

NEW SPECIES OF THE GENUS *AFROLEIUS* MAHUNKA, 1984
(ACARI, ORIBATIDA, MYCOBATIDAE) FROM SOUTH AFRICA

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Three new species in the genus *Afroleius* Mahunka, 1984 are described from South Africa. *A. crassus* sp. n. can be recognised by the wedge-shaped lateral profile and undulated latero-postero notogastral margin; *A. decurvatus* sp. n. is recognised by the slender, sharply decurved sensillar stalk and thick-walled tubular sacculi, and *A. deformatoides* sp. n. is similar to the type species *A. deformis* but differs by the octotaxic system consisting of porose areas and the presence of foveae in the central parts of the notogaster.

Key words: Oribatida, Mycobatidae, *Afroleius*, new species, South Africa.

INTRODUCTION

The genus *Afroleius* has been described by MAHUNKA (1984) from material collected in the southern parts of the Western Cape Province of South Africa. At the time Mahunka described three species namely *A. deformis* (type species), *A. minor* and *A. simplex*. The relationship of this genus has been uncertain. Mahunka placed the genus in the family Haplozetidae (MAHUNKA 1984) while BALOGH and BALOGH (1992) treated it under Haplozetidae as well as under “ceratozetoid” genera. SUBÍAS (2004, 2012) placed the genus in Haplozetidae.

More new species have been discovered in South Africa, of which the first three new species *A. crassus* sp. n., *A. decurvatus* sp. n. and *A. deformatoides* sp. n. are described in this paper. COETZEE and TIEDT (2013) presented arguments for the inclusion of the genus in the family Mycobatidae. A much neglected structure of certain groups of oribatid mites is the axillary saccule - a porose saccule extending internally from the base of the palp. GRANDJEAN (1936) first noted this saccule in *Pelops acromios* Hermann. In brachypylinae families, the axillary saccule is present in all Ceratozetoidea, certain families of Oribatelloidea and Galumnoidea, but it is absent in Oripodoidea (NORTON & BEHAN-PELLETIER 1986, NORTON *et al.* 1997, NORTON & BEHAN-PELLETIER 2009). The axillary saccule is present in *Afroleius*, which excludes it from Oripodoidea. It must be emphasized that this study was based on adult characters only, as immatures are still unknown.

Diagnosis of *Afroleius* Mahunka, 1984

Integument darkly sclerotized, foveate or reticulate; lamella marginal, rostral seta short to medium length; lamellar seta medium to long; interlamellar seta minute; pteromorph large, distal edge rounded, fully hinged; lyrifissure *ia* situated paraxially on pteromorph; octotaxic system consisting of four pairs of sacculi or porose areas; ten pairs of minute notogastral setae present; undivided posterior notogastral tectum present; genal notch and broad genal tooth usually present; axillary sacculi of subcapitulum present; number of setae on epimeres I–IV 2/3–1–2–2, epimeral seta *1c* present or absent; epimeral setae *3c* and *4c* absent; custodium absent; darkly sclerotized band running from acetabulum IV on one side anterior of genital plates to acetabulum IV on other side; genital plates with six pairs of setae, adanal setae inserted close to each other on posterolateral border of anal plates, *ad*₃ inserted posterior to *iad* (exceptions: *A. deformis* Mahunka, 1984 and *A. deformatoides* sp. n.); post anal porose area usually present; tutorium consisting of dorsal ridge with deep incurvation in basal part; pedotectum I broad, covering acetabulum I; all legs heterotridactylous; dorsal integument of tibiae and tarsi of legs I, II, and IV thick; tarsi I and II with dorsal dens proximal to tectal setae, varying from small point to large well-developed spur (exception: dens on tarsus I of *A. deformis* and *A. deformatoides* absent); distal end of genua I and II antiaxially with prominent cusps; femur IV with ventral projection forming ridge on abaxial side; porose areas present on femora I–IV, and trochantera III and IV.

MATERIAL AND METHODS

All studied material derives from South Africa. Soil fauna was extracted by Berlese-Tullgren funnels. Specimens were temporarily mounted on cavity slides with glycerol for study purposes and thereafter stored in 70% alcohol. All material, including holotypes and paratypes, are deposited in the Acarology Collection of the National Museum, Bloemfontein, South Africa.

RESULTS

***Afroleius crassus* sp. n.**

(Figs 1–7)

Diagnosis – Notogastral surface reticulate, prodorsal and ventral surfaces foveate; lateral and posterior margins of notogaster undulate; octotaxic system consisting of sacculi with wide openings; bothridial seta clavate, stalk short; rostral seta very short; lamellar seta long, roughened, curving medially; interlamellar seta minute; notogastral setae minute; lateral notogastral profile

wedge-shaped; prominent dorsal dens on tarsi I and II; distal end of genu I antiaxially with prominent dorsal and ventral cusps; distal end of genu II antiaxially with prominent lateral cusp.

Dimensions – Holotype (female): Length 330 μm , width 230 μm . Paratypes: Females (n = 2): Length 324 μm (311–338 μm), width 222 μm (213–236 μm). Males (n = 7): Length 299 μm (284–316 μm), width 206 μm (196–218 μm).

Prodorsum (Figs 1 & 2) – Rostrum rounded in dorsal view, rostral profile deeply indented in lateral view; prodorsal surface foveate, foveae becoming smaller and fractioned towards posterior border of prodorsum; lamella (*L*) wide, extending over lateral margin of prodorsum; rostral seta (*ro*) (ventrally visible) short, (~ 16 μm) roughened, inserted at anterior apex of tutorium; lamellar seta (*le*) long (~ 32 μm), roughened, curved medially; interlamellar seta (*in*) minute (~ 7 μm); bothridium small, opening directed ventrally; head of bothridial seta (*bo*) clavate, granular, surface roughened, length of bothridial stalk more or less as long as bothridial head.

Notogaster (Figs 1 & 2) – Surface reticulate; medially slightly elevated, marginally depressed, postero-lateral margin deeply undulate; octotaxic system consisting of sacculi, openings of sacculi surrounded by thick integument; ten pairs of minute (~ 7 μm) notogastral setae present; lyrifissure *im* clearly visible; opisthosomal gland *gla* small, situated close to sacculi *S*₁; in lateral view posterior part of notogaster much higher than anterior part.

Podosoma and gnathosoma (Figs 2 & 3) – Surface of mentum foveate, foveae fading posteriorly; genal notch (*gn*) present; genal tooth very broad, short; axillary sacculi short; epimeral setae minute; epimeral surface foveate; epimeral seta *1c* absent; tutorium (*tu*) narrow, anterior surface below *tu* finely granulate; pedotectum I (*pdI*) large, wide, surface foveate; pedotectum II (*pdII*) small.

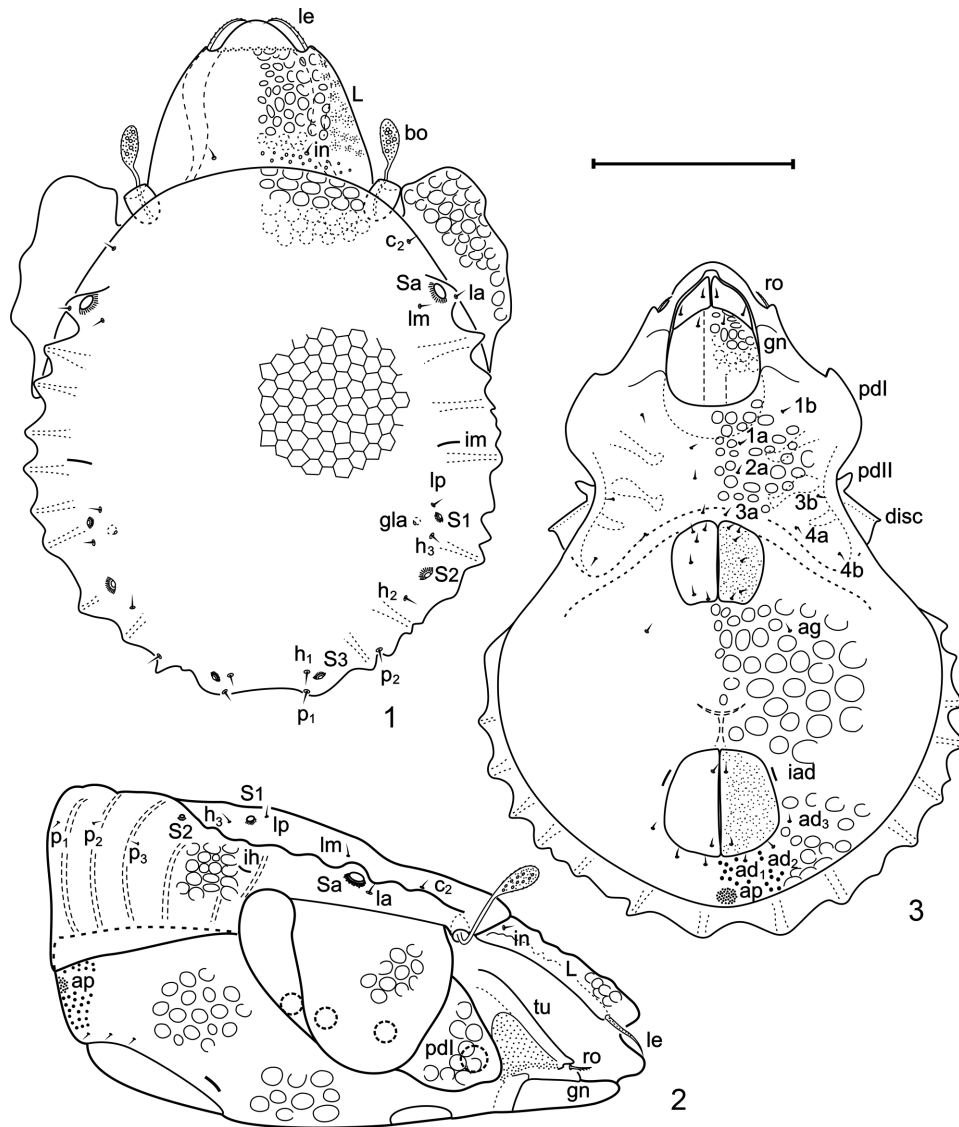
Ventral plate (Fig. 3) – Surface of genital and anal plates faintly foveate, ventral plate medially with large foveae, marginally with smaller foveae; region posterior to anal plates granulate; *iad* situated laterally of anal plates; *ad*₁₋₂ inserted posteriorly to anal plate, *ad*₃ inserted medio-laterally to anal plate, posterior to *iad*; post anal porose area small, round; preanal organ of medium length.

Legs (Figs 4–7) – Setal formula (trochanter to tarsus, famulus included): Leg I 1–5–3–4–20; Leg II 1–5–3–4–15; Leg III 2–2–1–3–15; Leg IV 1–2–2–3–12. Solenidial formula (genu to tarsus): Leg I 1–2–2; Leg II 1–1–2; Leg III 1–1–0; Leg IV 0–1–0.

Legs relatively short; dorsal integument of tarsi I, II and IV and tibiae I, II and IV thick; porose areas on femora I–IV narrow, situated postero-dorsally; porose areas on trochanters III and IV situated paraxially. Leg I: Sharply pointed curved dens present on dorsal side of tarsus proximal to tectal setae; antiaxial fastigial seta (*ft''*) very short and thin; famulus (ϵ) minute; distal end of genu antiaxially with dorsal and ventral cusps (indicated by arrows). Leg II: Tarsus short, broad; sharply pointed curved dens present on dorsal side of tarsus proximal to tectal setae; distal end of genu antiaxially with ventral cusp (indicated by arrow). Leg III: All setae smooth. Leg IV: Dorsal surface of tarsus and tibia uneven; tarsus antiaxially with diagonal tectum running from insertion of *ft''* to proximo-ventral base of segment; femur ventrally with wide flange; dorsal seta (*d*) on femur thick, roughened, all other setae smooth.

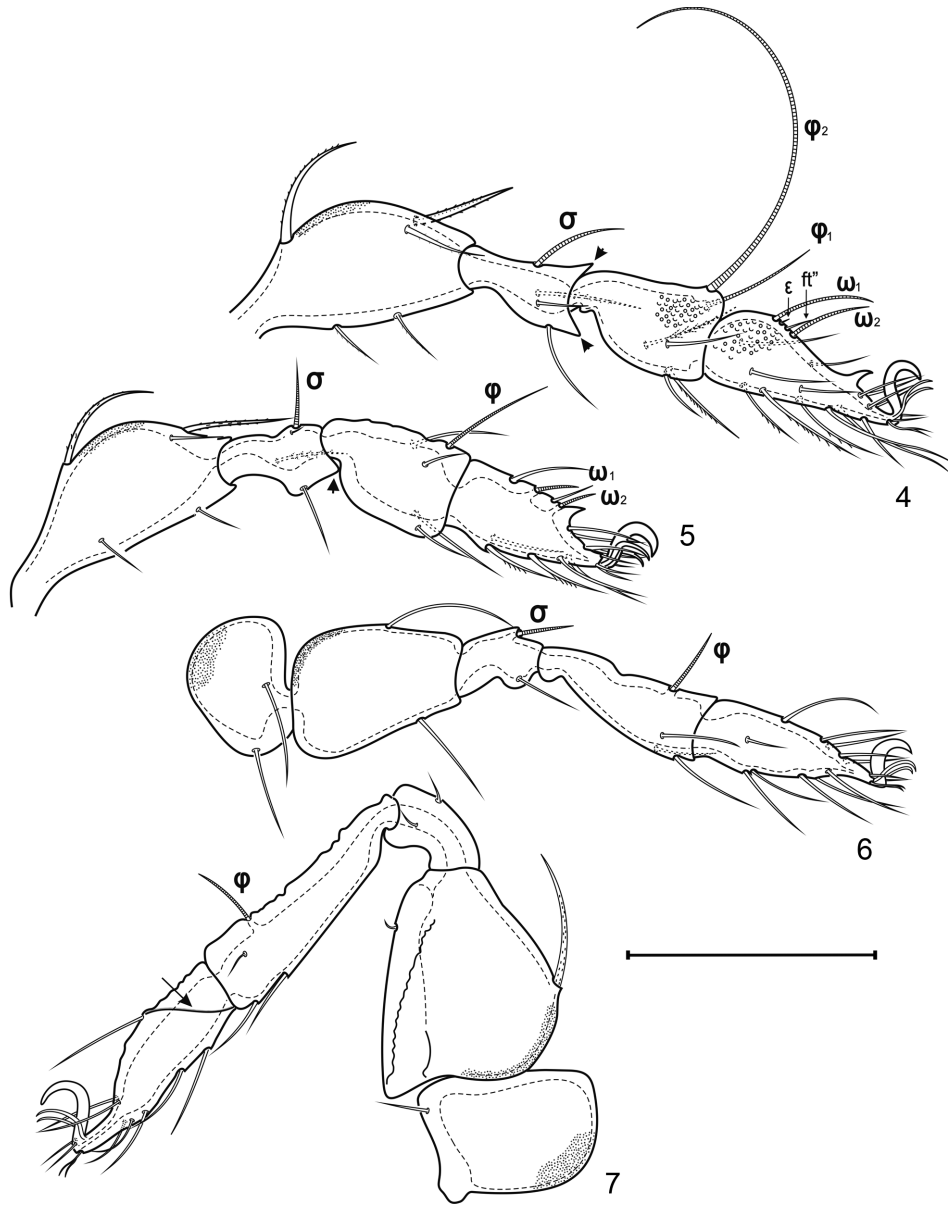
Material examined: Holotype (female) (NMB 2099.32.1) (Fig. 18) and nine paratypes (two females, seven males) (NMB 2099.32.2) – Winklespruit 30°07'S 30°50'E, 7 March 1982 (C. M. Engelbrecht), soil and plant debris from urban environment.

Additional material: Indian Ocean coastal belt – Soil and litter samples from temperate forests, riverine forests, thickets and urban environments collected at Mtunzini (Waterloo Estate) (28°59'S 31°44'E), Vernon Crookes Nature Reserve (30°16'S 30°35'E), Mapelane (28°22'S 32°23'E), St. Lucia (Mission Rocks) (28°15'S 32°30'E), Cape Vidal (28°6'S 32°33'E), Dukuduku (28°20'S 32°18'E), Charter's Creek (28°22'S 32°24'E), Oribi Gorge (30°41'S 30°16'E)



Figs 1–3. *Afroleius crassus* sp. n.: 1 = dorsal aspect, 2 = lateral aspect, 3 = ventral aspect. Scale bar 100 μ m.

Scottburgh (30°16'S 30°44'E), Umkomaas (30°14'S 30°46'E), Margate (30°2'S 30°22'E), Palm Beach (31°03'S 30°14'E). Northern mistbelt forests – Lydenburg (25°08'S 30°32'E).



Figs 4–7. *Afroleius crassus* sp. n.: 4 = leg I, right side, antiaxial aspect, 5 = leg II, right side, antiaxial aspect, 6 = leg III, left side, antiaxial aspect, 7 = leg IV, right side, antiaxial aspect. Diagonal tectum indicated. Scale bar 50 μ m.

Etymology – The species name refers to the coarse appearance of the notogastral integument.

Remarks – The uneven outline of the notogaster in dorsal view, the different patterns of the integument of the notogaster (reticulate) and the ventral plate (large foveae), and the wedge-shaped lateral profile distinguishes this species from its congeners. Although this species seems to be widely distributed in the eastern parts of the country, it is not abundant - on average about two *A. crassus* sp. n. specimens per sample. This species is restricted to the eastern, well vegetated regions of South Africa, where high rainfall occurs.

***Afroleius decurvatus* sp. n.**

(Fig 8–14)

Diagnosis – Dorsal and ventral surfaces reticulate; bothridial seta clavate, finely barbed, stalk sharply decurved proximally at about 1/3 of length of stalk, directed posteriorly; rostral seta short, finely barbed; lamellar seta long, smooth, curved medially, apices meeting in front of rostrum; interlamellar seta very short; notogastral setae minute; four pairs of thick-walled, tubular sacculi present; tarsi I and II each with large, curved dorsal dens; genu I and II each with large antiaxial distal cusp.

Dimensions – Holotype (female): Length 314 μm , width 239 μm . Paratypes: Females (n = 8) Length 312 μm (range 306–322 μm); width 222 μm (range 211–230 μm). Males (n = 4) Length 293 μm (range 282–304 μm); width 206 μm (range 196–213 μm).

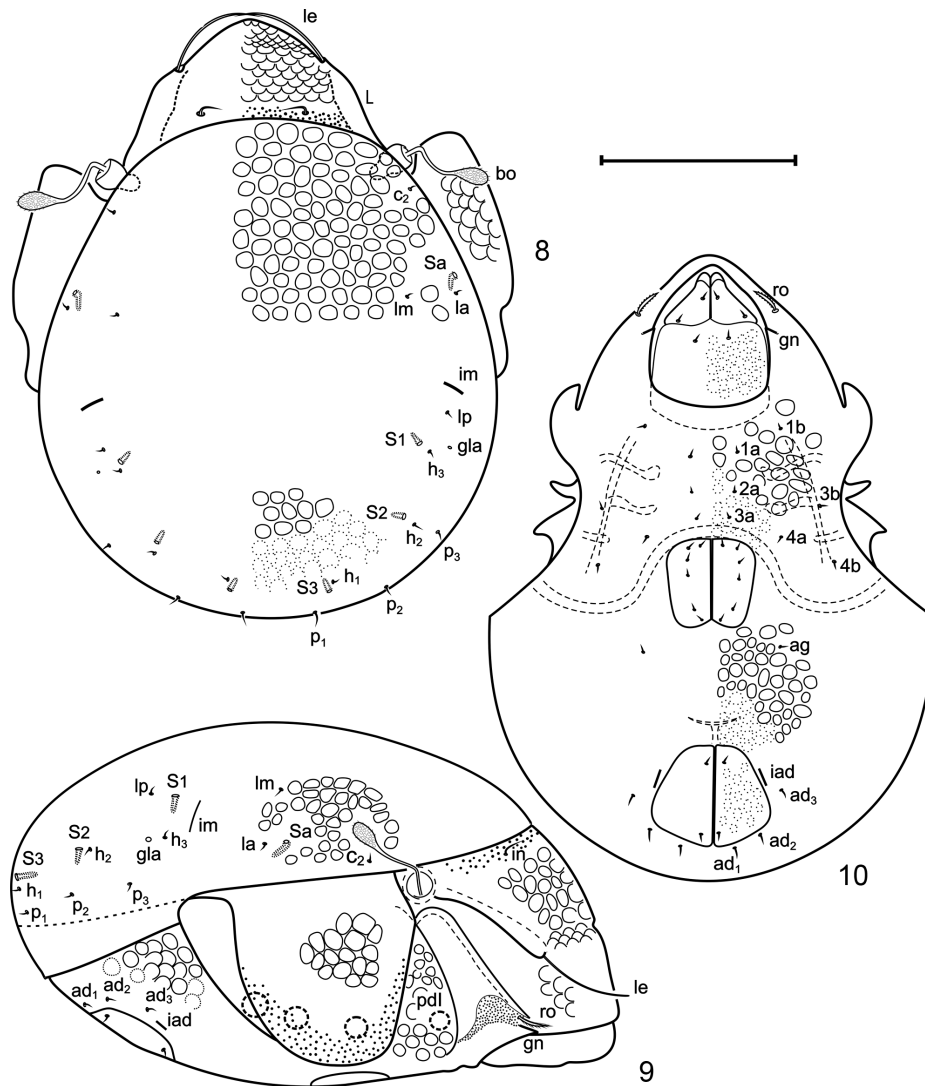
Prodorsum (Figs 8 & 9) – Rostrum rounded in dorsal view; prodorsal profile in lateral view with slight indentation at level of lamellar apices; prodorsal surface reticulate; band of small tubercles present anterior of dorsosejugal furrow, up to level of interlamellar setae; lamella wide, extending slightly over lateral margin of prodorsum; rostral seta short (~ 19 μm), barbed, slightly phylliform, visible ventrally and laterally, inserted below apex of tutorium; lamellar seta long (~ 53 μm), smooth, curving medially, apices overlapping slightly in front of rostrum; interlamellar seta very short (~ 13 μm), smooth, curving medially; head of bothridial seta clavate, finely barbed; stalk long, sharply decurved proximally at about 1/3 of length of stalk, directed posteriorly, total length from where stalk emerges from bothridium to tip of bothridial head ~ 52 μm ; bothridium ventrally with overlapping slit.

Notogaster (Figs 8 & 9) – Notogastral setae minute (~ 5 μm), all setae more or less the same length, smooth; surface reticulate, forming large irregular circles; octotaxic sacculi tubular, thick-walled, openings wide; opisthosomal gland very small, difficult to detect, situated close to S1; pteromorphae large, distal edge without reticulation but surface irregular; posterior notogastral tectum wide.

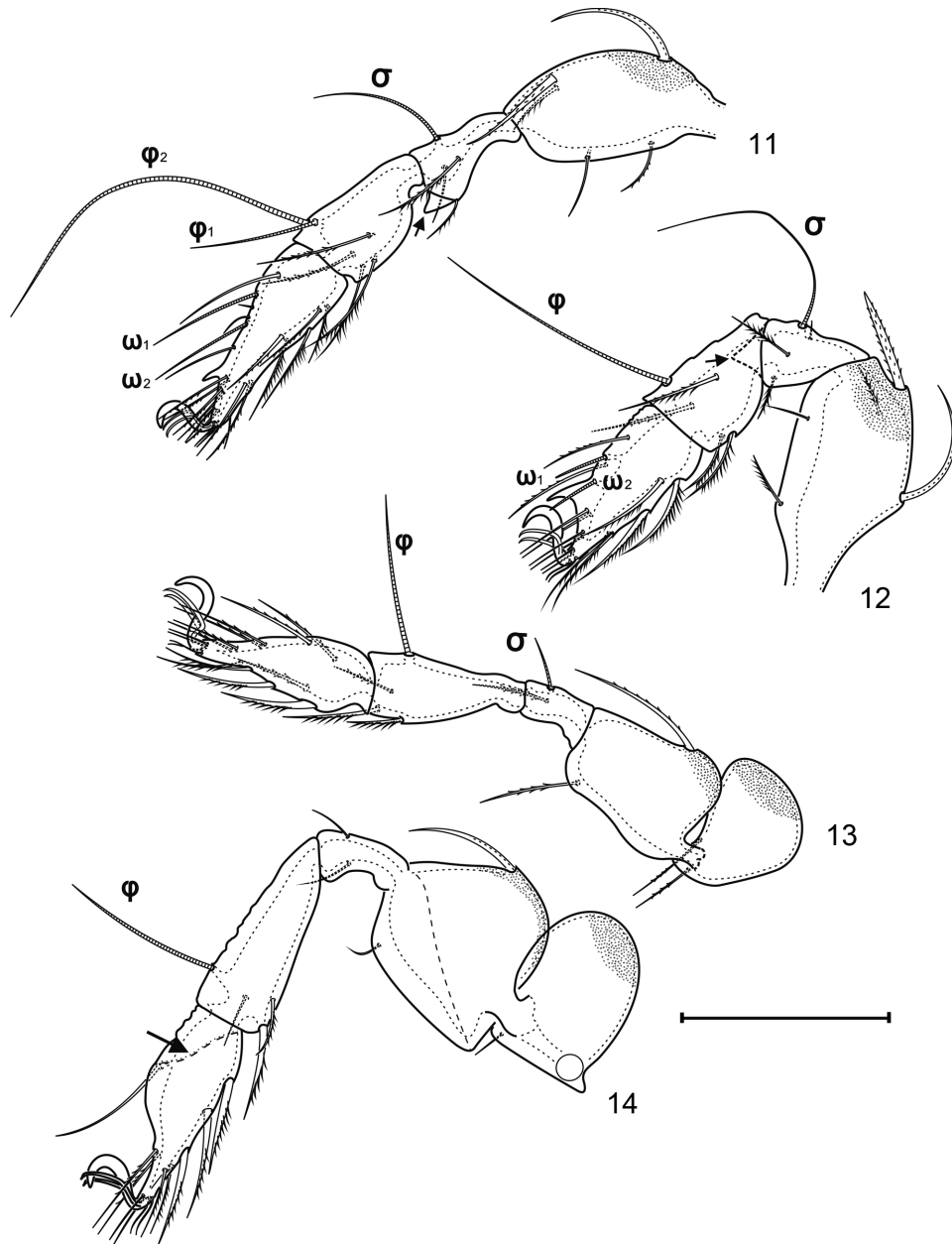
Podosoma and gnathosoma (Figs 9 & 10) – Surface of mentum faintly patterned; axillary sacculi short; genal tooth short, broad; epimeral setae minute, seta *1c* absent; epimeral surface reticulate; longitudinal line present on lateral sides of epimeres stretching more or less from *1b* to *4b*; tutorium narrow, anterior surface below *tu* with small tubercles;

rostral seta inserted below apex of tutorium; pedotectum I large, wide, surface reticulate; pedotectum II small.

Ventral plate (Fig. 10) – Surface of genital plate faintly patterned, surface of anal plate faintly reticulate; ventral plate reticulate; *iad* situated laterally of anal plates; *ad*₁₋₂ inserted close to each other posteriorly to anal plate, *ad*₃ inserted medio-laterally to anal plate, posterior to *iad*; post anal porose area absent; preanal organ short.



Figs 8–10. *Afroleius decurvatus* sp. n.: 8 = dorsal aspect, 9 = lateral aspect, 10 = ventral aspect. Scale bar 100 μ m.



Figs 11–14. *Afroleius decurvatus* sp. n.: 11 = leg I, right side, paraxial aspect, 12 = leg II, right side, paraxial aspect, 13 = left side, paraxial aspect, 14 = left side, paraxial aspect. Diagonal tectum indicated. Scale bar 50 μ m.

Legs (Figs 11–14) – Setal formula (trochanter to tarsus, famulus included): Leg I 1–5–3–4–20; Leg II 1–5–3–4–15; Leg III 2–2–1–3–15; Leg IV 1–2–2–3–12; Solenidial formula (genu to tarsus): Leg I 1–2–2; Leg II 1–1–2; Leg III 1–1–0; Leg IV 0–1–0.

Legs relatively short; dorsal integument of tarsi I, II and IV and tibiae I, II and IV thick; porose areas on femora I and II large; porose areas on femora III and IV narrow, situated dorsally; porose areas on trochanters III and IV large. Leg I: Large, curved dens present on dorsal side of tarsus, situated proximal to tectal setae; antiaxial fastigial seta (ft'') short, thin; famulus (ϵ) minute; distal end of genu antiaxially with ventral cusp (indicated by arrow). Leg II: Tarsus short, broad; large, curved dens present on dorsal side of tarsus, situated proximal to tectal setae; distal end of genu antiaxially with large cusp (indicated by arrow). Leg III: All setae (except (p) and (u)) barbed. Leg IV: Dorsal surface of tarsus and tibia uneven; diagonal tectum antiaxially present on tarsus running dorsally from insertion of ft'' to proximo-ventral base of segment; femur ventrally with wide flange; dorsal seta (d) on femur thick, roughened.

Material examined – Holotype (female) (NMB 1735.10.1) (Fig. 18) and 12 paratypes (four males, eight females) (NMB 1735.10.2) – Frankfort, eastern Free State 27°17'S 28°30'E, 18 January 1982 (C. M. Engelbrecht), soil and plant debris associated with shrubs.

Additional material: Grassland biome – soil and litter samples from natural grassland, soil and litter associated with shrubs and urban environments collected at Golden Gate (28°29'S 28°38'E), Fouriesburg (28°37'S 28°12'E), Kroonstad (27°39'S 27°14'E), Potchefstroom (26°42'S 27°05'E), Northam (24°57'S 27°16'E), Rosendal (28°30'S 27°55'E), Reitz (27°48'S 28°25'E), Heilbron (27°17'S 27°58'E), Clarens (28°31'S 28°25'E), Weenen (28°51'S 30°03'E). Northern Mistbelt Forests – forest litter collected at Montrose (25°27'S 30°42'E), Sabie (25°04'S 30°47'E). Kalahari Thornveld - litter under *Rhus lancea* Warrenton (28°06'S 24°50'E). Indian Ocean coastal belt – litter from coastal dune forests – Cape Vidal (28°07'S 32°33'E), St Lucia (28°07'S 32°33'E).

Etymology – The species name refers to the sharply decurved sensillar stalk.

Remarks – This species is superficially similar to *Afoleius simplex* Mahunka, 1984, but the thick-walled, tubular sacculi and sharply decurved sensillar stalk are characteristic of this species and distinguish it from congeners. The absence of the post anal porose area is probably a secondary loss. This species seems to be ecologically tolerant as it has been collected from diverse habitats such as Kalahari Thornveld in the arid western part of the country, to coastal dune forests in the moist eastern part of the country.

***Afoleius deformatoides* sp. n.**

(Figs 15–17)

Diagnosis – Dorsal surface and ventral plate foveate; epimeral surface partly foveate; octotaxic system consisting of porose areas; in lateral view notogaster indented, ventral plate convex; bothridial seta clavate, stalk short; bothridial opening wide, directed anteriorly; rostral seta minute; lamellar seta

long, smooth, curving medially; interlamellar seta minute; notogastral setae very short; tarsus I without dorsal dens; dorsal dens on tarsus II reduced to small point.

Dimensions – Holotype (female): Length 374 μm , width 279 μm . Paratypes: Females (n = 2): Length 363 μm (362–364 μm), width 281 μm (279–282 μm). Males (n = 2): Length 331 μm (325–338 μm), width 247 μm (238–256 μm).

Prodorsum (Figs 15 & 16) – Rostrum rounded in dorsal view; prodorsal surface foveate; lamella wide, extending over lateral margin of prodorsum, surface finely punctate; rostral seta (ventrally visible) minute (~ 5 μm), inserted at anterior apex of tutorium; lamellar seta long (~ 66 μm), smooth, curved medially; interlamellar seta minute (~ 8 μm); bothridium large, opening wide, directed anteriorly; head of bothridial seta clavate, granular, surface smooth; prodorsal profile in lateral view declining sharply from lamellar apex towards rostrum, with narrow ridges from lamellar apex towards rostral seta (see remarks).

Notogaster (Figs 15 & 16) – Ten pairs of minute notogastral setae (~ 8 μm) present; entire surface foveate; in dorsal view anteriorly with high elevation, medially slightly elevated, laterally with deep depression in region of *im*; postero-lateral margin slightly undulate; four pairs of porose areas, canals often clearly visible; porose areas A1 and A2 situated close together, near seta h_3 ; opisthosomal gland *gla* small.

Podosoma and gnathosoma (Figs 16 & 17) – Surface of mentum with fine ridges and punctae; genal notch absent but small ridge present extending from genal border towards anterior end of tutorium; axillary sacculle of medium length, epimeral setae minute; epimeral surface anteriorly foveate, posteriorly finely punctate; epimeral setae *1c*, *3c* and *4c* absent; tutorium narrow; anterior surface below tutorium finely granulate; pedotectum I large, wide, surface foveate, in ventral view with deep notch at point of fusion with epimere I; pedotectum II small.

Ventral plate (Fig. 17) – Ventral plate highly convex; surface of genital plates striated, anal plates faintly foveate, ventral plate with large foveae; aggenital setae present; preanal organ long, narrow; post anal porose area absent.

Legs – Setal formula (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 0–2–2–3–12; Solenidial formula (genu to tarsus): Leg I 1–2–2; Leg II 1–1–2; Leg III 1–1–0; Leg IV 0–0–0.

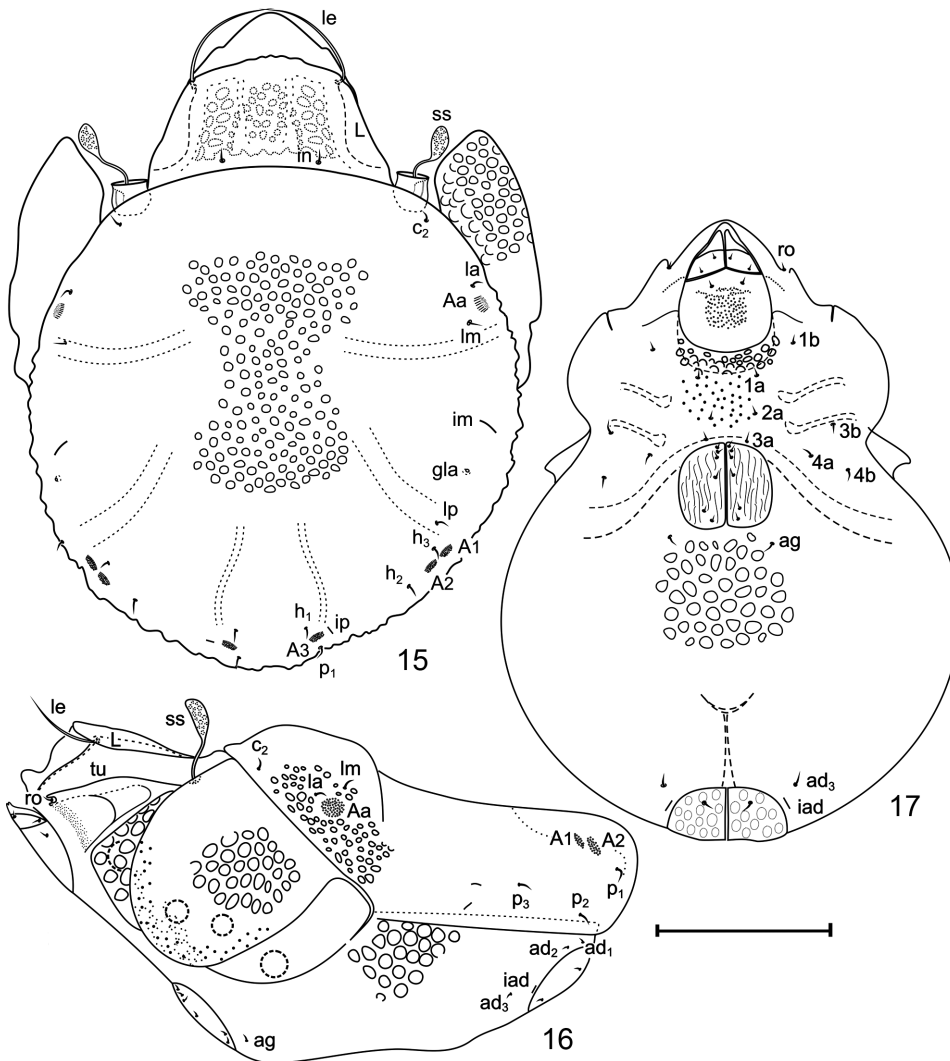
Legs similar to *A. deformis* Mahunka, 1984 (see COETZEE 2007); dorsal integument of tarsi I, II and IV and tibiae I, II and IV thick. Leg I: Antiaxial fastigial seta short and thin; famulus very short; distal end of genu antiaxially with dorsal and ventral cusps. Leg II: Tarsus with small point on dorsal side proximal to tectal setae; distal end of genu antiaxially with dorsal and ventral cusps. Leg III: Less sclerotized than other legs. Leg IV: Dorsal surface of tarsus and tibia slightly uneven; tarsus antiaxially with diagonal tectum running from *ft''* to proximo-ventral base of segment; femur ventrally with wide flange; Solenidion ϕ on tibia IV absent, solenidial canal present.

The limited number of specimens available for study prohibited dissection of material for detailed sketches of legs.

Material examined – The holotype (female) (NMB 2905.4) (Fig. 18) and four paratypes (two females, two males) (NMB 2905.4, NMB 2904.4, 2902.5) – Royal Natal National Park 28°40'S 28°55'E, 14 December 1982 (C. M. Engelbrecht), soil and litter in forested gorges on eastern slopes of the northern Drakensberg mountain range.

Etymology – The suffix –oides meaning “like” or “similar to” refers to the superficial resemblance of the new species to *A. deformis*.

Remarks – This species is very similar to the type species of the genus, *Afroleius deformis* Mahunka, 1984 in the unusual indented shape of the notogaster and convex shape of the ventral plate. It differs from *A. deformis* in having porose areas instead of the unusually shaped sacculi present in *A.*



Figs 15–17. *Afroleius deformatoides* sp. n.: 15 = dorsal aspect, 16 = lateral aspect, 17 = ventral aspect. Scale bar μm .

deformis, central part of the notogaster foveate (smooth in *A. deformis*) and the presence of aggenital setae (absent in *A. deformis*). The ridges extending from the lamellar apices towards the rostral seta are in my view not homologous to prolamellae, but may be the result of the unusual shape of the prodorsum. These ridges are also present in *A. deformis*. The new species is also smaller than *A. deformis*. The average length and width of *A. deformis* is $392\ \mu\text{m} \times 323\ \mu\text{m}$, while in the new species it is $353\ \mu\text{m} \times 271\ \mu\text{m}$. *A. deformis* is an inhabitant of lowlying forested areas in the south and east of the country, while *A. deformatoides* sp. n. has so far only been found in the high altitude forested gorges of the Drakensberg mountain range.

DISCUSSION

These are the first additional species in the genus *Afroleius*. COETZEE (2007) redescribed the three species of MAHUNKA (1984), but the presence of the axillary sacculi and notogastral tectum was not recorded at the time.

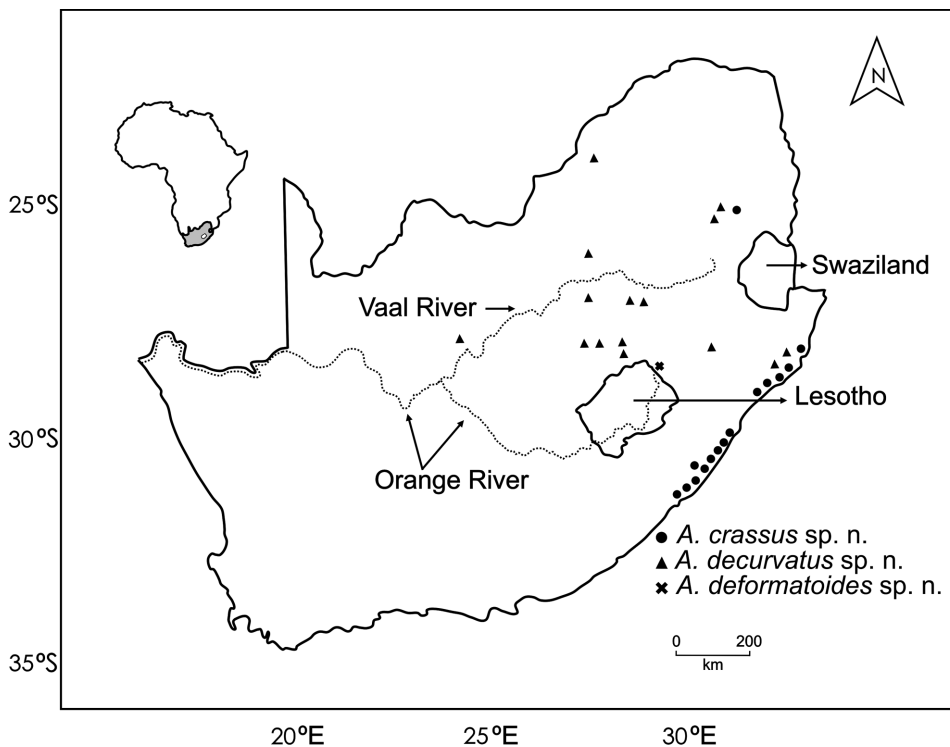


Fig. 18. Known distribution of *A. crassus* sp. n. (circle); *A. decurvatus* sp. n. (triangle) and *A. deformatoides* sp. n. (cross) in South Africa.

Therefore, the family relationship was not questioned. Since immatures are still unknown, their discovery in future may bring further clarity.

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REFERENCES

- BALOGH, J. & BALOGH, P. (1992) *The oribatid mites genera of the world*. Vol. 1. Hungarian Natural History Museum, Budapest, 263 pp.
- COETZEE, L. (2007) The genus *Afroleius* Mahunka (Acari, Oribatida, Haplozetidae). 1. Redescriptions of *A. deformis*, *A. minor* and *A. simplex*. *Navorsinge van die Nasionale Museum, Bloemfontein* **23**: 101–118.
- COETZEE, L. & TIEDT, L. R. (2013) Overview of the genus *Afroleius* Mahunka, 1984 (Acari, Oribatida). *Acarologia* **53**(2): 163–173.
- GRANDJEAN, F. (1936) Les Oribates de Jean Frédéric Hermann et de son père (Arachn. Acar.). *Annales de la Société entomologique de France* **105**: 27–110.
- MAHUNKA, S. (1984) Oribatids of the eastern part of the Ethiopian Region (Acari) VI. *Acta Zoologica Hungarica* **30**: 393–444.
- NORTON, R. A., ALBERTI, G., WEIGMANN, G. & WOAS, S. (1997) Porose integumental organs of oribatid mites (Acari, Oribatida). 1. Overview of types and distribution. *Zoologica* **48**: 1–31.
- NORTON, R. A. & BEHAN-PELLETIER, V. M. (1986) Systematic relationships of *Propelops*, with a modification of family-group taxa in Phenopeloidea (Acari: Oribatida). *Canadian Journal of Zoology* **64**: 2370–2383.
- NORTON, R. A. & BEHAN-PELLETIER, V. M. (2009) Suborder Oribatida. Pp. 430–564. In: KRANTZ G. W. & WALTER D. E. (eds): *A manual of acarology*. 3rd ed. Texas Tech University Press, Lubbock.
- SUBÍAS, L. S. (2004) Listado sistemático, sinonímico y biogeográfico de los Ácaros oribátidos (Acariformes, Oribatida) del mundo (1758–2002). *Graellsia* **60**: 3–305.
- SUBÍAS, L. S. (2012) Listado sistemático, sinonímico y biogeográfico de los Ácaros oribátidos (Acariformes, Oribatida) del mundo (1758–2002). Available from: <http://www.ucm.es/info/zoo/Artropodos/Catalogo.pdf> (accessed June 2012).

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