



## *Ebogotermes raphaeli*, new genus and new species, an African soldierless termite described from the worker caste (Isoptera, Termitidae, Apicotermatinae)

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### Abstract

*Ebogotermes raphaeli* gen. n. sp. n., is described from workers collected in Cameroon. This soil-feeding termite is the largest soldierless termite from central Africa and aligns with the *Anoplotermes* subgroup. The enteric valve armature is weakly armed and, as with most apicotermatine species, is uniquely diagnostic.

**Key words:** Cameroon, enteric valve armature

### Introduction

The “Treatise on the Isoptera of the World” (Krishna *et al.* 2013) established the benchmark for the taxonomic status of termites to the year 2011. At that time, 115 genera in four families and seven Termitidae subfamilies were recognized from the Ethiopian Region. Since then, the following seven Ethiopian genera have been added: *Roisinitermes* Scheffrahn, 2018 (Kalotermitidae); *Isognathotermes* Sjöstedt, 1926 n. comb. by Josens & Deligne, 2021, *Polyspathotermes* Josens & Deligne, 2021, and *Ternicubitermes* Josens & Deligne, 2021 (Termitidae: Cubitermitinae, Hellemans *et al.* 2021); and *Gastrotermes* Scheffrahn, 2020, *Apolemotermes* Romero Arias & Roisin, 2021, and *Koutabatermes* Romero Arias & Roisin, 2021 (Termitidae: Apicotermatinae, Romero Arias *et al.* 2021). Furthermore, Romero Arias *et al.* 2021 have identified six additional monotypic apicotermatine genera from the Ethiopian Region using mitochondrial genome sequencing. Herein the worker denoted as ‘Apicotermatinae genus L’ (Romero Arias *et al.* 2021) is described as *Ebogotermes raphaeli* gen. n. sp. n..

### Material and methods

All samples of *Ebogotermes raphaeli* were collected in primary forest near Ebogo II village. The preserved material was transported to Europe, subject to strict legal procedures, based on terms and conditions specified in Permits N°010/MINRESI/B00/C00/C10/C12, N°075/MINRESI/B00/C00/C10/C12, N°079/CO/MINFOF/SETAT/SG/DFAP/SDVEF/SC/BJ, and N°079/P/MINFOF/SETAT/SG/DFAP/SDVEF/SC/BJ (supervised by Dr. P. D. Akama). Preserved workers, stored in 85% ethanol, were positioned in a transparent petri dish filled with Purell® hand sanitizer (70% EtOH). Body sections and dissected guts were photographed as multi-layer montages using a Leica M205C stereomicroscope with a Leica DFC 425 module run with Leica Application Suite software version 3. Mandibles and EVA within the proctodeal second segment (P2) were mounted on slides with PVA mounting medium

(Bioquip Products, Inc.) and photographed with a Leica CTR 5500 compound microscope using bright field lighting and the same montage software. Terminology of the worker gut follows that of Sands (1998) and Noirot (2001). Measurements were obtained using an Olympus SZH stereomicroscope fitted with an ocular micrometer.

## Taxonomy

### *Ebogotermes* Scheffrahn & Roisin gen. nov.

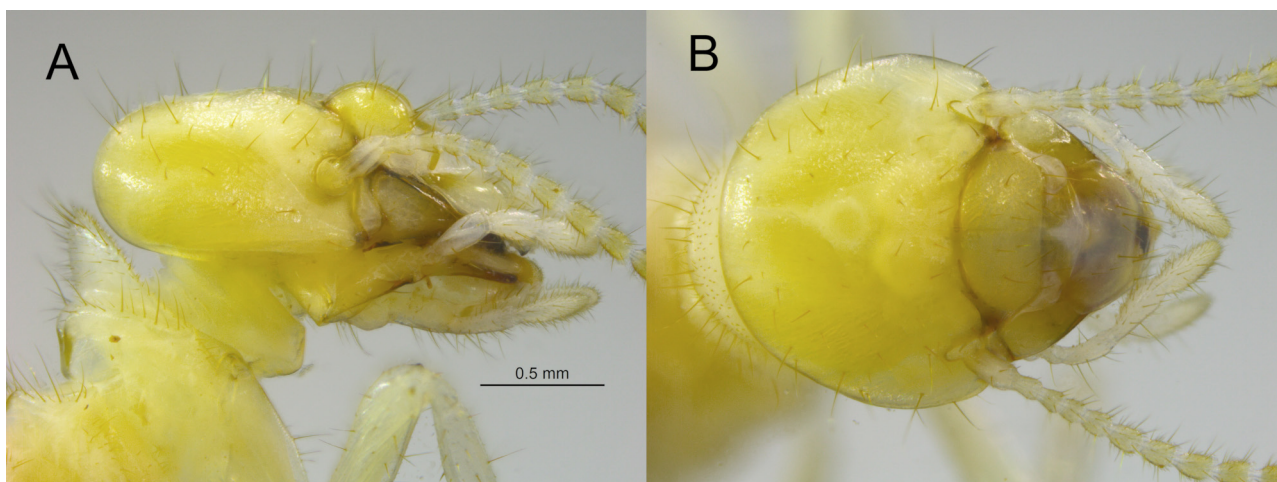
**Type species.** *Ebogotermes raphaeli* sp. n.

## Description

**Imago.** Unknown.

**Soldier.** Unknown, belongs to a soldierless clade.

**Diagnosis.** *Ebogotermes* is the largest (Figs. 1, 2) of the soldierless apicotermite workers in equatorial Africa. The circular mesenteron, well-developed mixed segment, moderately long P1, P3/P4 isthmus, and long tubular P4 place *Ebogotermes* in the *Anoplotermes*-group (Noirot, 2001). *Ebogotermes* is closest to *Aderitotermes* Sands, 1972 workers (*A. cavator* and *A. fossor*) which Sands (1972) describes as being large (HW= 0.90–0.99 mm) with the fore tibia “scarcely swollen” and a longer mixed segment than *Ebogotermes*. Unlike the pyriform enteric valve seating of *Ebogotermes*, *Aderitotermes* has trilobed seating. Also, the *Ebogotermes* EVA lacks fringes present in *Aderitotermes*.



**FIGURE 1.** *Ebogotermes raphaeli* worker. A) Lateral and B) dorsal views of the head and pronotum.

**Worker.** Head, thorax, abdomen, and legs covered with setae of varying lengths. Antennae with 14 articles. Postclypeus moderately inflated. Fore tibia slightly inflated. Tibial spurs 3, 2, 2. Mesenteron forming circular loop; mixed segment about one fourth length of P1; P1 diameter greater than mesenteron, almost four times as long as wide. Enteric valve armature with six subequal ovoid cushions within lumen of P2. Paunch (P3) large, comprises about half the volume of entire gut.

**Etymology.** From Ebogo, a village near Mbalmayo in southern Cameroon, and Latin *termes*, termite. Gender: masculine

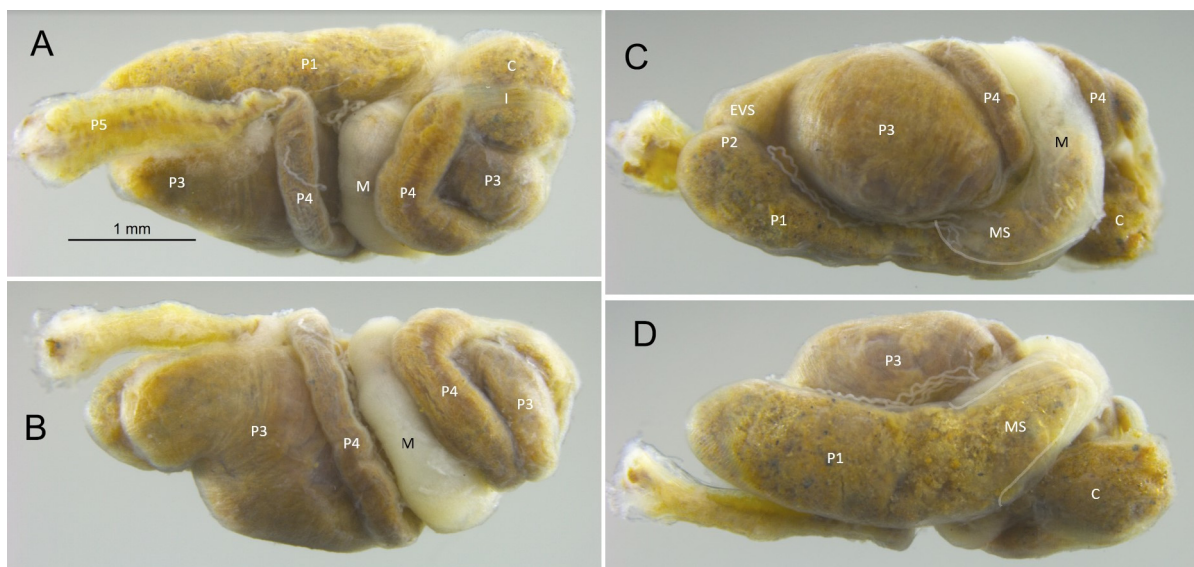
### *Ebogotermes raphaeli* Scheffrahn & Roisin sp. n.

**Type Material.** Holotype worker, Cameroon, Ebogo II, Jan Šobotník, University of Florida Termite Collection no. AFR3551 (Scheffrahn 2019), with 12 other workers (paratypes). Primary forest near Ebogo II village, 24FEB2019

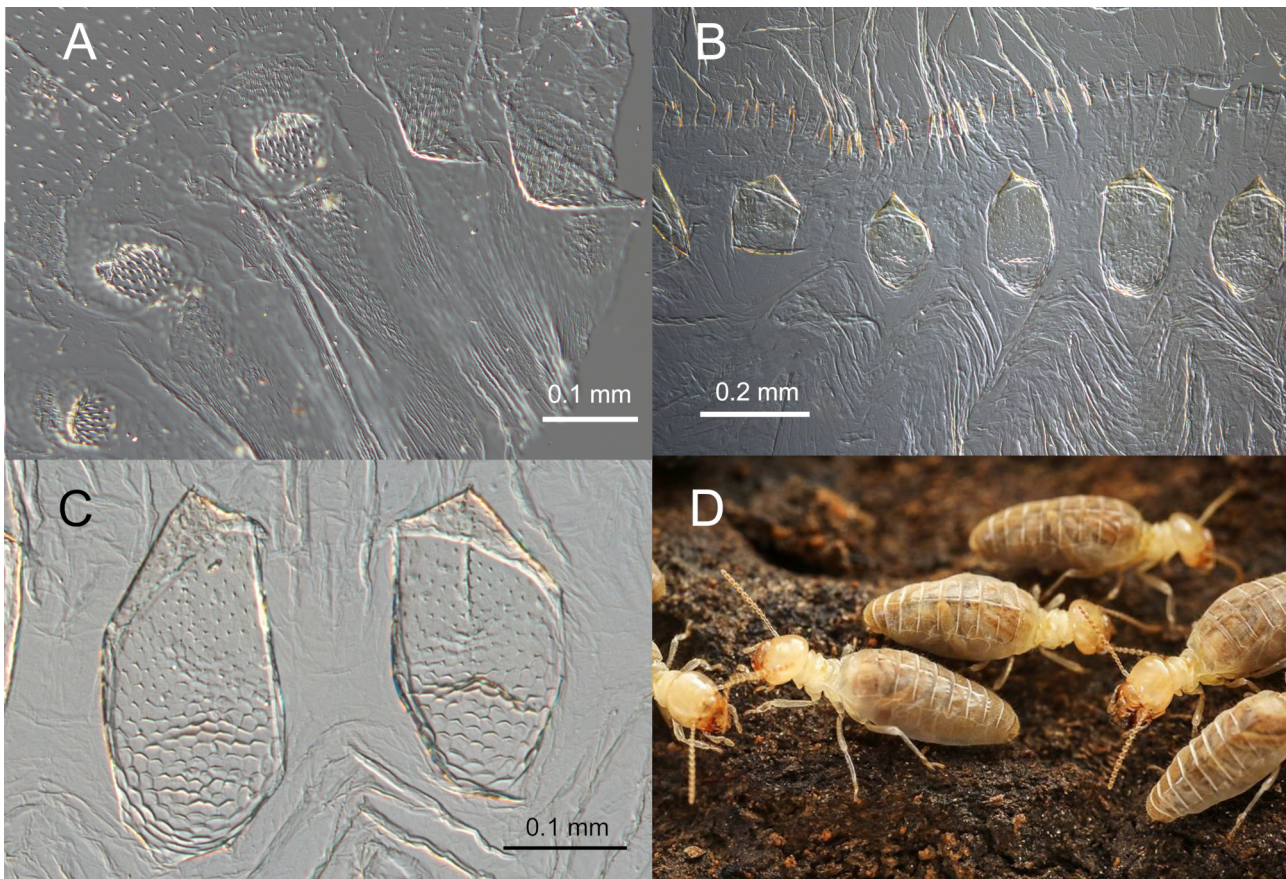
(CZU no. Cam19-1\_PG\_75). Paratype workers, J. Šobotník, primary forest near Ebogo II, (3.3820, 11.4632), elev. 677 m, UFTC no. AFR3617 (subsample of CAM20\_PG\_002). Paratype workers, Y. Roisin and J. Romero Arias, primary forest near Ebogo II, (3.3825, 11.4632), elev. 685 m, 7JUN2017 (ULB collection no. CMRT172), to be deposited in the Africa Museum (formerly Royal Museum of Central Africa, RMCA), Tervuren, Belgium.



**FIGURE 2.** *Ebogotermes raphaeli* worker. A) Lateral habitus of whole worker, fifth proctodeal segment (rectum) prolapsed, B) mandibles, and C) right foreleg.



**FIGURE 3.** *Ebogotermes raphaeli* worker whole gut. A) dorsal, B) right, C) ventral, and D) left aspects. Abbreviations: C = crop, M = mesenteron, MS = mixed segment (margin highlighted in C and D), P1 = first proctodeal segment, EVS = enteric valve seating, P3 = third proctodeal segment, I = isthmus, P4 = fourth proctodeal segment, P5 = fifth proctodeal segment.



**FIGURE 4.** *Ebogotermes raphaeli* worker. A) Gizzard, showing the five spiny mats, B) enteric valve armature, C) detail of EVA cushions, and D) live habitus.

**Type locality.** Cameroon, Lekié, Ebogo, lat 3.3820, long 11.4632, elev. 677 m.

**Diagnosis.** The genus diagnosis will probably be consistent with any future new *Ebogotermes* species, however the EVA, the most diverse character in the Apicotermitinae, should reveal diagnostic differences.

**Worker** (Figs. 1–4). Very large. In lateral view (Fig. 1A), postclypeus moderately inflated; anterior lobe of pronotum tall, anterior rim covered with a field of small, uniform setae, posterior covered with about 35 setae of varying lengths. Posterior lobe of pronotum angled about  $80^\circ$  from anterior lobe. In dorsal view (Fig. 1B), head capsule covered with about 40 setae of varying lengths; fontanelle and large anterior frontal glands lighter than remainder of vertex. Mandibular dentition as in Fig. 2B. Fore tibia weakly inflated, about five times longer than wide. (Fig. 2C); about eight spines along inner margin, and three terminal spines; outer spine smallest. Antennal articles 1–4 about equal in length, article 5 and beyond wider and slightly longer. Mesenteric tongue of mixed segment lies along the inner side of the midgut ring (Fig. 3C). First proctodeal segment (P1) tubular, at least 2.5X long as wide (Fig. 3D). Second proctodeal segment (P2) armature does not extend into the lumen of the P3; EVA (Fig. 4B) consists of six cushions of similar shape that are either slightly larger or smaller than their neighbor. The anterior margin of each cushion is hemispherical while the posterior margin (pointing to the P3 lumen) is slightly sclerotized and forms a  $90^\circ$  pouch. The surface of each cushion is adorned with ca. 70–140 scales rounded and broad near base of cushion, then narrowing into a tiny spine distally (Fig. 4C). Orientation of P2 to P3  $180^\circ$ ; P2 seating spheriform, without lobes. Third proctodeal segment (P3) expanding posteriorly from P2 seating lobe into voluminous main chamber (Fig. 3C) which bends to right and thins at P3/P4 isthmus at dorsal anterior. Fourth proctodeal segment (P4) long, narrow, and tubular, winding from isthmus around the anterior P3 for  $180^\circ$ , then bending posteriorly under P3, and finally bending  $180^\circ$  around the middle of P3 from ventral side to terminate at P5 in dorsum. Measurements in Table 1.

**Etymology.** Named for Raphael Awoumou Onana, the chief of Ebogo village, a resilient guide, and expert on Cameroonian termites.

**TABLE 1.** Measurements (mean, range in mm) of *Ebogotermes raphaeli* workers (n=10 per colony).

Measurement	Colony		
	AFR3551	CMRT172	AFR3617
Head length to end of postclypeus	0.95, 0.89–1.00	0.92, 0.85–0.97	0.93, 0.88–0.98
Postclypeus length	0.35, 0.30–0.40	0.30, 0.28–0.31	0.35, 0.33–0.37
Maximum head width	1.42, 1.37–1.47	1.35, 1.32–1.38	1.45, 1.40–1.47
Pronotum width	1.01, 0.98–1.07	0.93, 0.91–0.96	0.99, 0.96–1.02
Hind tibia length	1.44, 1.37–1.49	1.37, 1.31–1.42	1.45, 1.37–1.53
Fore tibia length	1.01, 0.93–1.05	1.04, 1.00–1.06	1.06, 1.02–1.11
Fore tibia width	0.19, 0.18–0.19	0.20, 0.19–0.21	0.19, 0.18–0.21
Fore tibia width-to-length ratio	0.19, 0.18–0.20	0.19, 0.18–0.20	0.18, 0.16–0.20

## Discussion

*Ebogotermes* is the largest of all Ethiopian apicotermite workers along with the Namibian *Skatitermes* Coaton, 1971. *Skatitermes* has a wide range of worker head widths: *Skatitermes psammophilus* Coaton 1971 (1.18–1.20 mm) and *Skatitermes watti* Coaton 1971 (1.18–1.56). Like many other rare apicotermite genera (JŠ pers. obs.), *Ebogotermes* was always collected from humus-rich habitats between buttress roots of a large tree or under a fallen and partially decomposed white-rot log. There are quite a number of monotypic genera within Apicotermatinae (Krishna *et al.* 2013), showing a fast split and subsequent specialization of plentiful lineages during the Cenozoic in Africa and South America (Engel *et al.* 2009, Krishna *et al.* 2013, Bourguignon *et al.* 2017). *Ebogotermes* is a new member to this group, characterized by its large body size, unique unsclerotized enteric valve armature, and thin fore tibiae. Using complete mitochondrial genome sequencing, Romero Arias *et al.* 2021 place *E. raphaeli* (paratype colony CMRT172, identified as Apicotermatinae genus L) in the main clade of African soldierless Apicotermatinae. *Ebogotermes raphaeli* is most closely related to another new genus (labelled genus E) also with rather large-sized workers, whose study is in progress.

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