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Revision of the African ants of the *Bothroponera sulcata* species complex (Hymenoptera: Formicidae: Ponerinae)

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ABSTRACT

The *Bothroponera sulcata* ant species complex is distributed in Afrotropical areas, including tropical and subtropical ecosystems and is part of a poorly known group of ants. The *sulcata* species complex now includes 10 species, including 3 new species, 2 taxa elevated to species status and 7 new synonyms: *B. ancilla* Emery, *B. crassa* Emery, *B. crassior* Santschi (= *B. ilgii* syn. nov., *Pachycondyla* (*Bothroponera*) *crassa* st. *crassior* var. *andrieui* referred here), *B. kruegeri* Forel (= *B. asina* **s**yn. nov., = *B. rhodesiana* syn. nov.), *B. notaula* (sp. nov.), *B. picardi* Forel, *B. pilosuperficia* (sp. nov.), *B. ryderae* (sp. nov.), *B. silvestrii* Santschi (= *B. kenyensis* syn. nov., = *B. nimba* syn. nov.) and *B. soror* Emery *(= B. lamottei* syn. nov., = *B. suturalis* (syn. nov.). The main defining character of this complex 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 and posterior dorsopropodeal 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.

Key words: Afrotropical, ants, Formicidae, biodiversity

INTRODUCTION

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 genus *Bothroponera* includes 43 taxa, distributed in the Afrotropical region, Madagascar, southern Asia and the Philippines, with the *sulcata* group found in all of these areas. The *sulcata* species complex in Africa (10 taxa) has a wider diversification than that of the *B. pumicosa* species complex and *B. talpa* species complex in terms of distribution and morphological characters. These variations are reflected in this study and were studied by comparing the morphological characters and resemblances in ants from the three complexes.

The objective of this paper is to revise the Afrotropical members of the *Bothroponera sulcata* species complex to continue to tackle the taxonomic status of *Bothroponera* ants in Africa.

METHODS AND MATERIALS

Museums and Collections:

The specimens of the African *Bothroponera* species complexes were obtained from the

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following museums:

American Museum of Natural History, New York, USA (AMNH).
British Natural History Museum, London, UK (BMNH).
The Mackay collection, the University of Texas at El Paso, USA (CWEM).
Iziko South African Museum, South Africa (Iziko).
Los Angeles County Museum of Natural History, California, USA (LACM).
Museo Civico di Storia Naturale, Genova, Italy (MCSN).
Museum of Comparative Zoology, Cambridge, Massachusetts, USA (MCZC).
Museum für Naturkunde, Berlin, Germany (MfN).
Muséum d'Histoire Naturelle, Geneva, Switzerland (MHNG).
Museum Nationale d'Histoire Naturelle, Paris, France (MNHN).
Naturhistorisches Museum, Basel, Switzerland (NHMB).

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 excluding the eyes.
Mandible length (ML), the distance from the mandible's outer 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's Length (WL), the length of the mesosoma 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.

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

In each specimen we 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, we measured the frontal lobe width and the gaster length. There are other characters that were taken into account including the shape of the head, size of the eyes, characteristics of the pronotum, mesopleuron, propodeum, petiole and postpetiole. The shape of the pronotal humerus, 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 included as well. The morphological terms are from Serna and Mackay (2010) and Keller (2011). Illustrations were completed using the typical methods such as a 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). Antweb was the alternative source for ant photos.

Maps of the distribution of African *Bothroponera* were completed using Golden Software MapViewer version 3.0. The terrestrial ecoregions map (Map 1) was used to display information about ecological and biological nature of the plant community distribution in Africa. Google Earth was also used to characterize the ant localities. The longitudes and latitudes of the specimen localities were determined using fuzzy gazetteer (isodp.hof-university.de/fuzzyg/query/).

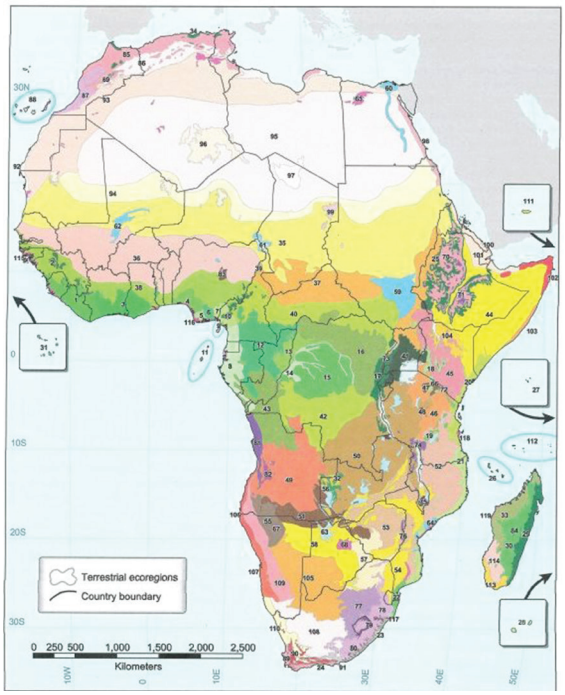
Lectotypes and paralectotypes were designated with the purpose of clarifying the applications of names to taxa.

RESULTS

Bothroponera sulcata species complex description

Worker Description — Specimens in the *B. sulcata* species complex are very similar within the group. 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 carinae; frontal lobes divided by frontal furrow, frontal lobes subquadrate anteriorly rather than

The legend for Map 1 (the terrestrial ecoregions of Africa, Burgess *et al*. 2004) used with permission from Island Press, Washington, D.C.



Map 1: The terrestrial ecoregions of Africa (Burgess *et al*. 2004) used with permission from Island Press, Washington, D.C.

rounded; scape extends slightly past posterior lateral corner of head in most species; compound eyes relatively small to large; pronotal humerus rounded; mesonotum and propodeum completely fused; meso-metapleural suture well developed; propodeum angulate or rounded posteriorly, basalar sclerite oval or round, propodeal spiracle elongated; metapleura compressed in one species (*B. crassa*), convex in other species; petiole large with spiracle and developed sternopetiolar process; metatibial gland present. Head roughly sculptured, rarely foveolate; mandibles smooth or covered with fine striae; pronotum, mesopleuron, propodeum, petiole and postpetiole roughly sculptured with scattered punctures on mesosoma, petiole and postpetiole in some species. Entire body covered with moderately short to long (0.22 - 0.36 mm) erect golden hairs or without hairs. Color usually black, red, or brown.

Female description — 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; 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 with anterior face rounded, posterior face nearly vertical (straight); postpetiole and remainder of gaster larger than mesosoma; metatibial gland present; color pale black to brown.

Male description — Head excluding mandibles suborbiculate; eyes large, cover most of sides 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 infra katepisternum and supra anepisternum, propodeum gradually sloping posteriorly to reach insertion of petiole; petiole small, width less than width of propodeum and height less than postpetiolar height, with pointed apex; postpetiole rounded; color usually light brown; metatibial gland apparently absent.

Key to the workers of the *Bothroponera sulcata* species complex

1. Lateropropodeum (side view) strongly compressed, distinctly concave as seen from above; dorsopropodeum narrowed, about ½ width of remainder 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 (side view) not compressed, or slightly concave, dorsopropodeum about as wide as width of posteropropodeum, sometimes slightly inflated; dorsopropodeum curved or forming 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 between latero- and posteropropodeum sometimes forming granulated and carinated edges; commonly collected and widely distributed. 2

2(1). Mandibles striated, rough, sometimes with scattered elongate punctures. 3

— Mandibles smooth, shiny, sometimes only moderately shining 5

3(2). Larger body length (TL 9 -13 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 6 9.5 mm); shaft of scape with fewer than 20 nearly erect hairs; widely distributed. 4

4(3). Surface sculpture rough without punctures; clypeus with wide shallow groove on raised longitudinal area of anterior medial area; usually without or with few erect hairs on posterior tibia; male with well-developed notauli; rarely collected, Kenya, Somalia and

Tanzania . . . . . ***B. notaula***

— Surface sculpture rough with strong evidence of punctures; clypeus without groove, or slightly narrowed groove present on raised longitudinal area of clypeus; generally with many suberect hairs on posterior tibia; male without or with poorly developed notauli; very common, eastern countries of Africa including Eritrea, Somalia, Ethiopia, Kenya and Zimbabwe . . . . . ***B. crassior***

5(2). Surface of head covered with moderately long (up to 0.5 mm on clypeus, 0.3 mm on posterior border of head) erect silver hairs, surface of pronotum, propodeum, 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; Gabon and Cameroon. . . . . ***B. pilosuperficia***

—Surface of head bare, lacking or nearly lacking erect hairs, possibly few relatively short hairs on posterior border or on frons, surface of pronotum, propodeum, 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; widely distributed. 6

6(5). Head without erect hairs, surface of pronotum, propodeum, petiole, postpetiole and 4th to 7th abdominal segments bare; rarely collected, known from Angola . . . . ***B. picardi***

— Head usually with few hairs on posterior border or on frons, surface of pronotum, propodeum, petiole, postpetiole and 4th to 7th abdominal segments covered with moderately long erect hairs 7

7(6). Total length nearly always greater than 7 mm; anterior medial area of clypeus partially or completely striated; common, widespread species, collected from Guinea, Ivory Coast, Ghana, Cameroon, Gabon, Congo Brazzaville, Congo (DRC), Angola, Ethiopia, Kenya, Burundi and Mozambique . . . . . ***B. soror***

—Total length nearly always less than 7 mm; anterior medial area of clypeus, not striated, forming shiny, smooth longitudinal narrowed strip with slight groove in some specimens or with weak evidence of fine striae in others; widespread but rarely collected **8**

8(7).Eye large, about 0.3 mm in maximum diameter, approximately as long as distance to anterior edge of head; head lacking of erect hairs, surface of pronotum, propodeum, petiole, postpetiole and 4th to 7th abdominal segments covered with few moderately long scattered erect hairs; rarely collected, Guinea and Nigeria . . . . . ***B. ryderae***

— Eye smaller, up to 0.2 mm in greatest diameter, shorter than distance to anterior edge of head; head usually with at least few hairs, with hairs on posterior border, surface of pronotum, propodeum, petiole, postpetiole and 4th to 7th abdominal segments covered with moderately long erect hairs **9**

9(8).Smaller, total length (5 - 6 mm); MandI 45.45 - 60.00; Cameroon, Ghana, Guinea, Ivory Coast Nigeria, Kenya and Tanzania . . . . . ***B. silvestrii***

— Larger total length (6 - 7 mm); MandI 58.62 - 64.70; widespread, Congo Brazzaville, Gabon, Kenya, Mozambique and Tanzania . . . . . ***B. ancilla***

Summary of the *Bothroponera sulcata* species complex in Africa (10 species)

B. ancilla Emery, 1899: 472
B. crassa Emery, 1877: 366
B. crassior Santschi, 1930a: 53 (=*B. ilgii* Forel, 1910b: 244 (**syn**. **nov**.)
B. kruegeri Forel, 1910a: 28 (=*B. asina* Santschi, 1912: 153 **syn**. **nov**. and *B. rhodesiana* Forel, 1913: 109 **syn**. **nov**.)
B. notaula Joma and Mackay 2015 (**sp**. **nov**.)
B. picardi Forel, 1901: 304
B. pilosuperficia Joma and Mackay 2015 (**sp**. **nov**.)
B. ryderae Joma and Mackay 2015 (**sp**. **nov**.)
B. silvestrii Santschi, 1914c: 313 (=*B. kenyensis* Santschi, 1937: 47 **syn**. **nov**. and *B. nimba* Bernard, 1953b: 188 **syn**. **nov**.)
B. soror Emery, 1899: 472 (=*B. suturalis* Forel, 1907: 133 **syn**. **nov**. and *B. lamottei* 1953b: 188 **syn**. **nov**.)

Diagnosis for members of the *B. sulcata* species complex

Bothroponera ancilla (Emery)

Figures 1, 2; Plate 1; Map 2

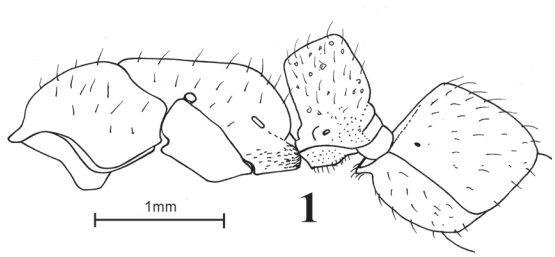
Ponera (Bothroponera) soror var. *ancilla* Emery, 1899: 472 (w) Congo, Kuilu; Emery, 1901: 46; *Pachycondyla soror* var. *ancilla*: Emery, 1911:78; Wheeler, W.M. 1922a: 74; Brown, in Bolton, 1995: 302; *Bothroponera soror ancilla*: Schmidt and Shattuck, 2014: 77.

Worker Diagnosis — 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 the 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, 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, and a pointed inferior pronotal process. The dorsopropodeum forms a strong curved posterior edge with the posteropropodeum. The posteropropodeum is slightly concave and the margins form granulated, carinated sharp edges.

The dorsum of the pronotum, 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 female and male are unknown.



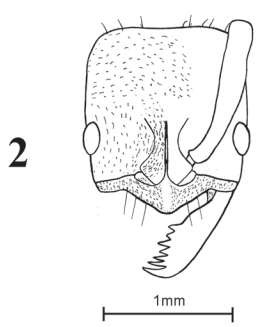


Fig 1. The lateral view of the holotype worker of *B. ancilla*.

Fig 2. The head of the holotype worker of *B. ancilla*.

Worker Description — (n=21 for 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 20.00 - 20.27, MandI 58.62 - 64.70, SI 91.89 - 92.00, PetI 130.76 -136.36. Total length 6.75 - 8.90 mm; head subquadrate; mandibles smooth, shiny; head, pronotum, propodeum, petiole and postpetiole roughly sculptured; petiole rounded dorso-anteriorly with medium rounded apex and vertical posterior face (side view); hairs on ventral surface of head few and long (0.25 - 0.35 mm); entire body black or brown, pronotum, 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 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 the type of *B. soror* in Emery was 7.50 – 9.00 mm whereas that of the holotype of *B. ancilla* is 6.66 mm), our 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-posteropropodeum are less developed, duller and the notopropodeum is without a trace of the notopropodeal suture. We do not see any significant difference in the formation of the propodeum between the two species.

Bothroponera ancilla can be separated by the following 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 clypeuses of the type specimens of *B. soror* have a single medial raised area that forms a shiny striated narrowed, slightly grooved strip. 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 was 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 differences are sufficient to consider *B. ancilla* to be as separate species.

The malar space length in *B. ancilla* is 0.20 - 0.25 mm, in *B. pilosuperficia* it is 0.17 - 0.22 mm and in *B. soror* it 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* it is 0.80 - 0.90 mm and in *B. soror* it 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, propodeum, petiole and postpetiole in *B. ancilla* are covered with a few moderately short (0.20 - 0.25 mm) erect scattered hairs similar to those of *B. soror* (0.15 - 0.25 mm) while the head is usually bare in *B. ancilla*, but the posterior border 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 shows a wide range of variability from light brown to dark brown and yellow to reddish brown in other cases.

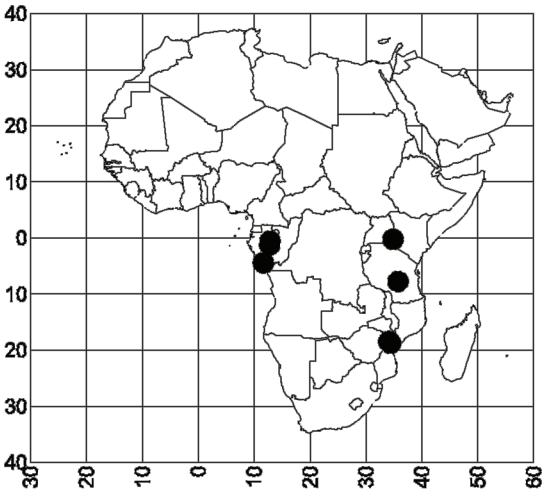
Type material examined — **PEOPLE'S REPUBLIC of the CONGO: Congo Brazzaville: Kouilou Province, Kuilu,** Congo Brazzaville River, [**Kouilou**] 3°30' to 4°30' S, 11°45' to 12°0'E,4°28'15'' S, 11°41'56'' E, *Ponera* (*Bothroponera) soror* ras. *ancilla* Emery 1899, museo Genova coll. C. Emery (dono 1925) (1w, holotype, MCSN).

Non-Type material examined — **GABON: T**. **Touro**, **Province du Woleu-Ntem**, 1°15'0'' N, 12°44'0'' E, F. Santschi det., collection of W. S. Creighton, purchased by LACM 1974, *Bothroponera soror* var. *ancilla* Emery (1w # 315945 LACM). **KENYA: Kakamega District**: Isecheno, Isecheno Forest Reserve, 1600m, 0.24°N, 34.85°E, 9-ii-2002, #02-033, Equatorial Rainforest: misc in guesthouse clearing, *Pachycondyla crassa* (Emery 1877) Det. R. R. Snelling 2002, (1w # 315861 LACM). **MOZAMBIQUE: Sofala Province,** Gorongosa National Park, Gorongosa Mtn., base of waterfall, 18°59'42.1'' S, 34°21'29'' E, 720m, 26-v-2012, coll. Gary D. Alpert, WP 038, Riparian, along forested edge of stream, leaf litter and on ground, Ant image Database, #'s 00515741, 00515814, 00515746, 00515743, 00515744, 00515745 (6w MCZC). 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, #'s 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 — Southern Africa including the 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 species. The type specimen was collected from the 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 a guesthouse clearing, along a forested edge of stream and from leaf litter and on the ground. The distribution of *B. ancilla* indicates that this species must be widespread in tropical and subtropical rainforests of Africa.



Map 2. The distribution of *B. ancilla*.

Bothroponera crassa (Emery)

Figures 3-6; Plates 2, 3; Map 3.

Ponera crassa Emery, 1877: 366 (w) 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.

Worker Diagnosis — 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 varies among *B. crassa* individuals and they may have a small depressed area anteriorly or even a short trough).

The head, pronotum, petiole and postpetiole are roughly sculptured with a few scattered punctures, but not on the 4th to 7th abdominal segments. The mandibles are smooth to striate with scattered punctures. The pronotal humerus is rounded anteriorly. The lateropropodeum is compressed laterally to form a slender lateropropodeum with concave sides as seen from above. The posteropropodeum usually declines gradually. The apex of the petiole is nearly flat 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.

Male Diagnosis (undescribed) — The head of the *B. crassa* male is suborbiculate, excluding the mandibles and the mouthparts. The ocelli are relatively large. The notauli are absent on the dorsum of the scutum. The metanepisternum is well developed and distinguished from the propodeum and mesopleuron with a suture, 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

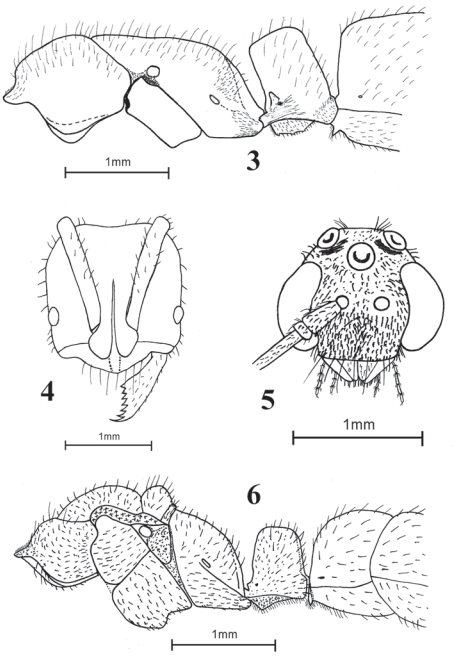


Fig 3. The lateral view of the lectotype worker of *B. crassa*.
Fig 4. The head of the lectotype worker of *B. crassa*.
Fig 5. The head of a male of *B. crassa* from Kenya (LACM).
Fig 6. The lateral view of a male of *B. crassa* from Kenya (LACM).

postpetiolar height and with a bluntly rounded apex. The pronotum, scutum, scutellum, propodeum, petiole and postpetiole are roughly sculptured. The postpetiole is rounded anteriorly.

Worker Description — (n=4 for measurements), HL 1.45 - 1.75, HW 1.25 - 1.45, ML 0.75 - 0.95, EW 0.20 - 0.30, EL 0.30 - 0.40, SL 1.20 - 1.45, FL 2.00 - 2.40, WL 2.30 - 2.70, WPL 3.25 - 3.40, PL 0.60 - 0.75, PW 0.85 - 0.90, PH 1.05 - 1.15, CI 82.85 - 86.20, OI 24.00 - 27.58, MandI 51.72 - 54.28, SI 96.00 - 100.00, PetI 120.00 - 141.66. 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 lateral corner 0.85 mm; pronotal humerus rounded; dorsopropodeum slightly slopes posteriorly to form posteropropodeum; petiole slightly rounded from top, anterior face straight, slightly concave posteriorly, apex of petiole slightly higher than heights of postpetiole and dorsopropodeum; 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, propodeum covered with short erect scattered hairs (0.15 mm); petiole and postpetiole covered with moderately long erect hairs (0.20 mm); long erect hairs (0.25 mm) arranged on edges of posteropropodeum; color of entire body dark reddish-black or dark brownish; legs light brown or reddish brown; mandibles reddish brown.

Male description — (n=14 for measurements), 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. Total length ranges from 5.90 - 7.50 mm; 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 second funicular segment, three times longer (0.10 mm) than first funicular segment; pronotum square laterally and rounded anteriorly; dorsum of scutum rounded (side view); scutellum subtriangular and elevated in lateral view; metanotum raised between scutellum and propodeum; mesopleuron divided by anapleural sulcus to form infra katepisternum and supra anepisternum; 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 slightly 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 of workers — It is difficult to separate *B. crassa* from *B. crassior*, *B. notaula*, *B. silvestrii* 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. silvestrii* (5.25 - 7.05 mm). The obvious characters that can separate those species are 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. silvestrii*, 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. silvestrii*. 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 the 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. silvestrii*, *B. notaula*, *B. ryderae* and *B. kruegeri* are rough, but 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 male 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. silvestrii* (0.12 - 0.13 mm) and *B. crassior* (0.17 mm).

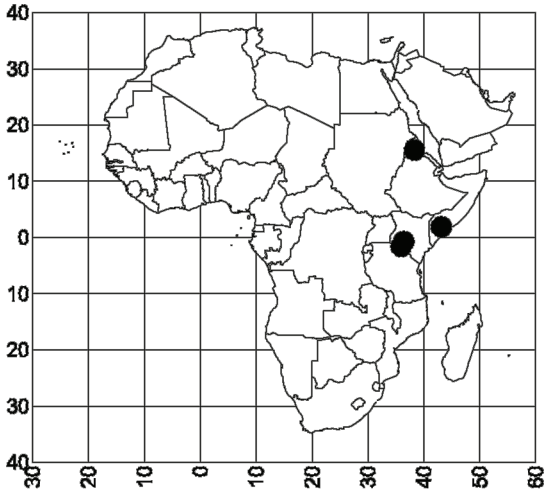
Type material examined — **ERITREA: Bogos**, **Sciotel**, 15°30’0’’ N; 38°14’0’’ E, O. Beccari 1870, type, *Ponera crassa*: Emery; syntype, *Ponera crassa* Emery 1877. Museo Civico di Genova (2w, lectotype and paralectotype, here designated, MCSN).

Non type material examined — **SOMALIA:** Da Matagoi A Lugh, 1°59’0’’ N; 43°8’0’’ E, V. Bottego, C. Emery, Pozzi maddo in 9-12. II; from L. U. G. H. In 1895 (2m, MCSN). **KENYA**: **Rift Valley Province**, 23mi W. of Magadi, 1°40’11.56’’ S; 35°57’33.61’’ E, to 1°56’8.96’’ S; 35°52’34.51’’ E, 1-3-1960, E. S. Ross collector, # 00525663 (1w MCZC); **Laikipia District**, Mpala Research Centre, 1650m, 0°17’23.9994” N, 36°53’59.9994” E, 6-x-1999, 17 - 30 -ix-1999, 18-ix-1999, #’s 99-115, 99-021, 99-017, 99-034, 2-ii-2000, # 00-026, 27-ix-1999, # 99-084, 24-iii-2001, # 01-140, R. R. Snelling, *Acacia* Woodland, nocturnal, around and at black light, malaise trap, misc. male, at black light, 2030-2130hrs, ex soil under stone, foraging on ground, *Pachycondyla crassa* Emery, Det. R. R. Snelling 2001, #’s 315895, 315897, 315898, 315899, 315901, 315902, 315905, 315906, 315907,

315908, 315910, 315911, 315775 (2w, 12m, LACM).

Distribution — Eastern Africa (Eritrea, Kenya and Somalia).

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. Three types of vegetation cover Ethiopia: the first is grassland, which includes dwarf shrubs and wooded grassland, the second is savanna, which includes dry and moist savanna, and finally the third is forests (McClanahan and Young, 1996). The main ecoregions in Ethiopia are Ethiopian upper montane forests, woodlands, bushlands and grasslands (70, habitat type in Map 1, all numbers refer to habitat types in map 1), 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 (worldwildlife.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 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 the specimens that were identified as *B. crassa* in many Museums and in previous studies are similar but are actually *B. crassior* and *B. soror*. 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. The few collections of *B. crassa* indicate that it is neither common nor widespread in Africa.



Map 3. The distribution of *B. crassa*.

Bothroponera crassior (Santschi)

Figures 7-10; Plates 4, 5; Map 4.

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

Bothroponera crassa var. *crassior* Santschi, 1930a: 53 (w), Kenya, western slopes of Mount Kenya; 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)**.

Worker Diagnosis — 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

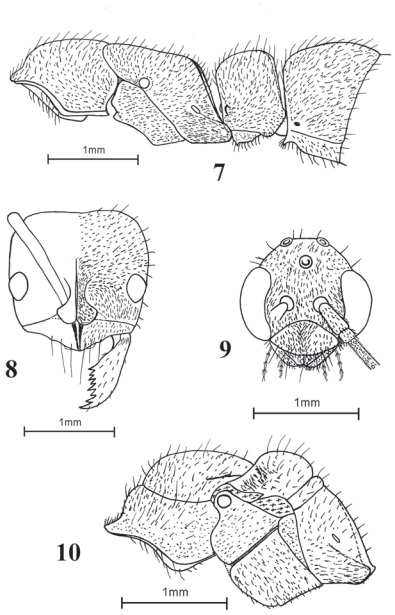


Fig 7. The lateral view of the lectotype worker of *B. crassior*.
Fig 8. The head of the lectotype worker of *B. crassior*.
Fig. 9 The head of a paralectotype male of *B. crassior*.
Fig 10. The lateral view of a paralectotype male of *B. crassior*.

posteropropodeum is slightly sloping and forms a broadly curved angle with the dorsopropodeum.

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

The female is unknown.

Male diagnosis —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 funicular segment), shorter and thicker than the second funicular segment.

The pronotum is square laterally and rounded anteriorly. The notauli are absent 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 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 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.

Worker descriptions — (n=25 for measurements), 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, MandI 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, MandI 5.40 - 5.88, SI 90.32 - 100.00, PetI 128.57 - 130.76. Total length 8.35 - 9.40 mm; head excluding mandibles nearly quadrate; eye diameter slightly longer than malar area length, 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; scape extends slightly past posterior lateral corner of head; pronotal humerus rounded anteriorly; apex of petiole slightly higher than level of postpetiole and dorsopropodeum. Dorsum of pronotum, and propodeum covered with short (0.15 mm) erect scattered silver hairs; dorsum of petiole and postpetiole covered with longer (0.20 mm) erect silver hairs; long (0.25 mm) erect silver hairs arranged on edges of posteropropodeum; 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 description — (n=1 for measurements), 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, MandI 27.27, SI 37.50. Total length unknown; 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); 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; 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.

Worker Comparisons — Many taxa were considered as separate species or as subspecies of *B. crassa* or *B. crassior* or even as *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 taxa are minimal and there is no reason to further consider *B. andrieui*, which will be referred to *B. crassior* in this revision.

Comparisons were 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 (side view) 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. silvestrii* and *B. kruegeri* gradually slopes posteriorly.

The worker of *B. crassior* is quite similar to that 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 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, 1.35 - 1.60 mm width) is slightly larger than the heads of *B. crassa* (1.45 - 1.75 mm length, 1.25 - 1.45 mm width) and *B. ilgii* (*B. gamzea*) (1.70 - 1.85 mm length, 1.40 - 1.55 mm width). This is more evidence that *B. ilgii* (*B. gamzea*) should 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. notaula* 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 greater (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*, which separates it from *B. crassa*. The single medial raised area of the clypeus of *B. soror* forms a 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 1910b, 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 (2010) 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 notopropodeum, 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, 2010) 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*. Therefore as the first reviewers of the *sulcata* group, we refer to this species as *B. crassior*.

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 (paralectotype) 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. silvestrii* (4.70 - 5.10 mm), indicate that the largest species is *B. kruegeri* and the smallest is *B. silvestrii*, but the other species tend to overlap in their total lengths.

The notauli are absent in *B. crassa* and *B. crassior* while they are present in *B. soror*, *B. notaula*, *B. ryderae*, *B. silvestrii* and the male of *B. kruegeri* has weak evidence of notauli. The ocelli are small in *B. crassior*, *B. soror*, *B. silvestrii* 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. silvestrii* are similar as it is usually 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. silvestrii* and *B. ryderae*.

Type material examined — 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 (1 lectotype and 3 paralectotypes, [here designated, and the type locality is restricted to this location], 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, 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: *Ophthalmopone ilgii* Forel 1894, Ilgii, *B. crassior*, johar (Ilg) (1w, syntype, MCSN).

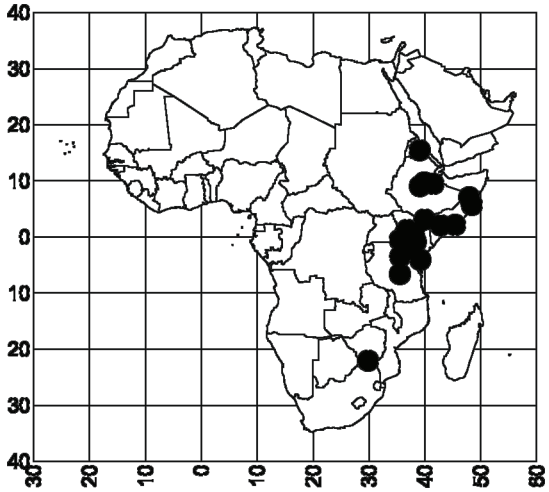
Non-type material examined — **52 workers: ERITREA: Embatcalla**, 15°24'5'' N; 39°4'50'' E, Muller 1.35, B. Finzi Coll. Purch 1950, *Bothroponera crassa* Emery, comp. with type, W. L. Brown 1964, # 00525707 (1w, MCZC). **ETHIOPIA: Scioa**, 9°0'0'' N; 39°0'0'' E, *Ponera crassa*, teste Emery; Museo Genova 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* (Emery 1877), det. 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* (Emery), det. R. R. Snelling (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* (Emery), det. R. R. Snelling (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* (Emery), det. R. R. Snelling (2w # 315894, LACM), same locality, ca 1650m, 24-i-2000, # 00-005, coll. R. R. Snelling 2000, *Acacia* woodland, worker tandem running, *Pachycondyla crassa* (Emery), det. R. R. Snelling (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 #'s 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* (Emery), det. R. R. Snelling (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* (Emery), det. R. R. Snelling (1w # 315770, LACM), same locality, Ewaso Ng'iro, 1600m, 0.24° to 0.29° N, 36.91° to 36.90° E, 5-iv-2001, # 01-191, coll. R.

R. Snelling, *Acacia* Woodland, on trunk of *Acacia xanthophloeum*, foraging on ground (1w # 315896, LACM), same locality, 1650m, 0.29° N, 36.90° E, 27-ix-1999, # 99-084, 1-x-1999, # 99-094, coll. R. R. Snelling, *Acacia* woodland, scavenging on rotting eland skull, stays in litter under *Acacia*, in litter under *Acacia* tree, ex soil under stone, workers tandem running, tandem running on ground, *Pachycondyla crassa* (Emery), det. R. R. Snelling 2000, 2001 (4w #'s 315785, 315894, LACM); **Malindi District**, Arabuko-Sokoke Forest, N of Nyari Cliffs, 3.32° S; 39.86° E, ca 75m, 28-v-2001, # 01-434, Cynometramani Ikara thicket: foraging on ground. R. R. Snelling & D. J. Martins, *Pachycondyla n.sp*. nr. *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°3'0'' 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, #'s 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°5'0'' 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, teste Emery, leg. V. Bottego collector**,** Museo Civico di Genova (1 w, MCSN).

Distribution — Eastern and southern Africa, including 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 Southwestern side of Mt Kenya are near 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 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* was 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 9/2/2014, Burgess *et al*., 2004). Large numbers of *B. crassior* specimens were identified as *B. crassa*, but now it is now apparent that *B. crassior* is a more widely distributed species in

Eastern countries of Africa than *B. crassa*.



Map 4. The distribution of *B. crassior*.

Bothroponera kruegeri Forel

Figures 11-14; Plates 6, 7; Map 5.

Pachycondyla (*Bothroponera*) *kruegeri* Forel, 1910a: 28 (w), South Africa, Valdezia, Transvaal; Santschi, 1914b: 4 (list); Santschi, 1914b: 43; *Pachycondyla kruegeri*: Emery, 1911: 77; Arnold, 1915: 56; Bolton, 1995: 306; *Bothroponera kruegeri*: Wheeler, W. M., 1922b: 770; Schmidt and Shattuck, 2014: 77.

Pachycondyla (*Bothroponera*) *asina* Santschi, 1912: 153 (w), Kenya, Afrique orientale anglaise; *Pachycondyla* (*Bothroponera*) *kruegeri asina*: Santschi, 1914b: 4; *Bothroponera kruegeri asina*: Wheeler, W.M. 1922b: 770; Schmidt and Shattuck, 2014: 77; *Pachycondyla asina*: Bolton, 1995: 303 (**syn**. **nov**.**)**.

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**.**)**.

Worker Diagnosis — The main distinguishing character of *Bothroponera kruegeri* is that it is the largest ant among the *B. sulcata* species complex (total length 11.75 - 12.55 mm). The mandibles are narrowed and 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 anteriorly (often absent). The frontal lobes are divided by a shallow frontal furrow, which is not continued to the frons.

The head, pronotum, 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 processes. 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.

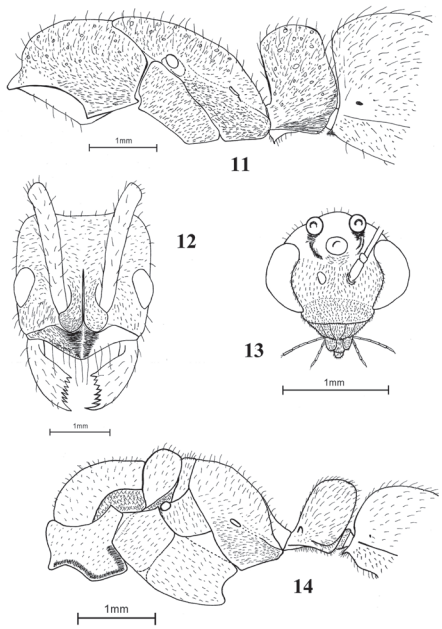


Fig 11. The lateral view of the worker of *B. kruegeri* (*B. rhodesiana* holotype).
Fig 12. The head of the worker of *B. kruegeri* (*B. rhodesiana* holotype).
Fig 13. The head of a male of *B. kruegeri* from N. Natal, South Africa.
Fig 14. The lateral view of a male of *B. kruegeri* from N. Natal, South Africa.

Male Diagnosis —The head is nearly circular, 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. 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 and one is a triangular spot between the notauli. The medial area, between the brown spots is pale brown or yellow in color. The scutellum is triangular and elevated in dorsal view. The metanepisternum is well distinguished while the metakatepisternum is triangular and poorly developed. The dorsopropodeum gradual slopes 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.

Worker descriptions — (n=9 for measurements), *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, MandI 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, MandI 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, MandI 57.40 - 60.00, SI 102.27 - 107.69, PetI 115.00 - 128.57. 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 humerus rounded anteriorly with straight ventral margin (side view) that forms sharp anteroinferior and inferior pronotal processes; dorsopropodeum slightly curved, posteropropodeum slightly concave, with slight medial depression, seen from dorsal or from posterior view; entire surface of body covered with fine hairs; dorsum of pronotum, propodeum, petiole and postpetiole covered with few 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 description — (n=1 for measurements), 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, CI 72.41, OI 90.47, MandI 24.13, SI 28.57, PetI 93.33. Total length 10.25 mm; 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); pronotum quadrate laterally and rounded anteriorly; scutellum triangular, elevated in dorsal view; 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.

Worker Comparisons — 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 (11.75 - 12.55 mm total length for the worker and 10.25 mm for the male), the number of mandibular teeth (8 - 9 teeth, which is the largest number among the *B. sulcata* complex species), the anterior raised area of the clypeus and the postero-dorsopropodeal shape. The anterior medial raised area of the clypeus is convex in all of the *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, B. silvestrii* and *B. ryderae*, a narrowed longitudinal smooth

strip usually without a groove in *B. silvestrii* 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 outline that connects gradually with the posteropropodeum and reaches the insertion point of the petiole. The dorsopropodea of *B. silvestrii*, *B. crassa*, *B. crassior* and *B. notaula* are 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 the type of *B. kruegeri* and its variety (*kruegeri* var. *rhodesiana*) as well as a closely related taxon (*asina*) indicates that *Bothroponera asina* is identical to *B. kruegeri* in nearly all characters except for a few insignificant differences. 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 a shorter (less than 0.30 mm) groove on the lower margin of the clypeus in *B. kruegeri*. As we studied large numbers of *B. sulcata* complex specimens, we concluded that the variations of the anterior raised area of the clypeus in these 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 in *B. kruegeri*, but is somewhat deep 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 are slightly smaller in *B. asina* (width 0.40, length 0.50 mm), and slightly larger in *B. kruegeri* (width 0.40, length 0.60 mm), but there is much overlap in measurements. The scape and funiculus of *B. asina* are short, 1.90 mm and 3.00 mm respectively, while they are slightly longer in *B. kruegeri* (2.00 - 2.20 mm and 3.00 - 3.10 mm respectively), which is nearly the same in both taxa. The petiole length in *B. asina* (0.90 mm) is shorter than that of *B. kruegeri* (1.00 mm). 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 dorsa of the pronotum and propodeum of *B. asina* are covered with a few short (0.15 - 0.20 mm) erect scattered hairs, but in *B. kruegeri* the dorsa of the pronotum, propodeum, petiole and postpetiole are covered with a few moderately short erect scattered hairs (0.20 mm) which indicate the overlap in 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 both *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 overlap in both species. Short erect hairs (0.10 mm) are scattered on the legs and scape of *B. asina*, these hairs on the 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). In contrast, the hairs on the ventral surface of the head are moderately long (0.20 - 0.35 mm) in *B. kruegeri*, identical to those of *B. asina*.

Santschi (1912) stated that *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 the types 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*). 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 the types of *B. kruegeri* and *B. asina*, do not appear to differ

significantly. The direct comparison of types of *B. kruegeri* and of *B. asina* confirms that they are the same species. Therefore, the *B. asina* is considered to be a synonym of *B. kruegeri*.

A direct comparison of the types of *B. kruegeri* and *B. rhodesiana* shows that *Bothroponera rhodesiana* is identical to *B. kruegeri* in nearly all characters with a few insignificant differences. *Bothroponera rhodesiana* is characterized by the form of the anterior medial margin of the clypeus that does not form a short groove on the lower margin as it does in *B. kruegeri* (less than 0.30 mm). This character is not consistent among individuals of the *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 the 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 are moderate in size in *B. kruegeri* (width 0.40, length 0.60 mm) and slightly larger in *B. rhodesiana* (width 0.45, length 0.65 - 0.70 mm). These diameters are not clearly distinguishable, showing 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 are longer in *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 of *B. kruegeri* (1.50 mm). The worker of *B. kruegeri* has a total length of 11.75 -12.55 mm 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 our 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, propodeum, petiole and postpetiole are covered with few 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, propodeum, petiole and postpetiole are covered with a 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* shows they overlap in 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. 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 Comparison — 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. silvestrii*, *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. silvestrii* (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. silvestrii, *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. silvestrii* 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 gradually slopes posteriorly in *B. kruegeri* as in *B. crassa, B. crassior*, *B. silvestrii* 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*.

Type material examined — **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 specimen [here designated and type locality restricted] NHMB) **6 workers: KENYA:** Afrique orientale anglaise, **Nirobi**, Nairobi Area, 1°17'0'' S; 36°49'0'' E, *Pachycondyla* (*Bothroponera*) *asina* Santschi (1w, holotype, NHMB). **ZIMBABWE: Bulawayo**, 2 Bulawayo Fan., 1912, 20°9'0'' S; 28°35'0'' E, *Bothroponera kruegeri* var. *rhodesiana* Forel, G Arnold, (3w, lectotype upper specimen, paralectotype lower specimens [here designated] NHMB).

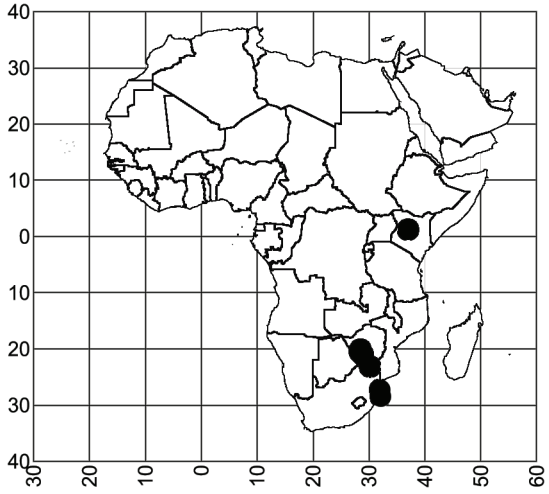
Non type material examined — **4 workers, 1 male: SOUTH AFRICA: KwaZulu-Natal Province,** N. Natal, Mkuse Game Reserve [Mkhuze or Mkuze], 27°39'0'' S, 32°15'0'' E, (24 to 27' S, 30 to 45' E), on ground nest emigration cp-8-x-1982 (2 w, MCZC) same locality, C. Peeters, 1984 (1m, MCZC). **ZIMBABWE: [**former name Rhodesia], **Matopos**, 20°35'0''S; 28°40'0''E, 14-ii-1978, Fletcher, *Pachycondyla kruegeri* Forel, det. B. Bolton 197, (2w # 315921 LACM).

Distribution — Kenya, South Africa and Zimbabwe.

Biology and habitat — *Bothroponera kruegeri* has been collected from different habitats in Africa, principally 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), control over reproduction (Wildman and Crewe, 1988) and qualitative relations of egg size, egg production and colony size (Villet 1990). *Bothroponera 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. krugeri* gamergates are able to produce between 0.5 - 3 eggs per day (Wildman and Crewe 1988).

Bothroponera 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 is 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 in 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, 1922b; Arnold, 1915).



Map 5. The distribution of *B. kruegeri*.

***Bothroponera notaula* Joma and Mackay, *sp. nov*.**
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Figures 15-18; Plates 8, 9; Map 6.

Worker Diagnosis — 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 shiny groove. The scape extends slightly past the posterior lateral corner of the head. The eyes are larger in diameter than the length of the malar area and project slightly 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, 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 silver hairs (up to 0.02 mm) and erect silver hairs from 0.20 up to 0.35 mm. The entire surface is black to dark brownish.

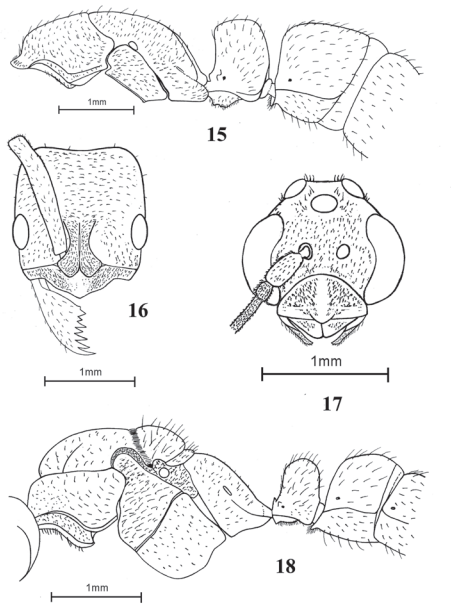


Fig 15. The lateral view of the paratype worker of *B. notaula*
Fig 16. The head of the paratype worker of *B. notaula*.
Fig 17. The head of a holotype male of *B. notaula.*
Fig 18. The lateral view of a holotype male of *B. notaula.*

Male diagnosis —The head of the *B. notaula* male is nearly round, excluding the mandibles. The medial ocellus is large, slightly smaller than the distance between it and the lateral ocelli. The scape is nearly three times as long as the pedicel, 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 separated from the propodeum and mesopleuron

with a suture, 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.

Worker description — (n=1 for measurements), HL 1.65, HW 1.45, ML 1.05, EW 0.25, EL 0.40, SL 1.30, FL 2.20, WL 2.50, WPL 3.15, PL 0.65, PW 0.85, PH 1.15, CI 87.87, OI 27.58, MandI 63.63, SI 89.65, PetI 130.76. Head subquadrate; malar space length 0.20 mm, length from upper edge of eye to edge of posterior lobe 0.70 mm; basalar sclerite oval-shaped; pronotal humerus rounded anteriorly; petiole slightly rounded from top, strongly curved lateroposteriorly, vertical anterior and posterior faces, apex of petiole slightly higher than postpetiole and dorsopropodeum. Entire body covered with fine silver hairs, 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, 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 description — (n=5 for measurements), HL 1.00 - 1.10, HW 0.57 - 0.80, ML 0.25 - 0.30, EW 0.40 - 0.45, EL 0.70 - 0.75, SL 0.30, FL (incomplete segments), WL 2.45 - 2.75, WPL 2.95 - 3.40, PL 0. 50 - 0.65, PW 0.50 - 0.55, PH 0.85 - 0.90, CI 57 - 72, OI 122.80 - 93.75, MandI 25.00 - 27.27, SI 52.63 - 37.5, PetI 100 - 84.61. The total length ranges from 5.60 - 7.90 mm; eyes large, cover most of sides of head, distance between eyes 0.55 - 0.70 mm from upper inner margins, medial ocellus width 0.22 - 0.25 mm, lateral ocellus 0.27 mm; scape shorter (0.30 - 0.35 mm) and thicker than second funicular segment (0.60 mm), two to 2 ½ times length of pedicel (first funicular segment, 0.10 - 0.15 mm); scutum rounded, separated from scutellum by scutoscutellar suture, scutellum subtriangular and elevated in lateral view; metanotum raised between scutellum and propodeum; basalar sclerite rounded; petiole small, width less than dorsopropodeal width (seen from above), higher than postpetiolar 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 short (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.

Comparison of worker — The worker of the *B. notaula* could be compared with those of *B. crassior*, *B. crassa*, *B. silvestrii*, *B. kruegeri* of the *B. sulcata* species complex species as the dorsopropodeum is generally identical in those five species in being broadly curved and the posteropropodeum gradually slopes posteriorly to reach the petiolar insertion between the propodeal lobes. 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 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* and *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. 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, 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, 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, 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* and *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. silvestrii* and *B. ryderae*, the erect hairs are present on the dorsum of the pronotum, 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 nearly 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. silvestrii*. The males of *B. picardi*, *B. ancilla* and *B. pilosuperficia* are unknown. *Bothroponera 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. silvestrii* 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. silvestrii*. Conversely, the notauli are not present on dorsum of scutum of *B. crassa* and *B. crassior*. *Bothroponera kruegeri* has weak evidence of notauli presence. 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.

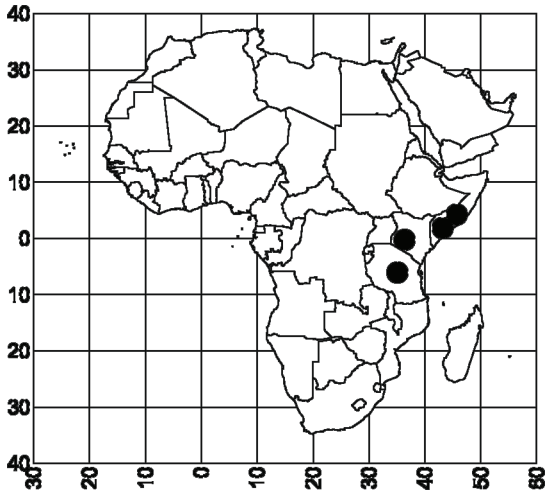
Etymology — The specific epithet of *B. notaula* is a plural noun in apposition that refers to the distinct notauli that are present on the dorsum of the male's scutum (mesoscutum), which characterizes this species. The noun was feminized to match the gender of the genus.

Type material examined — **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 examined — **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, 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 — Eastern Africa (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 other species of the *B. sulcata* complex including *B. ancilla*, *B. crassa*, *B. crassior*, *B. silvestrii* and *B. kruegeri*.



Map 6. The distribution of *B. notaula*.

Bothroponera picardi (Forel)

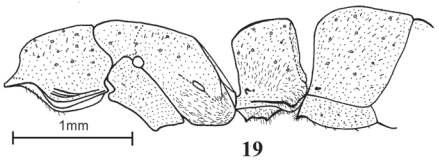
Figures 19-20; Plate 10; Map 7.

Pachycondyla (*Bothroponera*) *picardi* Forel, 1901: 304 (w), Angola, Mossamedes; Forel, 1903: 559; *Pachycondyla picardi* Emery 1911:77; Bolton, 1995: 308; *Bothroponera picardi*: Wheeler, W.M. 1922b: 771; Schmidt and Shattuck, 2014: 77.

Worker Diagnosis — The worker of *B. picardi* can be easily recognized, as the entire dorsal surface of the mesosoma is bare, without erect hairs that are generally seen in other *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 pygidium. 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 pygidium, 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 notopropodeum, petiole and postpetiole are roughly sculptured, weakly shiny with a few punctae spread on the dorsum, which is weakly shiny, but the petiole and postpetiole are shiny. The mesopleuron is roughly sculptured with a few punctae spread over the surface. The antennae, mandibles and legs are shiny.

The female and male are unknown.



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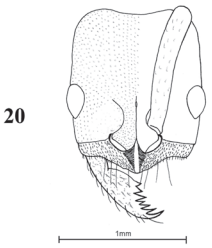

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Fig 19. The lateral view of the lectotype worker of *B. picardi* (middle specimen)

Fig 20. The head of the lectotype worker of *B. picardi* (middle specimen)

Worker Description — (n=4 for measurements), 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. Total length 6.30 - 6.50 mm; compound eyes relatively small; malar space length 0.15 mm, length from upper edge of eye to upper margin of posterior lobe 0.55 mm; pronotal humerus rounded anteriorly, lower margins (side view) slightly curved, rounded anteriorly, sharp posteriorly; nearly entire body lacks erect hairs; entire body black or reddish

brown; legs, antennae and mandibles red or reddish brown.

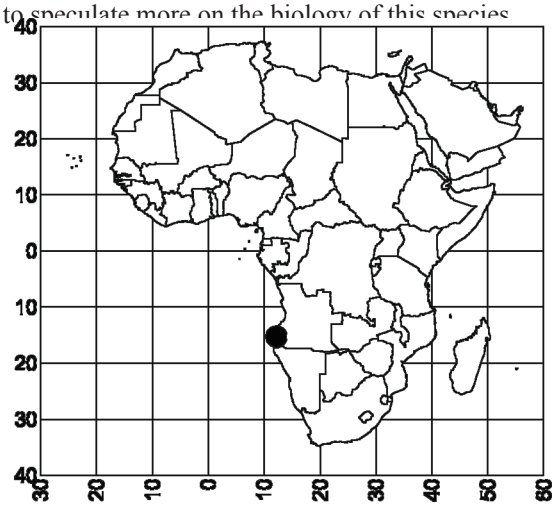
Worker comparison — Bothroponera picardi can be easily separated from the rest of the species in the *B. sulcata* species complex by lacking erect hairs on the notopropodeum. *Bothroponera picardi* has an anterior medial raised clypeal area that forms a smooth shiny groove or flat longitudinal raised narrow area that is identical to those of *B. crassa*, *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 is similar in length to *B. crassa* (6.00 - 8.80 mm) and *B. silvestrii* (5.25 - 7.05 mm). The dorsopropodeum is strongly curved to form a strong 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* and *B. pilosuperficia*.

Type material examined — **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 [here designated] MHNG).

Non type material examined — 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 7. The distribution of *B. picardi*.

Bothroponera pilosuperficia* Joma and Mackay, *sp. nov.

urn:lsid:zoobank.org:act:B99CCE82-95F9-41AF-88E1-498F041A4195

Figures 21-24; Plate 11; Map 8.

Worker Diagnosis — 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 the two basalmost teeth, wide enough for another tooth, in some specimens, there is 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 a shiny, partially striated 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 notopropodeum is 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 propodeum, petiole, postpetiole and the 4th to

7th abdominal segments are covered with abundant, relatively long (0.23 - 0.36 mm) abundant erect silver hairs.

The holotype specimen has a reddish brown head and a dark brown mesosoma, petiole and gaster, but other specimens are darker. The mandibles and appendages are light brown to medium brown.

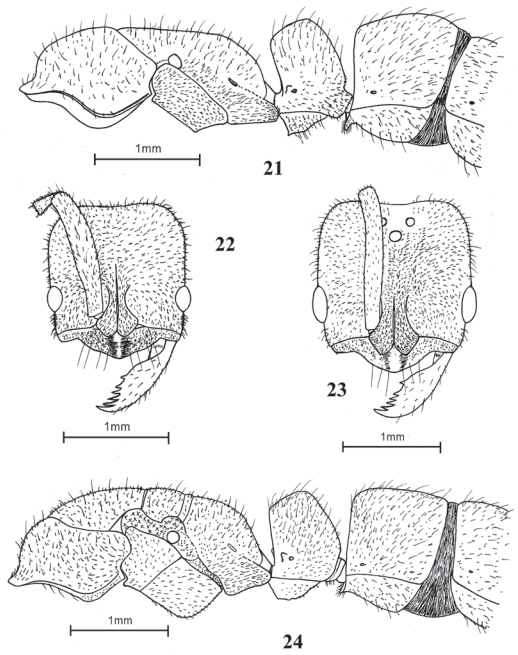


Fig 21. The lateral view of the holotype worker of *B. pilosuperficia*.
Fig 22. The head of the holotype worker of *B. pilosuperficia*.
Fig 23. The head of a paratype female of *B. pilosuperficia*.
Fig 24. The lateral view of a paratype female of *B. pilosuperficia*.

Female diagnosis — The female of *B. pilosuperficia* is similar to the worker, 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 the upper edge of eye to the upper margin of the 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 two basalmost 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, measuring 0.35 mm long from posterior edge of the posteropropodeum 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 meso-metapleural suture is well defined. The postpetiole and the 4th to 7th abdominal segments are slightly longer (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, postpetiole and 4th to 7th abdominal segments are covered with moderately long (0.15 - 0.36 mm) erect silver hairs.

The color of the head is reddish brown to dark brown, the notopropodeum, mesopleuron, propodeum and petiole are dark brown to 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.

Worker descriptions — (n=8 for measurements), 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. Total length 7.50 - 9.00 mm; head subquadrate; clypeal surface convex, anterior medial margin forms narrowed smooth, shiny, slightly depressed strip; 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, propodeum, petiole and postpetiole roughly sculptured with few scattered punctures, dense, slightly larger on petiole, tiny, dense on head; second gastral segment (fourth abdominal segment) shiny, slightly roughened (less sculptured and lacking punctures); clypeus, legs, antennae moderately shiny; lower margin of pronotal humerus 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 dorsoanteriorly with medial rounded apex, posterior and anterior faces vertical.

Female descriptions — (n=2 for measurements), 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. Head subquadrate; scape extends slightly past posterior lateral corner of head; clypeus convex, anterior medial margin of clypeus with single medial raised area that forms narrowed smooth, shiny, slightly depressed strip; compound eyes relatively large; head roughly sculptured with weak evidence of punctures; clypeus, legs, antennae moderately shiny; notopropodeum, petiole and postpetiole roughly sculptured with few scattered punctures on dorsum; metanepisternum poorly developed, metakatepisternum fused to form single surface with lateropropodeum; dorsopropodeum strongly curved posteriorly, to form slightly concave posteropropodeum; posteropropodeal lateral margins granulated; petiole rough, covered with slightly larger 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); petiole rounded dorso-anteriorly with medial rounded apex, posterior and anterior faces vertical; short (from 0.10 to 0.20 mm) erect and suberect hairs scattered on scapes and legs surface of head.

Comparison of workers — 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 a slightly concave surface and granulated curved lateral margins. On the other hand, *B. crassa*, *B. crassior*, *B. silvestrii* and *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 *B. pilosuperficia* is characterized by an unusual distribution of hair of various lengths (0.05 to 0.36 mm) on the head, pronotum, notopropodeum, mesopleuron, petiole, postpetiole and 4th to 7th abdominal segments. The head of *B. soror* lacks erect hairs except for a few on the dorsal surface or on the frons as in *B. ancilla*. The hairs on the dorsum of the pronotum, propodeum, 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 the eyes of *B. pilosuperficia* 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 easy to separate *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 separated because the entire surface lacks erect hairs except for a few erect hairs on the pygidium and hypopygidium.

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 only slightly raised.

Comparisons of females — 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 *B. pilosuperficia* can be separated based on some differences 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 for a few erect hairs on the posterior margin of the head (less than 0.15 mm). The notopropodeum, petiole, postpetiole and 4th to 7th abdominal segments are covered with moderately long hairs (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 without striae in *B. pilosuperficia*, while the anterior medial area of the clypeus of *B. soror* forms a raised area with a slight depression that is covered partially or completely with fine striae.

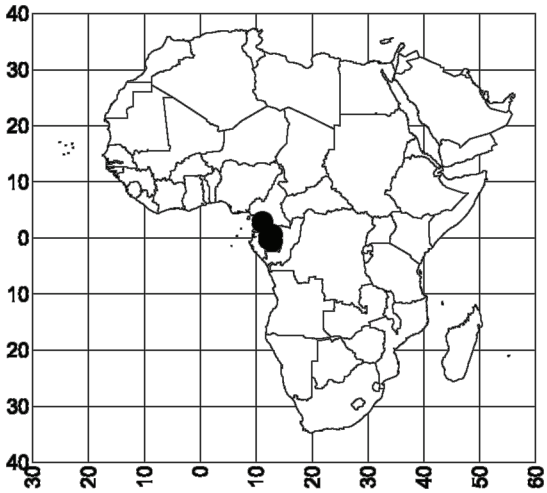
Etymology — The new species name "*pilosuperficia*" is derived from Latin. It is combination of two words, pilosus, which means hairy and superficie, which means surface. The specific epithet refers to the erect silver hairs that cover the entire surface including the head of this species.

Type material examined — **GABON: Makokou,** 0°34›0›› N; 12°52›0›› E, CNRS, vi-vii-1974, W. H. Gotwald, (1 w holotype, MCZC), **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, #'s 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 examined — **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. 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 8. The distribution of *B. pilosuperficia*

Bothroponera ryderae* Joma and Mackay, *sp. nov.
urn:lsid:zoobank.org:act:86036BCA-1295-47EC-8E04-EE9F05123016

Figures 25-28; Plate 12, 13; Map 9.

Worker Diagnosis — Bothroponera ryderae has a unique suite of characters including the form of the clypeus, differences in the mandibles, eyes, body sculpture, hairs and color. The anterior medial margin of the clypeus has a single medial raised area that forms a smooth, shiny, weakly narrowed longitudinal depression, or in some specimens, is formed into a flat narrowed longitudinal strip. The mandibles are smooth and shiny, and have about 7 teeth that alternate in size. The compound eyes are relatively large, but are less projecting in the holotype and the paratypes, and slightly more projecting in the other two examined specimens. The total length is 6.55 - 7.20 mm.

The head, pronotum, propodeum, petiole and postpetiole are roughly sculptured, foveolate without punctures. The head, pronotum, propodeum, petiole, postpetiole with the 4th to 7th

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, propodeum, petiole, postpetiole and 4th to 7th tergites and sternites of the abdominal segments are covered with moderately long (0.15 - 0.25 mm) erect hairs. The erect hairs are denser and slightly longer (0.20 - 0.25 mm) on the petiole, postpetiole and the 4th to 7th abdominal segments than those on the mesosoma (0.15 mm). The dorsum of the pronotum, propodeum, petiole, postpetiole and the remainder of the gastral segments are covered with scattered long erect hairs. The hairs on petiole, postpetiole and the 4th to 7th abdominal segments are denser and longer than those on the propodeum and pronotum; pygidium is covered with longer (0.30 - 0.32 mm), denser erect hairs. The entire surface is covered with fine hairs (less than 0.01 mm).

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

The female is unknown.

Male diagnosis —The head of the *B. ryderae* male is nearly suborbiculate, excluding the mandibles and the mouthparts. The scape is twice as long (0.20 mm length) as the pedicel (0.10 mm), shorter and thicker than the second funicular segment (0.40 mm). The clypeus is convex with a small peak that points ventrally on the lower anterior medial margin. The ocelli are relatively small. The notauli are present on the dorsum of the scutum and 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 are covered with a few short erect hairs that are scattered on the dorsum, while the head lacks erect hairs.

The entire male is yellowish.

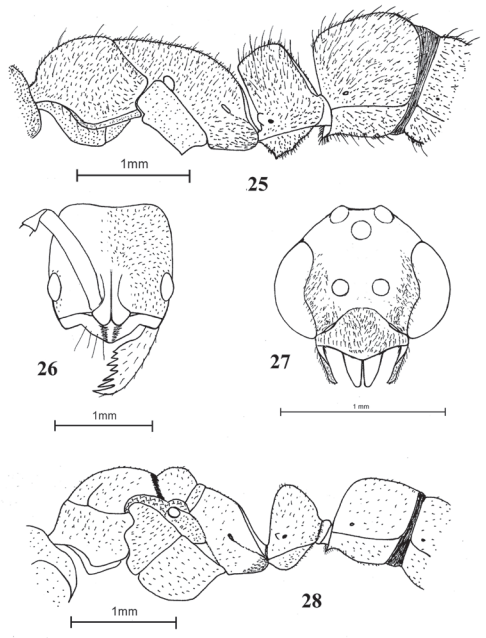


Fig 25. The lateral view of the holotype worker of *B. ryderae*.
Fig 26. The head of the holotype worker of *B. ryderae*.
Fig 27. The head of a paratype male of *B. ryderae*.
Fig 28. The lateral view of a paratype male of *B. ryderae*.

Worker Description — (n=9 for measurements), 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, MandI 57.69 - 56.66, SI 87.5 - 92, PetI 125 – 140. Head subquadrate; compound eyes relatively 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; pronotal humerus, lower margin of pronotum and basalar sclerite rounded.

Male description — (n=1 for measurements), 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. Total length 6.45 mm; eyes large, cover most of sides of head, distance between eyes 0.65 mm; medial ocellus width 0.19 mm; pronotum rounded anteriorly, straight lower lateral margin; scutellum subtriangular and elevated in lateral view; metanotum narrowed, slightly raised between dorsopropodeum and scutellum; metaepisternum well developed and separated from lateropropodeum by propodeal suture, and from supra anepisternum by mesometapleural suture; poorly developed sulcus separating metapleuron and infra katepisternum; basalar sclerite rounded; posteropropodeum slightly concave with slightly sharp posterior lateral edges; petiole narrow, width less than propodeal 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 longer 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 other segments; color mostly pale yellow.

Comparison of worker — Bothroponera ryderae belongs to a 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. ryderae* from *B. silvestrii* or even from the other species of the *B. sulcata* complex by considering the body length, the form of posteropropodeum and propodeum, the eye size and the erect hairs on top of the head.

The total length of the *B. ryderae* is 6.55 - 7.20 mm, which is larger than that of *B. silvestrii*. The total length of *B. silvestrii* is 5.25 - 7.05 mm, which is the smallest length in the *sulcata* complex. The only species that is close in total length to *B. ryderae* is *B. silvestrii*; however, this measurement overlaps in the two species.

It is easy to exclude *B. silvestrii* 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. silvestrii* 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 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 - 0.25, EL 0.20 - 0.25).

Comparison of male — The male of *B. ryderae* can be compared with the other known males of *B. crassa*, *B. crassior*, *B. silvestrii*, *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 ocellus 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. silvestrii* (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). The notauli are present on dorsum of the scutum of *B. ryderae* similar to that of *B. soror*, *B. notaula* and *B. silvestrii*. 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. silvestrii* (4.70 - 5.10 mm). *Bothroponera*

crassa has a total length of 6.00 - 8.80 mm and *B. notaula* has a total length of 5.60 - 7.90 mm, which overlaps in total length with *B. ryderae*, but they can be easily excluded since they both have similar posteropropodea that are different from that of *B. ryderae*. The posteropropodeum in *B. notaula* and *B. ryderae* form an obtuse angle with the dorsopropodeum, in contrast, the posteropropodeum in *B. crassa* seems to form one surface 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), 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 absent in *B. crassior* as mentioned above.

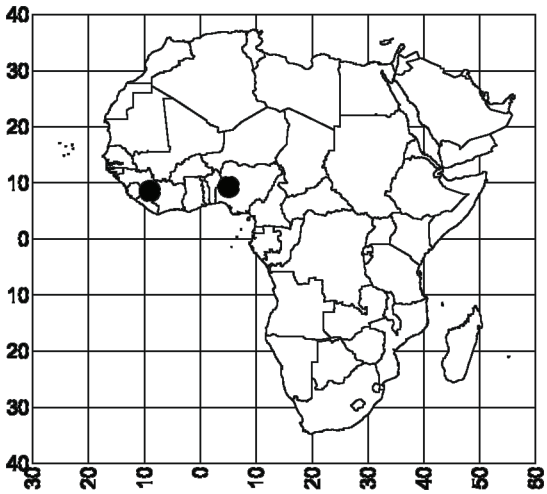
Etymology — This species is named in honor of Dr. Suzanne Ryder, curator of the Hymenoptera collection at the Natural History Museum, London, in recognition of her outstanding support in providing specimens for this revision.

Type material examined — **GUINEA: Nimba** (Guinee), TG-1300 m, Lamotte 1942, *B. ryderae* (1 holotype worker, 5 paratypes workers, MNHN (Holotype and 2 paratypes MNHN, one paratype Iziko, one paratype BMNH, one paratype CWEM), Mt To, Foret [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 urf vers la pierre Richard, # 130pa, *B. ryderae* (1w MNHN).

Non type material examined — **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 and 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 intermediate 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 associated with *Burkea africana*, *Detarium microcarpum* and *Afzelia africana, Parinari polyandra, Uapaca togoensis, Grewia mollis* and *Daniellia oliveri* trees (Collins, 1977) along with species of ants from the subfamily Ponerinae such as *Megaponera joetens* and termites (Longhurst *et al*. 1978). There is a strong relationship between ant species and termites in terms of predator-prey relations. *Bothroponera ryderae* lives in forest areas that are similar to the other *Bothroponera* species habitat.



Map 9. The distribution of *B. ryderae*.

Bothroponera silvestrii (SANTSCHI)

Figures 29-32; Plate 14; MAP 10.

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; *Pachycondyla silvestrii*: Bolton, 1995: 309.

Bothroponera silvestrii r. *nimba* Bernard, 1953: 188 (w), Guinea; *Pachycondyla silvestrii* r. *nimba*: Bolton, 1995: 307; *Bothroponera silvestrii nimba*: Schmidt and Shattuck, 2014: 77 (**syn**. **nov**.**)**.

Bothroponera kenyensis Santschi, 1937: 47 (w), Kenya, Kenya colony; Schmidt and Shattuck, 2014: 77; *Pachycondyla kenyensis*: Bolton, 1995: 306 (**syn**. **nov**.**)**.

Worker diagnosis — The main distinguishing character of the *B. silvestrii* worker is that the dorsum and sides of the head lack or nearly lack erect hairs. The surfaces of pronotum, propodeum, petiole and postpetiole are hairy and they are small ants (total length 5.25 - 7.05 mm). The anterior medial margin of the clypeus has a single medial longitudinal raised area that forms a smooth shiny longitudinal groove. The mandibles are smooth, shiny and have about 6 to 7 teeth. The compound eyes are relatively small.

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

The pronotal humerus is rounded anteriorly. The propodeum is subquadrate, with the latero- and dorsopropodeum forming an obtuse angle with the posteropropodeum. The basalar sclerite is rounded. The posteropropodeum is mostly straight, not concave, and slopes gradually to reach the connection with the petiole. The petiolar node height is the same as the height of the dorsopropodeum, but slightly higher than the postpetiole. The petiole is rounded anteriorly and slightly concaves posteriorly (side view).

The entire body is covered with fine hairs. Erect hairs are present on the mesosoma, petiole, postpetiole and 4th to 7th abdominal segments, except on the posterior border of head where there are a few scattered erect hairs from 0.02 to 0.12 mm. The entire body is mostly brown to brownish black; the legs, clypeus, mandibles and antennae are light brown.

The female is unknown.

Male diagnosis —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 humerus is rounded. The notauli are present and meet at a point medially on the scutum. The scutellum is subtriangular and elevated in lateral view. The metanotum separates the scutellum and propodeum with a medial sharp carina. The mesopleuron is divided by the anapleural sulcus to form the infra katepisternum and supra anepisternum. The metanepisternum is well developed and distinguished from the propodeum and mesopleuron while the metakatepisternum is narrow and poorly developed. The meso-metapleural 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.

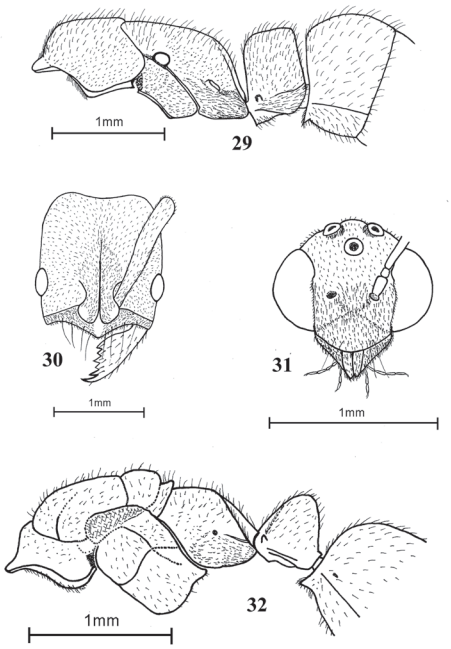


Fig 29. The lateral view of the lectotype worker of *B. silvestrii*.
Fig 30. The head of the lectotype worker of *B. silvestrii*.
Fig 31. The head of a male of *B. silvestrii* from Sankuri Tana, Coast Province, Kenya.
Fig 32. The lateral view of a male of *B. silvestrii* from Sankuri Tana, Coast Province, Kenya.

Worker Description — (n=25 for measurements), 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, HW 1.05 - 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. Measurements of *B. kenyensis*: 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. Head square; clypeus covered with fine hairs, medial area raised to form basal sculptured region, apical region forms triangular smooth area without groove; malar space length 0.15 mm, area from upper edge of eye to upper margin of posterior lobe 0.60 - 0.65 mm; entire body covered with fine dense hairs (0.02 mm) mixed with short (0.10 – 0.30 mm) erect golden hairs scattered on dorsum of pronotum and propodeum; pronotal humerus; dorsum of pronotum, 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 denser on ventral surface of postpetiole; hairs on ventral surface of head few and short (0.15 - 0.25 mm); short erect hairs (0.02 - 0.05 mm) on head, pronotum, 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.

Male description (undescribed) — (n=2 for measurements), HL 0.75 - 0.80, HW 0.45 - 0.50, ML 0.20 - 0.25, EW 0.30 - 0.35, EL 0.50, SL 0.20, FL 3.10, WL 1.55 - 1.60, WPL 2.00 - 2.05, PL 0.45, PW 0.40 - 0.45, PH 0.50 - 0.60, CI 60.00 - 62.50, OI 100.00 - 111.11, MandI 26.66 - 31.25, SI 40.00 - 44.44, PetI 88.88 - 100.00. Ocelli small; 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 scutellum, petiole and ventral surface of postpetiole denser and longer than on other body parts; color mostly yellow and light brown.

Worker comparison — Bothroponera silvestrii 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, by the relatively small total length and the lateropropodeal shape. It is easy to separate *B. picardi* from *B. silvestrii* because *B. picardi* is characterized by the bare surface (without erect hairs).

The clypeus is completely different from most

other species, in *B. silvestrii* as it is covered with fine hairs and the medial raised area forms a flat longitudinal region while in *B. crassa*, *B. crassior*, and *B. picardi* 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*. *Bothroponera silvestrii*, *B. crassior*, *B. kruegeri*, *B. picardi*, *B. crassa*, *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 a slight groove or is without groove in *B. silvestrii*, *B. crassior*, *B. picardi* and *B. crassa*. 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 smallest length range from 5.25 mm – 7.05 mm e.g. in *B. silvestrii* and the largest length range from 11.75 mm – 12.55 mm e.g. in *B. kruegeri*. The total length of *B. silvestrii* overlaps the dimensions with other species including *B. picardi* 6.30 - 6.50 mm, *B. crassa* 6.00 - 8.80 mm. *B. ryderae* 6.55 - 7.20 mm and *B. ancilla* 6.75 - 8.90 mm. The species with largest total length compared to *B. silvestrii* include *B. soror* 7.60 - 11.10 mm, *B. notaula* 7.60 mm, *B. pilosuperficia* 7.50 - 9.00 mm, *B. kruegeri* 11.75 - 12.55 mm and *B. crassior* 8.05 - 9.40 mm.

The form of the lateropropodeum is an obvious character to separate *B. silvestrii* from *B. crassa*. It is concave (from the top) in *B. crassa* while it is convex in *B. silvestrii*. Furthermore, it is easy to recognize *B. silvestrii* because it has small eyes (EW 0.10 - 0.25, EL 0.20 - 0.25 mm) as compared to the larger 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).

Bernard (1953) described *Bothroponera nimba* as a subspecies of *Bothroponera silvestrii*. He distinguished them based on the color, the shape of pronotum and the petiolar 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. nimba* 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 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 that different. The petiole measurements of the *B. silvestrii* type are: length 0.40 - 0.50 mm, width 0.60 - 0.70 mm, height 0.60 - 0.80 mm and of the *B. nimba* types are: length 0.45 mm, width 0.60 - 0.65 mm, height 0.75 - 0.80 mm and are thus almost identical. 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 do not exist and depend on the specimen size. In conclusion, there are no significant differences, and *B. nimba* is considered to be a synonym of *B. silvestrii*.

As Santschi (1937) mentioned, *B. kenyensis* is nearly identical to *B. silvestrii*. The holotype of *B. kenyensis* differs from the lectotype 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. When we studied several specimens of *B. silvestrii* and *B. kenyensis*, we found that the differences Santschi mentioned are similar in both species. The teeth number varies from 6-7 in the material examined for both species. The frontal lobes have the same format even in the type specimens. The eyes size overlap for both species, e. g. *B. silvestrii* (EW 0.10 - 0.20 mm, EL 0.15 - 0.25 mm) and *B. kenyensis* (EW 0.10 - 0.25 mm, EL 0.20 - 0.25 mm), which means that there is no significant difference between the eye sizes. The head width and length overlap in both type specimens and material examined of *B. silvestrii* and *B. kenyensis*. Therefore, we conclude that they are same species.

Male comparison — The male of *B. silvestrii* can be compared with the available males of *B. crassa*, *B. crassior*, *B. kruegeri*, *B. notaula*, *B. ryderae* and *B. soror*. The *B. silvestrii* 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 which have larger total lengths (5.60 - 10.25 mm). The metanotum of *B. silvestrii* is elevated between the scutellum and propodeum and forms a medial sharp carina. This carina is not present in *B. soror*, *B. kruegeri*, *B. notaula*, *B. ryderae*, *B. crassior* and *B. crassa*.

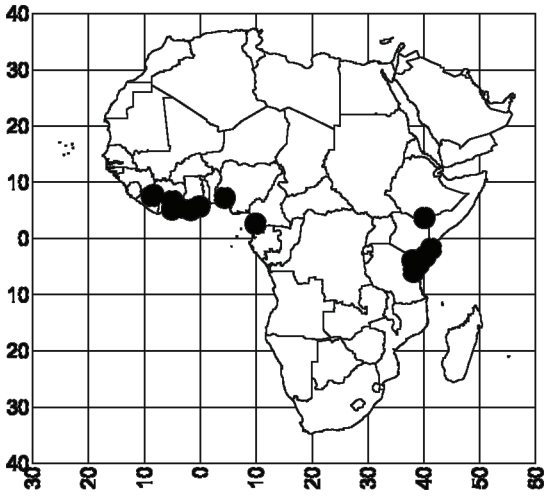
Type material examined — **9 workers:** *Bothroponera silvestrii*: **IVORY COAST: Aburi** silvestri, 5°3’0’’ N; 1°47’0’’ W, *Pachycondyla (Bothroponera) silvestrii* Santschi, holotype, Santschi det. 1913 (1w, NHMB). *Bothroponera silvestrii* Santschi st *nimba* **GUINEA: Nimba**, 500 m, Releve D keoulenta sarane, 7°42’17’’ N; 8°19’49’’ W, F. Bernard; *B. silvestrii* Santschi st *nimba*, F. Bernard 1950, EY6704 syntypes (2w, MNHN), Mt To (1600 m) camp 1, II. VI. 1942, M. Lamotte, *B. silvestrii nimba*, F. Bernard 1950, EY6702, EY6703, EY6705, EY6706 syntypes (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, syntypes (2w, MNHN). **KENYA**: **Kenya colony**, *Bothroponera kenyensis* holotype, no further information (1w, BMNH).

Non type material examined — **21 workers, 2 males: CAMEROUN: [CAMEROON]: Ebodjie, [Ebodie],** 2°34’0’’ N; 9°50’0’’ E, 28-x-1991, A. Dejean, *Pachycondyla silvestrii* (3w, BMNH). **GHANA: Legon**, 5°39’0’’ N; 0°11’0’’ W, A. D., 8-ix-1970, D. Leston, *Pachycondyla silvestrii* Santschi, det. B. Bolton 1977 (2w # 315927, LACM), same locality, 5°39’0’’ N; 0°11’0’’ W, A. D., 28-iv, 10-vii-1970, D. Leston, *Pachycondyla silvestrii* Santschi (2w, BMNH). **GUINEA: Nimba,** 7°32’ N, 8°28’ W, T 124, M. Lamotte 1942 (1w, MNHN). **IVORY COAST: Anyama**, Deteke forest, no 65, 5°26’0’’ N; 3°55’0’’ W, 22-v-1977, T. Diomande (3w, MCZC), **Nzi**. **Noua**, N. of Ndouci, 5°0’0’’ N; 5°0’ 0’’ W, 13-i-1977, degraded forests, rot. Log, WL & DE Brown (2w, MCZC). **KENYA: Malindi District**, Arabuko-Sokoke forest, ca 75m, 3°16’47.99’’ S; 39°58’11.99’’ E, 26-v-2001, # 01-411, 2nd Albizzia- *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). **NIGERIA: Ibadan,** 0°20› N, 30°5› E., I. I. T. A., 3-7-v-1973, B. R. Critch #14, *Pachycondyla silvestrii* Santschi, det. B. Bolton 1977 (3w # 315928, LACM).

Distribution — Cameroon, Ghana, Guinea, Ivory Coast, Nigeria, Kenya and Tanzania.

Biology and habitat — The type specimen of *B. silvestrii* was collected in Aburi City, Ghana. Aburi City which is located at about 37.8 km N of Accra (capital city of Ghana), and is one of the richest areas of tropical flora species. The other specimens were collected from Ivory Coast, west of Ghana

and Nigeria. These countries reflect the ability of *B. silvestrii* to inhabit various ecosystems 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. The synonym *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 published records of *B. kenyensis* (*B. silvestrii*). 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 another distribution of the synonym *B. kenyensis* from Tanzania: 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 hand collected 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). These wide range distributions of *B. silvestrii* in East Africa are other indicator that reflects the ability of *B. silvestrii* to inhabit various habitats with various ecological conditions.



Map 10. The distribution of *B. silvestrii*.

Bothroponera soror (Emery)

Figures 33-38; Plates 15-17; Map 11.

Ponera (Bothroponera) soror Emery, 1899: 472 (w, q), Cameroun; Eidmann, 1944: 431 (m, l); *Bothroponera soror*: Wheeler, W.M. 1922a: 72; Wheeler, G.C. & Wheeler, J. 1952: 623 (l); Wheeler, G.C. & Wheeler, J. 1971: 390 (immature larva); Schmidt and Shattuck, 2014: 77; *Pachycondyla (Bothroponera*) *soror*: Emery, 1901: 46; *Pachycondyla soror*: Arnold, 1915: 59; Brown, in Bolton, 1995: 309.

Pachycondyla (*Bothroponera*) *soror* subsp. *suturalis* Forel, 1907: 133 (w), Ethiopia, Karssa, southern Ethiopia; *Pachycondyla suturalis*: Emery, 1911:78; Brown, in Bolton, 1995: 310; *Bothroponera soror suturalis*: Wheeler, W.M. 1922b: 773; Schmidt and Shattuck, 2014: 77 (**syn**. **nov**.**)**.

Bothroponera lamottei Bernard, 1953b: 188 (w) Guinea; Schmidt and Shattuck, 2014: 77; *Pachycondyla lamottei*: Bolton, 1995: 306 (**syn**. **nov**.**)**.

Worker diagnosis — 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 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 the posterior lateral corner of head is 0.95 mm.

Most of the specimen is 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 humerus is rounded anteriorly, the lower margin is straight with a rounded anteroinferior pronotal process and a pointed inferior pronotal process. The propodeum is quadrate (lateral view), the dorsopropodeum forms a 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.

Most of the body is covered with a few moderately short erect scattered hairs, except for the head which is bare with a few short erect hairs dorsally.

Most of the ant is dark brown.

F*emale diagnosis* —The female of *B. soror* is similar to the worker. The total length of the *B. soror* female (8.60 - 10.10 mm) overlaps that of the worker. The head (excluding mandibles) 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 meso-metapleural suture is well defined. The metanepisternum is poorly developed. The katepisternum is separated from the lateropropodeum by a well-defined suture. The

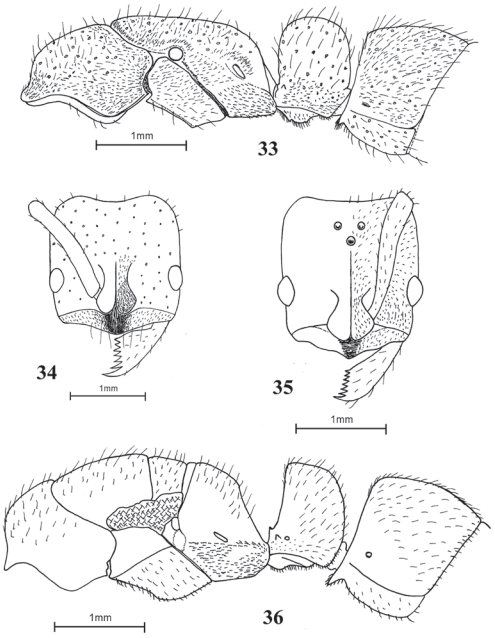


Fig 33. The lateral view of the lectotype worker of *B. soror*.
Fig 34. The head of the lectotype worker of *B. soror*.
Fig 35. The head a paralectotype female of *B. soror*.
Fig 36. The lateral view of a paralectotype female of *B. soror*.

petiolar level is slightly higher than the postpetiole and the dorsopropodeum. The postpetiole and the rest of gaster are larger than the mesosoma.

Most surfaces are covered with moderately long erect hairs. Hairs on the second gastral tergite are less dense and shorter than those on the postpetiole (less than 0.30 mm). Hairs on the pygidium are denser than those on the postpetiole and longer than 0.30 mm. 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 diagnosis — The ocelli and mandibles

are relatively small. Notauli are present on the dorsum of the scutum, but 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 gradually slopes posteriorly to reach the insertion of the petiole. The petiole is small and rounded dorsally. Most of the ant is 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 are scattered on most surfaces.

The surfaces are light to dark brown.

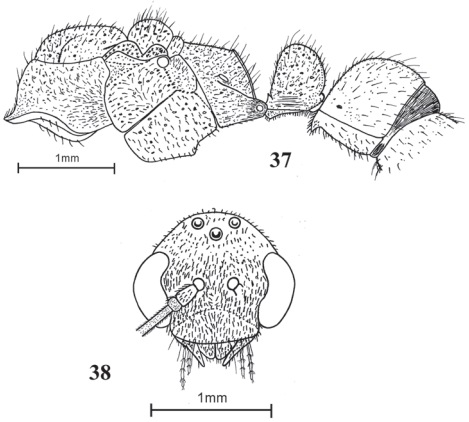


Fig 37. The lateral view of male of *B. soror* from Kenya.

Fig 38. The head of male of *B. soror* from Kenya.

Worker description — (n=40 for measurements), 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. Total length 8.65 - 11.10 mm; head subquadrate; 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; head, pronotum, propodeum, petiole and postpetiole roughly sculptured; pronotal humerus rounded anteriorly and straight on lower margin (lateral view); basalar sclerite rounded; petiole rounded dorsoanteriorly with medium rounded apex and vertical posterior face (side view); dorsum of pronotum, propodeum, petiole and postpetiole covered with few 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; color mostly black or dark brown to reddish brown; mandibles and head pale brown to dark brown; legs and mandibles often reddish brown; tibia and scape often dark brown, tarsus and funiculus light brown.

Female description — (n=15 for measurements), 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. Metanotum well separated between propodeum and scutellum; metakatepisternum distinctive from lateropropodeum; propodeal spiracle elongate; petiole rounded anteriorly, vertical posteriorly (side view); 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.

Male description — (n=12 for measurements), 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. Total length 6.45 - 7.45 mm; head excluding mandibles nearly round; eyes large, cover most of sides of head; scape shorter and thicker than second funicular segment, twice length the pedicel; pronotum rounded anteriorly, square posterior-laterally; notauli present on dorsum of scutum; metanotum without carina; postpetiole rounded (side view); pronotum, scutum, scutellum, propodeum, petiole and postpetiole roughly sculptured; 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.

Worker comparisons — The worker of *Bothroponera soror* is characterized by distinguishable traits among members of the *B. sulcata* species complex. The posteropropodeum in *B. soror* is strongly sloping posteriorly to form a semi-vertical face that is flat (side view) for the reception of the anterior face of the 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. silvestrii*, *B. crassa*, *B. crassior* and *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 a weak groove that forms a slight depression sometimes covered with fine striae. The similar clypeal structure can be found in *B. crassa*, *B. crassior*, *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 a 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 *B. crassior* forms a groove that sometimes has a straight flat strip or a slight depression. In *B. silvestrii*, 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 the clypeus, with a slight depression on the lower part. In *B. pilosuperficia*, the medial raised area is smooth and shiny but without a groove.

Bothroponera soror is smaller (total length 8.65 - 11.10 mm) than *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. silvestrii* (5.25 - 7.05 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 notopropodeal suture and he somewhat compared the metanotum, which is only found in the sexuals. Forel (1907) indicated that the head of *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 notopropodeal 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) near 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 lateral corner of the head 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 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 the head are sparse and moderately long (0.15 - 0.35 mm). Short erect hairs (0.10 mm) are scattered on the dorsum of the head. It is obvious that these characteristics and measurements overlap those of *B. soror*, therefore we 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 than *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 the surface, the shape of the propodeum and the petiole. Direct comparison of the types shows that *B. lamottei* is identical to *B. soror*.

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 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 in number 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, we conclude that *B. lamottei* is a synonym of *B. soror*.

Female comparison — The female of *Bothroponera soror* is similar in size or slightly smaller than the worker (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. pilosuperficia*) are the form of the hairs and the shape of the anterior medial area of the clypeus. The clypeus is convex in both species, but the anterior medial area of the 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. silvestrii*, *B. notaula*, *B. ryderae* and *B. crassior* by the total length, presence or absence of notauli, sculpture, ocellar size and the propodeal shape.

The total length of *B. soror* is larger (6.45 - 7.45 mm) than that of *B. silvestrii* (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. silvestrii* (0.12 - 0.13 mm), *B. ryderae* (0.15 mm) and the type specimen of *B. crassior* (0.17 mm); in comparison,

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 but do not meet on the dorsum of the scutum in *B. soror*, *B. notaula*, *B. ryderae* and *B. silvestrii*. The notauli are not present or poorly developed 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. silvestrii*.

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

Bothroponera soror suturalis: **ETHIOPIA: Karsa**, Southern Ethiopia, 07-i-1936, mars (maro) [mara, 11°29’0’’ N, 36°49’0’’ E, mountain area**],** EY6716, *Bothroponera soror* Emery, subspecies *suturalis* Forel, Museum of Paris, Ethiopie Merid Karssa Maurice de Rothschild 1905 (1w, holotype, MNHN).

Bothroponera lamottei: **GUINEA:** Camp 4 (1000 m), cf 255 mgros spco arec, F. Bernard, ii, vi-1942, M. Lamotte, *Bothroponera lamottei* (2w type # EY6708 lectotype and EY6707 paralectotype, here designated MNHN); **Nimba**, F. Bernard det. 1950, II. VI. 1942, M. Lamotte, *Bothroponera lamottei*, EY6713 (1w, paralectotype, here designated, MNHN), Mont to foret claire [Fôret, 8°30’0’’ N; 9°0’0’’ W], F. Bernard det. 1950, M. Lamotte, *Bothroponera lamottei*, EY6714 (1w, paralectotype here designated, MNHN); **Nion**, 7°36’34’’ N, 8°28’45’’ W, II. VI. 1942, M. Lamotte, *Bothroponera lamottei* F. Bernard det. 1950, Museum Paris (2w, paralectotypes, here designated #’s EY6709 and EY6710, MNHN); **Yalanzou**, 7°43’0’’ N; 8°41’0’’ W, II. VI. 1942, M. Lamotte, *Bothroponera lamottei* F. Bernard 1950, No. 256, Museum Paris EY6712 (1w, paralectotype, here designated, MNHN); **Yanle**, F. Bernard 1950, *Bothroponera lamottei* EY6711 (1w, paralectotype, here designated, MNHN).

Non type material examined — **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. l. 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-10-57, 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, Beni-Irumu, ii-1948, N. A. Weber, 2116, # 00525684 (1w MCZC), West Side Ruwenzori, 0°23’0’’ N, 29°54’0’’ E, ii-1948, N. A. Weber, 2111, #00525680 (1w MCZC), Akenge**,** 2°55’ N, 26°50’ E, collection of W. S. Creighton purchased by LACM 1974, Stomach of *Bufo funereus*, *B. soror* Emery (1w # 315947 LACM), Medje, 2°25’0’’ N; 27°18’0’’ E, H. O. Langg, stomach *Bufo polycercus*, 8480 (1f AMNH), Yangambi, [Zaire is former name] 0°47’0’’ N; 24°28’0’’ E, 1949 Raignier + van Bown (van Bonn or Borrn), *Bothroponera soror* (1w, 2 m, MCZC). **Bandundu Province**, Kikwit, 5°3’44’’ S, 18°52’38’’ E, 21-i-1984 (6w BMNH). **ETHIOPIA: Abessiecen** (Dive- Dalla), *Bothroponera soror suturalis*, 736 (1w, ZMHU); **SOMALIA: Arussi Galla**, A. Ganale Gudda, 7°9’0’’ N, 37°42’0’’ E, V. Bottego, 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-ix-2011, 1-v to 30-vi-2011, home gardens, coll. Debissa Lemessa, #’s 00525695, 00525696, 00525694, 00525698, 00525697, 00525700, 00525702, 00525699, 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* (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, #'s 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°3'0'' W, 5-iii-1977, PK., Primary Forest, dead trunks, I. Lobl (2w BMNH). K**ENYA: 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 Roth, 20966w, *Pachycondyla Gen*. Det. Gary D. Alpert, # 00525706 (1w MCZC); **Kakamega District**: Isecheno, Isecheno Forest Reserve, 1600m, 0°14'23.9994" to 0°15'0" N, 34°51'0" to 34°51'35.9994" E, 31, 6-i-2002, #'s 02-002, 10, 11, 13, 17, 18-ii-2002, #'s 02-043, 02 - 051, 02-034, 02-039, 02-040, 02-041, 02-030, 02-077, 01,13, 16-iii-2002, #'s 02-099, 02-154, 02-128, 02-021, 02-081, 14, 17-viii-2001, Equatorial Rainforest: on ground and in leaf litter, running on fallen log., descending trunk of *Measopsis emenii*, 1000-1020 hrs, ascending trunk of *Measopsis emenii*, 1530hrs, ex. litter under *Measopsis emenii*, in litter of *Measopsis emenii*, on ground following rain, foraging in litter, on vegetation, coll. R. R. Snelling, *Pachycondyla crassa* (Emery 1877), det. R. R. Snelling 2002, 2006, #'s 316008, 315809, 316011, 315865, 315866, 315873 and 315875, 315859, 315862, 315860, 315779, 315780, 315789, 315791, 315792, 315793, 315795, 315806, 315807, 315808, 315810, 315811, 315863, 315864(45w,1f # 316006 LACM), same locality, 1800m, 0°1'11.9994" to 0°14'23.9994" N, 34°51' 35.9994" to 34°58'11.9994" E, 21-iv- 1999, # 99-162, 20-iv-2001, # 01-241, 13-v- 1999, #'s 99-127, 99-128, 11–v-2001, #'s 01-381, 01-377, Equatorial Rainforest: misc workers on ground, ex debris at base of tree, ex. rotten log on ground, venom voucher, stray foragers on shrubs and in litter, foraging in litter, coll. R. R. Snelling, *Pachycondyla crassa* (Emery 1877), Det. R.R. Snelling 2002, 2003, #'s 315868, 315869, 315870, 315871, 315872, 315874. 315913, 315803, 315776, 315855, 315878, 315879, 315882, 315887, 315858, 315867, 315903, 315890, 315854 (47w, LACM); **Western Province**, Kakamega Forest, Kaimosi transect, 30, 04-viii-2008, Kaimosi Mission**,** 27 mi, NE of Kisumu, 29-xi-1957, 1600m, 1650m, leg. Georg Fischer, Kaimosi Forest, Fragment primary forest, transect 30, 40m and 160m, 00°07' 40.8'' N, 034°50'24'' E, Kakamega, 2008 survey, Leaf litter, Pitfall trap, E. S. Ross & R. E. Leech collectors (3w #'s 315943, 315852, 315853 LACM), Kakamega Forest, Ivakale Transect, 00°22' 19'' N, 34°53'56'' E, 13, 21-vii-2007, 1650m, leg. Georg Fischer, Ivakale, extensively used maize field, Transect 13, 0m, Kakamega 2007 survey leaf litter, pitfall trap (1w # 315957 LACM); **Salazar Circuit,** Buyangu Forest Reserve, 1500m, 0°20'6" N, 34°52'26.4" E, 15-iii-2002, #'s 02-151 and 02-149, Buyangu Hill, Buyangu Forest Reserve, 1570m, 0°20'34.8" N, 34°51' 46.7994" E, 14-iii-2002, # 02-130, Equatorial Rainforest, ex. debris and litter on rotten log, ex sifted leaf litter, coll. R. R. Snelling, *Pachycondyla crassa* (Emery 1877), det. R. R. Snelling 2002 (4w #'s 315781, 315782, 315783, 315794 LACM); **Kakamega District**: Isecheno, Isecheno Forest Reserve, 1600m, 0°14'23.9994" N, 34°51'0" E, 20-vii-2001, 9-ii-2002, # 02-033, Equatorial Rainforest: misc in guesthouse clearing, W. Okeka ex sifted litter, *Pachycondyla crassa* (Emery 1877) (1f # 315790 LACM), Isecheno Natural Reserve pump house, Isecheno, 1800m, 0°13'48" N, 34°51'35.9994" E, 7 May 2001, #01-368, Equatorial Rainforest, ex debris at base of tree, coll. R. R. Snelling, *Pachycondyla crassa* (Emery 1877) det., R. R. Snelling 2002 (13 w #'s 315884, 315847, 315848, 315881(2), 315883 (2), LACM), Isecheno Nature Reserve, near Kalunya Glade, 1600m, 1800m, 0°14' 23.9994" to 0°15'0" N, 34°51'0" to 34°52'11.9994" E, 20, 26, 28-30-iv-2001, #'s 01-319, 01-327, 01-237, 01-241, 01-254, 01-297, 01-335, 01-326, 01-343, 01-344, 01-377, 3, 5, 7, 15, 19, 21, iv 2001, #'s 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 #'s 315915, 315818 (3), 315819 (3) and 315820 (3), 315912 LACM); (5q #'s 315817 (3), 315828 (2), 315840 LACM); (80 w #'s 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, 315893, 315912 (2), 315914 and 315915 (2) LACM), Isecheno Natural Reserve pump house, 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* (Emery 1877), det. R. R. Snelling 2002 (2m #'s 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, #'s 01-284, 01-285, and 28-ii-2001, #'s 01-097, 18-ii-2002, # 02-067, 15-ii-2002, #'s 02-062, 02-066, 8-iii-2002, #'s 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* (Emery 1877), det. R. R. Snelling 2004, 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 #'s 315799, 315800, 1f # 315801 LACM); **Laikipia District**, Mpala Research Centre**,** 1650m, 0°17'23.9994" N, 36°53'59.9994" E, 9-x-1999, #'s 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°9'6'' E, 30-xii-1986, Gary D. Alpert, # 00525686 (1 w, MCZC). **SUDAN:** Khor Aba, Aloma Plateau Equatoria, Anglo-Egypt Sudan, 5°2'0'' 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-vi-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 — Equatorial Africa, including 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, the trunk of *Maesopsis eminii* trees in early morning (descending) and late afternoon (ascending), running on the ground, foraging in the litter, foraging on a rotten log, stray foragers on shrubs and at baboon dung. 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* workers 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,

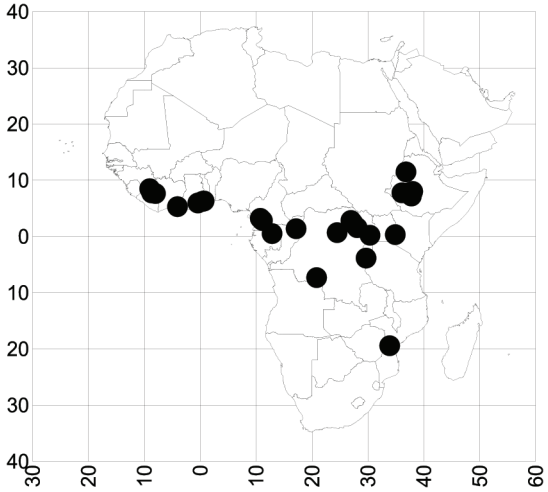
B. soror was collected from *Acacia* Woodland, on the trunk of *Acacia xanthophloeum*, foraging on the ground, scavenging on a rotting skull, in litter under an *Acacia* tree and excavating soil under a stone. Workers use tandem running on the ground.

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 were 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.

Females of *B. soror* from the Isecheno Forest Reserve, Kenya were collected by excavating sifted litter and also collected while 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 member of the *B. sulcata* species complex is distributed far from other members of the complex. The other specimens of *B. soror* examined were collected in the gallery forest of R. Camudembele, Angola.



Map 11. The distribution of *B. soror*.

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Plate 1. *Bothroponera ancilla*, holotype worker (MCZC, photo by A. Joma).

Plate 2. *Bothroponera crassa*, lectotype worker (photo by Dr. Jung W. Kim).

Plate 3. *Bothroponera crassa*, paralectotype male (photo by Dr. Jung W. Kim).

Plate 4. *Bothroponera crassior*, lectotype worker (MCZC, photo by A. Joma).

Plate 5. *Bothroponera crassior*, paralectotype male (MCZC, photo by A. Joma).

Plate 6. *Bothroponera kruegeri*, lectotype worker (MCZC, photo by A. Joma).

Plate 7. *Bothroponera kruegeri*, male (MCZC, photo by A. Joma).

Plate 8. *Bothroponera notaula*, holotype male (photo by Dr. Jung W. Kim).

Plate 9. *Bothroponera notaula*, paratype worker (photo by Dr. Jung W. Kim).

Plate 10. *Bothroponera picardi*, lectotype worker, middle specimen (MCZC, photo by A. Joma).

Plate 11. *Bothroponera pilosuperficia*, holotype worker (photo by Dr. Jung W. Kim).

Plate 12. *Bothroponera ryderae*, holotype worker (photo by Dr. Jung W. Kim).

Plate 13. *Bothroponera ryderae*, paratype male (photo by Dr. Jung W. Kim).

Plate 14. *Bothroponera silvestrii*, male, from Kenya (MCZC, photo by A. Joma).

Plate 15. *Bothroponera soror*, syntype worker (AntWeb Available from: https://www.antweb.org/specimenImages.do?name=rmcaent000017726&project=allantwebants. Accessed 17 April 2016).

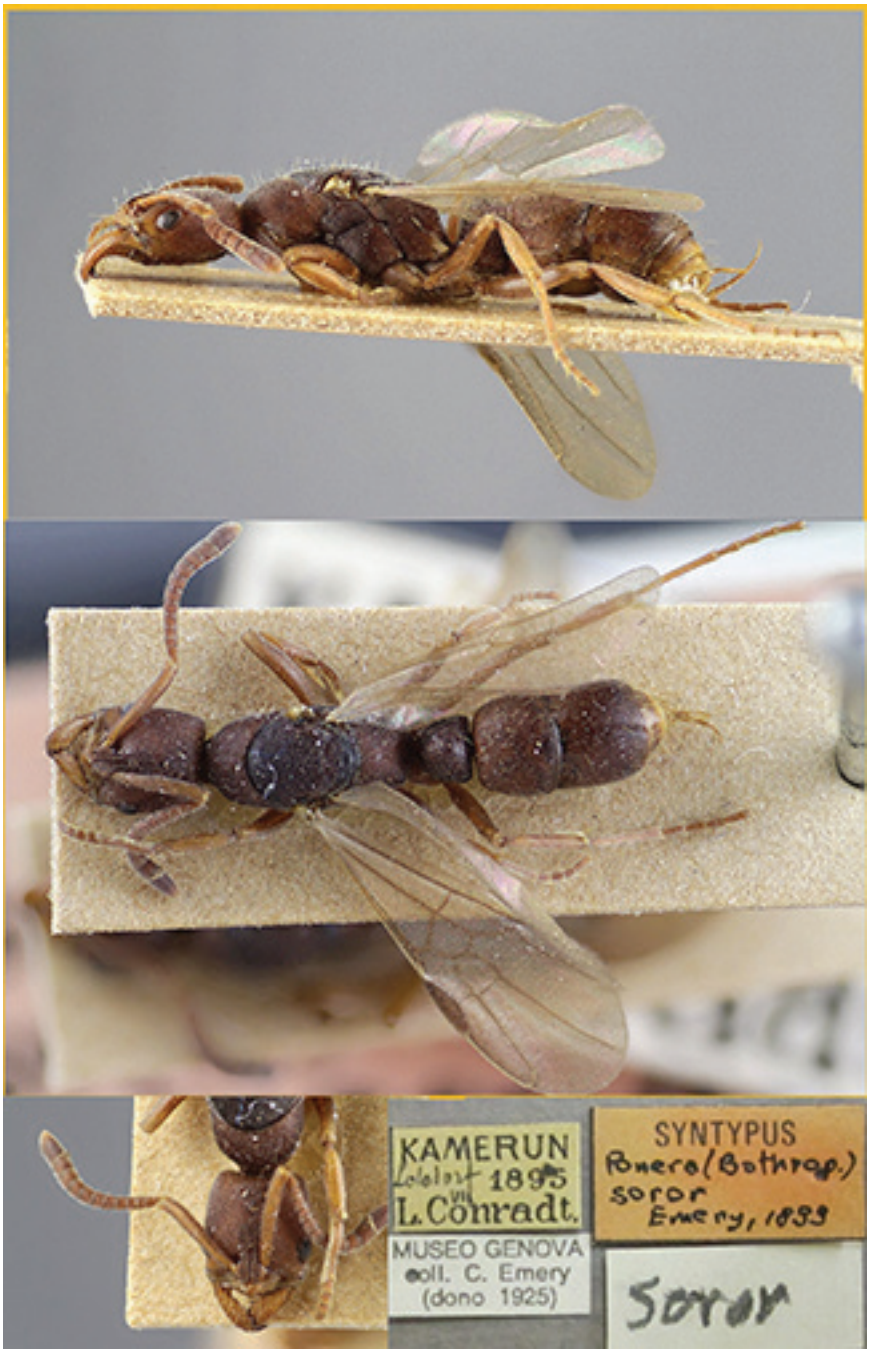

Plate 16. *Bothroponera soror*, paralectotype female (MCZC, photo by A. Joma).

Plate 17. *Bothroponera soror*, male (MCZC, photo by A. Joma).