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**Article**

# Revision of the African chigger mite genus *Hyracarus* (Acariformes: Trombiculidae: Leeuwenhoekiinae)

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**ABSTRACT**

Chigger mite genus *Hyracarus* Lawrence, 1949, endemic to Tropical Africa, was revised based on the examination of type series, new materials, unpublished archive sources, and the literature. Five new species were described: *Hyracarus bethuliensis* **sp. nov.**, *H. ethiopicus* **sp. nov.**, *H. sabiensis* **sp. nov.**, *H. aryanicki* **sp. nov.**, and *H. limpopoensis* **sp. nov.** Three new subjective synonyms were established: *Hyracarus* [= *Mastalacarus* Goff & Lukoschus, 1983, **syn. nov.**; = *Tateracarus* Goff, 1983, **syn. nov.**] and *Hyracarus thallomyia* (Radford, 1947) [= *Acomatacarus lawrencei* Radford, 1948, **syn. nov.**]. Six new combinations were proposed: *Hyracarus foliosetosus* (Stekolnikov & Matthee, 2022) **comb. nov.**, *H. kimberleyensis* (Stekolnikov & Matthee, 2022) **comb. nov.**, *H. quadrisetosus* (Goff, 1983) **comb. nov.** (originally in the genus *Tateracarus*), *H. namibiensis* (Goff & Lukoschus, 1983) **comb. nov.** (originally in the genus *Mastalacarus*), *H. thallomyia* (Radford, 1947) **comb. nov.**, and *H. mutabilis* (Vercammen-Grandjean & Brennan, 1957) **comb. nov.** (originally in the genus *Acomatacarus* Ewing, 1942). Currently, the genus includes 16 valid species known from South Africa (10 species), Namibia (2), Angola (1), Democratic Republic of the Congo (1), Uganda (1), and Ethiopia (1). Its species parasitize murid rodents (7 records), hyraxes (3), elephant shrews (2), dormice (1), shrews (1), bats (1), and skinks (1).

**KEYWORDS:** Afrotropical realm, chiggers, new combinations, new species, new synonyms, South Africa, taxonomy.

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## INTRODUCTION

The subfamily Leeuwenhoekiinae Womersley, 1944 is the worst-studied group of chigger mites on the African continent. None of its genera was ever revised, except for an endemic genus *Austracarus* Lawrence, 1949 (Stekolnikov 2022). The genus *Hyracarus* Lawrence, 1949, which includes several species known from rodents, hyraxes, and lizards of South Africa, Angola, and Democratic Republic of the Congo (Stekolnikov 2018), is currently the most problematic, due to incomplete diagnoses of this genus and many of its species.

Lawrence (1949) defined *Hyracarus* as a genus related to *Acomatacarus* Ewing, 1942 but differing in the absence of tracheae and stigmata and in having only a ventral row of teeth on the

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cheliceral blade, but not dorsal. The genus originally included three species, *H. typicus* Lawrence, 1949 (type species), *H. longipilosus* Lawrence, 1949, and *H. natalensis* Lawrence, 1949. Wharton and Fuller (1952) included *Hyracarus* in *Acomatacarus*, as a subgenus, and transferred *Acomatacarus lawrencei* Radford, 1948 to it. Later, Vercammen-Grandjean (1955, 1957) described two new species in this subgenus, *A.* (*H.*) *claviglis* Vercammen-Grandjean, 1955 and *A.* (*H.*) *lemniscomyia* Vercammen-Grandjean, 1957. These two descriptions were complete, but all other *Hyracarus* species were described very briefly. As a result, this taxon has no satisfactory diagnosis until the present. In particular, the chaetotaxy of legs and palps was almost unknown for *H. typicus* and all other species described by Lawrence and Radford.

In their preliminary note to the phylogeny of trombiculids, Vercammen-Grandjean *et al.* (1973) mentioned *Hyracarus* as a genus divided by two subgenera – the nominative, and a new one denoted by the abbreviation "*Hex*.". This new subgenus included *H. natalensis*; the authors gave the formulae of unspecialized leg setae for this species and stated that the presence of nine setae on leg I tibia is characteristic of *Hyracarus*. Unfortunately, their plan to publish the complete revision entitled "The Chigger Mites of the World" was not realized: they published only the parts on the genus *Guntherana* (Vercammen-Grandjean and Langston 1971) and the *Leptotrombidium* generic complex (Vercammen -Grandjean and Langston 1976). The drafts of multiple descriptions and redescriptions of species from other genera remained unpublished; they were preserved in the personal archive of Vercammen-Grandjean (Stekolnikov 2019).

Later two genera and species similar to *Hyracarus* were described from Namibia – *Mastalacarus namibiensis* Goff & Lukoschus, 1983 and *Tateracarus quadrisetosus* Goff, 1983. Both genera possessed the known traits of *Hyracarus* – the absence of trachea and stigmata and the presence of only a ventral row of teeth on the cheliceral blade. However, the authors did not compare these genera with *Hyracarus*. Stevens *et al.* (2022) recorded three species of *Hyracarus* in their material collected in South Africa – *H. longipilosus*, *H.* sp., and *H.* aff. *namibiensis*. Thus, they implicitly proposed the synonymy of *Mastalacarus* with *Hyracarus*.

We prepared our revision by examining new materials, types, and, finally, Vercammen-Grandjean's archive. In the present paper, we propose the complete diagnosis of *Hyracarus*, redescriptions of partially described species, descriptions of new species, and a key to species.

## MATERIAL AND METHODS

*List of depositories*

BPBM = Bernice Pauahi Bishop Museum, Honolulu, Hawaii, US (chigger collection currently deposited in USNM); IRSNB = Institut royal des Sciences naturelles de Belgique, Brussels, Belgium; MHNG = Muséum d'histoire naturelle, Geneva, Switzerland; MNHN = Muséum national d'Histoire naturelle, Paris, France; MRAC = Musée royal de l'Afrique Centrale, Tervuren, Belgium; NHM = The Natural History Museum, London, UK; NMSA (prefix for museum labels NM) = KwaZulu-Natal Museum (formerly Natal Museum of South Africa), Pietermaritzburg, KwaZulu-Natal, South Africa; SAIMR = National Health Laboratory Service (formerly South African Institute for Medical Research), Johannesburg, South Africa; SAM = South Australian Museum, Adelaide, South Australia, Australia; RUN = Radboud Universiteit Nijmegen (formerly Katholieke Universiteit Nijmegen), Nijmegen, Netherlands; USNM = National Museum of Natural History (formerly United States National Museum), Washington, DC, US; ZIN = Zoological Institute of the Russian Academy of Sciences, Saint Petersburg, Russia.

*Collection of new materials*

Specimens of *Hyracarus ethiopicus* **sp. nov.**, originally identified as *Mastalacarus namibiensis*, were collected in Ethiopia, Arsi zone, Asella town, as described elsewhere (Antonovskaia *et al.* 2023). The materials on *H. bethuliensis* **sp. nov.** were originally identified as *H.* aff. *namibiensis*; collection

methods were described by Stevens *et al.* (2022). Material on *H. sabiensis* **sp. nov.** was collected by SM close to Skukuza camp in Kruger National Park, Mpumalanga Province, South Africa by the same methods. Collections were approved by SANPARKS permit number SS1336. Materials on *H. aryanicki* **sp. nov.** and *H. limpopoensis* **sp. nov.** were collected by AH from dead animals donated to him by the members of a research team studied mammal ecology in the Lajuma Research Centre, Limpopo Province, South Africa.

*Materials from museum collections*

Microscope slides from the collection of NMSA were examined by AAS on loan, as described elsewhere (Stekolnikov 2024a). New materials currently deposited in ZIN were examined by the same methods. Microscope slides from the collection of NHM were examined by AAS twice. In 2017, measurements, drawings of idiosomal setae arrangement, and microphotographs were taken (Stekolnikov 2024a). Because the microphotographs were prepared by automatic merging serial shots, they could contain some artefacts, such as the visibility of humeroventral setae on the dorsal surface of idiosoma (Fig. 13A). All serial shots (at different focal depths) were saved for the microphotographs of gnathosoma of the *Acomatacarus lawrencei* and *A. thallomyia* Radford, 1947 holotypes; this allowed detailed examination of the chaetotaxy of palps in these specimens. In 2019, drawings of scutum, gnathosoma, and legs were prepared for one paratype of *H. typicus* on a Zeiss Axiophot microscope (Carl Zeiss AG, Oberkochen, Germany) with differential interference contrast (DIC). Microscope slides from the collection of MNHN were examined in 2019 on a Zeiss Axioskop microscope (Carl Zeiss AG, Oberkochen, Germany) with DIC, using an ocular micrometre with prior calibration by a stage micrometer for measurements and a drawing tube for drawings.

The planned loan of type specimens deposited in MHNG was not approved by the administration; therefore, the diagnoses of *H. claviglis*, *H. lemniscomyia*, and *H. mutabilis* (Vercammen-Grandjean & Brennan, 1957) **comb. nov.** are given based on literature. It was also not possible to examine any material of *Mastalacarus namibiensis*. We do not repeat results of recently published revision of the genus *Tateracarus* Goff, 1983 (Stekolnikov and Matthee 2022).

*Unpublished sources*

We used two unpublished sources in our work: the personal archive of P.H. Vercammen-Grandjean deposited in MHNG, together with his personal collection (further – V-G Archive), and the handwritten inventory of this collection, prepared by Vercammen-Grandjean (further – V-G Inventory). V-G Archive included work-sheets with the results of microscope examination (brief descriptions, measurements and pencil drawings) of chigger mites (Stekolnikov 2019). The materials on the species of Leeuwenhoekiinae were photographed by AAS during his visit to MHNG in October 2023 with the use of a Canon EOS 600D camera (Canon Inc., Tokyo, Japan). The drawings of scuta for two species (Fig. 2A, B) were prepared by outlining these photographs with the use of a Wacom Cintiq 22 interactive pen display (Wacom Co., Ltd., Kazo, Saitama, Japan) and Adobe Photoshop CC 2014 software (Adobe Inc., San Jose, CA, US).

Photocopies of V-G Inventory were published in the catalogue of holotypes of chigger mites in the personal collection of Vercammen-Grandjean (Stekolnikov 2019). However, the species names were sometimes hard to read in this handwritten document. AAS recognized and typed the text of Inventory in MHNG, checking the names by slide labels in the collection. The printed copy of this text was placed in the collection; the electronic copy is available in MHNG or by a personal request from AAS.

*Terminology*

We use the specific terminology, abbreviations, and diagnostic formulas traditionally used in the taxonomy of chigger mites and summarized by Goff *et al.* (1982), with a few additions: $D_{min}$ – length of the shortest dorsal idiosomal seta; $D_{max}$ – length of the longest dorsal idiosomal seta; Hv – number

of humeroventral setae (setae situated on the venral side of idiosoma laterally, between coxae II and III); NL – length of nasus; NW – width of nasus; TaIIIL – length of leg III tarsus; TaIIIW – width of leg III tarsus; $V_{min}$ – length of the shortest ventral idiosomal seta; $V_{max}$ – length of the longest ventral idiosomal seta.

## RESULTS

Species are arranged by the number of setae on the palpal tarsus (from 4B to 7B). Detailing of drawings may be different because of the unequal quality of microscope slides.

### Genus *Hyracarus* Lawrence, 1949

*Hyracarus* Lawrence, 1949: 420; Vercammen-Grandjean *et al.* 1973: 55; Stekolnikov 2018: 44.
*Acomatacarus* (*Hyracarus*): Wharton and Fuller 1952: 101; Audy *et al.* 1961: 177; Vercammen-Grandjean 1955: 183, 1957: 15.
*Mastalacarus* Goff & Lukoschus, 1983: 2, **syn. nov.**; Stekolnikov 2018: 46.
*Tateracarus* Goff, 1983: 2, **syn. nov.**; Stekolnikov 2018: 48; Stekolnikov and Matthee 2022: 256.

**Type species:** *Hyracarus typicus* Lawrence, 1949, by original designation.

*Diagnosis*

SIF = (4–7)B-B-3-2111.(0–5)(0–3)(0–2)(0–2); fsp = 6.6.6; fSt = 0.2; fCx = 2.1.1.

**Idiosoma –** Eyes 2 + 2, on ocular plate; 1st row of dorsal idiosomal setae (C) double or triple, two marginal setae of its posterior sub-row longest and shifted anteriad (humeral setae); two or four marginal setae of 2nd row (D) shifted anteriad (humeral setae); humeroventral setae present or absent; two sternal setae between coxae III; trachea absent; stigmata elongated, more or less reduced.

**Gnathosoma –** Cheliceral blade with ventrolateral row of denticles and one dorsal tooth; galeal setae ciliated; palpal claw with three prongs; palpal setae ciliated or branched, lateral or ventral palpal tibial seta sometimes nude; palpal tarsus with 4–7 unspecialized setae and tarsala ($\omega$).

**Scutum –** Nearly pentagonal, trapezoidal or rectangular; its posterior margin from straight to angulate; nasus frequently expanded medially; 2 AM, 2 AL, and 2 PL setae; sensilla flagelliform, nude or having few small cilia.

**Legs –** All six-segmented (with undivided femur), with one pair of claws and claw-like empodium, onychotriches absent. Specialized setae: Leg I: 2 genualae ($\sigma$), microgenuala ($\kappa$), 2 tibialae ($\varphi$) in tandem, microtibiala ($\kappa$) near distal tibiala, tarsala ($\omega$), famulus ($\varepsilon$) distal to tarsala, subterminala ($\zeta$), branched or nude parasubterminala ($z$), pretarsala ($\zeta$). Leg II: genuala ($\sigma$), microgenuala ($\kappa$) distal to genuala, 2 tibialae ($\varphi$) in tandem, tarsala ($\omega$), famulus ($\varepsilon$) behind, rarely at level of tarsala, pretarsala ($\zeta$). Leg III: genuala ($\sigma$), tibiala ($\varphi$). Unspecialized setae (legs I, II, III): coxae 2, 1, 1; trochanters 1, 1, 1; femora 6, 6, 5 (rarely 6, 5, 5); genua 4, 4, 4; tibiae 9, 6, 6 or 8, 6, 6, in one species 9, 5, 6; tarsi 22–26, 16–17, 15–17. In some species some dorsal setae on segments of all legs (or only on legs I and III) nude or having 1–2 small cilia.

*Remarks*

*Hyracarus* is similar to *Odontacarus* Ewing, 1929, but differs in its unique armament of the cheliceral blade, with one dorsal tooth and ventrolateral row of denticles, vs. cheliceral blade with dorsal and ventral rows of teeth; in the absence of tracheae; absence of onychotriches; presence of 4–7 unspecialized setae on the palpal tarsus vs. always 7; in having nude sensilla in the most part of species (vs. branched or ciliated); in formula of leg tibiae 9, 6, 6 in a part of species, vs. always 8, 6, 6; and in formula of leg femora 6, 6, 5 (rarely 6, 5, 5) vs. mostly 6, 5, 4 (Vercammen-Grandjean *et al.* 1973; Kudryashova 1998).

Goff and Lukoschus (1983) discriminated *Mastalacarus* from other genera of Leeuwenhoekiinae by the presence of multiple mastisetae on leg III femur, genu, tibia, and tarsus; by the absence of spiracles (stigmata) and tracheae; by the presence of five unspecialized setae on palpal tarsus; and by the two-pronged palpal claw (odontus) vs. three-pronged. According to our results, all species of *Hyracarus* have no tracheae; many species (including the type species, *H. typicus*) have five setae on palpal tarsus; and the majority of species have multiple nude setae on the segments of leg III. In addition, the armament of cheliceral blade in *Mastalacarus* is typical for *Hyracarus* and both these genera have no onychotriches. The two-pronged palpal claw could be recorded in *Mastalacarus* because of an examinations error, since the third prong (accessory, dorso-medial) can be unclearly visible on the background of the main prong. Thus, we synonymize here *Mastalacarus* with *Hyracarus*.

*Tateracarus* also has the characters of *Hyracarus*, such as the absence of tracheae and onychotriches and the specific shape of cheliceral blade. Two of its species also have multiple nude setae on the segments of leg III (Stekolnikov and Matthee 2022). *Tateracarus* can be discriminated from *Hyracarus* by the presence of four unspecialized setae on palpal tarsus. However, taking into account the variation of this character within *Hyracarus* (from five to seven setae) and the fact that this variation does not correlate with any other trait, we do not see a reason to keep *Tateracarus* as a separate genus, although it can constitute a natural (monophyletic) group of species. Therefore, we synonymize *Tateracarus* with *Hyracarus*.

### ***Hyracarus foliosetosus* (Stekolnikov & Matthee, 2022) comb. nov.**

*Tateracarus foliosetosus* Stekolnikov & Matthee, 2022: 260, Figs. 5–7; Stevens *et al.* 2022: 1232.

*Diagnosis (after Stekolnikov and Matthee 2022)*

SIF = 4B-B-3-2111.(2–3)322; fPp = B/B/BN(b)B; fD = [4-8]-10-14-11+14; DS = 61, V = 45, Hv = 0, NDV = 106; Ip = 680–724; scutum nearly trapezoidal, with straight posterior margin; nasus slightly expanded in medial part; sensillary bases anterior to level of PLs by 3–5 μm; PL > AL > AM; AM and AL slightly expanded, heavily barbed; PL and dorsal idiosomal setae expanded, foliate; sensilla nude; cheliceral blade with dorsal tooth and row of six ventral denticles; parasubterminala (*z*) branched. Unspecialized setae (legs I, II, III): femora 6, 6, 5; genua 4, 4, 4; tibiae 8, 6, 6; tarsi 22, 17, 16.

*Distribution and hosts*

This species was described from South Africa, Northern Cape, Kuruman, ex *Micaelamys namaquensis* (A. Smith) (Rodentia: Muridae).

*Type deposition*

Holotype and 21 paratypes (larvae) on three slides are deposited in ZIN (17247, 17231, 17235); two paratypes (larvae) on one slide were donated to NMSA (original number ZIN 17244).

### ***Hyracarus kimberleyensis* (Stekolnikov & Matthee, 2022) comb. nov.**

*Tateracarus kimberleyensis* Stekolnikov & Matthee, 2022: 257, Figs. 1–3; Stevens *et al.* 2022: 1232.

*Diagnosis (after Stekolnikov and Matthee 2022)*

SIF = 4B-B-3-2111.2(1–3)(1–2)2; fPp = B/B/BNB; fD = [4-8]-10-10-(7–9)+(9–10); DS = 49–51, V = 41–49, Hv = 0, NDV = 90–98; Ip = 752–779; scutum nearly trapezoidal, with straight posterior margin; nasus slightly expanded in medial part; sensillary bases anterior to level of PLs by

3–4 μm; PL > AL = AM; sensilla nude; cheliceral blade with dorsal tooth and row of eight ventral denticles; parasubterminala (*z*) branched. Unspecialized setae (legs I, II, III): femora 6, 6, 5; genua 4, 4, 4; tibiae 8, 6, 6; tarsi 22, 16, 15.

*Distribution and hosts*

This species was described from South Africa, Northern Cape, Kimberley, ex *Micaelamys namaquensis*.

*Type deposition*

Holotype and six paratypes (larvae) on one slide are deposited in ZIN (17249).

### ***Hyracarus quadrisetosus* (Goff, 1983) comb. nov.**

*Tateracarus quadrisetosus* Goff, 1983: 2, Fig. 1; Stekolnikov 2018: 48; Bassini-Silva *et al.* 2021: 91; Stekolnikov and Matthee 2022: 256.
*Tateracarus quadrasetosa* (misprint): Goff 1989: 124.

*Diagnosis (after Goff 1983)*

SIF = 4B-B-3-2111.0000; fPp = B/B/BbB; fD = 4H-[4-6]-8-10-8-6-2; DS = 48, V = 54–56, Hv = 0, NDV = 102–104; Ip = 695–706; scutum pentagonal, with slightly projected posterior margin; sensillary bases anterior to level of PLs; PL > AL > AM; AM with accessory branch; sensilla nude; cheliceral blade with dorsal tooth and row of 5–6 ventral denticles; parasubterminala (*z*) absent (replaced with branched seta). Unspecialized setae (legs I, II, III): femora 6, 5, 5; genua 4, 4, 4; tibiae 8, 6, 6; tarsi 24, 16, 16.

*Distribution and hosts*

This species was described from Namibia, Omaheke Region, Aminius, ex *Gerbilliscus leucogaster* (Peters) (syn.: *Tatera leucogaster*) (Rodentia: Muridae).

*Type deposition*

Holotype and nine paratypes (larvae) are deposited in USNM (USNMENT 01759159–01759168) (Bassini-Silva *et al.* 2021).

### ***Hyracarus longipilosus* Lawrence, 1949 (Figs. 1C, 3A)**

*Hyracarus longipilosus* Lawrence, 1949: 422, Fig. 10; Stekolnikov 2018: 45; Stevens *et al.* 2022: 1232 (misidentification).
*Acomatacarus* (*Hyracarus*) *longipilosus*: Wharton and Fuller 1952: 101; Audy *et al.* 1961: 177.

*Diagnosis*

SIF = 5B-B-3-2111.0000; fPp = B/B/BBB; fD = 2H-[4-8]-[6-8]-[2-6]-4-3; DS = 43, V = 34, Hv = 0, NDV = 77; Ip = 914; scutum nearly pentagonal, with arcuate, slightly projected posterior margin; nasus expanded in distal part; sensillary bases at level of PLs; PL > AL > AM; sensilla nude; cheliceral blade with dorsal tooth and row of eight ventral denticles; parasubterminala (*z*) branched. Unspecialized setae (legs I, II, III): femora 6, 6, 5; genua 4, 4, 4; tibiae 9, 6, 6; tarsi 26, 17, 17. Standard measurements are given in Table 1.

*Distribution and host*

This species is known from one specimen collected in South Africa, Cedara (KwaZulu-Natal Province), ex *Procavia capensis* (Pallas) (syn.: *Procavia natalensis* Roberts) (Hyracoidea:

Procaviidae).

*Type deposition*

Holotype is deposited in NMSA.

*Type material examined*

Holotype (larva), NM 4906, ex *Procavia natalensis*, Cedara, Natal, collector and date unknown (Fig. 1A).

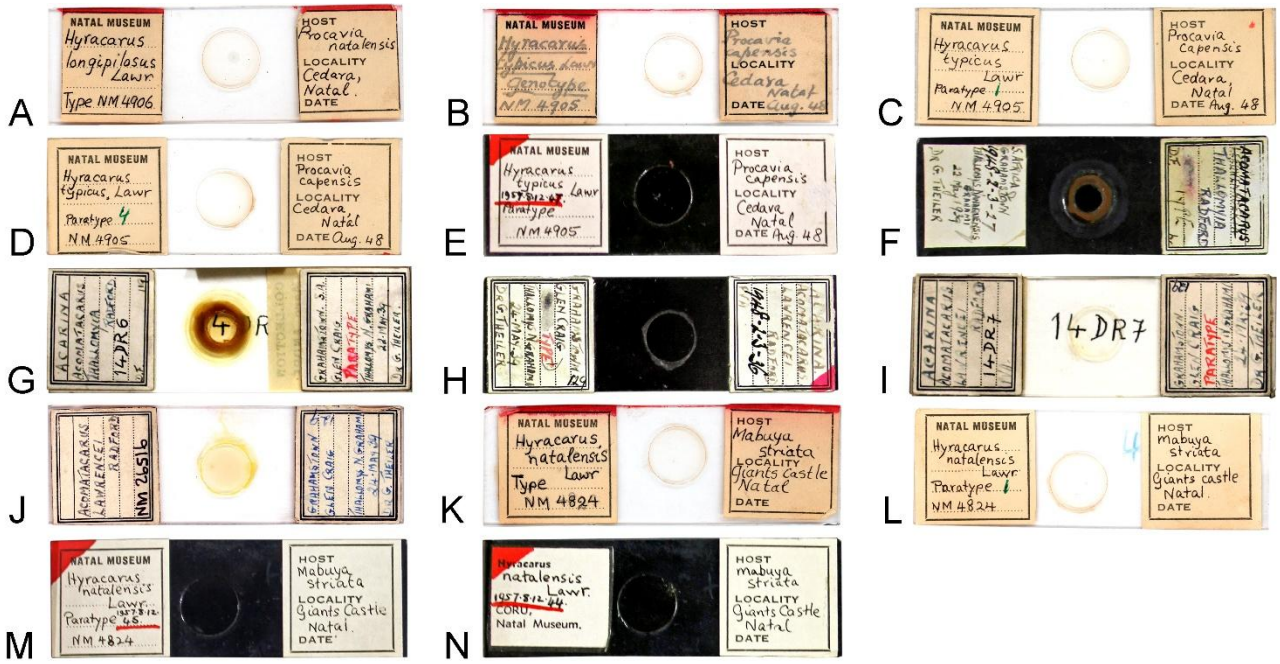


**Figure 1.** Slide labels – **A.** *Hyracarus longipilosus* Lawrence, 1949, holotype; **B.** *H. typicus* Lawrence, 1949, holotype; **C.** *H. typicus*, paratype 1; **D.** *H. typicus*, paratype 4; **E.** *H. typicus*, paratype NHM 1957.8.12.47; **F.** *H. thallomyia* (Radford, 1947), holotype; **G.** *H. thallomyia*, paratype MNHN 14DR 6; **H.** *Acomatacarus lawrencei* Radford, 1948, holotype; **I.** *A. lawrencei*, paratype MNHN 14DR 7; **J.** *A. lawrencei*, topotypic specimen (NMSA); **K.** *H. natalensis* Lawrence, 1949, holotype; **L.** *H. natalensis*, paratype 1; **M.** *H. natalensis*, paratype NHM 1957.8.12.45; **N.** *H. natalensis*, topotypic specimen NHM 1957.8.12.44.

*Remarks*

Setation of idiosoma, legs, and palps is given after V-G Archive. According to this source, sensilla of *H. longipilosus* are ciliated along their entire length, but our examination did not confirm that. The specimens identified as *H. longipilosus* by Stevens *et al*. (2022) do not belong to *Hyracarus*; we will report the results of their identification in our forthcoming paper.

### *Hyracarus* sp. 1 (Fig. 2A)

*Diagnosis*

SIF = 5B-B-3-2111.0000; fPp = B/B/BBB; fD = 4H-8-10-8-8-6-8-6-4-2; DS = 64, V = 72, Hv = 0, NDV = 136; Ip = 840–850; scutum pentagonal, with angulate, pointed posterior margin; nasus expanded in medial part; sensillary bases slightly anterior to level of PLs; PL > AL > AM; sensilla nude; cheliceral blade with dorsal tooth and row of six ventral denticles; parasubterminala (*z*) branched. Unspecialized setae (legs I, II, III): femora 6, 6, 5; genua 4, 4, 4; tibiae 9, 6, 6; tarsi 24, 17, 17. Standard measurements are given in Table 1.

**Table 1.** Morphometric (AW– $S_2$, µm) and meristic (DS–NDV) traits of *Hyracarus longipilosus* and *Hyracarus* sp. 1.

| Characters | *H. longipilosus* | | *H.* sp. 1 | |
|---|---|---|---|---|
| | Holotype | Holotype* | Holotype* | Paratype* |
| **AW** | 65 | 65 | 42 | 46 |
| **PW** | 83 | 83 | 57 | 62 |
| **SB** | 25 | 25 | 20 | 22 |
| **ASB** | 32 | 33 | 37 | 35 |
| **PSB** | 17 | 15 | 19 | 19 |
| **SD** | 49 | 48 | 56 | 54 |
| **AA** | 11 | 11 | 10 | 10 |
| **NL** | 18 | 18 | 27 | 28 |
| **NW** | 9 | 7 | 10 | 10 |
| **AP** | 29 | 29 | 33 | 33 |
| **AM** | 43 | 45 | 36 | 39 |
| **AL** | 49 | 51 | 49 | 47 |
| **PL** | 63 | 65 | 52 | 49 |
| **S** | - | 98 | 90 | 86 |
| **H** | - | 60 | 40 | 42 |
| **$D_{min}$** | 38 | 45 | 28 | 31 |
| **$D_{max}$** | 56 | 56 | 43 | 44 |
| **$V_{min}$** | 22 | 28 | 36 | 34 |
| **$V_{max}$** | 43 | 46 | 39 | 41 |
| **pa** | 313 | 318 | 297 | 299 |
| **pm** | 274 | 262 | 248 | 250 |
| **pp** | 328 | 324 | 295 | 301 |
| **Ip** | 914 | 904 | 840 | 850 |
| **$S_1$** | - | 19 | 18 | - |
| **$S_2$** | - | 16 | 18 | - |
| **DS** | - | 43 | 64 | - |
| **V** | - | 34 | 72 | - |
| **NDV** | - | 77 | 136 | - |

Note. * – after V-G Archive.

*Distribution and host*

This species is known from two specimens collected in South Africa, Pietermaritzburg (KwaZulu-Natal Province), ex *Aethomys chrysophilus* (de Winton) (Rodentia: Muridae).

*Remarks*

The diagnosis and drawing are given after V-G Archive. According to this source, Vercammen-Grandjean named this species *Hyracarus* (*H.*) *elegans* (*nomen nudum*). He designated a holotype and one paratype, two slides with the following data: #5839, ex *Aethomys chrysophilus*, Pietermaritzburg, Natal, July 1955, collector Lawrence. The labels contained printed logos of the University of California Medical Center and G.W. Hooper Foundation; photocopies of labels were glued to the worksheet. We have not found these specimens either in NMSA, or in MHNG. Seems probable that they were lost, together with types of many other African species examined by Vercammen-Grandjean (Stekolnikov 2024a). Thus, since the existence of types at present is not confirmed, we prefer not to make the above provisional name available. Therefore, we designate this species as *Hyracarus* sp. 1.

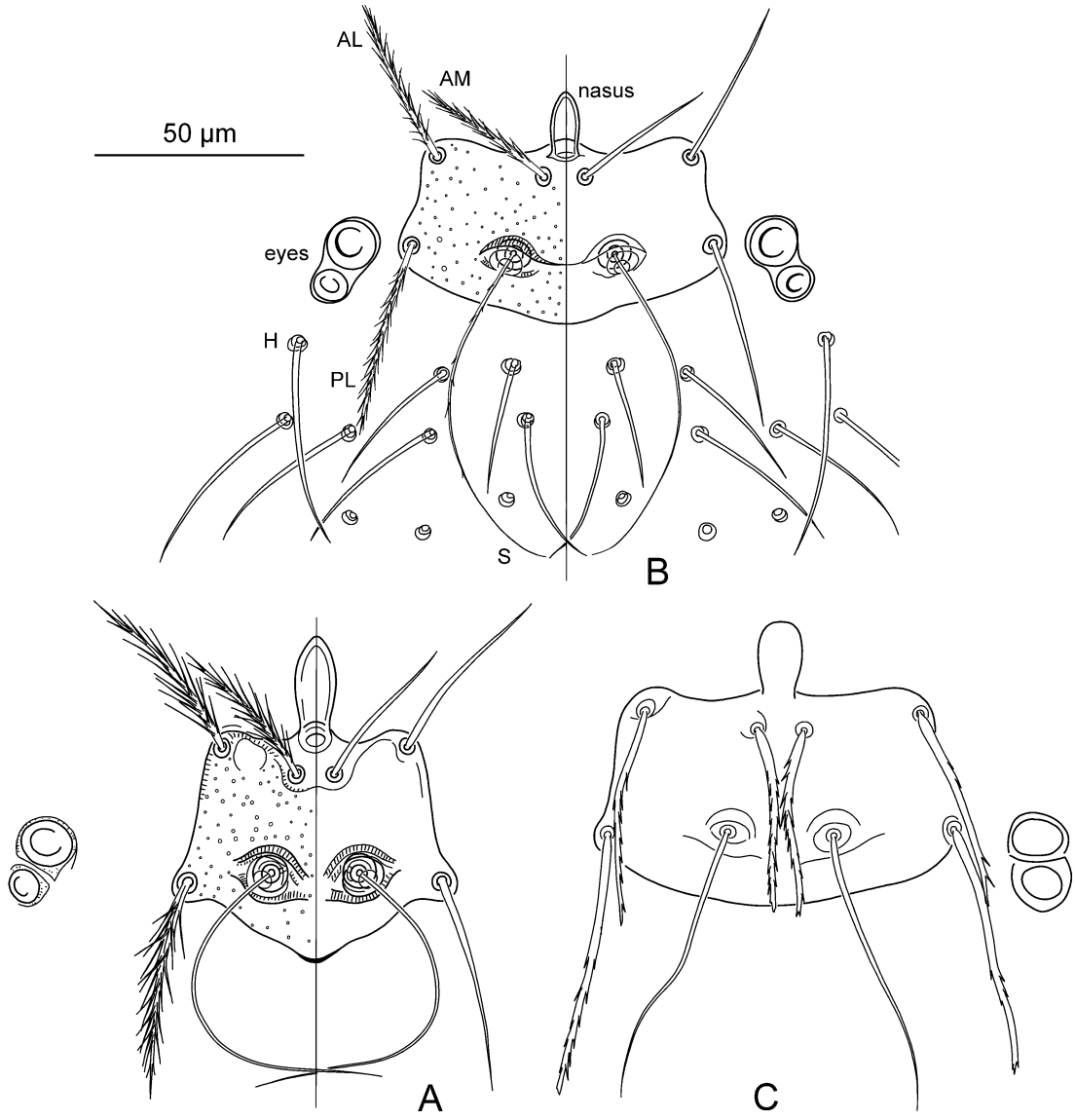


**Figure 2.** Scutum – **A.** *Hyracarus* sp. 1, after V-G Archive; **B.** *Hyracarus* sp. 2, after V-G Archive; **C.** *Hyracarus longipilosus* Lawrence, 1949, holotype. Abbreviations: AL, anterolateral seta; AM, anteromedian seta; H, humeral seta; PL, posterolateral seta; S, sensillum.

Vercammen-Grandjean put oblique strokes on the leg claws and empodia in his drawing of this species. These strokes could designate onychotriches, but the worksheet did not include any note on this.

### *Hyracarus* sp. 2 (Fig. 2B)

*Diagnosis*

SIF = 5B-B-3-2111.4322; fPp = B/B/BBB; fD = 2H-[4-8]-6-6-8-6-4-2; DS = 46, V = 36, Hv = 0, NDV = 82; Ip = 734; scutum nearly pentagonal, with angulate posterior margin; nasus unexpanded, with conical end; sensillary bases slightly posterior to level of PLs; PL > AL > AM; sensilla with few small cilia; cheliceral blade with dorsal tooth and row of 12 ventral denticles; parasubterminala (*z*) nude. Unspecialized setae (legs I, II, III): femora 6, 6, 5; genua 4, 4, 4; tibiae 9/8, 6, 6; tarsi 25, 17, 17. Standard measurements are given in Table 2.

**Table 2.** Morphometric (AW– $S_2$, µm) and meristic (DS–NDV) traits of *Hyracarus* sp. 2 and *H. bethuliensis* **sp. nov.**

| Characters | ***Hyracarus* sp. 2*** | ***H. bethuliensis* sp. nov.** | | | |
|---|---|---|---|---|---|
| | **Holotype** | **Holotype** | **Range** | **Mean** | **N** |
| **AW** | 60 | 59 | 54–59 | 56 | 5 |
| **PW** | 72 | 78 | 70–79 | 75 | 5 |
| **SB** | 24 | 25 | 21–25 | 23 | 5 |
| **ASB** | 27 | 32 | 25–32 | 30 | 5 |
| **PSB** | 17 | 27 | 23–27 | 24 | 5 |
| **P-PL** | - | 32 | 25–32 | 28 | 5 |
| **SD** | 44 | 59 | 49–59 | 54 | 5 |
| **AA** | 10 | 12 | 9–12 | 10 | 5 |
| **NL** | 15 | 14 | 14–16 | 15 | 4 |
| **NW** | 6 | 11 | 8–11 | 10 | 4 |
| **AP** | 22 | 23 | 19–24 | 22 | 5 |
| **AM** | 36 | 32 | 32–34 | 33 | 4 |
| **AL** | 40 | 42 | 38–42 | 40 | 5 |
| **PL** | 46 | 44 | 44–47 | 45 | 5 |
| **S** | 84 | 70 | 68–76 | 71 | 4 |
| **H** | 50 | 50 | 41–50 | 46 | 5 |
| **$D_{min}$** | 31 | 30 | 29–32 | 30 | 5 |
| **$D_{max}$** | 46 | 48 | 41–48 | 44 | 5 |
| **$V_{min}$** | 36 | 29 | 22–30 | 26 | 5 |
| **$V_{max}$** | 42 | 45 | 34–45 | 40 | 5 |
| **pa** | 254 | 270 | 259–274 | 268 | 5 |
| **pm** | 218 | 243 | 230–243 | 237 | 5 |
| **pp** | 262 | 279 | 266–279 | 271 | 5 |
| **Ip** | 734 | 792 | 763–792 | 777 | 5 |
| **TaIIIL** | - | 70 | 68–72 | 71 | 5 |
| **TaIIIW** | - | 15 | 15–16 | 16 | 5 |
| **$S_1$** | 16 | - | 14 | - | 1 |
| **$S_2$** | 15 | - | 16 | - | 1 |
| **DS** | 46 | 45 | 44–54 | 48 | 5 |
| **V** | 36 | 56 | 38–56 | 47 | 5 |
| **NDV** | 82 | 101 | 82–108 | 95 | 5 |

Note. * – after V-G Archive.

*Distribution and host*

This species is known from one specimen collected in South Africa, Pietermaritzburg, ex *Aethomys chrysophilus*.

*Remarks*

The diagnosis and drawing are given after V-G Archive. According to this source, Vercammen-Grandjean named this species *Hyracarus flagellifera* (*nomen nudum*) or *Pasternakia flagellifera* (*nomen nudum*). He designated its only specimen as holotype; the slide labels were the same as for *Hyracarus* sp. 1 (#5839, ex *Aethomys chrysophilus*, Pietermaritzburg, Natal, July 1955, collector Lawrence). Probably, this specimen was lost, as well as provisional types for the previous species.

### *Hyracarus bethuliensis* sp. nov. (Figs. 3B, 5)

http://zoobank.org/urn:lsid:zoobank.org:act:2A8695EA-E547-448C-BFBB-1158CBD7F8FF

*Hyracarus* aff. *namibiensis*: Stevens *et al.* 2022: 1232.

*Diagnosis*

SIF = 5B-B-3-2111.2322; fPp = B/B/BBN; fD = [4-8]-8-8-8(9)+(8–18), DS = 44–54, V = 38–56, Hv = 0, NDV = 82–108; Ip = 763–792; scutum pentagonal, with angulate, pointed posterior margin; nasus expanded in medial part; sensillary bases posterior to level of PLs by 2–5 µm; PL > AL > AM; sensilla nude; cheliceral blade with dorsal tooth and row of 11 ventral denticles; parasubterminala (*z*) nude. Unspecialized setae (legs I, II, III): femora 6, 6, 5; genua 4, 4, 4; tibiae 9, 6, 6; tarsi 24, 17, 17. Measurements are given in Table 2.

*Description of larva*

**Idiosoma –** Eyes 2 + 2, on ocular plate; 44–54 densely barbed dorsal idiosomal setae; distribution by anterior rows – 12 C, 8 D, 8 E, 8(9) F, 1st row double, two marginal setae of 2nd row shifted anteriad, marginal setae of 1st and 2nd rows (humeral setae) longest; two sternal setae between coxae III; 38–56 ventral setae; humeroventral setae absent; NDV = 82–108; reduced stigmata visible, tracheae absent.

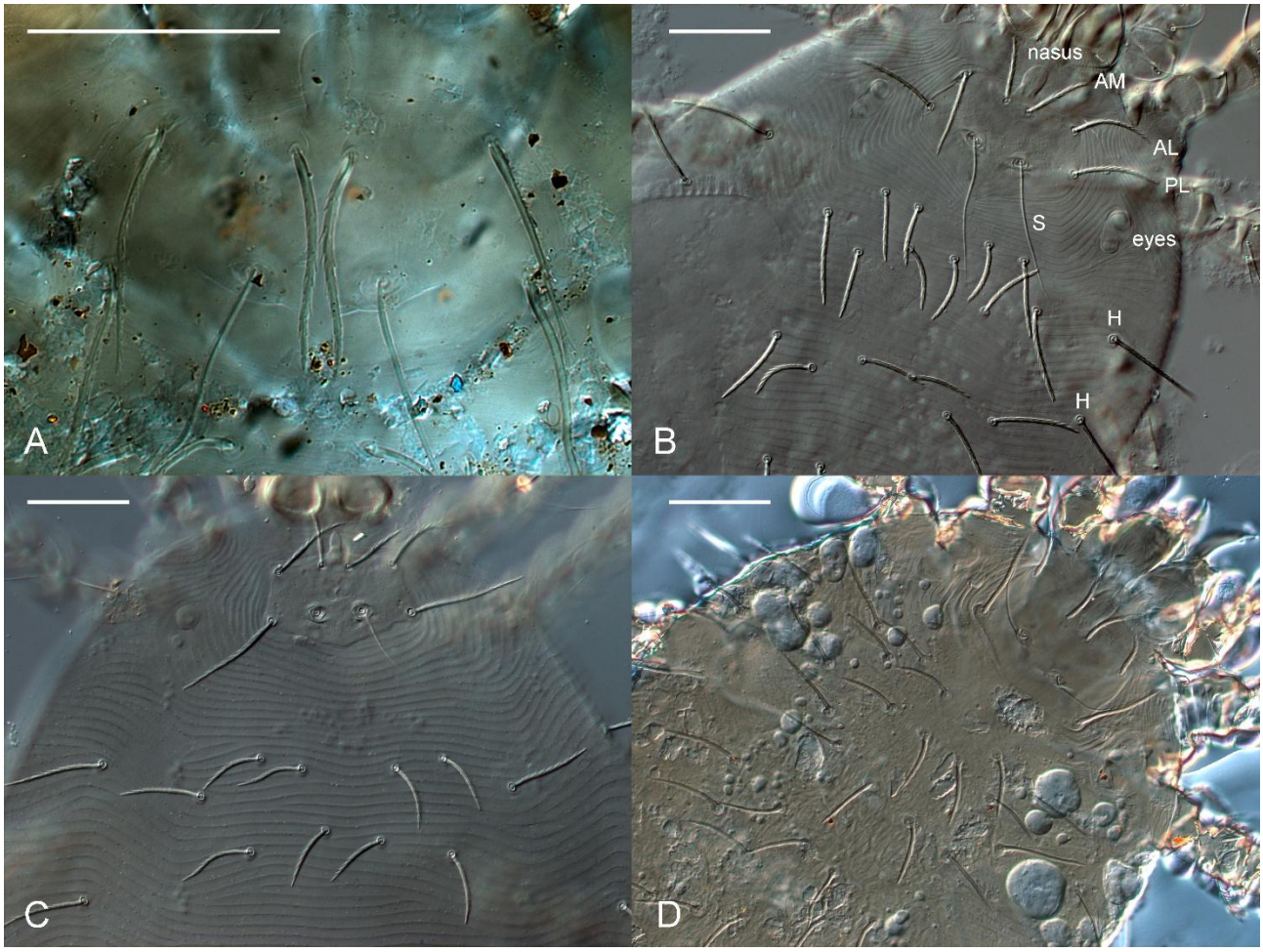


**Figure 3.** Scutum (A), anterior part of idiosoma, dorsal aspect (B–D) – **A.** *Hyracarus longipilosus* Lawrence, 1949, holotype; **B.** *H. bethuliensis* **sp. nov.**, holotype; **C.** *H. ethiopicus* **sp. nov.**, holotype; **D.** *H. typicus* Lawrence, 1949, holotype. Abbreviations as in Fig. 2. Scale bars: 50 µm.

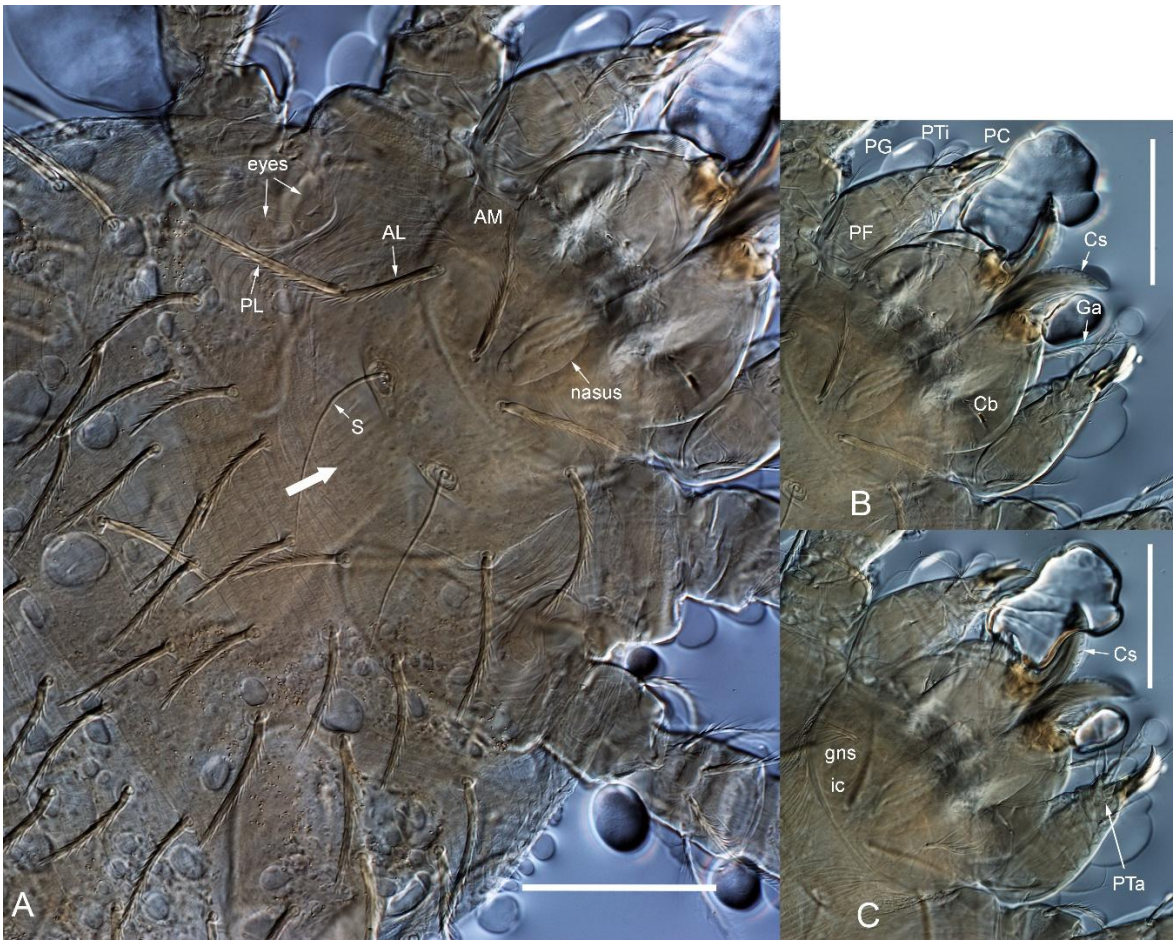


**Figure 4.** *Hyracarus typicus* Lawrence, 1949, paratype NHM 1957.8.12.47 – **A.** Anterior part of idiosoma, dorsal aspect; **B.** Gnathosoma, dorsal aspect; **C.** Gnathosoma, ventral aspect. Abbreviations: Cb, cheliceral base; Cs, cheliceral blade; Ga, galeal (deutorostral) seta; gns, gnathocoxal (tritorostral) seta; ic, infracapitulum (gnathobase, gnathocoxa); PC, palpal claw (odontus); PF, palpal femur; PG, palpal genu; PTa, palpal tarsus; PTi, palpal tibia. Other abbreviations as in Fig. 2. Posterior scutal margin shown by large arrow. Scale bars: 50 µm.

**Gnathosoma –** Cheliceral blade with one dorsal tooth and ventrolateral row of 11 denticles; cheliceral base with dense puncta in proximal part; gnathobase (infracapitulum) with sparse puncta, bears one pair of branched tritorostral setae; galeal (deutorostral) seta branched; palpal claw (odontus) with three prongs; palpal femur with sparse puncta; palpal femoral and genual setae branched; palpal tibia with ciliated dorsal and lateral setae and nude ventral seta; palpal tarsus with five branched setae and tarsala (ω).

**Scutum –** With multiple puncta, pentagonal, with angulate, pointed posterior margin; nasus large, expanded in medial part; AM situated slightly posterior to ALs, sensillary (trichobothrial) bases posterior to level of PLs by 2–5 µm; PL > AL > AM; all scutal setae barbed similarly to dorsal idiosomal setae; sensilla (trichobothria) flagelliform, nude.

**Legs –** All six-segmented (with undivided femur), with one pair of claws and claw-like empodium, onychotriches absent. Specialized setae: Leg I: 2 genualae (*σ*), microgenuala (*κ*), 2 tibialae (*φ*) in tandem, microtibiala (*κ*) near distal tibiala, tarsala (*ω*), famulus (*ε*) distal to tarsala, subterminala (*ζ*), nude parasubterminala (*z*), pretarsala (*ζ*). Leg II: genuala (*σ*), microgenuala (*κ*) distal to genuala, 2 tibialae (*φ*) in tandem, tarsala (*ω*), long famulus (*ε*) slightly proximal to tarsala, pretarsala (*ζ*). Leg III: genuala (*σ*), tibiala (*φ*). Unspecialized setae (legs I, II, III): coxae 2, 1, 1; trochanters 1, 1, 1; femora 6, 6, 5; genua 4, 4, 4; tibiae 9, 6, 6; tarsi 24, 17, 17. Ventral setae feathered, dorsal setae branched or nude. Numbers of nude setae: Leg I: tarsus 5, tibia 3, genu 1; Leg II: tarsus

2, tibia 2; Leg III: tarsus 1 (+ 1 bearing one branch), tibia 2 (+ 1 bearing basal cilium), genu 2, femur 2.

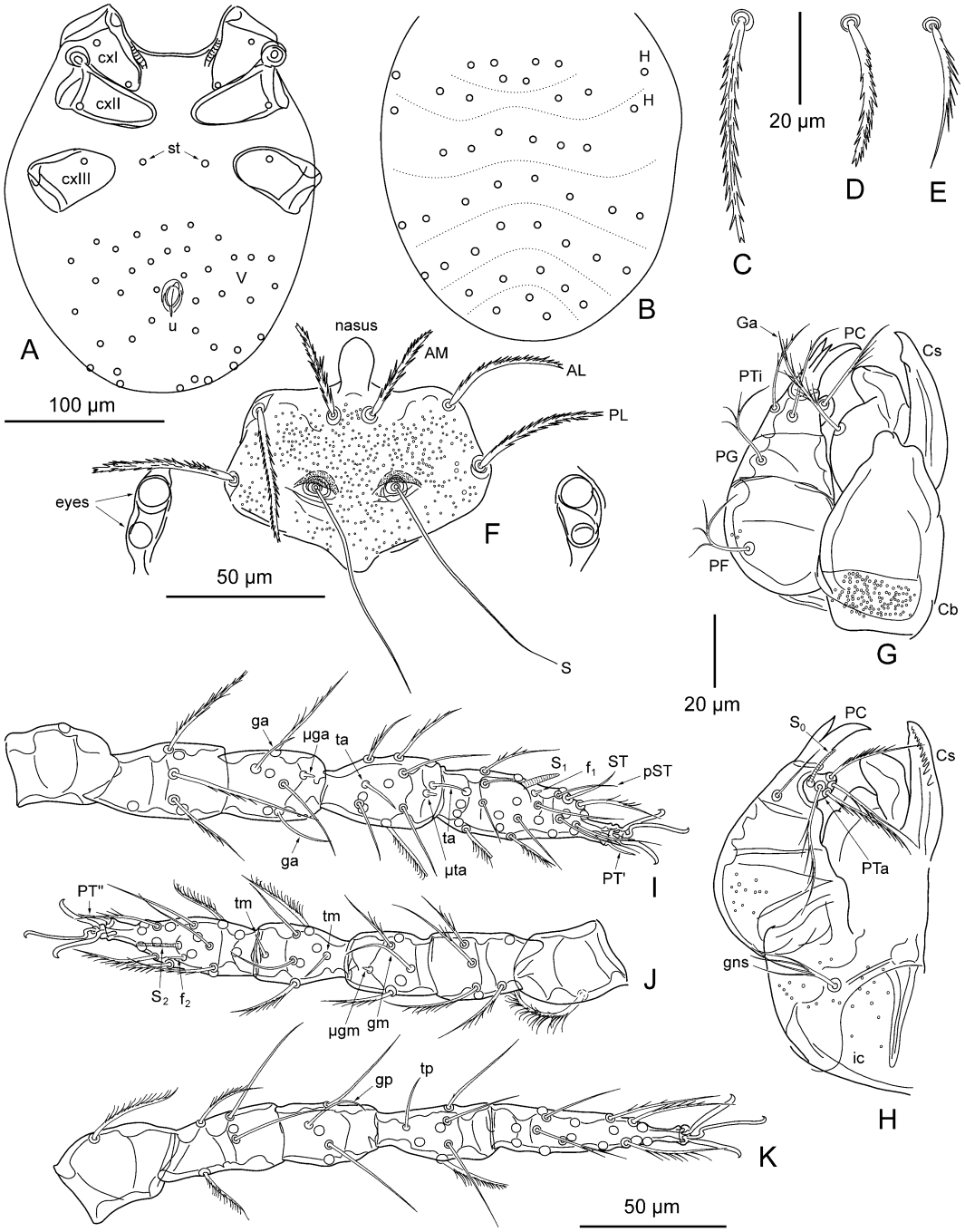


**Figure 5.** *Hyracarus bethuliensis* **sp. nov.** (A–B, paratype ZIN 17228, spec. 7; C–K, holotype) – **A.** Ventral aspect of idiosoma; **B.** Dorsal aspect of idiosoma; **C.** Humeral seta; **D.** Dorsal idiosomal seta (center of row C); **E.** Preanal seta; **F.** Scutum and eyes; **G.** Dorsal aspect of gnathosoma; **H.** Ventral aspect of gnathosoma; **I.** Leg I, trochanter–tarsus; **J.** Leg II, trochanter–tarsus; **K.** Leg III, trochanter–tarsus. Abbreviations: AL, anterolateral seta; AM, anteromedian seta; Cb, cheliceral base; Cs, cheliceral blade; cxI, leg I coxa; cxII, leg II coxa; cxIII, leg III coxa; $f_1$, famulus I ($\varepsilon$); $f_2$, famulus II ($\varepsilon$); ga, genuala I ($\sigma$); gm, genuala II ($\sigma$); gp, genuala III ($\sigma$); Ga, galeal (deutorostral) seta; gns, gnathocoxal (tritorostral) seta; H, humeral seta; ic, infracapitulum (gnathobase, gnathocoxa); PC, palpal claw (odontus); PF, palpal femur; PG, palpal genu; PL, posterolateral seta; pST, parasubterminala (*z*); PT', pretarsala I ($\zeta$); PT", pretarsala II ($\zeta$); PTa, palpal tarsus; PTi, palpal tibia; $S_0$, palpal tarsala ($\omega$); $S_1$, leg I tarsala ($\omega$); $S_2$, leg II tarsala ($\omega$); ST, subterminala ($\zeta$); st, sternal setae; ta, tibiala I ($\varphi$); tm, tibiala II ($\varphi$); tp, tibiala III ($\varphi$); u, uropore (anus); V, ventral setae; µga, microgenuala I ($\kappa$); µgm, microgenuala II ($\kappa$); µta, microtibiala ($\kappa$). Scale bars: A–B, 100 µm; C–E, 20 µm; G–H, 20 µm; F, 50 µm; I–K, 50 µm.

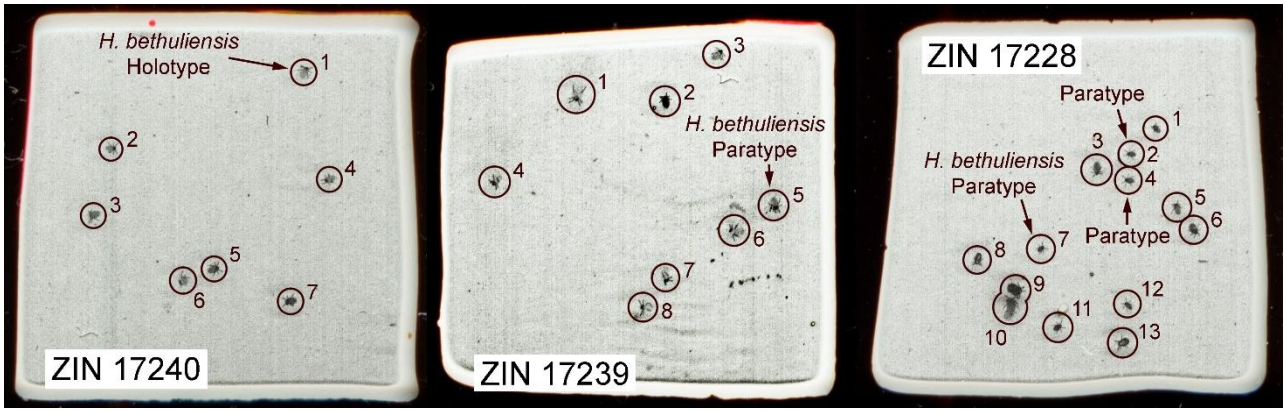


**Figure 6.** *Hyracarus bethuliensis* **sp. nov.** – Positions of type specimens on slides.

*Type material*

Holotype (larva), ZIN 17240, specimen 1, ex *Micaelamys namaquensis* No. Rs Mn 1, South Africa, Free State, Bethulie, 26–30 June 2017, coll. J.C. Bothma. Paratypes: one larva (ZIN 17239, specimen 5), ex *M. namaquensis* No. Bf Mn 9, South Africa, Free State, Bloemfontein, 23–26 June 2018, coll. J.C. Bothma; three larvae on one slide (ZIN 17228, specimens 2, 4, and 7, together with the holotype of *Kayella bothmai* Stekolnikov & Matthee, 2022), ex *M. namaquensis* No. Ek Mn 20, South Africa, Eastern Cape Province, Steynburg, 2–3 July 2017, coll. J.C. Bothma. Positions of type specimens on slides are shown in Fig. 6.

*Etymology*

The species name refers to the type locality (Bethulie).

*Differential diagnosis*

The new species is characterized by the presence of five branched setae on palpal tarsus, absence of humeroventral setae, pointed posterior scutal margin, and the presence of nude dorsal setae on all legs. It is probably identical to *Hyracarus* sp. 2 and differs from it in more projected posterior scutal margin (PSB 23–27 vs. 17 and SD 49–59 vs. 44), $S_2$ longer $S_1$ vs $S_1$ longer $S_2$ (Table 2) and in the presence of 24 setae on leg III tarsus vs. 25.

### ***Hyracarus namibiensis* (Goff & Lukoschus, 1983) comb. nov.**

*Mastalacarus namibiensis* Goff & Lukoshus, 1983: 2, Fig. 1; Goff 1989: 119; Stekolnikov 2018: 46; Antonovskaia *et al.* 2023: 55 (misidentification).

*Diagnosis (after Goff and Lukoschus 1983)*

SIF = 5B-B-2-2111.5322; fPp = B/B/BBB; fD = 2H-12(11)-6-8-8+14; DS = 49–50, V = 44, Hv = 4, NDV = 97–98; Ip = 715–743; scutum pentagonal, with angulate posterior margin; sensillary bases at level of PLs or slightly posterior; PL > AL > AM; sensilla with cilia in proximal 2/3; cheliceral blade with dorsal tooth and row of 10–11 ventral denticles; parasubterminala (z) nude. Unspecialized setae (legs I, II, III): femora 6, 5, 5; genua 4, 4, 4; tibiae 9, 5, 6; tarsi 23, 16, 15. Standard measurements are given in Table 3.

*Distribution and host*

This species was described from Namibia, Aroab, ex *Elephantulus intufi* (A. Smith) (Macroscelidea: Macroscelididae).

**Table 3.** Morphometric (AW– $S_2$, µm) and meristic (DS–NDV) traits of *Hyracarus namibiensis* (Goff & Lukoschus, 1983) and *H. ethiopicus* **sp. nov.**

| Characters | *H. namibiensis* comb. nov.* | | | *H. ethiopicus* sp. nov. | | | |
|---|---|---|---|---|---|---|---|
| | Holotype | Range | Mean | Holotype | Range | Mean | N |
| **AW** | 55 | 50–57 | 53 | 57 | 57–59 | 58 | 4 |
| **PW** | 72 | 70–75 | 72 | 68 | 68–75 | 71 | 4 |
| **SB** | 22 | 22–24 | 23 | 23 | 23–23 | 23 | 4 |
| **ASB** | 27 | 27–33 | 29 | 29 | 27–29 | 28 | 4 |
| **PSB** | 21 | 19–24 | 22 | 18 | 15–20 | 18 | 4 |
| **P-PL** | - | - | - | 15 | 13–16 | 14 | 4 |
| **SD** | 48 | - | - | 47 | 44–47 | 46 | 4 |
| **AA** | 9 | 8–10 | 9 | 13 | 11–13 | 11 | 4 |
| **NL** | - | 14–18 | - | 10 | 10–10 | 10 | 2 |
| **NW** | - | 8 | - | 5 | 5–5 | 5 | 2 |
| **AP** | 24 | 21–29 | 25 | 25 | 24–25 | 25 | 4 |
| **AM** | 29 | 27–35 | 30 | 32 | 28–32 | 29 | 4 |
| **AL** | 40 | 36–40 | 39 | 41 | 38–41 | 39 | 4 |
| **PL** | 44 | 38–44 | 41 | 57 | 48–57 | 51 | 4 |
| **S** | - | 62–73 | 68 | 54 | 54–54 | 54 | 1 |
| **H** | - | 33–40 | - | 49 | 45–49 | 46 | 4 |
| **$D_{min}$** | - | 26 | - | 31 | 25–31 | 28 | 4 |
| **$D_{max}$** | - | 41 | - | 47 | 40–47 | 42 | 4 |
| **$V_{min}$** | - | 26 | - | 23 | 20–23 | 22 | 4 |
| **$V_{max}$** | - | 40 | - | 32 | 29–32 | 31 | 4 |
| **pa** | - | 251–257 | - | 252 | 243–252 | 248 | 4 |
| **pm** | - | 206–227 | - | 211 | 203–216 | 211 | 4 |
| **pp** | - | 249–260 | - | 241 | 229–241 | 237 | 4 |
| **Ip** | - | 715–743 | - | 704 | 680–704 | 696 | 4 |
| **TaIIIL** | - | 65 | - | 63 | 58–63 | 61 | 4 |
| **TaIIIW** | - | 16 | - | 17 | 16–17 | 17 | 4 |
| **$S_1$** | - | 14–15 | - | 11 | 11–11 | 11 | 2 |
| **$S_2$** | - | 17 | - | 14 | 12–14 | 13 | 2 |
| **DS** | - | 49–50 | - | 50 | 50–56 | 52 | 4 |
| **V** | - | 44 | - | 51 | 46–55 | 51 | 4 |
| **Hv** | - | 4 | - | 5 | 4–5 | 5 | 4 |
| **NDV** | - | 97–98 | - | 106 | 101–115 | 107 | 4 |

Note. * – After Goff and Lukoschus (1983); N = 10; only single values were given for some variables; meristic traits were different (humeral setae were not included in DS; V were not calculated; NDV involved sternal setae).

*Type deposition*

According to the original description, holotype was deposited in USNM, paratypes in USNM, BPBM, IRSNB, RUN, and SAIMR. Currently, no types of this species are recorded in USNM (Bassini-Silva *et al.* 2021).

*Remarks*

Stekolnikov (2018) erroneously noted that genuala II is absent in this species, but it is present according to the original description (Goff and Lukoschus 1983). The presence of only two prongs of the palpal claw in this species is unusual and could be an examination error. Re-examination of

types would be desirable. Specimens from Ethiopia identified by Antonovskaia *et al.* (2023) as *M. namibiensis* are described below as *H. ethiopicus* **sp. nov.**

### ***Hyracarus ethiopicus* sp. nov. (Figs. 3C, 7, 8)**

http://zoobank.org/urn:lsid:zoobank.org:act:EAB4A04E-77F3-43FB-A8D4-42EA0BCD34DF

*Diagnosis*

SIF = 5B-B-3-2111.3100; fPp = B/B/BBb; fD = 12(15)-8-8-(8–10)+(13–15), DS = 50–56, V = 46–55, Hv = 4–5, NDV = 101–115; Ip = 680–704; scutum pentagonal, with angulate posterior margin; nasus almost unexpanded, with conical end; sensillary bases anterior to level of PLs by 3–5 μm; PL > AL > AM; sensilla nude; cheliceral blade with dorsal tooth and row of four ventral denticles; parasubterminala (*z*) nude. Unspecialized setae (legs I, II, III): femora 6, 6, 5; genua 4, 4, 4; tibiae 9, 6, 6; tarsi 24, 17, 16. Measurements are given in Table 3.

*Description of larva*

**Idiosoma –** Eyes 2 + 2, on ocular plate; 50–56 barbed dorsal idiosomal setae; distribution by anterior rows – 12(5) C, 8 D, 8 E, 8–10 F, 1st row double (variants of division by sub-rows 8-4, 4-8, and 7-8), in holotype fD = [8-4]-8-8-8+14, two marginal setae of 2nd row shifted anteriad, marginal setae of 1st and 2nd rows (humeral setae) longest; two sternal setae between coxae III; 46–55 ventral setae; 4–5 humeroventral setae between coxae II and III laterally; NDV = 101–115; stigmata and tracheae absent.

**Gnathosoma –** Cheliceral blade with one dorsal tooth and ventrolateral row of four denticles; cheliceral base with dense puncta in proximal part; gnathobase (infracapitulum) with sparse puncta, bears one pair of branched tritorostral setae; galeal (deutorostral) seta branched; palpal claw (odontus) with three prongs; palpal femoral and genual setae branched; palpal tibia with branched dorsal and lateral setae and ventral seta bearing one cilium; palpal tarsus with five branched setae and tarsala (ω).

**Scutum –** With sparse puncta, pentagonal, with angulate posterior margin; nasus relatively small, almost unexpanded, with conical end; AM situated at level of ALs, sensillary (trichobothrial) bases anterior to level of PLs by 3–5 μm; PL > AL > AM; all scutal setae barbed similarly to dorsal idiosomal setae; sensilla (trichobothria) flagelliform, nude.

**Legs –** All six-segmented (with undivided femur), with one pair of claws and claw-like empodium, onychotriches absent. Specialized setae: Leg I: 2 genualae (*σ*), microgenuala (*κ*), 2 tibialae (*φ*) in tandem, microtibiala (*κ*) near distal tibiala, tarsala (*ω*), famulus (*ε*) distal to tarsala, subterminala (*ζ*), nude parasubterminala (*z*), pretarsala (*ζ*). Leg II: genuala (*σ*), microgenuala (*κ*) distal to genuala, 2 tibialae (*φ*) in tandem, tarsala (*ω*), famulus (*ε*) behind tarsala, pretarsala (*ζ*). Leg III: genuala (*σ*), tibiala (*φ*). Unspecialized setae (legs I, II, III): coxae 2, 1, 1; trochanters 1, 1, 1; femora 6, 6, 5; genua 4, 4, 4; tibiae 9, 6, 6; tarsi 24, 17, 16. Ventral setae feathered, dorsal setae branched or nude. Numbers of nude setae: Leg I: tarsus 2 (+ 2 bearing one branch), tibia 1 (with one branch); Leg II: tibia 1 (with one branch), femur 1 (with one branch); Leg III: tarsus 1 (+ 2 bearing one branch), tibia 1.

*Type material*

Holotype (larva), ZIN 10497, ex *Laephotis capensis* (A. Smith) (syn.: *Neoromicia capensis*) (Chiroptera: Vespertilionidae) No. 2836, ZMMU S-197892, Ethiopia, Arsi Admin. Zone, Asella town, 23 February 2016, host collected by L.A. Lavrenchenko, mites collected by A.V. Bochkov. Three paratypes (larvae), ZIN 10495, 10496, and 10498, with same data.

*Etymology*

The species name refers to the type locality (Ethiopia).

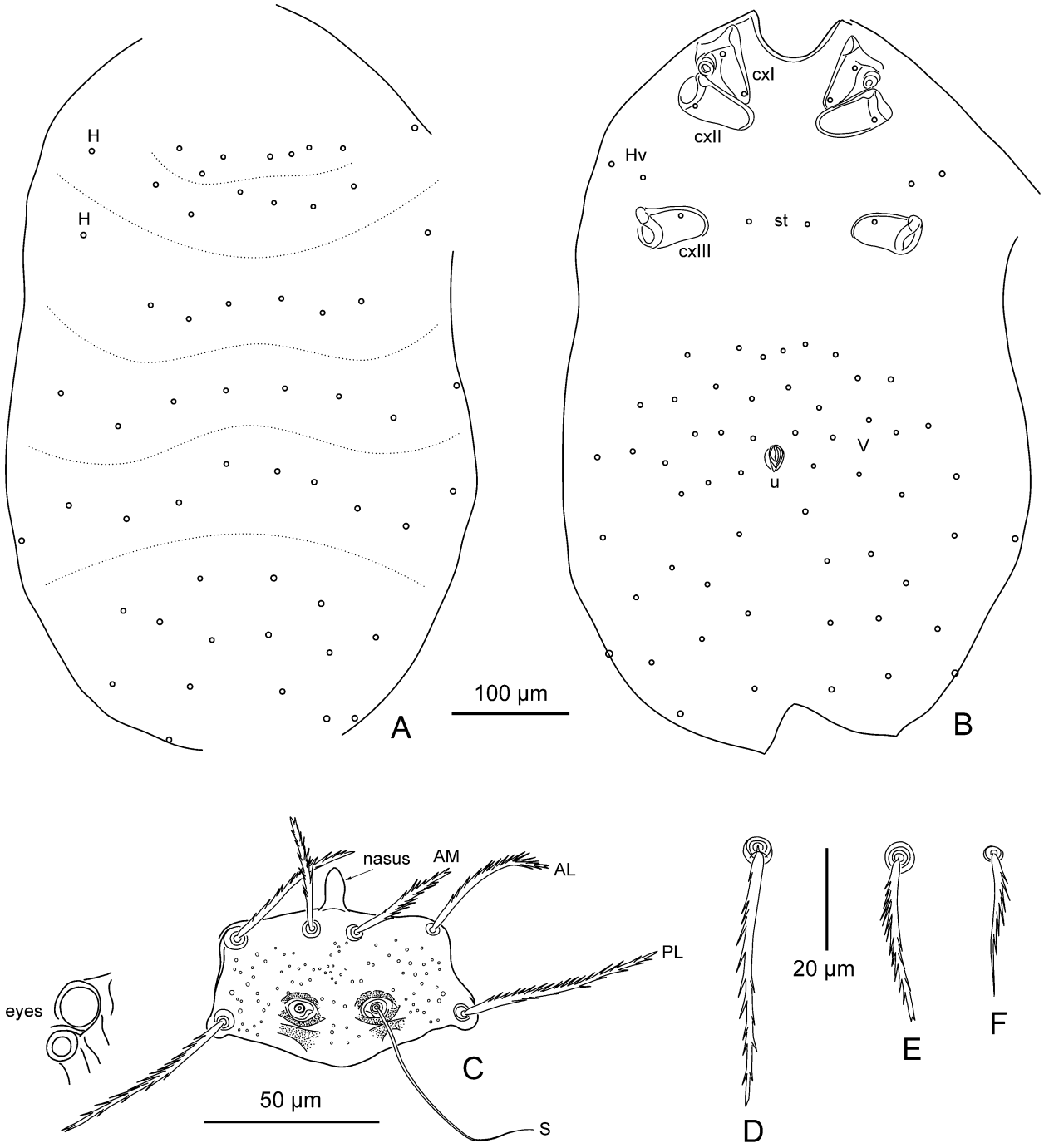


**Figure 7.** *Hyracarus ethiopicus* **sp. nov.** (A–B, paratype ZIN 10495; C–F, holotype) – **A.** Dorsal aspect of idiosoma; **B.** Ventral aspect of idiosoma; **C.** Scutum and eyes; **D.** Humeral seta; **E.** Dorsal idiosomal seta (center of row C); **F.** Preanal seta. Abbreviations: Hv, humeroventral setae; other abbreviations as in Fig. 5. Scale bars: A–B, 100 µm; C, 50 µm; D–F, 20 µm.

*Differential diagnosis*

The new species is similar to *Hyracarus namibiensis* **comb. nov.** and differs from it by nude sensilla vs. bearing cilia; four ventral denticles on cheliceral blade vs. 10–11; lesser number of nude setae on leg III (tarsus 1–3 and tibia 1 vs. tarsus 5, tibia 3, genu 2, and femur 2); formula of femoral setae 6, 6, 5 vs. 6, 5, 5; formula of tibial setae 9, 6, 6 vs. 9, 5, 6; formula of tarsal setae 24, 17, 16 vs.

23, 16, 15; much lesser nasus (NL 10 and NW 5 vs. 14–18 and 8, respectively), longer PL and H (48–57 and 45–49 vs. 38–44 and 33–40, respectively), shorter $S_1$ (11 vs. 14–15) and $S_2$ (12–14 vs 17).

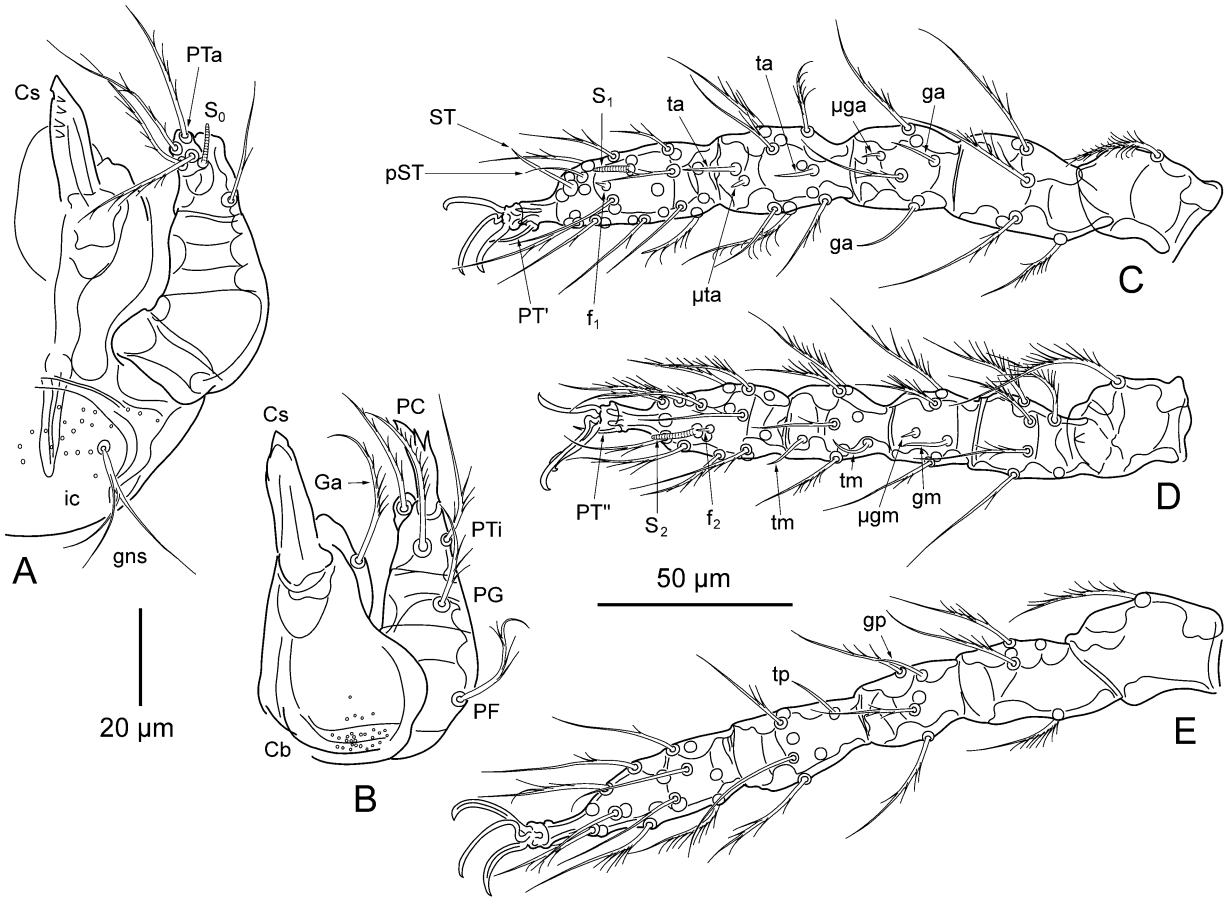


**Figure 8.** *Hyracarus ethiopicus* **sp. nov.** (A–B, holotype; C–E, paratype ZIN 10495) – **A.** Ventral aspect of gnathosoma; **B.** Dorsal aspect of gnathosoma; **C.** Leg I, trochanter–tarsus; **D.** Leg II, trochanter–tarsus; **E.** Leg III, trochanter–tarsus. Abbreviations as in Fig. 5. Scale bars: A–B, 20 µm; C–E, 50 µm.

## *Hyracarus typicus* Lawrence, 1949 (Figs. 3D, 4, 9, 10)

*Hyracarus typicus* Lawrence, 1949: 420, Fig. 9; Radford 1954: 269; Stekolnikov 2018: 46.
*Acomatacarus* (*Hyracarus*) *typicus*: Wharton and Fuller 1952: 101; Audy *et al.* 1961: 178.

*Diagnosis*

SIF = 5B-B-3-2111.0000; fPp = B/B/BBB; fD = (19–25)-(12–16)-(16-19)+(26–30), DS = 75–86, V = 54–67, Hv = 6–8, NDV = 146–156; Ip = 765–891; scutum nearly pentagonal, with rounded posterior margin; nasus expanded in medial part; sensillary bases at level or anterior to PLs; PL ≥ AL > AM; sensilla nude; cheliceral blade with dorsal tooth and row of 10 ventral denticles; parasubterminala (*z*) branched. Unspecialized setae (legs I, II, III): femora 6, 6, 5; genua 4, 4, 4; tibiae 9, 6, 6; tarsi 25, 16, 17. Measurements are given in Table 4.

*Redescription of larva*

**Idiosoma –** Eyes 2 + 2, on ocular plate; 75–86 densely barbed dorsal idiosomal setae; distribution by anterior rows – 19–25 C, 12–16 D, 16–19 E, 1st row triple, 2nd and 3rd rows double, in holotype fD = [4-6-9]-[10-4]-[10-6]-8-6-6-4-2; four marginal setae of 2nd row shifted anteriad, marginal setae of

1st and 2nd rows (humeral setae) longest; two sternal setae between coxae III; 54–67 ventral setae; 6–8 humeroventral setae between coxae II and III laterally; NDV = 146–156; stigmata and tracheae absent.

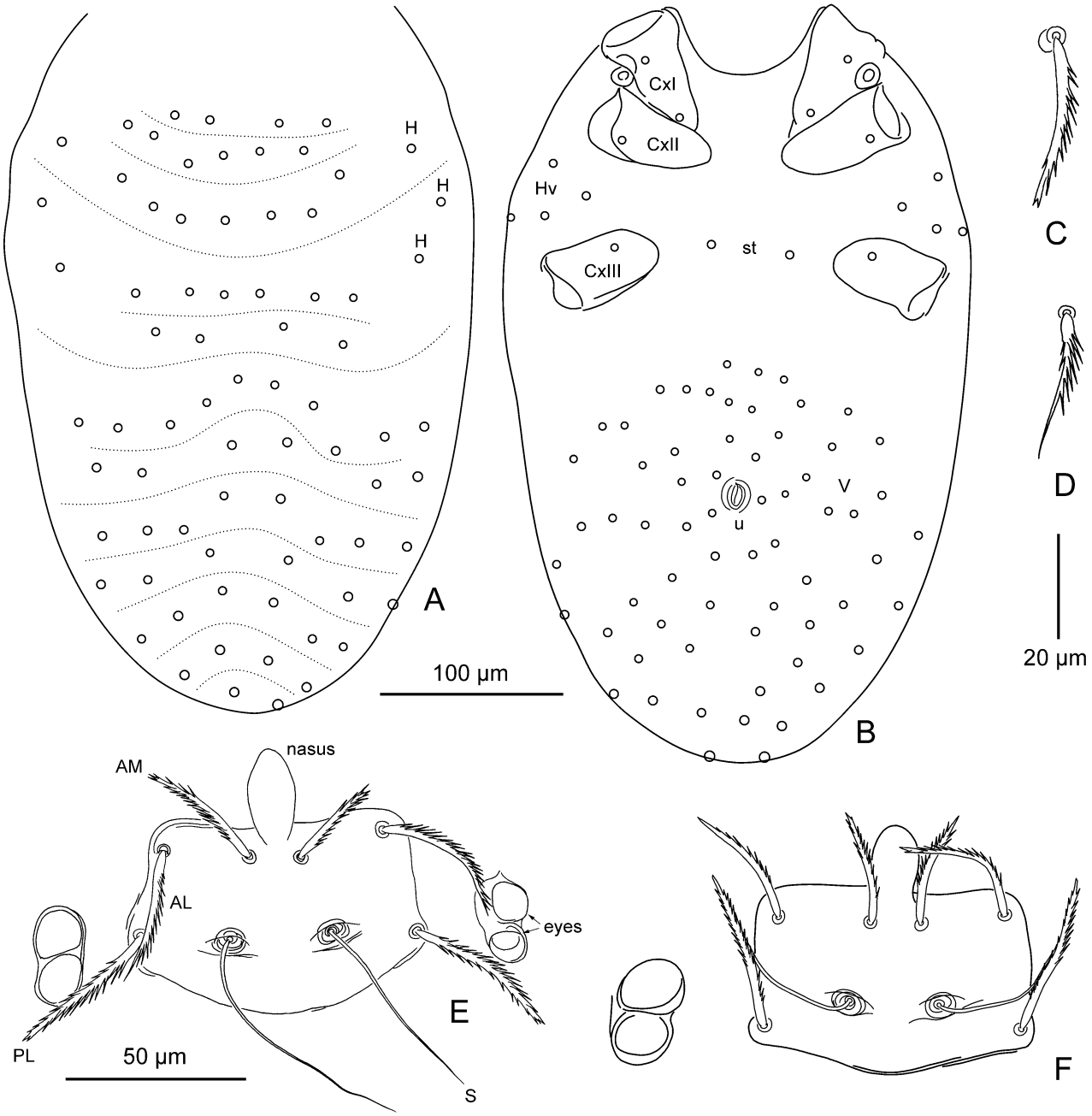


**Figure 9.** *Hyracarus typicus* Lawrence, 1949 (A, B, F, holotype; C–E, paratype NHM 1957.8.12.47) – **A.** Dorsal aspect of idiosoma; **B.** Ventral aspect of idiosoma; **C.** Dorsal idiosomal seta; **D.** Preanal seta; **E, F.** Scutum and eyes. Abbreviations as in Figs. 5 and 7.

**Gnathosoma –** Cheliceral blade with one dorsal tooth and ventrolateral row of ten denticles; cheliceral base and palps without puncta; gnathobase (infracapitulum) without puncta, bears one pair of branched tritorostral setae; galeal (deutorostral) seta heavily branched; palpal claw (odontus) with three prongs; palpal femoral, genual, and tibial setae branched; palpal tarsus with five branched setae and tarsala (ω).

**Scutum –** With sparse indistinct puncta, nearly pentagonal, with arcuate or slightly angulate posterior margin; nasus large, expanded in medial part; AM situated slightly posterior to ALs, sensillary (trichobothrial) bases situated anterior to level of PLs by 6–8 μm (at level of PLs in paratype deposited in NHM); PL ≥ AL > AM; all scutal setae barbed similarly to dorsal idiosomal setae; sensilla (trichobothria) flagelliform, nude.

**Legs –** All six-segmented (with undivided femur), with one pair of claws and claw-like empodium, onychotriches absent. Specialized setae: Leg I: 2 genualae (*σ*), microgenuala (*κ*), 2 tibialae (*φ*) with visible transverse striations, in tandem, microtibiala (*κ*) near distal tibiala, tarsala (*ω*), famulus (*ε*) distal to tarsala, subterminala (*ζ*), parasubterminala (*z*) with few branches, pretarsala (*ζ*). Leg II: genuala (*σ*), microgenuala (*κ*) distal to genuala, 2 tibialae (*φ*) in tandem, tarsala (*ω*), famulus (*ε*) behind tarsala, pretarsala (*ζ*). Leg III: genuala (*σ*), tibiala (*φ*). Unspecialized setae (legs I, II, III): coxae 2, 1, 1; trochanters 1, 1, 1; femora 6, 6, 5; genua 4, 4, 4; tibiae 9, 6, 6; tarsi 25, 16, 17. Ventral setae feathered, dorsal setae feathered or branched.

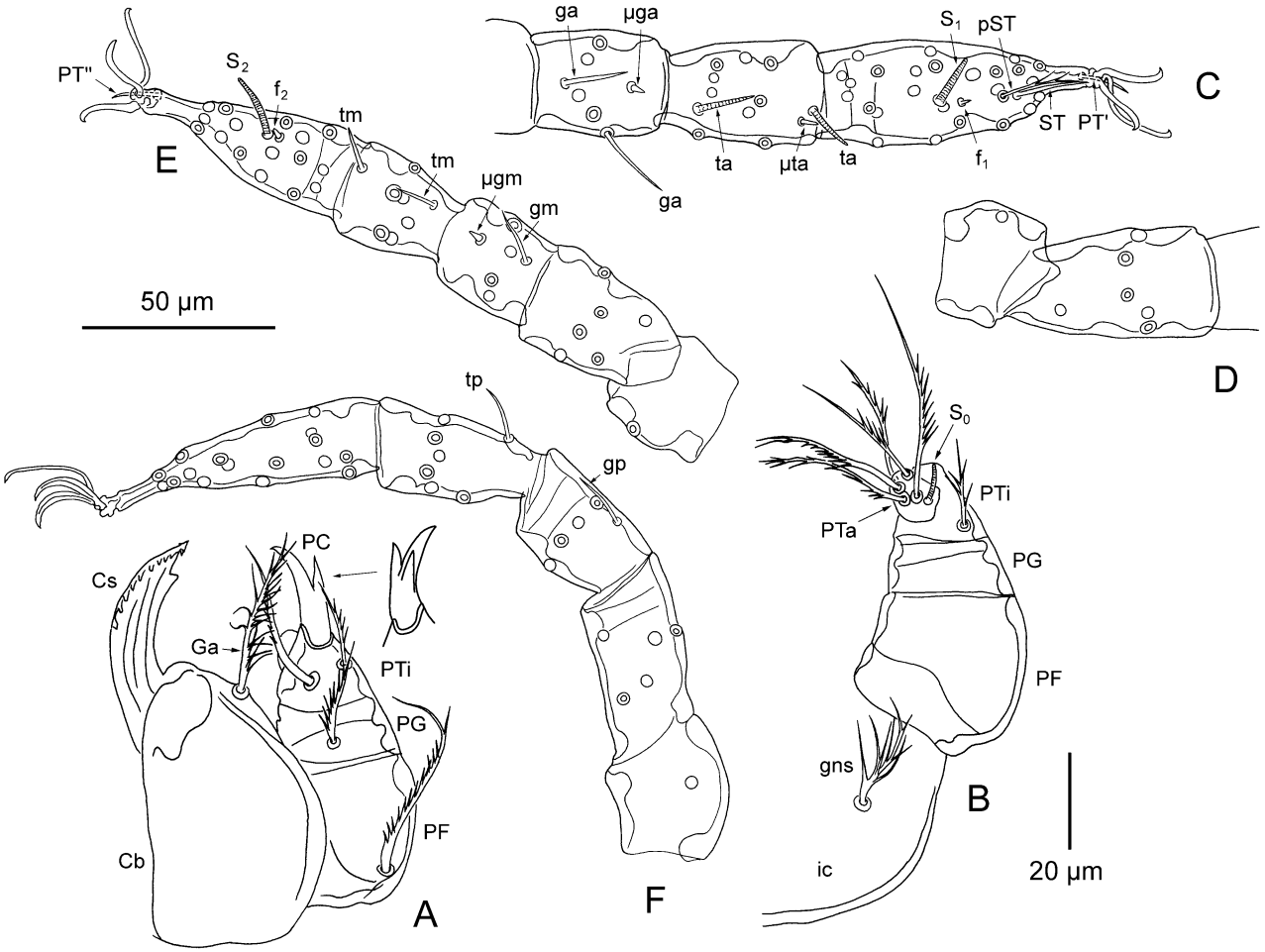


**Figure 10.** *Hyracarus typicus* Lawrence, 1949, paratype NHM 1957.8.12.47 – **A.** Dorsal aspect of gnathosoma; **B.** Ventral aspect of gnathosoma; **C.** Leg I, genu–tarsus; **D.** Leg I, trochanter–femur; **E.** Leg II, trochanter–tarsus; **F.** Leg III, trochanter–tarsus. Abbreviations as in Fig. 5. Scale bars: A–B, 20 μm; C–E, 50 μm.

*Distribution and host*

This species was described from South Africa, Natal (currently KwaZulu-Natal) Province, Cedara, ex *Procavia capensis*.

*Type deposition*

Originally, 11 type specimens (NM 4905), without mention of holotype, were deposited in

NMSA (Lawrence 1949). Currently, the holotype and four paratypes (larvae) are deposited in NMSA, two paratypes (larvae) are deposited in NHM (1957.8.12.46 and 1957.8.12.47), and one paratype (larva) is deposited in USNM (Bassini-Silva *et al.* 2021).

**Table 4.** Morphometric (AW– $S_2$, µm) and meristic (DS–NDV) traits of *Hyracarus typicus*.

| Characters | Original data | | | | After Vercammen-Grandjean* | | | |
|---|---|---|---|---|---|---|---|---|
| | Holotype | Range | Mean | N | Holotype | Range | Mean | N |
| **AW** | 63 | 58–63 | 60 | 4 | 64 | 59–64 | 60 | 5 |
| **PW** | 70 | 70–77 | 73 | 4 | 70 | 70–76 | 72 | 5 |
| **SB** | 25 | 23–29 | 26 | 4 | 25 | 24–26 | 25 | 5 |
| **ASB** | 31 | 26–32 | 29 | 4 | 30 | 30–32 | 31 | 5 |
| **PSB** | 19 | 18–22 | 19 | 4 | 20 | 18–20 | 19 | 5 |
| **P-PL** | 11 | 11–22 | 14 | 4 | - | - | - | 0 |
| **SD** | 50 | 48–50 | 49 | 4 | 50 | 48–52 | 50 | 5 |
| **AA** | 14 | 12–14 | 13 | 4 | 14 | 12–14 | 13 | 5 |
| **NL** | 23 | 18–23 | 22 | 4 | 24 | 24 | - | 1 |
| **NW** | 11 | 9–11 | 10 | 4 | 8 | 8 | - | 1 |
| **AP** | 32 | 28–33 | 31 | 4 | 32 | 31–33 | 32 | 5 |
| **AM** | 31 | 31–36 | 34 | 4 | 32 | 32–37 | 34 | 5 |
| **AL** | 43 | 40–43 | 42 | 4 | 42 | 37–48 | 42 | 5 |
| **PL** | 45 | 43–45 | 44 | 4 | 46 | 44–48 | 46 | 5 |
| **S** | - | 56–68 | 62 | 3 | 66 | 66–81 | 72 | 5 |
| **H** | - | 39 | - | 1 | - | - | - | 0 |
| **$D_{min}$** | 31 | 27–31 | 29 | 4 | 30 | 27–31 | 30 | 5 |
| **$D_{max}$** | 43 | 40–43 | 41 | 4 | 44 | 43–46 | 45 | 5 |
| **$V_{min}$** | 25 | 23–25 | 25 | 3 | 28 | 27–28 | 28 | 5 |
| **$V_{max}$** | 32 | 32–38 | 35 | 3 | 39 | 36–39 | 37 | 5 |
| **pa** | 266 | 259–306 | 275 | 4 | 268 | 266–268 | 267 | 3 |
| **pm** | 234 | 227–258 | 237 | 4 | 231 | 223–231 | 227 | 3 |
| **pp** | 279 | 277–327 | 290 | 4 | 271 | 271–276 | 274 | 3 |
| **Ip** | 779 | 765–891 | 801 | 4 | 770 | 764–770 | 768 | 3 |
| **TaIIIL** | 72 | 72–88 | 76 | 4 | - | - | - | 0 |
| **TaIIIW** | 20 | 16–21 | 19 | 4 | - | - | - | 0 |
| **$S_1$** | - | 13 | - | 1 | 14 | 14 | - | 1 |
| **$S_2$** | - | 18 | - | 1 | 19 | 19 | - | 1 |
| **DS** | 75 | 75–86 | 80 | 4 | 104 | 90–110 | 100 | 4 |
| **V** | 64 | 54–67 | 62 | 4 | 60 | 58–68 | 63 | 4 |
| **Hv** | 8 | 6–8 | 7 | 4 | - | - | - | 0 |
| **NDV** | 147 | 146–156 | 149 | 4 | 164 | 154–168 | 162 | 4 |

Note. * – measurements of the holotype and four paratypes, after V-G Archive.

*Type material examined*

Holotype (inscribed as “Genotype”) (larva), NM 4905, ex *Procavia capensis*, Cedara, Natal, August [19]48 (Fig. 1B); two paratypes (larvae) with same data deposited in NMSA, numbered 1 and 4 with green ink (Fig. 1C, D); one paratype (larva) with same data deposited in NHM (1957.8.12.47) (Fig. 1E).

*Remarks*

The paratype deposited in NHM differs from the holotype and two examined paratypes by a more prominent and arcuate (vs. slightly angulate) posterior scutal margin, twice larger P-PL (22 vs. 11–13), SB 29, ASB 26, and PSB 22 (vs. 23–25, 29–32, and 18–19, respectively), sensillary bases situated at level of PLs vs. anterior by 6–8 µm, and by definitely longer legs (pa 306, pm 258, pp 327, Ip 891, and TaIIIL 88 vs. 259–266, 227–234, 277–279, 765–779, and 72, respectively). Unfortunately, we were able to examine gnathosoma and legs only in this aberrant specimen. However, the data available in V-G Archive and based on the examination of the holotype and paratypes 1–4 agree with our results for the NHM paratype.

Although Vercammen-Grandjean noted the presence of "2 (4) ventral intercoxal" (humeroventral, according to our terminology) setae in his work-sheet, he did not count them separately for different specimens. Probably, he included these setae in the row C, as evident from the setal formulae in the work-sheet and his methodic used in the description of another species (Vercammen-Grandjean and Brennan 1957). The striking difference between our and Vercammen-Grandjean's fD for the holotype, [4-6-9]-[10-4]-[10-6]-8-6-6-4-2 vs. [12-12-6]-[8-4]-10-10-6-10-8-8-6-4 and, respectively, NDV = 147 vs. 164, can be explained, in addition, by a miscounting. The work-sheets of Vercammen-Grandjean did not include drawings of the arrangement of idiosomal setae; thus, he had to count setae directly under a microscope that could lead to errors.

### ***Hyracarus thallomyia* (Radford, 1947) comb. nov. (Figs. 11–14)**

*Acomatacarus thallomyia* Radford, 1947: 581, Figs. 3–4; 1954: 269, Fig. 100; Stekolnikov 2018: 40.
*Acomatacarus* (*Acomatacarus*) *thallomyia*: Wharton and Fuller 1952: 100; Audy *et al.* 1961: 177.
*Acomatacarus lawrencei* Radford, 1948, **syn. nov.**: 215, Figs 5–6; 1954: 269, Fig. 98.
*Acomatacarus* (*Hyracarus*) *lawrencei*: Wharton and Fuller 1952: 101; Audy *et al.* 1961: 177.
*Hyracarus lawrencei*: Stekolnikov 2018: 44.

*Diagnosis*

SIF = 5B(+1N?)-B-3-2111.0000; fPp = B/B/BBB(b); fD = (13–17)-(11–12)+(35–44), DS = 60–69, V = 40–53, Hv = 4–6, NDV = 111–123; Ip = 745–860; scutum nearly pentagonal, with rounded posterior margin; nasus expanded in medial part; sensillary bases at level of PLs; PL > AL > AM; sensilla nude; cheliceral blade with one dorsal tooth and ventrolateral row of 11–12 denticles; parasubterminala (*z*) branched. Unspecialized setae (legs I, II, III): femora 6, 6, 5; genua 4, 4, 4; tibiae 8(9?), 6, 6; tarsi 25(24), 16, 16. Measurements are given in Table 5.

*Redescription of larva*

**Idiosoma –** Eyes 2 + 2, on ocular plate; 60–69 barbed dorsal idiosomal setae; distribution by anterior rows – 13–17 C, 11–12 D, 1st row double (variants of division by sub-rows 6-8, 6-7, 9-8, in holotype 7-7), four marginal setae of 2nd row shifted anteriad, marginal setae of 1st and 2nd rows (humeral setae) longest; two sternal setae between coxae III; 40–53 ventral setae; 4–6 humeroventral setae between coxae II and III laterally; NDV = 111–123; reduced stigmata visible, tracheae absent.

**Gnathosoma –** Cheliceral blade with one dorsal tooth and ventrolateral row of 11–12 denticles; cheliceral base with dense puncta in proximal part; gnathobase (infracapitulum) with sparse puncta, bears one pair of branched tritorostral setae; galeal (deutorostral) seta branched; palpal claw (odontus) with three prongs; palpal femoral, genual, and tibial setae branched; palpal tarsus with five branched setae and tarsala (ω).

**Scutum –** With sparse indistinct puncta, nearly pentagonal, with arcuate or slightly angulate posterior margin; nasus large, expanded in medial part; AM situated posterior to ALs, sensillary (trichobothrial) bases situated at level of PLs (PSB – P-PL = –2 – 2); PL > AL > AM; all scutal setae barbed similarly to dorsal idiosomal setae; sensilla (trichobothria) flagelliform, nude.

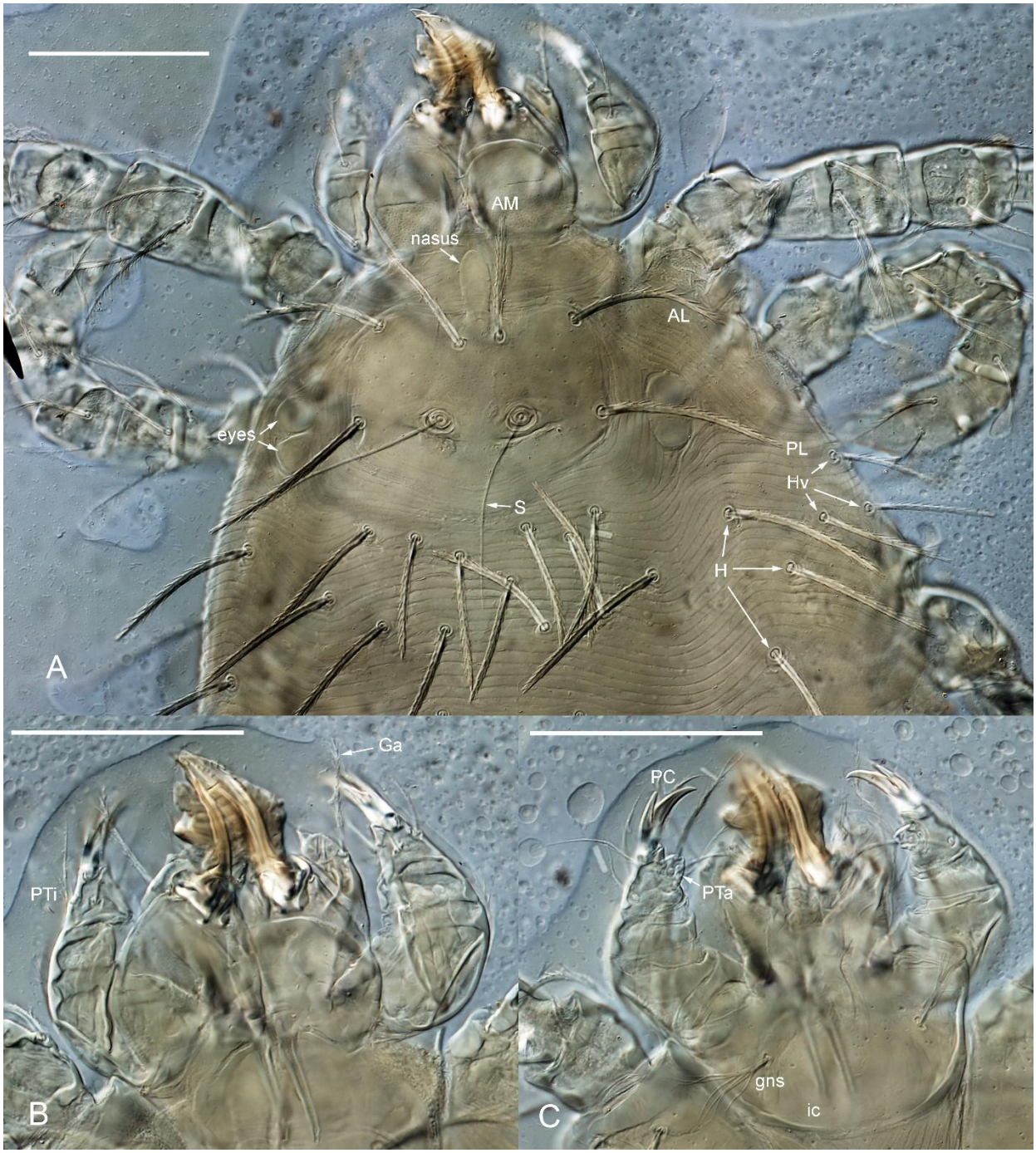


**Figure 11.** *Hyracarus thallomyia* (Radford, 1957) **comb. nov.**, holotype – **A.** Anterior part of idiosoma, dorsal aspect; **B.** Gnathosoma, dorsal aspect; **C.** Gnathosoma, ventral aspect. Abbreviations as in Figs. 5 and 7. Scale bars: 50 µm.

**Legs –** All six-segmented (with undivided femur), with one pair of claws and claw-like empodium, onychotriches absent. Specialized setae: Leg I: 2 genualae ($\sigma$), microgenuala ($\kappa$), 2 tibialae ($\varphi$) in tandem, microtibiala ($\kappa$) near distal tibiala, tarsala ($\omega$), famulus ($\varepsilon$) distal to tarsala, subterminala ($\zeta$), parasubterminala ($z$) with few branches, pretarsala ($\zeta$). Leg II: genuala ($\sigma$), microgenuala ($\kappa$) distal to genuala, 2 tibialae ($\varphi$) in tandem, tarsala ($\omega$), famulus ($\varepsilon$) behind tarsala, pretarsala ($\zeta$). Leg III: genuala ($\sigma$), tibiala ($\varphi$). Unspecialized setae (legs I, II, III): coxae 2, 1, 1; trochanters 1, 1, 1; femora 6, 6, 5; genua 4, 4, 4; tibiae 8(9?), 6, 6; tarsi 25(24), 16, 16. Ventral setae feathered, dorsal setae feathered or branched.

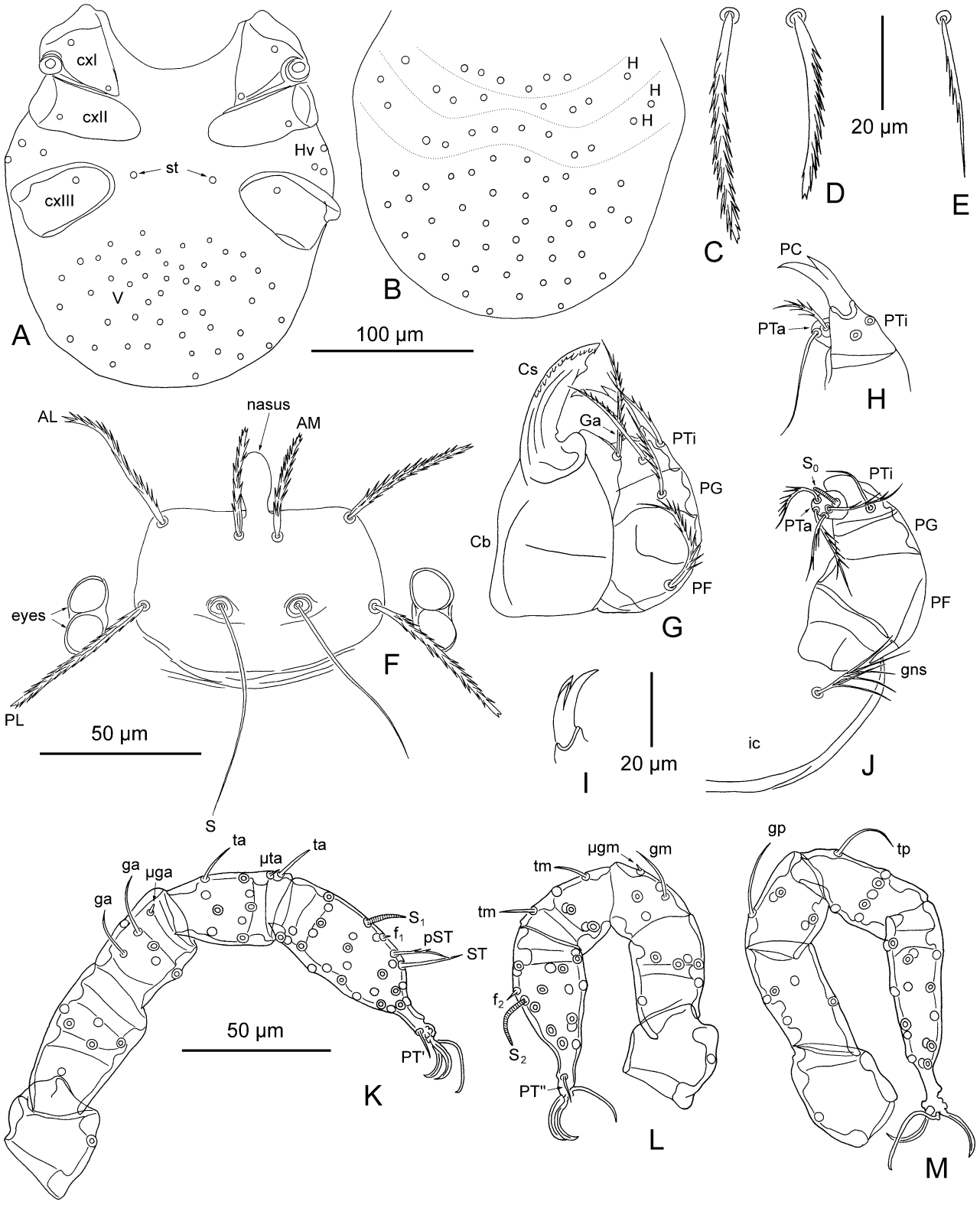


**Figure 12.** *Hyracarus thallomyia* (Radford, 1947) **comb. nov.**, paratype MNHN 14DR 6 – **A.** Ventral aspect of idiosoma (anus invisible); **B.** Dorsal aspect of idiosoma; **C.** Humeral seta; **D.** Dorsal idiosomal seta; **E.** Preanal seta; **F.** Scutum and eyes; **G.** Dorsal aspect of gnathosoma; **H.** Palpal tibia and palpal tarsus, dorsal aspect; **I.** Palpal claw (three prongs visible); **J.** Ventral aspect of gnathosoma; **K.** Leg I, trochanter–tarsus; **L.** Leg II, trochanter–tarsus; **M.** Leg III, trochanter–tarsus. Abbreviations as in Figs. 5 and 7. Scale bars: A–B, 100 µm; C–E, 20 µm; G–J, 20 µm; F, 50 µm; K–M, 50 µm.

**Table 5.** Morphometric (AW– $S_2$, μm) and meristic (DS–NDV) traits of *Hyracarus thallomyia* (Radford, 1947) **comb. nov.**, and *Acomatacarus lawrencei* Radford, 1948.

| Characters | *H. thallomyia* **comb. nov.** | | *Acomatacarus lawrencei* | | |
|---|---|---|---|---|---|
| | **Holotype** | **Paratype** | **Holotype** | **Paratype** | **Topotypic spec.** |
| **AW** | 54 | 60 | 60 | 59 | 59 |
| **PW** | 67 | 72 | 68 | 68 | 77 |
| **SB** | 22 | 25 | 24 | 22 | 23 |
| **ASB** | 31 | 29 | 32 | 31 | 29 |
| **PSB** | 20 | 25 | 21 | 17 | 16 |
| **P-PL** | 20 | 25 | 18 | 18 | 18 |
| **SD** | 51 | 54 | 53 | 48 | 45 |
| **AA** | 11 | 12 | 12 | 12 | 14 |
| **NL** | 19 | 21 | 22 | 21 | 22 |
| **NW** | 8 | 9 | 11 | 9 | 8 |
| **AP** | 27 | 27 | 29 | 27 | 27 |
| **AM** | 34 | 34 | 33 | 33 | 36 |
| **AL** | 44 | 45 | 45 | 45 | 43 |
| **PL** | 52 | 52 | 54 | 55 | 55 |
| **S** | 56 | 62 | 72 | - | 61 |
| **H** | 46 | 48 | 40 | 48 | 42 |
| **$D_{min}$** | 34 | 34 | 33 | 34 | 34 |
| **$D_{max}$** | 49 | 49 | 50 | 48 | 45 |
| **$V_{min}$** | - | 23 | - | - | 23 |
| **$V_{max}$** | - | 40 | - | - | 40 |
| **pa** | 301 | 271 | 287 | 280 | 261 |
| **pm** | 263 | 254 | 240 | 237 | 221 |
| **pp** | 296 | 280 | 281 | 268 | 263 |
| **Ip** | 860 | 805 | 808 | 785 | 745 |
| **TaIIIL** | 79 | 71 | 69 | 70 | 67 |
| **TaIIIW** | 19 | 18 | 21 | 20 | 15 |
| **$S_1$** | 14 | 13 | - | 15 | - |
| **$S_2$** | 18 | 18 | - | 18 | - |
| **DS** | 65 | 68 | - | 60 | 69 |
| **V** | 45 | 49 | - | 53 | 40 |
| **Hv** | 4 | 6 | 5 | 6 | 6 |
| **NDV** | 114 | 123 | 111 | 119 | 115 |

*Distribution and host*

Both *Acomatacarus thallomyia* and *A. lawrencei* were described from South Africa, Grahamstown (currently Makhanda, Eastern Cape Province), ex *Micaelamys namaquensis* (syn.: *Thallomys namaquensis grahami* Roberts) (Rodentia: Muridae).

*Type deposition*

Type specimens were not mentioned in the original description of *A. thallomyia*. Currently, the holotype is deposited in NHM; one paratype in MRAC (Stekolnikov 2018); one paratype in MNHN; one paratype in MHNG (V-G Inventory); and three paratypes in USNM (Bassini-Silva *et al.* 2021). The holotype of *A. lawrencei* is deposited in NHM; one paratype in MNHN; and four paratypes in

USNM (Bassini-Silva *et al.* 2021). According to the original description, paratypes were also sent to H. Womersley (SAM), to Dr. Carl Willmann (Bremen, Germany), and to Dr. P.J. Du Toit (Pretoria, South Africa). We have also found one topotypic specimen of *A. lawrencei* in MHNG and one in NMSA.

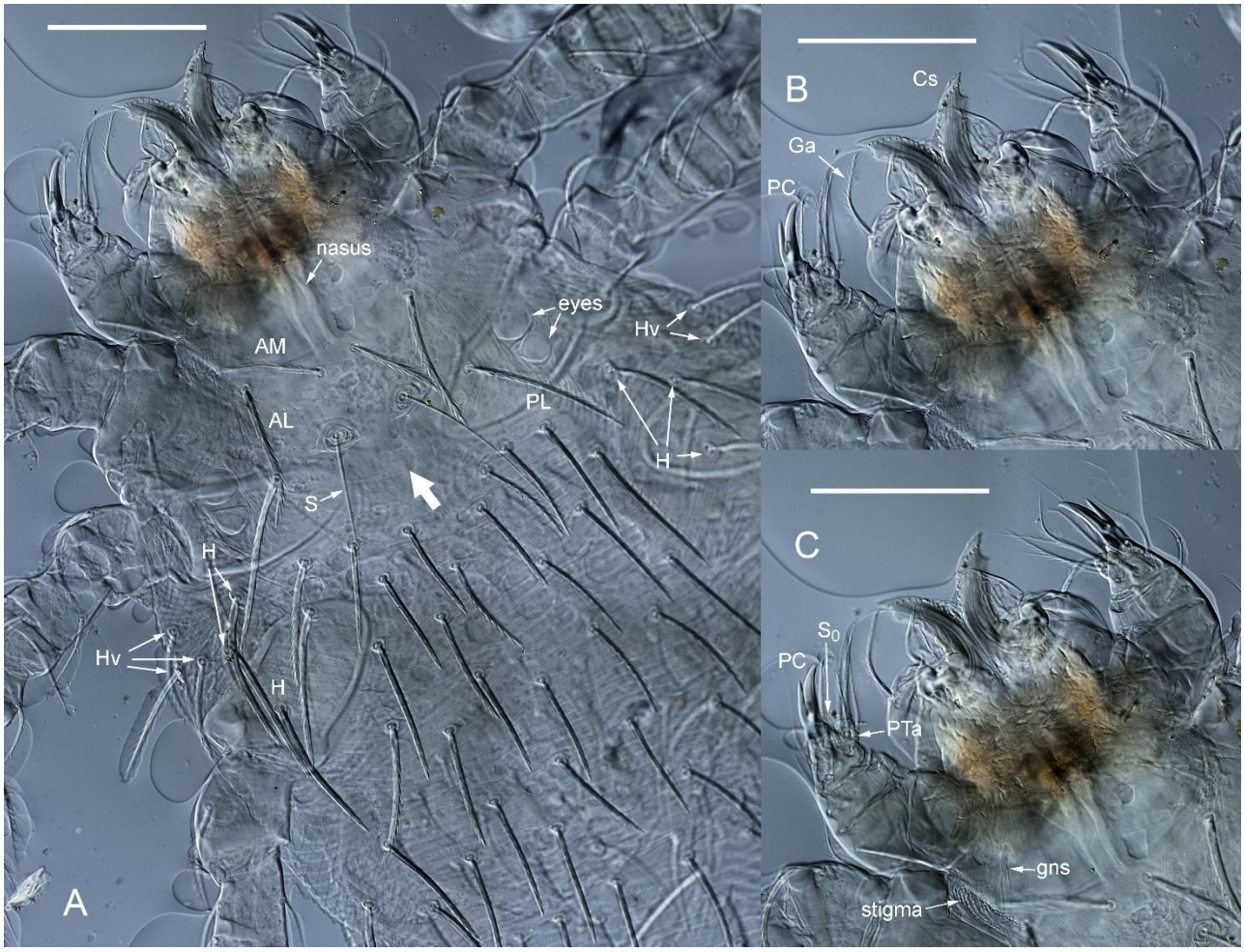


**Figure 13.** *Acomatacarus lawrencei* Radford, 1958, holotype – **A.** Anterior part of idiosoma, dorsal aspect; **B.** Gnathosoma, dorsal aspect; **C.** Gnathosoma, ventral aspect. Abbreviations as in Figs. 5 and 7. Posterior scutal margin shown by large arrow. Scale bars: 50 µm.

*Type material examined*

Holotype (larva) of *A. thallomyia*, NHM 1948.2.3.27, ex *Thallomys namaquensis grahami*, South Africa, Grahamstown, 22 May 1939, collector Dr. G. Theiler (Fig. 1F); one paratype (larva), MNHN 14DR 6, with same data (Fig. 1G). Holotype (larva) of *A. lawrencei*, NHM 1948.2.3.36, ex *Thallomys n. grahami*, Grahamstown, Glen Craig, 24 May [19]39, Dr. G. Theiler (Fig. 1H); one paratype (larva), MNHN 14DR 7, with same data (Fig. 1I).

We examined also one topotypic specimen (larva) of *A. lawrencei*, deposited in NMSA (NM 26516), with same data as holotype (Fig. 1J).

*Remarks*

In the original description of *H. thallomyia* drawings of this species and *Austracarus gateri* (Radford, 1942) are mixed up. Actually, Figures 5 and 6 represent the former species, while Figures 3 and 4 – the latter species.

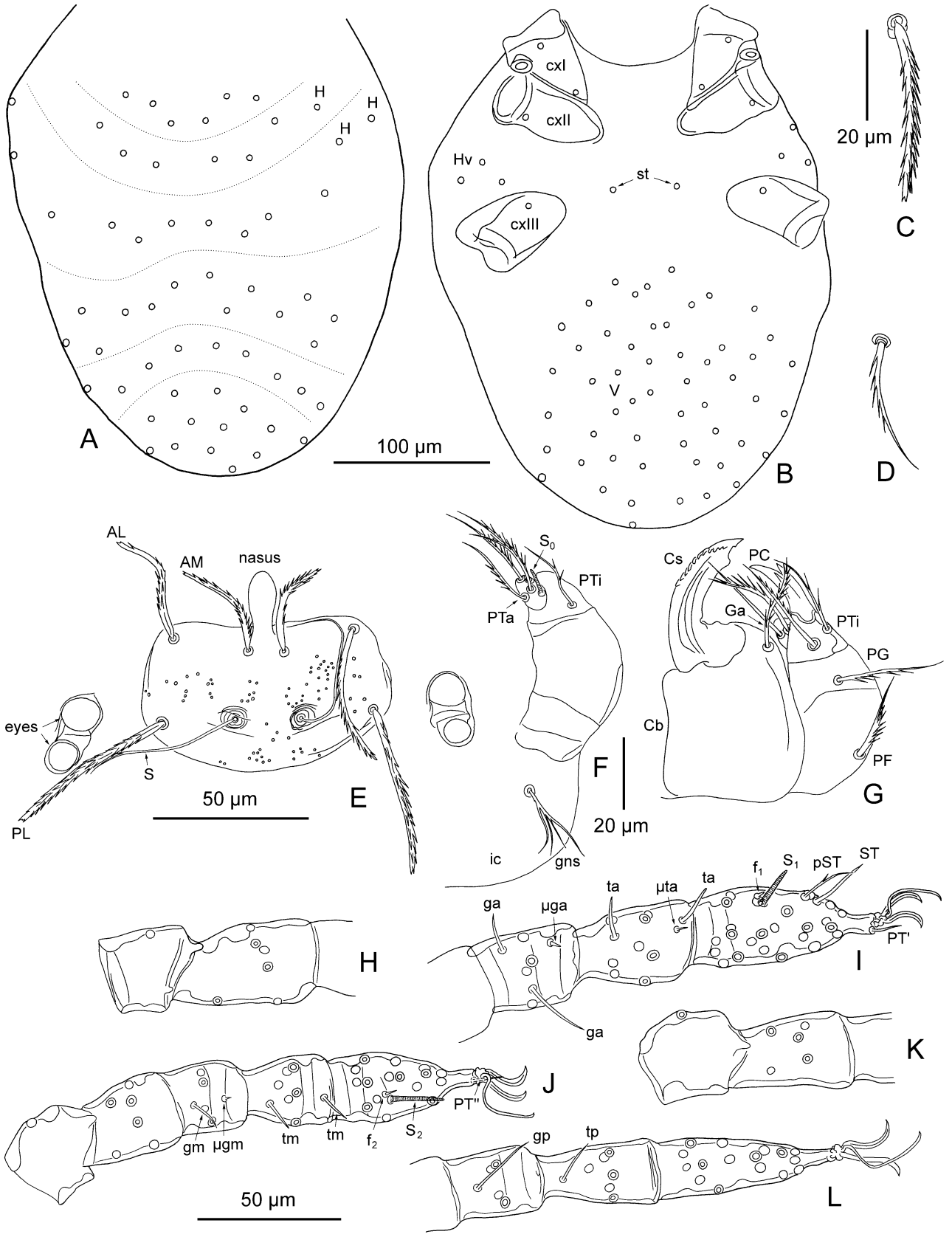


**Figure 14.** *Acomatacarus lawrencei* Radford, 1958, paratype MNHN 14DR 7 – **A.** Dorsal aspect of idiosoma; **B.** Ventral aspect of idiosoma (anus invisible); **C.** Dorsal idiosomal seta; **D.** Preanal seta; **E.** Scutum and eyes; **F.** Ventral aspect of gnathosoma; **G.** Dorsal aspect of gnathosoma; **H.** Leg I, trochanter–femur; **I.** Leg I, genu–tarsus; **J.** Leg II, trochanter–tarsus; **K.** Leg III, trochanter–femur; **L.** Leg III, genu–tarsus. Abbreviations as in Figs. 5 and 7. Scale bars: A–B, 100 µm; C–D, 20 µm; F–G, 20 µm; E, 50 µm; H–L, 50 µm.

The original description of *A. lawrencei* did not include differential diagnosis. Our examination of types for *H. thallomyia* and *A. lawrencei* revealed no differences between these species; therefore, we synonymize here the latter species with the former.

The holotypes of *H. thallomyia* and *A. lawrencei* have definitely five branched setae on the palpal tarsus. Our drawings of the paratypes of both species made in MNHN showed, however, presence of one additional nude seta. We cannot conclude with certainty whether it is a real variation or an examination error (this additional seta could be actually ciliated and one of other setae in the paratype of *A. lawrencei* could be erroneously interpreted as two superimposed setae). The holotypes also has fPp = B/B/BBB, but we were unable to observe branches on the ventral palpal tibial setae in the paratype of *H. thallomyia*.

The unusual numbers of unspecialized leg setae in the *H. thallomyia* paratype, namely, three setae on genu II, instead of four, five on tibia II, instead of six, and 15 on tarsus II, instead of 16 or 17, could be errors caused by insufficient quality of the microscope slide or of the optics. V-G Archive gave the following formula for a paratype of *H. thallomyia*: femora 6, 6, 5; genua 4, 4, 4; tibiae 9, 6, 6; tarsi 25, 17, 17. The formula for a topotypic specimen of *A. lawrencei* was the same, except the tarsi: 26, 17, 17. Our formula for the paratype of *A. lawrencei* from MNHN is: femora 6, 6, 5; genua 4, 4, 4; tibiae 8, 6, 6; tarsi 24, 16, 16.

### ***Hyracarus natalensis* Lawrence, 1949 (Figs. 15A, 16, 17)**

*Hyracarus natalensis* Lawrence, 1949: 459, Fig. 45; Radford 1954: 269; Stekolnikov 2018: 45.
*Acomatacarus* (*Hyracarus*) *natalensis*: Wharton and Fuller 1952: 101; Audy *et al.* 1961: 178.

*Diagnosis*

SIF = 6B-B-3-2111.2110; fPp = B/B/BBB; fD = [6-8]-8-8-8-6-4(3), DS = 45–48, V = 43–52, Hv = 4(3), NDV = 92–104; Ip = 715–756; scutum nearly trapezoidal, with slightly projected posterior margin; nasus slightly expanded in medial part; sensillary bases at level of PLs or anterior; PL > AL > AM; sensilla nude; cheliceral blade with one dorsal tooth and ventrolateral row of eight denticles; parasubterminala (*z*) branched. Unspecialized setae (legs I, II, III): femora 6, 6, 5; genua 4, 4, 4; tibiae 8, 6, 6; tarsi 23, 16, 17. Measurements are given in Table 6.

*Redescription of larva*

**Idiosoma –** Eyes 2 + 2, on ocular plate; 45–48 dorsal idiosomal setae covered by short barbs; distribution by anterior rows – 14 C, 8 D, 8 E, 8 F, 6 G plus 3–4 caudal setae, 1st row double (6 + 8), in holotype fD = [6-8]-8-8-8-6-3, two marginal setae of 2nd row shifted anteriad, marginal setae of 1st and 2nd rows (humeral setae) longest; two sternal setae between coxae III; 43–52 ventral setae; 4 (3 in one paratype) humeroventral setae between coxae II and III laterally; NDV = 92–104; stigmata and tracheae absent.

**Gnathosoma –** Cheliceral blade with one dorsal tooth and ventrolateral row of eight denticles; cheliceral base with dense puncta in proximal part; gnathobase (infracapitulum) with sparse puncta, bears one pair of branched tritorostral setae; galeal (deutorostral) seta branched; palpal claw (odontus) with three prongs; palpal femoral, genual, and tibial setae branched; palpal tarsus with six branched setae and tarsala (ω).

**Scutum –** With sparse indistinct puncta, nearly trapezoidal, with slightly projected posterior margin; nasus slightly expanded in medial part; AM situated at level of ALs, sensillary (trichobothrial) bases situated at level of PLs or anterior (up to 5 μm); PL > AL > AM; all scutal setae barbed similarly to dorsal idiosomal setae; sensilla (trichobothria) flagelliform, nude.

**Legs –** All six-segmented (with undivided femur), with one pair of claws and claw-like empodium, onychotriches absent. Specialized setae: Leg I: 2 genualae (*σ*), microgenuala (*κ*), 2 tibialae (*φ*) in tandem, microtibiala (*κ*) near distal tibiala, tarsala (*ω*), famulus (*ε*) distal to tarsala,

subterminala (ζ), parasubterminala (*z*) nude, pretarsala (ζ). Leg II: genuala (σ), microgenuala (κ) distal to genuala, 2 tibialae (φ) in tandem, tarsala (ω), famulus (ε) behind tarsala, pretarsala (ζ). Leg III: genuala (σ), tibiala (φ). Unspecialized setae (legs I, II, III): coxae 2, 1, 1; trochanters 1, 1, 1; femora 6, 6, 5; genua 4, 4, 4; tibiae 8, 6, 6; tarsi 23, 16, 17. Ventral setae branched, dorsal setae branched or nude. Numbers of nude setae: Leg I: tarsus 4 (+ 1 bearing one branch), tibia 2, genu 1; Leg II: tarsus 1, femur 2; Leg III: tarsus 2 (with one branch), tibia 1, genu 1 (with one branch).

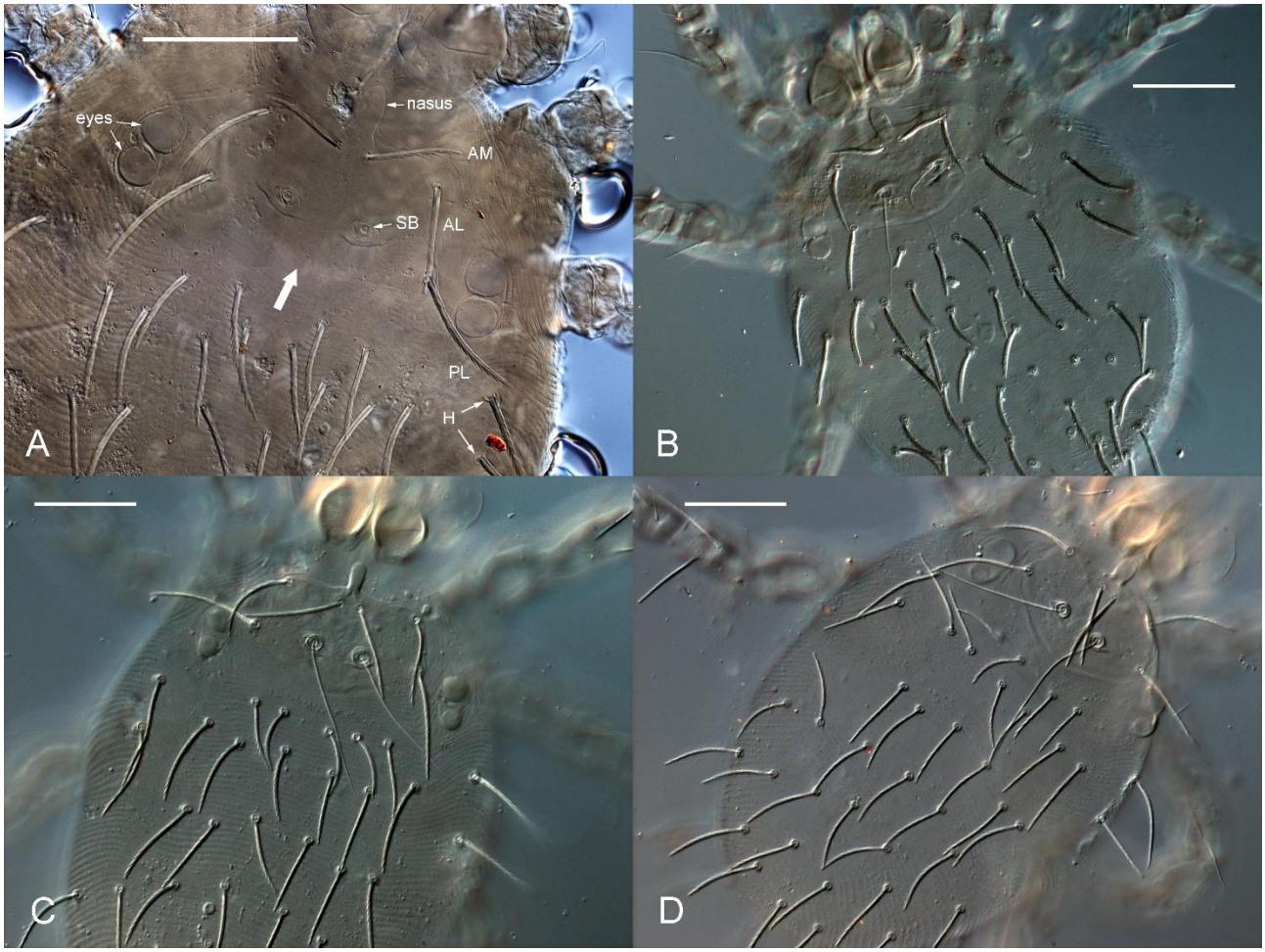


**Figure 15.** Anterior part of idiosoma, dorsal aspect – **A.** *Hyracarus natalensis* Lawrence, 1949, topotypic specimen NHM 1957.8.12.44; **B.** *H. sabiensis* **sp. nov.**, holotype; **C.** *H. aryanicki* **sp. nov.**, holotype; **D.** *H. limpopoensis* **sp. nov.**, holotype. Abbreviations as in Fig. 2. Posterior scutal margin of *H. natalensis* shown by large arrow. Scale bars: 50 µm.

**Table 6.** Morphometric (AW– $S_2$, µm) and meristic (DS–NDV) traits of *Hyracarus natalensis* Lawrence, 1949 and *H. sabiensis* **sp. nov.**

| Characters | *H. natalensis* | | | | *H. sabiensis* | | | |
|---|---|---|---|---|---|---|---|---|
| | Holotype | Range | Mean | N | Holotype | Range | Mean | N |
| **AW** | 59 | 56–59 | 58 | 4 | 59 | 56–59 | 58 | 6 |
| **PW** | 77 | 77–83 | 79 | 4 | 74 | 69–74 | 72 | 6 |
| **SB** | 27 | 25–29 | 27 | 4 | 29 | 23–29 | 25 | 6 |
| **ASB** | 27 | 27–31 | 28 | 4 | 27 | 25–27 | 27 | 6 |
| **PSB** | 19 | 19–20 | 20 | 2 | 20 | 19–22 | 20 | 6 |
| **P-PL** | 19 | 15–19 | 17 | 2 | 13 | 11–16 | 14 | 6 |
| **SD** | 46 | 46–47 | 47 | 2 | 47 | 46–49 | 47 | 6 |
| **AA** | 11 | 10–12 | 11 | 4 | 10 | 10–11 | 10 | 5 |

**Table 6.** Continued.

| Characters | *H. natalensis* | | | | *H. sabiensis* | | | |
|---|---|---|---|---|---|---|---|---|
| | Holotype | Range | Mean | N | Holotype | Range | Mean | N |
| **NL** | 14 | 14–17 | 16 | 4 | 14 | 13–15 | 14 | 5 |
| **NW** | 7 | 7–9 | 8 | 4 | 8 | 5–9 | 8 | 5 |
| **AP** | 23 | 23–29 | 27 | 4 | 30 | 26–30 | 28 | 6 |
| **AM** | 31 | 30–31 | 31 | 4 | 25 | 23–25 | 24 | 6 |
| **AL** | 40 | 36–40 | 38 | 4 | 31 | 30–32 | 31 | 6 |
| **PL** | 45 | 45–47 | 46 | 4 | 32 | 30–34 | 32 | 6 |
| **S** | - | 57–60 | 59 | 2 | 56 | 56–67 | 60 | 5 |
| **H** | - | 44–46 | 45 | 2 | 35 | 32–36 | 35 | 6 |
| **$D_{min}$** | 27 | 25–31 | 28 | 4 | 25 | 22–25 | 23 | 6 |
| **$D_{max}$** | 45 | 40–45 | 43 | 4 | 34 | 32–34 | 33 | 6 |
| **$V_{min}$** | 18 | 18–20 | 19 | 2 | 22 | 20–23 | 22 | 6 |
| **$V_{max}$** | 29 | 29–29 | 29 | 2 | 30 | 29–32 | 30 | 6 |
| **pa** | 274 | 251–274 | 259 | 3 | 284 | 265–286 | 277 | 6 |
| **pm** | 225 | 221–225 | 222 | 3 | 245 | 227–245 | 235 | 6 |
| **pp** | 257 | 241–258 | 252 | 3 | 270 | 261–274 | 268 | 6 |
| **Ip** | 756 | 715–756 | 734 | 3 | 799 | 758–799 | 780 | 6 |
| **TaIIIL** | 65 | 65–65 | 65 | 2 | 68 | 68–72 | 70 | 6 |
| **TaIIIW** | - | 22 | - | 1 | 14 | 13–14 | 14 | 6 |
| **$S_1$** | - | 14 | - | 1 | 17 | 17–19 | 18 | 4 |
| **$S_2$** | - | 14 | - | 1 | 14 | 14–16 | 15 | 4 |
| **DS** | 47 | 45–48 | 47 | 4 | 47 | 44–47 | 46 | 6 |
| **V** | 51 | 43–52 | 49 | 4 | 44 | 39–46 | 43 | 6 |
| **Hv** | 4 | 3–4 | 4 | 4 | - | - | - | - |
| **NDV** | 102 | 92–104 | 100 | 4 | 91 | 83–91 | 89 | 6 |

*Distribution and host*

This species was described from South Africa, Drakensberg mountains, Giants Castle (type series) and Dargle, Natal (currently KwaZulu-Natal) Province (additional material) ex *Trachylepis striata* (Peters) (syn.: *Mabuya striata*) (Squamata: Scincidae).

*Type deposition*

Originally, nine type specimens (NM 4824), without mention of holotype, were deposited in NMSA (Lawrence 1949). Currently, holotype and one paratype are deposited in NMSA and two paratypes are deposited in NHM.

*Type material examined*

Holotype (larva), NM 4824, Giants Castle, Natal, ex *Mabuya striata* (Fig. 1K). One paratype (larva) from NMSA, same data (Fig. 1L). One paratype (larva), NHM 1957.8.12.45 (Fig. 1M), same data.

We also examined and photographed one topotypic specimen (larva) of *H. natalensis* deposited in NHM (1957.8.12.44), with same data as holotype (Fig. 1N).

*Remarks*

Characters of gnathosoma are given after V-G Archive. The formulae for leg setae in this source are different from our observation made for the NMSA paratype – tibiae 9, 6, 6 vs. 8, 6, 6 and tarsi

25, 17, 17 vs. 23, 16, 17. We were also unable to observe one proximal seta on leg I femur.

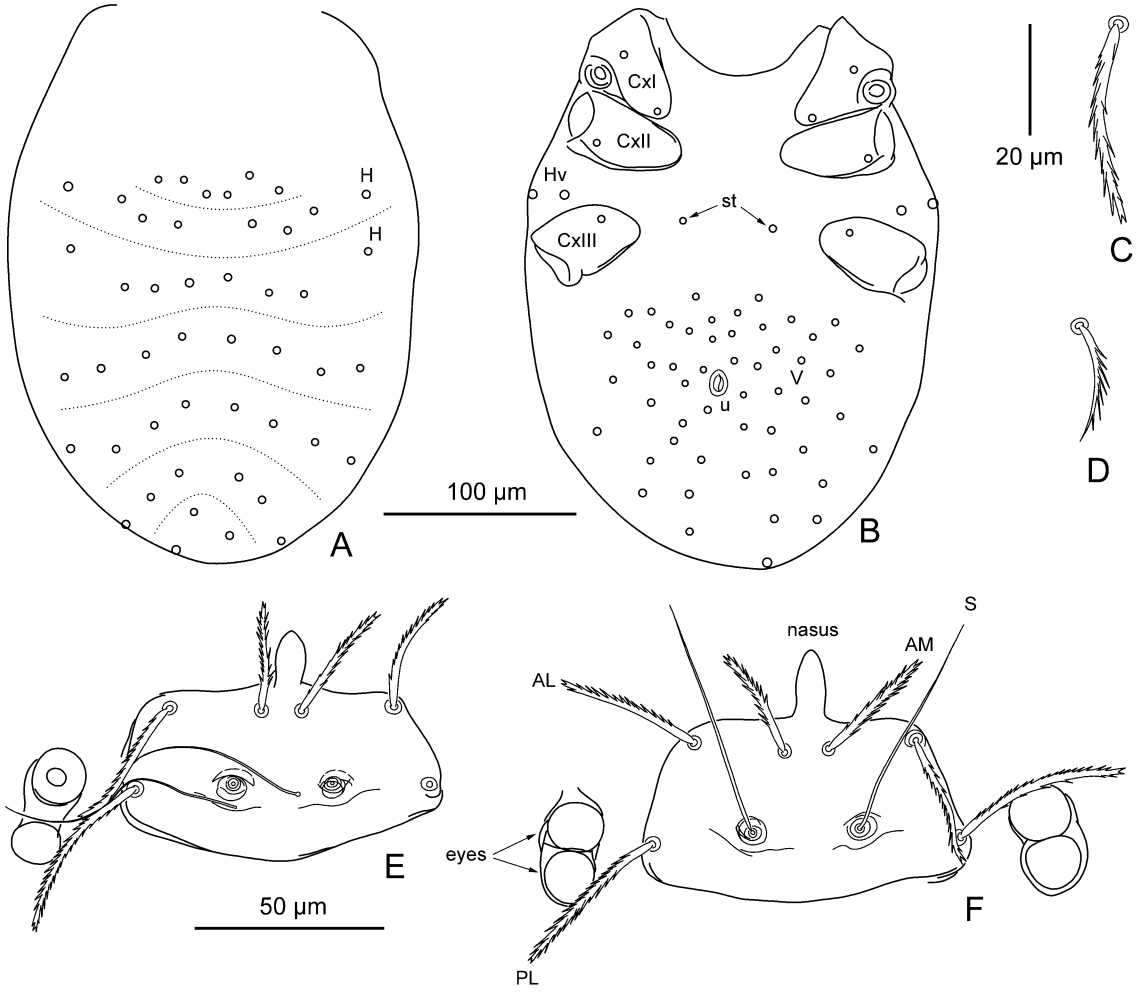


**Figure 16.** *Hyracarus natalensis* Lawrence, 1949 (A–E, holotype; F, paratype 1) – **A.** Dorsal aspect of idiosoma; **B.** Ventral aspect of idiosoma; **C.** Dorsal idiosomal seta; **D.** Preanal seta; **E, F.** Scutum and eyes. Abrreviations as in Figs. 5 and 7. Scale bars: A–B, 100 µm; C–D, 20 µm; E–F, 50 µm.

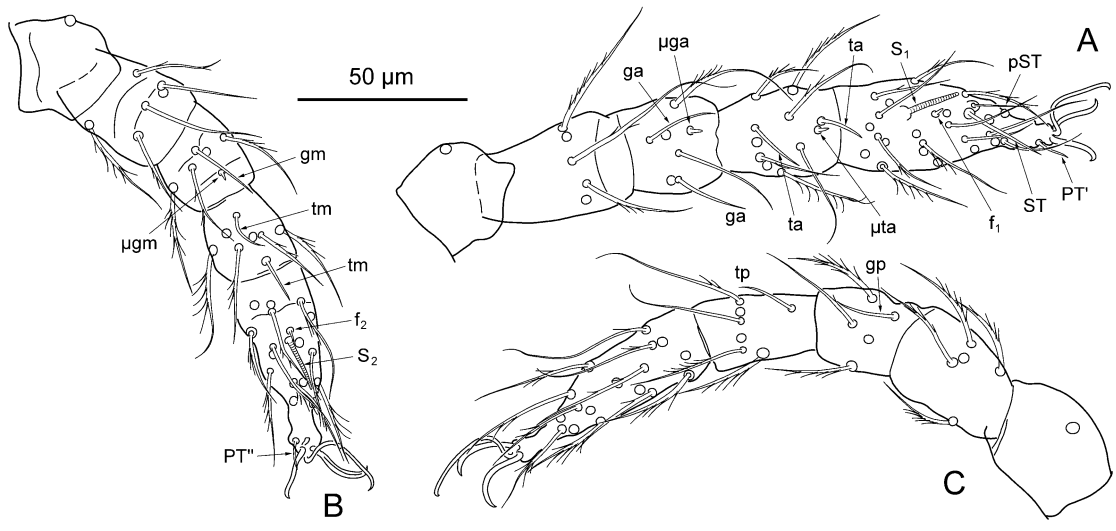


**Figure 17.** *Hyracarus natalensis* Lawrence, 1949, paratype 1 – **A.** Leg I, trochanter–tarsus; **B.** Leg II, trochanter–tarsus; **C.** Leg III, trochanter–tarsus. Abbreviations as in Fig. 5.

### ***Hyracarus sabiensis* sp. nov. (Figs. 15B, 18)**

http://zoobank.org/urn:lsid:zoobank.org:act:69B66D9D-091A-4B81-AA2D-5A92B755A3D7

*Diagnosis*

SIF = 6B-B-3-2111.4212; fPp = b/b/bbb; fD = (10–12)-8-8-8(9)-6(4)-2(6)-2, DS = 44–47, V = 39–46, Hv = 0, NDV = 83–91; Ip = 758–799; scutum nearly rectangular, with slightly projected, angulate posterior margin; nasus almost unexpanded, with conical end; sensillary bases anterior to level of PLs by 5–8 μm; PL ≥ AL > AM; sensilla nude; cheliceral blade with dorsal tooth and row of 7–8 ventral denticles; parasubterminala (*z*) branched. Unspecialized setae (legs I, II, III): femora 6, 6, 5; genua 4, 4, 4; tibiae 8, 6, 6; tarsi 24, 17, 16. Measurements are given in Table 6.

*Description of larva*

**Idiosoma –** Eyes 2 + 2, on ocular plate; 44–47 barbed dorsal idiosomal setae; distribution by anterior rows – 10–12 C, 8 D, 8 E, 8(9) F, 1st row double (variants of division by sub-rows 4-6, 4-7, 4-8, 5-6, and 6-6), in holotype fD = [4-7]-8-8-8-4-6-2, two marginal setae of 2nd row shifted anteriad, marginal setae of 1st and 2nd rows (humeral setae) longest; two sternal setae between coxae III; 39–46 ventral setae; humeroventral setae absent; NDV = 83–91; stigmata and tracheae absent.

**Gnathosoma –** Cheliceral blade with one dorsal tooth and ventrolateral row of 7–8 denticles; cheliceral base with dense puncta in proximal part and sparse puncta in distal part; gnathobase (infracapitulum) with dense puncta, bears one pair of branched tritorostral setae; galeal (deutorostral) seta with cilia; palpal claw (odontus) with three prongs; palpal femoral, genual, and tibial setae finely ciliated; palpal tarsus with six ciliated setae and tarsala (ω).

**Scutum –** With sparse puncta, nearly rectangular, with slightly projected posterior margin; nasus almost unexpanded, with conical end; AM situated at level of ALs, sensillary (trichobothrial) bases anterior to level of PLs by 5–8 μm; PL ≥ AL > AM; all scutal setae barbed similarly to dorsal idiosomal setae; sensilla (trichobothria) flagelliform, nude.

**Legs –** All six-segmented (with undivided femur), with one pair of claws and claw-like empodium, onychotriches absent. Specialized setae: Leg I: 2 genualae (*σ*), microgenuala (*κ*), 2 tibialae (*φ*) in tandem, microtibiala (*κ*) near distal tibiala, tarsala (*ω*), famulus (*ε*) distal to tarsala, subterminala (*ζ*), branched parasubterminala (*z*), pretarsala (*ζ*). Leg II: genuala (*σ*), microgenuala (*κ*) distal to genuala, 2 tibialae (*φ*) in tandem, tarsala (*ω*), famulus (*ε*) behind tarsala, pretarsala (*ζ*). Leg III: genuala (*σ*), tibiala (*φ*). Unspecialized setae (legs I, II, III): coxae 2, 1, 1; trochanters 1, 1, 1; femora 6, 6, 5; genua 4, 4, 4; tibiae 8, 6, 6; tarsi 24, 17, 16. Ventral setae feathered, dorsal setae branched or nude. Numbers of nude setae: Leg I: tarsus 5 (+ 1 bearing one cilium), tibia 1 (+ 1 bearing one branch), femur 1 (+ 1 bearing two cilia); Leg III: tarsus 2 (+ 2 bearing one cilium), tibia 2, genu 1, femur 2 (with one cilium).

*Type material*

Holotype (larva), ZIN 10430, ex unidentified shrew (Eulipotyphla: Soricidae) No. KNP Shw, South Africa, Skukuza, Kruger National Park, 24.9948° S, 31.5969° E, 16 November 2016, coll. S. Matthee. Six paratypes (larvae) (ZIN 10429, 10431, 10432, 10434–10436), with same data.

*Etymology*

The species name refers to the Sabie River flowing near the type locality.

*Differential diagnosis*

The new species is similar to *H. natalensis* and differs from it by the absence of humeroventral setae, $S_1 > S_2$ vs. $S_1 = S_2$ (Table 6), shorter scutal and dorsal idiosomal setae (AM 23–25, AL 30–32, PL 30–34, H 32–36, $D_{max}$ 32–34 vs. 30–31, 36–40, 45–47, 44–46, and 40–45, respectively), and by slightly longer legs (Ip 758–799 and TaIIIL 68–72 vs. 715–756 and 62–65).

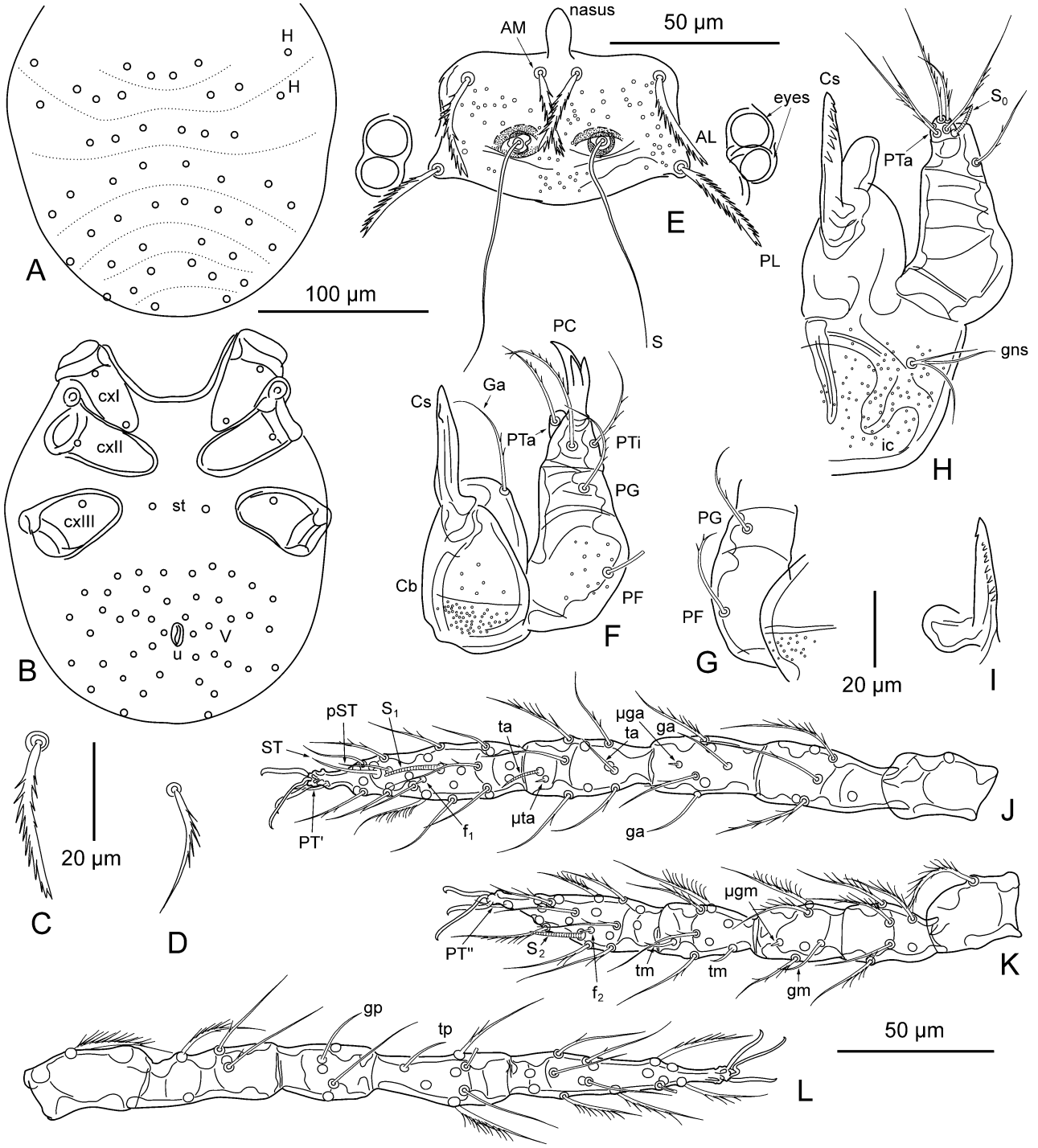


**Figure 18.** *Hyracarus sabiensis* **sp. nov.** (A–D, F–I, holotype; E, paratype ZIN 10431; J–L, paratype ZIN 10436) – **A.** Dorsal aspect of idiosoma; **B.** Ventral aspect of idiosoma; **C.** Dorsal idiosomal seta; **D.** Preanal seta; **E.** Scutum and eyes; **F.** Dorsal aspect of gnathosoma (palpal femoral seta broken); **G.** Palpal femur and genu; **H.** Ventral aspect of gnathosoma; **I.** Cheliceral blade; **J.** Leg I, trochanter–tarsus; **K.** Leg II, trochanter–tarsus; **L.** Leg III, trochanter–tarsus. Abbreviations as in Fig. 5. Scale bars: A–B, 100 µm; C–D, 20 µm; F–I, 20 µm; E, 50 µm; J–L, 50 µm.

## *Hyracarus claviglis* (Vercammen-Grandjean, 1955)

*Acomatacarus* (*Hyracarus*) *claviglis* Vercammen-Grandjean, 1955: 183, Fig. 1; Audy *et al.* 1961: 177.

*Hyracarus claviglis*: Stekolnikov 2018: 44; 2019: 14.

*Diagnosis (after Vercammen-Grandjean 1955)*

SIF = 7B-B-3-2111.1211; fPp = B/B/BBB; fD = 2H-[10-4]-6-8-8-8-6-4; DS = 56, V = 64, Hv = 4, NDV = 124; Ip = 756; scutum nearly trapezoidal, with slightly projected posterior margin; sensillary bases at level of PLs; PL > AL > AM; sensilla nude; cheliceral blade with dorsal tooth and row of ca. nine ventral denticles; parasubterminala (*z*) nude. Measurements are given in Table 7.

*Distribution and hosts*

This species is known from one specimen collected in Kabunga, 120 km NE Bukavu (Democratic Republic of the Congo), ex *Claviglis smithii* (Thomas), according to the original description, but ex *Graphiurus murinus* (Desmarest) (Rodentia: Gliridae) according to Audy *et al.* (1961).

*Type deposition*

Holotype (larva) is deposited in MHNG (Stekolnikov 2019).

### ***Hyracarus lemniscomyia* (Vercammen-Grandjean, 1957)**

*Acomatacarus* (*Hyracarus*) *lemniscomyia* Vercammen-Grandjean, 1957: 15, Pl. 1; Audy *et al.* 1961: 177, Fig. 99h.
*Odontacarus* (*Hyracarus*) *lemniscomyia*: Taufflieb 1965: 34.
*Hyracarus lemniscomyia*: Stekolnikov 2018: 45; 2019: 14.

*Diagnosis (after Vercammen-Grandjean 1957)*

SIF = 7B-B-3-2111.3120; fPp = B/B/BBB; fD = 2H-10-10-10-10-12-10-10-8-6-4-2; DS = 94, V = 68, Hv = 2, NDV = 164 (including Hv); Ip = 852; scutum nearly trapezoidal, with arcuate posterior margin; sensillary bases posterior to level of PLs; PL > AL > AM; sensilla densely ciliated in proximal 2/3; cheliceral blade with dorsal tooth and row of ca. 10–12 ventral denticles; parasubterminala (*z*) nude. Measurements are given in Table 7.

*Distribution and hosts*

This species was described from Angola, Alto Chicapa (Lunda Sul Province), ex *Lemniscomys striatus* (L.) (Rodentia: Muridae).

*Type deposition*

Holotype and four paratypes (larvae) are deposited in MHNG (Stekolnikov 2019; V-G Inventory).

*Remarks*

Vercammen-Grandjean (1957) noted that dorsal leg setae in this species bear only one or two barbs and that the setae of leg III, which he included in SIF (three mastitarsalae, one mastitibiala, and two mastigenualae), have up to four fine barbs.

### ***Hyracarus mutabilis* (Vercammen-Grandjean & Brennan, 1957) comb. nov.**

*Acomatacarus* (*Acomatacarus*) *mutabilis* Vercammen-Grandjean & Brennan, 1957: 487, Fig. 8; Audy *et al.* 1961: 177, Fig. 98a–e.
*Acomatacarus mutabilis*: Stekolnikov 2018: 39; 2019: 7.

*Diagnosis (after Vercammen-Grandjean and Brennan 1957)*

SIF = 7B-B-3-2111.2200; fPp = B/B/BBB; fD = 8-10-10-4-8-8-8-6-6-4-4 (including humeroventral setae); DS = 70, V = 60, Hv = 6, NDV = 136; Ip = 715; scutum nearly trapezoidal,

with slightly projected, arcuate posterior margin; nasus unexpanded, with conical end; sensillary bases at level of PLs; PL > AL > AM; sensilla with few cilia in distal half; cheliceral blade with dorsal tooth and row of six ventral denticles; parasubterminala (*z*) branched. Measurements are given in Table 7.

*Distribution and host*

This species is known from one specimen collected in Uganda, Kaabong, ex unidentified hyrax (Hyracoidea: Procaviidae).

*Type deposition*

Holotype (larva) is deposited in MHNG (Stekolnikov 2019).

*Remarks*

The holotype is an aberrant specimen having only one eccentric AM seta (Vercammen-Grandjean and Brennan 1957). Its description completely fits the diagnosis of *Hyracarus*.

### ***Hyracarus aryanicki* sp. nov. (Figs. 15C, 19, 20)**

http://zoobank.org/urn:lsid:zoobank.org:act:00E92423-263A-4B2C-BC49-52FE01E8EE6A

*Diagnosis*

SIF = 7B-B-3-2111.1110; fPp = B/B/bbb; fD = [4(5)-8]-8-8-8-6+(3–4), DS = 45–47, V = 37–41, Hv = 2, NDV = 86–88; Ip = 880–905; scutum pentagonal, with angulate posterior margin; nasus unexpanded, with rounded end; sensillary bases at level of PLs (PSB – P-PL = –2 – 2); PL > AM ≥ AL; sensilla nude; cheliceral blade with dorsal tooth and row of 11 ventral denticles; parasubterminala (*z*) branched. Unspecialized setae (legs I, II, III): femora 6, 6, 5; genua 4, 4, 4; tibiae 9, 6, 6; tarsi 25, 17, 17. Measurements are given in Table 8.

*Description of larva*

**Idiosoma –** Eyes 2 + 2, on ocular plate; 45–47 barbed dorsal idiosomal setae; distribution by rows – 12–13 C, 8 D, 8 E, 8 F, 6 G plus 3–4 caudal setae, 1st row double (variants of division by sub-rows 4-8 and 5-8), in holotype fD = [5-8]-8-8-8-6-2-2, two marginal setae of 2nd row shifted anteriad, marginal setae of 1st and 2nd rows (humeral setae) longest; two sternal setae between coxae III; 37–41 ventral setae; two humeroventral setae between coxae II and III laterally; NDV = 86–88; reduced stigmata visible, tracheae absent.

**Gnathosoma –** Cheliceral blade with one dorsal tooth and ventrolateral row of 11 denticles; cheliceral base and palpal femur with sparse puncta; gnathobase (infracapitulum) with sparse puncta, bears one pair of branched tritorostral setae; galeal (deutorostral) seta ciliated; palpal claw (odontus) with three prongs; palpal femoral and genual setae with few branches, tibial setae finely ciliated; palpal tarsus with seven ciliated setae and tarsala (ω).

**Scutum –** With sparse puncta, pentagonal, with angulate posterior margin; nasus unexpanded, with rounded end; AM situated slightly posterior to level of ALs, sensillary (trichobothrial) bases at level of PLs (PSB – P-PL = –2 – 2); PL > AM ≥ AL; all scutal setae barbed similarly to dorsal idiosomal setae; sensilla (trichobothria) flagelliform, nude or bearing one small cilium.

**Legs –** All six-segmented (with undivided femur), with one pair of claws and claw-like empodium, onychotriches absent. Specialized setae: Leg I: 2 genualae (*σ*), microgenuala (*κ*), 2 tibialae (*φ*) in tandem, microtibiala (*κ*) near distal tibiala, tarsala (*ω*), famulus (*ε*) distal to tarsala, subterminala (*ζ*), branched parasubterminala (*z*), pretarsala (*ζ*). Leg II: genuala (*σ*), microgenuala (*κ*) distal to genuala, 2 tibialae (*φ*) in tandem, tarsala (*ω*), famulus (*ε*) proximal to tarsala, pretarsala (*ζ*). Leg III: genuala (*σ*), tibiala (*φ*). Unspecialized setae (legs I, II, III): coxae 2, 1, 1; trochanters 1, 1, 1; femora 6, 6, 5; genua 4, 4, 4; tibiae 9, 6, 6; tarsi 25, 17, 17. Ventral setae feathered, dorsal setae

branched or nude. Numbers of nude setae: Leg I: tarsus 3 (+ 1 bearing two small cilia), tibia 1 (+ 1 bearing one branch), femur 1 (+ 1 bearing three cilia); Leg III: tarsus 1, tibia 1, genu 1.

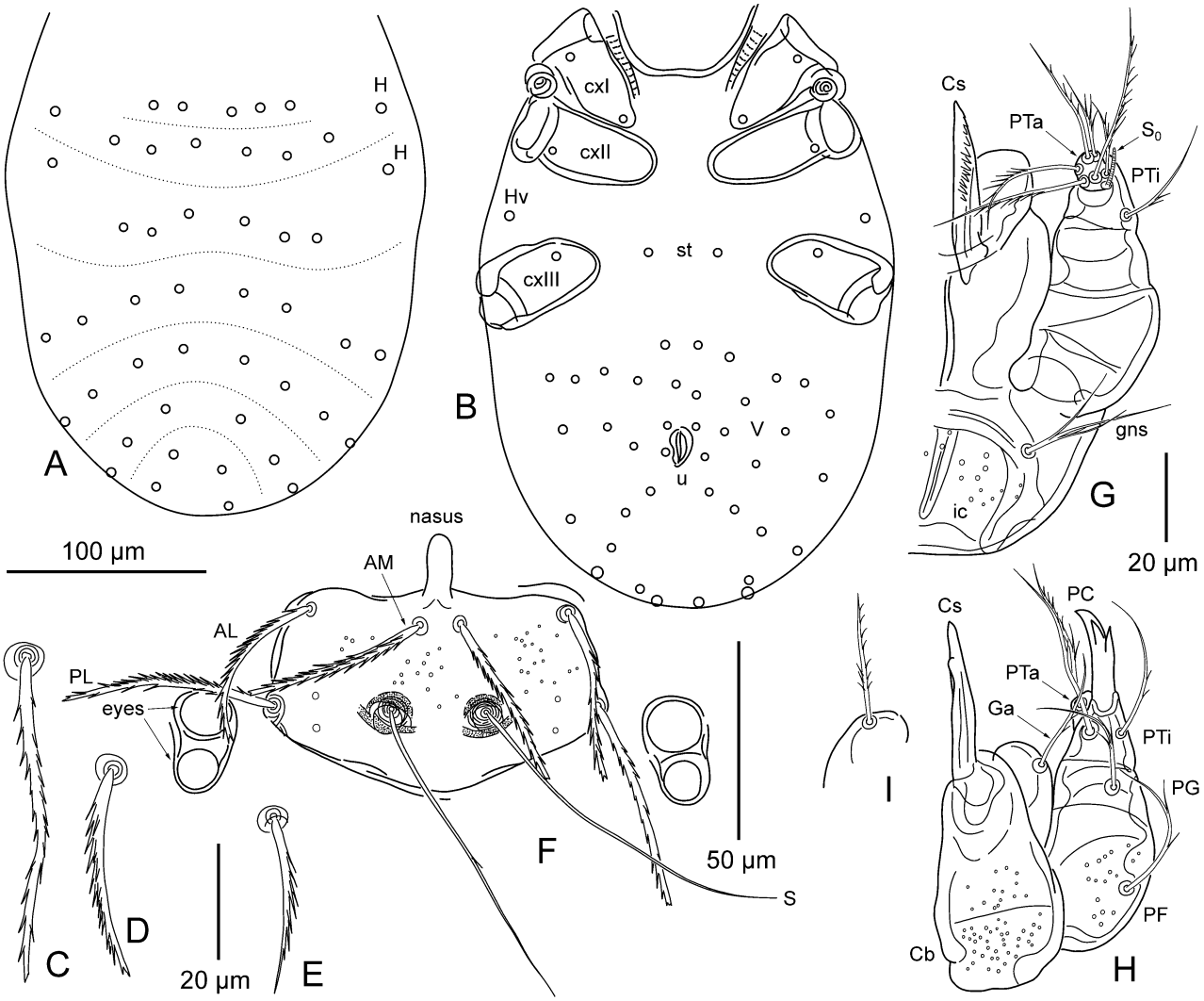


**Figure 19.** *Hyracarus aryanicki* **sp. nov.**, holotype – **A.** Dorsal aspect of idiosoma; **B.** Ventral aspect of idiosoma; **C.** Humeral seta; **D.** Dorsal idiosomal seta (center of row C); **E.** Preanal seta; **F.** Scutum and eyes; **G.** Ventral aspect of gnathosoma; **H.** Dorsal aspect of gnathosoma; **I.** Galeal seta. Abbreviations as in Figs. 5 and 7. Scale bars: A–B, 100 µm; C–E, 20 µm; F, 50 µm; G–I, 20 µm.

*Type material*

Holotype (larva), ZIN 9770, in ear of *M. namaquensis* No. PT 2013-7, X 14/50, South Africa, Limpopo Province, Louis Trichardt (Makhado), Lajuma Research Centre, 26 May 2013, coll. A. Halajian. Seven paratypes (larvae) (ZIN 9751, 9769, 9771, 9772, 9774, 9776, 9777) with same data.

*Etymology*

The species is named in honor of Arya Nick, the son of AH.

*Differential diagnosis*

The new species is similar to *H. lemniscomyia* by the presence of two humeroventral setae and seven unspecialized setae on the palpal tarsus, but differs in the pentagonal scutum vs. nearly trapezoidal, twice lesser number of idiosomal setae (NDV 86–88 vs. 164), sensillary bases at level of

PLs vs. posterior, sensilla nude vs. ciliated, parasubterminala branched vs. nude, AM ≥ AL vs. AL > AM, lesser scutum (AW–ASB, SD), shorter nasus (NL), and shorter setae (AM–$V_{min}$) (Table 7).

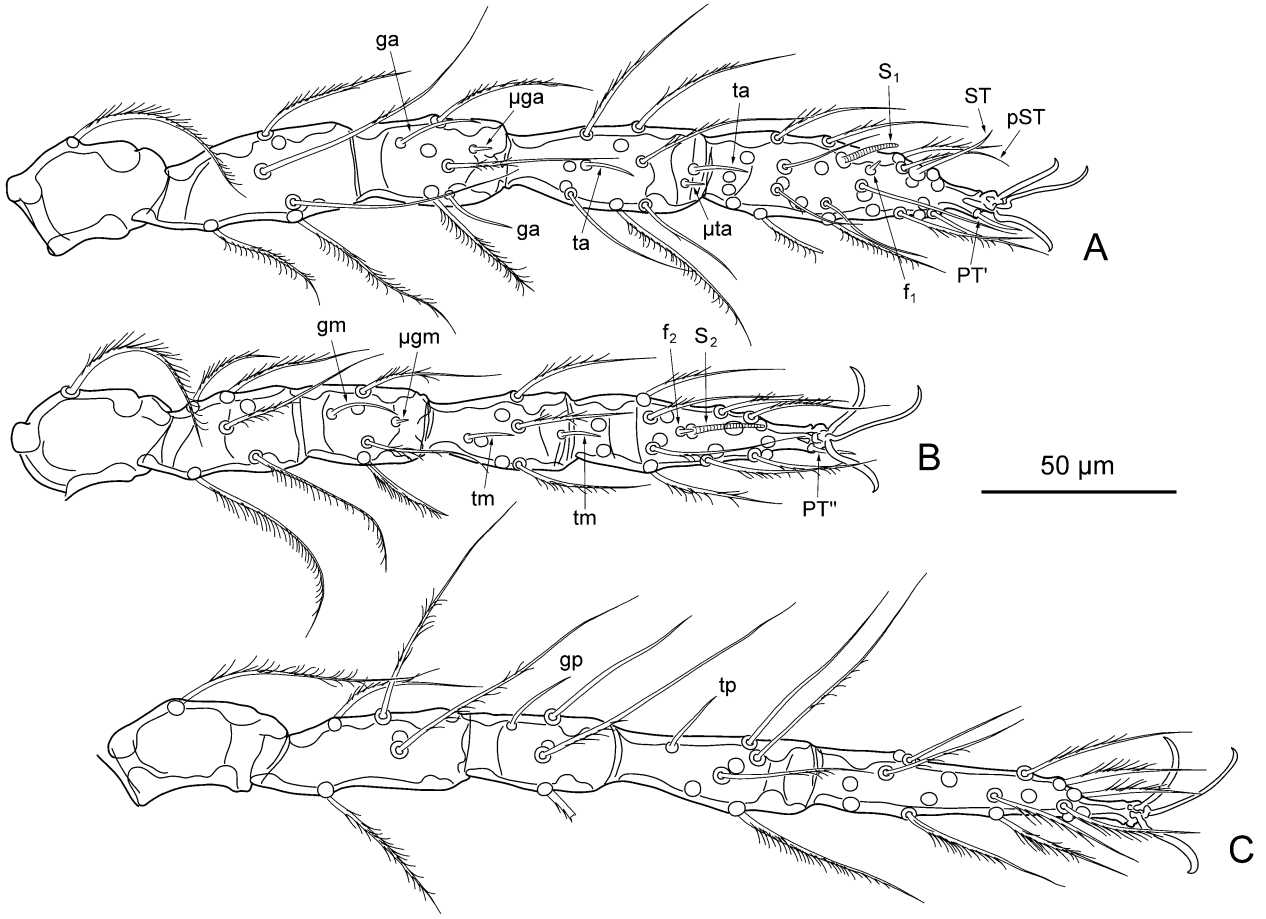


**Figure 20.** *Hyracarus aryanicki* **sp. nov.**, holotype – **A.** Leg I, trochanter–tarsus; **B.** Leg II, trochanter–tarsus; **C.** Leg III, trochanter–tarsus. Abbreviations as in Fig. 5.

**Table 7.** Morphometric (AW–$S_2$, μm) and meristic (DS–NDV) traits of *Hyracarus claviglis* Vercammen-Grandjean, 1955, *H. lemniscomyia* Vercammen-Grandjean, 1957, and *H. mutabilis* (Vercammen-Grandjean & Brennan, 1957) **comb. nov.**

| Characters | *H. claviglis** | *H. lemniscomyia*** | *H. mutabilis**** |
|---|---|---|---|
| | Holotype | Mean | Holotype |
| **AW** | 54 | 77 | 67 |
| **PW** | 74 | 99 | 88 |
| **SB** | 22 | 34 | 29 |
| **ASB** | 29 | 36 | 34 |
| **PSB** | 17 | 22 | 19 |
| **SD** | 46 | 58 | 53 |
| **AA** | 12 | 14 | - |
| **NL** | 17 | 18 | - |
| **NW** | 9 | 9 | - |
| **AP** | 25 | 24 | 28 |
| **AM** | 37 | 51 | 42 |
| **AL** | 42 | 61 | 47 |

Note. * – holotype, after Vercammen-Grandjean (1955); ** – mean of holotype and five paratypes (Vercammen-Grandjean 1957); *** – holotype, after Vercammen-Grandjean and Brennan (1957).

**Table 7.** Continued.

| Characters | *H. claviglis** | *H. lemniscomyia*** | *H. mutabilis**** |
|---|---|---|---|
| | Holotype | Mean | Holotype |
| **PL** | 60 | 74 | 64 |
| **S** | 74 | 93 | 79 |
| **H** | 57 | 75 | 62 |
| **$D_{min}$** | 27 | 45 | 33 |
| **$D_{max}$** | 43 | 67 | 58 |
| **$V_{min}$** | 25 | 30 | 20 |
| **$V_{max}$** | 32 | 45 | 35 |
| **pa** | 264 | 288 | 245 |
| **pm** | 230 | 255 | 204 |
| **pp** | 262 | 309 | 266 |
| **Ip** | 756 | 852 | 715 |
| **DS** | 56 | 94 | 70 |
| **V** | 64 | 68 | 60 |
| **Hv** | 4 | 2 | 6 |
| **NDV** | 124 | 164 | 136 |

Note. * – holotype, after Vercammen-Grandjean (1955); ** – mean of holotype and five paratypes (Vercammen-Grandjean 1957); *** – holotype, after Vercammen-Grandjean & Brennan (1957).

### *Hyracarus limpopoensis* sp. nov. (Figs. 15D, 21)

http://zoobank.org/urn:lsid:zoobank.org:act:7EB7C019-EE99-42A7-9922-EF7F21D50001

*Diagnosis*

SIF = 7B-B-3-2111.2210; fPp = B/B/BNB; fD = [4(5)-8(7)]-8-8-8-6-2-2, DS = 44–46, V = 30–38, Hv = 0, NDV = 75–84; Ip = 815–832; scutum pentagonal, with angulate posterior margin; nasus slightly expanded in medial part; sensillary bases at level of PLs or slightly posterior (PSB – P-PL = –3 – 1); PL > AM ≥ AL; sensilla nude; cheliceral blade with dorsal tooth and row of seven ventral denticles; parasubterminala (*z*) nude. Unspecialized setae (legs I, II, III): femora 6, 6, 5; genua 4, 4, 4; tibiae 9, 6, 6; tarsi 24, 16, 16. Measurements are given in Table 8.

*Description of larva*

**Idiosoma –** Eyes 2 + 2, on ocular plate; 44–46 barbed dorsal idiosomal setae; distribution by rows – 11–13 C, 8 D, 8 E, 8 F, 6 G plus 3–4 caudal setae, 1st row double (variants of division by sub-rows 4-8, 4-7, and 5-8), in holotype fD = [4-8]-8-8-8-6-2-2, two marginal setae of 2nd row shifted anteriad, marginal setae of 1st and 2nd rows (humeral setae) longest; two sternal setae between coxae III; 30–38 ventral setae; humeroventral setae absent; NDV = 75–84; reduced stigmata visible, tracheae absent.

**Gnathosoma –** Cheliceral blade with one dorsal tooth and ventrolateral row of seven denticles; cheliceral base with sparse puncta; gnathobase (infracapitulum) with sparse puncta, bears one pair of branched tritorostral setae; galeal (deutorostral) seta ciliated; palpal claw (odontus) with three prongs; palpal femoral seta branched, palpal genual seta with few branches, dorsal palpal tibial setae densely ciliated in distal half, lateral palpal tibial seta nude, ventral palpal tibial seta branched; palpal tarsus with seven ciliated setae and tarsala (ω).

**Scutum –** With sparse puncta, pentagonal, with angulate posterior margin; nasus slightly expanded in medial part; AM situated slightly posterior to level of ALs, sensillary (trichobothrial) bases at level of PLs or slightly posterior (PSB – P-PL = –3 – 1); PL > AM ≥ AL; all scutal setae barbed similarly to dorsal idiosomal setae; sensilla (trichobothria) flagelliform, nude.

**Legs –** All six-segmented (with undivided femur), with one pair of claws and claw-like empodium, onychotriches absent. Specialized setae: Leg I: 2 genualae (*σ*), microgenuala (*κ*), 2 tibialae (*φ*) in tandem, microtibiala (*κ*) near distal tibiala, tarsala (*ω*), famulus (*ε*) distal to tarsala, subterminala (*ζ*), nude parasubterminala (*z*), pretarsala (*ζ*). Leg II: genuala (*σ*), microgenuala (*κ*) distal to genuala, 2 tibialae (*φ*) in tandem, tarsala (*ω*), famulus (*ε*) proximal to tarsala, pretarsala (*ζ*). Leg III: genuala (*σ*), tibiala (*φ*). Unspecialized setae (legs I, II, III): coxae 2, 1, 1; trochanters 1, 1, 1; femora 6, 6, 5; genua 4, 4, 4; tibiae 9, 6, 6; tarsi 24, 16, 16. Ventral setae feathered, dorsal setae branched or nude. Numbers of nude setae: Leg I: tarsus 5, tibia 3, femur 1 (+ 1 bearing three cilia); Leg III: tarsus 1 (+ 1 bearing two cilia), tibia 2, genu 1.

**Table 8.** Morphometric (AW– $S_2$, μm) and meristic (DS–NDV) traits of *Hyracarus aryanicki* **sp. nov.** (N = 4) and *H. limpopoensis* **sp. nov.**

| Characters | *H. aryanicki* | | | *H. limpopoensis* | | | |
|---|---|---|---|---|---|---|---|
| | Holotype | Range | Mean | Holotype | Range | Mean | N |
| **AW** | 66 | 63–66 | 65 | 54 | 53–59 | 55 | 7 |
| **PW** | 83 | 81–83 | 82 | 73 | 72–77 | 73 | 7 |
| **SB** | 24 | 23–25 | 24 | 22 | 21–23 | 22 | 7 |
| **ASB** | 31 | 31–32 | 31 | 29 | 27–29 | 28 | 7 |
| **PSB** | 20 | 20–22 | 21 | 20 | 18–20 | 19 | 7 |
| **P-PL** | 22 | 20–22 | 21 | 23 | 17–23 | 20 | 7 |
| **SD** | 50 | 50–53 | 52 | 49 | 45–49 | 47 | 7 |
| **AA** | 10 | 9–11 | 10 | 9 | 8–9 | 8 | 7 |
| **NL** | 14 | 14–15 | 14 | 14 | 13–14 | 14 | 7 |
| **NW** | 6 | 6–10 | 8 | 10 | 7–10 | 8 | 7 |
| **AP** | 26 | 26–27 | 26 | 22 | 22–26 | 24 | 7 |
| **AM** | 47 | 40–47 | 43 | 41 | 41–43 | 42 | 7 |
| **AL** | 42 | 41–42 | 42 | 41 | 38–43 | 41 | 7 |
| **PL** | 54 | 52–54 | 53 | 49 | 45–49 | 47 | 7 |
| **S** | 85 | 81–85 | 83 | 83 | 77–88 | 83 | 6 |
| **H** | 56 | 52–56 | 53 | 45 | 42–45 | 45 | 7 |
| **$D_{min}$** | 32 | 32–32 | 32 | 27 | 27–29 | 28 | 7 |
| **$D_{max}$** | 45 | 45–49 | 47 | 41 | 40–41 | 41 | 7 |
| **$V_{min}$** | 27 | 24–27 | 26 | 23 | 21–23 | 22 | 6 |
| **$V_{max}$** | 46 | 45–49 | 46 | 37 | 36–38 | 37 | 6 |
| **pa** | 317 | 304–320 | 315 | 283 | 277–293 | 286 | 7 |
| **pm** | 272 | 254–272 | 264 | 234 | 234–245 | 240 | 7 |
| **pp** | 313 | 313–324 | 318 | 302 | 292–302 | 295 | 7 |
| **Ip** | 902 | 880–905 | 896 | 819 | 815–832 | 821 | 7 |
| **TaIIIL** | 85 | 85–90 | 87 | 86 | 79–86 | 83 | 7 |
| **TaIIIW** | 15 | 15–16 | 16 | 13 | 13–14 | 13 | 7 |
| **$S_1$** | 15 | 15–16 | 15 | 14 | 14–14 | 14 | 2 |
| **$S_2$** | 18 | 18–18 | 18 | 17 | 17–19 | 18 | 2 |
| **DS** | 47 | 45–47 | 46 | 46 | 44–46 | 46 | 7 |
| **V** | 39 | 37–41 | 39 | 31 | 30–38 | 32 | 7 |
| **Hv** | 2 | 2–2 | 2 | - | - | - | - |
| **NDV** | 88 | 86–88 | 87 | 77 | 75–84 | 78 | 7 |

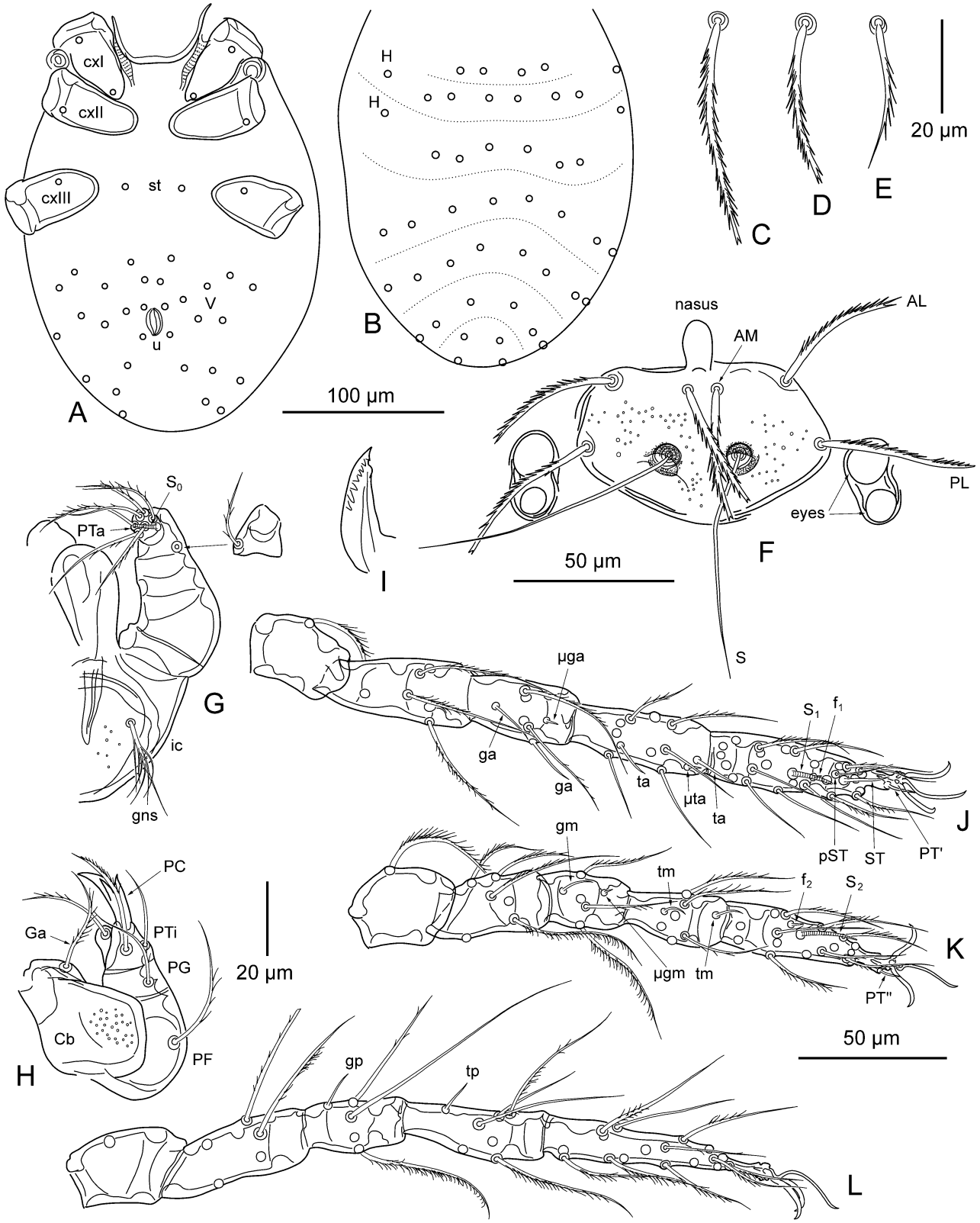


**Figure 21.** *Hyracarus limpopoensis* **sp. nov.** (A–F, holotype; G–L, paratype ZIN 9754) – **A.** Ventral aspect of idiosoma; **B.** Dorsal aspect of idiosoma; **C.** Humeral seta; **D.** Dorsal idiosomal seta (center of row C); **E.** Preanal seta; **F.** Scutum and eyes; **G.** Ventral aspect of gnathosoma; **H.** Dorsal aspect of gnathosoma; **I.** Cheliceral blade; **J.** Leg I, trochanter–tarsus; **K.** Leg II, trochanter–tarsus; **L.** Leg III, trochanter–tarsus. Abbreviations as in Fig. 5. Scale bars: A–B, 100 µm; C–E, 20 µm; F, 50 µm; G–I, 20 µm; J–L, 50 µm.

*Type material*

Holotype (larva), ZIN 9761, under tail of *Elephantulus myurus* Thomas and Schwann (Macroscelidea: Macroscelididae) No. PT 2013-9, X 14/58, South Africa, Limpopo Province, Louis Trichardt (Makhado), Lajuma Research Centre, Wilderness camp, A20, 1315 m a.s.l., 23.03901° S, 29.45154° E, 27 May 2013, coll. A. Halajian. Eight paratypes (larvae), ZIN 9760, 9762–9768, with same data; eight paratypes (larvae), ZIN 9778, 9779, 9781–9786, under tail of *E. myurus* No. PT 2013-8, same place, A17, 1320 m a.s.l., 23.03925° S, 29.45009° E, 27 May 2013, coll. A. Halajian; eight paratypes (larvae), ZIN 9752–9759, under tail of *E. myurus* No. PT 2013-5, same place, St3, 1331 m a.s.l., 23.03928° S, 29.45045° E, 26 May 2013, coll. A. Halajian.

*Etymology*

The species name refers to the Limpopo Province, where the type locality is situated.

*Differential diagnosis*

The new species is similar to *H. aryanicki* **sp. nov.**, and differs from it in the absence of humeroventral setae, nude lateral palpal tibial seta vs. ciliated, lesser number of unspecialized setae on leg tarsi (24, 16, 16 vs. 25, 17, 17), lesser number of ventral denticles on the cheliceral blade (7 vs. 11), slightly lesser scutum (AW 53–59, PW 72–77, SD 45–49 vs. 63–66, 81–83, and 50–53, respectively), slightly shorter PL (45–49 vs. 52–54) and idiosomal setae (H 42–45, $D_{max}$ 40–41, $V_{max}$ 36–38 vs. 52–56, 45–49, and 45–49, respectively), slightly lesser number of V (30–38 vs. 37–41) and NDV (75–84 vs. 86–88), and slightly shorter legs (Ip 815–832 vs. 880–905).

## Key to species of *Hyracarus* (larvae)

1. NL = 27–28; scutum almost as wide, as long (PW = 57–62 and SD = 54–56); scutal and dorsal idiosomal setae with very long barbs (Fig. 2A) ..... *H.* sp. 1
– NL < 25; scutum definitely wider than long; scutal and dorsal idiosomal setae with moderate barbs ..... 2
2. Humeroventral setae absent ..... 3
– Humeroventral setae present ..... 10
3. Posterior scutal margin straight; palp tarsus 4B ..... 4
– Posterior scutal margin arcuate or angulate; palp tarsus 5–7B ..... 6
4. PLs and dorsal idiosomal setae foliate ..... *H. foliosetosus*
– PLs and dorsal idiosomal setae unexpanded ..... 5
5. AM with accessory branch; cheliceral blade with 5–6 ventral denticles; all unspecialized leg setae branched; 14 setae in row C; NDV = 102–104; Ip = 695–706; AL > AM .....*H. quadrisetosus*
– AM without accessory branch; cheliceral blade with 8 ventral denticles; nude dorsal setae present on femur, genu, tibia, and tarsus of leg III; 12 setae in row C; NDV = 92–98; Ip = 752–779; AL = AM ..... *H. kimberleyensis*
6. Cheliceral blade with 11–12 ventral denticles; sensillary bases posterior to level of PLs ..... 7
– Cheliceral blade with 7–8 ventral denticles; sensillary bases at level of PLs or anterior ..... 8
7. Ventral palpal tibial seta branched; nasus unexpanded, with conical end; NW = 6; sensilla with small cilia; PSB = 17; $S_1 > S_2$ ..... *H.* sp. 2
– Ventral palpal tibial seta nude; nasus expanded medially; NW = 8–11; sensilla nude; PSB = 23–27; $S_1 < S_2$ ..... *H. bethuliensis*
8. Parasubterminala (*z*) nude; lateral palpal tibial seta nude; AM ≥ AL; palp tarsus 7B ..... ..... *H. limpopoensis*
– Parasubterminala (*z*) branched; lateral palpal tibial seta branched; AL > AM; palp tarsus 5B or 6B ..... 9

9. AM = 43; AL = 49; PL = 63; all unspecialized leg setae branched; 14 setae in row C; Ip = 914; nasus expanded in distal part; NL = 18; sensillary bases at level of PLs; palp tarsus 5B ..... *H. longipilosus*
– AM = 23–25; AL = 30–32; PL = 30–34; nude dorsal setae present on femur, genu, tibia, and tarsus of leg III; 10–12 setae in row C; Ip = 758–799; nasus unexpanded, with conical end; NL = 13–15; sensillary bases anterior to level of PLs by 5–8 μm; palp tarsus 6B ..... *H. sabiensis*
10. Two humeroventral setae ..... 11
– 3–8 humeroventral setae ..... 12
11. NDV = 164; sensillary bases posterior to level of PLs; sensilla ciliated in proximal 2/3; AL > AM; NL = 18; parasubterminala (*z*) nude ..... *H. lemniscomyia*
– NDV = 86–88; sensillary bases at level of PLs; sensilla nude; AM ≥ AL; NL = 14–15; parasubterminala (*z*) branched ..... *H. aryanicki*
12. Palp tarsus 7B ..... 13
– Palp tarsus 5B or 6B ..... 14
13. Four humeroventral setae; NDV = 124; parasubterminala (*z*) nude; sensilla nude; AW = 54 ..... *H. claviglis*
– Six humeroventral setae; NDV = 136; parasubterminala (*z*) branched; sensilla with small cilia; AW = 67 ..... *H. mutabilis*
14. Four ventral denticles on cheliceral blade; nasus small, unexpanded, with conical end; NL = 10; NW = 5; Ip = 680–704 ..... *H. ethiopicus*
– 8–11 ventral denticles on cheliceral blade; nasus expanded medially; NL = 14–23; NW = 7–11; Ip = 715–891 ..... 15
15. Six humeral setae; NDV = 111–156; all unspecialized leg setae branched; NL = 18–23 ..... 16
– Four humeral setae; NDV = 92–104; nude dorsal setae present on genu, tibia, and tarsus of leg III; NL = 14–18 ..... 17
16. 13–17 setae in row C; NDV = 111–123 ..... *H. thallomyia*
– 19–25 setae in row C; NDV = 146–156 ..... *H. typicus*
17. Palp tarsus 5B; 10–11 ventral denticles on cheliceral blade; parasubterminala (*z*) nude; sensilla with cilia in proximal 2/3; numbers of nude dorsal setae on leg III: tarsus 5, tibia 3, genu 2, femur 2; formula of setae on leg tibiae: 9, 5, 6 ..... *H. namibiensis*
– Palp tarsus 6B; 8 ventral denticles on cheliceral blade; parasubterminala (*z*) branched; sensilla nude; numbers of nude dorsal setae on leg III: tarsus 2, tibia 1, genu 1; formula of setae on leg tibiae: 8, 6, 6 ..... *H. natalensis*

## DISCUSSION

According to our results, *Hyracarus* includes 16 valid species vs. six previously known. We added five new species, four transferred from the synonymized *Mastalacarus* and *Tateracarus*, and one originally described as *Acomatacarus*. The genus is well represented in South Africa (ten species), which may partially reflect more extensive chigger studies in this country (Stekolnikov 2018). Two species were described from Namibia and by one from Angola, Democratic Republic of the Congo, Uganda, and Ethiopia. Until the present, no new findings of previously described species have been recorded – this suggests that the genus is highly speciose and it is expected that many new species will be discovered. The host spectrum of *Hyracarus* includes murid rodents (7 records), hyraxes (3), elephant shrews (2) and one case each reported from a dormouse, shrew, bat, and skink.

The genus is well-defined and clearly different from other Leeuwenhoekiinae distributed on the African continent, namely *Austracarus* Lawrence, 1949 (syn.: *Austrombicula* Lawrence, 1949), *Whartonia* Ewing, 1944, and *Odontacarus*. The status of *Matacarus* Vercammen-Grandjean, 1956 requires further investigation: it can be synonymized with *Odontacarus*. The name *Acomatacarus* was widely used in the past in combinations with the names of different African species (Stekolnikov

2018); however, Vercammen-Grandjean *et al.* (1973) and Reed and Brennan (1975) regarded this genus as a synonym of *Odontacarus* and Goff and Loomis (1977) regarded it as a monotypic American genus.

The presence of multiple nude or almost nude setae on dorsal surfaces of all legs in many species of *Hyracarus* is a unique trait of this genus. Goff and Lukoschus (1983) identified these setae as "mastisetae" that can be observed on leg III of many chigger mite genera. They described and drew them only on leg III; seems probable that they overlooked them on legs I and II because they did not expect to find nude setae there. The number of these setae is unstable, as evident by an example of *H. foliosetosus* **comb. nov.** and *H. kimberleyensis* **comb. nov.** (Stekolnikov and Matthee 2022), and there is a gradation between them and the usual branched setae. This pattern of leg setation is thus different from the case of true mastisetae, which are stable in number and easily distinguishable from other leg setae. It can be rather compared with the leg chaetotaxy of *Ornithogastia* Vercammen-Grandjean, 1960 (Stekolnikov 2024b) and *Lorillatum* Nadchatram, 1963 (Vercammen-Grandjean and Langston 1976; Stekolnikov 2021).

*Hyracarus* also exposes a uniquely wide range of variation in the number of setae on palpal tarsus among Trombiculidae – from 4B to 7B. Previously, the widest range was recorded for *Trombicula* Berlese, 1905 – from 5B to 7B (Daniel and Stekolnikov 2006). Vercammen-Grandjean (V-G Archive) planned to divide *Hyracarus* by three subgenera – (1) *H.* (*Hyracarus*), with 5B, comprising *H. typicus*, *H. elegans* (*nomen nudum*), *H. flagellifera* (*nomen nudum*), *H. lawrencei*, and *H. longipilosus*; (2) *H.* (*Hexhyracarus*) (*nomen nudum*), with 6B, comprising *H. natalensis*; and (3) *H.* (*Hepthyracarus*) (*nomen nudum*), with 7B, including *H. lemniscomyia*. We do not follow this classification, since it is not supported by any other trait and thus looks artificial.

We recorded the reduced stigmata (spiracles) not associated with tracheae in *H. foliosetosus* **comb. nov.**, *H. kimberleyensis* **comb. nov.**, *H. bethuliensis* **sp. nov.**, *H. thallomyia* **comb. nov.**, *H. aryanicki* **sp. nov.**, and *H. limpopoensis* **sp. nov.** These structures were elongated, cigar-shaped, similar to those of *Matacarus buretti* (Vercammen-Grandjean, 1956) and different from the funnel-shaped stigmata of *Odontacarus* (Alghamdi *et al.* 2023).

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# بازبینی هرناهای چیگر آفریقایی جنس *Hyracarus* (Acariformes: Trombiculidae: Leeuwenhoekiinae)

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**چکیده**

جنس *Hyracarus* Lawrence, 1949 از هرناهای چیگر، بومی آفریقای گرمسیری، بر اساس بررسی سری‌های تیپ، نمونه‌های جدید، اطلاعات بایگانی منتشر نشده، و منابع بازنگری شد. پنج گونه جدید توصیف شدند: *Hyracarus bethuliensis* **sp. nov.**، *H. ethiopicus* **sp. nov.**، *H. sabiensis* **sp. nov.**، *H. aryanicki* **sp. nov.** و *H. limpopoensis* **sp. nov.**. سه مترادف جدید معرفی شد: *Hyracarus* [= Mastalacarus Goff & Lukoschus, 1983, **syn. nov.**؛ *Tateracarus* Goff, 1983, **syn. nov.** = ] و *Hyracarus thallomyia* [= *Acomatacarus lawrencei* Radford, 1948, **syn. nov.**] (Radford, 1947). شش ترکیب جدید پیشنهاد شد: *Hyracarus foliosetosus* (Stekolnikov & Matthee, 2022) **comb. nov.**، *H. kimberleyensis* (Stekolnikov & Matthee, 2022) **comb. nov.**، *H. namibiensis* (Goff & Lukoschus, 1983) **comb. nov.** (در ابتدا در جنس *Tateracarus*)، *H. quadrisetosus* (Goff, 1983) **comb. nov.** (در ابتدا در جنس *Mastalacarus*)، *H. thallomyia* (Radford, 1947) **comb. nov.** و *H. mutabilis* (Vercammen-Grandjean & Brennan, 1957) **comb. nov.** (در ابتدا در جنس *Acomatacarus* Ewing, 1942). در حال حاضر، این جنس شامل ۱۶ گونه معتبر است که از آفریقای جنوبی (۱۰ گونه)، نامیبیا (۲)، آنگولا (۱)، جمهوری دموکراتیک کنگو (۱)، اوگاندا (۱)، و اتیوپی (۱) شناخته شده‌اند. گونه‌های این جنس میزبان‌های مختلفی مانند موش‌های خانواده Muridae (۷ گزارش)، خرگوش‌های کوهی (۳)، موش‌های خرطوم‌دار (۲)، موش‌های زمستان خواب(۱)، موش‌های کور (۱)، خفاش‌ها (۱)، و سوسمارها (۱) را شامل می‌شوند..

**واژگان کلیدی:** منطقه آفروتروپیکال، چیگرها، گونه‌های جدید، ترکیب‌های جدید، مترادف‌های جدید، آفریقای جنوبی، آرایه‌شناسی.

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