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

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ABSTRACT

The *B. talpa* species complex includes 8 valid species and 4 synonyms, including: *Bothroponera cribrata*, *B. fugax*, *B. pachyderma* (= *B. pachyderma* var. *attenata* **syn. nov.**, = *B. pachyderma* var. *postsquamosa* **syn. nov.**, = *B. pachyderma* var. *funerea* **syn. nov.**), *B. rubescens*, *B. sanguinea*, *B. sculpturata* (= *B. mlanjiensis* **syn. nov.**), *B. talpa* (= *Psalidomyrmyx clavicornis*) and *B. zumpti.* These species share similar characters such as the shape of the clypeus, the relative length of the antennal scape, mandibular shape and sculpture. The anterior medial margin of the clypeus is convex or straight with a slightly concave anterior border. The scape does not reach or barely reaches the posterior lateral corner of the head. The mandibles are triangular with striae and 6–7 teeth. There is no metatibial gland on the distal anterior surface of the posterior tibia. Diagnoses, descriptions, comparisons, illustrations, distributions, photographs and other ecological and biological information are provided. A taxonomic key is provided for the worker caste.
Key words: Afrotropical, ants, Formicidae, biodiversity

INTRODUCTION

The importance of Afrotropical ant studies:

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

A large number of Afrotropical organisms have been little studied and may well face extinction.

The probable high rate of extinction in ants is due to small body size and other factors shared with all invertebrate species (Chapman and Bourke, 2001). Due to habitat loss and fragmentation, researchers expect incremental loss in ant species (Crist, 2009). According to the International Union for the Conservation of Nature and Natural Resources (Chapman and Bourke, 2001), ants are among the threatened species that were studied by Hilton–Taylor (2000).

Previous studies of *Bothroponera*:

The Afrotropical ants of thgenus *Bothroponera* are a highly diverse group of Formicidae that belongs to the subfamily Ponerinae, tribe Ponerini. Little information is known about their behavior, biodiversity, richness, biology, ecology,

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biosystematics and evolution. The most common species in the Afrotropics are *B. talpa*, *B. crassa*, *B. soror* and *B. pachyderma*. In the Kakamega District of the Western Province of Kenya, Garcia *et al.* (2009) collected samples of *Bothroponera* including *B. talpa*, *B. pachyderma*, *B. crassa* and *B. soror*. In the primary and secondary forests of Ghana, Belshaw and Bolton (1994) sampled *B. fugax*, *B. pachyderma* and *B. soror* among other species of ants in their survey of the leaf litter ant fauna in Ghana. In the Mbalmayo Forest Reserve, Cameroon, Watt *et al.* (2002) recorded *B. fugax*, *B. pachyderma* and *B. soror* from the leaf litter in a study of the diversity and abundance of ants in relation to forest disturbance and plantation establishment. In the rainforests and savanna of Ivory Coast, Levieux and Diomande (1985) collected *B. pachyderma* and *B. silvestrii* among several species during their study of the evolution of the ant populations that live in the soil. In the Province de Ogooué–Maritime, southwestern Gabon, Fisher (2004) found *B. pachyderma* among 310 species of ants during his study of diversity and richness patterns along an elevational gradient on Monts Doudou. In 10 different forests of southern Cameroon, Dejean *et al.* (1996) studied ant species distribution that inhabited *Cubitermes* termitaries at the colony level and collected 15 species of *Pachycondyla*, all of which have been transferred to other genera (Schmidt and Shattuck, 2014), as well as unidentified or new species. Among their collection were *B. talpa*, *B. pachyderma*, *B. fugax*, *B. silvestrii* and *B. soror*. In the Marakele National Park, Schoeman and Foord (2012) found *Bothroponera granosa* during their study of ant species richness in South Africa. Collinet *et al.* (1984) collected *B. pachyderma*, *B. silvestrii* and *B. soror* among the ant species in the dense humid evergreen forests of the southern Ivory Coast.

Biology of *Bothroponera*:

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

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

The habitat of *Bothroponera* species is diverse depending on the species, ranging from rainforest, secondary forests, primary forests, lowlands, to savanna and grassland (data from *Bothroponera* labels). They build their nests in the soil, leaf litter, dead branches, plant cavities, and under stones. Nests of *Bothroponera* contain of number of underground chambers that open to the surface with a circular aperture, surrounded by pieces of piled debris from the diet and nest excavations (Lévieux

and Diomande, 1978; Peeters and Crewe, 1987).

Taxonomy of *Bothroponera*:

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

Although some specialists have recognized *Bothroponera* as a genus for some time, the taxonomic status has remained unresolved. Myrmecologists such as Emery (1895) and Forel (1900) defined *Bothroponera* as a subgenus of *Ponera* while others such as Emery (1901, 1911b), Wheeler W. (1910), Arnold (1915), Forel (1917), and Donisthorpe (1943) considered *Bothroponera* as a subgenus of *Pachycondyla*. These ants had been placed in several genera, but Brown (1973) and Bolton (1994) brought them into synonymy with *Pachycondyla*. Several studies of Afrotropical ants such as Hölldobler and Wilson (1990), Brown in Bolton (1995) and Bolton (2003) considered *Bothroponera* to be a junior synonym of *Pachycondyla*. Others considered *Bothroponera* as a genus, including Mayr (1862), Dalla Torre (1893), Bingham (1903), Ashmead (1905), Wheeler (1918,1922c), Wheeler and Chapman (1925), Chapman and Capco (1951), Bernard (1953a), Taylor (1987), Taylor and Brown (1985), Wheeler and Wheeler (1985), Dlussky and Fedoseeva (1988), Joma and Mackay (2013) and Schmidt and Shattuck (2014). As a result of the current morphological study, and molecular analysis (Schmidt and Shattuck, 2014), it is obvious that *Bothroponera* is a well-defined genus.

Distribution of *Bothroponera*:

Bothroponera is restricted to the tropics of two biogeographical regions of the Old World including the Afrotropical and the Oriental Regions, excluding North Africa, North Asia and the Australian Region. The global distribution of *Bothroponera* also excludes the Nearctic and Palearctic Regions where the climate is suboptimal for either *Bothroponera* or *Pachycondyla* and related genera. The ancestor of *Bothroponera* is likely to have evolved after the separation of the Neotropical Region from Afrotropical Region (more than 100 million years ago), based on the distribution in two separate biogeographical regions.

Afrotropical *Bothroponera* are divided into three species complexes, the *B. pumicosa* species complex; the *B. sulcata* species complex; and, the *B. talpa* species complex (Joma and Mackay, 2013, 2015, 2017). Elsewhere, four species are known from India, two species from the Philippines and one species from Myanmar.

The goal:

In this project, we focus on the *Bothroponera talpa* species complex from the Afrotropical region to clarify the biosystematics of this conspicuous and ecologically important group, extending our work on the *pumicosa* group (Joma and Mackay, 2015) and *sulcata* group (Joma and Mackay, 2017).

METHODS AND MATERIALS

Museums and Collections:

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

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.

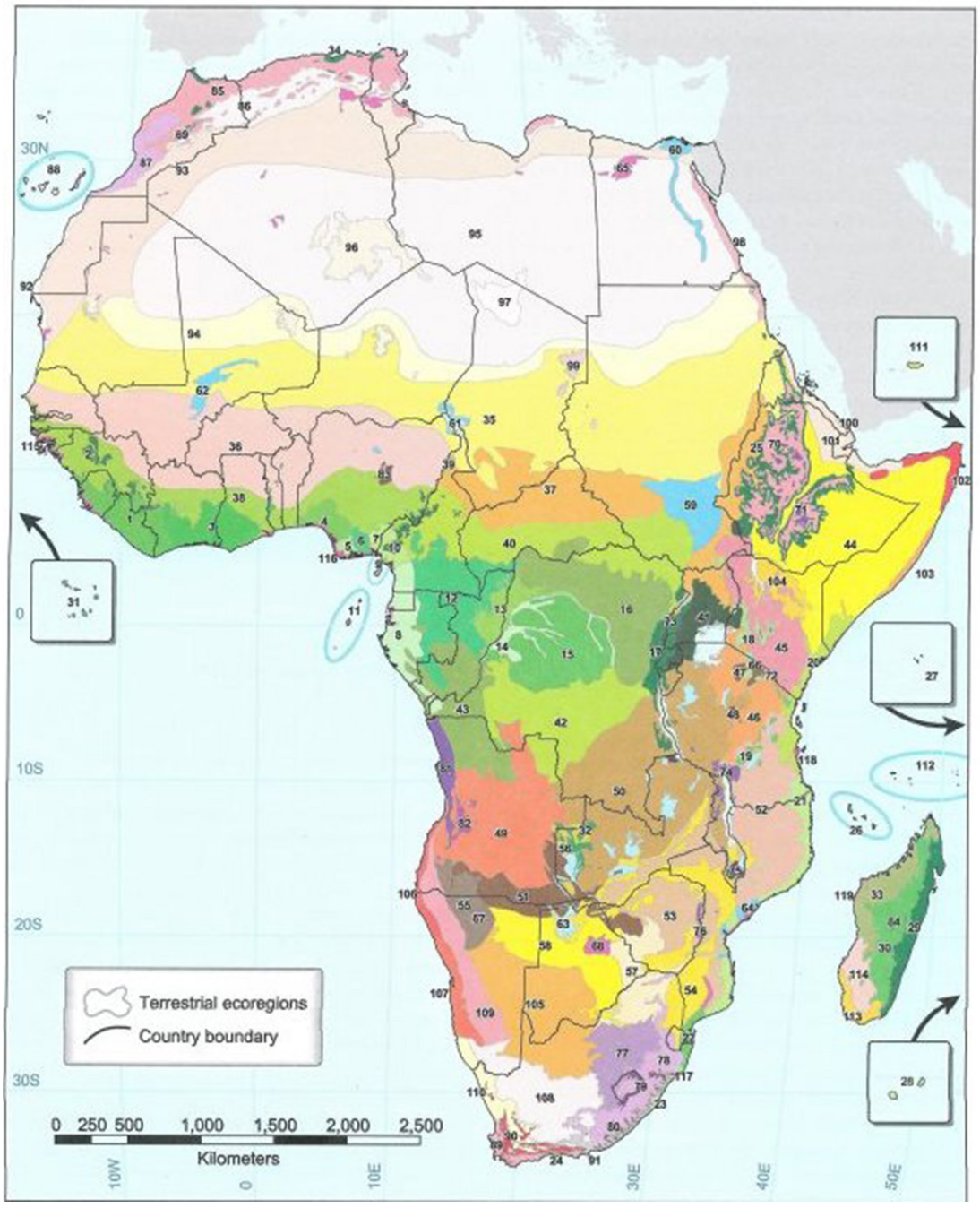
Mandibular Index (MandI), ML/HL x 100.

Scape Index (SI), SL/HW x 100.

Petiolar Index (PetI), PW/PL x 100.

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



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.

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

talpa complex description:

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

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

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

Worker Comparison — It is easy to separate

members of the *B. talpa* species complex from those of the *B. pumicosa* species complex by considering the following characters. The anterior border of the clypeus is convex or straight or slightly concave in members of the *B. talpa* species complex, as compared to the anterior border of the clypeus which is strongly convex and "u" or "v" shaped in members of the *B. pumicosa* species complex. The scape does not reach or barely reaches the posterior lateral corner of the head in members of the *B. talpa* species complex while it reaches or sometimes slightly exceeds the border in the *B. pumicosa* species complex. The eyes are relatively small in members of the *B. talpa* species complex as compared to those of members of the *B. pumicosa* species complex. The sculpture of the members of the *B. talpa* species complex is punctate or at least less foveolate, but the sculpture of *B. pumicosa* species complex is strongly foveolate. The body size is smaller in the *B. talpa* species complex especially in *B. cribrata*, *B. fugax*, *B. rubescens* and *B. zumpti*, which are up to 9.00 mm in total length while the body size is larger in the *B. pumicosa* species complex (the shortest total length is 9.60 mm in *B. berthoudi*).

Both complexes are simple to separate from the *B. sulcata* species complex. The metatibial gland is present in *B. sulcata* species complex while it is absent in *B. pumicosa* and *B. talpa* species complexes. The metatibial gland is an elongate slightly depressed oval–shaped, pale, smooth, barren area on the posterior surface of the tibia of the hind leg near the pectinated spur (Joma and Mackay 2015).

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

It is easy to separate females of the *B. talpa* species complex from females of the *B. sulcata* species complex, based on the presence or absence of the metatibial gland. The members of the *B. talpa* species complex lack the metatibial gland whereas members of the *B. sulcata* species complex have this gland.

Male Comparison — The male of the *B. talpa* group is known only from *B. pachyderma*. There is no way to compare the *B. talpa* species complex male with that of the *B. pumicosa* species complex as no males were found. There are pictures of a *cavernosa* male online (Website 1 antweb.org accessed May 28, 2014 and website 2 antwiki.org accessed May 28, 2014). It is not reasonable to depend on characters that might be seen from pictures online, which show the general characters, but not the specific details such as lower anterior medial area of the clypeus, the propodeal spiracles and the propodeal lobes.

Species excluded from this study or removed from *Bothroponera*

Bothroponera crassa st. *crassior* var. *andrieui* Santschi 1930 [unavailable name]

This species was collected in Sudan. The type specimen can be seen on AntWeb at CASENT0915254, where it is listed as a form of *Bothroponera ilgii*, ascribed to Bolton, 2020 (anonymous reviewer).

Pachycondyla (*Bothroponera*) *escherichi* Forel 1910

This species from Ethiopia was described as a member of *Pachycondyla* (*Bothroponera*). Emery (1911a) combined *P.* (*B.*) *escherichi* with *Euponera* (*Mesoponera*). It was considered as a member of *Pachycondyla* by Bolton in 1995. The presence of the metanotal suture between the mesonotum and the propodeum distinguish *B. escherichi* from *Bothroponera* and it has been moved to *Mesoponera* Schmidt and Shattuck, 2014).

Bothroponera gabonensis André 1892

The worker of *Bothroponera gabonensis* was collected from Gabon and described by André in 1892, the queen was described by Stitz in 1910. Emery (1901) combined *Bothroponera gabonensis* with *Pachycondyla* (*Bothroponera*). Wheeler (1920) moved it to *Phrynoponera*. In 2008, Fisher and Bolton described the male and considered *Bothroponera gabonensis* as a species in *Phrynoponera,* agreeing with Wheeler (1920), Brown (1950) and Bolton (1995) (Bolton & Fisher, 2008a, Website 1 accessed May 26, 2014). Bolton and Fisher recognized two

additional species in the genus *Phrynoponera* (*P. pulchella* and *P. transversa*) with the previous group of known species that include P. *bequaerti* Wheeler (1922a), *P. sveni* (Forel, 1916) and *P. gabonensis* (André, 1892). They also established two junior synonyms of *P. gabonensis* (*P. armata* Santschi, 1919 and *P. heterodus* Wheeler, 1922a both from DRC) with the earlier synonyms including *P. gabonensis* var. *striatidens* (Santschi, 1914) from Cameroon along with *P. gabonensis* var. *robustior* (Santschi, 1919), *P. gabonensis* var. *esta* Wheeler (1922a), *P. gabonensis* var. *fecunda* Wheeler (1922a) and *P. gabonensis* var. *umbrosa* Wheeler (1922a) from DRC (Bolton and Fisher, 2008a).

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

Santschi (1914) described the worker of this species as *Pachycondyla* (*Bothroponera*) *gabonensis* var. *striatidens* from Victoria, Cameroon. Later, this species was combined with *Phrynoponera* by W. M. Wheeler (1922b) and was considered a synonym of *Phrynoponera gabonensis* by Brown (1950). Recently, Bolton and Fisher (2008a) confirmed that it is a synonym of *Phrynoponera gabonensis*.

Pachycondyla (*Bothroponera*) *armata* Santschi

Santschi (1919) described the worker of *Pachycondyla* (*Bothroponera*) *armata* from Kitempuka, Democratic Republic of Congo. W. M. Wheeler (1922d) combined it in *Phrynoponera*; Bolton and Fisher (2008a) considered *P. gabonensis armata* to be a junior synonyms of *P. gabonensis*.

Pachycondyla (*Bothroponera*) *gabonensis* var. *robustior* Santschi 1919

Pachycondyla (*Bothroponera*) *gabonensis* var. *robustior* was collected in the Democratic Republic of Congo and the worker was described by Santschi (1919). The combination in *Phrynoponera* came from W. Wheeler (1922d); Brown (1950), considered it to be a synonym of *P. gabonensis*. Bolton and Fisher (2008a) agreed with Brown.

Bothroponera nasica Santschi, 1920

Bothroponera nasica, from Gabon, was described by Santschi in 1920 and moved to the genus *Loboponera* by Bolton and Brown (2002). In 2002, Bolton and Brown described several additional species of *Loboponera* including *L. basalis*, *L. trica*, *L. vigilans*, *L. edentula*, *L. subatra*, *L. politula*, and *L. obeliscata*. Fisher (2006) described the new species *Loboponera nobiliae*.

Pachycondyla (*Bothroponera*) *variolata* Santschi 1912

Pachycondyla (*Bothroponera*) *variolata* was described by Santschi in 1912, based on a worker from the Congo. Santschi (1914) considered it to be a race of *P.* (*B.*) *talpa* to which Wheeler (1922d) agreed. In this study, *B. variolata* is moved to the genus *Ectomomyrmex* because of the structure of the mesopleuron of the worker in profile. The mesopleuron of *Bothroponera* species workers is completely fused into a single structure while it is divided by the anapleural sulcus into the upper anepisternum and the lower katepisternum in the *Ectomomyrmex variolata* worker.

The unanimous reviewer noted that the queen of *B. clavicornis* was illustrated by Bernard, and that the type of *B. variolata* has a very similar, if not identical, head (CASENT0922352). The reviewer further noted that *B. variolata* could be an intersex, having characters of both queen and worker. The reviewer concluded that the placement of *B. variolata* as a species in *Ectomomyrmex*, a genus otherwise restricted to Asia and Australasia (Schmidt & Shattuck, 2014), is unlikely to be correct.

Ponera sjostedti Mayr 1896

The three castes, worker, male and female of *P. sjostedti* from Cameroon were described by Mayr (1896). G. C. Wheeler and J. Wheeler (1971) described the larva under the same name; however, it was combined in *Pachycondyla (Bothroponera*) by Emery (1901). Wheeler (1922b) placed it in *Bothroponera*, but Brown (Brown in Bolton, 1995) placed *Ponera sjostedti* under *Pachycondyla*. Schmidt and Shattuck (2014) speculated that this

species is a member of *Euponera*. This species was moved to *Euponera* because the eyes are vestigial in *B. sjostedti*. The palp formula in *B. sjostedti* is 2,2, while the palpal formula in *Bothroponera* is 4,4 similar to that of *B. nasica*. *Euponera sjostedti* has mandibular fovea situated basally on the dorsolateral surface as in *Brachyponera*, *Trachymesopus* and *Cryptopone* (Bolton, 1973). There are 6 taxa of *Euponera* from Africa (excluding Malagasy) including *E. aenigmatica* (Arnold, 1949), *E. wroughtonii* (Forel, 1901a), *E. wroughtonii crudelis* (Forel, 1901b), *E. fossigera* (Mayr, 1901) from South Africa and *E. brunoi* (Forel, 1913) from Zimbabwe along with *E. sjostedti* from Cameroon.

Key to the workers of the *B. talpa* species complex

1. Anterior medial area of clypeus broadly convex to "v" shaped; relatively small, total length of workers ranges from 6.00 mm to 7.40 mm and for females ranges from 7.10 mm to 7.85 mm **2**
— Anterior medial area of clypeus straight, "v" shaped to slightly concave; relatively large, total length of workers ranges from 8.10 mm to 14.95 mm and for females ranges from 9.90 mm to 15.90 mm 4

2(1).Mandibles with 7 teeth; carina on anterior medial area of clypeus poorly developed; yellow-brown . . . . . ***zumpti***
– Mandibles with 6 teeth; carina on anterior medial area of clypeus well developed.....3

3(2). Clypeal carina sharp and present along entire length of clypeus; erect hairs present on surfaces of head and body; anterior medial border of clypeus strongly curved, convex, forming "v" shape; queen only known; red-brown. . . . . ***rubescens***
— Carina sharp but not continuous; without erect hairs on surfaces of body and head; anterior medial border of clypeus broadly curved, slightly concave, not forming "v" shape; brown to dark brown .....***fugax***

4(1).Striae absent on surface of frons, sides of head and body surface, with poor evidence of fine striae on metapleuron; entire surface yellow . . . ***cribrata***
— Striae present on frons, sides of head, body, top of pronotum, mesonotum, dorsopropodeum, petiole, postpetiole and gastral segments; with strong evidence of fine striae on metapleuron; surfaces pale brown, dark yellowish brown, to reddish brown **5**

5(4).Anterior medial area of clypeus straight; all surfaces with coarse, large, deep foveolae and punctae …… ……***sculpturata***
— Anterior medial area of clypeus slightly concave; surfaces less coarsely sculptured, with small to large, shallow foveolae and punctae .**6**

6(5).Moderately smaller eyes (0.17 – 0.25 mm width, 0.15 – 0.25 mm length, OI 9.49 – 12.50); shallower foveolae to punctae on surfaces; smaller body size (8.10 – 9.95 mm for workers, 10.40 – 11.60 mm for females) ..... ***talpa***
— Moderately larger eyes (0.25 – 0.35 mm width, 0.30 – 0.45 mm length, OI 13.95 – 18.00); slightly deeper foveolae on surfaces; larger body size (10.70 – 14.95 mm for workers, 11.55 – 15.90 mm for females) **7**

7(6).Larger head (2.30 – 2.70 mm length, 2.15 – 2.50 width, CI 92.59 – 93.47); larger size (worker TL 10.90 – 13.75 mm, female 11.55 – 15.90 mm, male 9.55 mm); larger eyes (0.30 – 0.45 mm length, 0.20 – 0.40 mm width for worker); well defined fine striae on top of head, frons, cheeks, top of pronotum, meso–propodeum, mesopleuron, metapleuron, petiole, postpetiole and 4th to 7th tergites of gastral segments; dark brown; common, widely distributed .....***pachyderma***
— Smaller head (2.15 mm length, 1.95 mm width, CI 90.69); smaller size (worker TL 10.70 mm, female and male unknown); smaller eyes (0.30 mm length, 0.25 mm width); poorly defined fine striae on top of head, frons, cheeks, top of pronotum, meso–propodeum, mesopleuron, metapleuron, petiole, postpetiole and 4th to 7th tergite of gastral segments; red; rarely collected

List of the members of the *Bothroponera talpa* species complex in Africa (8 species and 5 synonyms)

Bothroponera cribrata
B. fugax
B. pachyderma (= *B. pachyderma* var. *attenata* **syn**. **nov**., = *B. pachyderma* var. *postsquamosa* **syn**. **nov**., = *B.* var. *funerea* **syn**. **nov**.)
B. rubescens
B. sanguinea
B. sculpturata (= *B. mlanjiensis* **syn**. **nov**.)
B. talpa (= *Psalidomyrmyx clavicornis*)
B. zumpti

TAXONOMY

***Bothroponera cribrata* (Santschi, 1910)**
Figures 1, 2 and Plate 1; Map 2

Pachycondyla (*Bothroponera*) *cribrata* Santschi, 1910: 349 (w) Congo, Brazzaville; *Bothroponera cribrata*: Wheeler, 1922b: 72; Wheeler, 1922d: 770; Schmidt and Shattuck, 2014: 76; *Pachycondyla cribrata*: Brown, in Bolton, 1995: 304.

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

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

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

The head, mandibles, clypeus, pronotum, mesonotum, mesopleuron and propodeum are yellow, but the scapes, funiculus, lower margins of the frontal lobes, mandibular margins and the tibiae with tarsi are pale brown. The mandibles have brown edges, and are yellow medially.

The female and male are unknown.

Worker descriptions — (n=1 for Measurements), HL 1.95, HW 1.75, ML 1.10, EW 0.20, EL 0.30, SL 1.20, FL 1.95, WL 2.80, WPL 3.25, PL 0.95, PW 1.30, PH 1.40, CI 89.74, OI 17.14, MandI 56.41, SI 68.57, PetI 136.84. Total length 9.00 mm; mandibles triangular, covered with fine striae; scape not reaching posterior lateral corner of head; frontal lobes covered with few fine punctulae, anterior edges shiny, smooth, 0.75 mm in maximum width; length of malar space between insertion of mandibles and lower edge of eye (side of head) 0.30 mm; length from upper edge of eye to highest point of posterior lateral corner of head 0.42 mm; head roughly sculptured, moderately punctulate; pronotal shoulder rounded, lower margin of pronotum straight, slightly concave with sharp angles on inferior and anteroinferior pronotal process; basalar sclerite semi–oval in shape; pronotum roughly sculptured, moderately punctate; dorsum of mesonotum, and of propodeum rough, sides punctate to foveolate; dorsum of petiole and postpetiole slightly roughened, coarsely punctate to alveolate; mesopleuron partially divided by anapleural suture, well separated from metapleuron by mesometapleural suture; petiole rounded anteriorly, anterior face vertical, slightly concave posteriorly; head, pronotum, mesonotum, propodeum, petiole and postpetiole covered with moderately long (0.25 mm) golden pubescence; ventral surface of postpetiole, 4th – 7th gastral segments covered with hairs up to 0.25 mm in length.

Worker Comparisons — Bothroponera cribrata is very similar to *B. talpa*, *B. pachyderma*, *B. fugax*, *B. zumpti*, *B. sanguinea* and *B. sculpturata*, excluding *B. rubescens* because only the female is known for this species. However, *B. cribrata* is characterized by specific properties that can be easily recognized when compared to the other members. For instance, in *B. cribrata* there is a partially developed anapleural

sulcus. Conversely, all of the other members in *B. talpa* species complex lack the anapleural sulcus, but have a well–developed mesometapleural suture. The erect hairs of *B. cribrata* are moderately long (up to 0.25 mm), about the same length on the dorsum of the head, top of the pronotum, mesonotum, propodeum, petiole and postpetiole. On the other hand, there are no striae on the frons; in contrast, very fine striae cover most of the body and the frons of the rest of *B. talpa* species complex species. The total length of the worker of *B. cribrata* is 9.00 mm, larger than those of *B. zumpti*, *B. fugax* and *B. rubescens*, while it is smaller than those of *B. talpa*, *B. pachyderma*, *B. sculpturata* and *B. sanguinea*.

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

Non type material examined — None.

Distribution — Congo, Brazzaville (Republic of the Congo).

Biology and habitat — The type specimen was collected from Brazzaville in the Republic of the Congo that is located in the western part of Central Africa, not to be confused with the adjacent country, the Democratic Republic of the Congo (DRC) that has Kinshasa as the capital (website 3 accessed Jan 2014). The equator crosses the country medially, and the area is characterized by high humidity and mean temperatures between 23°C – 27°C per year, with definite wet and dry season (website 4, accessed Jan 2014). Rain forest and equatorial forests cover about 70% of the country. The average annual rainfall is 137 cm. The main biome and vegetation near Brazzaville are forest and savannah grasslands (Website 5 accessed June 01, 2014). The average annual temperature in Brazzaville ranges from 14 to 32 °C, the average annual rainfall is about 56 mm (Website 2 accessed June 01, 2014).

The country is very diverse in habitats and supports different species of Ponerinae such as *Anochetus africanus*, *A. traegaordhi*, *A. pellucidus aurifrons*, *Odontomachus assiniensis*, *O. troglodytes*, *Bothroponera soror*, *Brachyponera sennaarensis* (Santschi 1910), *Mesoponera caffraria* var. *affinis* Santschi (1935b), *Bothroponera ancilla*, *B. talpa*, *B. pachyderma* and *Paltothyreus tarsatus* var. *mediana* (Website 3 accessed June 03, 2014).

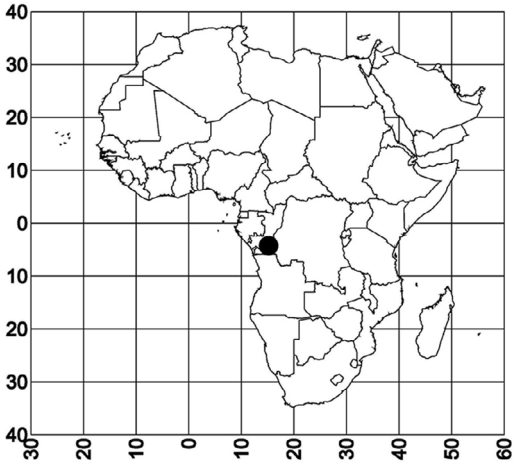
***Bothroponera fugax* (Forel, 1907)**

Figures 3, 4 and Plate 2; Map 3

Pachycondyla (*Bothroponera*) *fugax* Forel, 1907: 7 (w), Tanzania, Arusha Chini, Lac Djipe; Emery 1911a: 76; *Bothroponera fugax*: Wheeler, 1922b: 73 (in key); Wheeler, 1922d: 770; Schmidt and Shattuck, 2014: 76; *Pachycondyla fugax*: Bolton, 1995: 305.

Worker Diagnosis — The clypeal surface forms a well–developed sharp longitudinal carina that extends from the lower medial margin of the frontal lobe to the anterior medial margin of the clypeus. The frontal lobes cover most of the medial area of the clypeus. The mandibles have 6 teeth and the eyes are small (0.15 mm width – 0.15 mm length). The head is roughly sculptured, moderately punctulate.

The posteropropodeum is slightly concave with granulated lateral margins. The petiole is nearly rectangular (side view) with a slight medial depression on the upper posterior edge. The postpetiole and 4th to 7th gastral segments are



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

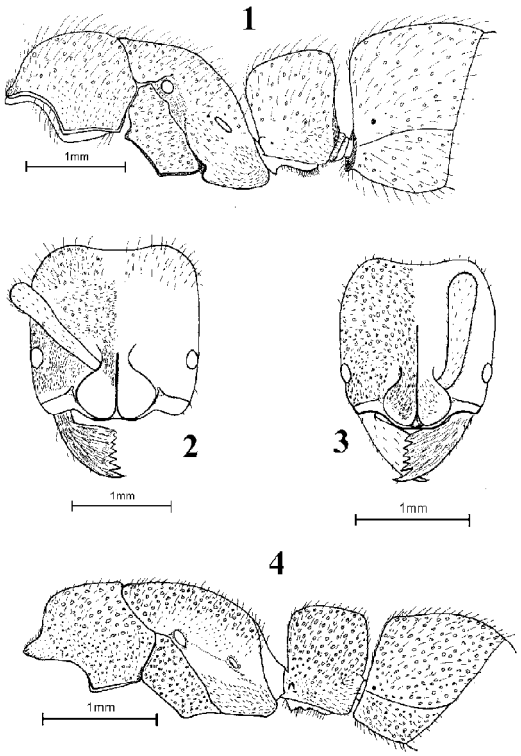


Figure 1. The lateral view of the holotype worker of *B. cribrata*.

Figure 2. The head of the holotype worker of *B. cribrata*.

Figure 3. The head of the holotype worker of *B. fugax*.

Figure 4. The lateral view of the holotype worker of *B. fugax*.

larger than the mesosoma. The petiole is rough with moderately dense large foveolae covering the lateral surfaces. The postpetiole is densely punctate with shallow foveolae. The entire surface is weakly shining.

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

Most surfaces are reddish brown, margins black. The female and male are unknown.

Worker descriptions — (n=1 for Measurements), HL 1.50, HW 1.30, ML 0.90, EW 0.15, EL 0.15, SL 1.00, FL 1.60, WL 1.90, WPL 2.60, PL 0.70, PW 0.90, PH 0.90, CI 86.66, OI 11.53, MandI 60.00, SI 76.92, PetI 128.57. Total length 7.40 mm; medial surface of anterior border of clypeus convex, strongly curved; length of malar space measured from side of head 0.20 mm, length from upper edge of eye to posterior lateral corner of head 0.80 mm; basilar sclerite small and rounded; petiole rounded anteriorly, straight posteriorly (dorsal view), slightly higher than level of postpetiole in side view; frontal lobes shiny with scattered punctures (appearing somewhat granulate); pronotum, mesonotum, propodeum, petiole, postpetiole roughly sculptured, densely punctate, weakly shining on dorsal face; metapleuron covered with poorly defined (fine) striae; petiole and dorsum of postpetiole covered with short hairs (less than 0.10 mm); ventral surface of postpetiole, gastral segments covered with moderately short hairs (0.15 – 0.20 mm); head, pronotum, mesonotum, propodeum, petiole, postpetiole, legs, antennae, mandibles, clypeus reddish brown; mandibular edges, lower margin of clypeus, margins of lateropropodeum, posterior margins of petiole black.

Worker Comparisons — The *B. fugax* worker is similar to the other *B. talpa* species complex members including *B. cribrata*, *B. zumpti*, *B. rubescens*, *B. talpa*, *B. pachyderma*, *B. sculpturata* and *B. sanguinea*.

Forel (1907) described *B. fugax* and compared it with *B. talpa*, and it is clear that *B. talpa* is distinct from *B. fugax*. The lower medial area of the clypeus of *B. talpa* is slightly concave without a carina while the same area of *B. fugax* is convex and narrowly curved and has a sharp longitudinal carina. The straight and slightly concave form of the lower medial edge of the anterior border of the clypeus that is found in *B. talpa* is also found in workers of *B. cribrata*, *B. pachyderma*, *B. sculpturata* and *B. sanguinea*.

The holotype worker of *B. fugax* is similar to workers of *B. zumpti* and *B. rubescens*. When we compare *B. fugax* with *B. zumpti* and *B. rubescens*, the lower anterior medial margin of the clypeus is convex with a longitudinal carina present in the

three species. Generally, the clypeal carina of the worker of *B. zumpti* is less developed, whereas the clypeal carina of *B. fugax* is more developed, based on the single holotype. *Bothroponera fugax* and *B. rubescens* are reddish brown while *B. zumpti* is yellow, but other specimens examined are dark brown. Even though the type specimen differs in color, this does not appear to be a significant character, especially as non–type specimens of *B. zumpti* and the type female of *B. rubescens* differ in color from the type worker of *B. zumpti*. The total length of the workers of *B. fugax* is 7.40 mm, which is larger than that of *B. zumpti* (6.00 – 6.80 for the workers and 7.85 for female); likewise, the female of *B. rubescens* is 7.10 – 7.80 mm.

The other *B. talpa* complex species have longer total lengths than that of *B. fugax* (9.00 mm in *B. cribrata*, 8.10 – 9.95 mm in *B. talpa* workers and 10.40 – 11.60 mm in *B. talpa* females, 9.90 – 11.20 mm in *B. sculpturata* workers and 9.65 – 13.45 mm in *B. sculpturata* females, 10.70 mm in *B. sanguinea* and 10.90 – 14.95 mm in *B. pachyderma* workers and 11.55 – 15.90 mm in *B. pachyderma* females).

There are several additional traits that differ between *B. zumpti* and *B. fugax*. Besides the carinal presence on the lower medial area of the clypeus of *B. fugax*, the total body length is different and the number of mandibular teeth differs from 6 in *B. fugax* and *B. rubescens* to 7 in *B. zumpti*. In fact, *B. fugax* and *B. rubescens* are the only species in the *B. talpa* species complex that have 6 mandibular teeth, the rest of members have 7 teeth. *Bothroponera fugax* essentially lacks erect hairs on the head, mesosoma, petiole, postpetiole and the gastral tergites, while erect and suberect hairs are present on the surfaces of *B. zumpti* and the other species in *B. talpa* species complex, including *B. cribrata*, *B. rubescens*, *B. talpa*, *B. pachyderma*, *B. sculpturata* and *B. sanguinea*. The head, pronotum, mesonotum, propodeum, mesopleuron, petiole, and postpetiole along with the gastral segments of *B. fugax* are rough, densely punctulate and granulated with weak evidence of foveolae, whereas they are rough, moderately punctate and mostly foveolate in *B. zumpti*.

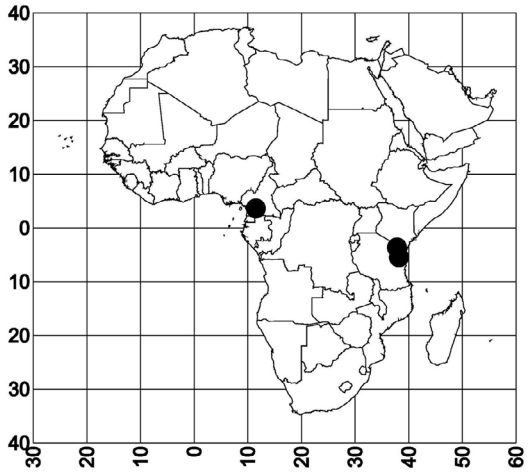
Bothroponera rubescens cannot be compared as it is known only from the female.

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

Non type material examined — None.

Distribution — The type specimen is known from Arusha–chini, Lake Jipe, Tanzania. The Ants of Africa website shows one specimen that was collected from Usambara Mts, Amani NR, Zigi Lodge at 2200 m, S 5° 05’, E 38° 38’ Tanzania (accessed June and August 2014). The species is also recorded from Mbalmayo Forest Reserve, Cameroon (Watt *et al.*, 2002).

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



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

***Bothroponera pachyderma* (Emery, 1901)**

Figures 5–10 and Plates 3, 4; Map 4

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

Pachycondyla (*Bothroponera*) *pachyderma* var. *attenata* Santschi, 1920: 7 (w), Democratic Republic of Congo, N'Gaza; *Pachycondyla* (*Bothroponera*) *attenata*: Wheeler, W. M. 1922d: 771; *Pachycondyla pachyderma* var. *attenata*: Bolton 1995: 303; *Bothroponera pachyderma attenata*: Schmidt and Shattuck, 2014: 76 (**syn**. **nov**.**)**.

Pachycondyla (*Bothroponera*) *pachyderma* var. *postsquamosa* Santschi, 1920: 7 (w), Congo, Lobaye; *Pachycondyla* (*Bothroponera*) *postsquamosa*: Wheeler, W. M. 1922d: 771; *Pachycondyla pachyderma* var. *postsquamosa*: Bolton 1995: 308; *Bothroponera pachyderma postsquamosa*: Schmidt and Shattuck, 2014: 76. (**syn**. **nov**.**)**.

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

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

The best distinguishing character is the body length of the worker, which ranges from 10.90 to 14.95 mm, larger than most of the other species. The basilar sclerite is oval–shaped and covered with fine striae. The mesopleuron is slightly punctate to foveolate. The metapleuron is covered with fine striae. The dorsum of the pronotum, mesonotum–propodeum, petiole, postpetiole and 4th to 7th gastral segments are somewhat covered with well-defined fine striae.

The entire surface of the head, pronotum, mesonotum, propodeum to the petiole and postpetiole along with the 4th – 7th gastral segments are covered with moderately dense fine hairs. The dorsum of the head, especially the frons and frontal lobes, are covered with moderately short (0.21 – 0.24 mm up to 0.27 mm) erect golden hairs that are absent on the sides. The dorsum of the pronotum, mesonotum and propodeum are covered with scattered erect golden hairs ranging from 0.21 to 0.24 mm in length. The petiole and postpetiole are covered with moderately long (0.30 – 0.33 mm up to 0.42 mm) erect golden hairs. The hairs are denser on the dorsum and ventral surfaces of the 4th – 7th gastral segments than on other surfaces.

Female Diagnosis — The female of *B. pachyderma* can be diagnosed by the large size (11.55 to 15.90 mm), which is larger than all of the other species in which the female is known. The anterior medial margin of the clypeus is nearly straight to slightly concave. The head is roughly sculptured and strongly punctulate. The pronotal shoulder is rounded anteriorly and the lower margin of the pronotum (side view) is straight with pointed anteroinferior

and inferior pronotal processes. The basilar sclerite is rounded rather than oval. The dorsopropodeum is narrowed (dorsal view). The posteropropodeum is slightly concave, slightly smooth and slightly shiny with sparse punctures and with rounded margins.

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

The typical color is brown to dark brown.

Male Diagnosis — The mesosoma and petiole of the male of *B. pachyderma* are completely roughly sculptured while the postpetiole along with the 4th – 7th gastral segments are smooth and shiny. The mesopleuron is exaggerated in size in comparison to males in other complexes, covering most of the mesosoma in lateral view. The scutellum is elevated, rounded nearly on the posterior half of the mesosoma.

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

Worker description — (n=34 for Measurements), HL 2.30 – 2.70, HW 2.15 – 2.50, ML 1.25 – 1.60, EW 0.25 – 0.35, EL 0.30 – 0.45, SL 1.55 – 1.95, FL 2.50 – 2.85, WL 3.25 – 4.00, WPL 4.15 – 5.25, PL 1.10 – 1.40, PW 1.35 – 1.80, PH 1.62 – 1.95, CI 92.59 – 93.47, OI 13.95 – 18, MandI 54.34 – 59.25, SI 72.09 – 78, PetI 122.72 – 128.57. Total length 10.90 – 14.95 mm; anterior border of clypeus slightly concave medially, lacking carina; clypeal length 1.70 – 2.15 mm; mandible triangular, covered with fine striae; scape not reaching posterior lateral corner of head; frontal lobes finely punctulate, anterior edges shiny, smooth, 0.95 – 1.20 mm in maximum width; length of malar space between insertion of mandibles to the lower edge of eye (side of head) 0.35 – 0.51 mm; length from upper edge of eye to highest point of posterior lateral corner of head 1.15 – 1.55 mm; head roughly punctulate; pronotal shoulder rounded, lower margin of pronotum straight with sharp inferior angle; pronotum roughly sculptured, moderately punctate; dorsum of mesonotum, and dorsopropodeum rough, sides punctate to foveolate; mesopleuron partially divided by anapleural suture, well separated from metapleuron by mesometapleural suture; dorsum of petiole and postpetiole rough, coarsely punctate and foveolate; petiole rounded anteriorly, anterior face vertical, slightly concave posteriorly; postpetiole, all gastral segments rough with large, moderately shallow foveolae; head, pronotum, mesonotum, propodeum, petiole and postpetiole covered with moderately long golden pubescence (0.10 – 0.40 mm); ventral surface of postpetiole, 4th – 7th gastral segments covered with hairs up to 0.45 mm in length; head dark red to dark brown, pronotum, mesonotum, mesopleuron, propodeum, petiole, postpetiole dark, reddish brown to black, legs, frontal lobes red, antennae, clypeus, mandibles reddish black.

Female descriptions — (n=8 for Measurements), HL 2.20 – 2.80, HW 2.15 – 2.70, ML 1.22 – 1.60, EW 0.30 – 0.55, EL 0.35 – 0.55, SL 1.50 – 2.05, FL 2.40 – 3.10, WL 3.60 – 4.85, WPL 4.80 – 6.40, PL 1.07 – 1.35, PW 1.40 – 1.95, PH 1.62 – 2.15, CI 96.42 – 97.72, OI 16.27 – 20.37, MandI 55.45 – 57.14, SI 69.76 – 75.92, PetI 130.84 – 144.44. Head subquadrate; posterior margin strongly concave; scape reaches posterior lateral corner of head; mandibles triangular, covered with striae, with 7 teeth; eye large; malar space from side of head 0.40 mm in length, length from upper edge of eye to highest point of posterior lateral corner of head 1.25 mm; scutum widened anteriorly, reaching same width as pronotum (2.35 mm), narrowed posteriorly to reach same width as propodeum (2.15 mm); smooth shiny depression on medial area of scutellum (dorsal view), entire scutellum weakly striated; posterior width of propodeum 1.75 mm; dorsopropodeum short (0.55 mm); petiole with smooth longitudinal narrowed strip extending medially on dorsum from anterior to posterior edge; postpetiole with remainder of gastral segments slightly larger than mesosoma (5.60 mm for postpetiole with gaster, 4.40 mm for mesosoma); head covered with moderately long (0.25 up to 0.35 mm) golden erect hairs; pronotum, scutum, scutellum, dorsopropodeum covered with long (up to 0.35 mm) moderately dense erect hairs; dorsum of petiole covered with long (0.45 mm) erect hairs; dorsum of postpetiole with remainder (4th – 7th) of gastral segments covered with longer (0.40 up to 0.50 mm) erect and suberect hairs; head, mandibles,

pronotum, scutum, scutellum, mesopleuron, propodeum, metapleuron, petiole and postpetiole dark brown; legs, antennae reddish brown.

Male descriptions — (n=1 for Measurements), HL 1.25, HW 1.25, ML 0.40, EW 0.50, EL 0.75, SL 0.30, WL 3.70, WPL 4.25, PL 0.75, PW 1.05, PH 1.20, CI 100, OI 60.00, MandI 32.00, SI 24.00, PetI 140.00. Total length 9.55 mm; head suborbiculate; mandibles nearly contact when closed; large eyes cover most of side of head; clypeus convex, raised medially, without carina; scape short, thicker than second segment of funiculus, first segment of funiculus about half length of scape; pronotal shoulder rounded, lower margin of pronotum straight, sharply angled anteriorly, compressed posteriorly; large horizontal parallel grooves on sides of pronotum; scutum elevated higher than pronotum, lower than scutellum; parapsidal sutures distinctive; propodeum angled posteriorly; mesopleuron divided into enlarged katepisternum and smaller upper anepisternum; mesometapleural suture well defined; petiole small, thick, apex rounded, higher than level of dorsopropodeum, lower than level of postpetiole; propodeum sloping strongly to reach insertion of petiole; head, pronotum, scutum, scutellum, propodeum, petiole rough, coarsely sculptured; postpetiole, gastral segments shiny, smooth; entire surface covered with fine hairs (0.20 mm) mixed with scattered moderately long (up to 0.37 mm) erect golden hairs; postpetiole and gastral segments covered with shorter hairs (0.20 mm, up to 0.25 mm) on dorsum and ventral surfaces.

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

Bothroponera pachyderma var. *attenata*, *B. pachyderma* var. *postsquamosa* and *B. pachyderma* var. *funerea* are new synonyms of *Bothroponera pachyderma*, based to the character similarities found in *B. pachyderma* and these varieties.

The worker of *B. pachyderma* var. *attenata* was described by Santschi (1920) as being slightly smaller than *B. pachyderma*, but this is not the case when we looked at the total length of the entire collection of specimens. All of the other characters are similar, even the hair length.

The lengths of the hairs on the pronotum, mesonotum and propodeum of *B. pachyderma* and *B. pachyderma* var. *attenata* range from 0.21 – 0.24 mm. The hairs on the petiole and postpetiole are usually longer (0.33 mm) than those on the pronotum, mesonotum and propodeum (slightly shorter than 0.33 in *B. pachyderma* var. *attenata*). There are no other obvious differences between *B. pachyderma* and *B. pachyderma* var. *attenata* and the latter is considered to be a synonym of *B. pachyderma*.

Santschi (1920) described *B. pachyderma* var. *postsquamosa* as being different from *B. pachyderma* var. *attenata* in being more strongly sculptured. The sculpture of *B. pachyderm* var. *postsquamosa* is the same as that of *B. pachyderma pachyderma* and *B. pachyderma* var. *attenata*. *Bothroponera.* var. *postsquamosa* can be characterized as having the longest hairs on the head and body among the three taxa (*B. pachyderma pachyderma* and *B. pachyderm* var. *attenata*). The hair length of *B.* var. *postsquamosa* on the petiole and postpetiole are usually longer (0.42 mm) than the hairs on the pronotum, mesonotum and propodeum (0.30 mm). Other than that, they are similar when compared with the type of *B. Pachyderma*. Therefore, we consider it to also be a synonym of *B. pachyderma*.

Female Comparisons — The females of *B. pachyderma* are similar to the females of *B. rubescens*, *B. sculpturata*, *B. talpa*, *B. zumpti* and among members of the *B. talpa* species complex (those of other species are unknown). The form of the anterior medial border of the clypeus can separate *B. pachyderma*, *B. sculpturata* and *B. talpa* from the other species as it is almost straight to slightly concave; it is convex to broadly rounded with a sharp

longitudinal carinae on the clypeus of *B. zumpti*, *B. rubescens* and *B. fugax*.

Bothroponera pachyderma can be separated from *B. talpa* by several differences such as the scape length, the surface sculpture and the total length and the hairs. The scape in females of *B. pachyderma* reaches the posterior lateral corner of the head whereas in females of *B. talpa* the scape does not reach the corner. The surface of *B. pachyderma* is more roughened and covered with larger and deeper foveolae while in *B. talpa* the surface is less roughened and covered with shallower and smaller foveolae. The *B. pachyderma* female's total length ranges from 11.55 mm to 15.90 mm; the total length of females of *B. talpa* reaches 10.40 to 11.75 mm. The entire surface of *B. talpa* is covered with dense fine hairs and long erect hairs, both types of hairs tend to be silver rather than golden, but in *B. pachyderma* the surface is covered with less dense fine hairs and golden erect hairs.

The posterior border of the head of *B. pachyderma* tends to be more broadly convex to slightly straighter than concave as in *B. sculpturata*.

Wheeler (1922b) separated the holotype female of *B. pachyderma* var. *funerea* from that of *B. pachyderma* based on a number of characteristics. He considered it to be larger, but in fact, it is smaller than the females of the *B. pachyderma* type series (*B. funerea* holotype total length 13.50 mm, *B. pachyderma* paralectotypes 15.15 – 15.90 mm). He also stated that *B. funerea* differed as it was dark and black, but it is the same color as the *B. pachyderma* paralectotype females. He also characterized the hairs on the dorsal surface as black in *B. funerea*, but many are golden in *B. pachyderma*, and are the same color as the hairs of the paralectotype females of *B. pachyderma*. The gastral surface of *B. funerea* has less distinct striae between the foveolae, that seem to be shallower than Wheeler (1922b) concluded, but this character appears to be identical to those of the paralectotype female of *B. pachyderma*. Therefore, we consider it to be a synonym of *B. pachyderma*.

Male Comparisons — The male of *B. pachyderma* was the only male found in the species of the B. *talpa* species complex. The total size is smaller than the female, somewhat similar to the size of the worker. The general color and sculpture of the *B. pachyderma* male are similar to those in other species complexes of *Bothroponera* males, particularly those in the *B. sulcata* species complex. We can compare the male of *B. pachyderma* with the male of *B. soror* in the *B. sulcata* species complex. The surface of *B. pachyderma* is coarsely sculptured while it is less sculptured or simply roughened in *B. soror*. The head is suborbiculate in the *B. pachyderma* male whereas it is suborbiculate to slightly elongate in males of *B. soror*.

Type material examined — 30 workers, 8 females, 4 males, all syntypes: *Pachycondyla* (*Bothroponera*) *pachyderma*, CAMEROON: Kamerun: [Cameroun]: L. Conradt, Museo Genova coll. C. Emery (dono 1925), no further information (3w) upper specimen is the paralectotype, two lower specimens syntypes, 2q syntypes, [here designated], MCSN).

Bothroponera pachyderma var. *funerea* Wheeler, CONGO, Democratic Republic of the Congo (DRC): Medje, 2°25'0" N; 27°30'0" E, Stomach *Bufo polycercus*, H. O. Langg, cotype on label, it is actually the holotype as no other specimens are in the type series # 848588 (1q, AMNH).

Bothroponera pachyderma var. *postsquamosa* Santschi det. 1920, Lobaye, 4°15' S., 18° E, coll. Rigonbach, missing gaster; type, Sammlung Dr. F. Santschi, Kairouan (1w syntype, NHMB).

Pachycondyla (*Bothroponera*) *pachyderma* var. *attenata* Santschi, Congo Belge, N'Gaza, 0°55' N, 24°50' E; coll. Elskens, Sammlung Dr. F. Santschi, Kairouan; type (1w syntype, NHMB).

Non type material examined — **ANGOLA**: Gallery forest, R. Kamuaji, trib Dilolo, 7°36'0" S; 20°53'0" E, trib Chiumbe, berlesate by native collector, 24–i–1963 (det. By W. L. Brown antweb 6/7/2014), *Bothroponera pachyderma* (2w, MCZC). **CENTRAL AFRICAN REPUBLIC**: French Equatorial Africa, Ubangi–Shari [Oubangui–Chari territory], **Haut Mbomu** [Haut Mbomou], 7°0'0" N; 21°0'0" E, iii–1948, N. A. Weber, *Pachycondyla* (*Bothroponera*) *pachyderma* Emery (1w, MCZC). **CONGO**: **Democratic Republic of the Congo**: **Akengi** [Akengei] 2°56'0" N; 26°50'0" E, Stomachs *Bufo polycercus* and *Bufo funereus*, H. O. Lang, *Bothroponera pachyderma* # 8507 and # 864249 (2q AMNH); **Congo**: 50 k NW Boha [Boho], 0°15'59" N; 14°29'49" E, 3 k SE Lac Tollo [Tolo], 0°35'8" N; 14°23'14" E, de la Cuvette region, 2–i–1987, Gary D. Alpert, *Pachycondyla*

(*Bothroponera*) *pachyderma* Emery (1w, MCZC); **Ituri**, Ituri Forest vic. Epulu, 1°30‘ N, 26° to 30° E, VII–55, T. Gregg (1w #9, MCZC); **Malela**, 6° S; 12°40‘0“ E, Village of Malela (Chief Kasende), from nest Kiaba R., 4°22‘57“ S; 12°49‘30“ E, i.vii.04, J. Bequaert collector (2w, MCZC); **Malela**, 6° S; 12°40‘0“ E, Village of Malela (Chief Kasende), from nest, Kiaba River, i–vii–1904, coll. J. Bequaert, *Pachycondyla pachyderma* Emery (1m MCZC); **Ngayu Congo**, 1°40‘0“ N; 27°40‘0“ E, Stomach *Bufo superciliaris*, N’Gayu, Congo, H. O. Lang #302 (1w, AMNH). **Pehata**, 10.5.26, J. Bequaert, *Pachycondyla* (*Bothroponera*) *pachyderma* Emery (1w MCZC). **GABON**: **Makokou**, **Ogooué–Ivindo Province,** rain forest, 0°34‘0“ N; 12°52‘0“ E, July–August 1974, W. H. Gotwald, *Pachycondyla* (*Bothroponera*) *pachyderma* Emery (3w, MCZC); **Makokou**, 0°34‘0“ N; 12°52‘0“ E, x–xii–1972, I. Lieberburg rain forest, *Pachycondyla* (*Bothroponera*) *pachyderma* Emery (1w #16, MCZC); **Plateau d’Ipassa**, IPA 5, 34, J. A. Barra, *Pachycondyla* (*Bothroponera*) *pachyderma* Emery, no further information (1w, MCZC). **GHANA**: **Kumasi Metropolitan District**, Bobiri Forest Reserve, Nr. Kumasi, 6°41‘ N, 1°21‘ W, 6.iv.1992, R. Belshaw, leaf litter primary forest, *B. pachyderma* (2w, BMNH); **Tafo**, **Kumasi Metropolitan District,** Ashanti Region, 6°44‘0“ N; 1°37‘0“ W, 31.vi.66, Leston, *Pachycondyla pachyderma* Emery, det. B. Bolton 1977, LACM ENT 315923 (1q, LACM), same locality, 31.viii.70, B. Bolton, *Pachycondyla pachyderma* det. B. Bolton 1977 (LACM ENT 315922 and 315924 (4w, LACM); **Tafo,** 4°44’9’’ N, 1°36’29’’ W, 15.viii.66, D. Leston, ant ecology sample, 206A (2w and 1q, BMNH). **IVORY COAST**: **Abidjan District**, Banco Forest, nr. Abidjan, 5°23’ N, 4°3’ W, 9–vi–1974, W. H. Gotwald, *Pachycondyla* (*Bothroponera*) *pachyderma* Emery (1w, MCZC); **Lamto** (**Toumodi**), 6°33’0’’ N; 5°1’0’’ W), Lamto Research Station, 6°22’0’’ N 5°03’0’’ W, 200 km north Abidjan, near of Divo town, A A 225, 9.3.68, coll. J. Levieux, *Bothroponera pachyderma* Emery (1w, MCZC), **same locality**, 6°22’0’’ N 5°03’0’’ W, 200 km north Abidjan, near of Divo town: AA 284 14.4.68, coll. J. Levieux, *Bothroponera pachyderma* (1w, MCZC); **Man**, Montagnes District, 7°24’19’’ N; 7°32’51’’ W, Museum of Paris, 12–1930–vi–1931, Ch. Alluaud & P. A. Chappuis, *Pachycondyla pachyderma* Emery (1q, MNHN). **SOUTH SUDAN**: **Imatong**, Imatong Mts. Equatoria, 4°10’26’’ N; 32°45’11’’ E, Anglo–Egypt, Lotti Forest, 4°2’41’’ N; 32°32’18’’ E, vii–24 – viii–5, 1939, N. A. Weber, *Bothroponera Pachyderma* Emery compared with type, W. L. Brown 1963, *Bothroponera Pachyderma* var. *attenuata* Santschi compared with type, W. L. Brown 1963, *Bothroponera Pachyderma* var. *postsquamosa* Santschi compared with type, W. L. Brown 1963 **(**1w # 1459, MCZC). **UGANDA**: **Eastern Province, Jinja District**, **Jinja**, 10 mi W. Jinja, 0°35’0’’ N; 33°15’0’’ E, 1200m, 1–xii–1957, coll. E. S. Ross & R. E. Leech, *Pachycondyla* (*Bothroponera*) *pachyderma* Emery (1w, MCZC); **Central Province, Buikwe District**, **Kimera**, 0°12’0’’ N; 32°59’0’’ E, 4–viii– 1914, Dr. G. D. H. Carpenter, *Bothroponera pachyderma attenata* Santschi; Sammlung Dr. F. Santschi, Kairouan (1w, NHMB).

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

Brian Taylor (Website 6 The Ants of Africa, accessed August 20, 2014) identified several *B. pachyderma* specimens (Oxford University Museum) that were collected from Liberia, E. Poirier Liabala P. F., Nimba county 07°31’06’’ N, 08°35’34’’ E and Ghana, S. Sky Stephens. Several specimens were collected from three different locations at different elevations in Central African Republic, P. Annoyer, J. P. Dzanga–Sangha [03° 03’ 58’’ N, 16°08’59.5’’ E] [2°28’45.9’’ N, 16°13’15.0’’ E] [2°28’49.5’’ N, 16°12’55.9’’ E]. Congo Brazzaville, Lesion–Louna, Gallery forest 3°16’21.7’’ S, 15°28’12.5’’ E (The Ants of Africa Website, 8/20/ 2014).

Biology and habitat — *Bothroponera pachyderma* is a widespread species in tropical Africa, distributed over a large area of terrestrial ecoregions in the southern, central, eastern and western African countries. Belshaw and Bolton (1994) collected 17 workers of *B. pachyderma* in a study identifying the presence and the geographical composition of ant species in Ghana. The samples were collected from 7 different sites (leaf litter samples) from primary and secondary forests. In Cameroon, one queen was collected by L. Conradt from a similar habitat (Emery, 1901). Two type workers of *B. pachyderma*

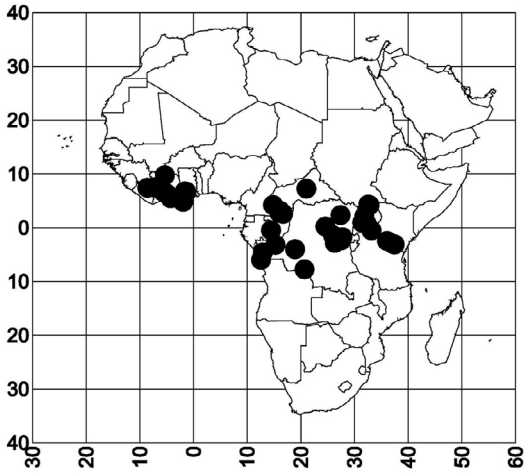
(=*B. attenata*) were collected from the Belgian Congo, Congo (DRC), and N'Gaza by Elskens (Santschi, 1920). *Bothroponera pachyderma* (=*B. postsquamosa*) was collected from the French Congo, Lobaye by Riggenbach (Santschi, 1920). The female *Bothroponera pachyderma funerea* and workers of *B. pachyderma* were collected from the Democratic Republic of Congo, Medje by Lang and Chapin (Wheeler, 1922b). The specimens of *B. pachyderma* (=*B. attenata*, =*B. postsquamosa*, =*B. funerea*) were collected mainly from rain forest areas and habitat characterized by swamps and riparian ecoregions. That is supported by having several specimens that were extracted from stomachs of predatory toad species such as *Bufo polycercus*, *Bufo funereus* and *Bufo superciliaris*, which live in such habitats. In the Ivory Coast, J. Levieux and T. Diomande collected *B. pachyderma* in the Ferkessedougou area (Levieux and Diomande, 1978). In Sudan, N. A. Weber and J. Myers, collected a number of workers from the Imatong Mountains and Lotti Forest (Weber, 1943). In Tanzania, workers were collected by Y. Sjostedt from Kibonoto, Mt Kilimanjaro and Lake Natron (Mayer, 1907). Specimens were collected from Mabira and Zika forests, Uganda (Arnold, 1954). The variety *B. pachyderma attenata* was collected from Kimini [Kimina], Uganda by G. D. H. Carpenter (Santschi, 1933). *Botroponera pachyderma* was studied extensively by Dejean and Lachaud (2011) and Dejean *et al*. (1999) when they investigated hunting behavior of African ponerine ants that prefer centipedes in their diet and are considered to be semi–specialized predators.

***Bothroponera rubescens* Santschi, 1937**

Figures 11, 12 and Plate 5; Map 5

Bothroponera rubescens Santschi, 1937a: 48 (q) Democratic Republic of Congo, Haut Ubangi; Schmidt and Shattuck, 2014: 76; *Pachycondyla rubescens*: Bolton, 1995: 309.

Female Diagnosis — The female of *B. rubescens* is a relatively small member of the genus (total length 7.10 – 7.80 mm), diagnosed by having a well–developed sharp continuous clypeal carina. The mandible has six teeth. The mesometapleural suture



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

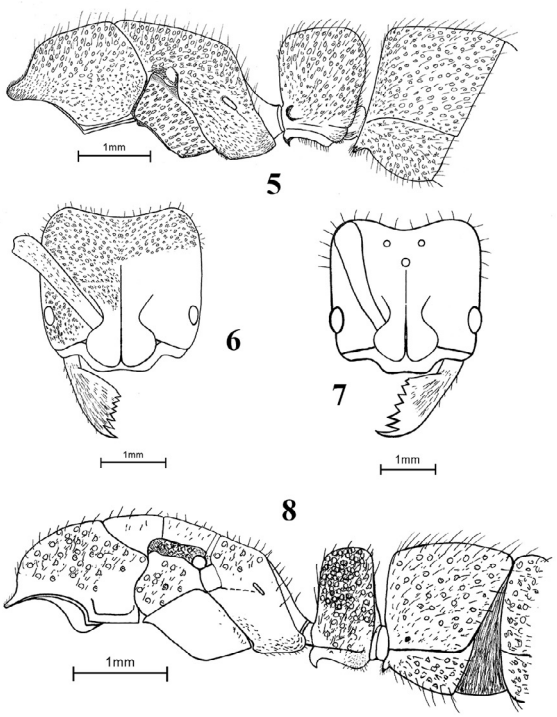
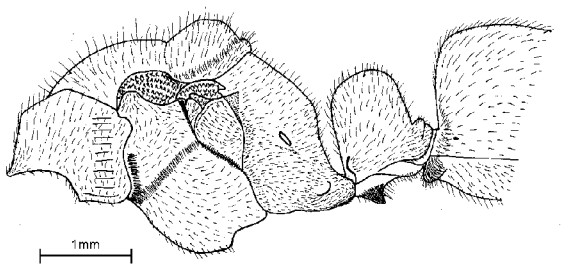


Figure 5. The lateral view of the lectotype worker of *B. pachyderma*.

Figure 6. The head of the lectotype worker of *B. pachyderma*.

Figure 7. The head of a syntype female of *B. pachyderma*.

Figure 8. The lateral view of a syntype female of *B. pachyderma*.



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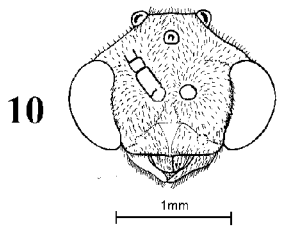

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Figure 9. The lateral view of a male of *B. pachyderma* from the Democratic Republic of the Congo.

Figure 10. The head of a male of *B. pachyderma* from the Democratic Republic of the Congo.

is distinctive. The petiole is rounded anteriorly and slightly concave posteriorly (best seen from above) with rough posterior margins. The head, pronotum, scutum, scutellum, mesopleuron and propodeum are strongly sculptured by dense punctulae. The dorsum of the petiole is coarsely covered with larger punctae, and rough sculpture laterally. The postpetiole and the remainder of the gastral segments are rough and covered with sparse shallow punctures.

The dorsal surface of the pronotum, mesonotum and propodeum are covered with fine hairs, and with scattered moderately short (0.15 – 0.18 mm up to 0.21 mm) erect hairs.

The entire ant is reddish brown.The worker and male are unknown.

Female descriptions — (n=2 for Measurements), HL 1.41 – 1.65, HW 1.23 – 1.50, ML 0.75 – 0.80, EW 0.21 – 0.30, EL 0.21 – 0.30, SL 0.87 – 1.10, FL 1.47 – 1.80, WL 2.22 – 2.50, WPL 2.79 – 3.20, PL 0.57 – 0.70, PW 0.87 – 1.00, PH 0.90 – 1.10, CI 87.23 – 90.90, OI 17.07 – 20.00, MandI 48.48 – 53.19, SI 70.73 – 73.33, PetI 142.85 – 152.63. Anterior medial border of clypeus (anteclypeus) strongly angulate, forming "v" shape with sharp clypeal carina; mandibles more elongated than triangular, covered with fine striae, with 6 teeth; scape slightly curved, not reaching posterior lateral corner of head; malar space from side of head 0.12 mm; length from upper margin of eye to highest point of posterior corner of head 0.65 mm; eyes relatively small; frontal lobes cover most of medial area of clypeus, total width 0.60 – 0.70 mm; clypeal width between bases of mandibles 1.10 – 1.25 mm; pronotum rounded anteriorly, from lateral view lower margin of pronotum straight with sharp (angled) extremes; scutum widened; anapleural suture well developed; mesosoma winged and modified for flight; posteropropodeum smooth, slightly concave with coarse angular margins; basilar sclerite rounded to oval; propodeal spiracle elongated, parallel with mesometapleural suture; metapleuron covered with fine striae; entire surface weakly shiny; petiole and postpetiole covered with moderately long (0.21 mm) hairs; mandibles, head, scape, pronotum, mesonotum, propodeum, legs and clypeus reddish; petiole, postpetiole and funiculus reddish brown.

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

The female of *B. rubescens* is quite similar to the workers of *B. fugax* and *B. zumpti*. It can be separated from *B. zumpti*, as it has only 6 mandibular teeth (*B. zumpti* has 7 teeth). The clypeal structure and the unique sculpture along with the hairs can help in separating these species; otherwise, the female caste is different from these workers. It is not possible to compare *B. rubescens* with *B. fugax*, as only the female is available in the first and the worker in the second.

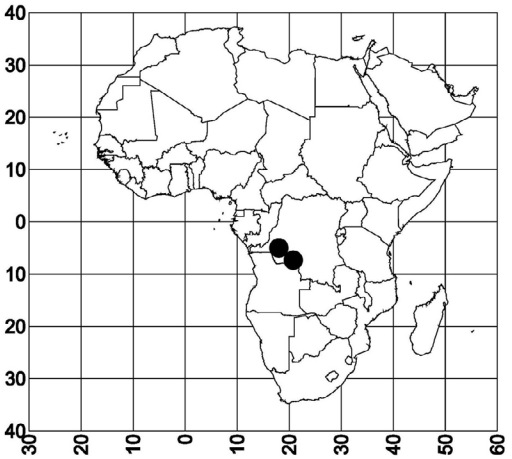
Type material examined — Pachycondyla rubescens Santschi, **DEMOCRATIC REPUBLIC OF CONGO (DRC)**: Congo belge, Haut Ubangi

river, 0° to 5° N, 18° to 23° E (Zimmermann) *Pachycondyla rubescens* Santschi, Sammlung Dr. F. Santschi, Kairouan (1q, holotype, NHMB).

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

Distribution — Democratic Republic of Congo (DRC) and Angola.

Biology and habitat — The holotype of *B. rubescens* was collected in the Ubangi River area at the northwestern part of the RDC. The Ubangi River is located at the border with Congo, Brazzaville, and extends into the DRC. The area is covered with rainforest and mainly characterized by the Western Congolian Swamp Forests (13, number explained on the vegetation Map 1), the Eastern Congolian Swamp Forests (14) and the Central Congolian Lowland Forests (15) ecoregions. It is the most diverse and rich habitat for Afrotropical organisms (Burgess *et al.*, 2004; Website 7 Worldwildlife.org, accessed August, 15, 2014). The additional queen was collected in the Lunda Norte Province located at the northeast border of Angola with the DRC. This Province includes three ecoregions: the Western Congolian Forest–Savanna Mosaic (43), the Southern Congolian Forest–Savanna Mosaic (42) and the Angola Miombo Woodlands (49) that extend into both countries (Burgess *et al*., 2004; Website 7 accessed August, 15, 2014). This reflection of habitat indicates the ability of *Bothroponera* to inhabit a wide range of biomes.



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

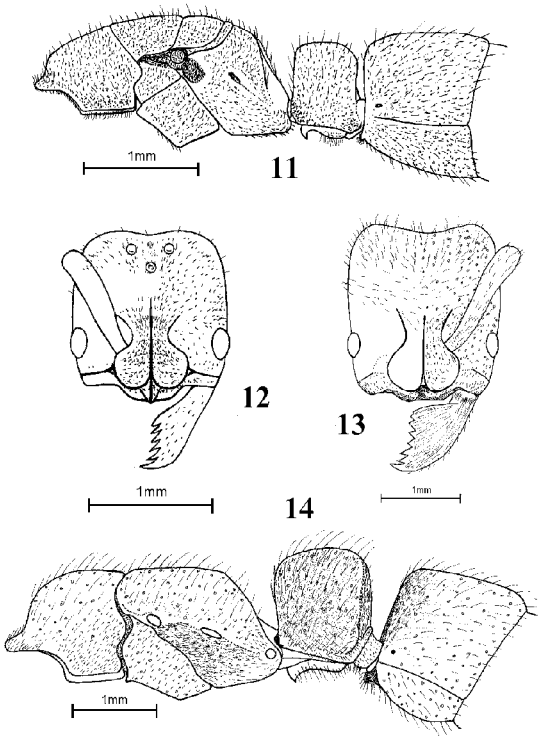


Figure 11. The lateral view of the holotype female of *B. rubescens*.

Figure 12. The head of the holotype female of *B. rubescens*.

Figure 13. The head of the holotype worker of *B. sanguinea*.

Figure 14. The lateral view of the holotype worker of *B. sanguinea*.

***Bothroponera sanguinea* (Santschi, 1920)**
Figures 13, 14 and Plate 6; Map 6

Pachycondyla (*Bothroponera*) *sanguinea* Santschi, 1920: 7 (w) Democratic Republic of Congo; *Bothroponera sanguinea*: Wheeler, W. M. 1922d: 772; Schmidt and Shattuck, 2014:76; *Pachycondyla sanguinea*: Bolton, 1995: 309.

Worker Diagnosis — The dorsum of the head is roughly sculptured and densely punctulate, covered with fine striae. The mandibles are covered with striae and sparse punctures. The lower medial margin of the clypeus is straight to slightly concave, the clypeus is without a carina. The malar space from the side of the head is 0.35 mm in length, the length from the upper edge of the eye to the posterior lateral corner of head is 1.30 mm.

The entire surface (pronotum, mesonotum, mesopleuron, propodeum, petiole, postpetiole (first gastral segment) and the 4th – 7th gastral segments) is roughly sculptured with shallow, moderately dense, poorly defined foveolae. The metapleuron and lateropropodeum (area between the basilar sclerite and propodeal spiracle) are rough and covered with poorly defined fine striae. The frons, sides of the head, petiole, postpetiole and the 4th – 7th gastral segments are covered with poorly defined fine striae. The mesometapleural suture is well developed. The petiole is rounded anteriorly and straight to slightly concave posteriorly (side view).

The dorsal surface of the body is covered with long erect golden hairs, ranging from 0.25 to 0.40 mm. The lower areas are covered by short (less than 0.21 mm) erect golden hairs.

Most surfaces brown to brownish red.

The female and male are unknown.

Worker descriptions — HL 2.15, HW 1.95, ML 1.35, EW 0.25, EL 0.30, SL 1.55, FL 2.45, WL 3.25, WPL 4.15, PL 1.15, PW 1.20, PH 1.42, CI 90.69, OI 15.38, MandI 62.79, SI 79.48, PetI 86.95. Total length 10.70 mm; mandibles with 7 teeth; head subquadrate; fine striae present on frons, sides of head, gena; clypeus covered with fine striae, clypeal length 1.65 mm; frontal lobes well developed with deep, short frontal furrow, cover large medial area of clypeus, frontal lobe maximum width 0.90 mm; scape fails to reach posterior lateral corner of head; eyes relatively large; pronotum rough, with shallow foveolae; basalar sclerite semi–oval shaped; mesonotum, propodeum rough with large shallow foveolae, moderately shiny; metapleuron, lateropropodeum covered with poorly defined fine striae; petiole, postpetiole rough with large shallow foveolae; top of head covered with moderately long (0.15 – 0.30 mm) golden erect hairs; dorsum of pronotum, mesonotum, dorsopropodeum covered with long (0.20 – 0.33 mm) erect scattered hairs; dorsum of petiole covered with long (0.25 – 0.40 mm) golden erect hairs; postpetiole covered with longer (0.21 – 0.40 mm) golden erect hairs; head, pronotum, mesonotum, propodeum brownish red, antennae brown, mandibles dark red, legs reddish brown, clypeus reddish yellow, lower margin of clypeus black.

Worker Comparisons — *Bothroponera sanguinea* can be compared with *B. pachyderma*, *B. talpa*, *B. fugax*, *B. sculpturata*, *B. cribrata* and *B. zumpti*, and *B. rubescens* (only the female caste is known). The specimens of the *B. talpa* species complex are quite similar to each other in their overall characters such as color, hairs, head shape, petiole shape, sternopetiolar and sternopostpetiolar processes, scape length, but specific variations can be recognized by carefully studying these species. The anterior medial area of the clypeus seems to be unique among individuals of the *B. talpa* species complex. It is narrowed, striated and covered medially by the frontal lobes. The lower margin of the anterior medial area of the clypeus is slightly concave in *B. talpa*, *B. pachyderma*, *B. cribrata* and *B. sanguinea*, straight or broadly convex in *B. fugax*, *B. zumpti*, *B. sculpturata* and *B. rubescens*. The eye size is relatively large in *B. sculpturata*, *B. sanguinea* and *B. pachyderma*, while it is small in *B. cribrata*, *B. zumpti*, *B. fugax* and moderate in *B. talpa*.

Santschi (1920) described *B. sanguinea* based on color differences ranging from dark reddish brown to reddish yellow. It is similar in color to other members of the *B. talpa* species complex, especially *B. talpa*, *B. pachyderma* and *B. sculpturata.* It also shares characteristics with *B. fugax*, *B. zumpti* and *B. cribrata.* The color of the only available specimen (holotype) of *B. sanguinea* is now pale brown, however, this color change is repeatedly found in the other species in the *B. talpa* species

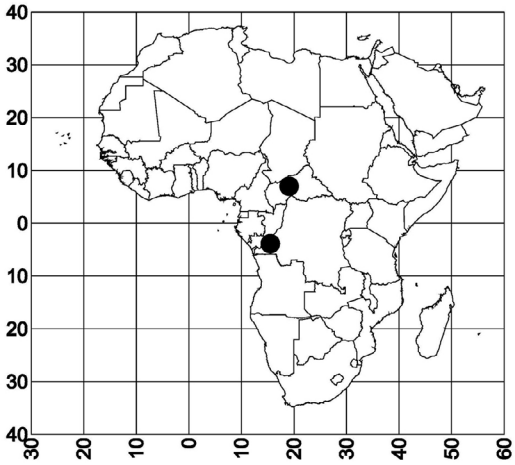
complex such as *B. talpa* and *B. pachyderma*. The obvious character that can be used to separate *B. sanguinea* is the surface that is covered with large, coarse moderately shallow foveolae. The erect hairs of *B. sanguinea* are golden to reddish golden, which is not usual among members of the *B. talpa* species complex. The entire surfaces of *B. sanguinea* including the head have very little evidence of fine striae; in contrast, the surfaces including the head are covered with strong evidence of striae in *B. talpa*, *B. pachyderma* and *B. sculpturata*. The total length can separate *B. sanguinea* from *B. cribrata*, that of *B. sanguinea* is 10.70 mm while that of *B. cribrata* is 9.00 mm. There is only one individual worker among the *B. pachyderma* specimens seen that has the same sculpture and hairs in terms of the form and color, but this specimen has larger range of measurements than the type specimen of *B. sanguinea*.

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

Non type material examined — None.

Distribution — Democratic Republic of Congo (DRC) and Central African Republic, Brian Taylor identified *B. sanguinea* at the Oxford University Museum from the Congo Brazzaville, Lesion–Louna [Lesio–Louna], Gallery forest 3°16’56.5’’ S, 15°28’28.3’’ E (Website 6 accessed August 20, 2014).

Biology and habitat — The holotype of *B. sanguinea* was collected from the “Congo” (Santschi, 1920), but the labels of the holotype specimen indicated that it is from Fort Crampel City in the Central African Republic. Both countries are neighbors and share three terrestrial ecoregions: the Northwestern Congolian Lowland Forests (12, numbers are from Map 1), the Northeastern Congolian Lowland Forests (16) and the Northern Congolian Forest–Savanna Mosaic (40) in central Africa (Burgess *et al*., 2004; Website 7 accessed August 5, 2014). These ecoregions cover a vast area including the Central Congolian lowland forests, the western Congolian swamp forests and the eastern Congolian swamp forests in Central Africa, around the Congo River and its tributaries, which make huge barriers that enhance the speciation rates in the area (Website 7 accessed August 5, 2014, Burgess *et al*., 2004).



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

***Bothroponera sculpturata* (Santschi, 1912)**
Figures 15–18 and Plate 7, 8; Map 7

Pachycondyla (*Bothroponera*) *sculpturata* Santschi, 1912: 151 (q), Zimbabwe, Zambezie; variety of *B. pumicosa*: Wheeler, W. M. 1922d: 772; *Pachycondyla sculpturata*: Bolton, 1995: 309; *Bothroponera sculpturata*: Schmidt and Shattuck, 2014: 76.

Bothroponera mlanjiensis Arnold, 1946: 55 (w and q), Malawi, Mlanje, Nyasaland; *Pachycondyla mlanjiensis*: Brown, in Bolton, 1995: 307 (**syn. nov.**).

Worker Diagnosis — Workers of *B. sculpturata* can be distinguished by the shape of the clypeus, the anterior margin which is broadly convex, but without a longitudinal medial carina. The scape nearly reaches the posterior lateral corner of the head. This ant has a moderately large body size (total length 9.90 – 11.20 mm), the dorsal surface of the head is densely punctate. The sides of the head, cheeks, frons and the dorsum of the pronotum are covered with poorly defined striae. The pronotum, mesonotum, mesopleuron, dorsopropodeum, lateropropodeum and metapleuron are densely foveolate and punctate. The petiolar and postpetiolar surfaces are covered with larger foveolae than the mesosoma. The mesopleuron, metapleuron, postpetiolar dorsum and the rest of the gastral segments are also covered with fine striae. The mesometapleural suture is developed. The posteropropodeum is straight (seen from the side), smooth and shiny. The entire body including the legs and the antennae are weakly shining. The petiole (dorsal view) is rounded and slightly narrowed anteriorly while it is vertical and slightly concave posteriorly.

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

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

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

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

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

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

Worker descriptions — (n=6 for Measurements), HL 1.70 – 1.80, HW 1.60 – 1.80, ML 1.10, EW 0.20, EL 0.20, SL 1.30 – 1.40, FL 2.00 – 2.10, WL 2.60 – 2.90, WPL 3.70 – 3.80, PL 0.90 – 1.00, PW 1.10 – 1.20, PH 1.30 – 1.40, CI 94.11 – 100.00, OI 11.11 – 12.50, MandI 61.11 – 64.70, SI 77.77 – 81.25, PetI 120.00 – 122.22. Total length 9.90 – 11.20 mm; head excluding mandibles subquadrate; anterior margin of clypeus slightly convex (broadly curved) without medial clypeal carina; frontal lobes cover most of medial area of clypeus; mandibles triangular with about 7 teeth; scape shorter, not reaching posterior lateral corner of head; length of malar space from lower edge of eye to base of mandible 0.25 – 0.30 mm; length from upper edge of eye to edge of posterior lobe 1.05 – 1.10 mm; frontal lobes cover medial area of clypeus except very narrow lower margin, width of frontal lobes 0.85 – 0.90 mm; clypeal width between bases of mandibles 1.55 – 1.65 mm; pronotal shoulder rounded; basalar sclerite oval shaped; mesometapleural suture developed;

posteropropodeum straight to slightly concave without coarse angular margins; petiole from dorsal view, slightly narrowed anteriorly, vertical, slightly concave posteriorly; mandibles shiny, covered with fine striae; surface of head densely punctulate; sides of head, cheeks, frons, dorsum of pronotum, mesopleuron, metapleuron, postpetiolar dorsum, other gastral segments covered with poorly defined striae; pronotum, mesonotum, mesopleuron, propodeum, lateropropodeum, metapleuron densely foveolate with punctae; posteropropodeum smooth, shiny, petiolar, postpetiolar surfaces covered with larger foveolae than those of mesosoma; entire body including legs, antennae weakly shining; entire dorsum of pronotum, mesonotum, propodeum covered with relatively short (0.06 – 0.20 mm) erect golden hairs; petiole, postpetiole covered with long (up to 0.30 mm) erect to suberect hairs; head, mandibles, pronotum, mesonotum, mesopleuron, propodeum, lateropropodeum, petiole, postpetiole and entire gaster dark reddish brown; legs, antennae light reddish brown.

Female descriptions — (n=2 for measurements), HL 2.07 – 2.47, HW 1.90 – 2.30, ML 1.17 – 1.45, EW 0.30 – 0.42, EL 0.35 – 0.47, SL 1.40 – 1.60, FL 1.95 – 2.35, WL 3.25 – 4.00, WPL 4.35 – 5.00, PL 1.00 – 1.10, PW 1.35 – 1.65, PH 1.50 – 1.70, CI 91.78 – 93.11, OI 18.42 – 20.43, MandI 56.52 – 58.70, SI 69.56 – 73.68, PetI 135 – 150. Total length 9.65 – 13.45 mm; head shape excluding mandibles subquadrate; mandibles triangular–shaped, shorter than head length, with 7 teeth, covered with fine striae; lower margin of anterior medial area of clypeus nearly straight to slightly convex, clypeus lacking carina; scape not reaching posterior lateral corner of head; frontal lobes divided by developed frontal furrow; frontal lobes cover most of medial area of clypeus, frontal lobe width 0.87 – 1.00 mm, clypeus width from cheek to cheek 1.60 – 1.85 mm; compound eyes relatively large; malar space from side of head 0.35 – 0.40 mm in length, length from upper edge of eye to highest point of posterior lateral corner of head 0.95 – 1.15 mm; pronotal shoulder rounded; pronotum rounded anteriorly, lower lateral margin straight with sharp inferior pronotal process and anteroinferior process; scutum and scutellum divided by transscutal suture, propodeum and scutellum divided by metanotum; propodeum subquadrate; basalar sclerite rounded; mesometapleural suture well defined, well developed; propodeal spiracle elongate; petiole subquadrate, rounded anteriorly and slightly concave posteriorly with sharp foveolate posterolateral margins; mesopleuron divided by anapleural sulcus to form lower katepisternum, upper anepisternum; mesosoma winged, modified for flight; scutum widened anteriorly, reaching same width as pronotum (1.90 – 2.00 mm), narrowed posteriorly to reach the same width as propodeum (1.50 – 1.45 mm); dorsopropodeum short (0.35 – 0.45 mm); posteropropodeum slightly concave, shiny, rough to sparsely punctate, with long erect hairs arranged on margins; metanotum narrowed, distinctive, slightly elevated, well separated from both propodeum and scutellum; postpetiole with remainder of gastral segments larger (3.75 – 4.75 mm) than mesosoma (3.40 – 4.00 mm); head roughly sculptured, coarsely punctulate; frontal lobes covered with fine hairs, punctures, anterior edge and sides of frontal lobes shiny; cheeks, frons, sides of head covered with fine striae; lateropropodeum and metapleuron covered with fine striae; scutellum from dorsal view with small elongate and finely striated medial depression; pronotum, scutum, scutellum, propodeum, petiole, postpetiole roughly sculptured, punctate to foveolate; mesopleuron covered with scattered punctae; petiole, postpetiole and remainder of gaster covered with fine striae; dorsum of postpetiole slightly concave, rough with sparse punctures; posteropropodeum slightly rough, but slightly shiny, with sparse punctures; anterior face of petiole rough, mostly covered with fine hairs; head covered with short (0.10 – 0.12 mm) erect golden hairs; pronotum, scutum, scutellum, petiole, postpetiole (first gastral segment) and 4th to 6th gastral segments covered with moderately long (0.17 – 0.27 mm) golden erect hairs, up to 0.35 mm on the 7th gastral segment, moderately long (0.25 mm) erect hairs arranged on margins of posteropropodeum; entire body including head, mandibles, antennae, clypeus, scapes, pronotum, scutum, scutellum, mesopleuron, propodeum, metapleuron, petiole, postpetiole, legs range from brown to dark brown.

Worker Comparisons — The nearly straight lower margin of the clypeus of *Bothroponera sculpturata* appears to be broadly convex (not slightly concave), separating it from the slightly different clypei of *B. talpa*, *B. pachyderma*, *B. sanguinea* and *B. cribrata*

which are nearly straight to concave. The anterior medial margins of the clypeuses of *B. zumpti*, *B. rubescens*, *B. fugax* are broadly convex similar to that of *B. sculpturata*, but in these species this area includes a longitudinal clypeal carina which is absent in *B. sculpturata*. The sculpture in *B. sculpturata* is coarsely punctate to foveolate while the sculpture is less pronounced in the case of *B. talpa*, *B. pachyderma*, *B. sanguinea*, *B. cribrata*, *B. zumpti*, *B. rubescens* and *B. fugax*.

We consider *B. mlanjiensis* to be a synonym of *B. sculpturata* based on the associated paratype female with the worker of *B. mlanjiensis* from the same nest, which was compared with the holotype female of *B. sculpturata*. The workers of both species are also identical.

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

Wheeler (1922d) considered *B. sculpturata* to be a variety of *B. pumicosa*. It does not appear to be similar to *B. pumicosa*, which has smooth mandibles, characteristic of most of the other species in the *B. pumicosa* species complex, whereas the mandible of *B. sculpturata* is rough and striated. He considered it to be closely related to *B. strigulosa* and *B. cariosa* as they have a similar black and reddish color, but that is not the case as they belong to different species complexes. On AntWeb there are photographs of the *B. sculpturata* male, which seems to be identical to the male of *B. talpa*.

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

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

Type material examined — **ZIMBABWE**: [**ZAMBEZIE**]: *Bothroponera sculpturata* Santschi, Santschi det. 1912, *Pachycondyla* (*Bothroponera*) *sculpturata* Santschi, Sammlung Dr. F. Santschi, Kairouan Coll. Demarchi (1q, holotype, NHMB, 7w paratypes # 28942, MCZC, 1w paratype, 1q paratype, BMNH). **MALAWI**: **Mlanje** [Mulanje] 1000, 2000, Nyasaland, 16°2'0" S; 35°30'0" E, 12–16– xii –1944, *Bothroponera mlanjiensis* G. Arnold, (1q paratype, 8w paratypes, Nat. Museum South Rhodesia).

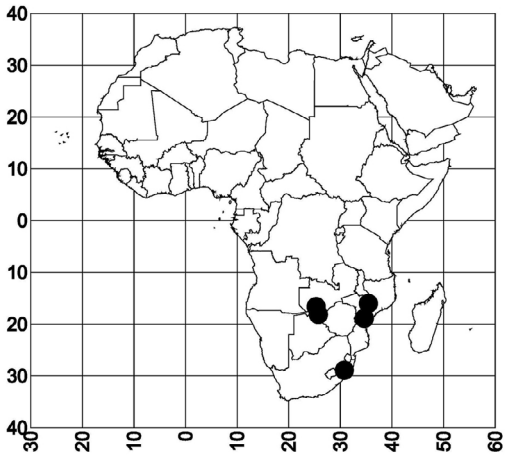
Non type material examined — **SOUTH AFRICA**: **Natal, Mtunzini**, Province of KwaZulu–Natal, Natal; Twinstreams, near Mtunzini, 2831DD, 28°57'0" S; 31°45'0" E, 6–xii–1990, M. H. Villet, *B. mlanjiensis* (Arnold, 1946), determined by H. G. Robertson, SAM–HYM 31.xii.1991 (2w # C002608, MCZC).

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

Biology and habitat — The specimens of *B. sculpturata* (= *B. mlanjiensis*), one female and eight workers, were collected in the Mlanje area. They were nesting under a leaf partially covered with clay soil and the ants were moving into the shaded forest areas (Arnold, 1946). The Mlanje district is located in the southeastern Nyasaland area of Malawi at 16°00'00" S, 35°35'00" E. High mountains and plateaus are the

main habitat types for the Mlanje area with several threatened and endemic species (Curran *et al*., 2012). The mountains are generally covered with forest and are the main source of the rivers and streams in the district. Diverse climates in Nyasaland support a wide range of vegetation and offer varied habitats for wildlife, agriculture is very poor in the area (Jackson, 1968). The ecosystems in the Mlanje are varied and include the *Brachystegia* woodland, *Copaifera mopane* woodland, deciduous forests, thickets and *Acacia* with *Combretum* species in a grass mixture (Jackson, 1968). The mountain grasslands in Mlanje with different vegetation types are considered as protected areas and offer various habitats for many species of Nyasaland organisms. The organisms that can be found in this protected area include birds, small mammals, reptiles and invertebrates (Mitchell, 1953). These elevations and habitats should also support high speciation rates of organisms such as ants, do to the various plant communities, mountains and variations in climates, and the area should have more species of *Bothroponera*. *Bothroponera sculpturata* (*mlanjiensis*) was also collected from KwaZulu–Natal Province at Natal, Mtunzini, South Africa (two workers in MCZC and data on the Ants of Africa (Website 6 accessed June 07, 2017). The major dominant biomes in the Natal province are savanna, grassland and thicket biomes with several subtypes of biomes that can host different species of small organisms such as ants (Jewitt, 2011).

Bothroponera sculpturata was also collected from Zambezi (former name Zambia). The other specimen was collected from Mozambique, Province du Gorongoza, Tendo du Songoue (Website 1 accessed August 21, 2014 and June 07, 2017) at 18°50’ 27’’ S, 34°25’ 15’’ E.



Map 7. The distribution of *B. sculpturata*.

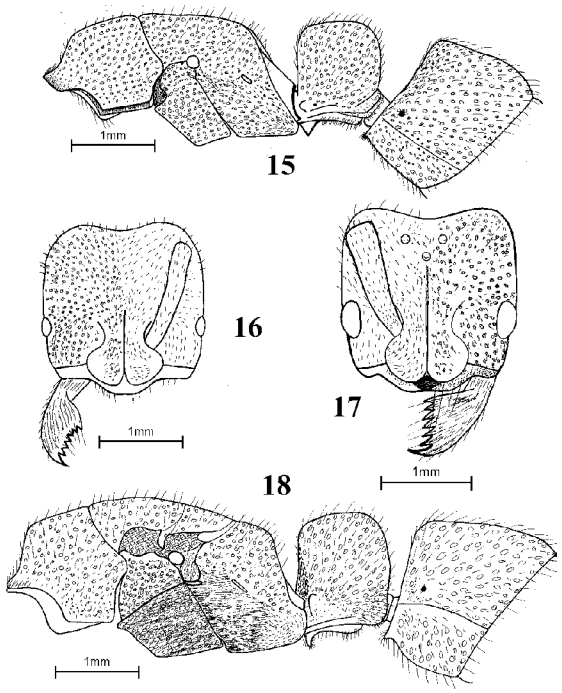


Figure 15. The lateral view of a worker of *B. sculpturata*.

Figure 16. The head of worker of *B. sculpturata*.

Figure 17. The head of the holotype female of *B. sculpturata*.

Figure 18. The lateral view of the holotype female of *B. sculpturata*.

Bothroponera talpa **André, 1890**

Figures 19– 22 and Plate 9, 10; Map 8

Bothroponera talpa André, 1890: 316 (w), Sierra Leone; Wheeler, W. M. 1922b: 72–73 (key); Schmidt and Shattuck, 2014: 76; *Pachycondyla* (*Bothroponera*) *talpa*: Emery, 1899: 473 (q); Emery, 1901: 45; Santschi, 1914: 314 (q); Wheeler, W. M. 1922d: 773; *Pachycondyla talpa*: Bolton, 1995: 310.

Psalidomyrmex clavicornis Bernard, 1953b: 209, fig. 5 (q) Guinea; Junior synonym of *Bothroponera talpa*: Bolton, 1975b: 6; Bolton, 1995: 304.

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

The entire surface from the dorsum of the head, the mesosoma to the petiole and postpetiole along with the remaining gastral segments are covered with very fine hairs and long (0.36 mm up to 0.42 mm) erect and suberect golden hairs.

The color is generally brown to light brown. Andre (1890) lists the color as blackish- brown, changing to reddish-brown on the head, antennae and extremity of the gaster, the legs are reddish-brown (thanks to the anonymous reviewer for pointing this out).

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

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

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

The typical color of the female of *B. talpa* ranges from brown, to reddish brown and light brown.

The male is unknown.

Worker descriptions — (n=79 for Measurements), HL 1.65 – 2.10, HW 1.58 – 2.00, ML 1.00 – 1.15, EW 0.17 – 0.25, EL 0.15 – 0.25, SL 1.05 – 1.35, FL 1.85 – 2.25, WL 2.45 – 3.10, WPL 3.30 – 3.90, PL 0.85 – 1.00, PW 1.07 – 1.30, PH 1.25 – 1.53, CI 95.23 – 95.75, OI 9.49 – 12.5, MandI 54.76 – 60.60, SI 66.45 – 67.5, PetI 125.88 – 130. Total length 8.10 – 9.95 mm; mandibles covered with fine striae, 7 toothed; head subquadrate, roughly, densely punctulate; fine striae present on frons, sides of head, gena; anterior medial margin of clypeus straight to slightly concave, clypeus lacking carina, clypeal length 1.40 – 1.60 mm; frontal lobes well developed with frontal furrow, cover large area of clypeus, frontal lobes width 0.75 – 0.90 mm; malar space from side of head 0.24 – 0.45 mm, length from upper edge of eye to posterior lateral corner of head 1.00 – 1.20 mm; scape fails to reach posterior lateral corner of head; eyes range from small to large; pronotum rough, punctate; mesometapleural suture well developed; basalar sclerite rounded; mesonotum, propodeum densely punctate to foveolate, moderately shiny on dorsal face; metapleuron, lateropropodeum covered with fine striae; petiole, postpetiole densely foveolate, covered with fine striae on dorsum; top of head covered with moderately long (0.15 – 0.25 mm) erect hairs; dorsum of pronotum, mesonotum, dorsopropodeum covered with long (0.20 – 0.33 mm) erect scattered hairs; dorsum of petiole covered with long (0.30 – 0.42 mm) erect hairs; postpetiole covered with long (0.30 – 0.40 mm) erect hairs; most surfaces brownish black; legs, antennae, mandibles, clypeus brownish red to black, especially at margins.

Female descriptions — (n=5 for Measurements), HL 2.15 – 2.20, HW 2.00 – 2.05, ML 1.25 – 1.35, EW 0.35 – 0.40, EL 0.35 – 0.45, SL 1.40 – 2.00, FL 2 – 2.40, WL 3.20 – 3.65, WPL 4.25 – 4.50, PL 0.90 – 0.95, PW 1.30 – 1.40, PH 1.45 – 2.00, CI 93.02

– 93.18, OI 17.5 – 21.95, MandI 58.13 – 61.36, SI 70 – 97.56, PetI 144.44 – 147.36. Total length 10.40 – 11.60 mm; head shape excluding mandibles subquadrate; mandibles triangular–shaped, shorter than head length, with 7 teeth; covered with fine striae; lower anterior medial margin of clypeus slightly concave, clypeus lacking carina; scape not reaching posterior lateral corner of head; frontal lobes divided by developed frontal furrow; frontal lobes cover most of medial area of clypeus, frontal lobe width 0.90 – 0.95 mm, clypeus width from cheek to cheek 1.65 – 1.85 mm; compound eyes relatively large; malar space from side of head 0.30 – 0.45 mm in length, length from upper edge of eye to highest point of posterior lateral corner of head 1.05 – 1.10 mm; pronotal shoulder rounded; lower lateral margin of pronotum straight with sharp angles at inferior pronotal process and anteroinferior pronotal process; scutum and scutellum divided by transscutal suture, propodeum and scutellum divided by metanotum; mesometapleural suture distinct, well developed; propodeal spiracle elongate; petiole subquadrate, rounded anteriorly and slightly concave posteriorly with sharp posterolateral margins (seen from above); mesopleuron divided by anapleural sulcus; mesosoma winged, modified for flight; scutum widened anteriorly, reaching same width as pronotum (1.75 – 1.90 mm), narrowed posteriorly to reach the same width as propodeum (1.25 – 1.50 mm); scutum, scutellum slightly raised (lateral view); dorsopropodeum short (0.30 – 0.40 mm), sub–rectangular shaped (dorsal view); posteropropodeum slightly concave, rough to sparsely punctate, with long erect hairs arranged on margins; metanotum narrowed, distinctive, elevated, well separated from both propodeum and scutellum; mesopleuron divided by anapleural sulcus to form lower katepisternum, upper anepisternum; mesometapleural suture well defined; basalar sclerite rounded; postpetiole with remainder of gastral segments larger (4.10 – 4.50 mm) than mesosoma (3.35 – 3.40 mm); head roughly sculptured, coarsely punctulate; frontal lobes covered with fine hairs, punctures, anterior edge and sides of frontal lobes shiny; cheeks, frons, sides of head covered with fine striae; lateropropodeum and metapleuron covered with fine striae; scutellum from dorsal view has small elongate and finely striated medial depression; pronotum, scutum, scutellum, propodeum, petiole, postpetiole roughly sculptured, moderately punctate and foveolate; mesopleuron covered with scattered punctae; petiole, postpetiole and remainder of gaster covered with fine striae; dorsum of postpetiole slightly depressed medially, rough with sparse punctures, anterior face of petiole rough, mostly covered with fine hairs; head covered with moderately short (0.20 – 0.30 mm) erect golden hairs; pronotum, scutum, scutellum covered with moderately long erect hairs (from 0.25 mm up to 0.30 mm), dorsopropodeum covered with longer (up to 0.35 mm) erect hairs, long (0.35 mm) erect hairs arranged on margins of posteropropodeum, hairs on dorsum of petiole and postpetiole long (0.35 mm), up to 0.50 mm on the 4th to 7th gastral segments; head, mandibles, antennae, clypeus, scapes, pronotum, scutum, scutellum, mesopleuron, propodeum, metapleuron, petiole, postpetiole, legs range from light brown, brown to dark brown.

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

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

The workers of *B. talpa* have a total size that ranges from 8.10 – 11.75 mm, which is larger than *B. zumpti* (6.00 – 6.80 mm) and *B. fugax* (7.40 mm), about the same size as *B. pachyderma* (9.00 mm)

and usually slightly smaller than *B. cribrata* (10.90 – 14.95 mm), *B. sanguinea* (10.70 mm), *B. sculpturata* (11.10 – 11.20 mm), *B. sanguinea* (11.30 mm) and *B. clavicornis* (11.75 mm). Emery (1901) described *B. pachyderma,* but did not mention *B. talpa* or any others.

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

Female Comparisons — The *B. talpa* female is similar to those of *B. rubescens*, *B. sculpturata*, *B. zumpti* and *B. pachyderma*. It is easy to separate *B. rubescens* and *B. zumpti* from the others as the lower medial margins of the clypeuses are convex and the clypeuses have a carina, while the anterior medial border of the clypeus is straight to slightly concave without a carina in *B. talpa*, *B. sculpturata*, and *B. pachyderma*. The dorsum of the body is covered with long hairs in *B. talpa* that range from 0.15 – 0.40 mm, whereas in *B. rubescens* it is covered with very fine short hairs and moderately long scattered hairs that range from 0.15 – 0.21 mm. The head of *B. talpa* is larger than that of *B. rubescens* and *B. zumpti* (compare measurements in the descriptions); likewise, the body is larger than those of *B. rubescens* and *B. zumpti*, usually smaller than those of *B. pachyderma* and *B. sculpturata*. The total size of female of *B. talpa* is 10.40 – 11.75 mm, in *B. pachyderma* it is 11.55 – 15.90, in *B. sculpturata* 9.65 – 13.45, in *B. rubescens* 7.10 – 7.80 mm, in *B. zumpti* 7.85 mm.

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

Type material examined — Type of *B. talpa* was not found.

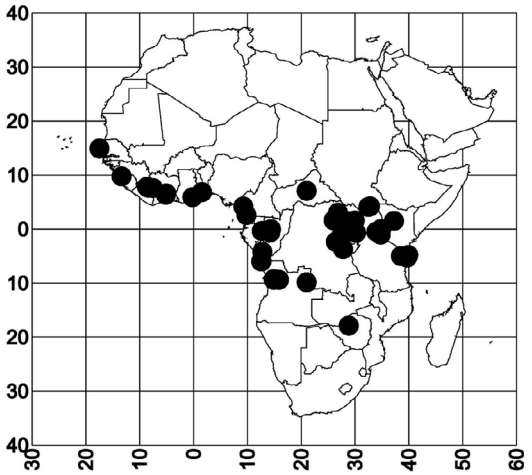
Non type material examined — **79 workers and 5 females**: **GUINEA**: **Nimba**, M. Lamotte, Camp 4 (1000 m) II.VI.42, Museum of Paris type *Psalidomyrmex clavicornis* (1 q # EY6717, MNHN). **ANGOLA**: **Salazar**, **Province do Cuanza Norte**, 9°18’0’’ S, 14°55’0’’ E, I. I. A. A., 9–15–iii–1972, P. Hammond (A26), *Pachycondyla talpa* Andre (2 w # 315955 LACM); **Duque de Bregan** fd falls, River bank; **Lunda Sul Province**, Gallery forest R. Kamuaji, trib Dilolo, trib Chiumbe, 9°49’59.99’’ S, 21°3’0.0’’ E, berlesate by native collector, 24–i–1963 (2w MCZC); **Malanje Province**, 9°6’0’’ S, 15°57’0’’ E, 12–iii–1972, Phammond, southern African Exp., B. M.1972–1, *B. talpa* (2w, BMNH). **CAMEROON**: M[TE] Camerun: **Buea**, **South West Province**, 4°9’0’’ N, 9°14’0’’ E, 800–1200 m.s.m., vi.vii–1902, L. Fea, Stessa colonia, Museo Civico di Genova (17w and 1q MCSN); **Ebodjie [Ebodie] Southern Province**, Compo district, 2°34’0’’ N, 9°50’0’’ E, 4.xi. 91, A. Dejean, *B. talpa* (2w, BMNH). **CONGO**: **Brazzaville**: **Irangi**, Luhoho River, 900 m, 1°31’0’’ S; 28°4’0’’ E, 10–ix–1957, E. S. Ross & R. E. Leech, *Bothroponera talpa* (1w MCZC); **Niangara**, 3°42’0’’ N, 27°52’0’’ E, Stomach *Bufo funereus*, H O Lang, *Bothroponera talpa* B550.51 (1w, AMNH); **Medje**, 2°25’0’’ N, 27°18’0’’ E, Stomach *Bufo funereus*, H O Lang, *Bothroponera talpa* Ernest André 3022 (1w, AMNH). **KENYA**: **Eastern Province**, 30 mi S. E. of

Kitale, 1950m, 1°29’0’’ S; 37°17’0’’ E, 14–x–1957, E. S. Ross & R. E. Leech, *Bothroponera talpa* (1w MCZC); **Kakamega District**: Isecheno Natural Reserve, 0.24 N, 34.87 E, 1800m, 15–v–2001, #01–386, Equatorial rainforest: under stone, Coll. R. R. Snelling, *Pachycondyla talpa*, LACM ENT 315992, 315954 (4w LACM), Isecheno Natural Reserve, Isecheno, 0.24 N, 34.87 E, 1800m, 15 May 2001, #01–386, Equatorial rainforest: under stone. Coll. R. R. Snelling 2002, *Pachycondyla talpa* (1q 315993 LACM), Isecheno Forest Reserve, 1600m, 0.24 N, 34.85 to 34.86 E, 14, 31 viii. 2001, 13–ii–2002, 19, 20–vii–2001, 7–ix–2001, 10–iii–2002, #’s 02–121, 02–045, 02–048, Equatorial rainforest: ex. sifted leaf litter, ex. sifted rotten log debris, sifted litter, W. Okeka ex. sifted litter, Coll. R. R. Snelling, *Pachycondyla talpa* (30w #’s 315965, 315966, 315967, 315968, 315969, 315970, 315973, 315974, 315975, 315976, 315978, 315979, 315980, 315982, 315983, 315984, 315985 LACM), Isecheno Forest Reserve, 0.24 N, 34.85 E, 1600m, 20–vii–2001, W. Okeka ex. sifted litter *Pachycondyla talpa* (1w 315977 LACM), Isecheno Natural Reserve, nr. Kalunya Glade, 0.25 N, 34.85 E, 1600m, 1800m, 4–ii–2002, #02–012, 4–v–2001, #’s 01–347, 01–348, Equatorial rainforest: ex. Sifted leaf litter, leaf litter ex. between buttresses, Coll. R. R. Snelling 2002, *Pachycondyla talpa* (3w 315989, 315990, 315994 LACM), Kakamega Forest Isecheno, 0.02 N, 34.37 to 34.97 E, 1800m, 14–x–1999, #99–134, #99–138, Equatorial rainforest: Sifted litter from between tree buttresses, Coll. R. R. Snelling, *Pachycondyla talpa* (3w, #’s 315958, 315960, 315961, LACM), Yala River Forest Reserve, 1450m, 1470m, 0.204 N, 34.873 E, 28, 15–ii–2002, #’s 02–060, 02–066, 02–096, 02–097, Equatorial rainforest: ex. sifted leaf litter, sifted litter ex. between tree buttresses, under bark of log, Coll. R. R. Snelling 2004, *Pachycondyla talpa* (5w #’s 315971, 315972, 315986, 315987, 315988 LACM), Buyangu Natural Reserve, nr. Salazar Circuit, 1500m, 1550m, 0.33 N, 34.87 E, 24–iv–2001, #’s 01–271, 01–272, 01–273, Secondary Equatorial rainforest: ex. Sifted leaf litter, Coll. R. R. Snelling & A. Espira *Pachycondyla talpa*, R. R. Snelling 2002 (3w #’s 315959, 315962, 315964 LACM), Buyangu Hill, Buyangu Forest Reserve, 1550m, 0.343 N, 34.863 E, 31 March 2002, # 02–139, Equatorial rainforest: in leaf litter, Coll. R. R. Snelling (1q, 315981 (LACM), Buyangu Natural Reserve, nr. Buyangu Hill, 1500m, 0.37 N, 34.87 E, 24–iv–2001, # 01–274, Secondary rainforest: ex. Sifted leaf litter, Coll. R. R. Snelling & A. Espira *Pachycondyla talpa*, R. R. Snelling 2002 (1w 315963 LACM); **Western Province**, E 34°50’ 24’’ N 0°57’40.8’’, Kakamega Forest, Kaimosi Transect 30, 04.08.2008, 1600 m, leg. Georg Fischer; Kaimosi Forest Fragment primary forest Transect 30, 110 m, Kakamega 2008 survey, Leaf litter, Pitfall trap, LACM ENT 315956 (1w, LACM). **UGANDA**: **KENYA–UGANDA** border, Eastern Region, **Busia District**, Busia, 0°30’0’’ N, 34°0’0’’ E, 17–ii–1948, N. A. Weber, 2080, *Bothroponera talpa* (1q, MCZC). Western Region, , **Kabarole District**, Fort Portal, 0°40’0’’ N, 30°17’0’’ E, ii–1948, N. A. Weber, *Bothroponera talpa* 2095 (1w MCZC).

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

Biology and habitat — Bothroponera talpa has been collected in several habitats, which suggests that this species is highly adaptive and occurs in diverse ecosystems. Workers of *B. talpa* were extracted from stomachs of the toads *Bufo superciliaris*, *Bufo polycercus* and *Bufo funereus*. *Bufo* species are mainly found in Africa at low elevations, in secondary forest and in tall primary forest, dense brush and cocoa plantations, which reflects the actual habitat of *Bothroponera* in tropical habitats (Website 8 accessed April 2013 and November 2014).

Based on information from the material examined in this study, *Bothroponera talpa* is widespread in Africa. Researchers have been actively working with this species, especially from 1999 – 2004 and in 2008. They collected samples mainly from the equatorial rainforests using methods such as pitfall traps. They excavated nests underground, collected specimens from sifted leaf litter and sifted rotten log debris. Specimens were also collected from sifted litter between tree buttresses, under bark of logs, under stones and in leaf litter.



Map 8. The distribution of *B. talpa*.

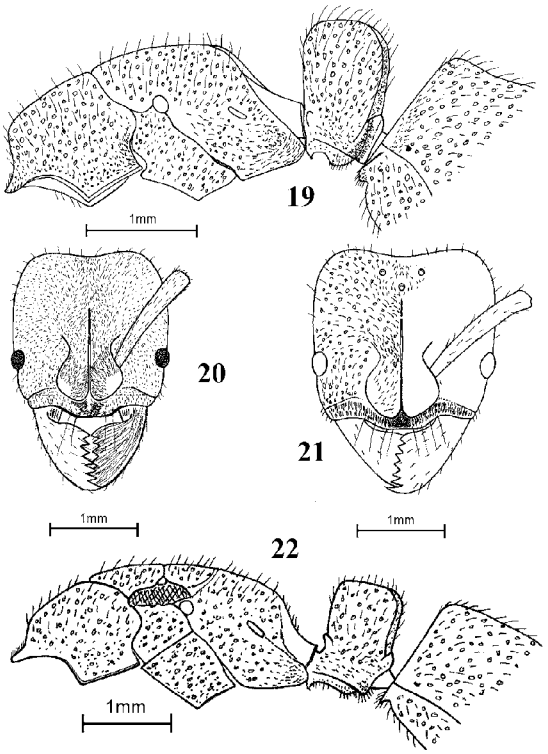


Figure 19. The lateral view of a worker of *B. talpa* from Uganda (MCZC).

Figure 20. The head of a worker of *B. talpa* from Uganda (MCZC).

Figure 21. The head of a female of *B. talpa* from Kenya–Uganda (MCZC).

Figure 22. The lateral view of a female of *B. talpa* from Kenya–Uganda (MCZC).

***Bothroponera zumpti* Santschi 1937**

Figures 23– 26 and Plate 11; Map 9

Bothroponera zumpti Santschi, 1937b: 94 (w), Cameroon, Missellele; Schmidt and Shattuck, 2014: 77; *Pachycondyla zumpti*: Brown, in Bolton, 1995: 311.

Worker Diagnosis — The anterior medial margin of the clypeus is convex and strongly curved. The sharp clypeal carina is present between the lower edges of the frontal lobes to the lower margin of the medial anterior border of the clypeus. The frontal lobes cover most of the medial area of the clypeus and nearly divide the clypeus. The basalar sclerite is small, rounded to oval in shape. The head is rough, moderately punctulate and mostly foveolae. The frons, sides of the head and the gena are covered with very fine striae. The mesosomal length is nearly equal to the length of the postpetiole and gastral segments, but this is probably because the 6th and 7th gastral segments are compressed into the remainder of the gaster, which is not the case of other specimens.

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

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

In general, the color is light yellowish to brown.

Female Diagnosis — The female of *B. zumpti* can be recognized by the small size (total length 7.85 mm) among *B. talpa* species complex members. The medial area of the clypeus is slightly convex, with a well–developed sharp carina that extends from the anterior medial margin of the clypeus to the lower medial margin of the frontal lobe. The mandibles have 7 teeth. The frontal lobes cover most of the medial area of the clypeus. The metapleural area is covered with fine striae. The basalar sclerite is small,

rounded to oval.

The dorsum of the head, pronotum, scutellum, scutum, metanotum, mesopleuron and propodeum are roughly sculptured, densely punctate and weakly shining. The petiole and postpetiole are densely punctate. The petiole is nearly square (side view) with a slight depression medially on the upper posterior edge (top view). The postpetiole and remainder of the gastral segments are rough and covered with sparse shallow punctures; the postpetiole and 4th to 7th gastral segments are larger than the mesosoma.

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

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

The male is unknown.

Worker descriptions — (n=7 for Measurements), HL 1.30 – 1.50, HW 1.15 – 1.35, ML 0.75 – 0.85, EW 0.10 – 0.15, EL 0.11 – 0.20, SL 0.80 – 0.96, FL 1.25 – 1.55, WL 1.75 – 2.10, WPL 2.35 – 2.76, PL 0.55 – 0.66, PW 0.75 – 0.90, PH 0.85 – 1.20, CI 88.46 – 90, OI 9.56 – 14.81, MandI 56.66 – 57.69, SI 69.56 – 71.11, PetI 136.36. Total length 6.00 – 6.80 mm; head densely punctulate, entire head covered with very fine striae; anterior medial margin of clypeus convex, covered posteriorly by frontal lobes; sharp clypeal carina present; compound eyes relatively small, approximately equal to distance between eye and malar area; malar space length on side of head 0.15 mm, length from upper edge of eye to posterior lateral corner of head 0.80 mm; pronotum, mesonotum, propodeum rough, punctate, foveolate; petiole, postpetiole densely punctate, foveolate; petiole length 0.60 mm in dorsal view; sternopetiolar process toothed posteriorly with one anterior spine pointed ventrally; entire surface covered with fine hairs and with moderately dense erect, suberect pubescence scattered on dorsum of pronotum, mesonotum, propodeum, petiole, postpetiole, 4th to 7th gastral segments (length of hairs 0.07 – 0.25 mm); body light yellowish to brown; legs, mandibles, funiculus, antennae, clypeus pale brownish.

Female descriptions — (n=1 for Measurements), HL 1.60, HW 1.40, ML 0.80, EW 0.25, EL 0.30, SL 0.95, FL 1.60, WL 2.45, WPL 3.10, PL 0.60, PW 0.97, PH 1.05, CI 87.5, OI 21.42, MandI 50, SI 67.85, PetI 161.66. Total length 7.85 mm; medial area of clypeus convex, with well–developed sharp longitudinal carina that extends from lower medial margin of frontal lobe to anterior medial margin of clypeus; mandibles covered with fine striae, with 7 teeth; scape slightly curved, not reaching posterior lateral corner of head; malar space from side of head 0.15 mm; length from upper margin of eye to highest point of posterior border of head 0.75 mm; eyes large; frontal lobes cover most of medial area of clypeus, total width 0.60 mm; clypeal width between bases of mandibles 1.10 mm; pronotum rounded anteriorly, lower margin of pronotum straight with angled extremes (lateral view); scutum widened; anapleural suture well developed; mesosoma winged and modified for flight; posteropropodeum slightly concave with granulated margins; propodeal spiracles parallel with mesometapleural suture; metapleural area covered with fine striae; petiole rounded anteriorly, slightly concave posteriorly with coarse, angular posterior margins; head roughly sculptured, moderately punctulate, frontal lobes shiny with scattered punctures (appearing somewhat granulate); dorsum of head, pronotum, scutellum, scutum, metanotum, mesopleuron, propodeum roughly sculptured, densely punctate, weakly shining; petiole, postpetiole densely punctate; petiole nearly square (side view) with slight depression medially on upper posterior edge; postpetiole and remainder of gastral segments rough and covered with sparse shallow punctures; postpetiole and gastral segments larger than mesosoma; dorsal surface of pronotum, scutum, scutellum and propodeum covered with fine hairs, with moderately short (0.10 – 0.18 mm) erect hairs, petiole covered with moderately long (0.20 – 0.21 mm) erect hairs; postpetiole and 4th to 7th gastral segments covered with slightly longer (0.20 – 0.25 mm) erect hairs; mandibles, head, scape, funiculus, clypeus, pronotum, scutellum, scutum, metanotum, mesopleuron, propodeum, legs, petiole and postpetiole brown, dark brown to reddish brown.

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

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

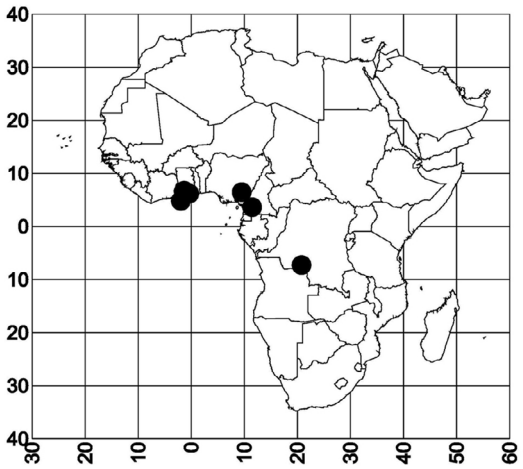
Type material examined — **CAMEROON**: **Missellele**, Umg. Kamerunberg Missellele, 6°21‘0“ S, 9° 35‘0“ E, Dr. F. Zumpt leg. Eing. Nr. 7,1986; *B. zumpti* Santschi; Sammlung Dr. F. Santschi, Kairouan (1w, holotype, NHMB).

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

Distribution — Known from Cameroon, Ghana (Belshaw and Bolton, 1994) and Angola.

Biology and habitat — The *Bothroponera zumpti* type specimen was collected from Missellele, Mount Cameroon. This area is located in the southwest of Cameroon at the shores of the Atlantic Ocean (Guinea Gulf) in Mount Cameroon National Park. The area is composed of volcanic mountains; the highest elevation is 4,095 meters, with rainfall up to 10,000 mm per year on the coasts, 1,700 mm per year in the north (Watts, 1994). The habitat around Mount Cameroon is characterized by rainforest, producing productive ecosystems that contain high biodiversity which is an important area of conservation plans for endemic organisms (flora and fauna) and endangered

species (Ambrose–oji, 2003). The importance of this region is due to the volcanic activity that causes fertile soils, with rainfall that occurs mainly on the west side of the mountains due to a rain shadow effect. The rainforest that surrounds these mountains results in various biomes ranging from mountains, and includes canopy lowland forest and evergreen forest to savannah and grassland (Ambrose–oji, 2003; Watts, 1994, Website 9 accessed April 24, 2014 and website 10 accessed April 24, 2014). In general, the habitat in Cameroon is variable and supportive in that it contains various species that belong to several genera in subfamily Ponerinae such as *Feroponera ferox* (Bolton & Fisher, 2008b), *Loboponera subatra* (Bolton & Brown, 2002), *Brachyponera sennaarensis* var. *ruginota* (Stitz, 1916: 372), *Hypoponera odiosa* (Bolton & Fisher, 2011), *Plectroctena cristata* (Emery 1899: 470), *Plectroctena thaui* (Fisher, 2006), *Leptogenys amon*, *L. bubastis*, and *L. camerunensis* (Bolton, 1975a). The species of *Bothroponera* that can be found in Cameroon include *Bothroponera pachyderma*, *B. soror* and *B. zumpti* (based on our results). In Ghana, 12 workers of *B. zumpti* (as *B. fugax*) were found by Belshaw & Bolton (1994) in leaf litter samples from cocoa at Effiduase and Nankasi, primary forest at Bobiri, and secondary forest at Atewa Forest Reserve. The presence of *B. zumpti* in these three distant areas in Ghana, Cameroon and Angola supports the wide range dispersion of this species in the Afrotropics.



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

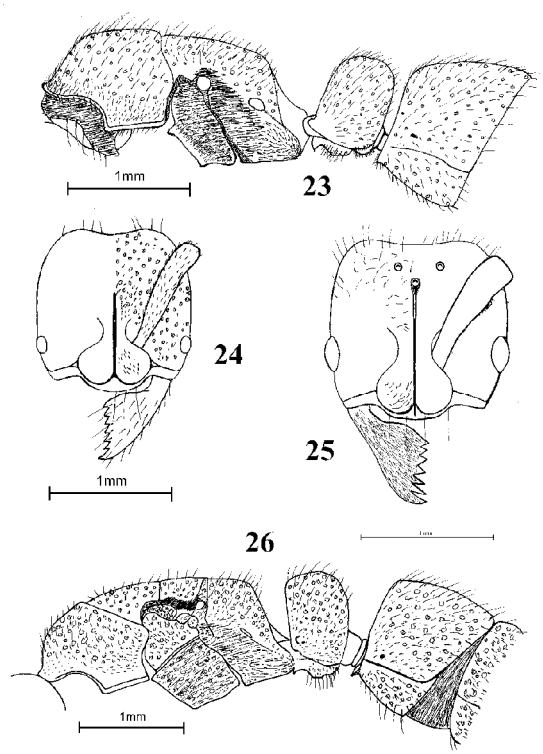


Figure 23. The lateral view of the holotype worker of *B. zumpti*.

Figure 24. The head of the holotype worker of *B. zumpti*.

Figure 25. The head of a female of *B. zumpti*, from Ghana (BMNH).

Figure 26. The lateral view of a female of *B. zumpti*, from Ghana (BMNH).

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PLATES

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

Plate 2. *Bothroponera fugax*, holotype worker (MCZC, photo by A. Joma).

Plate 3. *Bothroponera pachyderma*, worker (*B. pachyderma attenata* holotype) (MCZC, photo by A. Joma).

Plate 4. *Bothroponera pachyderma*, paralectotype female (MCZC, photo by A. Joma).

Plate 5. *Bothroponera rubescens*, holotype female (MCZC, photo by A. Joma).

Plate 6. *Bothroponera sanguinea*, holotype worker (MCZC, photo by A. Joma).

Plate 7. *Bothroponera sculpturata*, worker (*B. mlanjiensis* paratype) (MCZC, photo by A. Joma).

Plate 8. *Bothroponera sculpturata*, lectotype female (MCZC, photo by A. Joma).

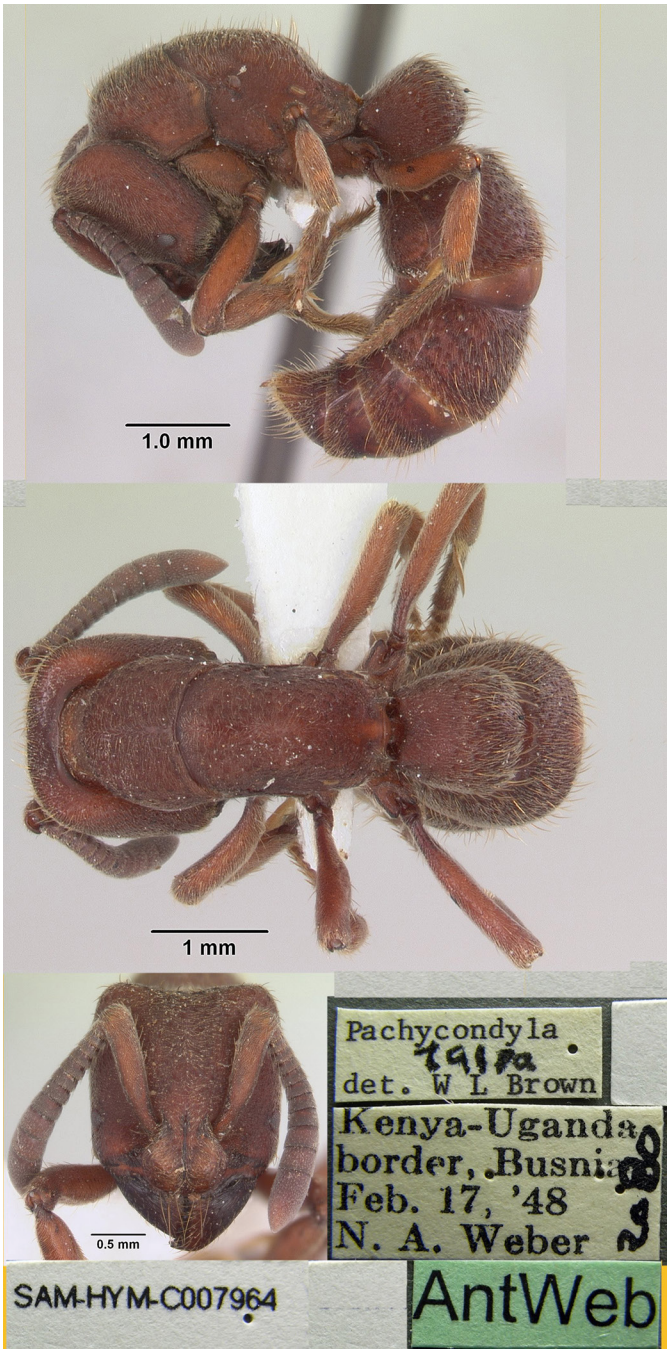

Plate 9. *Bothroponera talpa*, worker (Photo by Michele Esposito / From www.antweb.org accessed 26 February 2016).

Plate 10. *Bothroponera talpa*, female from Uganda (MCZC, photo by A. Joma).

Plate 11. *Bothroponera zumpti*, holotype worker (MCZC, photo by A. Joma).