

***Formicdubius* Philips & Scholtz from South Africa, a junior synonym of *Haroldius* Boucomont, and a survey of the trichomes in the African species (Coleoptera, Scarabaeidae, Onthophagini)**

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Abstract

Formicdubius Philips & Scholtz, 2000, a genus of South African scarab dung beetle, is synonymised with *Haroldius* Boucomont, 1914. All four African species of *Haroldius*, formerly in the genus *Afroharoldius* Janssens, possess trichomes. Trichome location and degree of development in the African species are discussed. The first record of *Haroldius modestus* Janssens from Malawi is given.

Keywords

Afrotropics, dung beetles, myrmecophiles, taxonomy

Introduction

Philips and Scholtz (2000) described a new genus and species of a tiny, myrmecophilous Scarabaeinae, *Formicdubius convexus* (Figs 1–6), based on 16 specimens found in a nest of *Pheidole megacephala* (F.) ants collected in a suburb of Pretoria, South Africa. The circular and convex body shape and a length less than 2 mm resemble those in the Oriental *Haroldius* Boucomont, 1914, but the possession of trichomes was considered unique within Scarabaeinae.

The genus *Afroharoldius* Janssens, 1949a, also of similar appearance, was classified in the tribe Alloscelini or subtribe Alloscelina (Janssens 1949b; Ferreira 1972). *Afroharoldius* contained three species from central Africa but was synonymised with *Haroldius* by Paulian (1985), because the only single differential diagnostic character, the number of antennomeres, was based on an incorrect observation. Janssens (1949a, b; 1953) erroneously claimed that *Afroharoldius* has nine antennomeres, but both *Afroharoldius* and *Haroldius* have eight antennomeres. Other characters differentiating these taxa remain unknown.

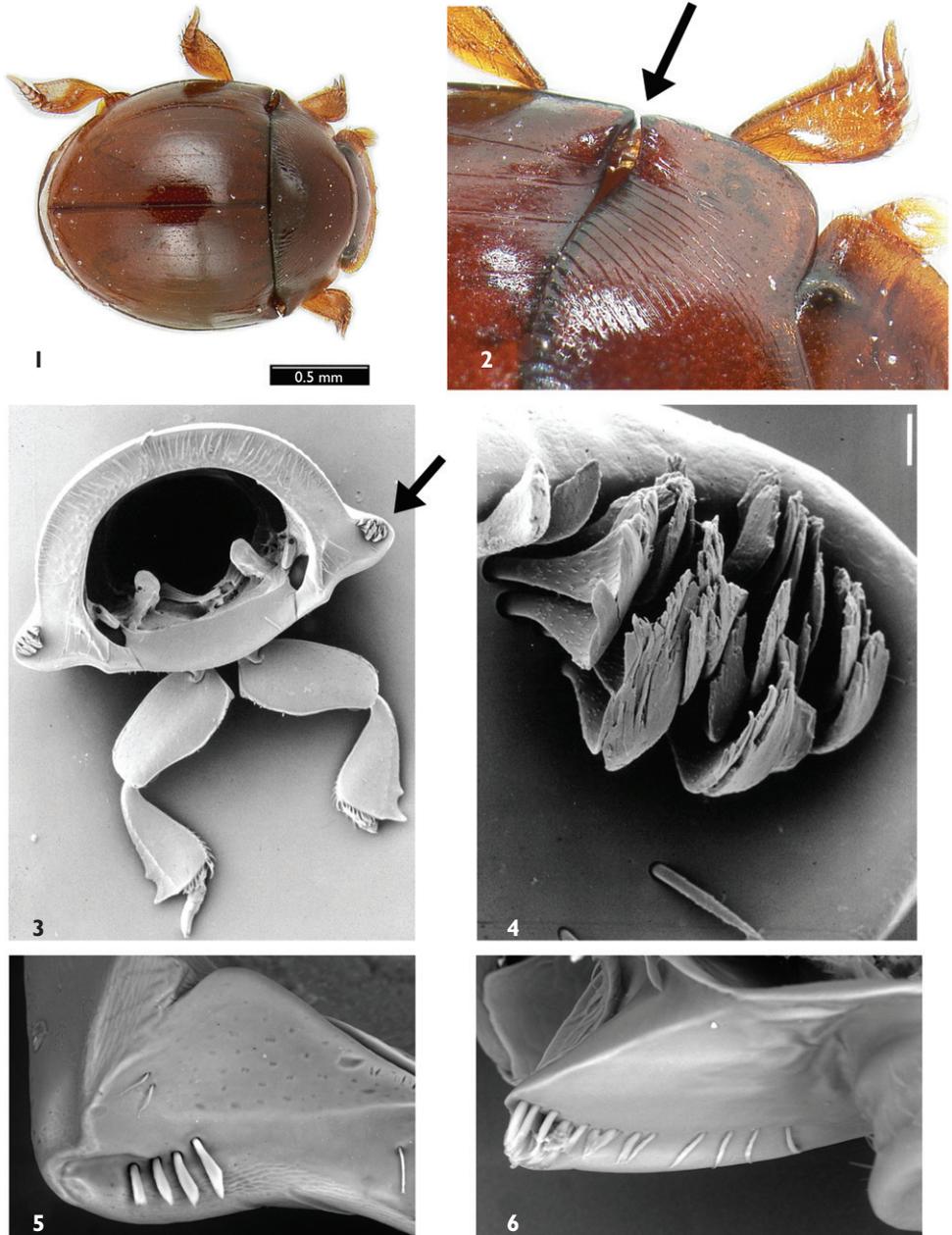
The three former *Afroharoldius* species were overlooked for comparison when *Formicdubius* was described. Furthermore, due to the earlier placement of this genus in the now unused “Alloscelina,” it was not included or studied in the revision of the southern African “Canthonina” (Scholtz and Howden 1987). Recently, the resemblance of *Formicdubius* with *Haroldius* and *Afroharoldius* became obvious and has already entered the scientific record in form of an “unpublished synonymy of *Formicdubius* Philips and Scholtz 2000” with *Haroldius* Boucomont (Davis et al. 2008: 216), which relates to the present paper, and Krikken and Huijbregts’ (2006: 168; 2009: 259) statement that *Formicdubius* should be placed in or near *Haroldius*. With this paper, we formalize the synonymy between *Formicdubius* with *Haroldius*.

Tribal placement for *Haroldius* is unsettled. Although currently placed in the tribe Canthonini (Hanski and Cambefort 1991; Krikken and Huijbregts 2006), a preliminary phylogenetic analysis (Philips 2005) placed this taxon in the Onthophagini. This is also where *Formicdubius* was provisionally placed in Philips and Scholtz (2000).

African *Haroldius* species

All African species of *Haroldius* appear to have trichomes on the mesepimeron, the pronotal base, and the elytral base. Trichomes appear as distinct and relatively tight clusters of setae while others are looser or even single rows of thick setae such as those on the elytral base. Without microsections we are unable to decide whether those might be proper trichomes associated with glands or mechanoreceptors. However, as further evidence of a glandular association, longitudinal grooves at the pronotal base are also present that may facilitate the spreading of allomone secretions onto the pronotal surface, increasing the attractiveness of these beetles to their host ants.

Formicdubius convexus (Figs 1–6) (and the very similar or conspecific *Haroldius leleupi* Janssens, 1953; Figs 11–13) can easily be distinguished from the remaining *Haroldius* species by the presence of a distinct notch between the pronotum and the elytral base accommodating the pronotal trichomes (Figs 2, 12). In *Haroldius ennearthrus* Janssens, 1949 (Figs 14–19), the basal margins of pronotum and elytra are straight with the pronotal margin slightly emarginate close to the edge (Figs 15, 18); a notch is missing, but a slight lateral depression towards the bases of the pronotum and elytra is visible. *H. modestus* Janssens, 1953 shares the general shape of the pronotal and elytral bases with *H. ennearthrus* but the pronotal margin is slightly more strongly emarginate laterally (Figs 8–9).



Figures 1–6. *Haroldius convexus*: **1** Dorsal habitus **2** Trichomes within cleft between prothorax and mesothorax and showing pronotal sulci **3** SEM (scanning electron microscope) view of pronotal trichome **4** SEM view of pronotal trichome showing possibly ant-gnawed tips of the setae **5** SEM view of possible trichomes on the elytral base **6** SEM view of trichome on the mesepisternum and additional setal row proximally.

The trichomes on these species are located on the mesepisternum anterolaterally, the elytra anterolaterally (on the vertical surface facing the pronotum), and on the pronotal base posterolaterally. One should be aware that these setae may be damaged from the effects of gnawing by their host ants and the actual number of setae may vary in number more than we report due to our limited sample sizes. Regardless, the degree of development of these structures in each species is as follows:

Specimens of *H. ennearthrus* possess a large rounded cluster of setae on the mesepisternum (Fig. 19) and no additional setae proximally. They also appear to have two short and relatively thick setae on the elytral base. Three to five thick setae are present on the pronotum (Figs 16–18) as well as a row of similar aligned setae proximal to these, all of which may be trichomes (Fig. 16).

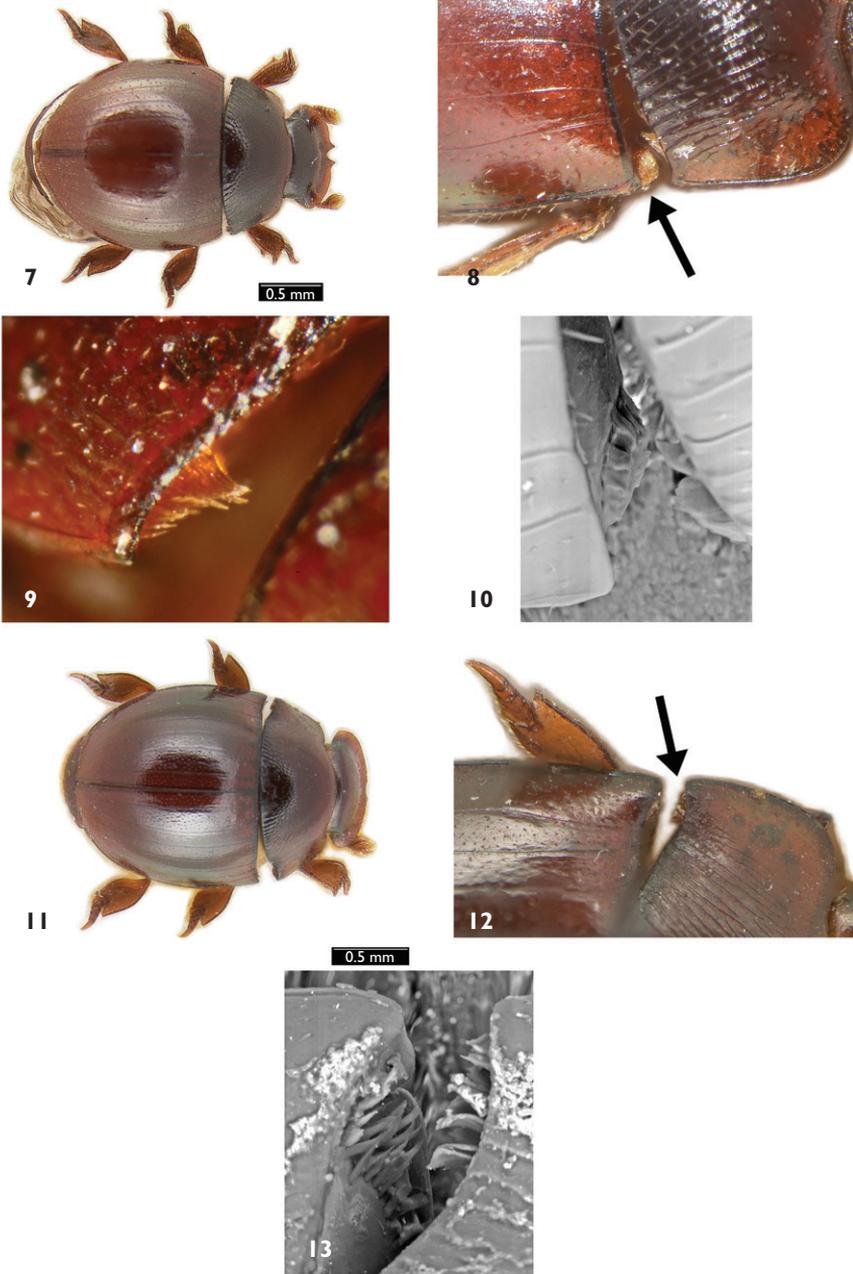
Haroldius modestus (Figs 7–10) also has a large, rounded cluster of setae on the mesepisternum (Fig. 10) and lacks any thick setae proximally. There are two to three thick setae on the elytral base. On the pronotum a brush-like trichome is well developed, consisting of six to sometimes ten or more, long, thick setae (Figs 8–9).

The third described *Haroldius* species from Africa, *H. leleupi* (Figs 11–13), is strikingly similar to *Formicdubius convexus* (Figs 1–6). They both have a small cluster of stout setae on the mesepisternum (Figs 6, 13) and proximal to this are a few more thick and elongate setae arranged in a transverse row (Fig. 6). These same setae become more slender and slightly more widely separated the further from the mesepisternal trichome. Additionally, there are four to five short, thick setae at the base of the elytra near the lateral margin (Fig. 5). Both species also have a well developed trichome on the pronotal base consisting of 20 or more lobe shaped setae (Figs 3–4, 12–13).

We are unsure whether *H. leleupi* and *F. convexus* are distinct taxa. *H. leleupi* is generally larger; the five specimens studied measure 1.80–2.20 mm in length (average 2.06 mm), whereas the 14 sampled types of *F. convexus* measure 1.63–1.90 mm (average 1.78 mm). *Haroldius leleupi* also has slightly stronger (more clearly defined) punctures on the disk of the pronotum and the elytral intervals and slightly deeper elytral striae, particularly near the suture. Additional material will be required from localities between the Congo and South Africa to decide to what extent these minor differences indicate taxonomic differentiation.

Synonymy

Haroldius leleupi and *Formicdubius convexus* are difficult to distinguish at the species level, but there is no doubt that *Formicdubius* is identical with *Haroldius* at the generic level. *Formicdubius* fully matches Boucomont's (1914) original description of *Haroldius*. It also agrees with the extended diagnosis of *Haroldius* recently published by Krikken and Huijbregts (2006) with the exception that all African species currently subsumed under *Haroldius* possess trichomes.



Figures 7–13. *Haroldius* species. Figures 7–10. *H. modestus* 7 Dorsal habitus 8 Trichomes within cleft between prothorax and mesothorax and showing pronotal sulci 9 Pronotal trichome 10 SEM view of trichomes on the pronotum and mesepisternum. Figures 11–13. *Haroldius leleupi*: 11 Dorsal habitus 12 Trichomes within cleft between prothorax and mesothorax and showing pronotal sulci 13 SEM view of trichomes on the pronotum and mesepisternum.

We propose the following synonymy:

Haroldius Boucomont, 1914 (type species by subsequent designation by Arrow, 1931: *Haroldius rugatulus* Boucomont, 1914)

= *Formicdubius* Philips & Scholtz, 2000 (type species by original designation: *Formicdubius convexus* Philips & Scholtz, 2000), syn. n.

Consequently, the following new combination is established:

Haroldius convexus (Philips & Scholtz, 2000) Krell & Philips, 2010, comb. n.

We refrain from determining the taxonomic status of the African species of the *Haroldius/Afroharoldius* group. All African *Haroldius* species have more or less distinct trichomes which could be a synapomorphy justifying a genus or subgenus *Afroharoldius*. However, we neither know if trichomes (vestigial or distinctive) are common in Asian *Haroldius* species, or whether the trichome-bearing species are the sister group of the trichome-less *Haroldius*, or whether their exclusion from *Haroldius* would leave *Haroldius* or *Afroharoldius* paraphyletic. In *Haroldius brendelli* Krikken & Huijbregts, antehumeral elytral trichomes are described (Krikken and Huijbregts 2009). Based on the illustrations in Krikken and Huijbregts (2006), it appears as though pronotal grooves are present on at least some Asian species and, moreover, trichomes seem to be present in *H. tangkoko* Krikken & Huijbregts and *H. cambeforti* Krikken & Huijbregts (see their figs 5 and 6). A revision and phylogenetic analysis of the whole group, including species of *Phaedotrogus* Paulian and probably *Ponerotrogus* Silvestri and *Cyclo-trogus* Wasmann (both currently considered to be junior synonyms of *Haroldius*), will probably be necessary to establish a sound genus-level classification. Currently we see no reason to change the status of *Afroharoldius* as junior synonym of *Haroldius*.

Material studied

40 Afrotropical *Haroldius* specimens from the following collections were studied:

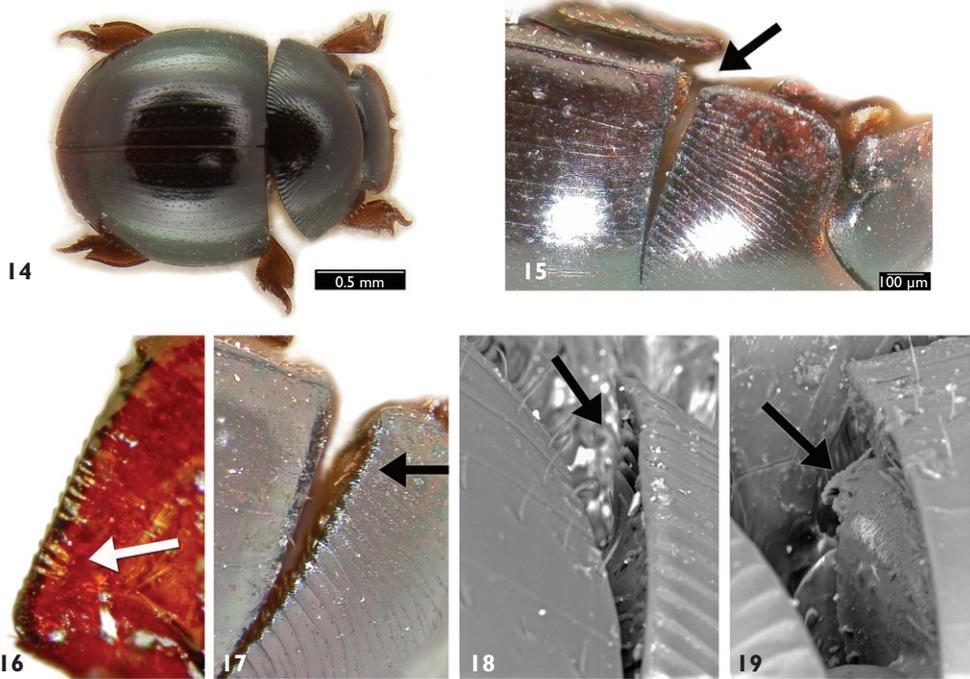
BMNH The Natural History Museum, London, UK.

MRAC Musée Royal de l’Afrique Centrale, Tervuren, Belgium.

TKPC T. Keith Philips Collection, Western Kentucky University, Bowling Green, USA.

Haroldius ennearthrus (7 spm.): Holotype: DR Congo, Katanga, Elisabethville [Lubumbashi], “dans petites termitières”, leg. N. Leleup 3.i.1949 [MRAC]. Additional material: 6 spm. Kasai [now Lulua Province], Luluabourg [Kananga], “Récolté sous des pierres (avec fourmis)”, leg. N. Leleup 3.ii.1953 (det. Janssens) [MRAC].

Haroldius modestus (22 spm.): Holotype: DR Congo, Katanga, Kundelungu, 1750m, “savane herb.”, “Myrmécophile”, leg. N. Leleup 23.iii.1950 [MRAC]. Paratypes: 1 spm., Massif des Kundelungu, leg. N. Leleup 7.ii.1950, “Rives d’une mare”, “Récolté dans pet. fourmilière”; 5 spm., dto., 1750 m, ii.1950, “savane herbeuse”, “Récolté dans petite fourmilière”; 1 spm., dto., 18.ii.1950; 8 spm., same data as holotype; 1 spm., 4.iii.1950, “Rives d’une mare”, “Myrmécophile”; 1 spm., dto.,



Figures 14–19. *Haroldius ennearthrus*. **14** Dorsal habitus **15** Trichomes within left between prothorax and mesothorax and showing pronotal sulci **16** Pronotal trichome and adjacent setae **17** Close-up view of trichome on the pronotum **18** SEM view of trichome on the pronotum **19** SEM view of trichome on the mesepisternum.

10.iii.1950; 1 spm., dto., 20.iii.1950, “Récolté dans pet. fourmilière”; 1 spm., dto. 24.iv.1950, “Myrmécophile”, “savane – parc”; 1 spm., dto., “savane boisée”, “Récolté sous écorce d’arbre” [MRAC]. Additional material: 1 spm., Malaŵi, Chisawira (Chinteche), leg. R. Jocqué 3.i.1978 [MRAC], **new record for Malaŵi**.

Haroldius leleupi (5 spm.): Holotype: DR Congo, Katanga [now in Lualaba Province], Kanzenze, “Récolté dans fourmilière”, leg. N. Leleup 5.ii.1949 [MRAC]. Paratypes: 4 spm., dto., 12.ii.1949 [MRAC].

Haroldius convexus (6 spm.): Paratypes: South Africa, Pretoria, The Willows, 25°45'S, 28°21'E, under stone with *Pheidole megacephala* (F.) [det. H.G. Robertson], leg. R. Oberprieler 1.i.1996 [2 spm. BMNH, 1 spm. MRAC, 3 spm. TKPC].

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