately long golden hairs, even on the mandibles, legs and scapes. The head is covered with short (less than 0.12 mm) erect golden hairs. The pronotum, mesonotum and propodeum
are covered with moderately short (up to 0.25 mm) erect golden hairs while the petiole and postpetiole are covered with moderately long (up to 0.35 mm) erect golden hairs, which are even longer on the ventral surface of the gastral segments.

The female and male are unknown.

**Description:**

**Worker Measurements:** (n=8)

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**Worker Description:**

Total length 9.60 - 12.00 mm; mandibles smooth with about 7 teeth; head subquadrate; anterior medial margin of clypeus convex, “u” shaped, with raised smooth anterior medial area; striae on posterior part of raised area between frontal lobes; maximum transversal clypeal length 1.60 mm; compound eyes relatively large (0.30 mm width and length); scape nearly reaches posterior lateral corner of head; length of malar space 0.40 mm; length from upper edge of eye to edge of posterior lobe 1.00 mm; maximum frontal lobes width 0.75 mm; surface of head, pronotum, mesonotum, mesopleuron, propodeum, lateropropodeum, metapleuron, densely foveolate, moderately shiny; petiolar and postpetiolar surfaces densely covered with larger foveolae than those of mesosoma, moderately shiny; cheek, sides of head, area posterior to eyes, frons covered with weakly defined striae; dorsum of fourth abdominal segment covered with shallow foveolae and striae; fifth-seventh abdominal segments smooth, shiny; basalar sclerite oval in depressed surrounding area; pronotal shoulder rounded, lower margin straight (lateral view), anteroinferior pronotal process angled, inferior pronotal process rounded; mesometa- pleural suture developed; mesopleural-coxal excavation developed and continued with mesometapleural suture; antennae, legs, lower edges of frontal lobes, mandibles shiny; anterior face of petiolar node from dorsal view rounded, slightly narrowed anteriorly, posterior face vertical in side view, slightly concave with slight depression on medial upper margin; metapleuron rough, covered with striae, foveolae; posteropropodeum rough, slightly concave; dorsum of postpetiole densely covered with large foveolae and striae; surface of 4th abdominal segment rough, covered with large foveolae; 5th to 7th abdominal segments moderately shiny, covered with fine striae; head, dorsum of pronotum, mesonotum, propodeum covered with fine moderately long golden erect hairs; hairs moderately long (0.20 mm up to
0.22 mm) on mandibles, legs, scapes; length of hairs on pronotum, mesonotum, propodeum slightly longer (0.20 - 0.25 mm); dorsum of petiole, dorsal and ventral surfaces of postpetiole, and 4th to 7th abdominal segments covered with longer erect golden hairs (0.30 - 0.35 mm); head, pronotum, mesonotum, mesopleuron, propodeum, petiole, postpetiole, entire gaster black; legs and antennae brownish black; mandibles reddish brown.

**Comparison:**

The worker of *B. berthoudi* is identical to the worker of *B. variolosa*, which is considered a synonym. They have the lower medial margin of the clypeus “u” shaped with a medial raised area and lack the sharp carinae.

*Bothroponera cariosa* and *B. strigulosa* have the same “u” shaped lower medial anterior margin of the clypeus, but this area forms a sharp clypeal carinae in both species, which is lacking in *B. berthoudi*.

Arnold (1952) considered *B. berthoudi* to be a race of *B. pumicosa*, but it is clear that this species is different from *B. pumicosa* in that *B. pumicosa* has long hairs that cover the entire body, which is not the case in *B. berthoudi*. There are other slight differences between the two species. The anterior medial raised area of the clypeus of *B. pumicosa* forms a partial carina on the posterior part and smooth narrowed area on the grooved anterior part. The same character is found in *B. berthoudi*, but the upper part forms striae instead of a partial carina, the lower part is smooth but wider than that of *B. pumicosa*. The mandibles have 7 teeth in *B. berthoudi*, similar to the other *B. pumicosa* species complex members, whereas *B. pumicosa* has 8 teeth.

*Bothroponera laevissima* has the same “u” shaped clypeus as does *B. berthoudi*, but is easily recognized by the unique sculpture: shiny with scattered punctures. The mandibles have 7 teeth in *B. berthoudi* and *B. laevissima*, similar to the other *B. pumicosa* species complex members.

The body surface of *B. berthoudi* is densely foveolate, and the fourth abdominal segment is densely covered with foveolae and striae. Basically, the members of the type series consistently differ from the rest of *B. pumicosa* species complex species in having long erect hairs on most surfaces (except the head) and in lacking a well defined medial clypeal carina.

The specific epithet “berthoudi” was first used by Forel (Forel 1890) as name for *Ophthalmopone berthoudi* from South Africa. Later, he used it again to identify and describe the male of *Ophthalmopone berthoudi*. Wheeler and Wheeler (1971) used the same name to identify larva of *O. berthoudi*. In 1901, Forel used the same specific epithet to describe *Pachycondyla (Bothroponera)*
berthoudi. *Pachycondyla (Bothroponera) berthoudi* has been considered to be a secondary homonym of *Pachycondyla (Ophthalmopone) berthoudi*. The confusion of using “berthoudi” becomes major when authors use it to express species in the genus *Pachycondyla*. In this project, I clearly distinguish between *O. berthoudi* and *B. berthoudi* as those now belong to two different genera.

**Material examined:**

**Type material.**


**Non-type material.**

**SOUTH AFRICA: Eastern Cape Province,** Algoa-Bay, Capland, 33°50'0'' S; 25°50'0'' E, Dr. H. Brauns, Forel det. 1922, that deposited in the Berlin Museum was designated by Forel, (labeled *Pachycondyla (Bothroponera) berthoudi* Forel, 1w # 6692, ZMHU), but this specimen is broken into two parts (head with the pronotum is one part and the second part includes the mesonotum, mesopleuron, propodeum, petiole, postpetiole and the 2nd to 5th gastral segments). It is not clear if this specimen is the type or not. **Limpopo Province,** Mariepskop, 4000 Transvaal (farm), 26°42'0'' S; 29°53'0'' E, vii-1944; South Africa Museum ex. National Museum Bulawayo 1981, (labeled *Bothroponera variolosa*, 1w # 11524 SAM-ENT); Some of the *B. berthoudi* specimens that were collected by H. Brauns, Paul Berthoud and G. Arnold were considered to be subspecies of *B. strigulosa*.

**Distribution:**

The species is known from Salique in The Mpumalanga Province, Mariepskop and Valdezia in The Limpopo Province and from Algoa-Bay in The Eastern Cape Province of South Africa.
Bothroponera berthoudi specimens were collected from other localities in South Africa such as Valdezia (locality of the type specimen), Cape Willowmore (Forel, 1913), Cape Nordhoek and East Griqualand (Arnold, 1952).

**Biology and habitat:**

The type specimen was collected from Valdezia, Limpopo Province, which is far from the Eastern Cape Province where the other material was located. The habitat in Limpopo province is mainly covered with savanna biome (Mucina and Rutherford, 2008; Dubel integrated environmental services, 2009). The additional material examined of B. berthoudi in this study was collected from Algoa Bay, which is located at the east of the Cape of Good Hope, on the southeastern coast of South Africa. The Bay area is characterized by two seasons of rain, winter and summer (Goschen, and Schumann, 1988). The fynbos and thicket biomes are the major vegetation types that cover the Algoa Bay area. The collection site is in Mpumalanga Province is close to the Limpopo Province that are both covered mainly with savanna. The Mariepskop, Limpopo Province includes two continuous nature reserves: Blyde River and Motlatse Canyon Provincial Nature Reserves. They are covered with grassland and savanna biomes in both provinces, close to Kruger National Park, the vast area that shared between South Africa and Mozambique. Savanna is the major biome of Limpopo Province where the type specimens were collected (Goschen, and Schumann, 1988; Mucina and Rutherford, 2008; Dubel integrated environmental services, 2009). These specimens were mainly collected from farms, farmsteads and forest habitats (information from labels and the google maps).
Map 2.1: The distribution of *B. berthoudi*. 
Bothroponera cariosa Emery
Figures 5.1, 6.1 and Plate 3.1; Map 3.1


Diagnosis:
Worker:

The total length of B. cariosa is 10.15 - 11.50 mm. The head is subquadrate. The anterior border of the clypeus is convex medially, “u” shaped with the medial clypeal area raised to form a sharp carina that extends longitudinally. The frontal lobes are divided by a well-developed frontal furrow. The mandibles are partially covered by weakly defined striae with scattered coarse punctures. The scape reaches slightly less than the posterior lateral border of the head.

The head is densely foveolate and punctate. The pronotum, mesonotum, propodeum, lateropropodeum, mesopleuron, metapleuron, petiole and postpetiole are coarsely foveolate. The basalar sclerite is oval-shaped. The lower margin of the pronotum is straight and rounded at both ends (inferior pronotal process and anteroinferior pronotal process). The antennae, legs and mandibles are shiny. The anterior face of the petiole in dorsal view is rounded, slightly narrowed anteriorly and concave posteriorly with a depression on the upper medial posterior margin.

The entire surface of B. cariosa is covered with fine scattered suberect to erect hairs that range from 0.05 - 0.25 mm in length, including the mandibles and scapes.

The female and male are unknown.

Description:

Worker Measurements: (n=2)

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27
Worker Description:

Total body length 10.15 - 11.50 mm; head subquadrate; clypeus convex, “u” shaped with anterior medial area raised, forming sharp carina, maximum clypeal width 1.90 mm; mandibles with 7 teeth, partially covered by weakly defined striae with scattered coarse punctures; scape not reaching posterior border of head; maximum frontal lobe width 0.95 mm; length of malar space 0.40 - 0.60 mm, length from upper edge of eye to edge of posterior lobe 1.20 - 1.55 mm; compound eyes large; head, pronotum, mesonotum, mesopleuron, propodeum, lateropropodeum, metapleuron, petiole, postpetiole coarsely foveolate; lower margin of pronotum straight with rounded inferior and anteroinferior pronotal processes; basalar sclerite oval-shaped; antennae, legs, mandibles shiny; petiole thick, apex rounded, seen from above slightly narrowed anteriorly with depression on upper medial margin between two edges posteriorly (seen from above), posterior face vertical (side view), slightly concave; sternopetiolar process developed with one tooth pointed ventrally; entire surface covered with fine scattered suberect to erect hairs, including mandibles, scapes; head covered with short (0.05 - 0.10 mm) erect golden hairs, pronotum, mesonotum, propodeum covered with short (0.05 - 0.15 mm) erect golden hairs, petiole, postpetiole, entire gaster covered with longer (0.15 - 0.25 mm) erect golden hairs; head, entire mesosoma (pronotum, mesonotum, mesopleuron, propodeum), petiole, postpetiole, entire gastral segments black; appendages (legs, antennae, mandibles) reddish brown; clypeus dark-brown; entire body black, funiculus brown.

Comparison:

Bothroponera cariosa is similar to many other species of the B. puminosa species complex with a “u” shaped anterior medial margin of the clypeus (e.g. B. berthoudi, B. strigulosa, B. puminosa, and B. laevissima), but the anterior medial area of the clypeus is developed into a sharp longitudinal carina, which is similar to B. strigulosa. The sharp carina is partially present in B. puminosa while it is absent in B. berthoudi, and B. laevissima.

Bothroponera granosa is the other species in the B. puminosa species complex that has the clypeus raised to form a sharp carina, but the anterior medial margin of the clypeus is “v” shaped. The “v” shaped clypeus is also present in B. aspera and B. umgodikulula, but both B. aspera and B. umgodikulula lack the carina and the surface of the disc is smooth and rounded. This area is formed into partial carinae in B. montivaga and B. cavernosa. The petiole viewed from above is similar to that of B.
berthoudi, but is definitely indented posteriorly in *B. cariosa*, but nearly straight and not indented in *B. berthoudi*. *Bothroponera cariosa* has total length about 11.50 mm, which is longer than that of *B. berthoudi* (9.60 - 12 mm) while it is smaller than that of *B. cavernosa* (12 mm), *B. montivaga* (12.20 - 12.65 mm), *B. granosa* (13.75 - 14.50 mm), *B. strigulosa* (12.20 mm), *B. umgodikulula* (14.80 - 15.65 mm), *B. laevissima* (12 - 13.00 mm), and *B. aspera* (12 - 13 mm). The total length of *Bothroponera pumicosa* ranges from 11.00 - 11.65, which overlaps the total length of *B. cariosa*.

**Material examined:**

**Type material.**


**Non-type material.**

**SOUTH AFRICA: Eastern Cape Province,** Grahamstown, 33°18'0" S; 26°32'0" E, F. Jacot-Guillarmod, Highlands Rd, W. Grahamstown grassy grove, *B. cariosa* Em. WLB 1973, compared with type (1w, BMNH).

**Distribution:**

*Bothroponera cariosa* is distributed in South Africa, Tanzania, Gabon (Ant web, accessed May 2013) and Mozambique (Emery, 1895). Workers were collected from the Cape Province; Transvaal area, South Africa by G. Arnold (Arnold 1915).

**Biology and habitat:**

The *Bothroponera cariosa* holotype was collected from Delagoa Bay, Mozambique. This area is located at the southeast coast of Mozambique, near the South African border, on the coast of the Indian Ocean, East Africa. Delagoa Bay is the former name of Maputo Bay. The climate in the south of Mozambique is semi-arid and subtropical while it is tropical in the north; the southern areas of the country are generally drier than the northern areas and have fluctuations in temperature and rainfall (Country Briefs web page, accessed May 2013). The country has one rainy and one dry season per year.
The habitat in Mozambique is characterized by forest ecosystems that increase in elevation, especially close to Zimbabwe border and are also characterized by grassland ecosystems. The mangroves grow in the swamps and palm trees on the coast. These types of ecosystems most likely hold various species of ants, including Bothroponera (based on Bolton 1994, 1995, 2012; Ant web, accessed January 2012; Ant wiki, accessed May 2013). Mainly, this species can be found in habitats that are characterized by high humidities and wet soils, which is the typical environment of the tropical and subtropical areas. It builds nests underground or under stones to form colonies with a small number of individuals (Wheeler, 1922; Wheeler and Wheeler, 1971).

The ant biodiversity in Mozambique is high where we can find the following species: Megaponera crassicornis, Paltothyreus tarsatus delagoensis, Bothroponera strigulosa, B. kruegeri, B. talpa besides B. cariosa (Bolton 1994, 1995, 2012; Ant web, accessed January 2012). The recent ants collected from Mozambique, by Dr. Gary Alpert, are deposited in the MCZC. This collection includes variable species that belong to several genera of subfamily Ponerinae such as Bothroponera, Hypoponera, Leptogenys, Megaponera, Mesoponera, Odontomachus, Platythyrea, Paltothyreus and Plectroctena. (personal visit to MCZC in 2013). Bothroponera cariosa is also found in Cape Province, Transvaal. The Transvaal area is located at the north of Vaal River and extends to the borders of Botswana, Zimbabwe, Mozambique and Swaziland.

Map 3.1: The distribution of B. cariosa.
Figures 5.1 - 8.1

Fig. 5.1: The lateral view of the holotype worker of *B. cariosa*, (MCSN).
Fig. 6.1: The head of the holotype worker of *B. cariosa*, (MCSN).
Fig. 7.1: The head of the holotype worker *B. cavernosa* showing sculpture on the left side of the head.
Fig. 8.1: The lateral view of the holotype worker of *B. cavernosa* (ZMHU).
Bothroponera cavernosa (Roger)
Figures 7.1, 8.1 and Plate 4.1; Map 4.1

Paraponera cavernosa Roger, 1860: 288 (w) South Africa, Kaffernlande; Pachycondyla (Bothroponera) cavernosa: Emery, 1901: 45 (list); Arnold, 1915: 60 (w) Cape; Bothroponera cavernosa: Mayr, 1862: 717; Wheeler, 1922: 769, South Africa, Caffraria, Cape Province (w); Joma and Mackay: 2013: 3; Schmidt and Shattuck, 2014: 76; Pachycondyla cavernosa: Brown, in Bolton, 1995: 304.

Diagnosis:
Worker:

The main distinguishing character of B. cavernosa is the lack of foveolae on the second tergum of the gaster, which is rough and covered with short hairs. The worker is further characterized by the large total length (12 mm). There are some other characters such as the clypeus is “v” shaped and covered with fine striae. The anterior medial area of the clypeus is raised and coarsely punctate on the sides with an incomplete clypeal carina. The mandibles are rough, moderately shiny and covered with striae. The scape extends slightly past the posterior lateral border of the head. The frontal lobes are sculptured and covered with striae. The frons and the clypeus are weakly striated. The propodeal spiracle is parallel to the posteropropodeal margin. The lower margin of the pronotum is straight with a rounded anterior angle (anteroinferior pronotal process) and a pointed posterior angle (inferior pronotal process) (lateral view). The petiole is rounded and slightly narrowed anteriorly while it is vertical, slightly concave posteriorly.

The head is coarsely foveolate. The antennae are rough and the scape is covered with tiny, shallow punctures. The dorsum of the pronotum, mesonotum, mesopleuron and propodeum are foveolate and rough. The dorsum of the petiolo and postpetiole are coarsely covered with larger and deeper foveolae and more punctae than the pronotum, mesonotum, mesopleuron and propodeum. The metapleuron and lateropropodeum are covered with striae that have a perpendicular orientation with the posteropropodeal lateral margin.

The female and male are unknown.
Description:
Worker Measurements: (n=1)

HL 3.00, HW 2.70, ML 1.45, EW 0.40, EL 0.45, SL 2.10, FL 3.60, WL 4.15, WPL 4.70, PL 1.15, PW 1.45, PH 1.75, CI 90, OI 17, MI 48.33, SI 78, PI 126.08

Worker Description:

Total length 12 mm, head suborbiculate; mandibles covered with fine striae, with 7 teeth; clypeus covered with striae, anterior medial area raised to form discontinuous carina, coarsely punctate and rough on sides, clypeal length 2.35 mm; scape extends slightly past posterior border of head; maximum frontal lobe width 1.10 mm; length of malar space 0.55 mm; length from upper edge of eye to edge of posterior lobe 1.40 mm; pronotal shoulder rounded anteriorly, lower margin of pronotum straight with rounded anteroinferior pronotal process, pointed inferior pronotal process; basalar sclerite oval shaped; propodeal spiracle parallel to posteropropodeal margin; petiole rounded, slightly narrowed anteriorly, slightly concave posteriorly (seen from above); head mostly foveolate; antennae, legs shiny; entire dorsum of mesosoma foveolate and rough; mesopleuron, lateropropodeum foveolate; metapleuron, lateropropodeum covered with coarse striae and grooves orientated perpendicular to posteropropodeal margin; dorsum of petiole, postpetiole coarsely foveolate and punctate; entire head, pronotum, mesonotum, propodeum, petiole, postpetiole covered with short erect golden hairs (up to 0.20 mm), on head, antennae, mandibles (0.03 - 0.08 mm in length), on pronotum, mesonotum, propodeum (up to 0.10 mm length), on petiole, postpetiole (0.13 - 0.15 mm in length); sternopostpetiole and 4th to 7th abdominal segments covered with relatively short (0.20 mm) erect golden hairs; head, mesosoma, petiole, 3rd - 7th abdominal segments black; mandibles, clypeus, appendages brownish red.

Comparison:

Bothroponera cavernosa is very easy to recognize as it is one of the five species in the B. pumicosa species complex with a specific form of the tergum of the 4th segment of the abdomen (2nd gastral tergite), that is rough and covered with short hairs. The other species are Bothroponera laevissima, B. aspera, B. umgodikulula and B. montivaga. The 2nd gastral segment of B. umgodikulula is mostly smooth and glossy similar to that of B. aspera and B. laevissima while in B. montivaga it is smooth with few shallow scattered punctures and is moderately shiny. The head shape of B. cavernosa, B. aspera, and B. laevissima is suborbicular while it is subquadrate in B. umgodikulula and B.
montivaga. The other important differences between *B. cavernosa*, *B. umgodikulula* and *B. montivaga* compared to *B. laevissima* and *B. aspera* is that the body surface is heavily sculptured with foveolae in *B. cavernosa*, *B. umgodikulula* and *B. montivaga* while it is black, nearly smooth and shiny in *B. laevissima* and *B. aspera* with a few scattered punctures in *B. aspera*. *Bothroponera cavernosa* and *B. umgodikulula* both share all of the characteristics of *B. montivaga* except for the propodeal spiracle, which is obliquely vertical in *B. montivaga* and *B. cavernosa* while it is horizontal in *B. umgodikulula*. The anterior medial area of the clypeus is raised and does not form a complete clypeal carina in *B. cavernosa* (it is partially carinated). On the other hand, the anterior medial area of the clypeus of *B. umgodikulula* and *B. montivaga* is mostly smooth, and does not form carinae and in some specimens of *B. montivaga* the carinae is only on the upper part of the anterior medial raised area of the clypeus while the lower part is smooth.

**Material Examined:**

**Type material.**

**SOUTH AFRICA: Eastern Cape Province**, Caffraria Drege, farm, 27°48'0" S; 25°7'0" E, *Bothroponera cavernosa* Roger, Mayr (1 w # 7165 GBIF-D/FoCol 0955, holotype, ZMHU).

**Non-type material.**

Although I requested material from several collections, the holotype was the only specimen available for this study.

**Distribution:**

South Africa.

**Biology and habitat:**

The type specimen is known from Kaffernlande, South Africa. Kaffernlande is the former name of what is known today as the Transkei and Ciskei regions (Transkei District), Eastern Cape Province (Dr. Worden, personal communication). The habitat in this area is characterized by three types of biomes: Grassland, Savanna and Thicket. This indicates the high biodiversity and different habitats that are available to the organisms in the area, which could result in high speciation rates. In fact, most of the species in the *B. pumicosa* species complex species were found in South Africa. Caffraria or Kaffraria
also is a descriptive name that was given to the southeast part of what is called today the Eastern Cape of South Africa. The material examined was collected in farmland area in Caffraria. Wheeler (1922) and Wheeler and Wheeler (1971) reported that this species, as well as B. pumicosa and B. cariosa, are usually found in colonies with a small number of individuals under stones in humid habitats and wet soils.

Map 4.1: The distribution of B. cavernosa.
Bothroponera granosa (Roger)
Figures 9.1, 10.1 and Plate 5.1; Map 5.1

Ponera granosa Roger, 1860: 290 (w) SOUTH AFRICA, Cape of Good Hope; Mayr, 1862: 717; Bothroponera granosa: Mayr, 1862: 717; Dalla Torre, 1893:36; Wheeler, W. M. 1922: 770; Joma and Mackay: 2013: 3; Schmidt and Shattuck, 2014: 76; Pachycondyla (Bothroponera) granosa: Emery, 1901: 45; Arnold, 1915: 61(w); Pachycondyla granosa: Arnold, 1926: 201 (m); Brown, in Bolton, 1995: 305; Bolton, 2013.

Diagnosis:

Worker:

The head is large and subquadrat. The mandibles are covered with hairs and partially by fine weakly defined striae and with scattered coarse punctures. The anterior medial margin of the clypeus is convex, “v” shaped with a raised sharp medial longitudinal clypeal carina. The scape reaches the posterior lateral corner of the head. The lower margin of the pronotum is straight with strongly rounded angle at the anteroinferior pronotal process (lateral view), rounded inferior pronotal process and sometimes forming a sharp angle that is pointed postero-ventrally. The promesonotal suture is well developed. The petiole (dorsal view) is rounded and slightly narrowed anteriorly while it has a slight concavity on the upper medial margin between the two posterior angles of the petiolar apex. The posterior edge of the petiole is vertical (side view) and slightly concave (dorsal view). The sternopetiolar process is developed with a single tooth pointed ventrally.

The head is covered with small dense punctures, the sides of the head are covered with fine striae. The antennae, legs, lower edge of the frontal lobes and mandibles are shiny. The dorsum of the pronotum, mesonotum, propodeum, mesopleuron and lateropropodeum are moderately or sparsely punctate, but moderately shiny. The metapleuroton is rough and weakly punctate. The petiole is covered with deeper and sparser punctures and foveolae than the postpetiole, which is covered with shallow sparse punctures and foveolae, with weakly defined fine striae. The dorsum of the second segment of the gaster is covered with shallow foveolae and striae. The remainder of the gastral segments is shiny.

The entire surface of the B. granosa worker is covered with fine short (up to 0.15 mm) silver hairs, denser on the fourth - seventh abdominal segments (up to 0.20 mm). The entire surface is covered with scattered erect and suberect golden hairs, even on the mandibles and scapes.

The female and male are unknown.

Description:
Worker Measurements: (n= 20)

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Worker Description:

Total length 13.75 - 14.50 mm; head large subquadrate; mandibles with 7 teeth; anterior medial margin of clypeus convex, “v” shaped, with raised sharp single medial clypeal carina, clypeal length 1.70 - 2.35 mm; malar space length from lower edge of eye to base of mandible 0.40 - 0.65 mm; from upper edge of eye to edge of posterior lobe 1.35 - 1.70 mm; frontal lobe width 0.90 - 1.15 mm; mesopleural suture developed; petiole rounded (dorsal view), slightly narrowed anteriorly with slight declination between two posterior lateral angles of petiole, vertical posterior edge of petiole slightly concave (side or top view); sternopetiolar process developed with one tooth pointed ventrally; head covered with small dense punctures; sides of head covered with fine striae; dorsum of pronotum, mesonotum, mesopleuron, lateropropodeum and propodeum moderately punctate, moderately shiny; metapleuron rough, weakly punctate; petiole covered with deeper sparse punctures and foveolae than postpetiole; postpetiole covered with shallow sparse punctures, foveolate, with weakly defined fine striae; dorsum of second gastral segment covered with shallow foveolae and striae; gastral segments shiny; lower margin of pronotum straight with strong angle at anteroinferior pronotal process, rounded inferior pronotal process; antennae, legs, lower edge of frontal lobes, mandibles shiny; entire surface of *B. granosa* worker covered with fine short silver hairs, denser on second - seventh gastral segments; entire surface covered with scattered erect golden hairs, including mandibles, scapes; head, pronotum, mesonotum; propodeum covered with short erect golden hairs (0.10 - 0.15 mm); dorsum of petiole covered with short erect golden hairs (0.15 mm); postpetiole, entire gaster covered with longer erect golden hairs (0.15 - 0.20 mm); hairs on sternum of postpetiole, hairs on other gastral segments reach about 0.30 mm.

Head, pronotum, mesonotum, mesopleuron, propodeum, petiole, postpetiole, entire gaster black; legs, antennae, clypeus, mandibles brownish black.
Comparison:

The workers of *B. granosa* can be recognized by the anterior medial raised area of the clypeus ("v" shaped anterior border) that forms a sharp longitudinal carina, which differs from most of the other *B. pumicosa* species complex members (except *B. cariosa* and *B. strigulosa*). The anterior medial area of the clypeus is also "v" shaped in *B. cavernosa*, *B. montivaga*, *B. aspera* and *B. umgodikulula*, but without a carina in *B. aspera* and *B. umgodikulula* while it is partially carinated in *B. cavernosa* and *B. montivaga*. The other species, including *B. cariosa*, *B. strigulosa*, *B. pumicosa*, *B. laevissima* and *B. berthoudi* have an anterior medial raised area of the clypeus with a "u" shaped anterior border, however *B. cariosa* and *B. strigulosa* have a sharp carinae similar to *B. granosa*. The surface of *B. granosa* is more likely to be rough with moderately scattered punctures than that of the other *B. pumicosa* species complex taxa, which are always coarsely foveolate except for *B. aspera* and *B. laevissima*, which are shiny black with punctated sculpture. The petiolar shape of *B. granosa* is unique among the *B. pumicosa* species complex individuals even if the petiolar indices seem not to be separable. The petiole is rounded and slightly narrowed anteriorly (dorsal view) in all species of the *B. pumicosa* species complex including *B. granosa*, but the posterior face is deeply depressed from the upper edge to form two rounded apices found only in *B. granosa* (best seen from above). The petiolar indices vary among the *B. pumicosa* species complex members in that the smallest PetI recorded were for *B. aspera* (104.54 - 118.18), and *B. berthoudi* (105.55), whereas the largest PetI registered was for *B. montivaga* (130.00). The other species have intermediate PetI, *B. umgodikulula* (115 - 126), *B. granosa* (117 - 123), *B. strigulosa* (117.39), *B. laevissima* (118.18 - 121.05), *B. pumicosa* (120.00 - 125.00), *B. cariosa* (104 - 116), and *B. cavernosa* (126.08).

Material examined:

Type material.

The types were not found, therefore, I used specimens determined by Forel and Bolton to define this species. **SOUTH AFRICA**: KwaZulu-Natal Province, Natal, Broughton, (farm) 29°26'0" S; 30°27'0" E, Wm. M. Wheeler collection, *Pachycondyla (Bothroponera) granosa* Roger (1 worker, AMNH, one worker specimen from ZMHU determined by Forel in 1922. **SOUTH AFRICA**: George [cgeorge kocysica Browns], *Pachycondyla (Bothroponera) granosa* Roger, Forel det. 1922, Zool. Mus. Berlin (1w ZMHU and two specimens from LACM that were determined by Bolton in 1977). **Eastern Cape Province**, Highland Rd., W. Grahamstown grassy grove, 33°18'0" S; 26°32'0" E, 22-x-1966, F.
Jacot-Guillarmod, collection of W. S, Creighton purchased by LACM 1974 (2 workers # 315919 LACM). One specimen (1 worker # 315920) from the Los Angeles County Museum determined by Forel with no further information. This specimen was in collection of W. S. Creighton, but was purchased by the Los Angeles County Museum in 1974.

**Non-type material.**

**SOUTH AFRICA:** Eastern Cape Province, Highlands Rd. W., Grahamstown grassy grove, 33°18'0" S; 26°32'0" E, F. Jacot Guillarmod (3w MCZC, 1w CWEM), Coldsprings, Grahamstown, under stone, 33°18'0" S; 26°32'0" E, 9-viii-1964, C. Jacot-Guillarmod (1w MCZC), Near Highlands farm. SW of Grahamstown C. P., 33°18'0" S; 26°32'0" E, 22-x-1966, L. H. Weatherill, ANIC Ants Vial 14.164, Ent. 315917, 315918 (4w LACM), 27 km NW. of Cathcart, 32°18'0" S; 27°8'0" E, N. G. Robertson, 16-ix-1985, C46, h. rock, (2w BMNH); KwaZulu-Natal Province, Estcourt Natal, 29°0'0" S; 29°53'0" E (R.C.W.) 1914, G. Arnold, Arnold coll. B. M. 1934-354, *Pachycondyla pumicosa* Roger det. B. Bolton 1977 (1w # 315925 LACM). Natal, Drakensberg, 29°0'0" S; 29°0'0" E, 2200m, 1983, C. Peeters, Giant’s Castle DRA (P) io (3w, BMNH).

**Distribution:**

Most of the specimens of *Bothroponera granosa* were collected from South Africa, including the Eastern Cape and KwaZulu-Natal Provinces. They were also collected from the Cape of Good Hope (Roger, 1860), Natal area (Forel, 1901) and from Cape Knysna and Cape Majuba Nek areas (Arnold, 1926). Some specimens were collected from Victoria Falls, Zimbabwe (Arnold, 1926).

**Biology and habitat:**

*Bothroponera granosa* inhabits the grassy grove areas of West Grahamstown in South Africa, under stones. It can be also be found in rocky habitats such as the area north west of Cathcart City in South Africa (label information). The three specimens from Natal, Drakensberg and that from KwaZulu-Natal Province, Estcourt Natal, South Africa were misidentified as *B. pumicosa*.

Arnold (1926) reported that *B. granosa* was also taken at Victoria Falls located on the border between Zimbabwe and Zambia, which is far from the South Africa collection sites. The habitat at Victoria Falls is similar to that at the town of Knysna which has the Knysnarivier Stream (River) and the areas are covered with deciduous forests. The stream is connected with the Indian Ocean at the extreme
southern shores of South Africa. The material examined was collected from a grassy grove and farmland habitats (information from labels and Google Earth Maps). One specimen was collected from Cape Province, South Africa by F. Jacot-Guillarmod, misidentified in the MCZC as B. cariosa.

The Western Province, KwaZulu-Natal Province and Eastern Province include several other species that belong to the B. pumicosa species complex: B. montivaga, B. aspera and B. laevissima found in the Western Cape Province, B. umgodikulula, B. cariosa, B. granosa, B. cavernosa, B. berthoudi and B. pumicosa found in Eastern Cape Province. Bothroponera granosa was also collected from Knysna, Western Cape Province and Majuba Nek, Eastern Cape Province (2 workers and one male) as material examined (Arnold, 1926).

Map 5.1: The distribution of B. granosa.
Fig. 9.1: The lateral view of worker of *B. granosa* (South Africa ZMHU, AMNH, LACM).
Fig. 10.1: The head of worker of *B. granosa* (South Africa ZMHU, AMNH, LACM).
Fig. 11.1: The head of the lectotype worker of *B. laevissima* (SAM).
Fig. 12.1: Lateral view of the lectotype worker of *B. laevissima* (SAM).
Bothroponera laevissima (Arnold)
Figures 11.1, 12.1 and Plate 6.1; Map 6.1


Diagnosis:
Worker:

The workers of Bothroponera laevissima are large (total length 12 - 13 mm). The mandibles are shorter than the head length and covered with fine striae. The anterior medial raised area of the clypeus is convex, but lacks a longitudinal carina; the anterior border is “u” shaped. The lower margin of the clypeus has a short grooved beak on the lower margin of the posteroclypeus. The metapleural area is compressed in some specimens.

The head is smooth and shiny with few punctulae scattered on the surface. The pronotum, mesonotum, mesopleuron, propodeum, petiole and postpetiole are smooth and shiny with a few scattered punctulae. The petiole is more sculptured than the other body parts. The second gastral tergite is smooth and glossy.

The entire body is covered with scattered or moderately distributed short (up to 0.10 mm) erect silver hairs, but the hairs on the dorsum are denser than those on the sides and longer than those on the head, similar hairs are present on the petiole and postpetiole.

The female and male are unknown.

Description:
Worker Measurements: (n=9)

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Worker Description:

Total length 12.00 - 13.00 mm; head suborbiculate; mandibles with 7 teeth, covered with fine striae; clypeal length 2.15 - 2.35 mm, anterior medial margin convex, “u” shaped, clypeus lacking
carina; frontal lobe width 0.90 - 1.05 mm; scape nearly reaches posterior lateral corner of head; compound eyes relatively large; malar area length 0.60 - 0.75 mm, length from upper margin of eye to upper margin of posterior corner of head 1.25 - 1.45 mm; area around basalar sclerite depressed; basalar sclerite oval; propodeum rounded; propodeal spiracle elongated, diagonal on lateropropodeum; sternopostpetiolar process well developed; head smooth, shiny with few punctulae, edges and anterior part of frontal lobes shiny; pronotum, mesonotum, mesopleuron, propodeum, petiole, postpetiole smooth, shiny with few punctulae; petiole more sculptured than other body surfaces; 2nd gastral tergite smooth.

Entire body covered with scattered or moderately abundant short erect silver hairs (0.07 - 0.10 mm), hairs on dorsum denser than those on sides, longer than those on head, similar hairs on petiole, postpetiole, range from 0.10 - 0.15 mm.

Entire body black; legs, antennae and mandibles brownish.

Comparison:

The worker of *B. laevissima* can be recognized as a shiny black ant. The general characters of the worker of *B. laevissima* are similar to those of the worker of *B. aspera*, but the lower margin of the anterior medial raised area of the clypeus has a “u” shape in *B. laevissima* while it has “v” shape in *B. aspera*. The lower margin of the clypeus forms a grooved beak in *B. laevissima*, which is not found in *B. aspera*. Despite that they both have a shiny surface and black color, *B. laevissima* is characterized by a smooth head with few scattered punctulae, similar to the pronotum, mesonotum, mesopleuron, propodeum, petiole and postpetiole. The petiole is more sculptured than other body surfaces; the second gastral tergite is smooth. Conversely, *B. aspera* is recognized as rough with dense shallow punctulae on the body surface (head, pronotum, mesonotum, mesopleuron, propodeum, petiole and postpetiole), the tergum of the second-fifth gastral segments are mostly smooth and glossy. Due to the mostly polished sculpture, *B. laevissima* would not be confused with any other species except *B. aspera*. *Bothroponera laevissima* was collected from Saldanha Bay, Western province area of South Africa, where *B. aspera* also occurs, which further suggests they are separate species.

Material examined:
Type material.

**SOUTH AFRICA: Western Cape Province**, Saldanha Bay, 33°1'0" S; 17°57'0" E, ix-1912, L. P., Rhodesian museum, South Africa museum ex. national museum Bulawayo 1981, *Pachycondyla*
laevissima G. Arnold, SAM-ENT 11518, 11517, Bothroponera laevissima (4w, one lectotype marked with red dot and 3 paralectotype worker, no dot [here designated], Cotypes, SAM). leg. F. Peringuey; ix 1912; Pachycondyla laevissima, G. Arnold; Arnold coll. B. M. 1934-354 (BMNH (E) 1015515) Antweb Casent 0902471, Bothroponera laevissima (2w, Syntypes, BMNH).

Non-type material.

SOUTH AFRICA: Western Cape Province, Saldanha Bay, 33°1'0" S; 17°57'0" E, Sept. 1912, L. P., Arnold determ., Pachycondyla laevissima G. Arnold, SAM-ENT 0011517, Bothroponera laevissima (3w, SAM).

Distribution:

Known from Saldanha Bay, South Africa. A B. laevissima worker was collected from Jacobsbai, 32°58'0" S; 17°53'0" E, Cape Province by H. G. Robertson and C. Peeters (The Ants of Africa web, accessed March 2014).

Biology and habitat:

The Western Cape Province includes the Cape Floristic Region (CFR), which is considered one of the global biodiversity hotspots that needs priority conservation attention. It is small area, but it includes high plant species richness, especially plants considered as endemics to CFR. It also includes several endemic species of birds, amphibians, insects and a few invertebrates (Giliomee, 2003). Ants play an important role in maintaining this ecosystem and they use different habitat such as under litter, on the ground, in logs, inside dead trees and on tree branches. The nest of B. laevissima from Jacobsbai, Cape Province, South Africa was found in sandy soil (The Ants of Africa web, accessed May 2014). The main vegetation characterizing the Western Province are Fynbos and Succulent Karoo biomes with high floral diversity accompanied by a moderate to high biodiversity of ant species. Although these ecosystems have their own biodiversity and richness of organisms resembling similar global ecosystems, they contain less ant biodiversity and richness than rainforest habitats (Braschler et al., 2012). Both B. laevissima and B. aspera, with B. cavernosa, B. montivaga and B. granosa were collected from the Western Cape Province. The various vegetation types and biodiversity in the Western Cape Province has apparently led to high speciation in the area which may happen only in this and similar areas in South
Africa. The Cape Provinces in South Africa include Eastern Cape, Western Cape, and Northern Cape and includes about half of the *B. pumicosa* species complex species. For example, *B. strigulosa* is found in the Northern Cape, *B. berthoudi* in the Eastern Cape with the previous five species in the Western Cape Province. The Cape Provinces are unique because they also hold the majority of the South Africa area and all types of biomes, including Forest, Nama Karoo, Fynbos, Thicket, Savanna and Succulent Karoo.

Map 6.1: The distribution of *B. laevissima*.
Bothroponera montivaga Arnold, stat. nov.
Figures 13.1, 14.1 and Plate 7.1; Map 7.1


Diagnosis:
Worker:

The worker is large, total length (12.20 - 12.65 mm). The 2nd gastral segment of the B. montivaga worker is smooth and moderately shiny with a few shallow scattered punctures. The anterior border of the clypeus is convex, “v” shaped with a smooth anterior medial raised area and with a carina on the posterior half.

The head, pronotum, mesonotum, propodeum, mesopleuron, lateropropodeum, metapleuron, petiole and postpetiole are coarsely foveolate. The metapleuron and lateropropodeum are covered with striae that are vertical with the posteropropodeal margin at the upper part and coarse grooves that are vertical and nearly parallel with the posteropropodeal margin on the lower part. The second segment of the gaster is smooth, slightly shiny and with tiny scattered punctures. The mandibles, antennae and legs are shiny. The petiole is rounded and slightly narrowed anteriorly while it is slightly concave posteriorly.

The head, pronotum, mesonotum, propodeum, petiole and postpetiole are covered with short erect silver hairs.

The female and male are unknown.

Description:
Worker Measurements: (n=2)

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Worker Description:
Head subquadrate, mostly foveolate; clypeus convex, anterior border “v” shaped, clypeus with smooth anterior medial raised area, forming carina on posterior half, maximum clypeal length 2.00 - 2.05 mm; mandibles weakly striate with few scattered punctures, 7 teeth; scape nearly reaching posterior border of head; anterior margins of frontal lobes smooth, posterior part punctate; maximum width of frontal lobes 0.95 - 1.00 mm; length of malar space (0.50 mm), length from upper edge of eye to edge of posterior lobe 1.25 mm; head, pronotum, mesonotum, propodeum, mesopleuron, lateropropodeum, metapleuron, petiole, postpetiole coarsely foveolate; propodeal spiracle sloping vertically; antennae, legs, mandibles shiny; petiole rounded and slightly narrowed anteriorly (top view), slightly concave posteriorly; sternopetiolar process developed with one tooth pointed ventrally; head covered with short (0.10 mm) erect silver hairs; pronotum, mesonotum, propodeum covered with short (0.10 - 0.15 mm) erect silver hairs; petiole and postpetiole covered with similar hairs (0.15 mm); head, pronotum, mesonotum, mesopleuron, propodeum, petiole, postpetiole, entire gaster black; legs, antennae, mandibles brownish black; clypeus dark-brown.

Comparison:

The workers of *B. montivaga* are nearly identical to those of *B. cavernosa* and *B. umgodikulula*. They differ from *B. cavernosa* and *B. umgodikulula* in the following ways: the surface of the 4th abdominal segment is smooth, but slightly less shiny, with tiny scattered punctures in *B. montivaga* while it is somewhat rough and shiny in *B. umgodikulula* and *B. cavernosa*. The anterior medial area of the clypeus is raised, but does not form complete clypeal carina in *B. montivaga, B. umgodikulula* and *B. cavernosa*. The lower medial margin of the clypeus forms “v” shaped without a carina in *B. montivaga* similar to that in *B. umgodikulula, B. cavernosa* and *B. aspera*, but this shape is with a longitudinal sharp carina in *B. granosa*. This character separates *B. montivaga* from the other *B. pumicosa* species complex members in that all species including *B. berthoudi, B. cariosa, B. laevissima, B. pumicosa* and *B. strigulosa* have an “u” shaped anterior medial margin of the clypeus. The propodeal spiracle is nearly vertical, dorsally leaning slightly anteriorly in *B. montivaga* resembling that in *B. cavernosa* and the other species in this complex, but not horizontal as in *B. umgodikulula*. The scape nearly reaches the posterior lateral corner of the head in *B. montivaga* similar to that in *B. berthoudi, B. cariosa, B. granosa, B. laevissima, B. pumicosa and B. strigulosa*. Conversely, the scape slightly exceeds the posterior lateral border of head in *B. cavernosa* and *B. aspera*, but just reaches or slightly exceeds it in *B. umgodikulula*. The sculpture of *B. montivaga* is foveolate identical to that of *B. berthoudi, B. cavernosa, B. pumicosa, B. strigulosa, B. cariosa* and *B. umgodikulula* while it is mostly smooth in both.
B. laevissima and B. aspera with few punctures in B. aspera. The sculpture somewhat is less foveolate in B. granosa. The head is subrectangular of B. montivaga, but it is suborbicular in both B. laevissima and B. aspera.

**Material examined:**

**Type material.**

**SOUTH AFRICA:** Western Cape Province, Steenberg Mountains, Cape Peninsula, 34°4’0” S; 18°28’0” E, ii-1946, C. Pearson B. cavernosa v. montivaga (Arnold, 1947), 1 lectotype worker [here designated, marked with red dot] and 1 paralectotype worker, no dot (# 11516) Collection South Africa museum ex. National Museum Bulawayo 1981 SAM/ENT (SAM).

**Non-type material.**

None.

**Distribution:**

Only known from South Africa, Cape Province.

**Biology and habitat:**

Bothroponera montivaga specimens were collected from the Steenberg Mountains of the Cape Peninsula of South Africa. This area is located in Southern Cape Town City opposite the region with B. cavernosa, which is the Northern Cape Town. The habitat is similar in both areas; they are covered mostly with Fynbos and Thicket biomes (Picker and Samways, 1996). The Cape Peninsula is rich with very high percentage of endemic fauna and flora, especially for species that inhabit caves and mountains. The area is considered as a distinct hotspot that provides relictual habitats for organisms. Human activities, disturbances, introduce alien species and fragmentation increase the importance of conservation priority for species in the Cape Peninsula (Picker and Samways, 1996).
Map 7.1: The distribution of *B. montivaga*.
Figures 13.1 – 16.1

Fig. 13.1: The lateral view of the lectotype worker of *B. montivaga*.
Fig. 14.1: Head of the lectotype worker of *B. montivaga*.
Fig. 15.1: The head of the holotype worker of *B. pumicosa*.
Fig. 16.1: Lateral view of the holotype worker of *B. pumicosa*. 
Bothroponera pumicosa (Roger)
Figures 15.1, 16.1 and Plate 8.1; Map 8.1


Diagnosis:
Worker:

The worker of Bothroponera pumicosa is characterized by a large total length (11-12 mm). The main distinguishing character of the B. pumicosa worker is the long (up to 0.50 mm or more) golden hairs that are distributed on the entire body including the mandibles, clypeus, and legs. The hairs on the scape are long, at least as long as greatest diameter of the scape. The mandibles are hairy and smooth. The anterior medial margin of the clypeus is convex, “u” shaped, with a raised smooth medial clypeal area on the lower part and is partially carinate on the upper part between the frontal lobes. The lower part of the medial raised area tends to form a groove. The scape does not reach the posterior lateral corner of the head.

The surface of the head is densely punctate. The frontal furrow is well developed. The pronotum, mesonotum, propodeum, lateropropodeum, and metapleuron are densely foveolate. The mesopleuron is rough with a few scattered punctae and foveolae. The petiolar and postpetiolar surfaces are covered with larger foveolae than those of the mesosoma. The postpetiolar dorsum is partially covered with striae. The dorsum of the second segment of the gaster is covered with shallower foveolae than those of the petiole and postpetiole and covered with large fine striae. The rest of the gastral segments are rough and shiny. The antennae, legs, edges of the frontal lobes and mandibles are shiny.

The female and male are unknown.
Description:

Worker Measurements: (n=5)

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Worker Description:

Total length 11- 12 mm; head subquadrate; mandibles with about 8 teeth, covered with hair (0.20 mm in length); anterior medial margin of clypeus convex, “u” shaped, with raised smooth medial clypeal area on lower part, carina not continued to lower margin of clypeus, carina on upper part to between frontal lobes; lower part of medial raised area tends to form groove, maximum clypeal length 1.85 - 2.00 mm; scape not reaching posterior lateral corner of head; maximum frontal lobes width 0.90 - 0.95 mm; length of malar space from lower edge of eye to base of mandible 0.50 mm; length from upper edge of eye to edge of posterior lobe 1.20 mm; frontal furrow well developed; lower margin of pronotum straight with anteropronotonal area forming strongly curved angle, rounded inferior pronotal angle; basalar sclerite oval shaped; mesopleural suture developed; anterior face of petiole from dorsal view rounded, slightly narrowed, posterior face vertical, slightly concave posteriorly (side view); posterior edge of petiole with slight depression (seen from above); mandibles shiny; antennae, legs, edges of frontal lobes, surface of head densely punctate; pronotum, mesonotum, propodeum, lateropropodeum, and metapleuron densely foveolate; mesopleuron rough with few scattered punctae and foveolae; petiolar and postpetiolar surfaces covered with larger foveolae than those of mesosoma; postpetiolar dorsum partially covered with striae; dorsum of second segment of gaster covered with shallower foveolae than those of petiole and postpetiole, covered with large striae; gastral segments rough, shiny; long golden hairs (up to 0.50 mm or more) distributed on entire body including mandibles, clypeus, legs; hairs on scape long, at least as long as greatest diameter of scape; erect and suberect hairs on body surface as following: head, funiculus, mandibles with long hairs (0.20 mm), hairs on scape about 0.20 mm on far end, about 0.40 mm on near area of scape’s base, hairs on legs about 0.25 - 0.30 mm, on pronotum, mesonotum, propodeum (0.40 - 0.45 mm), on petiole, postpetiole, entire gaster (0.50 - 0.55 mm); head, pronotum, mesonotum, mesopleuron, propodeum, petiole, postpetiole, entire gaster black; femora, mandibles brownish black; tibia, tarsi, antennae, edges of frontal lobes brown.
Comparison:

The worker of *B. punicosa* has a similar “u” shaped anterior margin of the clypeus as those of *B. strigulosa*, *B. cariosa*, *B. berthoudi*, and *B. laevissima*. The upper part of the raised area of the clypeus forms a partial carina while it forms a complete longitudinal sharp carina in both *B. strigulosa* and *B. cariosa*, but *B. berthoudi*, and *B. laevissima* lack the carina. The long hairs (up to 0.50 mm or more) separate *B. punicosa* from all of the other members of the *B. punicosa* species complex. The hair length of the other *B. punicosa* species complex species is less than 0.20 mm for the head; less than 0.25 mm for the pronotum, mesonotum, and propodeum; and less than 0.35 mm for the petiole and postpetiole. The traits of *B. punicosa* are very similar to those of *B. berthoudi* and *B. strigulosa*, but it can be separated by the longer hairs and the form of the anterior medial border of the clypeus. The length of the hairs on the head of *B. strigulosa* is 0.07 - 0.13 mm with a few hairs up to 0.16 mm. The length of the hairs of the head of *B. berthoudi* is 0.20 mm. The hairs on the dorsum of the pronotum, mesonotum and propodeum are 0.25 mm and 0.07 - 0.16 mm in *B. berthoudi* and *B. strigulosa* respectively. The length of the hairs on the petiole and postpetiole in *B. strigulosa* is 0.15 - 0.18 mm, and those of *B. berthoudi* less than 0.30 mm. The hairs length comparison of these species with *B. punicosa* shows that *B. punicosa* has the longest hair length among those mentioned above. The hairs on the entire body of *B. berthoudi* are up to 0.35 mm in length, but the hairs of *B. punicosa* are longer, up to 0.45 - 0.55 mm.

Among the 5 specimens of *B. punicosa*, there is one specimen, a worker # 315926, from the LACM, that appears to be different from the others based on hair length. This specimen was collected from South Africa and determined by Forel without any further information. The hairs on the head measure from 0.07 to 0.11 mm, on the mandibles from 0.10 to 0.20 mm, on the scape from 0.14 to 0.21 mm, on legs hairs range from 0.15 to 0.22 mm, on the anterior part of the pronotum from 0.20 to 0.22 mm, posterior part of pronotum, sides of pronotum, mesonotum and propodeum from 0.05 to 0.15 mm, on edges of posteropropodeum up to 0.22 mm, on the petiole from 0.05 to 0.13 mm, on the postpetiole up to 0.10 mm, on the sides of postpetiole up to 0.22 mm, hairs between gastral segments (ventrally) from 0.36 to 0.44 mm, on the pygidium up to 0.22 mm and ventrally (hypopygium) up to 0.30 mm. The other characters for this specimen are quite similar to *B. punicosa*. It is possible it could be a new species, but when more specimens are collected, it can be reevaluated.
Material examined:

Type material.

SOUTH AFRICA: Kaffernlande, Transkei District, 31°30'0" S; 29°0'0" E, Bothroponera pumicosa type (Roger, 1860), (1 w holotype, #11522.) SAM-ENT (SAM).

Non-type material.


Distribution:

Bothroponera pumicosa is known from the Cape Province of South Africa (Wheeler 1922), the Cape of Good Hope (Roger, 1860), the Natal, Province of KwaZulu-Natal (Forel, 1901; Santschi, 1914) and some other workers were collected from a nest in Burntkraal, Cape Province (The Ants of Africa website; , accessed March 2014). This species collected also from Cameroon (Wheeler, 1922) and Mundame, Cameroon (Stitz, 1910).

Biology and habitat:

The type specimen was collected from Kaffernlande, former name of the Transkei and Ciskei regions, both in the Transkei District (per. comm. Dr. Worden) and the Eastern Cape Province, South Africa. The type specimens of B. cavernosa were also collected from Kaffernlande. The habitat in Transkei District is covered with three types of biomes: Grassland, Savanna, and Thicket biomes. These species, with B. cariosa, are recognized by their behavior in that they build small colonies under stones in moist clay soils. They are mainly specialized to feed on termites (Wheeler, 1922; Wheeler and Wheeler, 1971). The worker and male of B. pumicosa were collected from the Cape Province, Natal, South Africa (Forel, 1901b: Arnold, 1915).
Map 8.1: The distribution of \textit{B. pumicosa}.
Bothroponera strigulosa Emery
Figures 17.1, 18.1 and Plate 9.1; Map 9.1


Diagnosis:
Worker:

The head is subquadrate and the mandibles are smooth and covered with hairs. The anterior medial margin of the clypeus is convex and forms a “u” shaped edge, and the clypeus forms a raised medial sharp carina which extends from the base of the frontal furrow to the lower medial margin of the clypeus.

The surface of the head is coarsely foveolate. The pronotum, mesonotum, propodeum, metapleuron and lateropropodeum are densely foveolate and punctate. The petiolar and postpetiolar surfaces are densely covered with larger foveolae than those of the mesosoma. The postpetiolar dorsum is partially covered with striae. The rest of the gastral segments are densely covered with foveolae and punctures that become smaller and shallower from the fourth to the seventh segment. The dorsum of the second-fifth abdominal segments is covered with fine striae. The straight lower margin of the pronotum forms two sharp angles (inferior pronotal process and anteroinferior process). The posteropropodeum is rough and slightly concave. The antennae, legs, edges of the frontal lobes and mandibles are shiny.

Short golden erect hairs are distributed on the entire body including the mandibles, clypeus, scapes and legs. The top of the head covered with short (0.05 - 0.13 mm) golden erect hairs. The dorsum of the pronotum, mesonotum and propodeum are covered with short (0.07 - 0.18 mm) golden erect hairs, the petiole and postpetiole are covered with moderately short (0.08 – 0.22 mm) golden erect hairs. The sternopetiolar process, sternopostpetiolar process and the remainder of the ventral surface of the gastral segments are covered with moderately long hairs (0.15 – 0.32 mm).

The female and male are unknown.
Description:
Worker Measurements: (n=1)

HL 2.50, HW 2.10, ML 1.35, EW 0.35, EL 0.45, SL 1.65, FL 2.50, WL 3.60, WPL 4.50, PL 1.15, PW 1.35, PH 1.45, CI 84, OI 21.42, MandI 54, SI 79, PetI 117.39

Worker Description:

Total length 12.20 mm; mandibles triangular with 7 teeth, smooth, covered moderately with hairs (0.10 - 0.20 mm long); anterior medial margin of clypeus convex, “u” shaped, clypeal length 1.85 mm, with raised medial clypeal area forming longitudinal continuous sharp clypeal carina; scape nearly reaches posterior lateral corner of head; malar space from lower edge of eye to base of mandible 0.38 mm; length from upper edge of eye to edge of posterior lobe 1.10 mm; surface of head coarsely foveolate; frontal lobes rounded, smooth, shiny with width of 0.85 mm; pronotal shoulder rounded; two sharp angles on anterior (anteroinferior pronotal process) posterior (inferior pronotal process) ends of lower margin of pronotum (lateral view); basalar sclerite rounded; lower part of mesopleural suture well developed with mesopleural-coxal excavation; petiole in dorsal view rounded, slightly narrowed anteriorly, anterior face vertical (side view), slightly concave posteriorly (side view) with slight depression on upper medial margin (top view); mesosoma 3.4 mm, gaster length 4 mm; antennae, edges of frontal lobes, mandibles and legs shiny; pronotum, mesonotum, propodeum, lateropropodeum, metapleuron densely foveolate, punctate; posteropropodeum rough, slightly concave; petiolar and postpetiolar surfaces densely covered with larger foveolae than those of mesosoma; second - fifth gastral segments densely covered with foveolae, punctures that become smaller, shallower posteriorly; postpetiolar dorsum partially covered with striae; dorsum of 2nd - 5th segment of gaster covered with fine striae; short (0.05 – 0.22 mm) golden hairs distributed on entire body including mandibles, clypeus, head, scape, legs, dorsum of pronotum, mesonotum, propodeum covered with short golden erect hairs (0.07 - 0.13 mm, a few up to 0.18 mm); petiole (0.08 - 0.22 mm), postpetiole covered with moderately short erect hairs (0.12 - 0.18 mm); sternopetiolar and sternopostpetiolar processes and 3rd to 7th abdominal segments covered with moderately long hairs (0.11 – 0.22 mm); ventral of gastral segments and between segments (0.15 - 0.32 mm); pygidium and hypopygium (up to 0.30 mm); head, scape, pronotum, mesonotum, mesopleuron, propodeum, petiole, postpetiole, entire gaster, legs black or dark-brown; mandibles, funiculus, frontal lobes reddish brown.
Comparison:

*Bothroponera strigulosa* is similar to *B. cariosa*, and *B. pumicosa*, as they all have the “u” shaped lower medial margins of the clypeus. *Bothroponera strigulosa* is quite similar to *B. cariosa*, but it can be distinguished because the mandibles of *B. strigulosa* are smooth and shiny while in *B. cariosa* they are covered with fine striae. The mandibles in *B. pumicosa* are hairy and smooth. The hairs are long (from 0.20 up to 0.55 mm) in *B. pumicosa* while they are short in *B. strigulosa* (from 0.05 up to 0.32 mm) and *B. cariosa* (from 0.05 up to 0.25 mm).

The characters of *Bothroponera strigulosa* are similar to those of *B. berthoudi*. The only apparent differences between them are that the raised medial area of the clypeus of *B. berthoudi* is smooth and the clypeal carina is not present, but *B. strigulosa* has a clypeal carina (it partially forms a carina in *B. pumicosa*). The erect golden hairs on most surfaces are slightly longer in *B. berthoudi* than those of *B. strigulosa*.

**Material examined:**

Type material.


Non-type material.

None.

**Distribution:**

Known from the type locality of Kimberley, South Africa. *Bothroponera strigulosa* was collected from Vaalwater, Northern Province, South Africa (The Ants of Africa website, accessed March 2014).

**Biology and habitat:**

Kimberley, Northern Cape Province, South Africa is a large city that is located almost in the center of South Africa, close to the Free State Province. The summer climate is hot and wet, the annual
maximum temperature is 26.05 °C, the annual minimum temperature is 10.8 °C (Kimberley website 1 and Kimberley website 2). It rains an average of 42.0 cm/year while the winter climate is dry to moderately dry (Kimberley website 1 and Kimberley website 2). The area is considered as a dry or semi-arid region, which is the typical environment for the Northern Cape Province. Mokala National Park, one of the 20 national parks in South Africa, is located south-southwest of Kimberley. The main vegetation in this park is the savanna biome with Kameeldoring trees or camel thorn trees *Acacia erioloba*, one of the major tree species of the desert regions (Kimberley website 3). This park is also one of the protected areas that includes several endangered species and wild animals. The Northern Cape Province is characterized by three type of biomes, succulent karoo, nama karoo, and savanna biomes.

Map 9.1: The distribution of *B. strigulosa*. 

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Figures 17.1 – 20.1

Fig. 17.1: The lateral view of the holotype worker of *B. strigulosa.*

Fig. 18.1: Head of the holotype worker of *B. strigulosa.*

Fig. 19.1: The head of the holotype worker of *B. umgodikulula.*

Fig. 20.1: Lateral view of the holotype worker of *B. umgodikulula.*
Bothroponera umgodikulula Joma and Mackay
Figures 19.1-21.1 and Plate 10.1; Map 10.1


Worker Measurements: (n=3)

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Lower Limit (mm)</th>
<th>Upper Limit (mm)</th>
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<tr>
<td>HL</td>
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<td>3.65 - 3.75</td>
</tr>
<tr>
<td>HW</td>
<td>2.85 - 2.95</td>
<td>5.00 - 5.50</td>
</tr>
<tr>
<td>ML</td>
<td>1.50 - 1.70</td>
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<tr>
<td>EW</td>
<td>0.40 - 0.45</td>
<td>1.50 - 1.70</td>
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<tr>
<td>EL</td>
<td>0.45</td>
<td>1.75 - 1.80</td>
</tr>
<tr>
<td>SL</td>
<td>2.35 - 2.40</td>
<td>2.35 - 2.40</td>
</tr>
<tr>
<td>FL</td>
<td>3.65 - 3.75</td>
<td>3.65 - 3.75</td>
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<tr>
<td>WL</td>
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<tr>
<td>PetI</td>
<td>115 - 126</td>
<td>115 - 126</td>
</tr>
</tbody>
</table>

Diagnosis and Description:

Worker:

This species can be diagnosed by several morphological characters, such as the lack of sculpture on the tergum of the fourth abdominal segment (second gastral segment), which is mostly smooth and glossy. The propodeal spiracle is unusual in being nearly horizontal on the lateropropodeum (Figure 21a). The worker of B. umgodikulula is also characterized by the largest body size among Bothroponera species, which is 14.80 - 15.65 mm. The head is subquadrate. The mandibles are triangular, shorter than the head length, smooth and glossy with scattered elongated coarse punctures and about 7 teeth. The clypeus is convex, “v” shaped and covered with striae, except for the medial area. The anterior medial area is raised and coarsely punctate on the sides, smooth and glossy in the middle. The scape reaches or extends slightly past the posterior border of the head. The compound eyes are relatively large. The lower margins of the frontal lobes are smooth, the upper part is punctate. The maximal frontal lobe width is 1.10 - 1.20 mm. The head is coarsely foveolate. The length of the malar space on the side of the head is (0.65 - 0.70 mm), the length from the upper edge of the eye to the edge of posterior lobe is 1.35 - 1.50 mm.

The pronotal shoulder is rounded. The petiole is rounded and slightly narrowed anteriorly and is slightly concave posteriorly. The pronotum, dorsum of the mesonotum and dorsum of the propodeum are coarsely foveolate and rough. The dorsum of the petiole and postpetiole are coarsely foveolate and punctate. The mesopleuron and lateropropodeum are coarsely grooved and covered with striae, foveolae and punctures. The antennae, legs and posterior edge of each gastral tergite are shiny.

The entire head, pronotum, mesonotum, propodeum, petiole and postpetiole are covered with short (0.03 - 0.10 mm) fine golden hairs. The hairs on the underside of the head range from 0.25 - 0.50 mm.
mm in length. The ventral surface of the postpetiole and fourth–seventh abdominal segments are covered with relatively long (0.20 - 0.25 mm) golden suberect hairs.

The head, pronotum, mesonotum, mesopleuron, propodeum, petiole, postpetiole and entire gaster are black. The legs, antennae, mandibles are red. The clypeus is dark-brown.

The female and male are unknown.

Comparison:

The worker of Bothroponera umgodikulula is easily recognized by the horizontal propodeal spiracle on the lateropropodeum, while it is obliquely vertical in all of the other African Bothroponera species. The 4th abdominal segment (second gastral segment) is smooth and glossy in B. umgodikulula, conversely, the 4th abdominal segment of B. cavernosa is rough, moderately shiny with few scattered hairs and fine poorly defined striae; this structure is moderately smooth and shiny (less than B. umgodikulula) with a few scattered punctures of B. montivaga. The other taxa that can be confused with B. umgodikulula are B. laevissima and B. aspera, which both have a 4th abdominal segment that is smooth and shiny similar to B. umgodikulula. The unique sculpture of these three species simplifies their separation. The surface from the head to the postpetiole is smooth and shiny with few scattered punctulae in B. laevissima and is shiny, rough with dense, shallow punctures in B. aspera, but is coarsely foveolate in B. umgodikulula. The total length of B. umgodikulula is large (14.80 - 15.65 mm) compared to B. cavernosa (11.90 mm) and B. montivaga (12.20 - 12.65 mm). In fact, B. umgodikulula has the largest body size among the other B. pumicosa species complex species (e.g. B. granosa 13.75 - 14.50 mm, B. strigulosa 12.20 mm, B. laevissima 11.80 - 13.00 mm, B. aspera 11.70 - 12.70 mm, B. pumicosa 11.00 - 11.65 mm, B. cariosa 11.50 mm and B. berthoudi 9.60 - 12.75 mm). The anterior medial margin of the clypeus is “v” shaped in B. umgodikulula similar to that of B. granosa, B. cavernosa, B. montivaga, B. aspera, conversely, the anterior medial margin of the clypeus is “u” shaped in B. cariosa, B. strigulosa, B. pumicosa, B. laevissima and B. berthoudi. The anterior medial raised area of the clypeus of B. umgodikulula is completely smooth (lacking a carina), shiny, but sculptured and punctate on the sides of the medial raised area. The anterior medial raised area of the clypeus of B. granosa has a sharp clypeal carina whereas it is partially carinated in B. cavernosa and B. montivaga.
Material examined:

Type material.

**SOUTH AFRICA: Eastern Cape Province**, Bulhoek, klaver-clanw [Whittlesea], Bulhoek at 32°10'0" S; 26°49'0" E, Mus. Expd. Oct. 1950, identified as *Bothroponera cavernosa* Roger, 1860, F. W. G., (1 w holotype, MCZC) and (1 w paratype # C005835 SAM).

Non-type material.

**SOUTH AFRICA: Western Cape Province, Hopefield**, 33°03′56″S 18°21′03″E, identified as *Bothroponera cavernosa* Roger, Det. G. Arnold (1w BMNH).

Distribution:

Whittlesea and Hopefield areas in South Africa.

Biology and habitat:

The type specimens were collected in Whittlesea city in South Africa. This area is located in the Eastern Cape Province, but the additional material examined (one specimen) was collected in Hopefield city in the Western Cape Province. Hopefield is a small village situated 90 miles north of Cape Town and about 24.14 km [15 miles ] east of Saldanha Bay (Singer, 1954). The Fynbos biome is dominant in this area (South African National Spatial Biodiversity Assessment 2004), and it is one of the threatened ecosystems in South Africa (Farrier *et al.*., 2013). The ecological importance of Hopefield area results from the soil structure, water permeability, climatic influence and vegetational cover. The area is characterized by spreading of several alien invasive plants such as the alien wattles *Acacia cyclops* (Rooikrans), *A. longifolia* (long-leaf wattle), *A. saligna* (Port Jackson), a number of *Eucalyptus* species, Manitoka (*Myoporum montanum*) and prickly pear cactus (*Opuntia* sp.). Also many endemic and threatened plant taxa are present (Department of Environmental Affairs & Development Planning 2011). This type of mixed habitat is likely to include many species of insects such as tropical ants.
Map 10.1: The distribution of *B. umgodikulula*.

Figure 21.1: The lateral view of *Bothroponera umgodikulula* shows the propodeal spiracle.

Plates of workers in the *Bothroponera pumicosa* species complex

Plate 1.1: *Bothroponera aspera*, paratype worker.
Plate 2.1: *Bothroponera berthoudi* worker.
Plate 3.1: Holotype worker of *B. cariosa*. 
Plate 4.1: *Bothroponera cavernosa*, holotype worker.
Plate 5.1: *Bothroponera granosa*, worker.
(from Ant web)
Plate 6.1: *Bothroponera laevissima*, worker
(from Ant web).
Plate 7.1: *Bothroponera montivaga*, lectotype worker.
Plate 8.1: Bothroponera pumicosa, holotype worker.
Plate 9.1: *Bothroponera strigulosa*, holotype worker.
Plate 10.1: *Bothroponera* *ungodikulula*, holotype worker. (from Ant web).
References


Singer, Ronald. 1954. The Saldanha Skull from Hopefield, South Africa, A modified form of this paper was read on behalf of the author by Dr. W. L. Straus, Jr., at the 23rd Annual Meeting of the American Association of Physical Anthropologists, Yellow Springs, Ohio, on March 27, 1954.


Abstract

The *Bothroponera sulcata* species complex is distributed in Afrotropical areas including tropical and subtropical ecosystems. The *sulcata* species complex includes 11 species: *B. ancilla* (stat. nov.), *B. crassa*, *B. crassior* (stat. nov.), *B. notaula* (sp. nov.), *B. kenyensis*, *B. kruegeri*, *B. picardi*, *B. silvestrii*, and *B. soror*, *B. ryderae* (sp. nov.), *B. pilosuperficia* (sp. nov.), and 6 new synonyms *B. ilgii* (syn. nov.), *B. asina* (syn. nov.), *B. rhodesiana* (syn. nov.), *B. lamottei* (syn. nov.), *B. suturalis* (syn. nov.), *B. nimba* (syn. nov.). The main defining character of these species is the presence of a metatibial gland; however, there are other characters such as the shape of the anterior clypeal border, mandible surface and shape, teeth number, postero-dorsopropodeum shape (broadly or strongly curved or angulated). Diagnosis, comparisons, illustrations, distributions and other information about the species are provided with a key for the worker caste.
Introduction

The Formicidae is a highly diverse family of arthropods. Ants are considered to be one of the most biodiverse groups on earth (Hölldobler and Wilson 1990; Davidson et al. 2003; Lach et al. 2010). The actual number of ant species is still under investigation, but is estimated to be 12,027 valid extant species (Bolton 2014).

Despite the critical importance of ants, little is known about the taxonomy, ecology and biology of Afrotropical ants except the location and some other basic information from collections. Several ant genera still need modern revisions to support ant studies in Africa (Robertson, 2000) or even worldwide. For example, myrmecologists were dealing with about 28 genera in the subfamily Ponerinae, but recently, Schmidt and Shattuck (2014) raised the number to 47 genera. These genera need revision at the species level, especially for the genera that have large numbers of species.

The objective of this chapter is to revise the Afrotropical members of the *Bothroponera sulcata* species complex to tackle the biosystematics and taxonomic status of *Bothroponera* ants in Africa.
Methods and materials (refer to chapter 1)

Species descriptions

Family Formicidae, Subfamily Ponerinae

Bothroponera Mayr, 1862

B. sulcata species complex

Worker description:

Specimens in B. sulcata species complex are very similar. Head shape excluding mandibles subquadrate, slightly narrowed anteriorly; posterior border concave; mandibles narrowed, shorter than head length, with 6 to 9 teeth that alternate in size in most species; anterior border of clypeus broadly convex, clypeus with raised medial area, convex, smooth or with medial longitudinal groove instead of narrowed flat strip in some species, often with longitudinal striae that do not form carina; frontal lobes divided by frontal furrow, frontal lobes subquadrate anteriorly rather than rounded; scape extends slightly past posterior lateral corner of head in most species; compound eyes relatively small to large; pronotal shoulder rounded; mesonotum and propodeum completely fused; meso-metapleural suture well developed; propodeum angulate or rounded posteriorly, basalar sclerite oval or round, propodeal spiracle elongated; metapleuron compressed in one species (B. crassa), convex in other species petiole large with petiolar spiracle and developed sternopetiolar process; metatibial gland present. Head roughly sculptured, rarely foveolate; mandibles smooth or covered with fine striae; pronotum, mesonotum, mesopleuron, propodeum, petiole and postpetiole roughly sculptured with scattered punctures on the mesosoma, petiole and postpetiole in some species. Entire body covered with moderately short or long (0.22 - 0.36 mm) erect golden hairs or without hairs, Color usually black, red, or brown.

Female:

Head subquadrate; scape extends slightly past posterior lateral corner of head; pronotum rounded anteriorly; scutum widened anteriorly, reaching same width as pronotum, narrowed posteriorly, reaching same width as scutellum; parapsidal sutures present on dorsum of scutum; scutum elevated, narrowed, well separated from propodeum and scutellum; mesopleuron divided by anapleural sulcus to form lower katepisternum and upper anepisternum; meso-metapleural suture well defined; basalar sclerite rounded, propodeal spiracle elongate; petiole thick and rounded anteriorly, mostly vertical (straight) posteriorly;
postpetiole and the remainder of gaster larger than mesosoma; metatibial gland present; color pale black to brown.

**Male:**

Head excluding mandibles suborbiculate; eyes large, cover most of side of head; scape shorter and thicker than second segment of funiculus; maxillary palps with 5 segments, labial palps with 4 segments, pronotum triangular, scutum with or without notauli and parapsidal sutures present, scutellum triangular in dorsal view, raised between scutum and propodeum, mesopleuron divided by anapleural sulcus into ventral katepisternum and dorsal anepisternum, propodeum gradually sloping posteriorly to reach insertion of petiole; petiole small, width less than width of propodeum and height less than postpetiole height, with pointed apex; postpetiole rounded; color usually light brown; metatibial gland apparently absent.
Key to Bothroponera sulcata species complex

1. Lateropropodeum strongly compressed, distinctly concave as seen from above. Dorsopropodeum narrowed, about ⅓ width of propodeum, slightly curved posteriorly, Margins of posteropropodeum not forming granulated or carinated edges, but distinctly angulate with lateropropodeum. Posteropropodeum flat, without depression, rarely collected, known only from Eritrea and Kenya ................................. B. crassa
   - Lateropropodeum not compressed, or if slightly concave, dorsopropodeum much wider than ⅓ width of propodeum, sometimes slightly inflated, usually nearly as wide as remainder of propodeum. Dorsopropodeum curved to form slight or sharp obtuse angle with posteropropodeum, which is flat or slightly concave, with or without slight medial depression seen from above or from posterior side. Margins of lateropropodeum and posteropropodeum sometimes forming granulated and carinated edges; commonly collected and widely distributed ................................................................. 2

2(1). Mandibles smooth, shiny, sometimes moderately shining .............................. 3
   - Mandibles striated, rough, sometimes with scattered elongate punctures .................. 4

3(2). Surface of head covered with moderately long erect silver hairs, surface of pronotum, mesopropodeum, petiole, postpetiole and 4th to 7th abdominal segments covered with abundant erect and suberect hairs ranging in length from 0.20 to 0.36 mm; distributed in Gabon and Cameroon ................................................................. B. pilosuperficia
   - Surface of head bare, lacking erect hairs except few on posterior border or on frons in few cases, surface of pronotum, mesopropodeum, petiole, postpetiole and 4th to 7th abdominal segments covered with or without moderately long erect hairs, range in length from 0.15 to 0.30 mm .............................. 5

4(2). Larger body length (TL 11.75 - 12.55 mm); shaft of scape with more than 20 nearly completely erect hairs; collected from Kenya, Zimbabwe and South Africa ......................... B. kruegeri
   - Smaller body length (TL 7.60 - 9.40 mm); shaft of scape with fewer than 20 nearly erect hairs ......................................................................................................................... 6

5(3). Head bare, surface of pronotum, mesopropodeum, petiole, postpetiole and 4th to 7th abdominal segments bare; rarely collected, known from Angola .............................. B. picardi
- Head bare except few on top or on frons, surface of pronotum, mesopropodeum, petiole, postpetiole and 4th to 7th abdominal segments covered with moderately long erect hairs .......................... 7

6(4). Surface sculpture rough without punctures; wide and slightly deep groove on the raised longitudinal area of anterior medial area of the clypeus; collected from Kenya, Somalia and Tanzania ........................................................................................................ B. notaula

- Surface sculpture rough with strong evidence of punctures; no groove, or slightly narrowed groove present on the raised longitudinal area of the clypeus; distributed in the Eastern countries of Africa including Eritrea, Somalia, Ethiopia, Kenya and Zimbabwe ................................. B. crassior 7(5). Posteropropodeal margins do not form granulated, carinated and sharp margins with lateropropodeum; dorsopropodeum slightly curved without depression to form posteropropodeum; rarely collected from Kenya and Tanzania ................................................................. B. kenyensis

- Posteropropodeal margins form granulated, carinated and sharp margins with lateropropodeum; dorsopropodeum strongly curved with depression to form posteropropodeum .................................................. 8

8(7). Anterior medial area of clypeus partially or completely striated; scape extends slightly past posterior lateral corner of head; widespread species, collected from Guinea, Ivory Coast, Ghana, Cameroon, Gabon, Congo Brazzaville, Congo (DRC), Angola, Ethiopia, Kenya, Burundi and Mozambique ................................................................................................................................. B. soror

- Anterior medial area of clypeus, not striated, forming a shiny, smooth longitudinal narrowed strip with slight groove in some specimens or with weak evidence of fine striae in others ................. 9

9(8). Head bare of erect hairs, surface of pronotum, mesopropodeum, petiole, postpetiole and 4th to 7th abdominal segments covered with few moderately long scattered erect hairs; rarely collected, distributed in Guinea and Nigeria ............................................................................................................. B. ryderae

- Head bare of erect hairs except on top, surface of pronotum, mesopropodeum, petiole, postpetiole and 4th to 7th abdominal segments covered with moderately long erect hairs ...................... 10

10(9). Small, total length (5.25 - 6.15 mm); head lacking erect hairs except few scattered on posterior border; scape index from 78.94 to 95.45; OI 14.28 - 22.72, MandI 45.45 - 60.00; collected from Cameroon, Ghana, Guinea, Ivory Coast and Nigeria ................................................................. B. silvestrii

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- Large total length (6.75 - 8.90 mm); head lacking erect hairs on sides except few scattered on top and frons; scape index from 91.89 to 92.00; OI 20.00 - 20.27, MandI 58.62 - 64.70; widespread, collected from Congo Brazzaville, Gabon, Kenya, Mozambique and Tanzania ...................... B. ancilla
Diagnosis for each species of *B. sulcata* species complex

*Bothroponera ancilla* (Emery), stat. nov.

Figures 1.2, 2.2 and Plate 1.2; Map 1.2


**Diagnosis:**

**Worker:**

Workers of *Bothroponera ancilla* have characters similar to those of other members of the *B. sulcata* species complex with some exceptions. The mandibles are smooth, shiny and sparsely punctate, narrowed and have about 7 teeth that do not always alternate in size. The anterior medial area of the clypeus is raised to forms a shiny, smooth longitudinal narrowed strip with slight groove in some specimens or with weak evidence of fine striae in others. The compound eyes are relatively small. The malar space length is 0.20 - 0.25 mm while the area from upper edge of eye to the upper margin of posterior lobe is 0.65 - 0.90 mm.

The head is roughly sculptured with abundant small punctures that cover the surface. The pronotum, mesonotum, propodeum, petiole and postpetiole are roughly sculptured with a few scattered punctures. The second gastral segment (fourth abdominal segment) is mostly shiny and without punctures. The clypeus, legs and antennae are moderately shiny. The lower margin of the pronotum is straight with a rounded anteroinferior pronotal process, pointed inferior pronotal process. The dorsopropodeum forms a strong curved posterior edge with the posteropropodeum. The posteropropodeal is slightly concave and the margins form granulated, carinated sharp edges.

The dorsum of the pronotum, mesonotum, propodeum, petiole and postpetiole are covered with a few moderately short (0.15 - 0.25 mm) erect scattered hairs. The hairs on the 4th to 7th abdominal segments are 0.20 up to 0.30 mm in length. The dorsum of the head and frons are covered with a few short (0.10 - 0.15 mm) golden erect hairs. Hairs are silver on the mesosoma, but appear yellowish on petiole and gaster.
The entire body is brown or reddish brown, black or dark brownish in other specimens. The mandibles, legs and scapes are pale brown to dark brown.

The male and female are unknown.

Figures. 1.2-2.2

Fig. 1.2: The lateral view of the holotype worker of *B. ancilla*.

Fig. 2.2: The head of the holotype worker of *B. ancilla*.

**Description:**

**Worker Measurements:**

- HL 1.45 - 1.70, HW 1.25 - 1.48, ML 0.85 - 1.10, EW 0.18 - 0.22, EL 0.25 - 0.30, SL 1.15 - 1.36, FL 1.95 - 2.45, WL 2.20 - 2.50, WPL 2.75 - 3.25, PL 0.55 - 0.65, PW 0.75 - 0.85, PH 0.95 - 1.15, CI 86.20 - 87.05, OI 20 - 20.27, MandI 58.62 - 64.70, SI 91.89 - 92.00, PetI 130.76 - 136.36

**Worker Description:**

Total length 6.75 - 8.90 mm; head subquadrate; mandibles with about 7 teeth, smooth, shiny; clypeus convex, with single medial raised area that forms narrow smooth shiny flat strip; compound
eyes relatively small; malar area length 0.20 - 0.25 mm, area from upper edge of eye to upper margin of posterior lobe 0.65 - 0.90 mm; head, pronotum, mesonotum, propodeum, petiole and postpetiole roughly sculptured; inferior pronotal process pointed posteriorly, antero inferior pronotal process rounded; dorsopropodeum forms defined angle with posteropropodeum; petiole rounded dorso-anteriorly with medium rounded apex and vertical posterior face (side view); few short (0.10 - 0.15 mm) erect hairs on top of head; dorsum of pronotum, mesonotum, propodeum, petiole and postpetiole covered with moderately distributed, longer (0.15 - 0.25 mm) erect scattered hairs; hairs on ventral surface of head few and moderately long (0.25 - 0.35 mm); entire body black or brown, pronotum, mesonotum, propodeum, petiole and postpetiole brownish black (or dark brown). Head and clypeus light brown to reddish, mandibles reddish brown to yellowish brown, legs and antennae brown.

**Comparison:**

**Comparison of workers:**

The *B. ancilla* worker was described by Emery (1899) as a variety of *B. soror*. He used the total size, antennal shape and the form of the propodeum to separate it from *B. soror*. Although, Emery concluded that *B. ancilla* was much smaller than the type of *B. soror* (total length of type *B. soror* in Emery was 7.50 – 9 mm whereas that of the holotype of *B. ancilla* is 6.66 mm), my measurements of the total length of *B. ancilla* (6.75 - 8.90 mm) overlaps the total length of all specimens of *B. soror* (7.60 - 11.10 mm). Emery considered the antennae to be less thickened than in *B. soror*, but the direct comparison between the type specimen *B. ancilla* and the large number of *B. soror* specimens shows that there is no significant difference in the thickening of the antenna. Emery (1899) also indicated that the carinae of the lateropropodeum are less developed, more dull and without a trace of the notopropodeal suture. I do not see any significant difference in the formation of the propodeum.

*Bothroponera ancilla* can be separated by other characters. The anterior medial raised area of the clypeus forms a smooth shiny flat narrowed longitudinal strip that occasionally has a slight depression (groove) or even striae. The fine striae of the anterior medial raised area of the clypeus are absent in the type specimen of *B. ancilla* that was collected from Congo while the fine striae of the anterior medial raised area of the clypeus are poorly developed in the other material of *B. ancilla* that were collected from Gabon, Kenya, Tanzania and Mozambique. The eye size in *B. ancilla* is identical to that of *B. pilosuperficia*, but smaller than that of *B. soror.*
The malar space length in *B. ancilla* is 0.20 - 0.25 mm, in *B. pilosuperficia* is 0.17 - 0.22 mm and in *B. soror* is 0.25 - 0.35 mm while the area from upper edge of eye to the upper margin of posterior lobe in *B. ancilla* is 0.65 - 0.90 mm, in *B. pilosuperficia* is 0.80 - 0.90 mm and in *B. soror* is up to 0.95 mm. This indicates that the *B. soror* has a larger head than *B. pilosuperficia* and *B. ancilla*.

The distribution of the hairs on the surfaces is similar in *B. ancilla* and *B. soror*, but these two differ slightly from that in *B. pilosuperficia*. The dorsum of pronotum, mesonotum, propodeum, petiole and postpetiole in *B. ancilla* are covered with a few moderately short (0.20 - 0.25 mm) erect scattered hairs similar to that of *B. soror* (0.15 - 0.25 mm) while the head seems to be bare in *B. ancilla*, but the top and frons of the head are covered with a few scattered short (0.10 - 0.15 mm) erect hairs in *B. ancilla*. In *B. pilosuperficia*, the entire surface including the head is covered with abundant and moderately long (0.15 - 0.30 mm) silver erect hairs.

The general color among these species and even the others in the complex suggest that the color shows a wide range of variability from light brown to dark brown and yellow to brown reddish in other cases.

**Material examined:**

**Type material:**


Non-type material:

Same locality, base of waterfall, 18°29'43.6" S, 34°2'54.6" E, 895m, 26-v-2012, coll. Gary D. Alpert, WP 039, Secondary forest, general collecting, on ground, # 00515795, 00515747, 00515748, 00515749, 00515750 (5w MCZC). TANZANIA: Iringa, 7°46'0" S; 35°42'0" E, 3-viii-1865, coll. G. J. James (6 w 315942 and 315941 LACM).

**Distribution:**

Congo, Gabon, Kenya, Mozambique and Tanzania.

**Biology and habitat:**

The biogeographical area of the type specimen of *B. ancilla* has habitat that differs from that of the other specimens. The type specimen was collected from Congo, on the Western side of the African continent while the additional specimens were collected from Gabon, Kenya, Mozambique and Tanzania on the Eastern side of Africa. The specimens were collected from the Equatorial Rainforest in Kenya and from Secondary forests in Mozambique. They were loose individuals from guesthouse clearing, along forested edge of stream, and from leaf litter and on ground. The distribution of *B. ancilla* indicates that this species must be widespread in tropical and subtropical rainforests of Africa.
Map 1.2: The distribution of *B. ancilla*.
Bothroponera crassa (Emery)
Figures 3.2-6.2; Map 2.2

Ponera crassa Emery, 1877: 366 (2w) Eritrea [was part of Ethiopia], Sciotel; Bothroponera crassa: Emery, 1892: 111; Dalla Torre, 1893: 36; Wheeler, W. M. 1922a: 73 (in key); Wheeler 1922b: 769; Schmidt and Shattuck, 2014: 77; Pachycondyla (Bothroponera) crassa: Emery, 1895: 177; Emery, 1901: 46 (list); Pachycondyla crassa: Bolton, 1995: 304; Özdikmen 2010: 994.

**Diagnosis:**

**Worker:**

The *B. crassa* workers are characterized by being relatively small (total length 6.0 - 8.8 mm), having the anterior medial margin of the clypeus convex with a smooth and shiny medial raised area, but without a clypeal carina (this raised area has different forms among *B. crassa* individuals and may have a small depressed area anteriorly or even a short trough).

The head, pronotum, mesonotum, petiole and postpetiole are roughly sculptured with a few scattered punctures, but not on 4th to 7th abdominal segments. The mandibles are smooth to striate with scattered punctures. The pronotal shoulder is rounded anteriorly. The lateropropodeum is compressed laterally to form a slender mesonotum-propodeum as seen from above. The posteropropodeum usually declines gradually. The apex of the petiole is slightly rounded with a straight anterior face while it is slightly concave posteriorly (side view). The apex of the petiole is slightly higher than the postpetiole and the dorsopropodeum.

The female is unknown.
Figures. 3.2-6.2

Fig. 3.2: The lateral view of the lectotype worker of *B. crassa*.

Fig. 4.2: The head of the lectotype worker of *B. crassa*.

Fig. 5.2: The head of a male of *B. crassa* from Kenya (LACM).

Fig. 6.2: The lateral view of a male of *B. crassa* from Kenya (LACM).
Male:

The head of the *B. crassa* male is suborbiculate, excluding the mandibles and the mouthparts. The ocelli are relatively large. The notauli are present on the dorsum of the scutum. The metanepisternum is well developed and distinguished from the propodeum and mesopleuron while the metakatepisternum is narrowed and poorly defined. The dorsopropodeum is gradually sloped posteriorly to reach the insertion of the petiole at the lowest medial point of the propodeum. The petiole is small; its width is less than that of the dorsopropodeum (seen from above) and the height is less than the postpetiolar height and with a bluntly rounded apex. The pronotum, scutum, scutellum, propodeum, petiole and postpetiole are roughly sculptured. The postpetiole is rounded.

Fine short dense hairs cover the entire body, which are denser on the pronotum, scutum, scutellum and propodeum than that on the petiole and postpetiole with the rest of the abdominal segments.

Description:

Worker Measurements (n=4):

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Worker Description:

Total length relatively small (total length 6.00 - 8.80 mm); head quadrate, mandibles narrow with about 7-8 teeth, compound eyes relatively large; clypeus convex, dorsum shiny, smooth to striate with scattered punctures; scape extends slightly past posterior lateral corner of head; malar space length 0.25 mm, length from upper edge of eye to edge of posterior lobe 0.85 mm; pronotal shoulder rounded; dorsopropodeum slightly slops posteriorly to form postero-propodeum; petiole slightly rounded from top, anterior face straight, slightly concave posteriorly, apex of petiole slightly higher than postpetiole and dorsopropodeum; head, pronotum, mesonotum, petiole, postpetiole roughly sculptured; entire body covered with fine hairs; head covered with short erect hairs (less than 0.10 mm); hairs on ventral surface moderately long (0.15 - 0.35 mm). Dorsum of pronotum, mesonotum, propodeum covered with short erect scattered hairs (0.15 mm); petiole and postpetiole covered with moderately long erect hairs (0.20 mm).
male Measurements: (n=14)

HL 1.05 - 1.20, HW 0.70 - 0.95, ML 0.25 - 0.35, EW 0.45 - 0.60, EL 0.60 - 0.80, SL 0.25 - 0.35, FL 5.05 - 5.55, WL 2.25 - 2.80, WPL 2.85 - 3.45, PL 0.60 - 0.65, PW 0.55 - 0.65, PH 0.75 - 0.85, CI 66.66 - 79.16, OI 84.21 - 85.71, MandI 23.80 - 29.16, SI 35.71 - 36.84, PetI 91.66 - 100.00

Male Description:

Total length ranges from 5.90 - 7.50 mm; head excluding mandibles nearly suborbiculate; eyes large, cover most of sides of head, distance between eyes 0.65 - 0.70 mm, medial ocellus width 0.20 - 0.25 mm; scape shorter (0.30 mm) and thicker than first funicular segment, three times longer (0.10 mm); maxillary palps with 5 segments, labial palps with 4 segments; pronotum square laterally and rounded anteriorly; scutum rounded; notauli present on dorsum of scutum; scutellum subtriangular and elevated in lateral view; metanotum raised between scutellum and propodeum; mesopleuron divided by anapleural sulcus to form ventral katepisternum and dorsal anepisternum; metaepisternum well developed and separated from propodeum and mesopleuron by suture; dorsopropodeum gradually sloping down posteriorly to insertion of petiole; petiole small, petiole width less than dorsopropodeum width (seen from above) and height less than postpetiolar height, with bluntly rounded apex; postpetiole rounded; pronotum, scutum, scutellum, propodeum roughly sculptured; fine short (less than 0.05 mm) dense hairs cover entire body; moderately long hairs (0.15 - 0.25 mm) scattered on dorsum of scutellum, metanotum, propodeum, petiole, postpetiole, on suture between pronotum and scutum; hairs on dorsum of scutellum, petiole and ventral surface of postpetiole denser than on other parts; ventral surface of head with moderately long (0.20 mm) erect hairs; color mostly brown, light brown to yellowish.

Comparison:

Comparison of worker:

It is difficult to separate B. crassa from B. crassior, B. notaula, B. kenyensis, and B. kruegeri because these species have similar dorsopropodea and posteropropodea. The total length of the worker of B. crassa ranges from 6.00 - 8.80 mm, which overlaps that of B. crassior (8.35 - 9.40 mm), B.
notaula (7.60 mm), and B. kenyensis (5.65 - 7.05 mm). The obvious characters that can separate those species is the structure of the clypeus and the form of the propodeum. The clypeus of B. crassa always has a smooth and shiny medial raised area, but without a groove in the two type specimens or with no more than a partial clypeal groove in other three specimens from Kenya. On the other hand, the type specimens of B. crassior have a complete longitudinal shiny raised strip on the anterior medial area of the clypeus that forms a narrowed groove, and this area has a partial groove in the specimens from Kenya, Tanzania and Ethiopia. The anterior medial area of the clypeus of B. notaula forms a shiny smooth longitudinal strip with a clear wide groove. The other character is the structure of the lateropropodeum. This area is laterally compressed in B. crassa, including the three specimens from Kenya, apparently for the positioning of the metafemora (best seen from above). This character separates B. crassa from all of the others in the complex including B. crassior, B. kruegeri and the B. notaula. Conversely, B. crassior has a convex lateropropodeum. Finally, the propodeum is subquadrate and angulate between the faces of B. crassa, while it is mostly rounded (broadly curved) in B. crassior.

Comparison of males:

The male of Bothroponera crassa is similar to other known males of the B. sulcata complex, including B. crassior, B. kruegeri, B. notaula, B. ryderae, B. kenyensis, and B. soror. The notauli are absent in B. crassa and B. crassior while they are present in B. soror B. notaula, B. ryderae and B. kenyensis. The notauli in B. kruegeri are not well defined. The pronotum, scutum, scutellum and propodeum are roughly sculptured with a few scattered punctures on surface of B. soror. The petiole and postpetiole with the rest of gastral segments of B. soror are less sculptured (rough) than they are in B. crassa. The pronotum, scutum, scutellum and propodeum of B. crassior and B. crassa are rough (not punctuated). The head, pronotum, scutum, scutellum, metanotum, propodeum and petiole of males of B. kenyensis, B. notaula, B. ryderae, B. kruegeri are rough, shiny while the postpetiole and 4th to 7th abdominal segments are mostly smooth and shiny. The petiole and postpetiole with the rest of gastral segments of B. crassa are similar to that of B. soror (rough); unfortunately, the gaster is missing in the only specimen of B. crassior; therefore, the measurement is missing in B. crassior. The dorsopropodeum gradually slopes posteriorly in B. crassior and B. crassa similarly to that in B. kruegeri whereas the dorsopropodeum is strongly curved nearly angulate posteriorly in B. soror. The dorsopropodeum in the males of B. notaula and B. ryderae is moderately broadly curved posteriorly to gradually reach the connection of the posteropropodeum with the petiole. The medial ocelli are large in B. crassa (0.20 - 0.25 mm), B. notaula (0.20 - 0.25 mm) and B. kruegeri (0.35 mm), which distinguish them from species
with small medial ocelli including *B. soror* (0.10 - 0.15 mm), *B. ryderae* (0.16 mm), *B. kenyensis* (0.12 - 0.13 mm) and *B. crassior* (0.17 mm).

**Material examined:**

**Type material:**

**ERITREA:** Bogos, Sciotel, 15°30'0'' N; 38°14'0'' E, O. Beccari 1870, type, *Ponera crassa*: Emery; syntype, *Ponera crassa* Emery 1877. Museo Civico di Genova (2w, lectotype and paralectotype, MCSN).

**Non-type material:**


**Distribution:**

Eastern Africa (Eritrea, Ethiopia and Kenya).

**Biology and habitat:**

The type specimens of *B. crassa* were collected from Sciotel in Eritrea, 15°30'0'' N; 38°14'0'' E, by Beccari; however, in several publications, the type specimens of *B. crassa* were reported from Ethiopia. Ethiopia is the adjacent country of Eritrea along the Southern borders of Eritrea. The two countries are located on the Western side of the African continent, but Eritrea has a long shoreline on the Red Sea. The ecoregions and vegetation cover of the two countries are different. Ethiopia is covered by 3 vegetation types: the first, with grassland, which includes dwarf shrubs and wooded grassland, the
second, with savanna, which include dry and moist savanna, and finally the third, with forests (McClanahan and Young, 1996). The main ecoregions in Ethiopia are Ethiopian upper montane forests, woodlands, bushlands and grasslands (70), Ethiopian montane moorlands (71) and Ethiopian lower montane forests, woodlands and bushlands (25); in addition to a large area of the country that is covered with Somali *Acacia-Commiphora* bushlands and thickets (44). The Ethiopian xeric grasslands and shrublands (101), (70) and (25) ecoregions are shared between Ethiopia and Eritrea (fix font sizeWorldwildlife.org, accessed 9/2/2014, Burgess et al., 2004). Sciotel City, the type locality of *B. crassa*, is located in Gash-Barka Region in Eritrea, which is very rich with various agriculture products such as crops, fruits and vegetables (Eritrea website). Mainly, this region is covered with Sahelian *Acacia* Savanna (35) (Worldwildlife.org, accessed 9/2/2014; Burgess et al., 2004). The majority of specimens that were identified as *B. crassa* in previous studies are similar but not identical to *B. crassa* and are actually *B. crassior* and *B. soror*. For this reason, they are moved in this study to the right species group. Ten males were collected from Kenya, Laikipia District, Mpala Research Centre at night (8:30 to 9:30 pm) where they were flying at lights. This information indicates that *B. crassa* is neither common nor widespread in Africa.
Map 2.2: The distribution of *B. crassa*.
Bothroponera crassior (Santschi), stat. nov.
Figures 7.2-10.2 and Plates 2.2, 3.2; Map 3.2

Pachycondyla (Bothroponera) crassa var. ilgii Forel, 1910b: 244 (w) ETHIOPIA, Schoa, Abyssinia;
Pachycondyla crassa var. ilgii: Brown, in Bolton, 1995: 306; Bothroponera crassa var. ilgii: Emery 1911:77 (w); Santschi, 1914a: 50; Schmidt & Shattuck, 2014: 77; replacement name B. crassa gamzea: Özdikmen, 2010c: 994, (syn. nov.).

Bothroponera crassa var. crassior Santschi, 1930a: 53 (w), Kenya, western slopes of Mount Kenya;
Bothroponera crassa var. crassior: Santschi, 1930b: 267 (m and w); Bothroponera crassa crassior: Santschi, 1932: 382 (w); Schmidt and Shattuck, 2014: 77; Pachycondyla crassa crassior: Bolton, 1995: 304; Özdikmen 2010:995.

Pachycondyla (Bothroponera) crassa st. crassior var. andrieui Santschi, 1930a: 54 (w), unavailable name, material referred here.

Diagnosis:

Worker:

The worker of Bothroponera crassior can be characterized by the narrowed mandibles that have about 7 - 9 teeth, which alternate in size and the mandibles that are covered with fine striae and large scattered elongate punctures. The anterior medial margin of the clypeus is convex with a medial raised area that has a longitudinal narrowed shiny groove. The posteropropodeum is slightly sloping and forms a broadly curved angle with the dorsopropodeum.

The head and dorsum of the pronotum, mesonotum, petiole and postpetiole are roughly sculptured with very few scattered punctulæ. The anterior face of the petiole (seen from above) is rounded and the posterior face is slightly concave. The entire body is covered with a fine pubescence.

The female is unknown.
Figures 7.2-10.2

Fig. 7.2: The lateral view of the lectotype worker of *B. crassior*.

Fig. 8.2: The head of the lectotype worker of *B. crassior*.

Fig. 9.2: The head of a paralectotype male of *B. crassior*.

Fig. 10.2: The lateral view of a paralectotype male of *B. crassior*.

**Male:**

The head of the *B. crassior* male is nearly round, excluding the mandibles. The ocelli are relatively small. The scape is twice as long as the pedicel (first funiculus segment), shorter and thicker than the second funicular segment.
The pronotum is square laterally and rounded anteriorly. The notauli are not present on the dorsum of the scutum. The scutellum is subtriangular and elevated above the level of the mesosoma as seen in lateral view. The metanotum is raised between the scutellum and propodeum. The metaneupisternum is well developed and distinguished from the propodeum and mesopleuron while the metakatepisternum is narrowed and poorly defined.

The dorsopropodeum is gradually sloped posteriorly to the insertion of the petiole. The petiole, postpetiole and the remainder of the gastral segments are missing.

The color of the entire body is mostly light brown to medium brown.

Description:

Worker Measurements: (n=25)

HL 1.65 - 1.90, HW 1.35 - 1.60, ML 1.05 - 1.15, EW 0.30 - 0.35, EL 0.40 - 0.45, SL 1.35 - 1.55, FL 2.10 - 2.30, WL 2.15 - 2.85, WPL 2.70 - 3.50, PL 0.65 - 0.75, PW 0.90 - 0.95, PH 1.15 - 1.30, CI 81.81 - 84.21, OI 28.12 - 29.62, Mandl 60.52 - 63.63, SI 96.87 - 100.00, PetI 126.66 - 138.46. The measurements of B. gamzea (synonym of B. ilgii): HL 1.70 - 1.85, HW 1.40 - 1.55, ML 1.00, EW 0.30 - 0.35, EL 0.40, SL 1.40, FL 2.25, WL 2.60 - 2.65, WPL 3.25 - 3.30, PL 0.65 - 0.70, PW 0.85 - 0.90, PH 1.20 - 1.15, CI 82.35 - 83.78, OI 25.80 - 28.57, Mandl 5.40 - 5.88, SI 90.32 - 100.00, PetI 128.57 - 130.76

Worker Description:

Total length 8.35 - 9.40 mm; head excluding mandibles nearly quadrate; mandibles shiny, narrowed, covered with fine striae and with 7 - 9 teeth; anterior medial border of clypeus raised to form longitudinal shiny narrowed groove. Eye diameter relatively longer than malar area length; scape extends slightly past posterior lateral corner of head; length of malar space on side of head 0.20 - 0.25 mm, length from upper edge of eye to top of posterior lobe 0.80 - 0.90 mm; dorsum of pronotum, mesonotum, petiole and postpetiole roughly sculptured with very few punctulae scattered on dorsum; pronotal shoulder rounded anteriorly; anterior face of petiole rounded, slightly concave posteriorly, apex of petiole slightly higher than level of postpetiole and dorsopropodeum. Dorsum of pronotum, mesonotum and propodeum covered with short (0.15 mm) erect scattered silver hairs; dorsum of petiole and postpetiole covered with long (0.20 mm) erect silver hairs; long (0.25 mm) erect silver hairs arranged on edges of postpropodeum; head covered with short (less than 0.10 mm) erect hairs;
ventral surface of head covered with moderately long (0.15 - 0.35 mm) erect hairs; entire body covered with fine pubescence. Body black, dark brown or reddish brown; mandibles, head dark brown; legs and mandibles reddish brown. In some specimens, tibia and scape dark brown, tarsus and funiculus light brown.

**Male Measurements: (n=1)**

HL 1.10, HW 0.80, ML 0.30, EW 0.40, EL 0.70, SL 0.30, FL 4.80, WL 2.30. The petiole and the gaster are missing. CI 72.72, OI 87.50, Mandl 27.27, SI 37.50

**Male Description:**

Total length unknown; head excluding mandibles suborbicular; eyes large, cover most of sides of head, distance between eyes (0.70 mm) from upper inner sides, medial ocellus width 0.15 mm; scape shorter (0.35 mm) and thicker than first funicular segment, twice length of pedicel (0.15 mm); maxillary palps with 5 segments, labial palps with 4 segments; pronotum square laterally and rounded anteriorly; scutum rounded; notauli absent on dorsum of scutum; scutellum triangular in dorsal view and elevated in side view; metanotum raised between scutellum and propodeum; mesopleuron divided by anepisternal sulcus to form ventral katepisternum and dorsal anepisternum; metaepisternum well developed and separated from propodeum and mesopleuron by suture; dorsopropodeum gradually sloping down posteriorly to insertion of petiole; pronotum, scutum, scutellum, propodeum roughly sculptured; fine short dense hairs cover entire body; moderately long hairs (0.10 - 0.15 mm) scattered on dorsum of scutellum, metanotum, propodeum, on suture between pronotum and scutum; hairs on dorsum of scutellum longer (0.20 - 0.25 mm) and denser than on other parts; ventral surface of head with moderately long (0.20 mm) erect hairs; color mostly light brown to medium brown and yellowish.

**Comparison:**

**Worker Comparison:**

Many taxa were classified as separate species or as subspecies of *B. crassa* or *B. crassior* or even under *B. soror*, including *B. crassior andrieui* Santschi (1930a), *B. gamzea* Özdikmen 2010 and *B. ilgii* Forel 1910b (*B. gamzea* is the replacement name for *B. ilgii* Forel, 1910b: 244). In this revision, *B. ilgii* is a new synonym of *B. crassior* because they possess the same characters that are listed below.
Pachycondyla (Bothroponera) crassa st. crassior var. andrieui from Sudan is an unavailable name (Bolton, 1995: 302). Based on the description, B. andrieui is somewhat intermediate between B. crassior and B. crassa, but the differences between the three species are minimal and there is no reason to further consider B. andrieui, which will be referred to B. crassior in this revision.

Comparisons will be made among eight worker type specimens of B. crassior, two worker type specimens of B. crassa, two type workers of B. ilgii (B. gamzea), and several type specimens of B. soror. Four types of B. picardi, two type specimens with a number of examined specimens of B. ancilla, eight or more of workers of B. notaula, six type specimens and several additional workers of B. ryderae and the holotype and several additional specimens of B. pilosuperficia. Bothroponera ancilla, B. soror, B. silvestrii, B. ryderae, B. pilosuperficia can be directly separated because of the structure of the dorsopropodeum with the posteropropodeum. The posteropropodeum is semi-vertical (strongly sloping posteriorly) in B. ancilla, B. soror, B. silvestrii, B. ryderae and B. pilosuperficia while the posteropropodeum of the other species including B. crassa, B. crassior, B. notaula, B. kenyensis and B. kruegeri gradually slopes posteriorly (slightly sloping posteriorly).

The worker of B. crassior is quite similar to those of B. crassa, B. notaula and B. ilgii (B. gamzea), but the total length of B. crassior is slightly longer (8.35 - 9.40 mm) than that of both B. crassa and B. ilgii (6.00 - 8.80 mm and 8.05 - 8.50 mm respectively). The total length of B. notaula (7.60 mm) is smaller than B. ilgii and B. crassior, which overlaps with that of B. crassa.

The medial raised area of the clypeus is nearly always completely convex in B. crassa similar to that of B. crassior, but with some exceptions in both species. There are slight grooves or partial depressions on the anterior raised area of the clypeus of B. crassa and B. crassior. The medial raised area of the clypeus of B. notaula forms a longitudinal shiny smooth wide and slightly shallow groove. This difference is based on the type series of B. crassior, B. ilgii (B. gamzea), B. notaula and B. crassa, which is might be variable in other specimens.

The head of B. crassior (1.65 - 1.90 mm length and from 1.35 - 1.60 mm width) is slightly larger than the heads of B. crassa (1.45 - 1.75 mm length and from 1.25 - 1.45 mm width) and B. ilgii (B. gamzea) (1.70 - 1.85 mm length and from 1.40 - 1.55 mm width). This is more evidence that B. ilgii (B. gamzea) be considered as a synonym of B. crassior as stated above. The petioles of the two species (B. crassa and B. crassior, measured from above) are about the same length, but the width is slightly greater in B. crassior (0.90 mm) than that of B. crassa (0.85 mm). The petiole width and length in B. n sp 1 is 0.85 mm and 0.65 mm respectively, this is similar to B. crassa, but smaller than that of B. crassior. The postpetiolar tergite (dorsal view) is larger (1.1 mm long and 1.50 mm wide) in B. crassior compared
with that of *B. crassa* (1.05 mm long and 1.45 mm wide). The postpetiole measurements in *B. notaula* are 1.05 mm long and 1.40 mm wide.

The workers of *B. soror* are also nearly identical to those of *B. crassior*, but there are some specific differences. The total length of *B. soror* is slightly longer (8.65 - 11.10 mm, compared to 8.35 - 9.40 in *B. crassior*). The margins of the lateropropodeum of *B. soror* are rough and angular, while it has sharp posterior margins and is slightly chunkier in *B. crassior*. The posteropropodeum is slightly concave and strongly sloped posteriorly in *B. soror*, whereas it is straight with a slight depression at the dorsopropodeum (seen from above) in *B. crassior*.

The longitudinal depression forms a groove on the medial raised area of the clypeus of *B. crassior* that separates it from *B. crassa*. The single medial raised area of the clypeus of *B. soror* forms shiny, striated area without a longitudinal depression The head measurements are larger in *B. soror* (length is 1.70 - 1.90 and width is 1.50 - 1.65) than in *B. crassior*.

Forel (1894) described *Ophthalmopone ilgii*, which is completely different from the *B. sulcata* species complex. In 1910, Forel described a new species *Bothroponera ilgii*, based on a holotype worker, which was collected by Mr. A. Ilg from Western Abessinien [Abyssinia]. It becomes a junior secondary homonym when both were considered to be members in *Pachycondyla* (Bolton 1995). This is no longer a problem, as *Ophthalmopone and Bothroponera* are now considered separate genera (Schmidt and Shattuck, 2014). The latter homonym taxon was renamed as *Pachycondyla crassa gamzea* by Özdikmen (2010c) and is essentially identical to *B. crassior*, with both species having the longitudinal depression medially on the clypeus, but it has few or no erect hairs on the dorsum of the mesosoma, as compared to *B. crassior*, which has abundant hairs. In *B. ilgii*, the petiole is slightly higher, the malar space from the side of the head is 0.20 - 0.30 mm, and the length from upper edge of eye to the posterior lobe is 0.80 - 0.85 mm. Similarly, in *B. crassior*, the length of malar space on the side of head is 0.20 - 0.25 mm, the length from the upper edge of eye to the top of the posterior lobe is 0.80 - 0.90 mm, which indicate the overlap in measurements between *B. crassior* and *B. ilgii*. Based on direct comparison of the types, *B. ilgii* Forel, 1910b (and therefore *B. gamzea* Özdikmen, 2010c) is a synonym of *B. crassior* Santschi, 1930a. The name *B. crassior* has been repeatedly used to refer to this species in most of publications and *B. ilgii* has been rarely used. Moreover, the specific epithet “ilgii” is more recognized for *Ophthalmopone ilgii*. Both species were previously in the genus *Pachycondyla* (Bolton, 1995), which created a homonym.

*Ophthalmopone ilgii* (Forel, 1894) was mentioned in several references as *Ophthalmopone ilgii* (Wheeler, 1922b:768; Emery, 1897:597; Emery, 1911:70), whereas *Bothroponera ilgii* (Forel, 1910b)
has been referred to in several other publications (Emery 1911:77 as Bothroponera crassa var ilgii, Santschi 1914a:50 as Pachycondyla (Bothroponera) crassa var. ilgii, Wheeler 1922b: 770 as Bothroponera crassa var. ilgii and in the 20th century by Bolton (1995) as Pachycondyla (Bothroponera) crassa var. ilgii). Recently, Schmidt and Shattuck (2014) considered B. ilgii as a subspecies of B. crassa. In this revision, it is considered to be a valid species of genus Bothroponera.

**Male Comparison:**

The male specimen of Bothroponera crassior can be compared with the other known males of the B. sulcata species complex including B. crassa, B. kruegeri, B. silvestrii and B. soror. The total length of the B. crassior type male is unavailable because the only specimen (lectotype) is missing both the petiole and the gaster, The total lengths of the males of B. soror (6.45 - 7.45 mm), B. crassa (5.90 - 7.50 mm), B. kruegeri (10.25 mm), B. notaula (5.60 - 7.90 mm), B. ryderae (6.45 mm), and B. kenyensis (4.70 - 5.10 mm), indicate that the largest species is B. kruegeri and the smallest is B. kenyensis, but the other species tend to overlap in their total length.

The notauli are absent in B. crassa and B. crassior while they are present in B. soror, B. notaula, B. ryderae, B. kenyensis, and the male of B.kruegeri male has weak evidence of notauli. The ocelli are small in B. crassior, B. soror, B. kenyensis and B. ryderae, but they are large in B. crassa, B. kruegeri and B. notaula.

The pronotum, scutum, scutellum and propodeum of all of the species are roughly sculptured. Bothroponera soror can be separated, as there are a few scattered punctures on most surfaces, petiole and postpetiole while the 4th to 7th abdominal segments are less sculptured or even smooth. The pronotum, scutum, scutellum, propodeum, petiole and postpetiole of B. crassa and B. crassior are roughly sculptured. The 4th to 7th abdominal segments are smooth without punctures in Bothroponera soror, B. crassa and B. crassior. The sculpture of B. notaula, B. ryderae and B. kenyensis are similar most of the time as it is rough and moderately shiny, and without punctures on the head, pronotum, scutum, scutellum, metanotum, propodeum, mesopleuron, and petiole. Conversely, the postpetiole and 4th to 7th abdominal segments are smooth and shiny. The dorsopropodeum slopes gradually posteriorly in B. crassa and B. crassior similar to that in B. kruegeri, whereas the dorsopropodeum is strongly curved into the posteropropodeum in B. soror. The ocelli are large in B. crassa, but they are small in both B. soror and B. crassior; likewise, the ocelli are small in B. kenyensis and B. ryderae.
Material examined:

Type material: 10 workers and one male.

KENYA: Rift Valley Province, Amboni, 0°24'0" S; 36°59'0" E, prairies decouv 1900 - 2200 m., Afrique orientale anglaise, Mt Kenya verst ouest zone inferieure, [Southern West side of Mount Kenya, between Amboni river and Naremuru river], by Alluaud & Jeannel, Enter River Amboni Et River Naremuru, i. and ii-1912, Bothroponera crassa crassior Santschi (4w, 1 is lectotype and 3 paralectotypes, [here designated], NHMB); Eastern Province Dimons Rhila, [Diamono], , near Nairobi, 0°49'0" S, 38°20'0" E, 2-v-1930, H. C. James; 12, Bothroponera crassa var. crassior Santschi, Type; sammlung Dr. F. Santschi Kairouan (3w and 1m missing petiole and gaster, paralectotypes, here designated, NHMB).

Pachycondyla (Bothroponera) crassa var. ilgi Forel, ETHIOPIA: Harar ilg, 9°30'0" N; 41°30'0" E, Forel ded. 1922 (1 w paratypus [designator not listed], ZMHU).

Also seen: Ilgii, B. crassior, johar (Ilg), Ophthalmopone ilgii Forel 1894 (1w, syntypus, MCSN).

Non-type material: 52 workers


ETHIOPIA: Scioa, 9°0'0" N; 39°0'0" E, Ponera crassa, teste Emery; Museo Genova coll. C. Emery (dono 1925) missing head, leg. Fea,(1w MCSN). KENYA: Baragoi, Rift Valley Province, from 1°41'0" to 1°47'0" N; from 36°34'0" to 36°47'0" E, Samburu District (N. F. D.), 29-vi-1966, coll. K. E. Stager, Pachycondyla crassa det. (Emery 1877), R. R. Snelling 2002, (1w # 315802, LACM), same locality, H. C. James; Type 42; Bothroponera crassa var crassior Santschi 1937; collection of W. S. Creighton purchased by L. A. C. M. 1974, (1w specimen missing head, # 315778, LACM); Laikipia, Mpala Research Center, Ewaso Ng’ iro 0.24 N, 36.91 E, 1600m, 21-iii-2001 # 01-137, Acacia Woodland: on trunk Acacia xanthophloeum coll. R. R. Snelling, (1w # 315786, LACM), same locality, 1700m, 0.28° N, 36.87° E, 16-iii-2001, pitfall, “Black Cotton” area, northern exclosure, coll. D. Misurelli (1w # 315885, LACM), same locality, 1650m, 0.29° N, 36.90° E, 27-ix-1999, #99-084, coll. R. R. Snelling, Acacia Woodland, ex soil under stone, Pachycondyla crassa det. (Emery) (1w # 315771, LACM), same locality, 1650m, 0.29° N, 36.90° E, 29-iii-2001, # 01-165, coll. R. R. Snelling, Acacia Woodland, tandem running on ground, Pachycondyla crassa det. (Emery) (2w # 315886, LACM), same
locality, ca 1650m, 1-x-1999, # 99-094, coll. R. R. Snelling, *Acacia* Woodland, ex soil under *Acacia* tree, Venom Voucher, *Pachycondyla crassa* det. (Emery), (2w # 315894, LACM), same locality, ca 1650m, 24-i-2000, # 00-005, coll. R. R. Snelling 2000, *Acacia* woodland, worker tandem running, *Pachycondyla crassa* det. (Emery), (2w # 315777, LACM), same locality, 1650m, 0.29° N, 36.90° E, 11-ii-2000, # 00-056, *Acacia* woodland, scavenging on rotting eland skull (2w # 315769, LACM), same locality, 1650m, 0.29° N, 36.90° E, 11-ii-2000, # 00-056, *Acacia* woodland, scavenging on rotting eland skulls (2w # 315788, LACM), same locality, 1650m, 0.29° N, 36.90° E, 27-ix-1999, # 99-084, *Acacia* woodland, ex soil under stone, (3w # 315773, 315772, 315774, LACM), same locality, 1650m, 0.29° N, 36.90° E, 24-iii-2001, # 01-140, *Acacia* woodland, foraging on ground, coll. R. R. Snelling, *Pachycondyla crassa* det. (Emery) (1w # 315787, LACM), same locality, 1650m, 0.29° N, 36.90° E, 6-x-1999, # 99-113, *Acacia* woodland, stays in litter under *Acacia*, coll. R. R. Snelling, *Pachycondyla crassa* det. (Emery) (1w # 315770, LACM), same locality, Ewaso Ng'iro, 1600m, 0.24° to 0.29° N, 36.91° to 36.90° E, 5-v-2001, #01-434, coll. R. R. Snelling & D. J. Martins, *Pachycondyla n.sp. vr. kruegeri* (2w # 315996, LACM), same locality, 3.2 S, 39.97 E, ca 75m, 6-v-2001 # 01-409, Albizzia-Bracysteia forest: foraging in litter R. R. Snelling & D. J. Martins (3w # 315997, LACM); **Rift Valley Province**, Eldama Ravine, 0°30' N; 35°43'0" E, 23-ix-1954, # A.19, R. M. Williams, from mounds of *Cubitermes*, termite research unit, in side of *Cubitermes* mound (5w BMNH); **Coast Province**, Diani Beach, 4°18'0" S; 39°35'0" E, vii-1951, N. L. H. Krauss, B. M. 1951-541 (4w BMNH); **Shimba Hills**, Shimba Hills National Reserve, 04°15′26″ S, 39°23′16″ E, vii-1978, B. Hölldobler, # 27, #14, 00525676 (4w BMNH). **SOMALIA**: **Mogadicio (Somali)** [Mogadiscio, Gobolka Banaadir, 2°4'0" N; 45°22'0" E], Bricchetti iv-1891, *Ponera crassa* Em. Teste Emery, Museo Civico di Genova coll. C. Emery (dono 1925) (1w MCSN); **Obbia**, Gobolka Mudug, 5°21'5" N; 48°31'32" E, Obbia 27.5., Bricchetti-Robecchi, *Ponera crassa* Emery, teste Emery, Museo Civico di Genova (3 w, MCSN); **Ogaden**, Gobolka Gedo, 2°50' N; 42°10'0" E, 1891, L Bricchetti *Ponera crassa* Emery, teste Emery, Museo Civico di Genova (1 w, MCSN); **Webi [Webiyo]**, Gobolka Bay, 3°19'0" N; 43°13'0" E, 1891, *Ponera crassa* Emery, teste Emery. Museo Civico di Genova, L
Bricchetti (1 w, MCSN); La Faruch [Laffarugh Aberio], 7°9'0" N; 37°42'0" E, ix-1992, Ponera crassa Emery, tests Emery, leg. V. Bottego collector, Museo Civico di Genova, (1 w, MCSN).

Distribution:

Eritrea, Ethiopia, Kenya, Somalia and Zimbabwe.

Biology and habitat:

The majority of the *B. crassior* specimens in this study were collected in Kenya. The holotype was collected from the southwestern side of Mount Kenya, between Amboni River and Naremuru River, in the Rift Valley Province by Alluaud and Jeannel. Other material examined was collected from the Laikipia District, Mpala Research Centre and Baragoi both in the Rift Valley Province and from Malindi District, Arabuko-Sokoke Forest in the Coast Province by R. R. Snelling, D. Misurelli and D. J. Martins between 1999 and 2001. The Laikipia District and Southern West side of Mt Kenya are close to each other, but Baragoi is located at the North of Laikipia District; however, they are included in the Rift Valley Province. The *B. crassior* specimens from these areas were collected from different elevations: 1600m-2200m. The three locations are covered with one ecoregion (Northern *Acacia-Commiphora* bushlands and thickets 45) (Worldwildlife.org, accessed fix font 9/2/2014; Burgess *et al*., 2004). The vegetation in this ecoregion encompasses several kinds of plants and trees such as *Acacia (Acacia xanthophloeum)*. The specimens of *B. crassior* were specifically found on and under trunks of *Acacia* trees, in litter, under stones and on ground of the *Acacia* woodland and on a rotting eland skull. The *B. crassior* in the forests were performing activities such as foraging, tandem running, scavenging in litter and excavating under *Acacia* trees and in the soil under stones. In Somalia, *B. crassior* were collected from 4 different localities: Ogaden, Webi, Obbia and Mogadicio. Mogadicio and Obbia are located on the oceanic shores and characterized by the Hobyo grasslands and shrublands ecoregion (103), but Ogaden and Webi are covered with Somali *Acacia-Commiphora* bushlands and thickets (44). The ecoregions in Somalia and Kenya are different, but they are both covered with *Acacia* trees, which is the typical pattern of woodland forests of *B. crassior*. *Bothroponera crassior* was also collected from Mtetengwe, Zimbabwe (Santschi 1932), where the ecoregion is Zambezian and Mopane woodland (54). (Worldwildlife.org, accessed font 9/2/2014, Burgess *et al*., 2004). Large numbers of *B. crassior* specimens were identified as *B. crassa*, but now it is apparent that *B. crassior* is a more widely distributed species in Eastern countries of Africa than *B. crassa*.

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Map 3.2: The distribution of *B. crassior*. 
Bothroponera kenyensis Santschi
Figures 11.2-14.2 and Plates 4.2, 5.2; Map 4.2

Bothroponera kenyensis Santschi, 1937: 47 (w), Kenya, Kenya colony; Schmidt and Shattuck, 2014: 77;

Diagnosis:
Worker:

The worker of Bothroponera kenyensis can be easily recognized by the hairy surface and the small length (total length 5.65 - 7.05 mm). The mandibles are narrow, smooth and shiny. The clypeus is convex, covered with fine hairs and the anterior medial area is raised to form a narrowed longitudinal smooth strip, without a groove.

The pronotal shoulder is rounded anteriorly, but the propodeum is subquadrate. The mesonotum dorsopropodeum forms an obtuse angle with the posteropropodeum. The posteropropodeum is mostly straight not concave, and slopes gradually to reach the connected point with the petiole. The petiolar node height is the same as the height of dorsopropodeum, but slightly taller than the postpetiole. The petiole is rounded anteriorly and slightly concave posteriorly (side view).

The head, pronotum, mesonotum, propodeum, petiole and postpetiole are roughly sculptured.
The color is brown to dark reddish brown.
The female is unknown.
Figures. 11.2-14.2

Fig. 11.2: The lateral view of the holotype worker of *B. kenyensis*.

Fig. 12.2: The head of the holotype worker of *B. kenyensis*.

Fig. 13.2: The head of a male of *B. kenyensis* from Sankuri Tana, Coast Province, Kenya.

Fig. 14.2: The lateral view of a male of *B. kenyensis* from Sankuri Tana, Coast Province, Kenya.
Male:

The total length is 4.70 - 5.10 mm. The head is suborbiculate. The medial ocellus is relatively small (0.12 - 0.13 mm). The scape is shorter (0.20 mm) and thicker than the second funicular segment (0.27 mm), twice the length of the pedicel (0.10 mm). The compound eyes are large (width 0.30 - 0.35 mm, length 0.50 mm), and cover most of the sides of the head.

The pronotum is square laterally and rounded anteriorly. The pronotal shoulder is rounded. The notauli are present and meet at a point medially on the scutum, forming a triangle. The scutellum is subtriangular shaped and elevated in lateral view. The metanotum separates the scutellum and propodeum with medial sharp carina. The mesopleuron is divided by the anepisternal sulcus to form the ventral katepisternum and dorsal anepisternum. The metanepisternum is well developed and distinguished from the propodeum and mesopleuron while the metakatepisternum is narrow and poorly developed. The mesopleural suture is very distinct. The propodeal spiracle is elongated. The dorsopropodeum gradually slopes posteriorly to reach the insertion point of the petiole. The petiole is small, with a rounded apex and the width is less than the width of the propodeum; the height is less than that of the postpetiolar height. The postpetiole is rounded anteriorly. The head, pronotum, scutum, scutellum, propodeum, petiole and postpetiole are roughly sculptured.

The entire body is covered with fine short (less than 0.02, - up to 0.05 mm) dense hairs. The dorsum of the scutellum, metanotum, propodeum, petiole and postpetiole are covered with scattered and moderately short hairs (0.20 - 0.25 mm). The hairs on the suture between the pronotum and scutum are moderately short. The hairs on the dorsum of the scutellum, petiole and ventral surface of the postpetiole are denser and longer than on the other body parts.

The body color is mostly yellow to light brown.

Description:

Worker Measurements: (n=2)

HL 1.20 - 1.50, HW 1.05 - 1.25, ML 0.65 - 0.75, EW 0.10 - 0.25, EL 0.20 - 0.25, SL 1.00 - 1.10, FL 1.65 - 1.85, WL 1.75 - 2.25, WPL 2.20 - 2.60, PL 0.45 - 0.60, PW 0.65 - 0.70, PH 0.70 - 0.90, CI 83.33 - 87.50, OI 19.04 - 20.00, MandI 50.00 - 54.16, SI 88.00 - 95.23, PetI 144.44 - 116.66
Worker Description:

Total length is 5.65 - 7.05 mm; mandibles with about 7 teeth; eyes relatively small (EW 0.10 mm, EL 0.20 mm); clypeus covered with fine hairs, medial area raised to form upper sculptured part, lower part forms triangular smooth area without groove; length of malar space 0.15 mm, length from upper margin of eye to upper margin of posterior lobe 0.65 mm; pronotal shoulder and basalar sclerite rounded, propodeum quadrate; mandibles smooth and shiny; head, pronotum, mesonotum, propodeum, petiole, postpetiole roughly sculptured; height of petiolar node similar to height of dorsopropodeum, but slightly taller than dorsum of postpetiole; entire body covered with fine dense hairs mixed with short (0.10 mm) erect golden hairs scattered on dorsum of pronotum, mesonotum and propodeum; petiole and postpetiole covered with moderately short (0.15 mm) erect golden hairs. Hairs denser on ventral surface of postpetiole; head, pronotum, mesonotum, propodeum, petiole and postpetiole reddish brown, mandibles pale colored.

Male Measurements: (n=2)

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Male Description:

Total length 4.70 - 5.10 mm; head shape orbiculate; scape 0.20 mm long, shorter and thicker than second funicular segment that measure 0.27 mm long; maxillary palps with 4 segments, labial palps with 3 segments; compound eyes large; ocelli small; pronotum quadrate laterally, rounded anteriorly at shoulder; notauli present on dorsum of scutum; scutellum triangular and elevated in lateral view, metanotum elevated between scutellum and propodeum with medial sharp carina; mesometapleural suture distinctive, metaneipisternum well developed and distinguished from propodeum and mesopleuron, metakatepisternum narrowed and poorly developed; propodeum gradually sloping down posteriorly to reach insertion of petiole; petiole small, rounded, width less than width of propodeum and height less than height of postpetiole; postpetiole rounded anteriorly; head, pronotum, scutum, scutellum, propodeum, petiole and postpetiole roughly sculptured; fine short dense hairs cover entire body; moderately short hairs (0.20 - 0.25 mm) scattered on dorsum of scutellum, metanotum, propodeum, petiole, postpetiole and on suture between pronotum and scutum; hairs on dorsum of
Comparison:

Worker Comparison:

Bothroponera kenyensis can be separated from the other species of the crassa species complex by the higher density of hair on most surfaces, by the anterior raised area of the clypeus, and by the relatively small total length and the lateropropodeum shape. It is easy to separate B. picardi from B. kenyensis because B. picardi is characterized by the bare surface. The clypeus is completely different, in B. kenyensis the clypeus is covered with fine hairs and the medial raised area does not form a groove while in B. crassa, B. crassior, B. picardi and B. silvestrii the medial raised area of clypeus forms a smooth shiny groove, a completely or partially striated raised area as in B. soror or forms a tiny depression at the lower part of the narrowed strip, and a smooth shiny raised area of the clypeus as in B. kruegeri. The total length of B. kenyensis (5.65 - 7.05 mm) overlaps the dimensions with other species include B. silvestrii (5.25 - 6.15 mm), B. picardi (6.30 - 6.50 mm) and B. crassa (6.00 - 8.80 mm). The other members of the B. sulcata species complex are larger in the total length, including B. crassior (8.05 - 9.40 mm), B. soror (7.60 - 11.10 mm) and B. kruegeri (11.75 - 12.55 mm), which all have larger total lengths than B. kenyensis. The form of the lateropropodeum is an obvious character to separate B. kenyensis from B. crassa. It is compressed in B. crassa while it is convex in B. kenyensis. However, it is easy to recognize B. kenyensis because it has small eyes (EW 0.10 - 0.25, EL 0.20 - 0.25 mm) compared to the large eye in (B. crassa EW 0.20 - 0.30, EL 0.30 - 0.40 mm, B. crassior EW 0.30 - 0.35, EL 0.40 - 0.45 mm, B. notaula EW 0.25, EL 0.40 mm and B. kruegeri EW 0.40 - 0.45, EL 0.50 - 0.70 mm).

As Santschi (1937) mentioned, B. kenyensis is nearly identical to B. silvestrii. The holotype of B. kenyensis differs from the holotype of B. silvestrii in that the mandible of B. kenyensis has 7 teeth, with the 4th and 6th (counting from the apical tooth) smaller, whereas B. silvestrii has 6 teeth that are approximately equal in size. The frontal lobes of B. kenyensis are shorter and do not extend over the clypeus, but extend slightly over the clypeus in B. silvestrii. The eyes are larger and more elongate in B. kenyensis (maximum eye length 0.20 mm, width 0.10 mm) than are the eyes of the type of B. silvestrii (length 0.15 mm - 0.25 mm, width 0.10 - 0.20 mm). The head of B. kenyensis is slightly longer (1.20 mm) than that of the type of B. silvestrii (1.10 mm). The funiculus of B. kenyensis is slightly longer...
(1.65 mm) as compared to that of *B. silvestrii* (1.15 mm). There is little difference between the propodea and the petioles of the two types. Therefore, I conclude they are separate species.

**Male Comparison:**

The male of *B. kenyensis* can be compared with the available males of *B. crassa*, *B. crassior*, *B. kruegeri*, *B. notaula*, *B. ryderae* and *B. soror*. The *B. kenyensis* male has a total length about 4.70 - 5.10 mm, which is the smallest total length among the other males of the *B. sulcata* species complex (*B. soror*, *B. kruegeri*, *B. notaula*, *B. ryderae* and *B. crassa*) which have larger total lengths (6.45 - 7.45 mm, 10.25 mm, 5.60 – 7.90 mm, 6.45 mm and 5.90 - 7.50 mm respectively) than *B. kenyensis*. The metanotum of *B. kenyensis* is elevated between the scutellum and propodeum and forms medial sharp carina. This carina is not present in *B. soror*, *B. kruegeri*, *B. notaula*, *B. ryderae* and *B. crassa*.

**Material examined:**

**Type material:**

KENYA: Kenya colony, *Bothroponera kenyensis* holotype, no further information (1w, BMNH).

**Non-type material: 5 workers, 2 males**

KENYA: Malindi District, Arabuko-Sokoke forest, ca 75m, 3°16'47.99'' S; 39°58'11.99'' E, 26-v-2001, # 01-411, 2nd Albizia- Brachystegia forest: foraging in litter, R. R. Snelling & D. J. Martins, *Pachycondyla sp.* (1w # 315995, LACM). Coast Province, Sankuri Tana R, 160 m, 1°44'0'' S; 41°23'0'' E, 18-x-1977, V. Mahnert and J-L Perret, *Pachycondyla (Bothroponera) silvestrii* Santschi, (1w, 2m MCZC) same locality, R, 160 m, 1°44'0'' S; 41°23'0'' E, 18-x-1977, V. Mahnert and J-L Perret, *Pachycondyla (Bothroponera) silvestrii* Santschi (3w BMNH)

**Distribution:**

Kenya and Tanzania.
Biology and habitat:

The holotype of *Bothroponera kenyensis* was collected in Kenya, but unfortunately, the labels on this specimen are lacking further information. Kenya and the adjacent African countries are the richest areas in Africa for members of the *B. sulcata* complex; however, it is possible that they will be found in the other areas of Africa. In Tanzania there are several records of *B. kenyensis*. Robertson (1995) studied specimens from Tanzania, in the Mkomazi Game Reserve, Maji Kununua, 3°52'59.98" S; 37°49'0.01" E at 1600m. They were collected generally from dry forests below the summit, but specifically, they were in sheltered areas under rocks among leaf litter (Robertson H.G. 1995: Ant website). Brian Taylor (2002) recorded other distribution of *B. kenyensis* from the Usambara Mts., Amani NR, at the Zigi Lodge at 2200m, 5°05' S, 38°38' E (The Ants of Africa website). Bhoke and Richard 2007, collected specimens in Tanzania that were determined in 2010 by Hawkes as *B. kenyensis*. The specimens were collected by hand from primary forest in Tanzania, Morogoro district, at the Mkungwe Forest Reserve at 700m, 6°53'37.96" S; 37°54'14.90" E (Bhoke and Richard 2007: Antweb.org).

Map 4.2: The distribution of *B. kenyensis*.
Bothroponera kruegeri Forel
Figures 15.2-18.2 and Plates 6.2, 7.2; Map 5.2


Pachycondyla (Bothroponera) kruegeri var. rhodesiana Forel, 1913: 109 (w), Zimbabwe; Arnold, 1915: 57 (m); Bothroponera kruegeri var. rhodesiana: Wheeler, W. M. 1922b: 770; Pachycondyla kruegeri var. rhodesiana: Brown, in Bolton, 1995: 308; Bothroponera kruegeri rhodesiana: Schmidt and Shattuck, 2014: 77, (syn. nov.).

Diagnosis:

Worker:

The main distinguishing character of Bothroponera kruegeri is that it is the largest size among the B. sulcata species complex (total length 11.75 - 12.55 mm). The mandibles are covered with fine striae and have about 8 - 9 teeth. The anterior medial margin of the clypeus is convex, with a medial raised area that rarely forms a short elongate groove apically. The frontal lobes are divided by a shallow frontal furrow, which is not continued to the frons.

The head, pronotum, mesonotum, mesopleuron, propodeum, petiole and postpetiole are roughly sculptured and moderately shiny. The lower lateral margins of the pronotum are straight and form angular inferior and anteroinferior pronotal process. The dorsopropodeum broadly curves posteriorly to gradually reach the articulation point with the petiole between the propodeal lobes.

The entire surface of the body is hairy and black.

The female is unknown.
Figures. 15.2-18.2

Fig. 15.2: The lateral view of the worker of *B. kruegeri* (*B. rhodesiana* holotype).

Fig. 16.2: The head of the worker of *B. kruegeri* (*B. rhodesiana* holotype).

Fig. 17.2: The head of a male of *B. kenyensis* from N. Natal, South Africa.

Fig. 18.2: The lateral view of a male of *B. kenyensis* from N. Natal, South Africa.

**Male:**

The head is semicircular, excluding the mouth parts and the mandibles. The ocelli are relatively large. The scape is shorter and thicker than the second funicular segment, twice the length of the pedicel (first funicular segment). The notauli are weakly developed on the dorsum of the scutum. The scutum is
distinguished by three brown areas, two are around each of the parapsidal sutures, one is a triangular spot between the notauli. The medial area, between the brown spots is pale or yellow in color. The scutellum is triangular and elevated in dorsal view. The metanepisternum is well distinguished while metakatepisternum is triangular and poorly developed. The dorsopropodeum gradual slopes down posteriorly to reach the insertion of the petiole. The petiolar node is small, its width is less than the width of the dorsopropodeum and its height is less than that of the postpetiole height and has a pointed apex. The postpetiole is rounded anteriorly. The pronotum, scutum, scutellum, propodeum, petiole and postpetiole are roughly sculptured.

The entire body is covered with fine short dense hairs and scattered long hairs on the dorsum of the scutellum, metanotum, propodeum, petiole and postpetiole.

The surface color is mostly light brown and yellowish.

**Description: Worker Measurements:** (n=9)

* B. kruegeri measurements: HL 2.30 - 2.40, HW 2.00 - 2.10, ML 1.40, EW 0.40, EL 0.60, SL 2.00 - 2.20, FL 3.00 - 3.10, WL 3.70 - 3.80, WPL 4.60 - 4.70, PL 1.00, PW 1.10, PH 1.50 - 1.60, CI 86.95 - 87.50, OI 28.57 - 30.00, Mandl 58.33 - 60.86, SI 100.00 - 104.76, PetI 110.00. * B. asina measurements: HL 2.20, HW 2.00, ML 1.30, EW 0.40, EL 0.50, SL 1.90, FL 3.00, WL 3.70, WPL 4.50, PL 0.90, PW 1.20, PH 1.50, CI 90.90, OI 25.00, Mandl 59.09, SI 95.00, PetI 133.33. * B. rhodesiana measurements: HL 2.50 - 2.70, HW 1.95 - 2.20, ML 1.50 - 1.55, EW 0.45, EL 0.65 - 0.70, SL 2.10 - 2.25, FL 3.25 - 3.40, WL 3.60 - 4.20, WPL 4.40 - 5.00, PL 1.00 - 1.05, PW 1.15 - 1.35, PH 1.65 - 1.95, CI 78.00 - 81.48, OI 33.33 - 31.81, Mandl 57.40 - 60.00, SI 102.27 - 107.69, PetI 115.00 - 128.57

**Worker Description:**

Total length 11.75 - 12.55 mm; mandibles narrowed, covered with fine striae, with about 8 - 9 teeth; anterior medial margin of clypeus convex, with raised medial area forming short elongate groove anteriorly (often absent); frontal lobes divided by shallow frontal furrow, not continued to frons?; compound eyes relatively large; malar space length 0.45 - 0.50 mm, area from upper edge of eye to upper margin of posterior lobe 0.85 - 0.95 mm; pronotal shoulder rounded anteriorly with straight ventral margin (side view) that forms sharp anteroinferior and inferior pronotal process; dorsopropodeum slightly curved, posteropropodeum slightly concave, with slight medial depression, seen from dorsal or from posterior side; head, pronotum, mesonotum, propodeum, mesopleuron, petiole
and postpetiole roughly sculptured and moderately shiny; entire surface of body covered with fine hairs; dorsum of pronotum, mesonotum, propodeum, petiole and postpetiole covered with few and moderately short (0.20 mm) erect scattered hairs; head covered with few short (0.10 - 0.20 mm) erect hairs; short (0.10 - 0.15 mm) erect hairs scattered on legs and scape; hairs on ventral surface of head moderately long (0.20 - 0.35 mm); color of entire body black; tibia, clypeus and scape brownish black, tarsus, funiculus and mandibles reddish brown.

**Male Measurements:** (n=1)

- HL 1.45, HW 1.05, ML 0.35, EW 0.60, EL 0.95, SL 0.30, FL 5.90, WL 3.45, WPL 4.35, PL 0.75, PW 0.70, PH 1.15, Cl 72.41, OI 90.47, MandI 24.13, SI 28.57, PetI 93.33

**Male Description:**

Total length 10.25 mm; frontal view of head excluding mandibles sub-oval; eyes large, cover most of sides of head; scape shorter (0.35 mm), twice as long as pedicel length (0.15 mm) and thicker than second funicular segment (length 0.55 mm); labial palps 4 segmented, maxillary palps 5 segmented; pronotum quadrate laterally and rounded anteriorly; notauli weakly defined; scutellum triangular, elevated in dorsal view; mesopleuron divided by anapleural sulcus to form ventral katepisternum and dorsal anepisternum; metanepisternum well defined, metakatepisternum triangular and poorly developed; dorsopropodeum gradually sloping posteriorly to reach posteropropodeum and insertion of petiole; petiolar node small, width less than width of propodeum and height less than postpetiole height, with pointed apex; postpetiole rounded anteriorly; pronotum, scutum, scutellum, propodeum, petiole and postpetiole roughly sculptured. Body length 10.25 mm. Fine short dense hairs cover entire body, longer hairs (0.20 - 0.35 mm) scattered on dorsum of scutellum, metanotum, propodeum and petiole; hairs on dorsum of postpetiole range in length from 0.25 - 0.30 mm; long hairs appear on suture between pronotum and scutum; body color mostly light brown and yellowish.
Comparison:
Worker:

The worker of *Bothroponera kruegeri* is similar to those of the *B. sulcata* complex members except for some unique characters such as the large total length, the number of mandibular teeth, the anterior raised area of the clypeus and the postero-dorsopropodeum shape. This species is the largest (11.75 - 12.55 mm total length for the worker and 10.25 mm for the male) among the rest of *B. sulcata* complex individuals. The mandibles have about 8 - 9 teeth, which is the largest number among the *B. sulcata* complex species. The anterior medial raised area of the clypeus is convex in all of *B. sulcata* complex members, but this area forms a smooth and shiny raised medial area without a clypeal carina in *B. crassa*, a longitudinal shiny groove not well developed or even absent in *B. crassior, B. picardi* and *B. silvestri*, and *B. ryderae*, a narrowed longitudinal smooth strip usually without a groove in *B. kenyensis* and *B. pilosuperficia*. In *B. soror*, the clypeus has a single medial raised area that forms a shiny, completely or partially striated area or a smooth shiny narrowed groove. Conversely, the anterior raised area of the clypeus of *B. kruegeri* forms a raised sculptured area on the upper part and tiny shiny area that seems to have a small depression close to the lower clypeal margin. The dorsopropodeum forms a broadly curved dorsum that connects gradually with the posteropropodeum and reaches the insertion point of the petiole. The dorsopropodeum of *B. kenyensis, B. crassa, B. crassior* and *B. notaula* is more strongly curved than that of *B. kruegeri* to form an angle with the posteropropodeum. The dorsopropodeum forms a strong angle with the posteropropodeum, which strongly slopes posteriorly in *B. soror, B. silvestrii, B. picardi, B. ancilla, B. ryderae* and *B. pilosuperficia*.

The direct comparison of *B. kruegeri* and their varieties indicates that *Bothroponera asina* is identical to *B. kruegeri* in nearly all characters and there are a few unsignificant differences as following. The medial raised area of the clypeus in *B. asina* forms a short (less than 0.55 mm) groove on the lower margin while this area forms shorter (less than 0.30 mm) groove on the lower margin of clypeus in *B. kruegeri*. As I studied large numbers of *B. sulcata* complex specimens, I concluded that the variations of the anterior raised area of the clypeus in this species are weak characters to be used for recognizing different taxa. The frontal furrow development is slightly different between *B. asina* and *B. kruegeri*; it is shallow, divides the frontal lobes and does not reach the frons in *B. kruegeri*, but it is somewhat deep and not continued to the frons in *B. asina*. The length of the malar space is 0.45 - 0.50 mm in *B. kruegeri* and 0.40 mm in *B. asina* while the area from upper edge of eye to the upper margin of posterior lobe is 0.70 - 0.95 mm in *B. kruegeri* and 0.85 mm in *B. asina*. The compound eyes seem to be smaller in size in *B. asina* (width 0.40, length 0.50 mm), moderate in size in *B. kruegeri* (width 0.40,
length 0.60 mm). These diameters are not clearly distinguishable in eye size; instead, they show much overlap in measurements. The scape and funiculus of B. asina are short, 1.90 mm and 3.00 mm respectively, while they are moderate in length in B. kruegeri (2.00 - 2.20 mm and 3.00 - 3.10 mm respectively), which is nearly the same in both taxa in case of scape length and overlap in the case of the funicular length. The petiole length in B. asina (0.90 mm) is shorter than that of B. kruegeri (1.00 mm for both species). The total length in B. asina is 12.90 mm, which is larger than the total length in B. kruegeri (11.75 - 12.55 mm).

The entire body of B. asina is covered with fine hairs similar to B. kruegeri. The dorsum of the pronotum, mesonotum and propodeum of B. asina are covered with a few short (0.15 - 0.20 mm) erect scattered hairs, but in B. kruegeri the dorsum of pronotum, mesonotum, propodeum, petiole and postpetiole are covered with few and moderately short erect scattered hairs (0.20 mm) which indicate the overlap measurements of hairs of both species. Long (0.25 - 0.30 mm) erect hairs are present on the edges of the posteropropodeum of both, B. asina and B. kruegeri. The petiole and postpetiole of B. asina are covered with a few and moderately long scattered erect hairs (0.20 mm) similar to B. kruegeri, but on the ventral side of the postpetiole and gaster the segments are covered with denser hair than on the dorsum; the hairs on the petiolar node are denser than on the postpetiole of B. asina and B. kruegeri. The head of B. asina is covered with a few short (0.15 mm) erect hairs whereas in B. kruegeri those hairs measured from 0.10 to 0.15 mm, which is overlap in both species. Short erect hairs (0.10 mm) are scattered on the legs and scape of B. asina, this hairs on scape and legs of B. kruegeri measure (0.10 – 0.15 mm). The hairs on the ventral surface of the head of B. asina are sparse and moderately long (0.25 - 0.35 mm). On contrast, the hairs on the ventral surface of the head are moderately long (0.20 - 0.35 mm) of B. kruegeri identical to those of B. asina.

Based on Santschi (1912), B. asina differed from B. kruegeri in three main characters: mesosomal shape, petiole position and shape of the second gastral tergite. Santschi considered the mesosoma of B. asina to be a little less vaulted than that in B. kruegeri, but they are look similar. He also stated that the petiole of B. asina is high as it is in B. kruegeri, but the dorsal face is wider than long (more cramped in B. kruegeri). The direct comparison of the types shows no significant differences in the shape of the petiole. The differences in the shape of the second gastral tergite between B. kruegeri and B. asina as Santschi discussed, do not appear to differ significantly in comparison of the types of the two species. The direct comparison of B. kruegeri and the B. asina confirm that they are the same species. Therefore, the B. asina is considered to be a synonym of B. kruegeri.
Likewise, as a result of direct comparison of *B. kruegeri* and *B. rhodesiana* it is clear that *Bothroponera rhodesiana* is identical to *B. kruegeri* in nearly all characters with a few insignificant differences as following. *Bothroponera rhodesiana* is characterized by the form of the anterior medial margin of the clypeus that does not for a short groove on the lower margin as it is in *B. kruegeri* (less than 0.30 mm). This character is not stable among individuals of *B. sulcata* species complex. The frontal furrow development is slightly different between *B. rhodesiana* and *B. kruegeri*; it is shallow, divides the frontal lobes and does not reach the frons in *B. kruegeri*, shallow and continued to the frons area in *B. rhodesiana*. The length of the malar space is 0.45 - 0.50 mm in *B. kruegeri*, 0.40 - 0.45 mm in *B. rhodesiana* while the area from upper edge of eye to the upper margin of posterior lobe is 0.70 - 0.95 mm in *B. kruegeri*, 0.80 - 0.90 mm in *B. rhodesiana*. The compound eyes seem to be moderate in size in *B. kruegeri* (width 0.40, length 0.60 mm) and large in size in *B. rhodesiana* (width 0.45, length 0.65 - 0.70 mm). These diameters are not clearly distinguishable in eye size; instead, they show much overlap in measurements. The scape and funiculus are moderate in length in *B. kruegeri* (2.00 - 2.20 mm and 3.00 - 3.10 mm respectively), while the scape and funiculus recorded the longest measurements for *B. rhodesiana* (2.10 - 2.25 mm and 3.25 - 3.40 mm respectively). However, the scape length, which is an important character, shows overlap in length between *B. rhodesiana* and *B. kruegeri*. The petiole length in *B. rhodesiana* and *B. kruegeri* is identical (1.00 mm for both species). The petiole height is slightly higher in *B. rhodesiana* (1.65 - 1.95 mm) than that in *B. kruegeri* (1.50 mm). The worker of *B. kruegeri* has total length (11.75 -12.55 mm) that is overlapping with that of *B. rhodesiana* (11.85 -12.90 mm).

Based on Forel (1913), *Pachycondyla (Bothroponera) kruegeri* var. *rhodesiana* can be separated from *B. kruegeri* by considering three characters: total length, hairs and the sculpture. As a result of my comparison of the types of *B. kruegeri* and *Bothroponera rhodesiana*, the total length overlaps (11.75 - 12.55 mm in *B. kruegeri* and 11.85 - 12.90 in *B. rhodesiana*), and is useless to separate them. Although Forel concluded that *B. rhodesiana* had more notable and abundant pilosity than *B. kruegeri*, comparison of the two type specimens of *B. rhodesiana* and *B. kruegeri* shows the entire surface of body looks hairy with similar abundance in both. In *B. kruegeri*, the dorsum of pronotum, mesonotum, propodeum, petiole and postpetiole are covered with few and moderately short erect scattered hairs (0.20 mm); the head is covered with a few short erect hairs (0.10 - 0.20 mm); short erect hairs (0.10 - 0.15 mm) are scattered on the legs and scape; the hairs on the ventral surface of the head are moderately long (0.20 - 0.35 mm). On the other hand, in *B. rhodesiana*, the dorsum of pronotum, mesonotum, propodeum, petiole and postpetiole covered with few and moderately short (0.15 - 0.25 mm) scattered erect hairs, the head, legs and scape are covered with a few short (less than 0.15 mm) erect hairs, hairs
on ventral surface of head are few and moderately short (0.20 - 0.25 mm). The direct comparison of hairs between *B. kruegeri* and *B. rhodesiana* has no value because they are overlapping in their measurements. The sculpture looks identical between the two taxa; moreover, the slight variations in sculpture and even in color between members can be seen regularly in other series. Additional differences can be seen in a comparison of the two taxa. Thus, because there are no significant consistent differences in the sculpturing of the petiole and gaster, and the comparison of the other characters appear to be relatively minor differences, *B. rhodesiana* is considered to be a synonym of *B. kruegeri*.

**Male:**

The male of *Bothroponera kruegeri* can be compared with other known males of the *B. sulcata* species complex, including those of *B. crassa, B. crassior, B. kenyensis, B. notaula, B. ryderae* and *B. soror*. The total length of *B. kruegeri* is 10.25 mm which is the largest body length among other male castes, including *B. soror* (6.45 - 7.45 mm), *B. crassa* (5.90 - 7.50 mm), *B. notaula* (5.60 - 7.90 mm), *B. ryderae* (6.45 mm) and *B. kenyensis* (4.70 - 5.10 mm). The total length of *B. crassior* is unavailable as the gaster is missing in the only available male type specimen. The notauli are absent or weakly defined in *B. kruegeri* similar to those in *B. crassa* and *B. crassior* while they are present in *B. soror, B. kenyensis, B. notaula*, and *B. ryderae*. The ocelli are large in *B. kruegeri*, *B. notaula* and *B. crassa*, but they are small in *B. soror* and the type specimen of *B. crassior* similar to that in *B. kenyensis* and *B. ryderae*. The entire surface of *B. kruegeri* is rough, similar to that of *B. crassa* and *B. crassior*, but in *B. soror* the mesosoma and petiole are roughly sculptured with punctures. The dorsopropodeum is gradually sloping posteriorly in *B. kruegeri* as in *B. crassa* and *B. crassior*, *B. kenyensis* and *B. notaula*, but in *B. soror* it is strongly curved posteriorly similar to that in *B. picardi, B. silvestrii, B. ancilla, B. ryderae* and *B. pilosuperficia*.

**Material examined:**

**Type material: 6 workers**

*Pachycondyla (Bothroponera) kruegeri* **KENYA**: Afrique orientale anglaise, **Nirobi**, Nairobi Area, 1°17'0" S; 36°49'0" E, *Pachycondyla (Bothroponera) asina* Santschi (1w, holotype, NHMB). **SOUTH AFRICA**: **Valdezia**, Transvaal, 23°6'0" S; 30°11'0" E, P. Berthoud collector, *Pachycondyla (Bothroponera) kruegeri* Forel, 1910a, new species (2w, lectotype upper specimen, paralectotype lower

**Non-type material: 4 workers, 1 male**


**Distribution:**

Kenya, South Africa and Zimbabwe.

**Biology and habitat:**

*Bothronera kruegeri* has been collected from different habitats in Africa. The main habitats are farmlands and tropical forests. In South Africa, *B. kruegeri* colonies were collected from "Dunstable" Farm, near Jonkmanspruit in the Hoedspruit area of the Eastern Transvaal (Wildman and Crewe, 1988). Colonies of this ant were studied extensively to investigate the gamergate number (workers that have an ability to reproduce), and control over reproduction (Wildman and Crewe, 1988), and qualitative relations of egg size, egg production and colony size (Villet 1990). *Bothronera kruegeri* has a specific form of regulation of gamergate numbers in their colonies. There is a single gamergate present in *B. kruegeri* colonies, which had 3 to 6 mature oocytes (Peeters and Crewe, 1985; Peeters and Crewe, 1986; Wildman and Crewe, 1988; and Peeters and Higashi, 1989). Moreover, *B. kruegeri* gamergates are able to produce between 0.5 - 3 eggs per day (Wildman and Crewe 1988).

The *Bothronera kruegeri* (=*B. asina*) type specimen was collected from Afrique orientale anglaise, the former name of Kenya, the East African area that was controlled by British between 1880 - 1920 (Oonk, 2006). Kenya is located on the east side of Africa, on the Indian Ocean shores. The majority of the *B. sulcata* species complex species are found in Kenya and adjacent countries. The other material examined was collected in Mozambique and South Africa. Mozambique is located on the Indian Ocean shores and mainly has the same type of habitat as that in South Africa. In South Africa,
Bothroponera kruegeri (=B. asina) was collected from Zululand, Umfolozi. This area is located in the east of South Africa, on the Indian Ocean shores, south of Swaziland. The area is inhabited by a large number of organisms and considered as one of the largest areas of biodiversity in South Africa. The main habitats of Zululand and Umfolozi are subtropical ecosystems. The land is characterized by open areas covered with savannah at the south and has mountains with forests and grasslands in the north. It has rainy annual season from September to April and dry season from May to August.

Bothroponera kruegeri (= B. rhodesiana) is found in Zimbabwe in the north province of Matabeleland, near the northern city of Bulawayo. This area is located at the western border of Zimbabwe, on the Zambia, Botswana and Namibia borders. The specimens were collected from a nest found under a stone. Bothroponera kruegeri (= B. rhodesiana) builds several entrances for their nest and the adjacent area contains loose earth (Wheeler, 1922; Arnold, 1915).

Map 5.2: The distribution of B. kruegeri.
Bothroponera picardi (Forel)
Figures 19.2-20.2 and Plate 8.2; Map 6.2


Diagnosis:

Worker:

The worker of B. picardi can be easily recognized, as the entire dorsal surface of the mesosoma is bare, without any erect hairs that are frequently seen in Bothroponera species. The surface even lacks the fine hairs that usually appear in the other species complexes. There are other areas that are covered moderately to abundantly by moderately long hairs, including the mandibles, clypeus, ventral surface of the head and the dorsal-ventral sides of the last gastral segment. The hairs on the ventral surface of the head are few in number and short (0.15 - 0.20 mm). The hairs on the clypeus and mandibles are moderately denser than those on the other surfaces including the head (from 0.20 - 0.25 mm on the ventral surface of the head, less than 0.12 mm on the mandibles, clypeus and antennae). Slightly abundant long hairs are present on the last gastral segment, around the sting (up to 0.20 mm on the dorsum, less than 0.20 mm on the ventral surface). The mandibles have about 7 teeth and are smooth. The anterior medial margin of the clypeus forms a shiny groove on the medial raised area.

The head is densely and roughly sculptured with very few punctulae. The pronotum, mesonotum, propodeum, petiole and postpetiole are roughly sculptured with few punctae spread on the dorsum, which is weakly shiny, but the petiole and postpetiole are shiny. The mesopleuron is roughly sculptured with few punctae spread on the surface. The antennae, mandibles and legs are shiny.

The female and male are unknown.
Figures. 19.2-22.2

Fig. 19.2: The lateral view of the lectotype worker of *B. picardi* (middle specimen)

Fig. 20.2: The head of the lectotype worker of *B. picardi* (middle specimen)

Fig. 21.2: The head of the holotype worker of *B. silvestrii*.

Fig. 22.2: The lateral view of the holotype worker of *B. silvestrii*. 
Description:
Worker Measurements: (n=4)

HL 1.26 - 1.29, HW 1.05 - 1.11, ML 0.75 - 0.84, EW 0.18 - 0.27, EL 0.30 - 0.36, SL 1.05, FL 1.62 - 1.71, WL 1.92 - 1.98, WPL 2.40 - 2.49, PL 0.57 - 0.60, PW 0.66 - 0.72, PH 0.81 - 0.93, CI 83.33 - 86.04, OI 28.57 - 32.43, MandI 59.52 - 65.11, SI 94.59 - 100.00, PetI 115.78 - 120.00

Worker Description:

Total length 6.30 - 6.50 mm; mandibles smooth with about 7 teeth; anterior medial margin of clypeus forms shiny groove on medial raised area; compound eyes relatively small; malar space length 0.15 mm, area from upper edge of eye to upper margin of posterior lobe ~ 0.55 mm; head densely roughened with very few punctulae; pronotum, mesonotum, propodeum, petiole and postpetiole roughly sculptured, weakly shiny with few punctae spread on dorsum, petiole and postpetiole shiny; pronotal shoulder rounded anteriorly, lower margins (side view) slightly curved rounded anteriorly, sharp posteriorly, mesopleuron roughly sculptured with few punctae spread on surface; antennae, mandibles and legs shiny; nearly entire body lacks hairs; few short (0.15 - 0.20 mm) hairs on ventral surface of head; entire body black or reddish brown; legs, antennae and mandibles red or reddish brown.

Comparison:
Worker:

Bothroponera picardi can be easily separated from the rest of the species in the B. sulcata species complex by lacking erect hairs on the dorsum of the mesosoma. Bothroponera picardi has an anterior medial raised area that forms a smooth shiny groove or flat longitudinal raised narrow area that is identical to those of B. crassa, B. kenyensis, B. crassior, B. kruegeri, B. silvestrii and B. soror. This area is very short in B. kruegeri, forms a shiny wide longitudinal groove in B. notaula, a narrow sculptured slightly striated on the upper part, slightly depressed area on the lower part in B. ryderae, without a groove in B. pilosuperficia and covered completely or partially with fine striae in B. soror and B. ancilla. Bothroponera picardi is small (total length 6.30 - 6.50 mm), however, it overlaps in length with B. crassa (6.00 - 8.80 mm), B. silvestrii (5.25 - 6.15 mm) and B. kenyensis (5.65 - 7.05 mm). The dorsopropodeum is strongly curved to form a strong an obtuse angle with the posteropropodeum, which
is slightly concave with a slight dorsal depression. This character can also be seen in B. soror, B. silvestrii, B. ancilla, B. ryderae, B. pilosuperficia.

**Material examined:**

**Type material:**

ANGOLA: Cubango, 12°3'0" S; 15°40'0" E, Cuito [Kuito] Lat: 12°22'0" S; Long: 15°40'0" E; Mossamedes Lat: 15°11'46" S; Long: 12°9'8" E, West Africa, *Pachycondyla (Bothroponera) picardi* Forel, Baron v. Picard (4w, lectotype middle specimen, paralectotype lower and upper specimens, MHNG).

**Non-type material:**

None.

**Distribution:**

Angola.

**Biology and habitat:**

*Bothroponera picardi* was collected from trees in Cubango at the Southern East edge of Angola and from Cuito in the central region of Angola between the Cubango and Cuito Rivers. This habitat is different from the typical habitat for the members of *B. sulcata* complex, which are generally found nesting under stones or in and under *Acacia* trees trunks. It is possible that *B. picardi* also nests in the soil under stones and was only foraging on the trees. From the limited number of *B. picardi* specimens (4) that are available and the lack of published biological and ecological information, or even on the labels, it is impossible to speculate more on the biology of this species.
Map 6.2: The distribution of *B. picardi*. 
**Bothroponera silvestrii** (Santschi)

Figures 21.2-22.2; Map 7.2

*Pachycondyla (Bothroponera) silvestrii* Santschi, 1914c: 313 (w) Ghana, Aburi; *Bothroponera silvestrii*:

Wheeler, W.M. 1922b: 772; Wheeler, W.M. 1922a: 72 (in key); Schmidt and Shattuck, 2014: 77;


*Bothroponera silvestrii* r. *nimba* Bernard, 1953b: 188 (w) Guinea; *Pachycondyla silvestrii* r. *nimba*:


**Diagnosis:**

**Worker:**

The main distinguishing character of the *B. silvestrii* worker is that the dorsum of the head surface and sides are lacking erect hairs (bare) or with few hairs. The total length is 5.25 - 6.15 mm. The anterior medial margin of the clypeus is characterized by a single medial raised area that forms a smooth shiny longitudinal groove. The mandibles are smooth and have about 6 teeth. The compound eyes are relatively small.

The mandibles are smooth and shiny, the head, pronotum, mesonotum, propodeum, petiole and postpetiole are roughly sculptured with foveolae, without punctures. The head, pronotum, mesonotum and propodeum are dull, the petiole and postpetiole are slightly shiny, the legs and antennae are moderately shiny.

The entire body is covered with fine hairs (0.02 mm). The erect hairs are from 0.10 mm, up to 0.30 on the mesosoma, petiole, postpetiole and 4th to 7th abdominal segments, except on the top of head where there are a few scattered erect hairs from 0.02 to 0.12. The entire body is brown or brownish black; the legs, clypeus, mandibles and antennae are light brown.

The female and male are unknown.

**Description:**

**Worker Measurements:** (**n=25**)

HL 1.10 - 1.25, HW 0.95 - 1.10, ML 0.50 - 0.70, EW 0.10 - 0.20, EL 0.15 - 0.25, SL 0.75 - 1.05, FL 1.15 -1.70, WL 1.45 - 1.90, WPL 1.80 - 2.40, PL 0.40 - 0.50, PW 0.60 - 0.70, PH 0.60 - 0.80, CI 86.36 - 88.00, OI 15.78 - 22.72, MandI 45.45 - 56.00, SI 78.94 - 95.45, PetI 140.00 - 150.00.
Measurements of *B. nimba*: HL 1.25 - 1.10, ML 0.65 - 0.75, EW 0.15 - 0.20, EL 0.15 - 0.20, SL 0.95, FL 1.35 - 1.50, WL 1.35 - 1.85, WPL 2.20 - 2.35, PL 0.45, PW 0.60 - 0.65, PH 0.75 - 0.80, CI 84.00 - 88.00, OI 14.28 - 18.18, MandI 52.00 - 60.00, SI 86.36 - 90.47, PetI 133.33 - 144.44

**Worker Description:**

Total length 5.25 - 6.15 mm; head square; anterior medial margin of clypeus with single medial raised area with smooth shiny longitudinal groove; mandibles smooth and shiny with about 6 identical teeth; compound eyes relatively small; malar space length 0.15 mm, area from upper edge of eye to the upper margin of posterior lobe 0.60 - 0.65 mm; head, pronotum, mesonotum, propodeum, petiole and postpetiole roughly sculptured, dull; petiole and postpetiole slightly shiny, legs and antennae moderately shiny; pronotal shoulder; dorsum of pronotum, mesonotum, propodeum, petiole and postpetiole covered with few and moderately short (0.10 - 0.20 mm) erect scattered hairs, up to 0.30 in some specimens; hairs on ventral side of head few and short (0.15 - 0.25 mm); short erect hairs (0.02 - 0.05 mm) on head, pronotum, mesonotum, propodeum, petiole and postpetiole dark brown or reddish brown. Mandibles brown or reddish brown, legs and antennae brown. Body reddish brown in some specimens; petiole and postpetiole dark brown, legs, antennae, clypeus and mandibles brown.

**Comparison:**

**Worker:**

The species *Bothroponera silvestrii*, *B. crassior*, *B. kruegeri*, *B. picardi*, *B. crassa*, *B. kenyensis*, *B. ancilla*, *B. notaula*, *B. ryderae*, *B. pilosuperficia* and *B. soror* all have the same convex clypeus that has an anterior raised area that forms a longitudinal smooth shiny narrowed strip. The raised anterior area generally forms a smooth shiny longitudinal wide groove in the *B. ryderae*, forms slight groove or without groove in species including *B. silvestrii*, *B. crassior*, *B. picardi*, *B. crassa* or without groove as it is in *B. kenyensis*. In *B. soror* this character is covered completely or partially with striae while in *B. kruegeri* this area tends to lack a groove and is more sculptured rather than smooth. The members of the *B. crassa* species complex have a small length range from that of *B. silvestrii* (total length 5.25 - 6.15 mm) and *B. kenyensis* (5.65 - 7.05 mm) to much larger length ranges (e.g. *B. soror* 7.60 - 11.10 mm, *B. ancilla* 6.75 - 8.90 mm, *B. notaula* 7.60 mm, *B. ryderae* 6.55 - 7.20 mm, *B. pilosuperficia* 7.50 - 9.00 mm, *B. picardi* 6.30 - 6.50 mm, *B. crassa* 6.00 - 8.80 mm, *B. kruegeri* 11.75 - 12.55 mm and *B. crassior* 8.05 - 9.40 mm).
Bernard (1953) described *Bothroponera nimba* as a subspecies of *Bothroponera silvestrii*. He distinguished them *B. silvestrii* based on the color, the shape of pronotum and the petiole shape. Bernard considering the color of *B. nimba* to be different in that it is brownish black with red legs and *B. silvestrii* is red with brown legs. Direct comparison of the types of the two taxa shows little difference in color. Nearly all of the specimens of *B. silvestrii* are dark brown with slightly lighter colored legs (possible exceptions appear to be callows). Bernard stated that the pronotum of *B. nimba* is less convex, with a less margined pronotum, but again direct comparison of the types shows no significant differences between *B. nimbi* and *B. silvestrii* in the pronotal shape. Bernard indicated that the petiole in *B. nimba* is hemispheric, about the same length and width while it is ⅔ as wide as long in *B. silvestrii*. The petiolar shape of the type worker of *B. nimba*, has a posterior face is similar to the anterior face of the postpetiole, making it look somewhat more rounded posteriorly than it is in *B. silvestrii*, however, the close examination of the posterior face suggests that the shapes are not different. The petiole measurements of *B. silvestrii* are: length 0.40 - 0.50 mm, width 0.60 - 0.70 mm, height 0.60 - 0.80 mm and of *B. nimba* are: length 0.45 mm, width 0.60 - 0.65 mm, height 0.75 - 0.80 mm and thus are almost identical in *B. silvestrii* and *B. nimba*. The petiole and postpetiole in *B. nimba* are covered with moderately long (0.20 - 0.30 mm) erect hairs, longer than those of *B. silvestrii* (0.15 - 0.20 mm). The hairs on the ventral side of the head are few and moderately short (0.20 - 0.35 mm), but are longer than those of *B. silvestrii* (0.15 - 0.25 mm). The malar space length in *B. nimba* is 0.15 - 0.20 mm, slightly larger than that of *B. silvestrii* while the area from the upper edge of eye to the upper margin of the posterior lobe is 0.55 - 0.75 mm, which overlaps with distances in *B. silvestrii*. Taking into account the proportions among the body measurements, the differences are insignificant or non existent and depend on specimen size. In conclusion, there are no significant differences, and *B. nimba* is considered to be a synonym of *B. silvestrii*.

**Material examined:**

**Type material: 9 workers**

*Bothroponera silvestrii*: IVORY COAST: Aburi silvestrii, 5°3'0" N; 1°47'0" W, *Pachycondyla (Bothroponera) silvestrii* Santschi, holotype, Santschi det. 1913, (1w, NHMB). *Bothroponera silvestrii* Santschi st nimba GUINEA: Nimba, 500 m, Releve D keoulenta sarane, 7°42'17" N; 8°19'49" W, F. Bernard; *B. silvestrii* Santschi st nimba, F. Bernard 1950, EY6704 (2w, MNHN), Mt To (1600 m) camp 1, II. VI. 1942, M. Lamotte, *B. silvestrii nimba*, F. Bernard 1950, EY6702, EY6703, EY6705, EY6706
(4w, MNHN); **Nion**, 1300 m, maques crete lamotte, 7°36'34" N; 8°28'45" W, *B. silvestrii* st nimba, F. Bernard 1950, type, EY6701, (2w, MNHN).

**Non-type material: 16 workers**


**Distribution:**

Cameroon, Ghana, Guinea, Ivory Coast, and Nigeria.

**Biology and habitat:**

The type specimen of *B. silvestrii* was collected in Aburi City, Ghana. Aburi City is located at about 37.8 km N of Accra (capital city of Ghana), and is one of the richest areas with tropical flora species. The other specimens were collected from Ivory Coast and western of Ghana and Nigeria. These countries reflect the ability of *B. silvestri* to inhabit various habitats that may have different ecological conditions in the Western areas of Africa. The specimens of the synonym *B. nimba* are distributed in Nion and Nimba areas in the Mount Nimba Strict Nature Reserve, at the borders of the Ivory Coast and Liberia at 7°32’ N, 8°28’ W.
Map 7.2: The distribution of *B. silvestrii*.
Bothroponera soror (Emery)
Figures 23.2-26.2 and Plates 9.2-11.2; Map 8.2

Ponera (Bothroponera) soror Emery, 1899: 472 (w, q), Cameroun; Eidmann, 1944: 431 (m, l);
Pachycondyla (Bothroponera) soror: Emery, 1901: 46; Pachycondyla soror: Arnold, 1915: 59;

Pachycondyla (Bothroponera) soror subsp. suturalis Forel, 1907: 133 (w) Ethiopia, Karssa, southern
Ethiopia; Pachycondyla suturalis: Emery, 1911:78; Brown, in Bolton, 1995: 310; Bothroponera

Bothroponera lamottei Bernard, 1953b: 188 (w) Guinea; Schmidt and Shattuck, 2014: 77; Pachycondyla

Diagnosis:

Worker:

Workers of Bothroponera soror have similar characters as the other B. sulcata species complex
species with some exceptions. The mandibles are smooth, shiny and sparsely punctate, narrowed and
have about 6 - 8 teeth. The clypeus has a single medial raised area that forms a shiny, or completely or
partially striated area or a smooth shiny narrowed groove in other specimens. The compound eyes are
relatively large. The malar space length is 0.25 - 0.35 mm while the area from upper edge of eye to the
upper margin of posterior lobe is 0.95 mm.

The head, pronotum, mesonotum, propodeum, petiole and postpetiole are roughly sculptured
with a few scattered punctures. The second gastral segment (fourth abdominal segment) is mostly shiny
and slightly roughened (less sculptured and without punctures). The clypeus, legs and antennae are
moderately shiny. The pronotal shoulder is rounded anteriorly, the lower margin is straight with a
rounded anteroinferior pronotal process and a pointed inferior pronotal process. The propodeum is
quadrate, the dorsopropodeum forms a strong curve with the posteropropodeum. The posteropropodeal
lateral margins form granulated, carinated and sharp margins. The posteropropodeum is slightly concave
(side view). From a dorsal view, the posterior edge of the dorsopropodeum is slightly curved with a
depression where it joins with the posteropropodeum. The petiole is rounded dorso-anteriorly with a medial rounded apex and a vertical posterior face (side view).

The dorsum of the pronotum, mesonotum, propodeum, petiole and postpetiole are covered with a few moderately short (0.15 - 0.25 mm) erect scattered hairs. The hairs on the ventral surface of the head are sparse and moderately long (0.15 - 0.35 mm). The head is bare with a few short (0.10 mm) erect hairs dorsally.

The color of the entire body is black or dark brown or reddish brown. The mandibles and head are pale brown to dark brown. In some specimens, the legs and mandibles are reddish brown. In other specimens, the tibia and scape are dark brown while the tarsus and funiculus are light brown.
Figures. 23.2-26.2

Fig. 23.2: The lateral view of the lectotype worker of *B. soror*.

Fig. 24.2: The head of the lectotype worker of *B. soror*.

Fig. 25.2: The head a paralectotype female of *B. soror*.

Fig. 26.2: The lateral view of a paralectotype female of *B. soror*. 
Female:

The female of *B. soror* is most similar to the worker. In fact, the total length of the *B. soror* female (8.60 - 10.10 mm) overlaps that of the worker. The head shape is subquadrate, excluding the mandibles. The scape extends slightly past the posterior lateral corner of the head. The mandibles are smooth, narrowed and with 7 teeth.

The pronotum is rounded anteriorly, the lower margin is straight (seen from side view), the anterior end of the margin is strongly rounded, but the posterior end forms a sharp pointed tip. The scutum is as wide anteriorly as the pronotum (1.45 mm) and narrowed posteriorly to reach the same width as the scutellum (1.30 mm). The metanotum is slightly elevated, narrowed, well separated between the dorsopropodeum and scutellum. The posterolateral edges of posteropropodeum are angulate. The posteropropodeum is vertical and concave, structured to fit the anterior face of the petiole (the shape corresponds to the form of the petiole). The mesopleuron is divided by the anapleural sulcus to form the lower katepisternum and upper anepisternum. The mesopleural-metapleural suture is well defined. The metanepisternum is poorly developed. The katepisternum is separated from the lateropropodeum by a well-defined suture. The metakatepisternum is fused with the lateropropodeum. The propodeal spiracle is elongate. The petiole is thick and rounded anteriorly and vertical posteriorly (side view). The petiolar level is slightly higher than the postpetiole and the dorsopropodeum. The postpetiole and the rest of gaster are larger than mesosoma.

The dorsum of the pronotum, scutum, scutellum, propodeum, petiole and postpetiole are covered with moderately long (0.15 - 0.37 mm) erect hairs. Hairs on the second gastral tergite are less dense and shorter from those on the postpetiole (less than 0.30 mm). Hairs on the last gastral segment are denser than those on the postpetiole and longer than 0.30 mm. The head is lacking the erect hairs, or with scattered short (0.15 mm and less) erect hairs dorsally. Short erect and suberect hairs (0.10 - 0.15 mm) are scattered on the scape and legs. The mandibles are covered with moderately long hairs (0.15 - 0.20 mm).

The head, pronotum, propodeum, petiole and postpetiole are light brown, but the scutum, scutellum and metanotum are dark brown. The legs, scape and the mandibles are pale brown.

Male:

The head, excluding the mandibles, is nearly rounded (suborbicular). The ocelli are relatively small. The mandibles are small. The eyes are large, covering most of the sides of the head. The scape is
shorter and thicker than the second funicular segment, twice the length of the first funicular segment (pedicel).

The pronotum is rounded anteriorly, square posterior-laterally. Notauli are present on dorsum of the scutum, and do not meet at a central point. The metanotum is elevated between the scutellum and the propodeum, but without a carina. The metanepisternum is distinguished from the mesopleuron while the metakatepisternum is narrowed and poorly developed. The propodeum is gradually sloping posteriorly to reach the insertion of the petiole. The petiole is small, rounded and with a pointed apex. The postpetiole is rounded. The pronotum, scutum, scutellum, propodeum, petiole and postpetiole are all roughly sculptured. The 4th to 7th abdominal segments are smooth and shiny.

The entire body is covered with fine short (length less than 0.05 mm) dense hairs. Moderately long hairs (0.20 - 0.25 mm) are scattered on the dorsum of the scutellum, metanotum, propodeum, petiole and postpetiole.

The color of the pronotum, postpetiole, clypeus, scape and legs are light brown while the color of head, scutum, scutellum, propodeum and petiole are dark brown.

Figures. 27.2-28.2

Fig. 27.2: The lateral view of the male of *B. soror* from Kenya.

Fig. 28.2: The head of the male of *B. soror* from Kenya.
Description:

Worker Measurements: (n= 287)

HL 1.70 - 1.90, HW 1.50 - 1.65, ML 1.10 - 2.10, EW 0.25 - 0.30, EL 0.30 - 0.40, SL 1.45 - 1.70, FL 2.15 - 2.55, WL 2.65 - 3.00, WPL 3.35 - 3.70, PL 0.75 - 1.75, PW 0.90 - 1.00, PH 1.10 - 1.25, CI 86.84 - 88.23, OI 20.00 - 24.24, MandI 64.70 - 110.52, SI 96.66 - 103.03, PetI 57.14 - 120.00. B. suturalis measurements: HL 1.75, HW 1.50 - 1.55, ML 1.05 - 1.10, EW 0.30 - 0.40, EL 0.35 - 0.50, SL 1.40 - 1.45, FL 2.25 - 2.35, WL 2.65 - 2.70, WPL 3.30, PL 0.70, PW 0.85 - 0.95, PH 1.15 - 1.25, CI 85.71 - 88.57, OI 23.33 - 32.25, MandI 60.00 - 62.85, SI 93.33 - 93.54, PetI 121.42 - 135.71. B. lamottei measurements: HL 1.75 - 1.85, HW 1.55 - 1.60, ML 0.90 - 1.15, EW 0.20 - 0.35, EL 0.30 - 0.40, SL 1.45 - 1.50, FL 2.30 - 2.70, WL 2.50 - 2.95, WPL 3.15 - 3.80, PL 0.65 - 0.70, PW 0.90 - 0.65, PH 1.10 - 1.25, CI 86.48 - 88.57, OI 19.35 - 25.00, MandI 51.42 - 62.16, SI 93.54 - 93.75, PetI 92.85 - 138.46

Worker Description:

Total length 8.65 - 11.10 mm; head subquadrate; mandibles with about 6 - 8 teeth, mandibles smooth, sparsely punctate and shiny; anterior margin of clypeus with single medial raised area that forms narrow smooth shiny flat strip with slight depression on anterior part covered with fine striae in some specimens, simply small shiny groove without striae in other specimens; compound eyes relatively large; malar area length 0.25 - 0.35 mm, area from upper edge of eye to upper margin of posterior lobe 0.95 mm; head, pronotum, mesonotum, propodeum, petiole and postpetiole roughly sculptured; pronotal shoulder rounded anteriorly and straight on lower margin (lateral view); basalar sclerite rounded; dorsopropodeum forms defined angle with posteropropodeum; petiole rounded dorso-anteriorly with medium rounded apex and vertical posterior face; dorsum of pronotum, mesonotum, propodeum, petiole and postpetiole covered with few and moderately short (0.15 - 0.25 mm) erect scattered hairs; hairs on ventral surface of head few and moderately long (0.15 - 0.35 mm); short erect (0.10 mm) hairs on top of head; entire body black or brown; mandibles reddish brown to light brown.
**Female Measurements: (n=15)**

HL 1.55 - 1.80, HW 1.40 - 1.65, ML 0.80 - 1.10, EW 0.25 - 0.35, EL 0.30 - 0.40, SL 1.25 - 1.45, FL 2.25 - 2.45, WL 2.45 - 2.95, WPL 3.20 - 3.75, PL 0.65 - 1.70, PW 0.85 - 0.95, PH 1.05 - 1.20, CI 90.32 - 91.67, OI 21.42 - 24.24, MandI 51.61 - 61.11, SI 87.88 - 89.28, PetI 55.88 - 130.76

**Female Description:**

Total length 8.60 - 10.10 mm; head excluding mandibles subquadrate; scape extends slightly past posterior lateral corner of head; pronotum rounded anteriorly; metanotum slightly elevated, narrowed, well separated between propodeum and scutellum; posterior lateral edges of propodeum angular, posteropropodeum nearly vertical (side view) and slightly concave to fit anterior face of petiole; meso-metapleural suture well defined; metanepisternum poorly developed, metakatepisternum distinctive from lateropropodeum; propodeal spiracle elongate; petiole rounded anteriorly, vertical posteriorly; postpetiole and remainder of gaster larger than mesosoma. Erect hairs (0.20 - 0.37 mm) on dorsum of pronotum, scutum, scutellum, propodeum, petiole and postpetiole; top of head covered with few shorter erect hairs (0.15 mm). Short erect and suberect hairs (0.10 - 0.20) scattered on scape and legs; entire body brown, legs and mandibles pale brown.

**Male Measurements: (n=12)**

HL 1.20 - 1.25, HW 0.95, ML 0.30 - 0.45, EW 0.40, EL 0.60 - 0.70, SL 0.25, FL 3.90 - 4.05, WL 2.40 - 2.65, WPL 3.30 - 3.45, PL 0.60, PW 0.65 - 0.75, PH 0.90, CI 76.00 - 79.16, OI 63.15 - 76.68, MandI 25.00 - 36.00, SI 26.31, PetI 108.33 - 125.00

**Male Description:**

Total length 6.45 - 7.45 mm; head excluding mandibles nearly round; mandibles small; eyes large, cover most of sides of head; scape shorter and thicker than second funicular segment, twice length the pedicel; maxillary palps with 4 segments, labial palps with 3 segments; pronotum rounded anteriorly, square posterior-laterally; notauli present on dorsum of scutum; metanotum without carina; metanepisternum distinguished from mesopleuron, metakatepisternum narrowed and poorly defined; propodeum gradually sloping down to reach insertion of petiole; petiole small with pointed apex; postpetiole rounded (side view); pronotum, scutum, scutellum, propodeum, petiole and postpetiole
roughly sculptured; fine short dense hairs cover entire body; moderately long hairs (0.20 - 0.25 mm) scattered on dorsum of scutellum, metanotum, propodeum, petiole and postpetiole; pronotum, postpetiole, clypeus, scape and legs light brown, head, scutum, scutellum, propodeum and petiole dark brown.

**Comparison:**

**Worker Comparison:**

The worker of *Bothroponera soror* is characterized by some distinguishable traits among members of the *B. sulcata* species complex. The posteropropodeum in *B. soror* is strongly slopeing posteriorly to form a semi-vertical face that is slightly concave (side view) for the reception of the anterior face of petiole. This character in *B. soror* is similar to that in *B. ancilla, B. picardi, B. silvestrii, B. ryderae* and *B. pilosuperficia*. On the contrary, the posteropropodeum is flat, not concave as in *B. kenyensis, B. crassa, B. crassior, B. notaula* and forms an obtuse angle with the dorsopropodeum. In *B. kruegeri*, the dorsopropodeum is broadly curved posteriorly to form the posteropropodeum that slopes gradually to the insertion point of the petiole between the propodeal lobes.

The clypeus of *B. soror* forms a raised anterior medial area that has a longitudinal smooth and/or striate shiny strip similar to that of *B. ancilla*. In some specimens, this area has an unnoticeable groove that forms a slight depression sometimes covered with fine striae. The similar clypeal structure can be found in *B. crassa, B. crassior, B. kenyensis, B. kruegeri, B. picardi, B. notaula, B. ryderae, B. pilosuperficia* and *B. silvestrii*. In *B. crassa* the anterior medial margin of the clypeus is convex with a smooth and shiny medial raised area, sometimes with slight groove. In *B. crassior*, the anterior medial margin of the clypeus is convex with a medial raised area that forms a longitudinal shiny groove on the raised area that is sculptured and somewhat striated on the upper portion. The raised area in *crassior* forms a groove sometimes has a straight flat strip or a slight depression. In *B. kenyensis*, the medial raised area of the clypeus forms a posterior sculptured area while the anterior part forms a triangular smooth area without a groove. In *B. kruegeri*, the clypeus has a medial raised area that forms a sculptured upper part and flat or mostly raised area on the lower part. In *B. picardi*, the anterior medial margin of the clypeus forms a shiny groove on the medial raised area. In *B. silvestrii*, the clypeus has a single medial raised area that forms a smooth shiny longitudinal groove, which is similar to *B. picardi* and wide, slightly deeper in *B. notaula*. In *B. ryderae* there are fine striae on the upper portion and sides
of the medial raised area of clypeus, with a slight depression on the lower part. In *B. pilosuperficia*, the medial raised area is smooth and shiny but without groove.

*Bothroponera soror* is smaller (total length 8.65 - 11.10 mm) than of *B. kruegeri* (11.75 - 12.55 mm), but overlaps with *B. crassior* (8.35 - 9.40 mm), *B. ancilla* (6.75 - 8.90 mm), *B. notaula* (7.60 mm) and *B. pilosuperficia* (7.50 - 9.00 mm). On the other hand, the total length of *Bothroponera soror* is larger than that of *B. picardi* (6.30 - 6.50 mm), *B. kenyensis* (5.65 - 7.05 mm), *B. silvestrii* (5.25 - 6.15 mm), *B. crassa* (6.00 - 8.80 mm) and *B. ryderae* (6.55 - 7.20 mm).

Forel (1907) distinguished *B. suturalis* from the type worker of *B. soror* by considering the head size and shape, the scape length, the meso-metanotal suture and he somewhat compared the metanotum, which is only found in the sexuals. Forel (1907) indicated that the head in *B. suturalis* has larger dimensions and sides are less convex than the type of *B. soror*. He separated them on the basis of scape length as it does not exceed the occipital border of the head in *B. suturalis* while it slightly exceeds the occipital border in the type of *B. soror*. The extensive measurements in this revision show that there is no significant difference in scape length between the type of *B. suturalis* and the type of *B. soror*, based on the large number of specimens available. He stated that the meso-metanotal suture is more distinctive in the type of *B. soror* whereas it is less distinctive in *B. suturalis*. Direct comparisons of numerous specimens of *B. soror* with the type of *B. suturalis* show no significant difference in this character.

The main characters that separate the workers of *B. suturalis* is that the anterior medial raised area of the clypeus is a narrow, smooth, shiny anterior strip that has a fine striated short groove (depression) close to the anterior margin. The mandibles have about 8 teeth. The malar space length is ~0.25 - 0.30 mm while the area from the upper edge of eye to the upper margin of the posterior lobe is ~0.75 - 0.90 mm. The head is covered with short (less than 0.10 mm) erect scattered hairs. The dorsum of the pronotum, mesonotum and propodeum are covered with a few moderately short (0.15 - 0.20 mm) erect hairs. The petiole and postpetiole are covered with moderately long (0.20 - 0.25 mm) erect hairs. The hairs on the ventral surface of head are sparse and moderately long (0.15 - 0.35 mm). Short erect hairs (0.10 mm) are scattered on the head. It is obvious that these characteristics and measurements overlap those of *B. soror*, therefore I consider *B. suturalis* to be a synonym of *B. soror*.

The worker of *Bothroponera lamottei* was described by Bernard (1953). He considered it to be slightly larger from *B. soror*, darker and without bronze reflections. Bernard also mentioned differences in the sculpturing of the pronotum and the presence of more dense pilosity on surface, the shape of the propodeum and the petiole. Direct comparison of the types shows that *B. lamottei* is identical to *B. soror*. 

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Measurements and characters of the types of *Bothroponera lamottei* include the following: the malar space length is 0.20 - 0.25 mm while the area from upper edge of eye to the upper margin of the posterior lobe is 0.90 - 1.05 mm. The dorsum of the pronotum, mesonotum and propodeum, are covered with moderately short (0.15 - 0.25 mm) erect hairs. The petiole and postpetiole are covered with longer (0.25 - 0.30 mm) erect hairs. A few long erect hairs (0.30 mm) are located on the posteropropodeal edges. The hairs on the ventral surface of the head are few and moderately short (0.20 - 0.30 mm). These dimensions and measurements overlap those of *B. soror* and *B. lamottei*. Considering the similarities between the types of both species with the lack of significant differences between them, I conclude that *B. lamottei* is a synonym of *B. soror*.

Female Comparison:

The female of *Bothroponera soror* is similar to the worker with a similar or slightly smaller body length (total length 8.60 - 10.10 mm for the female, 8.65 - 11.10 for the worker). The *B. soror* female can only be compared with the female of *B. pilosuperficia* in the *B. sulcata* species complex, as the others are unknown or not available.

The major variations between the two females (*B. soror* and *B. n sp.3*) are the form of the hairs and the shape of the anterior medial area of clypeus. The clypeus is convex in both species, but the anterior medial area of clypeus forms a narrow, shiny, longitudinal slight depression that has fine striae in *B. soror*, but this character is with a slight groove and lacking striae in *B. pilosuperficia*. The entire surface including the head is covered with moderately long, abundant, silver erect hairs in *B. pilosuperficia* while the hairs are less abundant and lacking on the head except for some erect scattered short hairs on dorsum of the head in *B. soror*.

Male Comparison:

The male of *B. soror* can be separated from the males of *B. crassa, B. kruegeri, B. kenyensis, B. notaula, B. ryderae* and *B. crassior* by considering the total length, presence or absence of notauli, sculpture, ocelli size and the propodeum shape.

The total length of *B. soror* is larger (6.45 - 7.45 mm) than that of *B. kenyensis* (4.70 - 5.10 mm), which easily separates the two species. *Bothroponera kruegeri* can also be excluded from the comparison because it has the largest total length (10.25 mm) among the *B. sulcata* species complex.
members. The other species include *B. crassa* (5.90 - 7.50 mm), *B. notaula* (5.60 - 7.90 mm) and *B. ryderae* overlapping in total length with *B. soror*.

The medial ocellus is small in *B. soror* (0.12 - 0.15 mm), resembling that of *B. kenyensis* (0.12 - 0.13 mm), *B. ryderae* (0.15 mm) and the type specimen of *B. crassior* (0.17 mm); in contrary, the medial ocellus is large in *B. crassa* (0.22 - 0.25 mm), *B. kruegeri* (0.35 mm) and *B. notaula* (0.22 - 0.23 mm). The notauli are present on the dorsum of the scutum in *B. soror, B. notaula, B. ryderae* and *B. kenyensis*. Contradictory, the notauli are not present in *B. crassa, B. crassior* and *B. kruegeri*.

The dorsopropodeum is strongly curved posteriorly in *B. soror* whereas it slopes gradually to the posteropropodeum in *B. crassa, B. crassior, B. notaula, B. ryderae, B. kruegeri* and *B. kenyensis*.

**Material examined:**

**Type material:**

*Ponera (Bothroponera) soror*: **CAMEROUN**: South Province, Lolodorf, 3°14'0" N; 10°44'0" E, xi-xii, vii-1895, L. L. Conradt, *Ponera (Bothroponera) soror* Emery 1899, (1 lectotype worker, 8 paralectotype workers and 2 paralectotype females [here designated], MCSN).


Non-type material:

**ANGOLA:** Gallery Forest of R. Camudembele, 7°22' S, 20°50' E, berlesate by Luna de Carvalho, 2-iv-1964, W. L. Brown, *Bothroponera soror* (1q, MCZC). **BURUNDI:** Bururi Province, Burunga, 3°56' 50.6" S, 29°33' 43.2" E, 12-iii-1927, # 00525685 (1w MCZC). **CAMEROUN:** Nkoemvon, 1980. P. I. J. Jackson, *Pachycondyla Bothroponera soror* (3w MCZC). **DEMOCRATIC REPUBLIC of THE CONGO:** Nord-Kivu Province, Irangi. Luhoho River, from 1°31'35.04" to 1°31'0" S, 28°7'45.12" to 28°4'0" E, 900m, ix-10-1964, E. S. Ross & R. E. Leech collectors, *Bothroponera soror* Emery W LB (1 w # 315944 LACM); Orientale Province, Ituri Forest, 1°51'0" N, 29°58'0" E, ii-1948, N. A. Weber, 2111, #00525684 (1w MCZC) West Side Ruwenzori, 0°23'0" N, 29°54'0" E, ii-1948, N. A. Weber, 2116, #00525685 (1w MCZC). **ETHIOPIA:** Abessiecen (Dive-Dalla), *Bothroponera soror suturalis*, y 736, (1w, ZMHU); Arussi Galla, A. Ganale Gudda, Bottego, 7°9'0" N, 37°42'0" E, iii-v-1993, Bricchetti-Robecchi (2 w, MCSN). Gera district. Jimma zone, Chira (7°34' N, 36°4' E), 1800-2400 m, 1-viii to 30-vi-2011, home gardens, coll. Debissa Lemessa, #00525695, 00525696, 00525699, 00525700, 00525701 (9w MCZC). **GABON:** Makokou, 0°11'0" S; 12°12'0" E, Oct. 1972, I. Lieberburg, rain forest, (1 w and 1 f, MCZC), Same locality, CNRS, 1974 June-July, W. H. Gotwald, *Pachycondyla soror sutturalis* (1f MCZC). **GHANA:** no further data, 1966, D. Leston, No. 638, ANIC Ants Vial No 46, 50, ant ecology sample 1578 (2w # 315949 LACM), no further data, scarp FR, 7-viii-69, Leston, (1f # 315951 LACM), no further data, 1966, D. Leston, No. 641, ANIC Ants Vial No 46.61 (2w # 315948 LACM); Tafo, 6°13'0" N; 0°22'0" W, 23-vii-1970, B. Bolton, *Pachycondyla soror* Forel, det. B. Bolton 1977 (1m # 315950 LACM), same locality, West Africa, B. Bolton coll. B.M. 1971-89, In small rotten log, 23-vii-1970, PF 5:4 male, # 00525708, 00525709 (1w, 1m MCZC); same locality: 18-i-1968, D. Lestoh (1w BMNH), Mt. Atewa, from 5°58' to 6°20' North and longitudes 0°31' to 0°41' West, 31-vii-1969, D. Leston (1w # 315952 LACM), same locality from 5°58' to 6°20' North and 0°31' to 0°41' West, 1-12-1968, B. Bolton, *Pachycondyla soror* Forel, det. B. Bolton 1977 (2w # 315953 LACM). **IVORY COAST:** Banco forest, near Abidjan, 5°22'0" N, 4°30' W, 5-iii-1977, PK., Primary Forest, dead trunks, I. Lobl (2w BMNH). **KENYA:** Rift Valley Province, Mt. Kenya Bulguret Trail West side, Nanyuki, 0°1'0" N; 37°4’0" E, 1-x-1992, hand collected, Leg. Vince
Pachycondyla crassa Det. (Emery 1877), R. R. Snelling 2002 (13 w #315884, 315847, 315848, 315881(2), 315883(2), LACM), Isecheno Nature Reserve, nr Kalunya Glade, 1600m, 1800m, 0°14’23.9994” to 0°15’0” N, 34°51’0” to 34°52’11.9994” E, 20, 26, 28-iv-2001, #01-319, #01-327, #01-237, #01-241, #01-254, #01-297, #01-335, #01-344, #01-377, 3, 5, 7, 15, 19, 21, iv 2001, #01-312, #01-327, #01-360, #01-362, 01-363, 4 Feb. 2002, #02-013, Primary Equatorial Rainforest: colony in rotten log, sifted litter between tree buttresses, ex. litter or in flight, under moss mat on tree trunk, ex debris at base of tree, foraging in litter, foraging on rotten log, in and on rotten log, in litter or on vegetation, ex. rotten log, coll. R. R. Snelling, coll. R. R. Snelling & A. Espira, Pachycondyla crassa Det. (Emery 1877), R. R. Snelling 2002 and 2003, Det. R. R. Snelling 2002 (5m # 315915, 315818 (3), 315819 (3) and 315820 (3), 315912 LACM); (5q # 315817 (3), 315828 (2), 315840 LACM); (80 w # 315812, 315814, 315815, 315816, 315817 (2), 315821, 315822, 315823, 315824, 315825, 315827, 315829, 315830, 315831, 315832, 315833, 315834, 315835, 315836, 315837, 315838, 315839, 315849, 315856, 315857, 315876, 315877, 315880, 315888, 315889, 315891, 315892, 315912 (2), 315914 and 315915 (2) LACM), Isecheno Nature Reserve pumphouse, Isecheno, 1800m, 0°13’48” N, 34°51’35.9994” E, 7-v-2001, #01-368, Equatorial Rainforest: ex debris at base of tree, coll. R. R. Snelling, Pachycondyla crassa Det. (Emery 1877), R. R. Snelling 2002 (2m # 315881, 315883 LACM). (1m # LACM), Yala River Nature Reserve, 1450m, 1470m, 0°12’0” N, 34°52’11.9994” to 34°52’48” E, 25-iv-2001, #01-284, #01-285, and 28-ii-2001, #01-097, 18-ii-2002, #02-067, 15-ii-2002, #02-062, #02-066, 8-iii-2002, #02-117, #02-069, 22-ii-2002, #02-087, 15-ii-2002, #02-062, 15-ii-2002, #02-069, Primary Equatorial Rainforest: ex rotten log, at baboon dung, ex. rotten log, under bark of log, on ground and in leaf litter, in leaf litter, ex. rotten log, at baboon dung, under bark of log, on ground and in leaf litter, coll. R. R. Snelling and A. Espira, Pachycondyla crassa Det. R. R. Snelling 2004 (Emery 1877), R. R. Snelling 2002 ’s 316009, 315800, 315804, 315805, 315841, 315842, 315843, 315844, 315845, 315846, 315766, 315767, 315768, 315784, 315796, 315797, 315798, 315799 (2) (37w, 2m # 315799, 315800, 1f # 315801 LACM). Laikipia District, Mpala Research Centre, 1650m, 0°17’23.9994” N, 36°53’59.9994” E, 9-x-1999, #99-123a, # 315851 coll. R. R. Snelling, Acacia Woodland, in litter under Acacia tree, (1w LACM). MOZAMBIQUE: Manica Province, Amatongas Forest, P.E.A. 19°10’7’’ S; 33°45’37’’ E, 16-ii-1917, G Arnold, Arnold Coll., B.M. 1934-354, #40 (3w BMNH); PEOPLE’S REPUBLIC of the CONGO: Likouala Province, Congo Brazzaville, 25 k North West Boha, 30 k South East Lac Telle [Tele], 1°20’48” N; 17°06’ E, 30-xii-1986, Gary D. Alpert, # 00525686 (1 w, MCZC). SUDAN: Khor Aba, Aloma Plateau Equatoria, Anglo-Egypt Sudan, 5°20’0” N; 29°40’0” E, vii-viii-1939, N. A. Weber, Bothroponera soror Emery (1w, CWEM). UGANDA: Kibale Forest, 0°13’ N, 30°19’ E, 1-ii-1993,
primary rain forest, hand collected log, Lauren Chapman 20169w (MCZC), *Pachycondyla Gen.* Det. Gary D. Alpert, # 00525703 (2w MCZC); **Fort Portal,** 00°39′36″N 30°16′30″E, ii-1948, N. A. Weber, 2102, #00525682 (1w MCZC).

**Distribution:**

Angola, Burundi, Cameroon, Congo (DRC), Ethiopia, Gabon, Ghana, Guinea, Ivory Coast, Kenya, Mozambique, South Sudan and Uganda.

**Biology and habitat:**

*Bothroponera soror* is widespread in Eastern Africa, however, it can also be found in western, middle and southern areas of Africa. The main habitat for *B. soror* is tropical forests. Some specimens were collected from the stomach of the toad *Bufo* sp., which means that the habitat of *B. soror* in the tropics is close to the frogs’ habitat.

Ant specimens of *B. soror* were collected from 1000 - 1800m, mainly from Ethiopia, Kenya and Ghana. In a preliminary species checklist of the ants of Kakamega Forest, Western Kenya, Garcia *et al.* (2009) found *B. soror* at 1448 m and collected mostly from all habitats in this forest. Worker specimens from Kakamega Isecheno, Kenya, were collected while they were running on a fallen log, descending the trunk of *Maesopsis eminii* trees in early morning, running on the ground, foraging in the litter, foraging on a rotten log, stray foragers on shrubs, at baboon dung, and ascending the trunk of *Maesopsis eminii* trees in the late afternoon. They were also found hidden in leaf litter, in a rotten log, under a moss mat on a tree trunk, under the bark of a log and in the litter of *Maesopsis eminii* trees. Sometimes *B. soror* are found alone on the ground, in a guesthouse clearing, on the ground and in leaf litter and on vegetation. They have also been collected from the Equatorial Rainforest by excavating litter under *Maesopsis eminii* trees, excavating debris at base of a tree, by excavating a rotten log and excavating sifted leaf litter. In the Equatorial Rainforest, *B. soror* tend to build colonies in rotten logs on the ground.

At the Laikipia Mpala Research Centre, Kenya, *B. soror* was collected from *Acacia* Woodland, on the trunk of *Acacia xanthophloeum,* foraging on the ground, scavenging on a rotting skull, in litter under an *Acacia* tree and excavating soil under a stone. Workers use tandem running on the ground.

Males were collected from three localities in the Kenya Laikipia District: Mpala Research Centre, Kakamega District: Isecheno Nature Reserve, Isecheno and the Kakamega District: Isecheno Nature Reserve, nr Kalunya Glade. They are found in two habitats: *Acacia* woodland and equatorial
rainforest. Some of the male specimens were found on the ground, under litter, and walking on a log. The males are nocturnal and are attracted to light. They were also collected by malaise trap.

Female of *B. soror* from Isecheno Forest Reserve, Kenya were collected by excavating sifted litter and also collected while they were flying.

*Bothroponera suturalis* was collected from Karsa, Southern Ethiopia where the other species of the *B. sulcata* species complex are mostly found. The Karsa area is located about 241 km south of the capital city of Addis Ababa, Ethiopia (http://www.places-in-the-world.com). The elevation is about 1750 meters above sea level. The climate in Karsa is humid (greater than 0.65 p/pet) without a dry season. Typically, this climate results in a forest environment. The area is rich with biodiversity and is considered as a suitable environment for tropical organisms, which explains the wide distribution of ant species in this area.

*Bothroponera lamottei* is found in Guinea at the following localities: Yanlé, Yalanzou, Camp IV, 1000 m, Nion and Mount Tô (southern areas in Guinea). The majority of the specimens are from Nion, near the southern border with Liberia and Ivory Coast, in the western part of the Mt Nimba natural reserve. This species is one of the species in the *B. sulcata* species complex that is distributed far from other members of the *B. sulcata* species complex. The other specimens of *B. soror* examined were collected in the gallery forest of R. Camudembele, Angola.
Map 8.2: The distribution of *B. soror*.
Bothroponera notaula, sp. nov.  
Figures 29.2-32.2; Map 9.2

**Diagnosis:**

**Worker:**

The worker of *Bothroponera notaula* can be characterized by the narrowed mandibles that have 8 teeth, which alternate in size. The mandibles are covered with fine striae and a few scattered shallow punctures. The anterior medial margin of the clypeus is convex with a medial raised area that has a longitudinal wide, shallow and shiny groove. The scape extends slightly past the posterior lateral corner of the head. The eyes are larger in diameter than malar area and slightly project past the sides of the head (full face view).

The head surface is rough with weak evidence of moderately distributed small punctulae. The dorsum of the pronotum, mesonotum, petiole and postpetiole are roughly sculptured with a few scattered poorly defined punctulae. The dorsopropodeum is smoothly curved posteriorly to form an obtuse angle with the posteropropodeum. The posteropropodeum is slightly concave with angulated margins (side view). The anterior face of the petiole (seen from above) is rounded and the posterior face is slightly concave. The total length is moderately small (7.60 mm).

The entire body is covered with fine hairs (up to 0.02 mm) and erect silver hairs from 0.20 up to 0.35 mm. The head has shorter (less than 0.10 mm) erect silver hairs and fine hairs. The entire surface is black to brownish dark.

The female is unknown.
Figures 29.2-32.2

Fig. 29.2: The lateral view of the paratype worker of *B. notaula*.

Fig. 30.2: The head of the paratype worker of *B. notaula*.

Fig. 31.2: The head of a holotype male of *B. notaula*.

Fig. 32.2: The lateral view of a holotype male of *B. notaula*. 
Male:

The head of the *B. notaula* male is nearly round, excluding the mandibles. The medial ocellus is large (0.22 mm maximum diameter), slightly smaller than the distance between it and the lateral ocelli (0.27). The scape is nearly three times (0.35 mm length) as long as the pedicel (0.12 mm, first funicular segment), shorter and thicker than the second funicular segment (0.60 mm length). The clypeus is convex with a small peak that points ventrally on the lower anterior medial margin.

The pronotum is quadrate laterally and rounded anteriorly. The notauli are present on the dorsum of the scutum, but they are not connected posteriorly. The metanepisternum is well developed and distinguished from the propodeum and mesopleuron while the metakatepisternum is narrowed and poorly defined. The dorsopropodeum is gradually sloped posteriorly to reach the insertion of the petiole between the propodeal lobes.

The entire body is covered with fine, silver, short, dense hairs. The dorsum of the scutellum, scutum, metanotum, propodeum, petiole, postpetiole and the gastral segments are covered with scattered, moderately long silver erect hairs.

The color of the entire body is mostly light brown to medium brown or yellowish.

Description:

**Worker Measurements:** (n=1)

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**Worker Description:**

Total length 7.60 mm; head subquadrate, mandibles narrow with 8 teeth, compound eyes relatively large; clypeus convex, anterior medial raised area with wide longitudinal groove; scape extends slightly past posterior lateral corner of head; malar space length 0.20 mm, length from upper edge of eye to edge of posterior lobe 0.70 mm; head rough, covered with few scattered punctures; pronotum, mesonotum, petiole, postpetiole roughly sculptured; basalar sclerite oval; pronotal shoulder rounded anteriorly; dorsopropodeum sloping gradually to form obtuse angle with posteropropodeum; petiole slightly rounded from top, strongly curved latero-posteriorly, vertical anterior face and vertical posteriorly, apex of petiole slightly higher than postpetiole and dorsopropodeum. Entire body covered
with fine silver hairs (less than 0.02 mm in length) and moderately abundant silver erect hairs (0.10 - 0.20 mm); head covered with shorter (0.05 - 0.07 mm) erect hairs than those on mesosoma and gastral tergites; hairs on ventral surface moderately long (0.25 mm); pygidium and hypopygium covered with longer (up to 0.35 mm) erect hairs; dorsum of pronotum, mesonotum, propodeum covered with moderately short (0.12 mm) erect silver hairs; petiole and postpetiole covered with moderately long (0.17 - 0.20 mm) erect hairs; long (0.25 mm) erect hairs arranged on edges of posteropropodeum; color of entire body brownish dark; legs, scapes, mandibles brown.

**Male Measurements: (n=5)**

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<tr>
<td>SL</td>
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<td>WL</td>
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<tr>
<td>PL</td>
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<td>PW</td>
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<td>OI</td>
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<td>SI</td>
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<tr>
<td>PetI</td>
<td>100</td>
<td>84.61</td>
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</tbody>
</table>

**Male Description:**

The total length ranges from 5.60 - 7.90 mm; head excluding mandibles nearly round (suborbicular); eyes large, cover most of sides of head, distance between eyes is (0.55 - 0.70 mm) from upper inner margins, medial ocellus width (0.22 - 0.25 mm); scape shorter (0.30 mm) and thicker than second funicular segment (0.60 mm), two to 2 ½ times length of pedicel (first funicular segment that measure 0.10 - 0.15 mm); maxillary palps with 5 segments, labial palps with 4 segments; pronotum squared laterally, rounded anteriorly; scutum rounded, separated from scutellum by scutoscutellar suture, notaui present on dorsum of scutum; scutellum subtriangular and elevated in lateral view; metanotum raised between scutellum and propodeum; mesopleuron divided by anapleural sulcus to form ventral katepisternum and dorsal anepisternum; metaepisternum well developed and separated from propodeum and mesopleuron by suture; basalar sclerite rounded; dorsopropodeum gradually sloping down posteriorly to insertion of petiole; petiole small, width less than dorsopropodeum width (seen from above), higher than postpetiole height, with bluntly rounded apex; postpetiole smoothly rounded anteriorly; pronotum, scutum, scutellum, propodeum, petiole roughly sculptured with few scattered punctures; gastral segments smooth shiny; fine, silver, short (less than 0.02 mm), dense hairs cover entire body; moderately long (less than 0.07 - 0.10 mm) hairs scattered on dorsum of scutellum, metanotum, propodeum, petiole, postpetiole; long (0.25 mm) erect hairs on dorsum of scutellum; long (0.10 - 0.25 mm) erect hairs on petiole; moderately long (0.15 - 0.17 mm) erect hairs on gastral
segments, longer (0.25 - 0.35 mm) hairs between gastral segments; hairs on ventral surface of all gastral segments (up to 0.15 mm) denser than on other parts; color mostly light brown to brown.

**Comparison:**

**Comparison of worker:**

The worker of the *B. notaula* could be compared with *B. crassior, B. crassa, B. kenyensis, B. kruegeri* of the *B. sulcata* species complex species because the dorsopropodeum is generally identical in those five species in being broadly curved and the posteropropodeum gradually sloping posteriorly to reach the petiole insertion between the propodeal lobes. The lateral edges of the posteropropodeum form sharp angles with lateropropodeum. This configuration is different in *B. soror, B. pilosuperficia, B. ryderae, B. silvestrii, B. ancilla* and *B. picardi*. In those species, the posteropropodeum is nearly vertical, flat (not concave), the margins are granulated and strongly curved to form a sharp angle lateroposteriorly.

The anterior medial area of the clypeus forms a narrow longitudinal strip that may have a slight groove in a majority of the species including *B. ancilla, B. ryderae, B. crassior*, or a raised shiny longitudinal strip in *B. picardi, B. crassa, B. pilosuperficia*. In *B. notaula*, the anterior medial raised area of the clypeus forms a wide groove while *B. soror* usually has a completely or partially striated longitudinal depression.

The eyes are large in *B. notaula* similar to those of *B. picardi, B. ryderae, B. crassa* and *B. crassior*. The eyes in *B. kruegeri* are larger than those of *B. notaula*, but they are smaller in *B. kenyensis, B. soror, B. ancilla, B. silvestrii* and *B. pilosuperficia* than that in *B. notaula*.

The head of *B. notaula* is rough with weak evidence of punctures on the surface similar to the pronotum, mesopropodeum, mesopleuron, petiole, postpetiole and the surfaces of the 4th to 7th abdominal segments. *Bothroponera crassior*, on the other hand, has a rough surface on the head, pronotum, mesopropodeum, mesopleuron, petiole and the postpetiole is with tiny dense shallow punctures scattered on the entire surface. The 4th to 7th abdominal segments are smooth, shiny without any evidence of punctures.

The surface (pronotum, mesopropodeum, petiole, postpetiole and 4th to 7th abdominal segments) in *B. notaula* is covered with dense fine silver hairs and moderately scattered erect silver hairs while the top of the head is covered with relatively short erect silver hairs and dense fine silver hairs similar to those of *B. kruegeri*. The hairs in *B. ancilla, B. soror* are relatively long and moderately dense on the
mesosoma, petiole and the gaster; meanwhile, the top and frons of the head are covered with a few erect hairs in those species (*B. ancilla* and *B. soror*). The head, mesosoma, petiole and the gaster in *B. pilosuperficia* are covered with relatively long erect silver hairs and dense fine silver hairs. In *B. kenyensis, B. silvestrii* and *B. ryderae*, the erect hairs are present on the dorsum of the pronotum, mesopropodeum, petiole, postpetiole and gaster whereas the head lacks the erect hairs. The head, mesosoma, petiole, postpetiole and 4th to 5th abdominal segments in *B. picardi* lack erect hairs.

**Comparison of males:**

Collection of the male of *B. notaula* is very important for identification because the worker of *B. notaula* is identical to the worker of *B. crassior*. The male of *B. notaula* was mounted with a worker on the same pin, which strongly suggests that they are from the same nest.

The male of *B. notaula* can be compared with males of *B. crassior, B. crassa, B. soror, B. kruegeri, B. ryderae* and *B. kenyensis*. The males of *B. picardi, B. silvestrii, B. ancilla* and *B. pilosuperficia* are unknown. *Bthroponera notaula* has large ocelli, which is similar to those of *B. kruegeri* and *B. crassa*. The ocelli of *B. crassior, B. soror, B. ryderae* and *B. kenyensis* are smaller than those of *B. notaula, B. kruegeri* and *B. crassa*. The notauli are present on the dorsum of the scutum of *B. notaula*, which resemble those of *B. soror, B. ryderae* and *B. kenyensis*. Conversely, the notauli are not present on dorsum of scutum of *B. crassa* and *B. crassior. Bothroponera kruegeri* has weak evidence of notauli presence.

**Etymology:**

The specific epithet of *B. notaula* refers to the distinct notauli that are present on the dorsum of the male’s scutum (mesoscutum), which characterizes this species. The worker of this species is similar to the worker of *B. crassior* and *B. crassa*, but the males of both of these species lack the notauli.

**Material examined:** 5 males and 1 worker

**Type material:**

**TANZANIA: Tanganyika, 6°0'0'' S; 35°0'0'' E, Windy Gap, W. slope Ngorongoro Crater, 23-x-1957, 2100m, collectors E. S. Ross & R. E. Leeon, *B. notaula* (1 paratype w, 1 holotype m, MCZC).**
Non-type material:

KENYA: Laikipia district: Mpala Research Center, 0°17'23.99'' N; 36°53'59.99'' E, 1650m, 18-ix-1999 #99-021, Acacia Woodland. Nocturnal around black light, coll. R. R. Snelling, # 315900 B. notaula (1m LACM). SOMALIA: Da Matagoi a Lugh, [Damatagoi Alugh], Matagoi, Gobolka Mudug, 1°59'0'' N; 43°8'0'' E], -2°30' N, 43°25' E, E, C. Emery, from L. U. G. H. In xi and xii-1895 (2 m, MCSN). Pozzi Maddo [Pozzimaddo], C. Emery, Pozzimaddo in 9-12. ii-1896, collector V. Bottego, B. notaula (1 m MCSN).

Distribution:

Kenya, Somalia and Tanzania.

Biology and habitat:

The specimens of B. notaula were collected mainly from three of the East African countries, Somalia, Kenya and Tanzania that have long beaches on the Indian Ocean shore. The area extends from the Gulf of Aden (north) where the habitat is more xeric to the Ruvuma. Bay (south) where the habitat is more mesic. These countries are characterized by different kinds of habitats that are more likely to include several species of organisms. Bothroponera notaula is distributed in this area with the other species of the B. sulcata complex including B. ancilla, B. crassa, B. crassior, B. kenyensis and B. kruegeri.
Map 9.2: The distribution of *B. notaula*. 
**Bothroponera ryderae, sp. nov.**

Figures 33.2-36.2; Map 10.2

**Diagnosis:**

**Worker:**

*Bothroponera ryderae* can be diagnosed with some unique characters such as the clypeus with an anterior medial raised area, the mandibles, eyes, body sculpture, hairs and color. The anterior medial margin of the clypeus is characterized by a single medial raised area that forms a smooth, shiny, slightly narrowed longitudinal depression, or, in some specimens, is formed into a flat narrowed longitudinal strip. The mandibles are smooth and have about 7 teeth that alternate in size. The compound eyes are relatively large that are less projecting in the holotype and the paratypes, and slightly projecting in the other two examined specimens.

The head, pronotum, mesonotum, propodeum, petiole and postpetiole are roughly sculptured, without punctures. The head, pronotum, mesonotum, propodeum, petiole, postpetiole with the 4\textsuperscript{th} to 7\textsuperscript{th} abdominal segments, legs and antennae are slightly or moderately shiny.

The main distinguished character of the *B. ryderae* worker is that the head surface is lacking erect hairs, but the pronotum, mesopropodeum, petiole, postpetiole and 4\textsuperscript{th} to 7\textsuperscript{th} tergites and sternites of the abdominal segments are covered with moderately long erect hairs. The erect hairs are denser and slightly longer on the petiole, postpetiole and the 4\textsuperscript{th} to 7\textsuperscript{th} abdominal segments than that on the mesosoma. The total length is 6.55 - 7.20 mm.

The entire surface is covered with fine hairs. The dorsum of the pronotum, mesonotum, propodeum, petiole, postpetiole and the rest of the gastral segments are covered with scattered long erect hairs. The hairs on petiole, postpetiole and the 4\textsuperscript{th} to 7\textsuperscript{th} abdominal segments are denser and longer than that on propodeum, mesonotum and pronotum.

The entire body is dark brownish except for the appendages. The legs, clypeus, mandibles and antennae are light brown.

The female is unknown.
Figures. 33.2-36.2

Fig. 33.2: The lateral view of the holotype worker of *B. ryderae*.

Fig. 34.2: The head of the holotype worker of *B. ryderae*.

Fig. 35.2: The head of a paratype male of *B. ryderae*.

Fig. 36.2: The lateral view of a paratype male of *B. ryderae*. 
Male:

The head of the *B. ryderae* male is suborbiculate, excluding the mandibles and the mouthparts. The scape is twice as long (0.20 mm length) as the pedicel (0.10 mm -first funiculus segment), shorter and thicker than the second funicular segment (0.40 mm length). The clypeus is convex with a small peak that points ventrally on anterior medial lower margin. The ocelli are relatively small. The notauli are present on the dorsum of the scutum and they connect posteriorly.

The dorsopropodeum is slightly concave and gradually slopes posteriorly to reach the insertion of the petiole. The mesosomal surface is rough while the petiole and postpetiole along with 4th to 7th abdominal segments are smooth and shiny.

Fine dense silver hairs cover the entire surface. The pronotum, scutum, scutellum, propodeum, petiole and postpetiole covered with a few short erect hairs that are scattered on the dorsum, while the head lacks the erect hairs.

The entire male is yellowish.

Description:

Worker Measurements: (n=9)

- HL 1.30 - 1.50, HW 1.20 - 1.25, ML 0.75 - 0.85, EW 0.20 - 0.25, EL 0.25 - 0.30, SL 1.05 - 1.15, FL 1.80 - 1.90, WL 2.10 - 2.25, WPL 2.65 - 2.80, PL 0.50 - 0.60, PW 0.70 - 0.75, PH 0.90 - 1.00, CI 83.33 - 92.30, OI 20.83 – 24.00, Mandl 57.69 - 56.66, SI 87.5 - 92, PetI 125 - 140

Worker Description:

Total length 6.55 - 7.20 mm; head subquadrate; anterior medial margin of clypeus with single medial raised area with smooth shiny longitudinal depression; mandibles smooth, shiny with 7 teeth which alternate in size; compound eyes large; malar space length 0.11 - 0.15 mm, area from upper edge of eye to the upper margin of posterior lobe 0.75 mm; head, pronotum, mesonotum, propodeum, petiole, postpetiole, gastral segments, legs and antennae moderately shiny; head, pronotum, mesonotum, propodeum, petiole, postpetiole roughly sculptured foveolate?, without punctures; pronotal shoulder, lower margin of propodeum and basalar sclerite rounded; entire body covered with fine short (less than 0.01 mm) hairs. Head surface lacking erect hairs; dorsum of pronotum, mesonotum, propodeum, petiole,
postpetiole and remainder of gastral segments covered with scattered moderately long (0.15 - 0.25 mm) erect hairs. Hairs on petiole, postpetiole, gastral segments denser, longer (0.20 - 0.25 mm) than that on propodeum, mesonotum, pronotum (0.15 mm); last gastral segment covered with longer (0.30 - 0.32 mm), denser erect hairs; head, pronotum, mesonotum, propodeum, petiole, postpetiole dark brown; clypeus, mandibles, legs, antennae brown or light brown.

**Male Measurements: (n=1)**

- HL 0.96, HW 0.60, ML 0.22, EW 0.35, EL 0.60, SL 0.20, FL 4.35, WL 2.15, WPL 2.75, PL 0.65, PW 0.46, PH 0.70, CI 62.5, OI 100, MandI 22.91, SI 33.33, PetI 70.76

**Male Description:**

Total length 6.45 mm; head excluding mandibles nearly suborbiculate; eyes large, cover most of sides of head, distance between eyes 0.65 mm; medial ocellus width 0.19 mm; scape shorter (0.20 mm) and thicker than first funicular segment, two times longer (0.10 mm); maxillary palps with 5 segments, labial palps with 4 segments; pronotum rounded anteriorly, straight lower lateral margin; notauli present on dorsum of scutum, notauli meet at end of scutum (dorsal view); transcutal suture developed, separate between scutum and scutellum; scutellum subtriangular and elevated in lateral view; metanotum narrowed, slightly raised between dorsopropodeum and scutellum; metanepisternum well developed and separated from lateropropodeum by propodeal suture, and from dorsal anepisternum by mesometapleural suture; poorly developed sulcus separating metapleuron and ventral katepisternum; basalar sclerite rounded; dorsopropodeum gradually sloping down posteriorly to reach the insertion of petiole; posteropropodeum slightly concave with slightly sharp posterior lateral edges; petiole small with width less than propodeum width (seen from above) and height near height of propodeum and postpetiole, with bluntly rounded apex, lacking teeth on ventral process; postpetiole rounded anteriorly; head, pronotum, scutum, scutellum, propodeum, petiole roughly sculptured and postpetiole with remainder of gastral segments smooth and shiny; fine short (less than 0.02 mm) dense hairs cover entire body; entire surface lacking erect hairs except on margins of posteropropodeum (0.15 mm) and very few erect hairs scattered on dorsum of petiole, postpetiole (0.15 mm); 4th to 7th gastral segments covered with very few, moderately long erect hairs (0.15 - 0.20 mm) denser on last two segments than the other segments; color mostly pale yellow.
Comparison:

Comparison of worker:

Bothroponera ryderae belongs to the group of species that have a nearly vertical posteropropodeum, including B. picardi, B. silvestrii, B. soror, B. ancilla, and B. pilosuperficia. The B. ryderae worker is similar to B. silvestrii in that they both lack the erect hairs on the head (except for a few on the posterior margin). It is easy to separate B. silvestrii from B. ryderae or even from the other species of the B. sulcata complex by considering the body length. The total length of the B. ryderae is 6.55 - 7.20 mm, which is larger than that of B. silvestrii and B. kenyensis. The total length of B. silvestrii is 5.25 - 6.15 mm, which is the smallest length in the sulcata complex. The only species that is close in total length to B. silvestrii is B. kenyensis that measures (5.65 - 7.05 mm); however, it is easy to exclude B. kenyensis because of the form of the posteropropodeum and propodeum. In B. ryderae and B. silvestrii, the posteropropodeum is semi-vertical and sloping strongly from the posterior edge of the dorsopropodeum to the insertion point of the petiole between the propodeal lobes. The posteropropodeum is slightly concave with granulated curved lateral edges similar to those of B. picardi, B. soror, B. ancilla and B. pilosuperficia. In contrast, the posteropropodeum in B. kenyensis slopes gradually posteriorly and forms an obtuse angle with the dorsopropodeum. The posteropropodeum is flat with weak evidence of a depressed surface and the edges are almost straight forming a sharp edge with the lateropropodeum, resembling species such as B. crassa, B. kruegeri, B. crassior and B. notaula.

The eye length is another significant variable that can used to help separate B. ryderae from B. silvestrii. Bothroponera ryderae has a larger eye (EW 0.20 - 0.25, EL 0.25 - 0.30) than does B. silvestrii (EW 0.10 - 0.20, EL 0.15 - 0.25). The other species that is similar to B. silvestrii in eye length is B. kenyensis (EW 0.10 - 0.25, EL 0.20 - 0.25), but as I mentioned, this species can be easily identified and separated from the B. ryderae due to the difference of the posteropropodeum.

The head lacks erect hairs in B. ryderae, except for a few erect hairs on the posterior margin of the head, but the mesosoma and gaster are covered with scattered erect hairs of moderate length.

Comparison of male:

The male of B. ryderae can be compared with the other known males of B. crassa, B. crassior, B. kenyensis, B. notaula, B. soror and B. kruegeri in the B. sulcata species complex. Two characters are very important in recognizing males in this complex, the ocelli width and the presence or absence of the notauli. The maximum diameter of the median ocellus is small in B. ryderae (0.16 mm) similar to that in
males of *B. crassior* (0.17 mm), *B. soror* (0.10 – 0.15 mm) and *B. kenyensis* (0.12 – 0.13 mm). In contrast, the maximum diameter of the median ocellus is large in males of *B. kruegeri* (0.35), *B. notaula* and *B. crassa* (0.20 – 0.25 mm) in both species. The notauli are present on dorsum of the scutum of *B. ryderae* similar to that of *B. soror, B. notaula* and *B. kenyensis*. The notauli are not present on dorsum of the scutum of *B. crassa* and *B. crassior*. The notauli in *B. kruegeri* are not distinctive, but *B. kruegeri* can be recognized by the large size (10.25 mm) among the other *B. sulcata* species complex males. The total length of *B. ryderae* male is 6.45 mm, which is smaller than that of both *B. kruegeri* (10.25 mm) and *B. soror* (6.45 - 7.45 mm), but it is larger than that of *B. kenyensis* (4.70 - 5.10 mm). *Bothroponera crassa* has a total length of 6 - 8.80 mm and *B. notaula* has a total length of 5.60 - 7.90 mm, which overlap in total length with *B. ryderae*, but they can be easily excluded since they both have similar posteropropodea that is different from that of *B. ryderae*. The posteropropodeum in *B. notaula* and *B. ryderae* seem to form an obtuse angle with the dorsopropodeum, in contrast, the posteropropodeum in *B. crassa* seems to form one part that is slightly curved and extends from dorsopropodeum to the insertion point of the petiole. The total length of the *B. crassior* male is not available (without gaster) to compare with *B. ryderae*, but the *B. crassior* male can be recognized by having a slightly larger eye (0.40 width, 0.70 length) than that of *B. ryderae* (0.35 width, 0.60 length). The notauli are present in *B. ryderae*, but they are absence in *B. crassior* as mentioned above.

**Etymology:**

This species is named in honor of Dr. Suzanne Ryder, curator of the Hymenoptera collection at the Natural History Museum, London, in recognition of her outstanding support to provide specimens for this revision.

**Material examined:** 12 workers, 1 male

**Type material:**

**GUINEA:** Nimba (Guinee), TG-1300 m, Lamotte 1942, *B. ryderae* (6w, holotype, 5 paratypes, MNHN), Mt To, Forêt [Fôret, 8°30'0" N; 9°0'0" W], ravine, B2-41, II 1942, Lamotte (1w, paratype, MNHN), Mont to Forêt Claire [mount to woodland], (1600 m), Camp 1, II. VI. 1942, M. Lamotte, *Bothroponera lamottei* F. Bernard, 1950, Museum Paris EY6715 (1w, paratype, MNHN), Lamotte et
Roy, VII XII 51, 39 Pa (1 w, paratype, MNHN), M. Lamotte coll., 28-x-1956, prairie eu mout a uf vers la pierre Richard, # 130pa, B. ryderae (1w MNHN).

Non-type material:

NIGERIA: Niger State, 13 km North Mokwa, Mokwa, 9°17'0" N; 5°3'0" E, C. Longhurst coll., 3/4/A, Pachycondyla sp. (2w & 1m MEWC).

Distribution:

Guinea and Nigeria.

Biology and habitat:

The Guinea Montane Forests is the number 2 ecoregion among the 119 ecoregions that are known in Africa (Burgess et al. 2004; www.worldwildlife.org). This ecoregion encompasses several mountains and plateaus across 4 countries, Guinea, Ivory Coast, Liberia and Sierra Leon that are located on the western side of the African continent. Bothroponera ryderae, was collected mainly from Nimba in the Guinean mountains. The region includes medium biodiversity in that it encompasses nearly 35 plant species and high diversity of fauna (Burgess et al. 2004; www.worldwildlife.org). The majority of these species are recognized to be endemic to Mount Nimba (Burgess et al. 2004; www.worldwildlife.org). Bothroponera ryderae along with other species of Bothroponera such as B. talpa, B. silvestrii are recorded in this region. The male and workers were collected also from Mokwa in Nigeria. The area of Mokwa is likely to be a preferred habitat for ants in that it is covered with the primary savanna woodland that associated with Burkea africana, Detarium microcarpum and Afzelia Africana, Parinari polyandra, Uapaca togoensis, Grewia mollis, Daniellia oliveri trees (Collins, 1977) along with species of ants from subfamily Ponerinae such as Megaponera joetens and termites (Longhurst et al. 1978). There is strong relationship between ant species and termites in terms of predator-prey relations. Bothroponera ryderae lives in forest land areas and behaves similar to the other Bothroponera species in the afrotropics.
Map 10.2: The distribution of *B. ryderae*.
Bothroponera pilosuperficia, sp. nov.
Figures 37.2-40.2; Map 11.2

Diagnosis:
Worker:

The worker of Bothroponera pilosuperficia is similar to other B. sulcata species complex species with some exceptions. The mandibles are narrowed and have 7 teeth that alternate in size with space between teeth numbers one and two (counting from the basal border), wide enough to hold another tooth, in some specimens, there is already a small tooth between the two teeth; the mandibles are smooth and weakly shiny. The clypeus has a single medial raised longitudinal area that forms shiny, partially striated longitudinal raised medial strip, but does not form a groove. The compound eyes are relatively small.

The entire surface of the head, mesosoma and gaster is covered with fine hairs (length less than 0.02 mm). The head is covered with relatively short to moderately long (0.05 - 0.20 mm) abundant erect silver hairs of different lengths. The pronotum and mesopropodeum are covered with moderately longer (0.10 up to 0.22 mm) erect silver hairs, more abundant than those on the head. The posterior half of the pronotum is covered with longer (up to 0.26 mm) erect hairs . The petiole, postpetiole and the 4th to 7th abdominal segments are covered with relatively long (0.23 - 0.36 mm) abundant erect silver hairs.

The type specimen has a reddish brown head and a dark brown mesosoma, petiole and gaster. The appendages are light brown to medium brown.
Figures. 37.2-40.2

Fig. 37.2: The lateral view of the holotype worker of *B. pilosuperficia*.

Fig. 38.2: The head of the holotype worker of *B. pilosuperficia*.

Fig. 39.2: The head of a paratype female of *B. pilosuperficia*.

Fig. 40.2: The lateral view of a paratype female of *B. pilosuperficia*. 
Female:

The female of B. pilosuperficia is similar to the worker of this species, but with some significant differences in the measurements. The total length of the B. pilosuperficia female is 8.60 - 10.30 mm. The malar space length is 0.15 - 0.20 mm while the area from upper edge of eye to the upper margin of posterior lobe is 0.70 - 0.85 mm. The mandibles are smooth, pale, narrowed and with 7 teeth that alternate in size with wide space between the first and second teeth. This space is with or without a small tooth.

The lower lateral margin of the pronotum is straight (seen from side view), the anteroinferior pronotal process is rounded while the inferior pronotal process forms a sharp pointed tooth. The dorsopropodeum is narrowed, measured 0.35 mm long from posterior edge to the notopropodeal suture, 0.90 - 1.00 mm wide (seen from above). The dorsopropodeum is strongly curved posteriorly to join the posteropropodeum that is semi vertical (lateral view). The posteropropodeum is slightly concave, structured to fit the anterior face of the petiole, and the margins are curved and granulated. The mesopleural-metapleural suture is well defined. The postpetiole and the 4th to 7th abdominal segments are slightly larger (3.25 - 3.85 mm) than the mesosoma (2.50 - 2.80 mm).

The entire surface including the head, mesosoma and gaster is covered with fine hairs that measure up to 0.05 mm in length. The head is covered with moderately short (0.05 - 0.20 mm) erect hairs. The dorsum of the pronotum, scutum, scutellum, propodeum, petiole and postpetiole are covered with moderately long (0.15 - 0.36 mm) erect hairs.

The color of the head is brown dark, the pronotum, scutum, scutellum, metanotum, mesopleurun, propodeum and petiole are black, The postpetiole and the rest of the gastral segments are reddish brown to dark brown. The legs and scapes are light brown. The mandibles are pale yellowish to light brown.

The male is unknown.

Description:

Worker Measurements: (n=8)

HL 1.45 - 1.65, HW 1.30 - 1.48, ML 0.95 - 1.05, EW 0.15 - 0.22, EL 0.25 - 0.30, SL 1.20 - 1.40, FL 1.95 - 2.25, WL 2.20 - 2.50, WPL 2.90 - 3.25, PL 0.60 - 0.68, PW 0.85 - 0.90, PH 0.95 - 1.25, CI 89.65 - 89.69, OI 19.23 - 20.27, MandI 63.63 - 65.51, SI 92.30 - 94.59, PetI 132.35 - 141.66
Worker Description:

Total length 7.50 - 9.00 mm; head subquadrate; mandibles with 7 teeth which alternate in size; clypeus convex, anterior medial margin with single medial raised area that forms narrowed smooth, shiny, slight depressed strip; compound eyes relatively small; malar space length 0.17 - 0.22 mm, area from upper edge of eye to upper margin of posterior lobe 0.80 - 0.90 mm; head, pronotum, mesonotum, propodeum, petiole and postpetiole roughly sculptured with few scattered punctures, dense, slightly large on petiole, tiny, dense on head; second gastral segment (fourth abdominal segment) shiny, slightly rough (less sculptured lacking punctures); clypeus, legs, antennae moderately shiny; lower margin of pronotal shoulder straight with rounded anteroinferior pronotal process, pointed inferior pronotal process; dorsopropodeum slightly curved posteriorly, posteropropodeum strongly sloped to insertion of petiole to form slightly concave posteropropodeum; posteropropodeal margins form lateral granulated edges; petiole rounded dorso-anteriorly with medial rounded apex, posterior and anterior faces vertical; head covered with mostly short (0.05 - 0.20 mm) hairs, dorsum of pronotum, mesonotum, propodeum, petiole, postpetiole, 4th to 7th abdominal segments covered with abundant, moderately long (0.10 - 0.36 mm) silver erect hairs; surface of head reddish brown, mesosoma dark brown; mandibles pale brown, legs, antennae brown to light brown.

Female Measurements: (n=2)

HL 1.50 - 1.75, HW 1.35 - 1.55, ML 0.95, EW 0.25 - 0.30, EL 0.40, SL 1.15 - 1.30, FL 2.10 - 2.30, WL 2.60 - 2.90, WPL 3.35 - 3.70, PL 0.65 - 0.70, PW 0.85 - 0.98, PH 1.05 - 1.30, CI 88.57 - 90, OI 25.80 - 29.62, MandI 54.28 - 63.33, SI 83.87 - 85.18, PetI 130.76 – 140.00

Female Description:

Total length 8.60 - 10.30 mm; subquadrate head; scape extends slightly past posterior lateral corner of head; mandibles with 7 teeth alternating in size; clypeus convex, anterior medial margin of clypeus with single medial raised area that forms narrowed smooth, shiny, slightly depressed strip; compound eyes relatively large; malar space length 0.15 - 0.20 mm, area from upper edge of eye to upper margin of posterior lobe 0.70 - 0.85 mm; lower margin of lateropronotum straight (side view), anteroinferior pronotal process rounded, inferior pronotal process forming sharp tooth; head roughly sculptured with weak evidence of punctures; pronotum, mesonotum, propodeum, petiole and postpetiole
roughly sculptured with few scattered punctures on dorsum; metanepisternum poorly developed, metakatepisternum fused to form one file? of lateropropodeum; petiole is rough, covered with slightly large punctures; postpetiole smooth with weak evidence of few scattered shallow punctures; second gastral segment (fourth abdominal segment) to fifth gastral segment (seventh abdominal segment) smooth, shiny (lacking punctures); clypeus, legs, antennae moderately shiny; dorsopropodeum strongly curved posteriorly, to form slightly concave posteropropodeum; posteropropodeal lateral margins granulated; petiole rounded dorso-anteriorly with medial rounded apex, posterior and anterior faces vertical; head covered with mostly short (0.05 - 0.20 mm) hairs, dorsum of pronotum, mesonotum, propodeum, petiole, postpetiole, 4th to 7th abdominal segments covered with abundant, moderately long (0.15 - 0.36 mm) silver erect hairs; short (from 0.10 up to 0.20 mm) erect and suberect hairs scattered on scapes and legs; surface of head reddish brown, mesosoma dark brown to black; mandibles pale brown to yellowish, legs, antennae brown to light brown.

Comparison:
Comparison of worker:

The species most similar to *B. pilosuperficia* in regards to the structure of the dorsopropodeum and posteropropodeum are *B. ancilla, B. soror, B. silvestrii, B. picardi* and *B. ryderae*. Those species have a semi-vertical posteropropodeum with slightly concave surface and granulated curved lateral margins. On the other hand, *B. crassa, B. crassior, B. kenyensis, B. notaula* have a posteropropodeum that slopes gradually posteriorly to reach the insertion point of the petiole with the mesosoma, between the propodeal lobes.

The worker of the *B. pilosuperficia* is characterized by an unusual distribution of hair of various lengths (0.05 to 0.36 mm) on the head, pronotum, mesopropodeum, mesopleuron, petiole, postpetiole and 4th to 7th abdominal segments. The head of *B. soror* lacks the erect hairs except for a few on the dorsal surface or on the frons as in *B. ancilla*. The hairs on dorsum of the pronotum, mesopropodeum, mesopleuron, petiole, postpetiole and 4th to 7th abdominal segments of *B. soror* and *B. ancilla* are less abundant than those of *B. pilosuperficia*. The eyes of *B. soror* (0.20 - 0.40 length, 0.30 - 0.50 width) are larger than that of *B. pilosuperficia* (EW 0.15 - 0.22, EL 0.25 - 0.30), but they are almost identical to those of *B. ancilla* (0.18 - 0.22 length, 0.25 - 0.30 width) and *B. ryderae* (0.20 - 0.25 length, 0.25 - 0.30 width). It is easily to exclude *B. silvestrii* because it has a small total length (5.25 - 6.15 mm) and small eye diameters (0.10 – 0.20 mm width, 0.15 – 0.25 mm length). *Bothroponera picardi* can be excluded
because the entire surface lacks erect hairs except for a few erect hairs on the pygidium and hypopygium.

The anterior medial raised area of the clypeus of *B. pilosuperficia* is narrowed, extends longitudinally and is shiny and raised without a groove. There is a slight groove or depression on the raised anterior medial area in both *B. ancilla* and *B. ryderae*, but forms a completely or partially striated depression in *B. soror*. In *B. picardi*, the anterior medial area of clypeus forms a raised shiny longitudinal strip that is flat or slightly raised.

**Comparison of female:**

The female of *Bothroponera pilosuperficia* can be only compared with the female of *B. soror* since the female castes of the remaining *B. sulcata* complex species are unknown. Generally, the females of *B. soror* and *B. pilosuperficia* have the same characters, but it can be separated based on some variations between them. The head of *B. pilosuperficia* is covered with dense erect hairs that range from 0.05 to 0.20 mm in length, but the head of *B. soror* is bare (except few erect hairs on posterior margin of head that measure less than 0.15 mm). The pronotum, scutum, scutullum, metanotum, propodeum, petiole, postpetiole and 4th to 7th abdominal segments are covered with moderately long hairs that measure 0.15 - 0.36 mm in *B. pilosuperficia* and (0.15 - 0.37 mm in *B. soror*. The anterior medial area of the clypeus is raised and forms a longitudinal, narrowed, slightly shiny weak groove in *B. pilosuperficia* without striae, while the anterior medial area of clypeus of *B. soror* forms raised area with slight depression that is covered partially or completely with fine striae.

**Etymology:**

The new species name “*pilosuperficia*” is derived from Latin. It is combination of two words, pilosus, which means hairy and superficie, which means surface. The specific epithet refers to the erect silver hairs that cover the entire surface including the head of this species.

**Material examined:** 8 workers, 2 females

**Type material:**
GABON: Makokou, 0°34'0" N; 12°52'0" E, CNRS, vi-vii-1974, W. H. Gotwald, (1 w, holotype, CWEM), Same locality: C. N. R. S., 0°11'0" S; 12°12'0" E, vi-1974, W. Gotwald (2 f, paratypes, MCZC), Same locality: 0°34'0" N; 12°52'0" E, x-1972, I. Lieberburg collector, rain forest, # 16, # 15, 00525692, 00525693 (3w, paratypes, MCZC), same locality, C. N. R. S., 0°11'0" S; 12°12'0" E, vi-1974 W. H. Gotwald coll., 00525690 (2 w, paratypes, CWEM).

Non-type material:

CAMEROUN: [Cameroon] Nkoemvon, 2°48'0" N; Long: 11°8'0" E, 1980 P.I, j. Jackson (3w MCZC).

Distribution:

Gabon and Cameroon.

Biology and habitat:

Bothroponera pilosuperficia was collected from rainforests in Gabon and Cameroon. This species appears to be sympatric with B. ancilla and B. soror, which are distributed in the same geographical area of Africa, however, B. soror is widespread in tropical rainforests of Africa from the western and central Africa to the eastern countries of Africa. The type locality of B. pilosuperficia and the studied specimens are restricted in western part of Africa while B. ancilla is widespread in the east and west of Africa. These three species are the very similar to each other in the B. sulcata species complex.
Map 11.2: The distribution of *B. pilosuperficia*. 

Map of Africa showing the distribution of *B. pilosuperficia*. The area shaded black indicates the region where the species is found.
Plates of workers, males and females in the *B. sulcata* species complex

Plate 1.2: *Bothroponera ancilla*, syntype worker.
Plate 2.2: *Bothroponera crassior*, lectotype worker.
Plate 3.2: *Bothroponera crassior*, paralectotype male.
Plate 4.2: *Bothroponera kenyensis*, holotype worker.
Plate 5.2: *Bothroponera kenyensis*, male, from Kenya.
Plate 6.2: *Bothroponera kruegeri*, lectotype worker.
Plate 7.2: Bothroponera kruegeri, male.
Plate 8.2: *Bothroponera picardi*, lectotype worker (middle specimen)
Plate 9.2: Bothroponera soror, syntype worker (from Ant website).
Plate 10.2: Bothroponera soror, paralectotype female.
Plate 11.2: *Bothroponera soror*, male.
References


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www.conservation.org, accessed 10/10/2014
Chapter 3: Revision of the African ants of the *Bothroponera talpa* species complex (Hymenoptera: Formicidae: Ponerinae)

Abstract

The members of the *Bothroponera talpa* species complex are distributed in Afrotropical areas along with the *B. pumicosa* and *B. sulcata* species complexes. The *B. talpa* species complex includes 8 valid species and 5 synonyms: *Bothroponera cribrata*, *B. fugax*, *B. pachyderma* (= *B. pachyderma attenata*, = *B. pachyderma postsquamosa*, = *B. funerea* syn. nov.), *B. rubescens*, *B. sanguinea*, *B. sculpturata* stat. nov. (= *B. mlanjiensis* syn. nov.), *B. talpa* (= *Psalidomyrmex clavicornis* syn. nov.), and *B. zumpti*. These species share similar characters such as the shape of the clypeus, the length of the antennal scape, mandibular shape and sculpture. The anterior medial margin of the clypeus is convex or straight with a slightly concave anterior border. The scape does not reach the posterior lateral corner of the head. The mandibles are triangular with striae and 6 - 7 teeth. There is no metatibial gland on the ventral anterior surface of the posterior tibia. Diagnoses, descriptions, comparisons, illustrations, distributions and other ecological and biological information are provided. A taxonomical key is provided for the worker caste.
Introduction

The importance of the Afrotropical ant studies.

The African continent has some of the most productive ecosystems on earth in terms of biodiversity, richness, evenness and species abundances (Fjeldsa et al., 1997; Burgess, 2000; Chapman et al., 2001; Thuiller et al., 2006; Burgess et al., 2007). African habitats include tropical and subtropical rain forests, savanna and grasslands. All of these African habitats are constituted by immense biodiversity in groups such as ants, vertebrates, plants and other Afrotropical organisms. Ants are dominant over the other Afrotropical organisms where they represent about 50% of the animal biomass and 90% of the individuals (Dejean et al., 2007).

However, a large number of Afrotropical organisms face extinction or are neglected rather than being studied. The probable high rate of extinction in ants is due to small body size and other factors impact all invertebrate species (Chapman and Bourke, 2001). Due to habitat loss and fragmentation, researchers expect incremental loss in ant species (Crist, 2009). According to the International Union for the Conservation of Nature and Natural Resources (Chapman and Bourke, 2001) ants are among the threatened species that were studied by Hilton-Taylor (2000).

Previous studies of Bothroponera:

The Afrotropical ants of the genus Bothroponera are a highly diverse group of Formicidae that belongs to the subfamily Ponerinae, tribe Ponerini. Little information is known about their behavior, biodiversity, richness, biology, ecology, biosystematics and evolution. The most common species in the Afrotropics are B. talpa, B. crassa, B. soror, and B. pachyderma among 43 taxa of Bothroponera that are distributed in the Afrotropics and Southern Asia. For example, in the Kakamega District of the Western Province of Kenya, Garcia et al. (2009) collected samples of Bothroponera including B. talpa, B. pachyderma, B. crassa and B. soror when they presented a preliminary species checklist of the ants in Kenya. In the primary and secondary forests of Ghana, Belshaw and Bolton (1994) sampled B. fugax, B. pachyderma and B. soror among other species of ants in their survey of the leaf litter ant fauna in West Africa. In the Mbalmayo Forest Reserve, Cameroon, Watt et al. (2002) recorded B. fugax, B. pachyderma and B. soror from the leaf litter in a study of the diversity and abundance of ants in relation to forest disturbance and plantation establishment in southern Cameroon. In the rainforests and savanna of Ivory Coast, Levieux and Diomande (1985) collected B. pachyderma and B. silvestrii among several
species of different genera during their study of the evolution of the ant populations that live in the soil. In the Province de Ogooué-Maritime, southwestern Gabon, Fisher (2004) surveyed *B. pachyderma* among 310 species of ants during his study of diversity and richness pattern along an elevational gradient on Monts Doudou. In 10 different forests of southern Cameroon, Dejean and Durand (1996) studied ant species distribution that inhabited *Cubitermes* termitaries at the colony level and collected 15 species of *Pachycondyla*, some of which have recently been transferred to other genera (Schmit and Shattuck 2014), as well as unidentified or new species. Among their collection there were five taxa of *Bothroponera* including *B. talpa*, *B. pachyderma*, *B. fugax*, *B. silvestrii* and *B. soror*. In the Marakele National Park, Schoeman and Foord (2012) found *Bothroponera granosa* during their study of ant species richness in South Africa. Collinet *et al.* (1984) collected *B. pachyderma*, *B. silvestrii*, and *B. soror* among the ant species in the dense humid evergreen forests of the southern Ivory Coast. These are a few of Afrotropical *Bothroponera* compared to the rest of the African species of *Bothroponera* (29 species), and the question now revolves around the other species.

Most *Bothroponera* species are known as generalist scavengers and predators of arthropods. This activity is usually accompanied with the injection of venom using their sting (Wheeler, 1900; Orivel and Dejean, 2001; Wild, 2002; Dejean and Lachaud, 2011). The behavior, ecology and food habits of some species of African *Bothroponera* are known, such as *B. pachyderma* studied by Dejean and Lachaud (2011) and *B. soror* by Dejean (1991). Dejean and Lachaud (2011) studied the hunting behavior of *B. pachyderma*, which is recognized as a “semi-specialized predator” (Dejean *et al.*, 1999b); specializing in eating various species of termites (Bolton, 1973; Mill, 1984; Leal and Oliveira, 1995). Studies recorded that the major termite species are *Microtermes sp.* and *Macrotermes bellicosus*) and some species are also specialized for eating myriapods (Wheeler, 1900; Dejean *et al.*, 1993; 1999b; Dejean and Lachaud, 2011). This specialization for myriapods is found in related species of *Pachycondyla* and related genera (Mill, 1984; Leal and Oliveira, 1995). The prey species include three orders of centipedes and millipedes (Lithobiomorpha, Geophilomorpha, and Scolopendromorpha) that belong to the class Chilopoda of the Subphylum Myriapoda. The centipedes are nocturnal predators, but millipedes are herbivorous. *Bothroponera pachyderma* use a different behavioral technique to hunt different prey species depending on the prey size. They deal with prey up to 30 mm in length without stinging, but they sting larger species such as Geophilomorphs and Scolopendromorphs, which have a total length that reaches 50 mm or more. They sting once or repeatedly depending on the prey size (Dejean and Lachaud, 2011).
Variability of taxonomy and biology of *Bothroponera*:

*Bothroponera* is a genus of Afrotropical ants that has been considered as a subgenus of *Pachycondyla*. The first description of *Pachycondyla* was in 1858 when Frederick Smith described ten species of *Pachycondyla* worldwide. Since then, myrmecologists added species to the genus and even they described new subgenera. They added 18 subgenera during the years from 1858 to 1943 including *Megaponera* Mayr, 1862, *Bothroponera* Mayr, 1862, *Paltothyreus* Mayr, 1862, *Ectomomyrmex* Mayr, 1867, *Ophthalmopone* Forel, 1890, *Euponera* Forel, 1891, *Brachyponera* Emery, 1900b, *Pseudoponera* Emery, 1900b, *Mesoponera* Emery, 1900a, *Eumecopone* Forel, 1901, *Hagensia* Forel, 1901, *Neoponera* Emery, 1901, *Trachymesopus* Emery, 1911b, *Xiphopelta* Forel, 1913, *Syntermitopone* Wheeler, W. M. 1936, *Termitopone* Wheeler, W. M. 1936, *Wadeura* Weber, 1939 and *Pseudoneoponera* Donisthorpe, 1943a, with collection of more than 200 described species (Bolton et al., 2006 and Bolton, 1995). The taxonomic history of the genus *Pachycondyla* reflects the tremendous diversity of this group, which has been divided into several genera based partially on the subgenera (Joma and Mackay, 2013; Schmidt and Shattuck, 2014). This is supported by non monophyletic evidence in *Pachycondyla* and the paraphyletic assemblage of the large number of genera under this group (Keller, 2011; Mariano et al., 2012; Schmidt, 2013; Schmidt and Shattuck, 2014).

These genera are diverse in morphology and reproduction, which supports separate taxonomic status. The nest may include members without a morphological queen caste or with a typical queen-worker dimorphism together with the typical workers in the colony (Heinze and Hölldobler, 1995). There are species that build queenless colonies where workers have a dominance hierarchy to play the reproductive role in the colony (Oliveira and Hölldobler, 1990; Ito, 1993; Heinze et al., 1996; Hölldobler and Wilson, 2009). In Asian *Bothroponera* such as *B. tridentata* (known by *Pseudoneoponera tridentata*) from Borneo, a male can mate with two or even several workers; however, only one worker will lay eggs (Ito, 1999).

Queens may have dependent nest founding, when they build their colony with cooperation between queen and workers, or independent founding when a queen establishes the colony by herself. The colony can be started with a single queen (haplometrosis) or with more than one queen (pleometrosis) (Trunzer et al., 1998). They are recognized by the overt aggressive behavior, which is normally found in several species of Ponerinae ants. It is possible that this is an ancestral trait, which might be common in the phylogenetically primitive Ponerinae (Oliveira and Hölldobler, 1990).

The habitat is diverse depending on the species, ranging from rainforest, secondary forests, primary forests, lowlands, to savanna and grassland (*Bothroponera* label information). They build their
nests in the soil, leaf litter, dead branches, plant cavities, under stones and most of the species of *Pachycondyla* and related genera in the New World tropics build their nests in rotten wood or twigs (Wheeler, 1942; Leal and Oliveira, 1995; Trunzer *et al*., 1998; Lucas *et al*., 2002; Wild, 2002; Mackay and Mackay, 2006; Mackay and Mackay, 2010; Fernandes *et al*., 2014). The nests of *Bothroponera* contain of number of underground chambers that open to the surface with a circular aperture, surrounded by pieces of piled debris from the diet and nest excavations (Lévieux and Diomande, 1978; Peeters and Crewe, 1987).

**Genus *Bothroponera***:

In 1862, Mayr first characterized *Bothroponera* as a genus when he described *B. puminosa* [type species of the genus] and compared it with *B. cavernosa* and *B. granosa* all from South Africa. The worker of the genus is characterized by having a subquadrate head excluding the mandibles. The mandibles are sub-triangular, shorter than the head length. The number of teeth ranges from 6 to 9. The clypeus is convex, and the anterior area is raised medially. The cheeks lack a carina, and there are fine striae on the cheeks, frons and sides of the head. The antenna has 12 segments, including the antennal scape and 11 segments of the antennal funiculus, which includes a club (last 3 segments). The club segments are thicker and larger than the rest of the funicular segments. The compound eyes are relatively large, situated lateral-anteriorly on the head. The posterior margin of the head (upper edge) is concave medially, rounded at the corners. The mesosoma is slightly curved from the pronotum to the propodeum. The pronotal shoulder is rounded without spines, sharp edges or a carina. The posteropropodeum is slightly concave with angular lateral margins of some species. The mesopleuron is not divided, and flattened in lateral view. The propodeum is fused with mesonotum and metanotum, with no evidence of the notopropodeal suture. The petiole represents the second abdominal segment, the postpetiole is the third abdominal segment (first gastral segment) and the rest of abdominal segments 4th to 7th are the 2nd to 5th gastral segments.

**Status of *Bothroponera***:

Although some specialists have recognized *Bothroponera* as a genus for some time, the taxonomic status of this group of ants has remained unresolved. Myrmecologists such as Emery (1895) and Forel (1900) defined *Bothroponera* as a subgenus of *Ponera* while others such as Emery (1901, 1911b), Wheeler W. (1910), Arnold (1915), Forel (1917), and Donisthorpe (1943b) considered

**Distribution of Bothroponera:**

The distribution of Bothroponera is restricted to the tropics of two biogeographical regions of the Old World including the Afrotropical and the Oriental Regions, excluding North Africa, North Asia and the Australian Region. Meanwhile, Pachycondyla is restricted to the New World, including Mesoamerica and South America excluding most of North America. The global distribution of Bothroponera excludes the Nearctic and Palaeartic Regions where the climate is suboptimal for either Bothroponera or Pachycondyla and related genera. The ancestor of Bothroponera is likely to have evolved after the separation of the Neotropical Region from Afrotropical Region (more than 100 million years ago).

Previous studies such as Bolton (1995), Bolton et al. (2006) and Nikbakhtzadeh et al. (2009) recorded around 200 described species of Pachycondyla worldwide, mostly from the tropical and subtropical areas. Mackay and Mackay (2010) raised the number to around 300 species that are distributed in the New and Old World. However, considering the modern assessment of this group, these species are now classified into several genera including Megaponera, Paltothyreus, Ectomomyrmex, Ophthalmopone, Euponera, Brachyponera, Pseudoponera, Mesoponera, Hagensia, Neoponera, Pseudoneoponera and the new genera Austroponera, Fisheronpe, Rasopone, Parvaponera, Iroponera, Mayaponera and Buniapone (Schmidt and Shattuck 2014). The actual number of world Bothroponera is as follows: 29 species in the Afrotropical region classified in three complexes including the B. punicosa species complex, B. sulcata species complex and B. talpa species complex. Eight species in Madagascar (B. cambouei, B. comorensis, B. masoala, B. perroti, B. planicornis, B. tavaratra, B. wasmannii and B. vazimba) that have been recently revised as members of the genus Pachycondyla (Rakotonirina and...
Fisher, 2013). Four taxa occur in India: (B. henryi, B. sulcata fossulata, B. sulcata sulcatotesserinoda and B. tesseronoda), 2 species in Philippines (B. glabripes and B. williamsi) and one species in Myanmar (B. rubiginosa). These numbers of Bothroponera species will be much greater in the future as more revisionary studies, survey projects and investigations continues for this genus.

**The goal:**

In this project, I will focus on the Bothroponera talpa species complex from the Afrotropical region, excluding Madagascar, to clarify the biosystematics of this conspicuous and ecologically important group.
Materials and Methods (refer to chapter1)

Family Formicidae
Genus Bothroponera Mayr, 1862

Bothroponera talpa species complex

Worker:

Head shape excluding mandibles subquadrate; posterior border of head concave; mandibles triangular, shorter than head length, with 6 or 7 teeth; anterior border of clypeus nearly straight to slightly concave or convex, medial area of clypeus covered by frontal lobes with or without sharp carina; frontal lobes divided by frontal furrow; scape fails to reach or barely reaches posterior lateral corner of head; compound eyes relatively small; pronotal shoulder rounded, lower margin of pronotum straight with sharp angles anteriorly and posteriorly; promesonotal suture well developed, notopropodeal suture absent, mesonotum and propodeum completely fused; basalar sclerite oval or round; mesopleural suture developed; propodeum square or round posteriorly (in profile), propodeal spiracle elongate or slit-shaped; metatibial gland absent; petiole well developed with petiolar spiracles and developed sternopetiolar process; sternopostpetiolar process poorly developed. In general, head rough with dense punctures; frontal lobes covered with fine hairs and punctures, bottom edge and sides of frontal lobes shiny with or without punctures; dorsum of pronotum, mesonotum and propodeum mostly rough, but sides punctate; mesopleuron, petiole and postpetiole mostly punctate; metapleural area and lateropropodeum covered with fine striae; mandibles covered with fine striae. Entire body covered with short (0.12 mm) to moderately long (0.42 mm) erect golden hairs, denser on dorsum than on sides; hair length on head mostly equal to that on mesosoma. Color mostly black, reddish, brown, or yellow.

Female:

Head shape excluding mandibles square; posterior border concave; mandibles triangular, shorter than head length, with 6 to 7 teeth; anterior border of clypeus straight to slightly concave without sharp carina in B. talpa, convex with carina in B. rubescens, medial area covered by frontal lobes; frontal lobes divided by frontal furrow; scape slightly curved, not reaching posterior lateral corner of head; compound eyes relatively small; pronotal shoulder square, but without carina; mesopleural suture present; propodeum square posteriorly, propodeal spiracle elongate; metatibial gland absent; petiole with
petiolar spurs and well developed sternopetiolar process; sternopostpetiolar process well developed. In general, mandibles covered with fine striae, head rough with dense punctures; frontal lobes covered with fine hairs and punctures, anterior edge and sides of frontal lobes shiny with punctures; dorsum of pronotum, mesonotum and propodeum mostly rough with few punctures; mesopleuron punctate; petiole and postpetiole mostly punctate; metapleural area and lateropropodeum covered with fine striae. Entire body covered with moderately long (0.25 - 0.40 mm) erect golden hairs, but denser on dorsum than on sides. Color mostly brown or reddish brown.

**Male (based only on *B. pachyderma*):**

Head rounded, suborbiculate; eyes large, cover most of side of head; scape shorter and thicker than second segment of funiculus; pronotum narrowed (dorsal view); scutum with notauli, scutellum subtriangular (dorsal view) and elevated (lateral view), metanotum raised between scutellum and propodeum, propodeum sloping down strongly to reach insertion of petiole; petiole small, thick, lower than level of postpetiole; mesopleuron enlarged and divided by anapleural sulcus into ventral katepisternum and dorsal anepisternum, postpetiole rounded; head, pronotum, scutum, scutellum, propodeum and petiole rough and coarsely sculptured, postpetiole and gastral segments smooth and shiny; head, mesosoma and petiole black, postpetiole and gastral segments brown.

**Comparison of the group:**

**Worker:**

It is easy to separate members of the *B. talpa* species complex from those of the *B. cavernosa* species complex by considering the following characters. The anterior border of the clypeus is convex or straight or slightly concave in members of the *B. talpa* species complex. On the other hand, the anterior border of the clypeus is strongly convex and “u” or “v” shaped in members of the *B. pumicosa* species complex. The scape barely reaches the posterior lateral corner of the head in members of the *B. talpa* species complex while it reaches or sometimes slightly exceeds the border in the *B. pumicosa* species complex. The eyes are relatively small in members of the *B. talpa* species complex as compared to those of members of the *B. pumicosa* species complex. The sculpture of the species of the *B. talpa* species complex is punctate or at least less foveolate, but the sculpture of *B. pumicosa* species complex is strongly foveolate. The body size is smaller in the *B. talpa* species complex especially in *B. cribrata, B. fugax, B. rubescens* and *B. zumpti*, which are up to 9.00 mm in total length while the body size is larger
in the *B. pumicosa* species complex (the shortest total length is 9.60 mm in *B. berthoudi*). Both complexes are simple to separate from the *B. sulcata* species complex. The metatibial gland is present in *B. sulcata* species while it is absent in *B. talpa* and *B. pumicosa* species complexes.

**Female:**

The separation of the female of the *B. talpa* species complex from that of the *B. pumicosa* species complex is not possible at the present time because I do not have any females of the *B. pumicosa* species complex.

It is easy to separate females of the *B. talpa* species complex from females of the *B. sulcata* species complex, based on the presence or absence of the metatibial gland. The members of the *B. talpa* species complex lack the metatibial gland whereas members of the *B. sulcata* species complex have this gland. The metatibial gland is an elongate slightly depressed oval-shaped, pale, smooth, barren area on the posterior surface of the tibia of the hind leg near the pectinated spur.

**Male:**

The male of *B. talpa* group is known only from *B. pachyderma*. The description of the male is presented above. There is no way to compare the *B. talpa* species complex male with that of the *cavernosa* male because no males of the *B. pumicosa* species complex were found. There are pictures of a *cavernosa* male online (cavernosa male http://www.antweb.org and http://www.antwiki.org). It is not reasonable to depend on characters that might be seen from pictures online. The pictures show the general characters not the specific details such as lower anterior medial area of the clypeus, the propodeal spiracles and the propodeal lobes.
Species excluded or moved from *Bothroponera*

**Bothroponera crassa** st. *crassior* var. *andrieui* Santschi

This species was collected from Sudan and described by Santschi 1930, but no further publications or other information is available about this taxon. The taxon is mentioned as an unavailable name in catalogs and publications such as Bolton 1995, http://www.antwiki.org/wiki/Unavailable_Species_Names accessed 06/25/2014, and the types could not be located.

**Pachycondyla (Bothroponera) escherichi** Forel

This species from Ethiopia was described by Forel in 1910c as member of *Pachycondyla* (*Bothroponera*). It was considered as a species of genus *Pachycondyla* by Bolton in 1995; however, Emery 1911a combined *P. (B.) escherichi* with *Euponera* (*Mesoponera*). Based on Forel (1910) description of *B. escherichi*, this species is more likely to be one of the *Mesoponera* species. The presence of the metanotomal suture between the mesonotum and the propodeum distinguish *B. escherichi* from *Bothroponera*. Therefore, I removed this species from the genus *Bothroponera* and transferred it to the genus *Mesoponera*.

**Bothroponera gabonensis** Andre

The worker of *Bothroponera gabonensis* was collected from Gabon and described by André in 1892: 50, the queen was described by Stitz in 1910: 130. Emery, 1901: 45 combined *Bothroponera gabonensis* in *Pachycondyla* (*Bothroponera*). In 2008, Fisher and Bolton described the male and considered *Bothroponera gabonensis* a species in *Phrynoponera* coinciding with Wheeler, W. 1920: 53 and Brown, 1950  (Bolton & Fisher, 2008b, gabonensis information http://www.antweb.org accessed 05/26/2014). Bolton and Fisher recognized two additional species in the genus *Phrynoponera* (*P. pulchella* and *P. transversa*) with the previous group of known species that include *Phrynoponera bequaerti* Wheeler, W., 1922a, *Phrynoponera sveni* (Forel, 1916) and *Phrynoponera gabonensis* (André, 1892). They also established two junior synonyms of *P. gabonensis* (*P. armata* Santschi, 1919) and *P. heterodus* Wheeler, 1922a both from DRC) with the earlier synonyms including *P. gabonensis* var. *striatidens* (Santschi, 1914) from Cameroon along with *P. gabonensis* var. *robustior* (Santschi,

**Pachycondyla (Bothroponera) gabonensis var. striatidens Santschi**

The worker of this species was described by Santschi, 1914: 315 as *Pachycondyla (Bothroponera) gabonensis* var. *striatidens* from Victoria, Cameroon. Later, this species was combined with *Phrynoponera* by Wheeler, W.M. 1922b: 78; and a synonym with *Phrynoponera gabonensis* by Brown, 1950: 246. Recently, Bolton and Fisher (2008b), *gabonensis* information http://www.antweb.org accessed 05/26/2014, Brown, 1950 and Wheeler, 1920: 53 confirmed that it is a synonym of *Phrynoponera gabonensis*.

**Pachycondyla (Bothroponera) armata Santschi**


**Pachycondyla (Bothroponera) gabonensis var. robustior Santschi**


**Bothroponera nasica Santschi**

The type specimen of *Bothroponera nasica* is from Gabon, described by Santschi in 1920. This species was moved to the genus *Loboponera* by Bolton and Brown (2002). In 2002, Bolton and Brown described several additional species of *Loboponera* including *L. basalis*, *L. trica*, *L. vigilans*, *L.

**Pachycondyla (Bothroponera) variolata Santschi**

Pachycondyla (Bothroponera) variolata was described by Santschi in 1912, based on a worker from the Congo. William Wheeler (1922d) considered it as a subspecies of Bothroponera talpa. Santschi (1914) moved it back to Pachycondyla (B.) variolata as a subspecies of P. (B.) talpa. In this study, B. variolata is moved to the genus Ectomomyrmex because of the structure of the mesopleuron of the worker in profile. The mesopleuron of Bothroponera species is completely fused into a single structure while it is divided by anapleural sulcus into upper anepisternum and lower katepisternum in the Bothroponera talpa variolata worker. It may be a synonym of E. wasmanii, but E. wasmanii is from Madagascar and E. variolata is from the Congo.

**Ponera sjostedti Mayr**

The three castes, worker, male and female of Pachycondyla (Bothroponera) sjostedti from Cameroon were described by Mayr (1896: 231) as a member of Ponera. G.C. Wheeler and J. Wheeler (1971: 392) described the larva under the same name; however, it was combined in Pachycondyla (Bothroponera) by Emery (1901: 45). W.M. Wheeler (1922b: 73) placed it in Bothroponera, but Brown (Brown in Bolton 1995) classified Ponera sjostedti under Pachycondyla. Schmidt and Shattuck (2014) speculated that this species is a member of Euponera. This species was moved to Euponera because the eyes are vestigial in B. sjostedti. The palp formula in B. sjostedti is 2,2, while the palp formula in Bothroponera is 4,4 similar to that of B. nasica. Bothroponera sjostedti has mandibular fovea situated basally on the dorsolateral surface as in Brachyponera, Trachymesopus and Cryptopone (Bolton 1973). There are about 6 species of Euponera from Africa (excluding Malagasy) including E. aenigmatica (Arnold, 1949), E. wroughtonii (Forel, 1901), E. wroughtonii crudelis (Forel, 1901), E. fossigera (Mayr, 1901) from South Africa and E. brunoi (Forel, 1913) from Zimbabwe along with E. sjostedti from Cameroon.
Key to the workers of the *B. talpa* species complex

1. Anterior medial area of clypeus straight to slightly concave; total length of workers ranges from 8.10 mm to 14.95 mm and for females ranges from 9.90 mm to 15.90 mm .......................... 2
   - Anterior medial area of clypeus broadly convex; total length of workers ranges from 6.00 mm to 7.40 mm and for females ranges from 7.10 mm to 7.85 mm ................................................. 3

2(1). Striae on surface of frons and sides of head absent, head and body surface lack striae, poor evidence of fine striae on metapleuron; entire surface yellow ................................. *cribrata*
   - Striae present on frons, sides of head, body, top of pronotum, mesonotum, dorsopropodeum, petiole, postpetiole and gastral segments; strong evidence of fine striae on metapleuron; surfaces pale brown, dark yellowish brown, to reddish brown ................................................................. 4

3(1). Mandibles with 7 teeth; poorly developed carina on anterior medial area of clypeus .......... *zumpti*
   - Mandibles with 6 teeth; well developed carina on anterior medial area of clypeus ............. 5

4(2). Anterior medial area of clypeus straight; all surface with coarse, large, deep foveolae and punctae .......................................................................................................................... *sculpturata*
   - Anterior medial area of clypeus slightly concave; surfaces less coarse, with large to small, shallow foveolae and punctae ........................................................... 6

5(3). Clypeal carina sharp and present along entire length of clypeus; anterior medial border of clypeus strongly curved, convex, forming “v” shape; erect hairs present on surfaces of head and body ...... *rubescens*
   - Carina sharp but not continuous; without erect hairs on surfaces of body and head; anterior medial border of clypeus broadly curved, slightly concave, not forming “v” shape ........................................... *fugax*

6(4). Moderately smaller eyes (0.17 – 0.25 mm width, 0.15 – 0.25 mm length), OI 9.49 – 12.5; shallower foveolae to punctae on surfaces; smaller body size (8.10 – 9.95 mm for workers, 10.40 – 11.60 mm for females) ............................................................................................................. *talpa*
   - Moderately larger eyes (0.25 – 0.35 mm width, 0.30 – 0.45 mm length), OI 13.95 – 18; slightly deeper foveolae on surfaces; larger body size (10.70 – 14.95 mm for workers, 11.55 – 15.90 mm for females) .......................................................................................... 7
7(6). Larger head (2.30 – 2.70 mm length, 2.15 – 2.50 width), CI 92.59 – 93.47; larger size (worker TL 10.90 – 13.75 mm, female 11.55 – 15.90 mm, male 9.55 mm); larger eyes (0.30 – 0.45 mm length, 0.20 – 0.40 mm width for worker); well defined fine striae on top of head, frons, cheeks, top of pronotum, meso-propodeum, mesopleuron, metapleuron, petiole, postpetiole and 4th to 7th tergites of abdominal segments; dark brown; common, widely distributed .................................. *pachyderma*

- Smaller head (2.15 mm length, 1.95 mm width), CI 90.69; smaller size (worker TL 10.70 mm, female and male unknown); smaller eyes (0.30 mm length, 0.25 mm width); poorly defined fine striae on top of the head, frons, cheeks, top of pronotum, meso-propodeum, mesopleuron, metapleuron, petiole, postpetiole and 4th to 7th tergite of abdominal segments; red; rarely collected .......... *sanguinea*
Characterization of each species of the *B. talpa* species complex

*Bothroponera cribrata* (Santschi)
Figures 1.3, 2.3 and Plate 1.3; Map 1.3


**Diagnosis:**

**Worker:**

The head is subquadrate. The holotype can be characterized by having the anterior medial margin of the clypeus straight, but slightly concave medially. The clypeus is divided by the frontal lobes, but without a longitudinal clypeal carina. The eyes are small and do not project past the sides of the head.

The head is strongly roughened and moderately punctulate; the mesosoma is rough with few punctae and foveolae scattered on the dorsum and sides of the mesosoma. The petiole and postpetiole with the 4th to 7th abdominal segments are rough with shallow foveolae and foveolae that are arranged in a moderately alternative pattern on the surface. The mesopleuron is partially divided by the anapleural suture and well separated from the metapleuron. The general feature of *B. cribrata* surfaces is that they lack striae or poorly defined striae except on the mandibles.

The top of head and the frons along with the entire body surface are covered with moderately long (0.25 mm) golden erect hairs.

The head, mandibles, clypeus, pronotum, mesonotum, mesopleuron, and propodeum of *B. cribrata* are yellow, but the scapes, funiculus, lower margins of the frontal lobes, mandiblar margins and the tibiae with tarsi are pale brown.

The female and male are unknown.

**Description:**

**Worker Measurements:** (n=1)

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**Worker Description:**

Total length 9.00 mm; anterior border of clypeus straight, slightly concave medially, lacking carina, 1.50 mm in length; mandibles triangular, covered with fine striae; scape not reaching posterior lateral corner of head; frontal lobes covered with few fine punctulae, anterior edges shiny, smooth, 0.75 mm in maximum width; length of malar space between insertion of mandibles and lower edge of eye (side of head) 0.30 mm; length from upper edge of eye to highest point of posterior lateral corner of head 0.42 mm; head roughly sculptured, moderately punctulate; pronotal shoulder rounded, lower margin of pronotum straight, slightly concave with sharp angles on inferior and anteroinferior pronotal process; basalar sclerite semi-oval; pronotum roughly sculptured, moderately punctate; dorsum of mesonotum, and of propodeum rough, sides punctate to foveolate; dorsum of petiole and postpetiole slightly rough, coarsely punctate to alveolate; mesopleuron partially divided by anapleural suture, well separated from metapleuron by mesopleural suture; petiole rounded anteriorly, anterior face vertical, slightly concave posteriorly; postpetiole, all gastric segments rough with moderately scattered shallow foveolae; head, pronotum, mesonotum, propodeum, petiole and postpetiole covered with moderately long (0.25 mm) golden pubescence; ventral side of postpetiole, 4\textsuperscript{th} - 7\textsuperscript{th} abdominal segments covered with hairs up to 0.25 mm in length; head, pronotum, mesonotum, mesopleuron and propodeum yellow; bottom edges of frontal lobes and antennae yellowish brown; mandibles with brown edges, yellow medially.

**Comparison:**

*Bothroponera cribrata* is very similar to *B. talpa*, *B. pachyderma*, *B. fugax*, *B. zumpti*, *B. sanguinea* and *B. sculpturata*, excluding *B. rubescens* because only the female is known for this species. However, *B. cribrata* is characterized by specific properties that can be easily recognized when compared to the other members. For instance, in *B. cribrata* there is a partially developed anapleural sulcus. This sulcus emerges from the meso-metapleural suture. Conversely, all of the other members in *B. talpa* species complex lack the anapleural sulcus, with a well developed mesometa pleural suture. The erect hairs of *B. cribrata* are moderately long (up to 0.25 mm), about the same length on the dorsum of the head, top of the pronotum, mesonotum, propodeum, petiole and postpetiole. On the other hand, there are no striae on the frons; in contrast, very fine striae cover most of the body and the frons of the rest of *B. talpa* species complex species. The total length of the worker of *B. cribrata* is 9.00 mm, larger than
those of *B. zumpti*, *B. fugax* and *B. rubescens*, while it is smaller than those of *B. talpa*, *B. pachyderma*, *B. sculpturata* and *B. sanguinea*.

**Material examined:**

**Type material.**

**CONGO: Brazzaville**, 4°15'33" S; 15°17'5" E, 1907, A. Weiss *Bothroponera cribrata* Santschi 1907 (1 holotype worker, NHMB).

**Non-type material.**

None.

**Distribution:**

Congo Brazzaville (Republic of the Congo).

**Biology and habitat:**

The type specimen was collected from Brazzaville in the Republic of the Congo that is located in the western part of Central Africa, not to be confused with the adjacent country, the Democratic Republic of the Congo (DRC) that has Kinshasa is the capital (DRC website accessed Jan 2014). The equator crosses the country medially, and the area is characterized by high humidity and mean temperatures between 23°C - 27°C per year, with definite wet and dry season (Congo website, accessed Jan 2014) The rain forest and equatorial forests cover about 70% of the country, the average annual rainfall is 137 cm. The main biome and vegetation near Brazzaville is forest and savannah grasslands (Cribrata habitat website). The average annual temperature in Brazzaville is from 14 to 32 °C, the average annual rainfall is about 56 mm (Brazzaville weather website).

The country is very diverse in habitats and supports different species of Ponerinae such as *Anochetus africanus*, *Anochetus traegaordhi*, *Anochetus pellucidus aurifrons*, *Odontomachus assiniensis*, *Odontomachus troglodytes*, *Bothroponera soror*, *Brachyponera sennaarensis* (Santschi 1910c), *Mesoponera caffraria* var. *affinis* Santschi 1935b, *Bothroponera ancilla*, *B. talpa*, *B. pachyderma*, and *Paltothyreus tarsatus* var. *mediana* (Cribrata antwiki, accessed 06/03/2014).
Map 1.3: The distribution of *B. cribrata.*
Figures. 1.3-4.3

Fig. 1.3: The lateral view of the holotype worker of *B. cribrata*.

Fig. 2.3: The head of the holotype worker of *B. cribrata*.

Fig. 3.3: The head of the holotype worker of *B. fugax*.

Fig. 4.3: The lateral view of the holotype worker of *B. fugax*. 

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Bothroponera fugax (Forel)
Figures 3.3, 4.3 and Plate 2.3; Map 2.3


Diagnosis:
Worker:

The medial area of the clypeus is convex, with a well-developed sharp longitudinal carina that extends from the lower medial margin of the frontal lobe to the anterior medial margin of the clypeus. The frontal lobes cover most of the medial area of the clypeus. The mandibles have 6 teeth. The head is roughly sculptured, moderately punctate.

The metapleuron is covered with poorly defined striae. The posteropropodeum is slightly concave with granulated lateral margins. The petiole is nearly rectangular (side view) with a slight medial depression on the upper posterior edge. The postpetiole and 4th to 7th abdominal segments are larger than the mesosoma. The dorsum of the pronotum, mesonotum and propodeum are roughly sculptured, densely punctate and weakly shining. The petiole is rough with moderately dense large foveolae covering the lateral surfaces. The postpetiole is densely punctate with shallow foveolae. The entire surface is weakly shining.

The surfaces of the head, pronotum, mesonotum and propodeum are covered with fine short silver hairs (from less than 0.05 - up to 0.07 mm in length) and up to 0.10 mm on petiole and postpetiole. Generally, the entire surface is covered with fine silver hairs, except the ventral surface of the postpetiole and abdominal segments (3rd to 7th), which covered with moderately short erect silver hairs (0.15 – 0.20 mm).

All surfaces are reddish brown.

The female and male are unknown.

Description:
Worker Measurements: (n=1)

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Worker Description:

Total length 7.40 mm; medial area of anterior border of clypeus convex, strongly curved with medial well-developed sharp carina; mandibles with 6 teeth; eyes small; malar space from side of head 0.20 mm, length from upper edge of eye to posterior lateral corner of head 0.80 mm; basalar sclerite small and rounded; petiole rounded anteriorly, straight posteriorly from dorsal view, slightly higher than level of postpetiole in side view; head roughly sculptured, moderately punctulate, frontal lobes shiny with scattered punctures (appearing somewhat granulate); pronotum, mesonotum, propodeum, petiole, postpetiole roughly sculptured, densely punctate, weakly shining on dorsal face; metapleuron covered with fine striae; surface of head, pronotum, mesonotum, propodeum, covered with fine dense short hairs (length less than 0.05 mm); petiole and dorsum of postpetiole covered with short hairs (less than 0.10 mm); ventral surface of postpetiole, gastral segments covered with moderately short hairs (0.15 – 0.20 mm); head, pronotum, mesonotum, propodeum, petiole, postpetiole, legs, antennae, mandibles, clypeus reddish brown; mandibular edges, lower margin of clypeus, margins of lateropropodeum, posterior margins of petiole black.

Comparison:

Worker:

The *B. fugax* worker is similar to the other *B. talpa* species complex members including *B. cribrata*, *B. zumpti*, *B. rubescens*, *B. talpa*, *B. pachyderma*, *B. sculpturata* and *B. sanguinea*. A direct comparison of the *B. fugax* worker can be made with 6 species of *B. talpa* species complex members; *B. rubescens* is known only from female. Forel (1907) described *B. fugax* and he compared it with *B. talpa*, but, it is clear that *B. talpa* is distinct from *B. fugax*. The lower medial area of the clypeus of *B. talpa* is slightly concave without a carina while the same area of *B. fugax* is convex and narrowly curved and has a sharp longitudinal carina. The straight and slightly concave form of the lower medial edge of the clypeal anterior border of the clypeus that occurs in *B. talpa* is also found in workers of *B. cribrata*, *B. pachyderma*, *B. sculpturata* and *B. sanguinea*. The holotype of *B. fugax* is quite similar to *B. zumpti* and *B. rubescens*. When we compare *B. fugax* with *B. zumpti* and *B. rubescens*, the lower anterior medial margin of the clypeus is convex with a longitudinal carina present in the three species, but *B. rubescens* has a well developed continuously sharp carina, and is probably the female of *B. zumpti*. Generally, the clypeal carina of the worker of *B. zumpti* is less developed whereas the clypeal carina of *B. fugax* seems to be more developed. In addition, other characters are the same, the color of *B. fugax* and *B. rubescens*
are reddish brown while *B. zumpti* is yellow, but other specimens examined are dark brownish. Even though the type specimen differs in color, this does not appear to be a significant character, especially as the non type specimens of *B. zumpti* and the type female of *B. rubescens* differ in color from the type worker of *B. zumpti*. The total length of *B. fugax* is 7.40 mm, which is larger than that of *B. zumpti* that measures 6.00 – 6.80 for the workers and 7.85 for female; likewise, the female of *B. rubescens* is 7.10 - 7.80 mm. The other *B. talpa* species complex species have longer total length than *B. fugax* (9.00 mm in *B. cribrata*, 8.10 - 9.95 mm in *B. talpa* workers and 10.40 - 11.60 mm in *B. talpa* females, 9.90 - 11.20 mm in *B. sculpturata* workers and 9.65 - 13.45 mm in *B. sculpturata* females, 10.70 mm in *B. sanguinea* and 10.90 - 14.95 mm in *B. pachyderma* workers and 11.55 - 15.90 mm in *B. pachyderma* females. There are several traits that differ between *B. zumpti* and *B. fugax*. Besides the carinal presence on the lower medial area of the clypeus, the total body length is different and the number of mandibular teeth differs from 6 in *B. fugax* and *B. rubescens* to 7 in *B. zumpti*. In fact, *B. fugax* and *B. rubescens* are the only species in the *B. talpa* species complex that have 6 teeth, the rest of members have 7 teeth. *Bothroponera fugax* essentially lacks erect hairs on the head, mesosoma, petiole, postpetiole and the abdominal tergites, while erect and suberect hairs are present on the surfaces of *B. zumpti* and the other species in *B. talpa* species complex, including *B. cribrata*, *B. rubescens*, *B. talpa*, *B. pachyderma*, *B. sculpturata* and *B. sanguinea*. The head, pronotum, mesonotum, propodeum, mesopleuron, petiole, and postpetiole along with the gastral segments of *B. fugax* are rough, densely punctulate and granulated with weak evidence of foveolae, whereas they are rough, moderately punctate and mostly foveolate in *B. zumpti*.

**Material examined:**

**Type material.**

**TANZANIA:** Arusha, Arusha-chini, Lake Jipe [Lac Djipe], 3°35'0" S; 37°45'0" E; *Pachycondyla (Bothroponera) fugax* Forel, coll. Katona (1w, holotype # 404, NHMB).

**Non-type material.**

None.
Distribution:

The type specimen is known from Arusha-chini, Lake Jipe, Tanzania. There are pictures of *B. fugax* that appear on the Ants of Africa website, accessed June and August 2014 (one specimen), collected from Usambara Mts, Amani NR, Zigi Lodge at 2200 m, S 5° 05', E 38° 38' Tanzania. The species is also recorded from Mbalmayo Forest Reserve, Cameroon (Watt *et al.*, 2002).

Biology and habitat:

*Bothroponera fugax* was collected from Arusha, Lake Jipe, which is located at the northeastern border of Tanzania, between Tanzania and Kenya. The habitat around this lake on the Tanzania side is covered with a series of mountains including Mount Kilimanjaro (the highest mountain in Africa at 5,895 m) on the northern side of the lake and Pare Mountains on the western side of the lake, both are located in the Kilimanjaro region (Ikeno 2007). There are a number of *Pachycondyla* species known from Tanzania, but only *Pachycondyla (Trachymesopus) suspecta* was collected from Mount Kilimanjaro close to the Arusha Chini region where *B. fugax* was found. This unique environment in Tanzania is likely to offer several types of isolated habitat for several species such as *B. fugax*, but not for *B. zumpti*, which is found from the opposite side of African continent in Ghana (Belshaw and Bolton, 1994). However, specimens of *B. fugax* were also collected from Cameroon (Watt *et al.*, 2002), which indicates the wide range of this species.
Map 2.3: The distribution of *B. fugax*. 
Bothroponera pachyderma (Emery)

Figures 5.3 – 10.3 and Plates 3.3, 4.3; Map 3.3

Bothroponera pachyderma Emery, 1901: 45 (list), 49 (w and q), Cameroun; Wheeler, W.M. 1922d: 771; Bothroponera pachyderma: Wheeler, W. M. 1922b: 72-73 (w and q); Schmidt and Shattuck, 2014: 76; Pachycondyla pachyderma: Bolton, 1995: 308.


Bothroponera pachyderma var. funerea Wheeler, W.M. 1922b: 73 (q) Democratic Republic of the Congo (DRC); Pachycondyla pachyderma var. funerea: Bolton, 1995: 305; Bothroponera pachyderma funerea: Schmidt and Shattuck, 2014: 76. (syn. nov.).

Diagnosis:
Worker:

Bothroponera pachyderma can be recognized by the rough to punctulate surface of the head and the large and moderately deep foveolae mainly on the propodeum, petiole, postpetiole and 4th to 7th abdominal segments. The lower anterior medial margin of the clypeus is straight to slightly concave, and lacks a carina. The frons and sides of the head are covered with poorly defined striae. The frontal lobes cover a large area of the clypeus, they extend to connect with the lower medial margin of the clypeus.

The most distinguishing character is the body length, which ranges from 10.90 to 14.95 mm. The pronotal shoulder is rounded latterly with straight lower margins of the lateropronotum and pointed anteroinferior and inferior pronotal processes. The basalar sclerite is oval-shaped and covered with fine striae. The mesopleuron is slightly punctate to foveolate. The metapleuron is covered with fine striae. The dorsum of the pronotum, meso-propodeum, petiole, postpetiole and 4th to 7th abdominal segments are somewhat covered with well defined fine striae.
The entire surface of the head, pronotum, mesonotum, propodeum to the petiole and postpetiole along with the 4th - 7th abdominal segments are covered with moderately dense fine hairs. The top of the head (frons and frontal lobes are covered with moderately short (0.21 - 0.24 mm up to 0.27 mm) erect golden hairs that are absent on sides. The dorsums of the pronotum, mesonotum and propodeum are covered with scattered erect golden hairs ranging from 0.21 to 0.24 mm in length. The petiole and postpetiole are covered with moderately long (0.30 - 0.33 mm up to 0.42 mm) erect golden hairs. The hairs are denser on the dorsum and ventral surfaces of the 4th - 7th abdominal segments than on other surfaces.

The head is dark reddish to dark brownish, the pronotum, mesonotum, mesopleuron, propodeum, petiole and postpetiole are dark reddishbrown to black, the legs and frontal lobes are red, but the antennae, clypeus and mandibles are black reddish.

**Female:**

The female of *B. pachyderma* can be diagnosed by the large size (11.55 to 15.90 mm). The anterior medial margin of the clypeus is nearly straight to slightly concave. The head is roughly sculptured and strongly punctulate. The pronotal shoulder is rounded anteriorly, the lower margin of the pronotum (side view) is straight with pointed anteroinferior and inferior pronotal process. The basalar sclerite is rounded more than oval. The dorsopropodeum is narrowed (dorsal view). The posteropropodeum is slightly concave, slightly smooth and slightly shiny with sparse punctures and rounded margins.

The dorsum of the pronotum, scutum and scutellum, propodeum, petiole and postpetiole are rough with punctures and densely foveolate on the dorsum. The anterior edges and sides of the frontal lobes are shiny with punctures. The metapleural area is covered with fine striae with very few sparse punctures. The entire surface of the pronotum, scutellum, scutum, propodeum, petiole, postpetiole and the 4th to 7th abdominal segments are covered with well defined fine striae.

The head is covered with moderately long (0.25 up to 0.35 mm) erect golden hairs. The rest of body surface is covered with long moderately dense erect hairs (0.25 - 0.35 mm on mesosoma, 0.25 - 0.40 mm on petiole, 0.30 - 0.40 on postpetiole, up to 0.50 mm on 4th to 7th abdominal segments).

The typical color of the female *B. pachyderma* is brown to dark brown.
Male:

The male of *Bothroponera pachyderma* is unique in that the mesosoma and petiole are completely roughly sculptured while the postpetiole along with the 4th - 7th abdominal segments are smooth and shiny. The mesopleuron is exaggerated in size, covering most of the mesosoma in lateral view. The scutellum is elevated, rounded nearly in the middle of the mesosoma.

The entire surface is covered with fine hairs mixed with scattered moderately long (up to 0.37 mm) erect golden hairs. The postpetiole is covered with moderately dense fine hairs and few scattered erect hairs (up to 0.17 mm). The 4th to 7th abdominal segments are covered with dense fine hairs and few scattered erect hairs (0.15 up to 0.45 mm)

The surfaces of the head, mesosoma and petiole are black, the postpetiole and gastral segments are light brown.

**Descriptions:**

**Worker Measurements**: (n=34)

- HL 2.30 - 2.70, HW 2.15 - 2.50, ML 1.25 - 1.60, EW 0.25 - 0.35, EL 0.30 - 0.45, SL 1.55 - 1.95, FL 2.50 - 2.85, WL 3.25 - 4.00, WPL 4.15 - 5.25, PL 1.10 - 1.40, PW 1.35 - 1.80, PH 1.62 - 1.95, CI 92.59 - 93.47, OI 13.95 - 18, MandI 54.34 - 59.25, SI 72.09 – 78, PetI 122.72 - 128.57

**Worker Description:**

Total length 10.90 - 14.95 mm; anterior border of clypeus straight, slightly concave medially, lacking carina; clypeus length 1.70 - 2.15 mm in length; mandibles triangular, covered with fine striae; scape not reaching posterior lateral corner of head; frontal lobes covered with fine punctulae, anterior edges shiny, smooth, 0.95 - 1.20 mm in maximum width; length of malar space between insertion of mandibles to the lower edge of eye (side of head) 0.35 - 0.51 mm; length from upper edge of eye to highest point of posterior lateral corner of head 1.15 - 1.55 mm; head roughly punctulate; pronotal shoulder rounded, lower margin of pronotum straight with sharp ends; pronotum roughly sculptured, moderately punctate; dorsum of mesonotum, and dorsopropodeum rough, sides punctate to foveolate; mesopleuron partially divided by anapleural suture, well separated from metapleuron by meso-metapleural suture; dorsum of petiole and postpetiole slightly rough, coarsely punctate and foveolate; petiole rounded anteriorly, anterior face vertical, slightly concave posteriorly; postpetiole, all abdominal segments rough with large, moderately shallow foveolae; head, pronotum, mesonotum, propodeum,
petiole and postpetiole covered with moderately long golden pubescence (0.10 - 0.40 mm); ventral side of postpetiole, 4th - 7th abdominal segments covered with hairs up to 0.45 mm in length; head, pronotum, mesonotum, mesopleuron and propodeum brown; bottom edges of frontal lobes and antennae pale brown; mandibles with brown edges; entire surfaces dark brownish.

**Female Measurements: (n=8)**

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<th>Maximum</th>
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<tr>
<td>PetI</td>
<td>130.84 - 144.44</td>
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**Female Description:**

Head subquadrate; frontovertexal posterior margin strongly concave; scape reaches posterior lateral corner of head; mandibles triangular, covered with striae, with 7 teeth; eye large; malar space from side of head 0.40 mm in length, length from upper edge of eye to highest point of posterior lateral corner of head 1.25 mm; scutum widened anteriorly, reaching same width as pronotum (2.35 mm), narrowed posteriorly to reach the same width as propodeum (2.15 mm); smooth shiny depression on medial area of scutellum (dorsal view), entire scutellum poorly striated; posterior width of propodeum 1.75 mm; dorsopropodeum short (0.55 mm); petiole with smooth longitudinal narrowed strip extending medially on dorsum from anterior to posterior (dorsal view); postpetiole with remainder abdominal segments slightly larger than mesosoma (5.60 mm for postpetiole with gaster, 4.40 mm for mesosoma); head covered with moderately long (0.25 up to 0.35 mm) golden erect hairs; pronotum, scutum, scutellum, dorsopropodeum covered with long (0.35 mm) scattered erect hairs; dorsum of petiole covered with long (0.45 mm) erect hairs; dorsum of postpetiole with remainder abdominal segments covered with longer (0.40 up to 0.50 mm) erect and suberect hairs; head, mandibles, pronotum, scutum, scutellum, mesoplonur, propodeum, metaplonur, pediole postpetiole dark brown; legs, antennae reddish brown.

**Male Measurements: (n=1)**

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<td>PetI</td>
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</tr>
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</table>
Male Description:

Total length 9.55 mm; head suborbiculate; mandibles nearly contact when closed; large eyes cover most of side of head; clypeus convex, raised medially, without carina; scape short, thicker than second segment of funiculus, first segment of funiculus about half length of scape; pronotal shoulder rounded, lower margin of pronotum straight, sharply angled anteriorly, compressed posteriorly; large horizontal parallel grooves on sides of pronotum; scutum elevated higher than pronotum, lower than scutellum; parapsidal sutures distinctive; propodeum angled posteriorly; mesopleuron divided into enlarged katepisternum and smaller upper anepisternum; mesopleural suture well defined; petiole small, thick, apex rounded, higher than level of dorsopropodeum, lower than level of postpetiole; propodeum sloping strongly to reach insertion of petiole; head, pronotum, scutum, scutellum, propodeum, petiole rough, coarsely sculptured; postpetiole, gastral segments shiny, smooth; entire surface hairy, long (0.20 - 0.35 mm) erect hairs moderately scattered on top of head, pronotum, scutum and scutellum; postpetiole and the gastral segments covered with shorter hairs 0.20 mm, up to 0.25 mm) on dorsum and ventral surfaces; head, mesosoma, petiole black, postpetiole, gastral segments brown.

Comparison:
Worker:

The worker of *B. pachyderma* is characterized by having an anterior medial margin of the clypeus that is straight to slightly concave. This character is somewhat similar to that of other species in *B. talpa* species complex, especially, *B. sanguinea*, *B. talpa*, *B. cribrata* and *B. sculpturata*. In contrast, this clypeal character is different in *B. rubescens*, *B. zumpti* and *B. fugax* because the medial area of clypeus is convex (broadly convex), with a medial sharp carina extending latitudinally from the lower medial margin of the frontal lobe to the lower medial margin of the clypeus. *Bothroponera pachyderma* is the largest species among *B. talpa* species complex, with a body length of workers ranging from 10.90 to 14.95 mm. The eye size is smaller in *B. talpa*, *B. zumpti*, and *B. fugax* than that in *B. pachyderma* and *B. sanguinea* and moderate in *B. sculpturata*.

Based to the character similarities among *B. pachyderma* and their varieties (*B. attenuata*, *B. postsquamosa* and *B. funerea*), these varieties are considered to be new synonyms of *Bothroponera pachyderma*. The worker of *B. pachyderma* var. *attenuata* was described by Santschi (1920) as being slightly smaller than *B. pachyderma*, but this is not the case when we look at the total length of entire series. All of the characters are similar even the hair length. The lengths of the hairs on the pronotum, mesonotum and propodeum of *B. pachyderma* and *B. attenuata* range from 0.21 - 0.24 mm. The hairs on
the petiole and postpetiole are usually longer (0.33 mm) than those on the pronotum, mesonotum and propodeum (slightly shorter than 0.33 in \textit{B. pachyderma attenata}). The hair length of \textit{B. attenata} are the same as that on pronotum, mesonotum, propodeum, petiole and postpetiole (0.24 mm); therefore, is considered to be a new synonym of \textit{B. pachyderma}.

Santschi (1920) described \textit{B. pachyderma} var. \textit{postsquamosa} as being different from \textit{B. pachyderma} var. \textit{attenata} in being strongly sculptured. It appears they do not differ from the typical \textit{B. pachyderma}. The sculpture of \textit{B. pachyderma postsquamosa} is the same as \textit{B. pachyderma pachyderma} and \textit{B. pachyderma attenata}; however, \textit{B. postsquamosa} is characterized by having the longest hairs on the head and body among the other two species (\textit{B. pachyderma pachyderma} and \textit{B. attenata}). The hair length of \textit{B. postsquamosa} on the petiole and postpetiole are usually longer (0.42 mm) than hairs on the pronotum, mesonotum and propodeum (0.30 mm). Other than that they have similar characters. Therefore, I considered it to be a new synonym of \textit{B. pachyderma}.

\textbf{Female:}

The female of \textit{Bothroponera pachyderma} can be compared with the females of \textit{B. talpa}, \textit{B. sculpturata}, \textit{B. zumpti} and \textit{B. rubescens} among \textit{B. talpa} species complex. The anterior medial area of clypeus can separate \textit{B. pachyderma}, \textit{B. talpa} and \textit{B. sculpturata} in that it is almost straight to slightly concave shaped from the other species (\textit{B. zumpti}, \textit{B. rubescens} and \textit{B. fugax}) that characterized by convex to broadly convex with sharp carinae on the anterior medial area of the clypeus. This character tends to be more broadly convex to slightly straight than concave in \textit{B. sculpturata}. The species of \textit{B. pachyderma} can be separated from \textit{B. talpa} by considering several variations such as the scape length, the surface sculpture, the total size length and the hairs. The scape in females of \textit{B. pachyderma} reaches the posterior lateral corner of head whereas in females of \textit{B. talpa} the scape failed to reach the posterior lateral corner of head. The surface in \textit{B. pachyderma} is more roughened and covered with larger and deeper foveolae while in \textit{B. talpa} the surface is less roughened and covered with shallower and smaller foveolae. The females of \textit{B. pachyderma}’s total length range from 11.55 mm to 15.90 mm, on the other hand, the total length of \textit{B. talpa} reach 10.40 to 11.75 mm. The entire surface in \textit{B. talpa} is covered with dense fine hairs and long erect hairs, both type of hairs tend to be silver than golden, but in \textit{B. pachyderma} the surface covered with less dense fine hairs and golden erect hairs.

Wheeler (1922b) separated the holotype female of \textit{B. pachyderma} var. \textit{funerea} from that of \textit{B. pachyderma} based on a number of characteristcics. He considered it to be larger, but in fact, it is smaller than the females of the \textit{B. pachyderma} type series (\textit{B. funerea} total length 13.50 mm and \textit{B. pachyderma}

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paralectotypes 15.15 - 15.90 mm). He also stated that *B. funerea* is dark and black, but in fact, it is the same color as the *B. pachyderma* paralectotype females. He also characterized the hairs on the dorsal surface as black in *B. funerea*, conversely, many are golden, and are the same color as the paralectotype females of *B. pachyderma*. The foveolae on the gastral segments of *B. funerea* have less distinct striae between the foveolae that seem to be shallower than Wheeler concluded, but this character appears to be identical to those of the paralectotype female of *B. pachyderma*. Therefore, I consider it to be a new synonym of *B. pachyderma*.

**Male:**

The male of *B. pachyderma* was the only male found in the *B. talpa* species complex in this study. The total size is smaller than the female, similar somewhat to the size of the worker. The general color and the sculpture of the *B. pachyderma* male seem to be identical with other *Bothroponera* males, particularly those in the *B. sulcata* species complex. It is possible to compare the male of *B. pachyderma* with the male of the *B. sulcata* species complex (*B. soror*). The surface of *B. pachyderma* is coarsely sculptured while it is less sculptured or simply roughened in *B. soror*. The head is suborbiculate in the *B. pachyderma* male whereas it is suborbiculate to slightly elongated in males of *B. soror*.

**Material examined: 42(4m+8f+30w)**

**Type material.**

*Pachycondyla* (*Bothroponera*) *pachyderma*, **CAMEROON: Kamerun:** [Cameroun]: L. Conradt, museo Genova coll. C. Emery (dono 1925), no further information (3w upper specimen) paratype, two lowr specimens paralectotypes, 2q paralectotypes, [here designated], MCSN). **CONGO, Democratic Republic of the Congo (DRC): Medje,** 2°25'0" N; 27°30'0" E, Stomach *Bufo polycercus*, H. O. Langg, *Bothroponera pachyderma* var. *funerea* Wheeler, cotype on label, it is actually the holotype # 848588 (1q, AMNH); *Bothroponera pachyderma* var. *postsquamosa* Santschi det. 1920, **Lobaye,** 4°15' S., 18° E, coll. Rigonbach, missing gaster; type, Sammlung Dr. F. Santschi Kairouan (1w, paratype, NHMB); *Pachycondyla (Bothroponera) pachyderma* var. *attenata* Santschi, Congo Belge, **N’Gaza,** 0°55' N, 24°50' E; coll. Elskens, Sammlung Dr. F. Santschi Kairouan; type (1w, paratype, NHMB).
Non-type material.

ANGOLA: Gallery forest, R. Kamuaji, trib Dilolo, 7°36'0'' S; 20°53'0'' E, trib Chiumbe, berlesate by native collector, 24-i-1963 (det. By W. L. Brown antweb 6/7/2014) Bothroponera pachyderma (2w, MCZC). CENTRAL AFRICAN REPUBLIC: French Equatorial Africa, Ubangi-Shari [Oubanguï-Chari territory], 7°0'0'' N; 21°0'0'' E, Haut Mbomu [Haut Mbomou], iiii-1948, N. A. Weber, Pachycondyla (Bothroponera) pachyderma Emery (1w, MCZC). CONGO: Democratic Republic of the Congo: Akengi [Akengei] 2°56'0'' N; 26°50'0'' E, Stomachs Bufo polycercus and Bufo funereus, H. O. Lang, Pachycondyla (Bothroponera) pachyderma Emery (1w, MCZC). CONGO: Central African Republic, Ubangi-Shari [Oubanguï-Chari territory], 7°0'0'' N; 21°0'0'' E, Haut Mbomu [Haut Mbomou], iii-1948, N. A. Weber, Pachycondyla (Bothroponera) pachyderma Emery (1w, MCZC). GABON: Makokou, Ogooué-Ivindo province, rain forest, 0°34'0'' N; 12°52'0'' E, July-August 1974, W. H. Gotwald, Pachycondyla (Bothroponera) pachyderma Emery (3w, MCZC); Makokou, 0°34'0'' N; 12°52'0'' E, x-xii-1972, I. Lieberburg rain forest, Pachycondyla (Bothroponera) pachyderma Emery (1w #16, MCZC); Plateau d'Ipassa, IPA 5, 34, J. A. Barra, Pachycondyla (Bothroponera) pachyderma Emery, no further information (1w, MCZC). GHANA: Kumasi Metropolitan District, Bobiri Forest Reserve, Nr. Kumasi, 6°41' N, 1°21' W, 6.iv.1992, R. Belshaw, leaf litter primary forest, B. pachyderma (2w, BMNH); Tafo, Kumasi Metropolitan District, Ashanti Region, 6°44'0'' N; 1°37'0'' W, 31.vi.66, Leston, Pachycondyla pachyderma Emery, det. B. Bolton 1977, LACM ENT 315923 (1q, LACM), same locality, 31.viii.70, B. Bolton, Pachycondyla pachyderma Emery det. B. Bolton 1977 (LACM ENT 315922 and 315924 (4w, LACM); Tafo, 4°44'9'' N, 1°36'29'' W, 15.viii.66, D. Leston, ant ecology sample, 206A (2w and 1q, BMNH). IVORY COAST: Abidjan District, Banco Forest, nr. Abidjan, 5°23' N, 4°3' W, 9-vi-1974, W. H. Gotwald, Pachycondyla (Bothroponera) pachyderma Emery (1w, MCZC); Lamto (Toumodi), 6°33'0'' N; 5°10'0'' W), Lamto Research Station, 6°22'0'' N 5°03'0'' W, 200 km north Abidjan, near of Divo town, A A 225, 9.3.68, coll. J. Leveux, Bothroponera pachyderma Emery (1w, MCZC), same locality, 6°22'0'' N 5°03'0'' W, 200 km north Abidjan, near of Divo town: AA 284 14.4.68, coll. J. Leveux, Bothroponera pachyderma (1w, MCZC); Man, Montagnes District,

**UGANDA:** Eastern Province, Jinja District, **Jinja**, 10 mi W. Jinja, 0°35'0" N; 33°15'0" E, 1200m, XII-1-1957, coll. E. S. Ross & R. E. Leech, *Pachycondyla (Bothroponera) pachyderma* Emery (1w, MCZC); Central Province, Buikwe District, **Kimera**, 0°12'0" N; 32°59'0" E, 4-viii-1914, Dr. G. D. H. Carpenter, *Bothroponera pachyderma attenuata* Santschi; Sammlung Dr. F. Santschi Kairouan (1w, NHMB).

**Distribution:**

Angola, Cameroon, Congo Brazzaville, Democratic Republic of the Congo (DRC), Central African Republic, Gabon, Ghana, Ivory Coast, South Sudan, Tanzania, Uganda.

Brian Taylor (ants of Africa website, accessed 8/20/ 2014) identified several *B. pachyderma* specimens (Oxford University Museum) that were collected from Liberia E. Poirier Liabala P. F., Nimba county 07°31'06" N, 08°35'34" E and Ghana S. Sky Stephens. Several specimens were collected from three different locations at different elevations in Central African Republic, P. Annoyer J. P., Dzanga-Sangha [03° 03' 58" N, 16°08'59.5" E] [2°28'45.9" N, 16°13'15.0" E] [2°28'49.5" N, 16°12'55.9" E]. Congo Brazzaville, Lesion-Louna, Gallery forest 3°16'21.7" S, 15°28'12.5" E (The Ant of Africa Website, 8/20/ 2014).

**Biology and Habitat:**

*B. pachyderma* is widespread species in tropical Africa, they are distributed over large area of terrestrial ecoregions in southern, central, eastern and western African countries. Belshaw and Bolton (1994) collected 17 workers of *B. pachyderma* in a study identifying the presence and the geographical composition of ant species in Ghana. The samples were collected from 7 different sites (leaf litter samples) from the primary and secondary forests. In Cameroon, one queen was collected by L. Conradt (Emery 1901). Two type workers of *B. pachyderma* (=*B. attenuata*) were collected from the Belgian Congo, Congo (DRC), and N’Gaza (Elskens) (Santschi, 1920). *Bothroponera pachyderma* (=*B. postsquamosa*) was collected from the French Congo, Lobaye (Riggenbach) (Santschi, 1920).
Bothroponera pachyderma funerea and workers of B. pachyderma were collected from the Democratic Republic of Congo, Medje by Lang and Chapin (Wheeler 1922b). The species of B. pachyderma (=B. attenata, =B. postsquamosa, =B. funerea) were collected mainly from rain forest areas and habitat characterized as swamps and riparian ecoregions. That is supported by having several specimens that were extracted from stomachs of the predatory toad species such as Bufo polycercus, Bufo funereus and Bufo superciliaris, which live in such habitats. In the Ivory Coast, collectors, J. Levieux and T. Diomande collected B. pachyderma in the Ferkessedougou area (Levieux 1978). In Sudan, N. A. Weber and J. Myers, collected number of workers from the Imatong Mountains, and Lotti Forest (Weber 1943). In Tanzania, workers were collected by Y. Sjostedt from Kibonoto, Mt Kilimanjaro and Lake Natron (Mayer 1907). There were specimens that were collected from Mabira and Zika forests, Uganda (Arnold 1954). The variety B. pachyderma attenata was collected from Kimini [Kimina ], Uganda by G. D. H. Carpenter (Santschi 1933). B. pachyderma was studied extensively by Dejean and Lachaud (2011) and Dejean et al. (1999) when they investigated hunting behavior of African ponerine ants that prefer centipedes in their diet and considered to be semi-specialized predators.

Map 3.3: The distribution of B. pachyderma.
Figures 5.3-8.3

Fig. 5.3: The lateral view of the lectotype worker of *B. pachyderma*.

Fig. 6.3: The head of the lectotype worker of *B. pachyderma*.

Fig. 7.3: The head of a paralectotype female of *B. pachyderma*.

Fig. 8.3: The lateral view of a paralectotype female of *B. pachyderma*. 
Figures 9.3, 10.3

Fig. 9.3: The lateral view of the male of *B. pachyderma* from the Democratic Republic of the Congo.

Fig. 10.3: The head of the male of *B. pachyderma* from the Democratic Republic of the Congo.
Bothroponera rubescens Santschi
Figures 11.3 and 12.3 and Plate 5.3; Map 4.3


Diagnosis:

Female:

The female of B. rubescens is a relatively small member of the genus (total length 7.10 - 7.80 mm), diagnosed by having a well-developed sharp continuous clypeal carina. The anterior border of the clypeus is convex and with the carina forms a v-shape. The mesopleural suture is distinctive. The petiole is rounded anteriorly and slightly concave posteriorly (best seen from above) with rough posterior margins. The head, pronotum, scutum, scutellum, mesopleuron and propodeum are strongly sculptured by dense punctatae. The dorsum of the petiole is coarsely covered with larger punctae and rough sculpture laterally. The postpetiole and the remainder of the abdominal segments are rough and covered with sparse shallow punctures.

The dorsal surface of the pronotum, mesonotum and propodeum are covered with fine hairs, and with scattered moderately short to long (up to 0.21 mm) erect hairs.

The entire ant is reddish brown.

The worker and male are unknown.

Description:

Female Measurements: (n=2)

HL 1.41 - 1.65, HW 1.23 - 1.50, ML 0.75 - 0.80, EW 0.21 - 0.30, EL 0.21 - 0.30, SL 0.87 - 1.10, FL 1.47 - 1.80, WL 2.22 - 2.50, WPL 2.79 - 3.20, PL 0.57 - 0.70, PW 0.87 - 1.00, PH 0.90 - 1.10, CI 87.23 - 90.90, OI 17.07 - 20.00, MandI 48.48 - 53.19, SI 70.73 - 73.33, PetI 142.85 - 152.63

Female Description:

Anterior medial border of clypeus (anteriorclypeus) strongly angulate, forming “v” shape with sharp clypeal carina; mandibles more elongated than triangular, covered with fine striae, with 6 teeth; scape slightly curved, not reaching posterior lateral corner of head; malar space from side of head 0.12 mm;
length from upper margin of eye to highest point of posterior corner of head 0.65 mm; eyes relatively small; frontal lobes cover most of medial area of clypeus, total width 0.60 - 0.70 mm; clypeal width between bases of mandibles 1.10 - 1.25 mm; pronotum rounded anteriorly, from lateral view lower margin of pronotum straight with sharp (angled) extremes; scutum widened; anapleural suture well developed; mesosoma winged and modified for flight; posteropropodeum smooth, slightly concave with coarse angular margins; basalar sclerite rounded to oval; propodeal spiracles parallel with mesopleural suture; metapleuron covered with fine striae; petiole rounded anteriorly, slightly concave posteriorly with coarse, angular posterior margins. Head, pronotum, scutum, scutellum, propodeum, mesopleuron coarsely sculptured with dense punctulae; dorsum of petiole coarsely covered with larger punctae, but rough laterally and anteriorly. Postpetiole and remainder of abdominal segments rough and covered with sparse shallow punctures; entire surface weakly shiny; dorsal surface of pronotum, mesonotum and propodeum covered with fine hairs, with scattered moderately short (0.15 - 0.18 mm) erect hairs, petiole and postpetiole covered with moderately long (0.21 mm) hairs; mandibles, head, scape, pronotum, mesonotum, propodeum, legs and clypeus reddish; petiole, postpetiole and funiculus reddish brown.

Comparison:

The total size of the *B. rubescens* female is smaller than that of the *B. talpa* female. It is easy to distinguish *B. rubescens* from other females in the *B. talpa* species complex as it has a well-developed sharp clypeal carina on the lower medial margin of the clypeus whereas *B. talpa* is lacking the carina. The lower margin of the clypeus is convex in *B. rubescens*, but it is straight and slightly concave of the other female members of the *B. talpa* species complex. Another difference is that the hairs on the pronotum, mesonotum, propodeum, petiole and postpetiole are denser and slightly longer in *B. talpa* than that of *B. rubescens*.

The female of *B. rubescens* is quite similar to the workers of *B. fugax* and *B. zumpti*. The clypeal structure and the unique sculpture along with the hairs can help in separating these species; otherwise, the female caste is different from worker caste.

Material examined:

Type material.

**CONGO**, Democratic Republic of Congo (DRC): Congo belge, Haut Ubangi river, 0° to 5° N, 18° to 23° E (Zimmermann) *Pachycondyla rubescens* Santschi, Sammlung Dr. F. Santschi Kairouan (1q,
holotype, NHMB).

**Non-type material.**

**ANGOLA: Dundo, Lunda Norte Province**, Carrisso Park gallery for R. Luachimo, 7°22'0" S; 20°50'0" E, berlesate by Luna de Carvalho 13-i-1964, *Bothroponera rubescens* Santschi, compared with type, W. L. Brown, 1963 (1q, MCZC).

**Distribution:**

Democratic Republic of Congo (DRC) and Angola.

**Biology and habitat:**

The holotype of *B. rubescens* was collected in the Ubangi River area at the northwestern part of the Congo (RDC). The Ubangi River is located at the border with Congo, Brazzaville, and extends into the DRC. The area is covered with rainforest and mainly characterized by the Western Congolian Swamp Forests (13), the Eastern Congolian Swamp Forests (14) and the Central Congolian Lowland Forests (15) ecoregions. It is the most diverse and rich habitat for Afrotropical organisms (Burgess et al. 2004; Worldwildlife.org, accessed 8/15/2014). The material examined was collected in the Lunda Norte Province located at the northeast border of Angola with the DRC. This Province includes three ecoregions: the Western Congolian Forest-Savanna Mosaic (43), the Southern Congolian Forest-Savanna Mosaic (42) and the Angola Miombo Woodlands (49) that extend into both countries (Burgess et al. 2004; Worldwildlife.org, accessed 8/15/2014). This reflection of habitat indicates the ability of *Bothroponera* to inhabit a wide range of biomes.
Map 4.3: The distribution of *B. rubescens*.
(in Congo 0° to 5° N, 18° to 23° E)
Figures. 11.3-14.3

Fig. 11.3: The lateral view of the holotype female of *B. rubescens*.

Fig. 12.3: The head of the holotype female of *B. rubescens*.

Fig. 13.3: The head of the holotype worker of *B. sanguinea*.

Fig. 14.3: The lateral view of the holotype worker of *B. sanguinea*. 
Bothroponera sanguinea (Santschi)
Figures 13.3, 14.3 and Plate 6.3; Map 5.3

Pachycondyla (Bothroponera) sanguinea Santschi, 1920b: 7 (w) Democratic Republic of Congo;
Bothroponera sanguinea: Wheeler, W.M. 1922d: 772; Schmidt and Shattuck, 2014:76;

Diagnosis:
Worker:

The head surface is rough to punctulate, covered with fine striae. The lower medial margin of the
clypeus is straight to slightly concave, without a carina. The malar space length from side of head is 0.35
mm in length.

The entire surface (pronotum, mesonotum, mesopleuron, propodeum, petiole, postpetiole and the
4th - 7th abdominal segments) are roughly sculptured with shallow, moderately dense, poorly defined
foveolae. The metapleuron and lateropropodeum (area between the basalar sclerite and propodeal
spiracle) are rough and covered with poorly defined fine striae. The frons, head sides, petiole,
postpetiole and the 4th - 7th abdominal segments are covered with poorly defined fine striae. The
mesopleural suture is present. The petiole is rounded anteriorly and straight to slightly concave
posteriorly.

The dorsal surface of the body is covered with long erect golden hairs, ranging from 0.25 mm in
length on the pronotum, mesonotum, and propodeum to 0.40 mm on the petiole and postpetiole. The
occipital area of the head is covered with long (up to 0.30 mm) erect golden hairs, the lower areas are
covered by short (less than 0.21 mm) erect golden hairs.

The head, pronotum, mesonotum and propodeum are brownish red while the antennae are brown,
the mandibles are dark red, the legs are reddish brown, and the clypeus is reddish yellow, but the lower
margin is black.

The female and male are unknown.

Descriptions:
Worker Measurements:

HL 2.15, HW 1.95, ML 1.35, EW 0.25, EL 0.30, SL 1.55, FL 2.45, WL 3.25, WPL 4.15, PL
Worker Description:

Total length 10.70 mm; mandibles covered with striae and sparse punctures, with 7 teeth; head subquadrate, roughly sculptured, densely punctulate; fine striae present on frons, sides of head, gena; anterior medial margin of clypeus straight to slightly concave, clypeus lacking carina, covered with fine striae, clypeal length 1.65 mm; frontal lobes well developed with deep, short frontal furrow, cover large medial area of clypeus, frontal lobe width 0.90 mm; malar space from side of head 0.35 mm, length from upper edge of eye to posterior lateral corner of head 1.30 mm; scape fails to reach posterior lateral corner of head; eyes relatively large; pronotum rough, shallow foveolate; mesopleural suture well developed; basalar sclerite semi-oval; mesonotum, propodeum rough with large shallow foveolae, moderately shiny; metapleuron, lateropropodeum covered with poorly defined fine striae; petiole, postpetiole rough with large shallow foveolate; top of head covered with moderately long (0.15 - 0.30 mm) golden erect hairs; dorsum of pronotum, mesonotum, dorsopropodeum covered with long (0.20 - 0.33 mm) erect scattered hairs; dorsum of petiole covered with long (0.25 - 0.40 mm) golden erect hairs; postpetiole covered with longer (0.21 - 0.40 mm) golden erect hairs; most surfaces brown to brownish red; legs, antennae reddish brown, mandibles dark brown, clypeus reddish yellow, margins black.

Comparison:

*Bothroponera sanguinea* can be compared with *B. pachyderma*, *B. talpa*, *B. fugax*, *B. sculpturata*, *B. cribrata* and *B. zumpti*, excluding *B. rubescens* because only the female caste is known of this species. The species of the *B. talpa* species complex are quite similar to each other in their overall characters such as color, hairs, head shape, petiole shape, sternopetiolar and sternopostpetiolar processes, scape length, but specific variations can be recognized by carefully studying these species. The anterior medial area of clypeus seems to be unique among individuals of the *B. talpa* species complex. It is narrowed, striated and covered medially by the frontal lobes. The lower margin of anterior medial area of clypeus is slightly concave in *B. talpa*, *B. pachyderma*, *B. cribrata* and *B. sanguinea*, straight or broadly convex in *B. fugax*, *B. zumpti*, *B. sculpturata* and *B. rubescens*. The eye size is large in *B. sculpturata*, *B. sanguinea* and *B. pachyderma*, while it is small in *B. cribrata*, *B. zumpti*, *B. fugax* and moderate in *B. talpa*. 
Santschi (1920b) described *B. sanguinea* based on color differences ranging from dark reddish brown to reddish yellow. It is similar to other members of the *B. talpa* species complex, especially *B. talpa*, *B. pachyderma* and *B. sculpturata*. It also shares characteristics with *B. talpa*, *B. fugax*, *B. zumpti*, *B. cribrata* along with *B. pachyderma*, and *B. sculpturata*. The color of the only specimen (holotype) of *B. sanguinea* is now pale brown, however, this color is repeatedly found in the other species in the *B. talpa* species complex such as *B. talpa* and *B. pachyderma*. The obvious character that can be used to separate *B. sanguinea* is the roughly sculptured surface that is covered with large, moderately shallow foveolae. The erect hairs of *B. sanguinea* are golden to reddish golden, which is not usual among members of the *B. talpa* species complexe. The entire surfaces of *B. sanguinea* including the head have very little evidence of fine striae, in contrast, the surfaces including head are covered with strong evidence of striae in *B. talpa*, *B. pachyderma* and *B. sculpturata*. The total length can separate *B. sanguinea* from *B. cribrata*. The total length of *B. sanguinea* is 10.70 mm while that of *B. cribrata* is 9.00 mm. There is only one worker individual among the *B. pachyderma* specimens that have the same sculpture and hairs in terms of the form and color, but this specimen has larger range of measurements from the type specimen of *B. sanguinea*, which is considered not to be *B. sanguinea*.

**Material examined:**

**Type material.**

**CENTRAL AFRICAN REPUBLIC:** Fort Crampel, 6°59' 0'' N, 19°11' 0'' E, coll. Le Moult, sammlung Dr. F. Santschi Kairouan, *Pachycondyla (Bothroponera) sanguinea* type Santschi det. 1920 (1w, Holotype, NHMB).

**Non-type material.**

None.

**Distribution:**

Biology and habitat:

The holotype of *B. sanguinea* was collected from the Congo (Santschi, 1920b), but the labels of the holotype specimen indicated that it is from Fort Crampel City in the Central African Republic. Both countries are neighbors and share three terrestrial ecoregions: the Northwestern Congolian Lowland Forests (12), the Northeastern Congolian Lowland Forests (16) and the Northern Congolian Forest-Savanna Mosaic (40) in central Africa (Burgess *et al.*, 2004; Worldwildlife.org, accessed 8/5/2014). These ecoregions cover a vast area including the Central Congolian Lowland Forests, the Western Congolian Swamp Forests and the Eastern Congolian Swamp Forests in Central Africa, around the Congo River and its tributaries, which make huge barriers that enhance the speciation rates in the area (Worldwildlife.org, accessed 8/5/2014, Burgess *et al.* 2004).

Map 5.3: The distribution of *B. sanguinea*.
Bothroponera sculpturata (Santschi) stat. nov.
Figures 15.3 – 18.3 and Plate 7.3, 8.3; Map 6.3


Diagnosis:

Worker:

Workers of B. sculpturata can be distinguished by the shape of the clypeus, the surface of `which is broadly convex, but without a longitudinal medial carina. The scape nearly reaches the posterior lateral corner of the head. This ant has a moderately large body size (total length 9.90 - 11.20 mm). The dorsal surface of the head is densely punctate. The sides of the head, cheeks, frons and the dorsum of the pronotum are covered with poorly defined striae.

The pronotum, mesonotum, mesopleuron, dorsopropodeum, lateropropodeum and metapleuron are densely foveolate and punctate. The petiolar and postpetiolar surfaces are covered with larger foveolae than the mesosoma. The mesopleuron, metapleuron, postpetiolar dorsum and the rest of the 4th to 7th abdominal segments are also covered with fine striae. The mesopleural suture is developed. The posteropropodeum is straight (seen from the side), smooth and shiny. The entire body including the legs and the antennae are weakly shining. The petiole (dorsal view) is rounded and slightly narrowed anteriorly while it is vertical and slightly concave posteriorly.

The entire dorsum of the pronotum, mesonotum and propodeum are covered with relatively short (0.06 - 0.20 mm) erect golden hairs while the petiole and postpetiole are covered with long (up to 0.30 mm) erect to suberect hairs.

The head, mandibles, pronotum, mesonotum, mesopleuron, propodeum, lateropropodeum, petiole, postpetiole and entire gaster are dark brown to black. The legs and the antennae are light reddish brown.

Female:
The female of *B. sculpturata* can be diagnosed by the large deep foveolae on most of the mesosoma and large body size (total length is 9.65 – 13.45 mm). The anterior medial margin of the clypeus is nearly straight to slightly convex. The head is strongly punctulate. The eyes are relatively large. The pronotal shoulder is rounded anteriorly, the lower margin of the pronotum is straight with a pointed anteroinferior pronotal process and inferior process. The promesonotal suture is well developed. The mesopleural suture is distinctive. The metapleural area is covered with fine striae. The propodeum is subquadrate. The petiole has foveolate posterolateral margins.

In general, the head is strongly punctulate; the dorsum of the pronotum, scutum and scutellum, propodeum, petiole and postpetiole are roughly foveolate. The anterior edges and sides of the frontal lobes are shiny with punctures. The metapleural area is covered with fine striae. The posteropropodeum is slightly rough but shiny with sparse punctures.

The head is covered with short (0.10 – 0.12 mm) golden erect hairs. The rest of body surface is covered with moderately long (0.17 – 0.27 mm) golden erect hairs. Hairs on the pygidium and the hypopygium are denser, up to 0.35 mm in length.

The typical color of the female of *B. sculpturata* is brown to dark brown. The Male of *B. sculpturata* is unknown.

**Description:** (n=6)

**Worker Measurements:**

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<tr>
<td>ML</td>
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<tr>
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<td>0.20</td>
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**Worker Description:**

Total length about 9.90 - 11.20 mm; head excluding mandibles subquadrate; anterior margin of clypeus slightly convex (broadly curved) without medial clypeal carina; frontal lobes cover most of medial area of clypeus; mandibles triangular with about 7 teeth; scape shorter, not reaching posterior lateral corner of head; length of malar space from lower edge of eye to base of mandible 0.25 - 0.30 mm; length from upper edge of eye to edge of posterior lobe 1.05 - 1.10 mm; frontal lobes cover medial area of clypeus except very narrow lower margin, width of frontal lobes 0.85 - 0.90 mm; clypeal width between bases of mandibles 1.55 - 1.65 mm; pronotal shoulder rounded; basalar sclerite oval;
mesopleural suture developed; posteropropodeum straight to slightly concave without coarse angular margins; petiole from dorsal view, slightly narrowed anteriorly, vertical, slightly concave posteriorly; mandibles shiny, covered with fine striae; surface of head densely punctulate; sides of head, cheeks, frons, dorsum of pronotum, mesopleuron, metapleuron, postpetiolar dorsum, other gastral segments covered with poorly defined striae; pronotum, mesonotum, mesopleuron, propodeum, lateropropodeum, metapleuron densely foveolate with punctae; posteropropodeum smooth, shiny, petiolar, postpetiolar surfaces covered with larger foveolae than those of mesosoma; entire body including legs, antennae weakly shining; entire dorsum of pronotum, mesonotum, propodeum covered with relatively short (0.06 - 0.20 mm) erect golden hairs; petiole, postpetiole covered with long (up to 0.30 mm) erect to suberect hairs; head, mandibles, pronotum, mesonotum, mesopleuron, propodeum, lateropropodeum, petiole, postpetiole, entire gaster dark reddish brown; legs, antennae light reddish brown.

Female Measurements: (n=2)

HL 2.07 - 2.47, HW 1.90 - 2.30, ML 1.17 - 1.45, EW 0.30 - 0.42, EL 0.35 - 0.47, SL 1.40 - 1.60, FL 1.95 - 2.35, WL 3.25 - 4.00, WPL 4.35 - 5.00, PL 1.00 - 1.10, PW 1.35 - 1.65, PH 1.50 - 1.70, CI 91.78 - 93.11, OI 18.42 - 20.43, MandI 56.52 - 58.70, SI 69.56 - 73.68, PetI 135 - 150

Female Description:

Total length 9.65 – 13.45 mm; head shape excluding mandibles subquadrate; mandibles triangular-shaped, shorter than head length, with 7 teeth, covered with fine striae; lower margin of anterior medial area of clypeus nearly straight to slightly convex, clypeus lacking carina; scape not reaching posterior lateral corner of head; frontal lobes divided by developed frontal furrow; frontal lobes cover most of medial area of clypeus, frontal lobes width 0.87 - 1.00 mm, clypeus width from cheek to cheek 1.60 - 1.85 mm; compound eyes relatively large; malar space from side of head 0.35 - 0.40 mm in length, length from upper edge of eye to highest point of posterior lateral corner of head 0.95 - 1.15 mm; pronotal shoulder rounded; pronotum rounded anteriorly, lower lateral margin straight with sharp inferior pronotal process and anteroinferior process; scutum and scutellum divided by transscutal suture, propodeum and scutellum divided by metanotum; propodeum subquadrate; mesopleural suture distinctive, well developed; propodeal spiracle elongate; petiole subquadrate, rounded anteriorly and slightly concave posteriorly with sharp foveolate posterolateral margins; mesopleuron divided by anapleural sulcus to form lower katepisternum, upper anepisternum; mesosoma winged, modified for
flight; scutum widened anteriorly, reaching same width as pronotum (1.90 - 2 mm), narrowed posteriorly to reach the same width as propodeum (1.50 - 1.45 mm); dorsopropodeum short (0.35 - 0.45 mm); posteropropodeum slightly concave, shiny, rough to sparsely punctate, with long erect hairs arranged on margins; metanotum narrowed, distinctive, slightly elevated, well separated from both propodeum and scutellum; mesopleural-metapleural suture well defined; basalar sclerite rounded; postpetiole with remainder of abdominal segments larger (3.75 - 4.75 mm) than mesosoma (3.40 - 4 mm); head roughly sculptured, coarsely punctulate; frontal lobes covered with fine hairs, punctures, anterior edge and sides of frontal lobes shiny; cheeks, frons, sides of head covered with fine striae; lateropropodeum and metapleuron covered with fine striae; scutellum from dorsal view with small elongate and finely striated medial depression; pronotum, scutum, scutellum, propodeum, petiole, postpetiole roughly sculptured, punctate to foveolate; mesopleuron covered with scattered punctae; petiole, postpetiole and remainder of gaster covered with fine striae; dorsum of postpetiole slightly concave, rough with sparse punctures; posteropropodeum slightly rough, but slightly shiny, with sparse punctures; anterior face of petiole rough, mostly covered with fine hairs; head covered with short (0.10 - 0.12 mm) erect golden hairs; pronotum, scutum, scutellum, petiole, postpetiole and 4th to 6th abdominal segments covered with moderately long (0.17 - 0.27 mm) golden erect hairs, up to 0.35 mm on the 7th abdominal segment, moderately long (0.25 mm) erect hairs arranged on margins of posteropropodeum; entire body including head, mandibles, antennae, clypeus, scapes, pronotum, scutum, scutellum, mesopleuron, propodeum, metapleuron, petiole, postpetiole, legs range from brown to dark brown.

**Comparison:**

**Worker:**

The nearly straight anterior margin of the clypeus of *Bothroponera sculpturata* (= *mlanjiensis*, worker type) appears to be broadly convex (not slightly concave), separating it from the slightly different clypeuses of *B. talpa, B. pachyderma, B. sanguinea, B. cribrata* which is slightly straight to concave. The anterior medial margin of the clypeus of *B. zumpti, B. rubescens, B. fugax* is broadly convex similar to that of *B. sculpturata,* but in these species this area includes a longitudinal clypeal carina. The sculpture in *B. sculpturata* is coarsely punctate to foveolate while the sculpture is less pronounced in the case of *B. talpa, B. pachyderma, B. sanguinea, B. cribrata, B. zumpti, B. rubescens* and *B. fugax.*
This study considered the worker of *B. mlanjiensis* to be a new synonym of *B. sculpturata* based on the associated paratype female with worker of *B. mlanjiensis* from the same nest and compared it with holotype female of *B. sculpturata*. The workers of both species are identical.

**Female:**

The female of *Bothroponera sculpturata* is similar to the females of *B. talpa*, *B. pachyderma* and *B. rubescens*. The traits of *B. sculpturata* are based on two females, one is a holotype of *B. sculpturata* and the other is a paratype of *B. mlanjiensis*. The comparison with a female of *B. talpa*, *B. pachyderma*, *B. zumpti*, *B. rubescens* shows that they are nearly identical. The only significant difference is that *B. sculpturata* female is slightly more sculptured, with a higher density of foveolae than the other members of the *B. talpa* species complex. The anterior medial area of clypeus is straight to slightly convex in *B. sculpturata*, which is different from that straight to slightly concave in *B. talpa*, *B. pachyderma*, *B. cribrata* (worker), *B. sanguinea* (worker), and that broadly convex with sharp carina in *B. zumpti*, *B. rubescens* and *B. fugax* (worker). *Bothroponera sculpturata* is also darker than the brownish and reddish females of *B. talpa*, *B. zumpti* and *B. rubescens*, *B. sculpturata* seems to be more close in color to the female of *B. pachyderma*. In fact, the color of *B. talpa* species complex individuals ranges from light brown, dark brown and reddish to black with exception of *B. cribrata* that I have only the holotype which is yellow.

Although Santschi (1912) described *B. sculpturata* as a subspecies of *B. pumicosa*, it does not appear to be closely related, and *B. pumicosa* has the smooth mandibles characteristic of most of the other species in the *B. pumicosa* species complex. He considered it to be closely related to *B. strigulosa* and *B. cariosa* as they have similar black and reddish color, but that is not the case as they belong to different complexes. On antweb there are pictures of the *B. sculpturata* male, and it seems to be identical to the male of *B. talpa*.

I conclude that the female of *B. mlanjiensis* is identical to *B. sculpturata*. They are both have the same clypeal shape, lacking a carina, rounded frontal lobes that cover most of the medial area of clypeus, same mandibular teeth number (7) and striae, a scape that does not reach the posterior lateral corner of head, striae on the metapleuron area, brown to dark brown surface color and strongly foveolate sculpture.

In 1925, Karavaiev used the *sculpturata* name when he described the *Pachycondyla (Ectomomyrmex) sculpturata* worker from Indonesia (Sumatra), but in 2010, Özdkim re replaced the name of this species with *Pachycondyla sumatrana*. 

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Material examined:

Type material.


Non-type material.


Distribution:

Malawi, South Africa, Zimbabwe and Mozambique (Santschi 1912) Sofala Province, [Tando do Sungue].

Biology and habitat:

A nest of B. sculpturata (= mlanjiensis) was located in shaded forest and clay soil area in Malawi, Mlanje district (The ant of Africa website, accessed 6/2014). The Mlanje district is located in the southeastern Nyasaland area of Malawi at 16°00'00" S, 35°35'00" E. High mountains and plateaus are the main habitat types for the Mlanje area with several threatened and endemic species (Curran et al. 2012). The mountains are generally covered with forest and they are the main source of the river and streams in the district. Diverse climates in Nyasaland support a wide range of vegetation and offer varied habitats for wildlife, agriculture is very poor in the area (Jackson, 1968). The ecosystems in the Mlanje are varied and include the Brachystegia woodland, Copaifera mopane woodland, deciduous forests, thickets, and Acacia with Combretum species in a grass mixture (Jackson, 1968). The mountain grasslands in Mlanje with different vegetation types are considered as protected areas and offer various
habitats for many species of Nyasaland organisms. The organisms that can be found in this protected area include birds, small mammals, reptiles, and invertebrates (Mitchell, 1953). These elevations and habitats should also support speciation of organisms such as ants and the area should have more species than *B. sculpturata*. The specimens of *B. sculpturata (=mlanjiensis)*, one female and eight workers, were collected in the Mulanje area. They were nesting under a leaf partially covered with clay soil and the ants were moving into the shaded forest areas (Arnold, 1946). Human activity is one factor that can eliminate organisms from the area. *Bothroponera sculpturata (=mlanjiensis)* was also collected from KwaZulu-Natal Province at Natal, Mtunzini, South Africa (The Ants of Africa website). The major dominant biomes in the Natal province are savanna, grassland and thicket biomes with several subtypes of biomes that can host different species of small organisms such as ants (Jewitt, 2011).

*B. sculpturata* was also collected from Zambezi, the former name of Zambia. The other type specimen was collected from Mozambique, Province du Gorongoza, Tendo du Songoue (Ant web 08/21/2014) at 18°50' 27" S, 34°25' 15" E.

Map 6.3: The distribution of *B. sculpturata*. 
Figures 15.3-18.3

Fig. 15.3: The lateral view of worker of *B. sculpturata* (Paratype of *B. mlanjiensis*).

Fig. 16.3: The head of worker of *B. sculpturata* (Paratype of *B. mlanjiensis*).

Fig. 17.3: The head of the holotype female of *B. sculpturata*.

Fig. 18.3: The lateral view of the holotype female of *B. sculpturata*. 
Bothroponera talpa André, 1890: 316 (w), Sierra Leone; Wheeler, W. M. 1922b: [72-73] (key); Schmidt and Shattuck, 2014: 76; Pachycondyla (Bothroponera) talpa: Emery, 1899: 473 (q); Emery, 1901: 45; Santschi, 1914d: 314 (q); Wheeler, W.M. 1922d: 773; Pachycondyla talpa: Bolton, 1995: 310.


**Diagnosis:**

**Worker:**

The head surface is rough to punctulate with small dense foveolae, covered with fine striae. The anterior medial clypeal margin is straight to slightly concave. The pronotum is rough and punctate to foveolate while the mesonotum and propodeum are densely punctate to foveolate. The metapleuron is covered with fine striae. The petiole and postpetiole are weakly to densely foveolate, as well as covered with fine striae.

The entire surface from the top of the head, the mesosoma to the petiole and postpetiole along with the 4th - 7th abdominal segments are covered with very fine hairs and long (0.36 mm up to 0.42 mm) erect and suberect golden hairs.

The color is generally brown to light brown.

**Female:**

The female of *B. talpa* can be diagnosed by the subquadrate head shape. The anterior medial margin of the clypeus is nearly straight to slightly concave. The head is roughly sculptured and strongly punctulate. The pronotal shoulder is rounded. The promesonotal suture is well developed, the scutum and scutellum are divided by the transscutal suture, the propodeum and scutellum are divided by the metanotum; the mesopleural suture is distinctive. The propodeum is subquadrate. The mesopleuron is divided by the anapleural sulcus. The mesosoma is winged, modified for flight. The postpetiole and the remainder of the gaster are larger than the mesosoma. The petiole has sharp posterolateral margins.

In general, the dorsum of the pronotum, scutum and scutellum, propodeum, petiole and postpetiole are roughly sculptured, moderately covered with punctures and densely foveolate; the
anterior edges and sides of the frontal lobes are shiny with punctures; the metapleural area is covered with fine striae. The entire surface of the pronotum, scutellum, scutum, propodeum, petiole and postpetiole is covered with fine striae. The posteropropodeum is slightly smooth with sparse punctures and slightly shiny.

The head is covered with short (0.20 mm - 0.30 mm) erect golden hairs. The rest of the body surface is covered with long (0.25 mm - 0.50 mm) scattered erect hairs.

The typical color of the female of *B. talpa* is brown, reddish brown and light brown. The Male is unknown.

**Descriptions:**

**Worker Measurements: (n=79)**

- HL 1.65 - 2.10, HW 1.58 - 2.00, ML 1.00 - 1.15, EW 0.17 - 0.25, EL 0.15 - 0.25, SL 1.05 - 1.35, FL 1.85 - 2.25, WL 2.45 - 3.10, WPL 3.30 - 3.90, PL 0.85 - 1.00, PW 1.07 - 1.30, PH 1.25 - 1.53, CI 95.23 - 95.75, OI 9.49 - 12.5, MandI 54.76 - 60.60, SI 66.45 - 67.5, PetI 125.88 – 130

**Worker Description:**

Total length 8.10 - 9.95 mm; mandibles covered with fine striae, 7 toothed; head subquadrate, rough, densely punctulate; fine striae present on frons, sides of head, gena; anterior medial margin of clypeus straight to slightly concave, clypeus lacking carina, clypeal length 1.40 - 1.60 mm; frontal lobes well developed with frontal furrow, cover large area of clypeus, frontal lobes width 0.75 - 0.90 mm; malar space from side of head 0.24 - 0.45 mm, length from upper edge of eye to posterior lateral corner of head 1.00 - 1.20 mm; scape fails to reach posterior lateral corner of head; eyes range from small to large; pronotum rough, punctate; mesopleural suture well developed; basalar sclerite rounded; mesonotum, propodeum densely punctate to foveolate, moderately shiny on dorsal face; metapleuron, lateropropodeum covered with fine striae; petiole, postpetiole densely foveolate, covered with fine striae on dorsum; top of head covered with moderately long (0.15 - 0.25 mm) erect hairs; dorsum of pronotum, mesonotum, dorsopropodeum covered with long (0.20 - 0.33 mm) erect scattered hairs; dorsum of petiole covered with long (0.30 - 0.42 mm) erect hairs; postpetiole covered with long (0.30 - 0.40 mm) erect hairs; most surfaces brownish black; legs, antennae, mandibles, clypeus brownish red to black especially at margins.
Female Measurements: (n=5)

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Female Description:

Total length 10.40 - 11.60 mm; head shape excluding mandibles subquadrate; mandibles triangular-shaped, shorter than head length, with 7 teeth; covered with fine striae; lower anterior medial margin of clypeus slightly concave, clypeus lacking carina; scape not reaching posterior lateral corner of head; frontal lobes divided by developed frontal furrow; frontal lobes cover most of medial area of clypeus, frontal lobes width 0.90 - 0.95 mm, clypeus width from cheek to cheek 1.65 - 1.85 mm; compound eyes relatively large; malar space from side of head 0.30 - 0.45 mm in length, length from upper edge of eye to highest point of posterior lateral corner of head 1.05 - 1.10 mm; pronotal shoulder rounded; lower lateral margin of pronotum straight with sharp angles at inferior pronotal process and anteroinferior pronotal process; scutum and scutellum divided by transscutal suture, propodeum and scutellum divided by metanotum; mesopleural suture distinctict, well developed; propodeal spiracle elongate; petiole subquadrate, rounded anteriorly and slightly concave posteriorly with sharp posterolateral margins (seen from above); mesopleuron divided by anapleural sulcus; mesosoma winged, modified for flight; scutum widened anteriorly, reaching same width as pronotum (1.75 - 1.90 mm), narrowed posteriorly to reach the same width as propodeum (1.25 - 1.50 mm); scutum, scutellum slightly raised (lateral view); dorsopropodeum short (0.30 - 0.40 mm), sub-rectangular shaped (dorsal view); posteropropodeum slightly concave, rough to sparsely punctate, with long erect hairs arranged on margins; metanotum narrowed, distinctive, elevated, well separated from both propodeum and scutellum; mesopleuron divided by anapleural sulcus to form lower katepisternum, upper anepisternum; mesopleural-metapleural suture well defined; basalar sclerite rounded; postpetiole with remainder of abdominal segments larger (4.10 - 4.50 mm) than mesosoma (3.35 - 3.40 mm); head roughly sculptured, coarsely punctulate; frontal lobes covered with fine hairs, punctures, anterior edge and sides of frontal lobes shiny; cheeks, frons, sides of head covered with fine striae; lateropropodeum and metapleuron covered with fine striae; scutellum from dorsal view has small elongate and finely striated medial depression; pronotum, scutum, scutellum, propodeum, petiole, postpetiole roughly sculptured, moderately punctate and foveolate; mesopleuron covered with scattered punctae; petiole, postpetiole
and remainder of gaster covered with fine striae; dorsum of postpetiole slightly depressed medially, rough with sparse punctures, anterior face of petiole rough, mostly covered with fine hairs; head covered with moderately short (0.20 - 0.30 mm) erect golden hairs; pronotum, scutum, scutellum covered with moderately long erect hairs (from 0.25 mm up to 0.30 mm), dorsopropodeum covered with longer (up to 0.35 mm) erect hairs, long (0.35 mm) erect hairs arranged on margins of posteropropodeum, hairs on dorsum of petiole and postpetiole (0.35 mm. up to 0.50 mm) on the 4th to 7th abdominal segments; head, mandibles, antennae, clypeus, scapes, pronotum, scutum, scutellum, mesopleuron, propodeum, metapleuron, petiole, postpetiole, legs range from light brown, brown to dark brown.

**Comparison:**

**Worker:**

The worker of *Bothroponera talpa* is similar to those of *B. sculpturata*, *B. cribrata*, *B. zumpti*, *B. rubescens*, *B. fugax*, *B. pachyderma* and *B. sanguinea* in the *B. talpa* species complex. They have similar heads, mesosomata, petioles, gastral segments and color. However, it is easy to separate *B. talpa* from the other members in the complex by examining the anterior medial area of clypeus, the basalar sclerite shape and size, the hairs on the surface of head and other surfaces total body length and sculpture differences. The lower margin of the anterior medial border of the clypeus is straight to slightly concave in *B. talpa*, similar to *B. pachyderma*, *B. sanguinea*, *B. cribrata*. The lower margin is broadly convex, lacking a carina in *B. sculpturata*, but it looks broadly convex with a sharp carina that extends longitudinally in *B. zumpti*, *B. fugax* and *B. rubescens*. *Bothroponera cribrata* can be separated from *B. talpa* by having a partial development of the anapleural sulcus. The striae on *B. cribrata* surface are poorly defined. The basalar sclerite is rounded in both the worker and female of *B. talpa*, similar to that in *B. fugax* and *B. zumpti*, in contrast, oval in the workers of *B. sculpturata* and *B. pachyderma*. The basalar sclerite seems to be semi-oval in *B. cribrata*, *B. sanguinea*, but looks rounded to oval in the females of *B. rubescens* and *B. sculpturata*.

Fine abundant golden hairs cover the entire surface, denser on the frons and top of the head and dorsum of the mesosoma and gaster. Moderately dense erect hairs are spread on top of the head and frons.

The workers of *B. talpa* have a total size range from 8.10 - 9.95 mm, which is larger than that of *B. zumpti* (6.00 – 6.80 mm) and *B. fugax* (7.40 mm), smaller than that of *B. pachyderma* (9.00 mm about the same size as *B. pachyderma*) and *B. cribrata* (10.90 - 14.95 mm), *B. sanguinea* (10.70 mm), and *B.
sculpturata (11.90 - 11.20 mm), B. sculpturata (11.10 mm), B. sanguinea (11.30 mm), B. clavicornis (11.75 mm). Emery (1901) described B. pachyderma, he did not mention B. talpa or any others.

The sculpture is rough and covered with moderately to poorly defined punctae and foveolae in B. talpa, but it is rough with well-defined foveolae in B. pachyderma. In B. sanguinea, the sculpture is rough with poorly defined foveolae.

**Female:**

The B. talpa female is similar to those of B. rubescens, B. sculpturata, B. zumpti and B. pachyderma females. It is easy to separate B. rubescens and B. zumpti from the others as the lower medial margin of the clypeus is convex and has a carina, while the anterior medial area of the clypeus is straight to slightly concave without a carina in B. talpa, B. sculpturata, and B. pachyderma. The dorsum of the body is covered with long hairs in B. talpa that range from 0.15 - 0.40 mm whereas in B. rubescens it is covered with very fine short hairs and moderately long scattered hairs that range from 0.15 - 0.21 mm. The head of B. talpa is larger than that of B. rubescens and B. zumpti; likewise, the body size is larger than B. rubescens and B. zumpti, smaller than B. pachyderma and B. sculpturata. The total size of female of B. talpa is 10.40 - 11.75 mm, in B. pachyderma it is 11.55 – 15.90, in B. sculpturata 9.65 – 13.45, in B. rubescens 7.10 - 7.80 mm, in B. zumpti 7.85 mm.

The description of female holotype of *Psalidomyrmex clavicornis* is identical to that of female of Bothroponera talpa. The total length of *P. clavicornis* is 11.75 mm; the malar space from the side of the head is 0.35 - 0.45 mm in length, the length from upper edge of eye to highest point of posterior lateral corner of head 1.10 - 1.15 mm; there is a smooth shiny line on the medial area of the mesosoma from the pronotum to the scutellum (dorsal view), poorly defined striae on the scutellum, the scutum is widened anteriorly, reaching the same width as the pronotum (1.70 mm), which is narrowed posteriorly to reach the same width as the propodeum (1.65 mm). The posterior width of the propodeum is 1.00 mm, the dorsopropodeum is short (0.25 mm). The postpetiole with the remainder of the gaster is slightly larger than the mesosoma (4.00 mm for postpetiole with gaster, 3.65 mm for mesosoma). The head is covered with short (0.15 - 0.25 mm) erect golden hairs, the pronotum, scutum, scutellum and dorsopropodeum are covered with long (0.35 mm) scattered erect hairs, the dorsum of the petiole is covered with long (0.40 mm) erect hairs. The dorsum of the postpetiole with the remainder of the abdominal segments are covered with long (0.35 to 0.40 mm) erect and suberect hairs. The head, mandibles, pronotum, scutum, scutellum, mesopleuron, propodeum, metapleuron, petiole, and postpetiole are brown to reddish brown. Bolton (1975) considered *Psalidomyrmex clavicornis* to be a synonym of B. talpa. Comparison of the
holotype female of *B. clavicornis* with females of *B. talpa* shows them to be identical. Generally, they are similar to females of *B. sculpturata* and *B. pachyderma* with specific variations. *Bothroponera clavicornis* is slightly darker than females of *B. sculpturata, B. pachyderma* and *B. talpa*. The total length of the female of *B. talpa* ranges from 10.40 to 11.25 mm, similarly, the total length of *B. clavicornis* is 11.75 mm, which overlap with that of *B. sculpturata* (9.65 – 13.45 mm). Thus I agree with Bolton (1975) that *B. clavicornis* is a synonym of *B. talpa*.

**Material examined:** (79 workers and 5 females)

**Type material.**

**GUINEA:** Nimba, M. Lamotte, Camp 4 (1000 m) II.VI.42, Museum of Paris type Psalidomyrmex clavicornis (1 q # EY6717, MNHN).

**Non-type material.**

**ANGOLA:** Lunda Sul Province, Gallery forest R. Kamuaji, trib Dilolo, trib Chiumbe, 9°49'59.99" S, 21°3'0.0" E, berlesate by native collector, 24-i-1963 (2w MCZC); Salazar, Province do Cuanza Norte, 9°18'0" S, 14°55'0" E, I. I. A. A. 9–15-iii-1972, P. Hammond (A26), Pachycondyla talpa Andre (2 w # 315955 LACM). Duque de Bregan fd falls, River bank, Malanje Province, 9°6'0" S, 15°57'0" E, 12-iii-1972, Phammond, southern African Exp., B. M.1972-1, B. talpa (2w, BMNH).

**CAMEROON:** MTE Camerun: Buea, South West Province, 4°34'0" N, 9°50'0" E, 800-1200 m.s.m., vi.vii-1902, L. Fea, Stessa colonia, Museo Civico di Genova (17w and 1q MCSN). Ebodjie [Ebodie] Southern Province, Compo district, 2°34'0" N, 9°50'0" E, 4.xi. 91, A. Dejean, B. talpa (2w, BMNH).

**CONGO:** Brazzaville: Irangi, Luhoho River, 900 m, 1°31'0" S; 28°4'0" E, 10-ix-1957, E. S. Ross & R. E. Leech, Bothroponera talpa (1w MCZC); Niangara, 3°42'0" N, 27°52'0" E, Stomach Bufo funereus, H O Lang, Bothroponera talpa B550.51 (1w, AMNH); Medje, 2°25'0" N, 27°18'0" E, Stomach Bufo funereus, H O Lang, Bothroponera talpa Ernest André 3022 (1w, AMNH); KENYA: Western Province, E 34°50' 24" N 0°57'40.8", Kakamega Forest, Kaimosi Transect 30, 04.08.2008, 1600 m, leg. Georg Fischer; Kaimosi Forest Fragment primary forest Transect 30, 110 m, Kakamega 2008 survey, Leaf litter, Pitfall trap, LACM ENT 315956 (1w, LACM). Kakamega District: Isecheno Natural Reserve, 0.24 N, 34.87 E, 1800m, 15-v-2001, #01-386, Equatorial rainforest: under stone, Coll. R. R. Snelling, Pachycondyla talpa, LACM ENT 315992, 315954 (4w LACM). Kakamega District: Isecheno Natural Reserve, Isecheno, 0.24 N, 34.87 E, 1800m, 15 May 2001, #01-386, Equatorial
**Distribution:**

*Bothroponera talpa* is distributed from Kenya to Uganda in the Eastern part of Africa. It is also found in Cameroon, Congo Brazzaville and Angola of Central Africa and Guinea of the western countries.

**Biology and habitat:**

*Bothroponera talpa* is mainly collected in areas that are characterized by various habitats, which suggests that this species is highly adaptive and occurs in diverse ecosystems. Workers of *B. talpa* were extracted from stomachs of the toads *Bufo superciliaris, Bufo polycercus* and *Bufo funereus*. *Bufo* species are mainly found in Africa at low altitudes, in secondary forest and in tall primary forest, dense brush and cocoa plantations, which reflects the actual habitat of *Bothroponera* in tropical habitats (www.arkive.org website, accessed April 2013 and November 2014). *Bothroponera talpa* is widespread in Africa. Researchers have been actively working with this species, especially from 1999 – 2004 and in 2008. They collected samples mainly from the equatorial rainforests using methods such as pitfall traps. They excavated nests underground, from sifted leaf litter and sifted rotten log debris. The specimens were also collected from sifted litter between tree buttresses, under bark of logs, under stones and in leaf litter.

![Map 7.3: The distribution of B. talpa.](image-url)
Figures 19.3-22.3

Fig. 19.3: The lateral view of a worker of *B. talpa* from Uganda (MCZC).

Fig. 20.3: The head of a worker of *B. talpa* from Uganda (MCZC).

Fig. 21.3: The head of a female of *B. talpa* from Kenya-Uganda (MCZC).

Fig. 22.3: The lateral view of a female of *B. talpa* from Kenya-Uganda (MCZC).
Bothroponera zumpti Santschi
Figures 23.3 – 26.3 and Plate 11.3; Map 8.3


**Diagnosis:**

**Worker:**

The anterior medial margin of the clypeus is convex, strongly curved. The sharp clypeal carina is present between the lower edges of the frontal lobes to the lower margin of the medial anterior border of the clypeus. The frontal lobes cover most of the medial area of the clypeus and tend to divide the clypeus. The basalar sclerite small, rounded to oval. The head is rough, moderately punctulate and mostly foveolae. The frons, sides of the head and the gena are covered with very fine striae. The mesosomal length is nearly equal to the length of the postpetiole and gastral segments, but this probably because the 6th and 7th abdominal segments are compressed into the remainder of the gaster.

The pronotum, mesonotum and propodeum are roughly sculptured, punctate and foveolate. The petiole and postpetiole are densely punctate to foveolate. The petiole is nearly rounded anteriorly and straight posteriorly (seen from above). Fine striae cover the entire body.

The entire surface of the body is covered with fine erect and suberect hairs scattered on the dorsum of the pronotum, mesonotum, propodeum, petiole and postpetiole. The frons and top of the head are covered with short (0.10 - 0.11 mm) silver erect hairs. The entire mesosoma is covered with moderately short (0.07 - 0.10 mm) erect hairs. Moderately long (0.20 - 0.25 mm) erect hairs are present on the margins of the posteropropodeum. The erect hairs scattered on the petiole are moderately short (up to 0.18 mm). The postpetiole and 4th to 7th abdominal segments are covered with scattered moderately long (0.16 - 0.21 mm) erect hairs.

In general, the color is light yellowish to brown.

**Female:**

The female of *B. zumpti* can be recognized by the small size (7.85 mm) among *B. talpa* species complex members. The medial area of the clypeus is slightly convex, with a well-developed sharp carina that extends from the lower medial margin of the frontal lobe to the anterior medial margin of the clypeus. The mandibles have 7 teeth. The frontal lobes cover most of the medial area of clypeus. The metapleural area is covered with fine striae. The basalar sclerite is small, rounded to oval.
The dorsum of the head, pronotum, scutellum, scutum, metanotum, mesopleuron and propodeum are roughly sculptured, densely punctate and weakly shining. The petiole and postpetiole are densely punctate. The petiole is nearly square (side view) with a slight depression medially on the upper posterior edge (top view). The postpetiole and remainder of the abdominal segments are rough and covered with sparse shallow punctures; the postpetiole and 4th to 7th abdominal segments are larger than the mesosoma.

The frons and the top of the head are covered with short (0.15 - 0.18 mm) erect hairs. The sides of the head lack any evidence of erect hairs. The dorsal surface of the pronotum, scutum, scutellum and propodeum are covered with fine hairs, with moderately short (0.10 - 0.18 mm) scattered erect hairs, the petiole and postpetiole are covered with moderately long (0.20 - 0.25 mm) scattered erect hairs. The sides of posteropropodeum are covered with a few long (0.25 - 0.26 mm) erect hairs arranged on the margins.

The mandibles, head, scape, funiculus, clypeus, pronotum, scutellum, scutum, metanotum, mesopleuron, propodeum, legs, petiole and postpetiole are brown, dark brown to brown reddish.

The male is unknown.

**Description:**

**Worker Measurements: (n=7)**

*HL 1.30 - 1.50, HW 1.15 - 1.35, ML 0.75 - 0.85, EW 0.10 - 0.15, EL 0.11 - 0.20, SL 0.80 - 0.96, FL 1.25 - 1.55, WL 1.75 - 2.10, WPL 2.35 - 2.76, PL 0.55 - 0.66, PW 0.75 - 0.90, PH 0.85 - 1.20, CI 88.46 - 90, OI 9.56 - 14.81, MandI 56.66 - 57.69, SI 69.56 - 71.11, PetI 136.36*

**Worker Description:**

Total length 6.00 - 6.80 mm; head densely punctulate, entire head covered with very fine striae; anterior medial margin of clypeus convex, covered posteriorly by frontal lobes; sharp clypeal carina present; compound eyes relatively small; malar space length on side of head 0.15 mm, length from upper edge of eye to posterior lateral corner of head 0.80 mm; pronotum, mesonotum, propodeum rough, punctate, foveolate; petiole, postpetiole densely punctate, foveolate; petiole length 0.60 mm in dorsal view; sternopetiolar process toothed posteriorly with one anterior spine pointed ventrally; entire surface covered with fine hairs and with moderately dense erect, suberect pubescence scattered on dorsum of pronotum, mesonotum, propodeum, petiole, postpetiole, 4th to 7th abdominal segments (length of hairs
0.07 - 0.25 mm); body light yellowish to brown; legs, mandibles, funiculus, antennae, clypeus pale brownish.

**Female Measurements: (n=1)**

- HL 1.60, HW 1.40, ML 0.80, EW 0.25, EL 0.30, SL 0.95, FL 1.60, WL 2.45, WPL 3.10, PL 0.60, PW 0.97, PH 1.05, CI 87.5, OI 21.42, MandI 50, SI 67.85, PetI 161.66

**Female Description:**

Total length 7.85 mm; medial area of clypeus convex, with well-developed sharp longitudinal carina that extends from lower medial margin of frontal lobe to anterior medial margin of clypeus; mandibles covered with fine striae, with 7 teeth; scape slightly curved, not reaching posterior lateral corner of head; malar space from side of head 0.15 mm; length from upper margin of eye to highest point of posterior border of head 0.75 mm; eyes large; frontal lobes cover most of medial area of clypeus, total width 0.60 mm; clypeal width between bases of mandibles 1.10 mm; pronotum rounded anteriorly, lower margin of pronotum straight with angled extremes (lateral view); scutum widened; anapleural suture well developed; mesosoma winged and modified for flight; posteropropodeum slightly concave with granulated margins; propodeal spiracles parallel with meso-metapleural suture; metapleural area covered with fine striae; petiole rounded anteriorly, slightly concave posteriorly with coarse, angular posterior margins; head roughly sculptured, moderately punctulate, frontal lobes shiny with scattered punctures (appearing somewhat granulate); dorsum of head, pronotum, scutellum, scutum, metanotum, mesopleuron, propodeum roughly sculptured, densely punctate, weakly shining; petiole, postpetiole densely punctate; petiole nearly square (side view) with slight depression medially on upper posterior edge; postpetiole and remainder of abdominal segments rough and covered with sparse shallow punctures; postpetiole and gastral segments larger than mesosoma; dorsal surface of pronotum, scutum, scutellum and propodeum covered with fine hairs, with moderately short (0.10 - 0.18 mm) erect hairs, petiole covered with moderately long (0.20 - 0.21 mm) erect hairs; postpetiole and 4th to 7th abdominal segments covered with slightly longer (0.20 – 0.25 mm) erect hairs; mandibles, head, scape, funiculus, clypeus, pronotum, scutellum, scutum, metanotum, mesopleuron, propodeum, legs, petiole and postpetiole brown, dark brown to reddish brown.
Comparison:

Worker:

The Bothroponera zumpti worker is similar to the worker of B. fugax, but with some important differences. The medial margin of the clypeus is convex, strongly curved with the clypeal carina present in both species, but the clypeal carina is more developed in B. fugax than that in B. zumpti. Santschi (1937) described B. zumpti and compared it to B. fugax, in that it differs in abundance of hairs, sculpture, and color. The color appears not to be an important character as I have yellow and brown specimens of B. zumpti. The head of B. zumpti is covered with few short (up to 0.15 mm) erect scattered hairs, as well as the pronotum (0.20 mm), mesonotum, propodeum, petiole, postpetiole and sterna of the gastral segments, which are moderately covered with suberect and erect hairs (up to 0.25 mm). The body surface of B. fugax is covered with dense fine hairs less than 0.05 mm in length on the head and mesosoma, to less than 0.10 mm on the petiole and postpetiole, the gastral sternum is covered with moderately short hairs (0.15 - 0.20 mm). Bothroponera fugax essentially lacks erect hairs on the entire surface. The sculpture of B zumpti is mostly foveolate, but in B. fugax the surface is mainly granulated without foveolae. The mandibular teeth number in B. zumpti is 7 while in B. fugax it is 6. The total body length of B. zumpti ranges from 6.00 - 6.80 mm, which is less than that of B. fugax (7.40 mm), B. rubescens (7.10 – 7.80 mm), B. cribrata (9.00 mm), B. talpa (8.10 – 9.95 mm), B. pachyderma (10.90 - 14.95 mm), B. sculpturata (9.90 - 11.20) mm and B. sanguinea 10.70 mm. As a result of this comparison, I would consider B. zumpti and B. fugax to both be valid species.

Female:

The B. zumpti female is similar to the other females in the B. talpa species complex including B. rubescens, B. talpa, B. pachyderma and B. sculpturata. The main distinguishing characters are clypeus formation, clypeal carina development, color, sculpture, body size, teeth number and hairs. The lower medial edge of the clypeus of B. zumpti is convex and broadly curved and mediated by a sharp carina that extends longitudinally while the lower medial areas of the clypeuses of B. talpa, B. pachyderma, B. sculpturata females are straight and slightly concave without carinas. The B. zumpti female is quite similar to that of B. rubescens with slight differences. The lower anterior medial margin of the clypeus is convex with a longitudinal carina present in the two species. The clypeal carina of B. rubescens is less developed whereas the clypeal carina of B. zumpti is more developed. The color of B. zumpti is dark brownish to reddish brown while B. rubescens is reddish brown. The sculpture in B. zumpti is rough,
densely punctulate and granulate without foveolae, whereas it is rough, moderately punctate and mostly
foveolate in B. rubescens, and it is foveolate in B. talpa, B. pachyderma and B. sculpturata. The female
of B. zumpti can be recognized by the small size (7.85 mm) among B. talpa species complex members,
which is close to B. rubescens total length (7.10 – 7.80 mm). The number of mandibular teeth differs
from 6 in B. rubescens to 7 in B. zumpti, B. talpa, B. pachyderma and B. sculpturata.

Material examined:

Type material.

CAMEROON: Missellele, Umg. Kamerunberg Missellele, 6°21'0" S, 9° 35'0" E, Dr. F. Zumpt leg.  Eing. Nr. 7,1986; B. zumpti Santschi; Sammlung Dr. F. Santschi Kairouan (1w, holotype, NHMB).

Non-type material.

ANGOLA: Dundo, Carrisso Park gallery for., R. Luachimo, 7°22'0" S, 20°50'0" E, berlesate by Luna de Carvalho, 13-i-1964, B. fugax (1w compared with type of B. fugax by W, Brown MCZC). CAMEROON: Centre Province, Mbalmayo, 3°31'0" N; 11°30'0" E, xi.1993 N. Stork, Ilekont. 6, Pachycondyla fugax (3w, BMNH). GHANA: Kwaebibirem District, Eastern Kade, 6°5'0" N; 0°50'0" W, 12.x.1992, collector R. Belshaw, leaf litter, secondary forest, Pachycondyla fugax (1w and 1q, BMNH).

Distribution:

Known from Cameroon, Ghana, Effiduase 6°6'0" N; 0°16'0" W, Bobiri Forest Reserve (primary forest) 6°38'0" N; 1°17'0" W, Atewa [Atwewa] Forest Reserve (primary forest) 4°46'0" N; 1°58'0" W (near Sagymasi [Sagyimase, 6°14'0" N; 0°31'0" W]) (Belshaw and Bolton 1994) and Angola.

Biology and habitat:

The Bothroponera zumpti (type specimen) was collected from Missellele, Mount Cameroon. This area located in the Southwest of the country at the Atlantic Ocean shores (Guinea Gulf) at Mount Cameroon National Park. The area is composed of volcanic mountains; the highest elevation is 4,095 meters, with rainfall up to 10,000 mm per year on the coasts, 1,700 mm per year in the north (Watts, 1994). The habitat around Mount Cameroon is characterized by rainforest, producing productive ecosystems that contain high biodiversity with an important area of conservation plans for endemic
organisms (flora and fauna) and some endangered species (Ambrose-oji, 2003). The importance of this region is due to the volcanic activity that causes fertile soils, with rainfall that occurs mainly on the west side of the mountains due to a rain shadow effect. The rainforest that surrounds these mountains results in various biomes ranging from mountains, and includes canopy lowland, vegetation from evergreen forest to savannah and grassland (Ambrose-oji, 2003; Watts, 1994, britannica.com and mount-cameroon.org). In general, the habitat in Cameroon is variable and supportive in that it contains various species that belong to several genera in subfamily Ponerinae such as *Feroponera ferox* (Bolton & Fisher, 2008a), *Loboponera subatra* (Bolton & Brown, 2002), *Brachydroponera senaarensis* var. *ruginota* (Stitz, 1916: 372), *Hypoponera odiosa* (Bolton & Fisher, 2011), *Plectroctena cristata* Emery, (1899: 470), *Plectroctena thau* (Fisher, 2006), *Leptogenys amon, L. bubastis, L. camerunensis*. (Bolton, 1975a). The species of *Bothroponera* that can be in Cameroon include *Bothroponera pachyderma, B. soror* and *B. zumpti*. In Ghana, 12 workers were found by Belshaw & Bolton (1994) in leaf litter samples from cocoa at Effiduase and Nankasi, primary forest at Bobiri, and secondary forest at Atewa Forest Reserve. Presence of *B. zumpti* in these three distant areas in Ghana, Cameroon and Angola supports the wide range dispersion of this species in the Afrotropics.

Map 8.3: The distribution of *B. zumpti*.
Figures 23.3-26.3

Fig. 23.3: The lateral view of the holotype worker of *B. zumpti*.

Fig. 24.3: The head of the holotype worker of *B. zumpti*.

Fig. 25.3: The head of a female of *B. zumpti*, from Ghana (BMNH).

Fig. 26.3: The lateral view of a female of *B. zumpti*, from Ghana (BMNH).
Plates of workers and females in the *B. talpa* species complex

Plate 1.3: *Bothroponera cribrata*, holotype worker.
Plate 2.3: Bothroponera fugax, holotype worker.
Plate 3.3: *Bothroponera pachyderma*, worker (*B. attenuata* holotype).
Plate 4.3: *Bothroponera pachyderma*, paralectotype female.
Plate 5.3: Bothroponera rubescens, holotype female.
Plate 6.3: *Bothroponera sanguinea*, holotype worker.
Plate 7.3: *Bothroponera sculpturata*, worker (*B. mlanjiensis* paratype)
Plate 8.3: *Bothroponera sculpturata*, lectotype female.
Plate 9.3: *Bothroponera talpa*, worker.
(ANT website).
Plate 10.3: *Bothroponera talpa*, female from Uganda.
Plate 11.3: *Bothroponera zumpti*, holotype worker.
References


Mlanjensis web sites 1, 2 and 3.

[Web1.
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[Web2.
  http://www.discoverlife.org/proceedings/0000/7/orgs/Pachycondyla/mlanjiensis/pachycondyla_mlanjiensis.html, accessed 6/7/2014]


Santschi, F. 1937b. Résultats entomologiques d'un voyage au Cameroun. Formicides récoltés par Mr. le Dr. F. Zumpt. *Mitteilungen der Schweizerischen Entomologischen Gesellschaft* 17: 93-104.


Conclusion

This is a revision of the Afrotropical species of the genus *Bothroponera* excluding Madagascar. The classification of *Bothroponera* has been unclear since 1862, when Mayr described the genus. In the past, researchers have not agreed on specific status of this group of ants. The conservationists, botanists, myrmecologists, biosystematics researchers, ecologists and many other scientists need to have a clear understanding of the organisms that they deal with in the field or in the laboratory. That is why it is important to define the species and provide keys and comparisons. This *Bothroponera* revision was conducted to clarify and understand the *Bothroponera* complexes.

The results from this study are beneficial to the field of ecology and evolutionary biology. This revision resulted in better defining three major species complexes of *Bothroponera* (B. sulcata species complex, B. pumicosa species complex and B. talpa species complex), based on morphology. Each complex includes a number of species that are carefully addressed to define their taxonomy, ecology, biology and biogeographic differences. Keys were given for each complex to ensure that species are easy to identify. The scope of this study will open doors for several kinds of ecological and biological studies such as the species & speciation studies and conservational studies of Afrotropical fauna.

Members of *Bothroponera* are distributed in Afrotropical areas, Madagascar, India and Philippines, absent from the New World and Australia. The B. pumicosa species complex and B. talpa species complex are restricted to Africa and Madagascar with some species endemic in specific regions of Africa. These species are distributed in the biodiversity hotspot areas in Africa that include Guinea Forests of West Africa, Eastern Afromontane forests, the Horn of Africa, Coastal Forests of Eastern Africa, Succulent Karoo and Cape Floristic Region (www.conservation.org, accessed 10/10/2014). The B. sulcata species complex has a wider distribution that reaches India, Southeast Asia and the Philippines.

As a result of this study, the genus *Bothroponera* is fully revised in the Afrotropical area. The revision of the *Bothroponera* in Malagasy area was provided by Rakotonirina and Fisher (2013). This genus includes 29 valid extant species. I grouped them into three complexes that are distributed in the Afrotropical areas (tropical and subtropical areas). Finally, to complete future revisionary studies in any part of the world, it is necessary to collected information similar to that mentioned above. By doing this, we will be able to decide which genera are more important than others to continue the study of ant taxonomy and biosystematics.
The three complexes of Afrotropical *Bothroponera* are:

**B. pumicosa species complex. 10 species**

*Bothroponera aspera* Arnold, 1962, South Africa  
*B. berthoudi* Forel, 1890, South Africa  
(=*B. variolosa*)  
*B. cariosa* Emery, 1895, Mozambique  
*B. cavernosa* Roger, 1860, South Africa  
*B. granosa* Roger, 1860, South Africa  
*B. laevisima* Arnold, 1915, South Africa  
*B. montivaga* Arnold, 1947, South Africa  
*B. pumicosa* Roger, 1860, South Africa  
*B. strigulosa* Emery, 1895, South Africa  
*B. umgodikulula* Joma and Mackay, 2013, South Africa

**B. sulcata species complex. 11 species**

*B. ancilla* Emery, 1899, Congo  
*B. crassa* Emery, 1877, Eritrea  
*B. crassior* Santschi, 1930, Kenya  
(=*B. ilgii*, =*B. gamzea*)  
*B. kenyensis* Santschi, 1937, Kenya  
*B. kruegeri* Forel, 1910a South Africa  
(=*B. asina*, =*B. rhodesiana*)  
*B. picardi* Forel, 1901, Angola  
*B. silvestrii* Santschi, 1914c, Ghana  
(=*B. nimba*)  
*B. soror* Emery, 1899, Cameroon  
(=*B. suturalis*)  
*B. notaula* Joma and Mackay 2014 Tanzania  
*B. ryderae* Joma and Mackay 2014 Guinea, Nigeria  
*B. pilosuperficia* Joma and Mackay 2014 Gabon
**B. talpa species complex. 8 species**

*Bothroponera cribrata* Santschi, 1910, Congo

*B. fugax* Forel, 1907, Tanzania

*B. pachyderma* Emery, 1901 Cameroon

(= *B. pachyderma attenata*, =*B. pachyderma postsquamosa*, =*B. funerea*)

*B. rubescens* Santschi, 1937, DRC

*B. sanguinea* Santschi, 1920, DRC

*B. sculpturata* Santschi, 1920

(= *B. mlanjiensis*)

*B. talpa* André, 1890 Sierra Leone

(= *Psalidomyrmyx clavicornis*)

*B. zumpti* Santschi, 1937 Cameroon.
Curriculum Vitae

Abdulmeneem Joma earned his Bachelor of Sciences degree in Zoology from Sebha University-Libya in 1992. He received his Master of Science degree in Ecology in 2004 from Sebha University-Libya. In 2010 he entered the doctoral program in Ecology and Evolutionary Biology at The University of Texas at El Paso.

Dr. Joma has been the recipient of numerous honors and awards including a Scholarship from the Ministry of Higher Education-Libya and a Graduate School travel funding grant from the University of Texas at El Paso. He was also a recipient of travel grants for research from Canadian Bureau for International Education (CBIE) and Libyan North American Scholarship program.

While pursuing his degree, Dr. Joma worked as a research associate and assistant instructor for the Department of Biological Sciences at UTEP.

Dr. Joma has published two papers in two different journals, the *Herpetologica Journal* and the *Journal of Entomology, Psyche*. He published a book on desert ecology.

Dr. Joma’s dissertation, Revision of the ants genus *Bothroponera* (Hymenoptera: Formicidae: Ponerinae) from the African continent, was supervised by Dr. William P. Mackay.

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