

OVERVIEW OF THE GENUS *AFROLEIUS* MAHUNKA, 1984 (ACARI, ORIBATIDA)

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ABSTRACT — The genus *Afroleius* Mahunka, 1984 was proposed for three species (*A. deformis*, *A. minor* and *A. simplex*) and is so far known only from South Africa. New species (not yet described) have been identified from the Oribatida collection of the National Museum in Bloemfontein, South Africa. An overview of the genus, including an analysis of character states on genus level and an investigation of its relationships, is presented. Habitat preferences and distribution are also discussed.

KEYWORDS — Acari; Oribatida; Systematics; *Afroleius*; Mycobatidae

INTRODUCTION

The genus *Afroleius* was described by Mahunka in 1984 from material collected at Nature's Valley, Western Cape, South Africa. At the same time he described three species namely *A. deformis* (type species), *A. minor* and *A. simplex*. Mahunka placed the genus in the family Haplozetidae (Oripodoidea) and remarked that it resembles *Magyaria* Balogh (also Haplozetidae) but differs from the latter genus by the number of genital setae (four pairs in *Magyaria*; six pairs in *Afroleius*) and number of claws (one claw in *Magyaria*; three claws in *Afroleius*). The character states in Mahunka's diagnosis (1984) are: darkly sclerotized, sculptured body; wide, marginal lamella; weak translamella; movable pteromorph; ten pairs of minute notogastral setae; four pairs of sacculi; epimeral and ano-adanal surfaces ornamented; six pairs of genital setae, 0 (?) or one pair of aggenital setae, two pairs of anal and three pairs of adanal setae present; all legs tridactyle.

In their key to oribatid mite genera of the world, Balogh and Balogh (1992) treated this genus under Haplozetidae (p. 133) as well as under "ceratozetoid" genera (p. 147) and listed the genus under Ceratozetidae (p. 222). Subías (2004, 2012) and Coetzee (2007) followed the classification as originally suggested by Mahunka (1984) with placement in the family Haplozetidae.

More specimens of this genus have been identified from the Acarology collection of the National Museum in Bloemfontein, South Africa, including eight new species which will be described in the near future, and three species which are to be transferred from other genera namely from *Magyaria* Balogh (one species), *Africoribates* Evans (one species) and *Kilimabates* Mahunka (one species); *Kilimabates* has been synonymized with *Africoribates* by Balogh and Balogh (1992) and with *Anellozetes* Hammer by Subías (2004). So far, immatures of *Afroleius* are unknown. A detailed study of adults

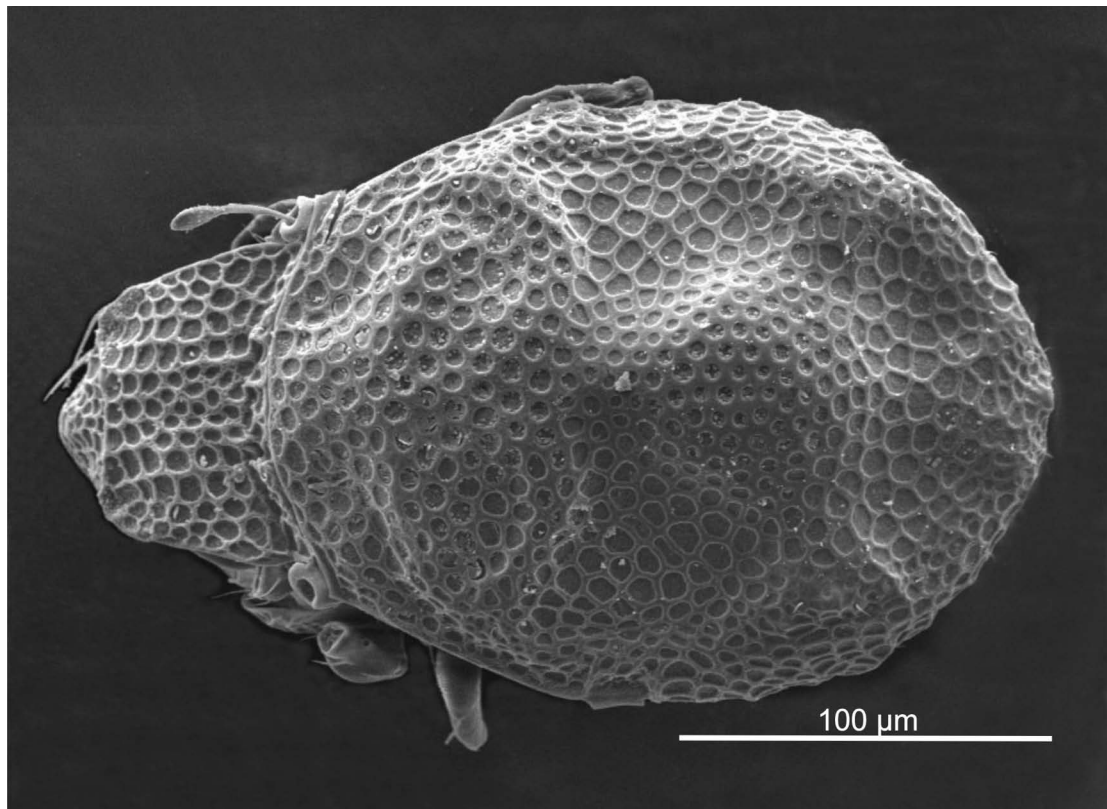


FIGURE 1: *Afroleius minor*. Dorsal view.

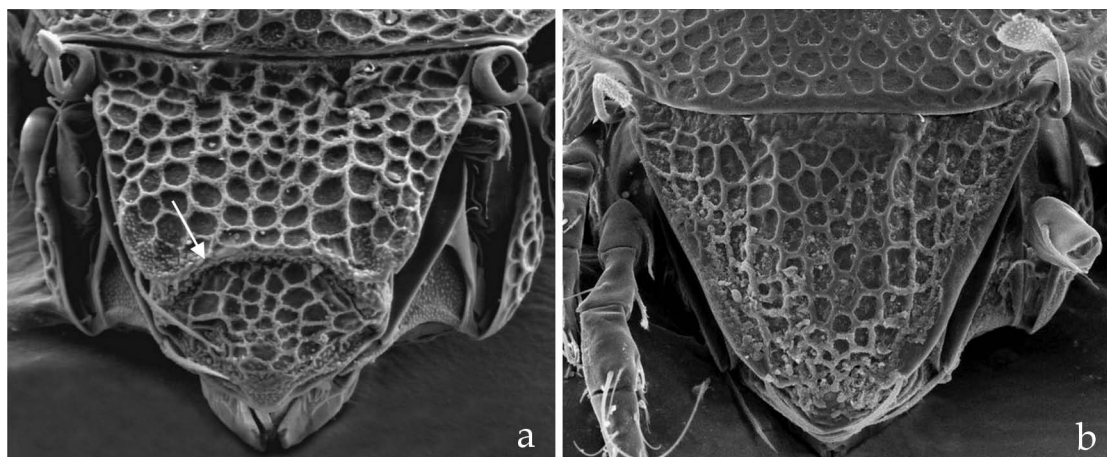


FIGURE 2: a – *Afroleius minor*. Anterior view, with costular ridge (arrow) between lamellar apices; b – *Afroleius* sp. Anterior view, costular ridge absent.

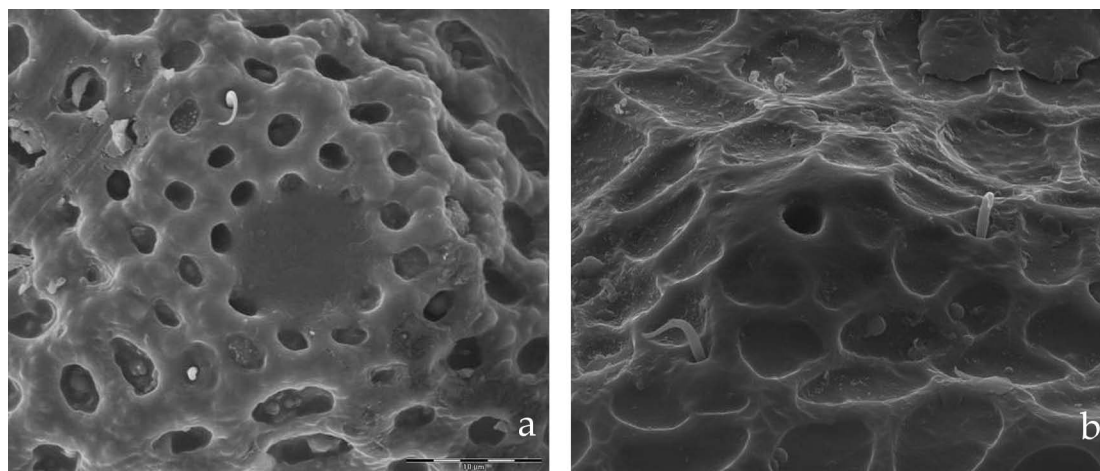


FIGURE 3: a – *Afroleius* sp. Notogaster, porose area Aa; b – *Afroleius minor*. Notogaster, sacculus Sa.

revealed new information which led to changes to the interpretation of certain character states, and hence to the classification.

MATERIALS AND METHODS

The material examined is housed in the Acarology collection of the National Museum. It consists of Berlese-funnel extractions of litter samples collected from 1960, and represents a wide range of localities and habitats in South Africa. Specimens are stored in 70 % ethanol + 5 % glycerol. For light microscope studies selected specimens were cleared in lactic acid at 50°C for 24 hours and then mounted temporarily in cavity slides with glycerol. A Nikon Eclipse 50i light microscope equipped with a DS-Fi1 digital camera and NIS-Elements imaging software were used for light microscope images. The following procedure was followed for Scanning Electron Microscope micrographs: Samples were fixed in 70 % ethanol for a minimum of 24 hours, dehydrated in a graded ethanol series of 80 %, 90 % and 2X 100 % for 30 minutes each. The samples were critical point dried in liquid carbon dioxide, mounted with double sided carbon tape on SEM-stubs and coated with 15 nm gold/palladium in a sputter coater, and viewed under a FEI Quanta 250 FEG SEM at 5 kV under high vacuum mode.

RESULTS

Revised diagnosis — *Afroleius* Mahunka, 1984 (Figures 1 – 9)

Integument — Darkly sclerotized, foveate or reticulate (Figure 1)

Size — Medium-sized ranging between 250 – 420 µm

Dorsal side (Figures 1, 2, 3, 4 and 8) — Lamella marginal, very short lamellar cusp present in some species, costular connection between lamellar apices sometimes present; rostral seta of medium length; lamellar seta of medium length; interlamellar seta minute; bothridium cup-shaped with lateral slit of which the lobes may overlap or not; narrow anterior notogastral tectum present, no medial process; pteromorph fully hinged; octotaxic system consists of four pairs of sacculi or porose areas; ten pairs of notogastral setae present, all setae minute (~ 10 µm); lyrifissures of medium length, lyrifissures *ia* situated anteriorly on pteromorph, lyrifissures *im*, *ih*, *ips* and *ip* in usual positions; undivided posterior notogastral tectum present.

Ventral side (Figures 4, 5, 6 and 7) — Genal notch and broad genal tooth present (see discussion); axillary saccule of subcapitulum present at base of palp; subcapitulum without mental tectum; epimeral surface foveate or partly punctate; apodemes II, sj and III short, parallel; epimeral seta *1c* present or absent; epimeral setae *3c* and *4c* absent (number of setae on

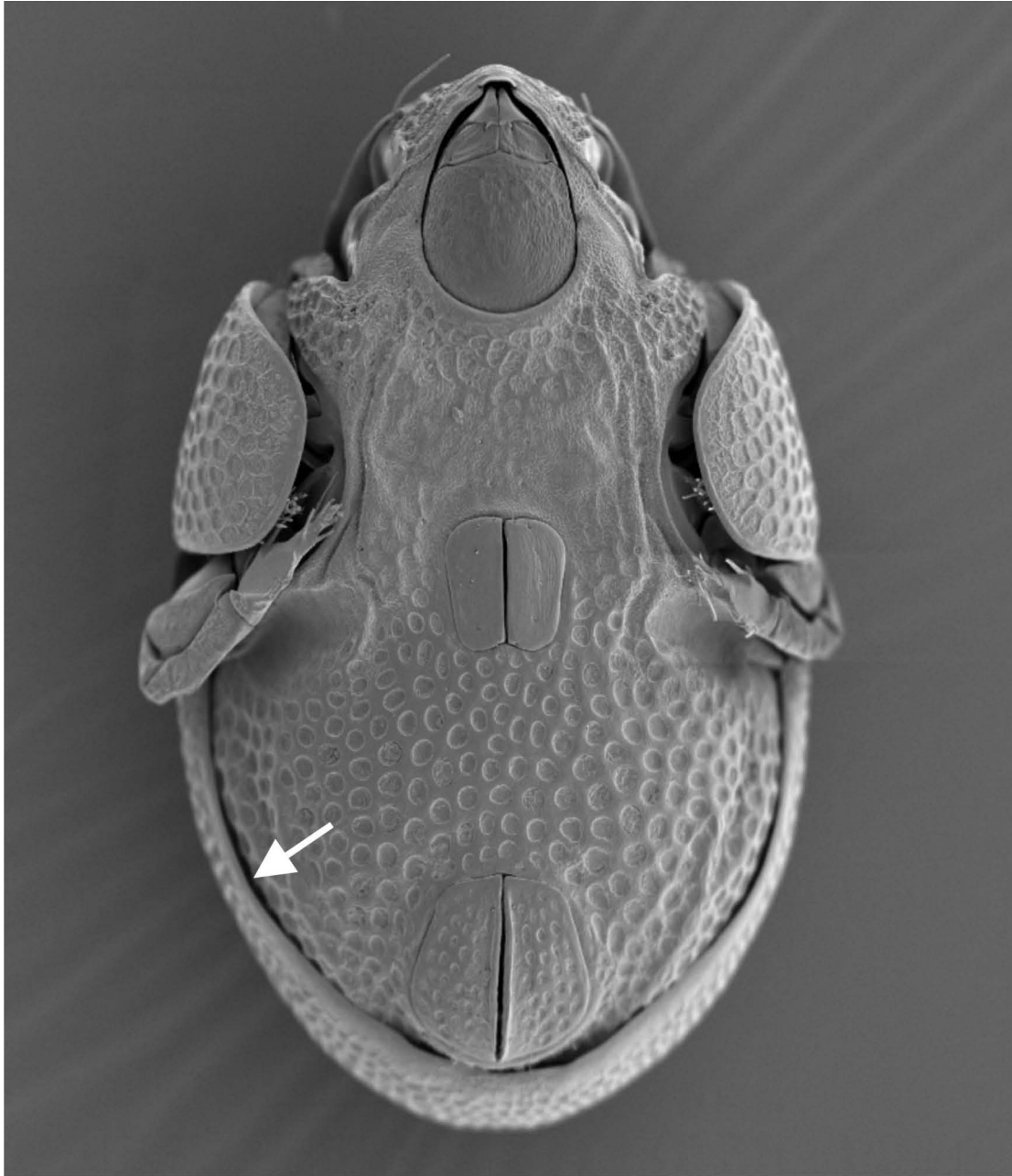


FIGURE 4: *Afroleius simplex*. Ventral view. Note posterior notogastral tectum (arrow).

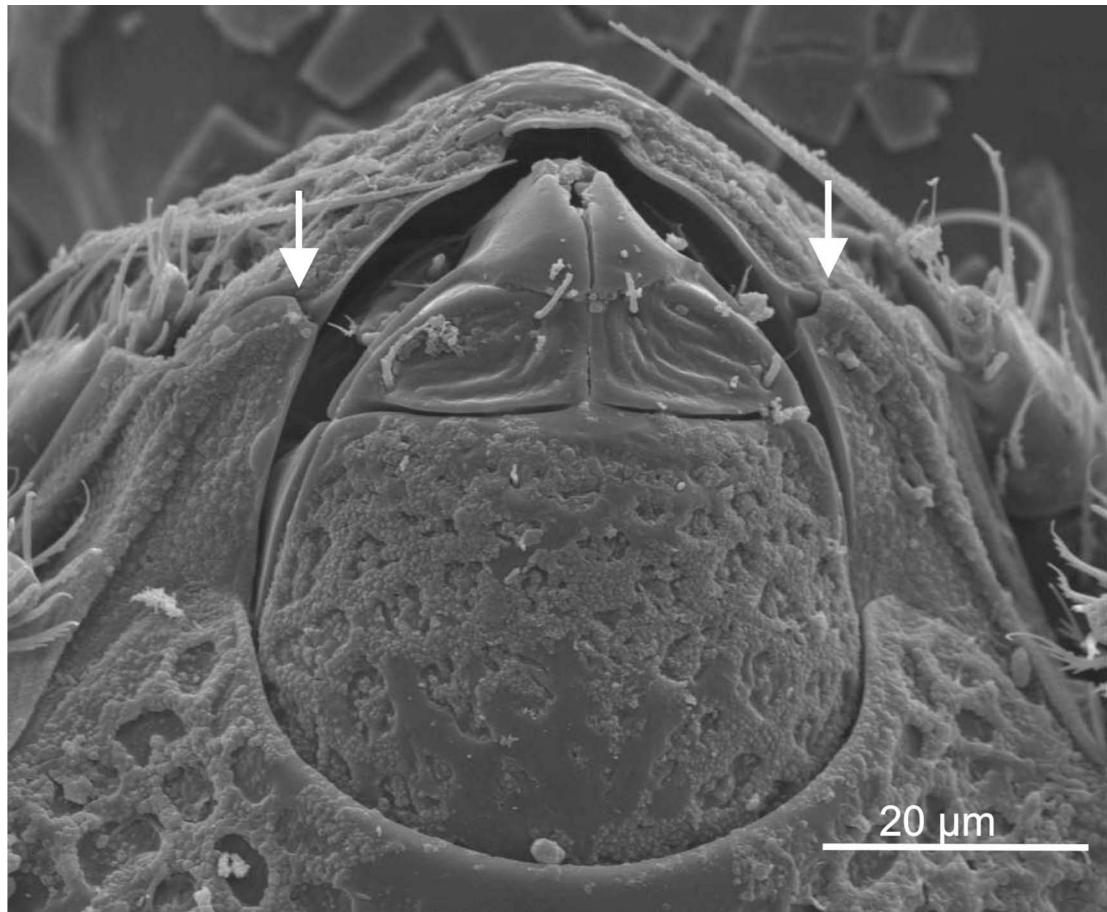


FIGURE 5: *Afroleius* sp. Subcapitulum. Note genal notch and genal tooth (arrows).

epimeres from anterior to posterior: 2/3-1-2-2); custodium absent; discidium large, triangular; darkly sclerotized band running from acetabulum IV on one side anterior of genital plates to acetabulum IV on other side; ventral plate foveate; genital plates with six pairs of setae, integument faintly striate or foveate; one pair of aggenital setae present (except *A. deformis*, aggenital seta absent); anal plates with two pairs of setae, integument foveate; lyri-fissure *iad* anterolaterally of anal plates; three pairs of adanal setae present, inserted close to each other on posterolateral border of anal plates (except *A. deformis*); pre-anal organ with narrow stem; post anal porose area present (see discussion).

Lateral view (Figure 8) — Tutorium consisting of dorsal ridge with deep incurvation in basal part; prodorsal integument at incurvation covered with

granular cerotegument; pedotectum I broad, covering acetabulum I, dorsally reaching exobothridial seta; pteromorph large, distal edge rounded, with complete hinge; two slightly curved carinae present dorsally of acetabulum IV.

Legs (Figure 9) — All legs heterotridactylous; dorsal integument of tibiae and tarsi of legs I, II and IV thickened; tarsi I and II with dorsal dens (varying from small point to large well-developed spur) proximally to tectal setae; genu I with dorsal and ventral distal cusps, genu II with sharp cusp situated ventrally or laterally; tarsus IV in some species proximo-dorsally with flattened ridge (? tectum) running from seta *ft*'' to proximo-ventral end of tarsus; femur IV with ventral projection forming ridge on abaxial side; femora I-IV and trochantera III-IV with porose areas.

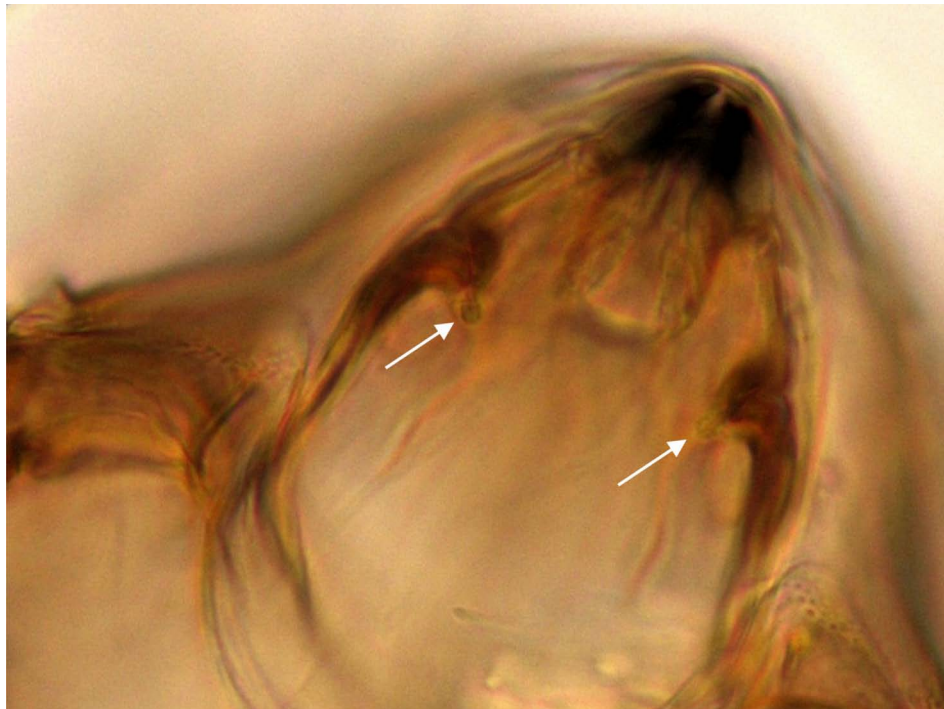


FIGURE 6: *Afroleius minor*. Subcapitulum. Note the axillary sacculles (arrows).

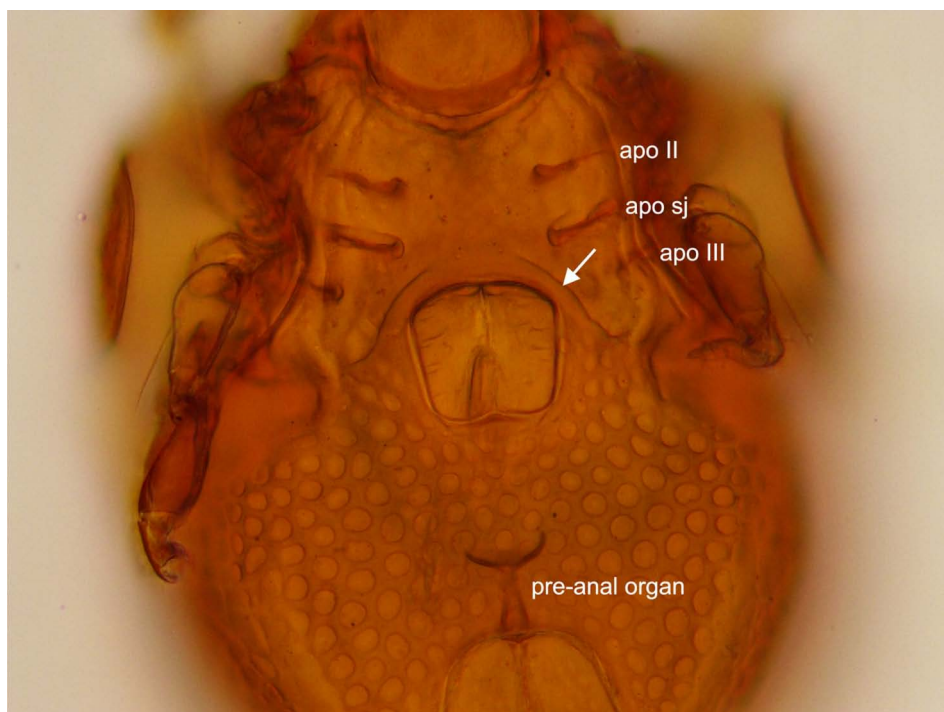


FIGURE 7: *Afroleius simplex*. Ventral view. Note the short apodemes II, sj and III, sclerotized band anterior of genital plates (arrow), narrow pre-anal organ and the absence of custodium.

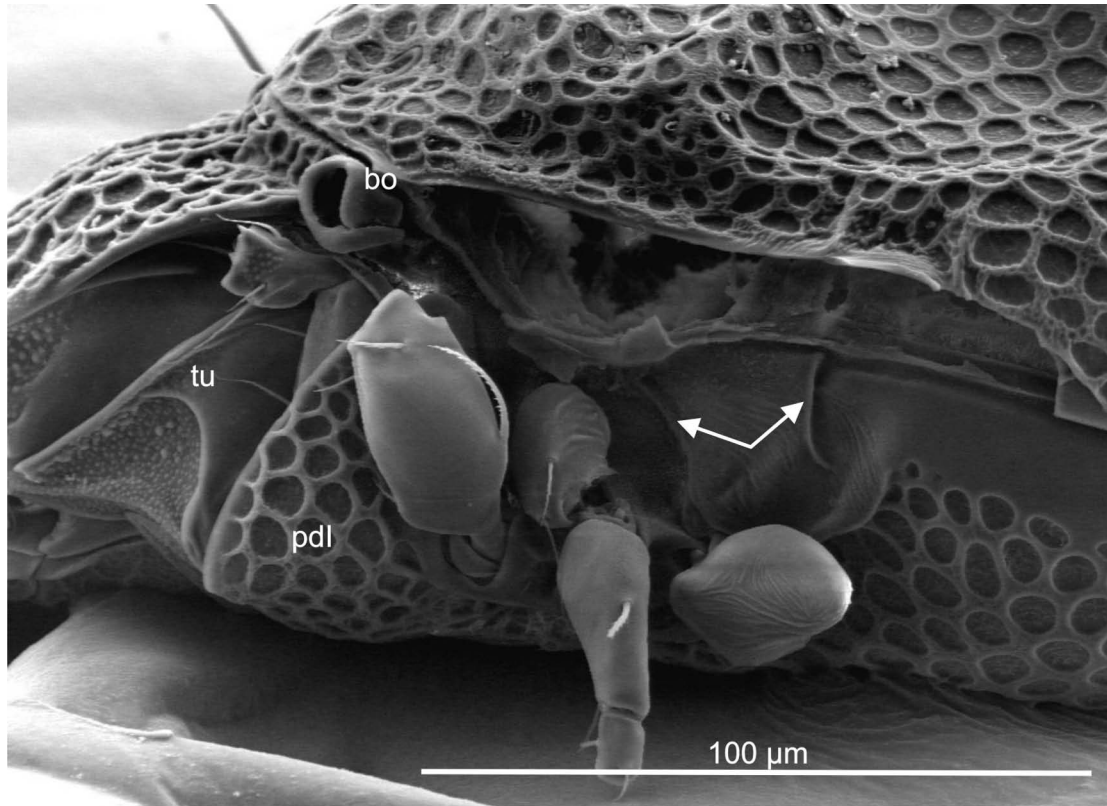


FIGURE 8: *Afroleius minor*. Lateral view (pteromorph removed). Note the shape of the tutorium (tu), lateral slit in bothridium (bo), shape of pedotectum I (pdl) and the lateral carinae dorsal of acetabulum IV (arrows).



FIGURE 9: a – *Afroleius* sp. A. Genu I with anterior cusps (arrows); b – *Afroleius* sp. B. Genu II with lateral cusp (arrow); c – *Afroleius* sp. B. Tarsus II with dorsal dens (arrow).

Setal formula (number of setae per digit from trochanter to tarsus, famulus included): Leg I 1-5-3-4-20; Leg II 1-4-3-4-15; Leg III 2-2-1-3-15; Leg IV 1-2-2-3-12. Solenidial formula (number of solenidia per digit from genu to tarsus): Leg I 1-2-2; Leg II 1-1-2; Leg III 1-1-0; Leg IV 0-1-0.

DISCUSSION

The axillary saccule is a porose sacculus extending internally from the base of the palp. It was first described by Grandjean (1936) as a brachytrachea in *Pelops acromios* Hermann. Norton and Behan-Pelletier (1986) brought this structure to the attention again fifty years later when they investigated the systematic relationships of *Propelops* Jacot. They determined the presence of this saccule in various poronotic brachypyline families, and it was found to be present in all Ceratozetoidea and some other superfamilies such as Oribatelloidea (certain families) and Galumnoidea, but no trace of such a structure was found in any of the Oripodoidea (Norton and Behan-Pelletier 1986; Norton *et al.* 1997; Norton and Behan-Pelletier 2009).

Another important character in Ceratozetoidea is the genal notch and genal tooth (Norton and Behan-Pelletier 2009). This is an indentation in the genal border, forming a tooth (dens) which can be long and narrow as in the majority of Ceratozetidae, to short and broad as in Zetomimidae (Behan-Pelletier 1986; Behan-Pelletier 1996). The genal tooth in *Afroileius* is short and broad, but may also be absent or fused to the rostrum. Niemi and Behan-Pelletier (2004) noted that a fused or absent genal tooth is rare in Ceratozetoidea, as is the case in *Nuhivabates* (Mycobatidae) and some species of *Melanozetes* (Ceratozetidae).

The third key character of Ceratozetoidea is the shape of Pedotectum I. A large, broad pedotectum which completely covers acetabulum I and stretches dorsally almost to the base of the bothridium is present in Ceratozetoidea as well as Oribatelloidea (Norton and Behan-Pelletier 2009). In *Afroileius* pedotectum I reaches the insertion of the exobothridial seta, with the distal margin straight to very slightly convex.

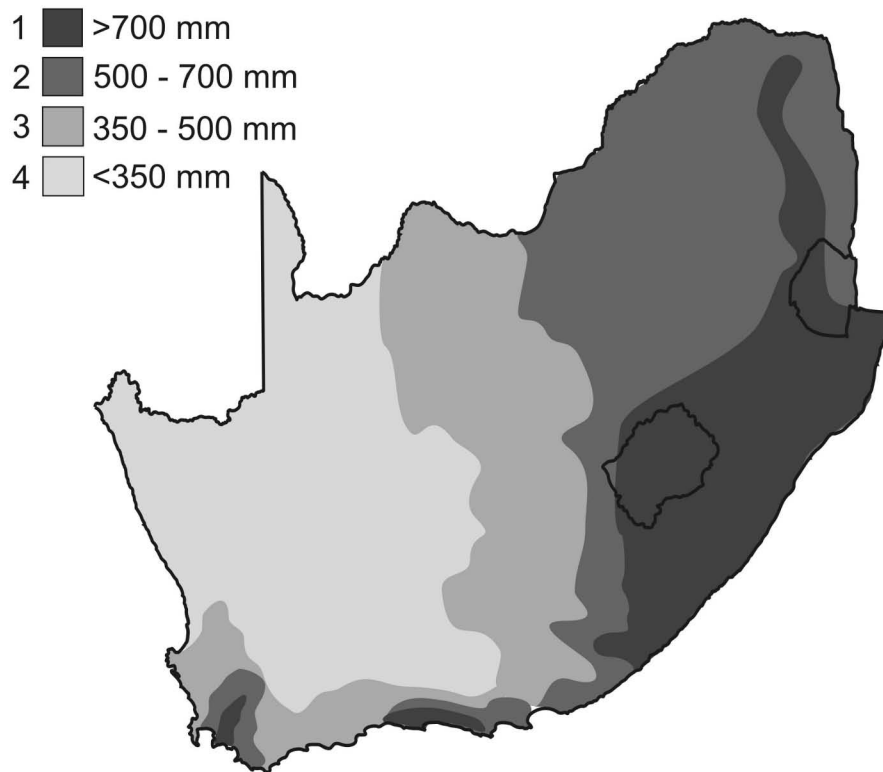
The tutorium of *Afroileius* has a peculiar shape, with a thickened ridge dorsally and the basal part with a deep incurvation. The integument beneath the incurvation is covered with granular cerotegument. The lamellae are situated marginally, sometimes with a very short cusp. Whether the ridge in some species between the lamellar apices can be called a translamella is debatable - in lateral view it appears to be a steep decline in the prodorsal profile. This ridge is variously expressed, from a costular ridge to (mostly) absent.

On the lateral side beneath the pteromorph, two carinae are present above acetabulum IV. Similar carinae are also present in the mycobatid genera *Mycobates* Hull, *Punctoribates* Berlese and *Pelopsis* Hall (Behan-Pelletier and Eamer 2003). These carinae are difficult to observe under light microscope despite having the pteromorph and leg IV removed.

The cup-shaped bothridium has no scales (extensions of the anterior border) as in the majority of Ceratozetoidea (Behan-Pelletier 1986), but has a lateral slit of which the lobes may overlap or not. The bothridium is often hidden beneath the pteromorph, and sometimes directed ventrally.

The octotaxic system is expressed as sacculi or porose areas, often surrounded by thick cuticle. The sacculi can be round or tubular. In the past much emphasis has been placed on whether the octotaxic system is expressed as sacculi or porose areas, but the systematic importance of this trait has been shown to be of value only on species level (Norton and Alberti 1997, Norton and Behan-Pelletier 2009, Weigmann 2009a, Weigmann 2009b).

An undivided posterior notogastral tectum is present as well as a post anal porose area, often covered by the tectum. Of the possible 14 species, the post anal porose area is absent in four species, in which it is considered a secondary loss. The presence of a post anal porose area is "almost universal" in Ceratozetoidea (Norton and Behan-Pelletier 1986). The presence or absence of a tectum along the posterior border of the notogaster is of importance in poronotic families, distinguishing for example between Ceratozetidae and Mycobatidae (Behan-Pelletier and Eamer 2008; Grandjean 1954). In *Afroileius* the custodium is absent, as is the case in



1. High rainfall & forests. 2. Savanna & montane grassland. 3. Grassland. 4. Arid

FIGURE 10: Distribution of *Afroleius*. Map of South Africa with biomes and rainfall (smoothed) indicated. The majority of species occur in the eastern high rainfall area.

some other mycobatid genera such as *Punctoribates*, where it may vary between species, and *Nuhivabates* (Behan-Pelletier and Eamer 2008; Niemi and Behan-Pelletier 2004).

The legs of *Afroleius* have a number of character states which are also found in some other mycobatid genera, such as the thickened dorsal integument of tarsi and tibiae I, II and IV, the dens on tarsus II (in *Afroleius* also present on tarsus I), and the ventral projections on femur IV. These character states are also seen in some species of *Pelopsis* and *Punctoribates* (Behan-Pelletier and Eamer 2008). The dens in *Afroleius* varies in size from a large, well-developed spur to a small point. Genu I of *Afroleius* has dorsal and ventral cusps on the distal end,

while genu II has a ventral (or sometimes lateral) cusp similar to that found in *Nuhivabates* (Niemi and Behan-Pelletier 2004).

Distribution and habitat (Figure 10)

So far, *Afroleius* is known only from South Africa - apart from one species from Tanzania, described by Balogh in 1959 as *Africoribates undulatus*. The oribatid faunas in the countries lying between Tanzania and South Africa, namely Malawi, Mozambique and Zimbabwe are unknown. *Afroleius* is mainly a species of the temperate forests and thickets of the eastern and southern regions of South Africa, which is a high rainfall area with annual precipitation from 700 mm. The brown soil of temperate forests is typi-

cally extremely fertile with abundant leaf litter (Van As *et al.* 2012). Of the possible 14 species, eight occur only in this biome. A further four species occur in the temperate forests as well as the savanna and temperate grassland biomes, with one species restricted to montane grassland. Only one species occurs predominantly in the grassland and arid regions. Only litter samples have been investigated.

Relationship

The three key characters of adult Ceratozetoidea namely the axillary saccule, the genal notch and the large pedotectum I (Norton and Behan-Pelletier 2009) are present in *Afroileius*. Therefore, this genus is firmly excluded from Oripodoidea and hence from Haplozetidae. Norton and Behan-Pelletier (2009) include nine families in Ceratozetoidea. The presence of a posterior notogastral tectum in *Afroileius* excludes Ceratozetidae, Euzetidae and Zetomimidae; the absence of a custodium excludes Ceratokalummidae, Chamobatidae, Humerobatidae and Onychobatidae and the presence of a pteromorph hinge excludes Maudheimiidae.

Mycobatidae is a family with a rather chequered set of character states with the presence of the posterior notogastral tectum (complete or divided) the definitive character state in adults of this family (Behan-Pelletier and Eamer 2008; Behan-Pelletier and Ryabinin 1991; Grandjean 1954). The presence of the pteromorph hinge (complete or partial; also referred to as line of desclerotization) used to carry much weight (Grandjean 1954), but this character state has since been shown not to be constant in Mycobatidae (e.g. absent in *Ceresella* Pavlitshenko and *Cyrtozetes* Behan-Pelletier) (Behan-Pelletier and Eamer 2008). The phylogenetic importance and polarity of certain character states on family level such as the sculptured integument, marginal lamellae and the peculiar shape of the tutorium needs to be established, while immature forms will undoubtedly provide valuable clues to the relationship of this genus. However, until the abovementioned questions have been resolved, this genus should be regarded as a member of Mycobatidae.

ACKNOWLEDGEMENTS

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