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The arrenurid water mites of Madagascar

(Acari, Hydrachnidia, Arrenuridae)

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A survey is given of the arrenurid water mites recorded from Madagascar. While former data published in bibliography derive mostly from standing waters, we include here numerous new records mainly from springs and running waters, collected in 2001 and 2011. A new genus, *Volobibikely* gen. nov., is defined for *Volobibikely primum* sp. nov., a species from a spring in Central Madagascar. A total number of 18 further new species is described, 17 in the genus *Arrenurus*: *Arrenurus* (*Arrenurus*) *ambrensis* sp. nov., *A.* (*Arrenurus*) *bispatulatus* sp. nov., *A.* (*Arrenurus*) *crenophilus* sp. nov., *A.* (*Brevicaudaturus*) *tandroka* sp. nov., *A.* (*Megaluracarus*) *ambohitra* sp. nov., *A.* (*Megaluracarus*) *concavoides* sp. nov., *A.* (*Megaluracarus*) *felix* sp. nov., *A. (Megaluracarus) uncipetiolatus* sp. nov., *A.* (*Micruracarus*) *aethes* sp. nov., *A.* (*Micruracarus*) *brunneus* sp. nov., *A.* (*Micruracarus*) *dobomponina* sp. nov., *A.* (*Micruracarus*) *mandrarensis* sp. nov., *A.* (*Truncaturus*) *cuspidipes* sp. nov., *A.* (*Truncaturus*) *delocercus* sp. nov., *A.* (*Truncaturus*) *gigas* sp. nov., *A.* (*Truncaturus*) *porphyrus* sp. nov., *A.* (*Truncaturus*) *riparius* sp. nov.; and one in the genus *Wuria*, *W. ferrumequorum* sp. nov. The female of *Arrenurus geniculatus* Koenike, 1898 is described for the first time. *Arrenurus* (subgen.?) *vigorans* Koenike, 1898, described from a deutonymph, is considered a 'species incerta'.

Arrenurus (*A.*) *capensis* Thor, 1902, previously known from continental Africa, is reported for the first time from Madagascar. New geographical records are given for the already known species *Arrenurus* (*A.*) *dentifer* Lundblad, 1946, *A.* (*A.*) *frustrator* Koenike, 1898, *A.* (*A.*) *obliquus* Koenike, 1898, *A.* (*A.*) *rudiferus* Koenike, 1898, *A.* (*A.*) *geniculatus* Koenike, 1898, *A.* (*A.*) *voeltzkowi* Koenike, 1898, and *Wuria milloti* Gerecke, 2004. In total, the number of arrenurids known from Madagascar grows from 23 to 43 species (not taking in consideration the females 'incertae sedis' mentioned in the following).

A survey is given of the documentation of Madagascan arrenurids. As large parts of the island are still completely uninvestigated, large numbers of undescribed species can still be expected. Additional females recorded as singletons from various parts of the island, probably representatives of further distinct species, are briefly characterized. They could belong to species known in the male sex only, or species new to science. A key is presented for all known arrenuroid species from Madagascar.

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Introduction

The family Arrenuridae is distributed worldwide, and counts (including the new genus described below) at present altogether nine genera. One of these, *Arrenurus* Dugès, 1834, is by far the most species-rich of all water mite genera, with globally about thousand recognized species (Smit 2020a). The subgeneric classification in eleven subgenera is not satisfying as a number of these taxa tend to grade into each other (for taxonomic details see Smit 2020b).

Research on arrenurid mites on Madagascar and its adjacent islands started with a publication of Koenike (1898), followed by Motaş (1932), Lundblad (1946), Walter & Bader (1953), K.O. Viets (1964) and Gerecke (2004, 2009). Both K. Viets (1942) and K.O. Viets (1961) described arrenurid species from Madagascar, and K.O. Viets (1974) revised a number of Koenike's descriptions. These published records refer to a few restricted study areas (North: Nossi-Bé, Ankarana; Centre: Antananarivo; East: Toamasina; West: Mahajanga; South: Taolanaro) and concern exclusively standing water habitats. Thus far, the total number of arrenurid species from Madagascar tallied 23, representing the genera *Allarrenurus* (monotypic, 1), *Arrenurus* (18, counting *A. laticodulus* sensu Lundblad 1946 and *A. dumazeri* Motaş, 1932 as separate species, see below), *Thoracophoracarus* (3), and *Wuria* (1). Based on published data, as far as possible enriched by information from our own material, we give a brief critical summary of diagnostic characters for all these previously described species. For the genus *Thoracophoracrus* we refer to Gerecke (2009).

The aim of the present paper is to add information about the fauna in numerous further parts of the island, mostly collected in stream and spring habitats. Consequently, most of the data do not overlap with previous information: The number of records of already known species is low while a high number of taxa new to science is reported, including the first records of the subgenus *Truncaturus* (*Arrenurus*) and the definition of a genus new to science. The beauty of all the species (re)described here gives an impression of the ecological diversity of their, often oasis-like, habitats. It will never be possible to gain an idea of the true variety of habitats and adaptations from molecular data only, without careful morphological analysis and detailed illustration of the involved taxa.

Arrenuridae is one of 19 families united in the superfamily Arrenuroidea (see Smit 2020b). From Madagascar, five further families of this group are reported (see Gerecke 2020 and 2024 and the bibliography cited there, species numbers in parentheses): Harpagopalpidae (3), Krendowskiidae (1), Mideopsidae (10), Momoniidae (1) and Neoacaridae (1).

Most arrenuroids are characterized by a heavy idiosoma sclerotization with a strong, coarse porosity. As this sclerotization develops in early adult development, individuals freshly moulted from the tritonymphal stage may display a weakly sclerotized integument. In these conditions, the body contour may differ from the definitive shape of a species, and such specimens are often difficult to classify – a frequent reason for misleaded species descriptions in the past. On the other hand, the study of weakly sclerotized "immature" adults may be helpful to detect structures imbedded in the integument (e. g. small setae, glandularia, acetabula) which later on will be more or less hidden in more strongly sclerotized animals. For instance, in mature adults it is often difficult to distinguish acetabula from idiosoma pores, especially in lateral body parts.

Due to a strong sexual dimorphism and the fact that several *Arrenurus* species are coexisting in many cases, species attribution of females and males is often difficult. In this point of view, three character states are of particular importance as they are found equally expressed in males and females of the same species: Colour patterns, general palp morphology, and ('cum grano salis', see below) swimming setation. In addition, also the type of coxal porosity and presence/absence of long setae near IV-leg insertions may be indicative.

In view of the taxonomic value of character states of idiosoma and IV-leg in males, and gonopore field and acetabular plates in females, the diagnostic potential of leg shape and setation in both sexes has remained widely unexploited so far. In view of the general lack of such information for the previously described species, also in the present paper a focus is given to standard characters of idiosoma and mouth parts. However, we try to give a thorough documentation of swimming setation for as many species as possible. In water mite morphology, setae are named "swimming setae" if they are (1) fine, hair-like and long, and (2) arranged near distal margin or in rows in the distal part of the posterior or anterior surface of leg segments. The rich and diversified leg setation in arrenurids renders the verification of these criteria sometimes difficult: In male IV-leg, but also on other legs in both sexes, long, but rather strong ventral setae may have a swimming-setae like appearance (and function?). As a general rule, swimming setae are more numerous in females than in males, but their arrangement may be helpful in attributing females and males to the same species. In species from streams and springs, typical swimming setae are often less numerous than in lake-dwelling species, and they are in many cases restricted to the posterior surface of leg segments (directed to the observer in specimens seen in dorsal view).

Material and methods

Holotypes are lodged in the Senckenberg Museum, Frankfurt am Main, paratypes and non-type material in Senckenberg Museum, Frankfurt am Main (Germany) and Naturalis Biodiversity Center, Leiden (the Netherlands).

The following abbreviations are used: Cx-I to -IV – first to fourth coxae; Dgl – dorso-glandularia; dn – deutonymph; H – height; IV-leg-4–6 – fourth to sixth segments of fourth leg; L – length; m a.s.l. – meters above sea level; MNHN – Muséum National d'Histoire naturelle, Paris; mL – medial length; P-1–5 – palp segments 1 to 5; SMF – Senckenberg Museum, Frankfurt am Main; RMNH – Naturalis Biodiversity Center, Leiden; Vgl – Ventroglandularia; W – width. Measurements are given in µm. Length of palp and leg segments are given as dorsal length, ventral length of idiosoma is measured from the anterior tip of Cx-I to the posterior idiosoma margin.

Swimming setae numbers are given as "anterior/posterior"; leg segments not mentioned explicitly do not bear swimming setae.

Most specimens were not mounted (a procedure that might result in idiosoma deformations and allows observation in one direction only), apart from palps and occasionally legs. For measurements, drawings and photos, specimens were temporarily placed in Koenike's fluid on a concavity slide. Micro-photos were taken with a Nikon V1 camera combined with a Leica Z16 Apo and a 2.0-fold objective, as well as a Leica DM 5000B compound microscope combined with a Jenoptik ProgRes Speed XT core 5 camera and ProgRes®Capture Pro 2.8 Jenoptik software. Images were stacked with Helicon Focus 5.3 software.

All new material was collected by Reinhard Gerecke and Tom Goldschmidt (2001, preserved in Koenike's fluid) or by Reinhard Gerecke (2011, preserved in ethanol, later on partly transferred to Koenike's fluid). If not stated otherwise, information about the morphology and measurements of previously described species is taken from the original description or additional cited bibliography; if material collected in 2001 and 2011 is consulted, this is explicitly mentioned.

The sequence of treatment of the taxa is alphabetical, within the subgenera *Arrenurus*, *Brevicaudaturus*, *Megaluracarus*, *Micruracarus* and *Truncaturus* already described species are treated first, followed by the species new to science.

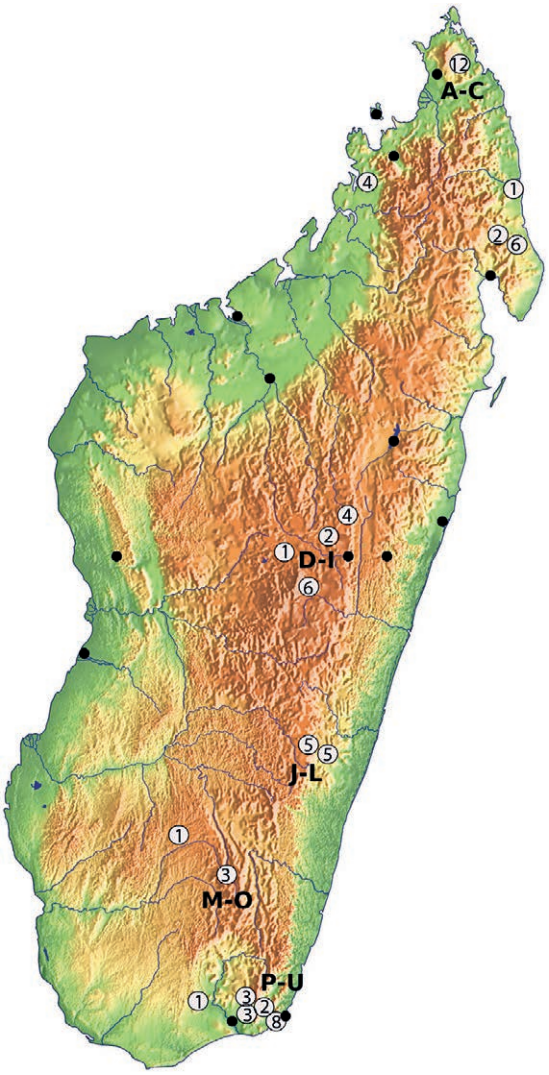


Fig. 1_1. Madagascar. Map of sample sites of Arrenuridae. Black dots: records from bibliography (exclusively single sample sites). Circles: new records (numbers give the amount of sample sites in the respective areas).


A
B
C

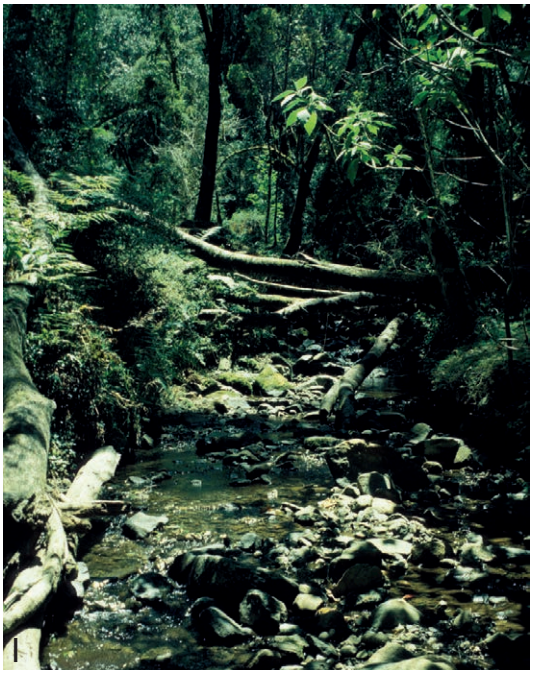

D


E


F


G


H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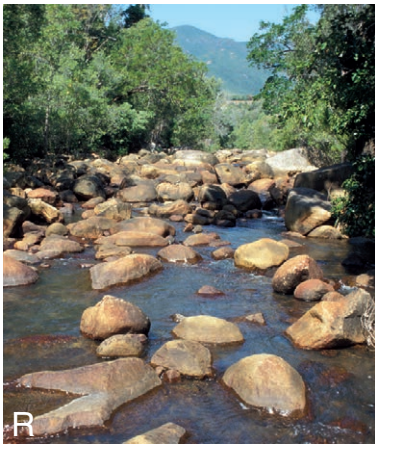
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Systematics

Family Arrenuridae Thor

Diagnosis. See Smit (2020b).

Genus *Allarrenurus* K.O. Viets, 1961

Diagnosis. Both sexes: Gnathosoma elongated, without proximal apodemes. Palp segments stout, proximally not narrowed; P-2 to -4 with long, whip-like setae – these, on P-2 scattered all over the medial surface. Males: I-/II-leg-6 extremely elongated and distally narrowed, with dense, fine setation. Females: Gonopore field with two pairs of large sclerotized patches.

Remarks. The only known species, *A. pudens* (Koenike, 1898) was carefully redescribed by K.O. Viets (1961). In both sexes, the idiosoma agrees with certain species of the genus *Arrenurus* (dorsal furrow complete; tips of Cx-I on level of frontal margin or slightly set back; coxae in three groups, separated by very broad interspaces; excretory pore terminal; dorsal idiosoma of male with several paired or unpaired humps, posterior margin of female idiosoma with paired humps). Gnathosomal bay characteristic, with a rounded basal part, lateral margins straight, V-shaped diverging. The formation of the caudal male idiosoma with a well-developed petiole would agree with the diagnosis of the subgenus *Arrenurus* s.s.; the shape of the female acetabular plates (in medial part directed caudally, on level of posterior gonopore field margin abruptly bent laterally) is highly characteristic, not found in any Malagasy *Arrenurus* species. Unique in arrenurid water mites is the combination of (1) an elongated gnathosoma, (2) a chelicera with a relatively long, strongly curved basal segment, (3) palp with rather stout segments bearing long, whip-like setae, and (4) male I-/II-leg with strongly elongated terminal segments. The genus is monotypic and endemic on Madagascar.

Allarrenurus pudens (Koenike, 1898)

Figs 2–3

Published records from Madagascar. Nossi-Bé: Lake Djabala (Koenike 1898), Taolanaro (Fort Dauphin): "Tilapia-Teich" (K.O. Viets 1961).

Description

Both sexes: Diagnostic features as given for the genus. Colour from yellowish-green to bluish-green.

◁ **Figs 1_2**. Typical landscapes, habitats and sample sites of *Arrenurus* and *Volobibikely* in Madagascar (photographs: A–B Reinhard Gerecke, C–U Tom Goldschmidt). A–C = Northern Madagascar; D–I = Central Highlands; J–O = Central Eastern foothills and South Central Plateau; P–U = South Eastern Coastal Region. **A.** Montagne d'Ambre, Antsiranana; **B.** Montagne d'Ambre, Antsiranana, lake Farihy Makery, MD 189 (sample site of *A. frustrator* and *A. dobomponina*), 377 m a.s.l., 29.03.2011; **C.** Montagne d'Ambre, Antsiranana, Rivière de Manques in Reserve Fontenay, MD 162/163 (sample site of *A. cuspidipes*), 580–730 m a.s.l., 20.11.2001; **D.** Central Highlands, NW of Antananarivo; **E.** Tampoketsan Ankazobe, Antananarivo, spring exposed W, W from R.N. 4 (km 157), MD 168 (sample site of *A. concavoides* and *Volobibikely primum*), 1400 m a.s.l., 29.11.2001; **F.** Tampoketsan Ankazobe (Antananarivo), Rivière Andranofeno Sud at bridge R.N. 4, km 130, MD 170, 1450 m a.s.l., 29.11.2001; **G.** Ankaratra Mountains (Antananarivo), Reserve Manjakatompo, Montagne Ambohimirandrana, spring area exposed SE (drainage Rivière Mahiavona), 07.10.2001; **H.** Detail of G, MD 106 (sample site of *A. gigas*), 2280 m a.s.l., 07.10.2001; **I.** Ankaratra Mountains (Antananarivo), Reserve Manjakatompo, affluent to station piscicole upstream road to Lac Froid, MD 112 (sample site of *A. bispatulatus*), 1700 m a.s.l., 09.10.2001; **J.** Central Eastern foothills, surroundings of Ionilahy, in the background Rivière Ionilahy, MD 026, 200 m a.s.l., 11./13.08.2001; **K.** Ionilahy (Fianarantsoa), Vodraindry, spring in primary forest exposed W, MD 030 (sample site of *A. crenophilus*), 400 m a.s.l., 16.08.2001; **L.** last remains of forest in the surroundings of MD 030; **M.** savanna NE of Betroka (Tulear), in the background spring stream near right affluent of Rivière Mangoky, MD 049, 850 m a.s.l., 26.08.2001; **N.** Betroka (Tulear), right affluent of Rivière Mangoky about 1 km NE village, MD 048 (sample site of *A. cuspidipes* and *A. delocercus*), 830 m a.s.l., 25.08.2001; **O.** Betroka (Tulear), helocrene exposed E at hill E Naninora (draining to MD 049), MD 050 (sample site of *A. aethes*), 870 m a.s.l., 26.08.2001; **P.** Tsimelahy (Tulear), Rivière Antarantsa downstream 'piscine naturelle', MD 060/061 (sample site of *A. voeltzkowi*, *A. obliquus* and *A. tandroka*), 200 m a.s.l., 05.09.2001; **Q.** Andohahela (Tulear), Fenoevo, right affluent of the turbid water stream (MD 064) at N margin of forest (clear water), MD 065, 330 m a.s.l., 08.09.2001; **R.** Tsimelahy (Tulear), Rivière Antarantsa about 1 km upstream from village, MD 058 (sample site of *A. cuspidipes*), 300 m a.s.l., 04.09.2001; **S.** Fort Dauphin (Tulear), Mandena (QMM area), lake situated inland from coastal lake at mouth of Rivière Amendano, MD 081 (sample site of *A. geniculatus* and *A. uncipetiolatus*), 2 m a.s.l., 14.09.2001; **T.** Fort Dauphin (Tulear), Mandena (QMM area), Rivière Amendano 0.5 km upstream road bridge, MD 078 (sample site of *A. porphyrus*), 12 m a.s.l., 15.09.2001; **U.** Fort Dauphin (Tulear), Mandena (QMM area), ditch at right bank of Rivière Amendano, MD 077 (sample site of *A. porphyrus*), 10 m a.s.l., 13.09.2001.

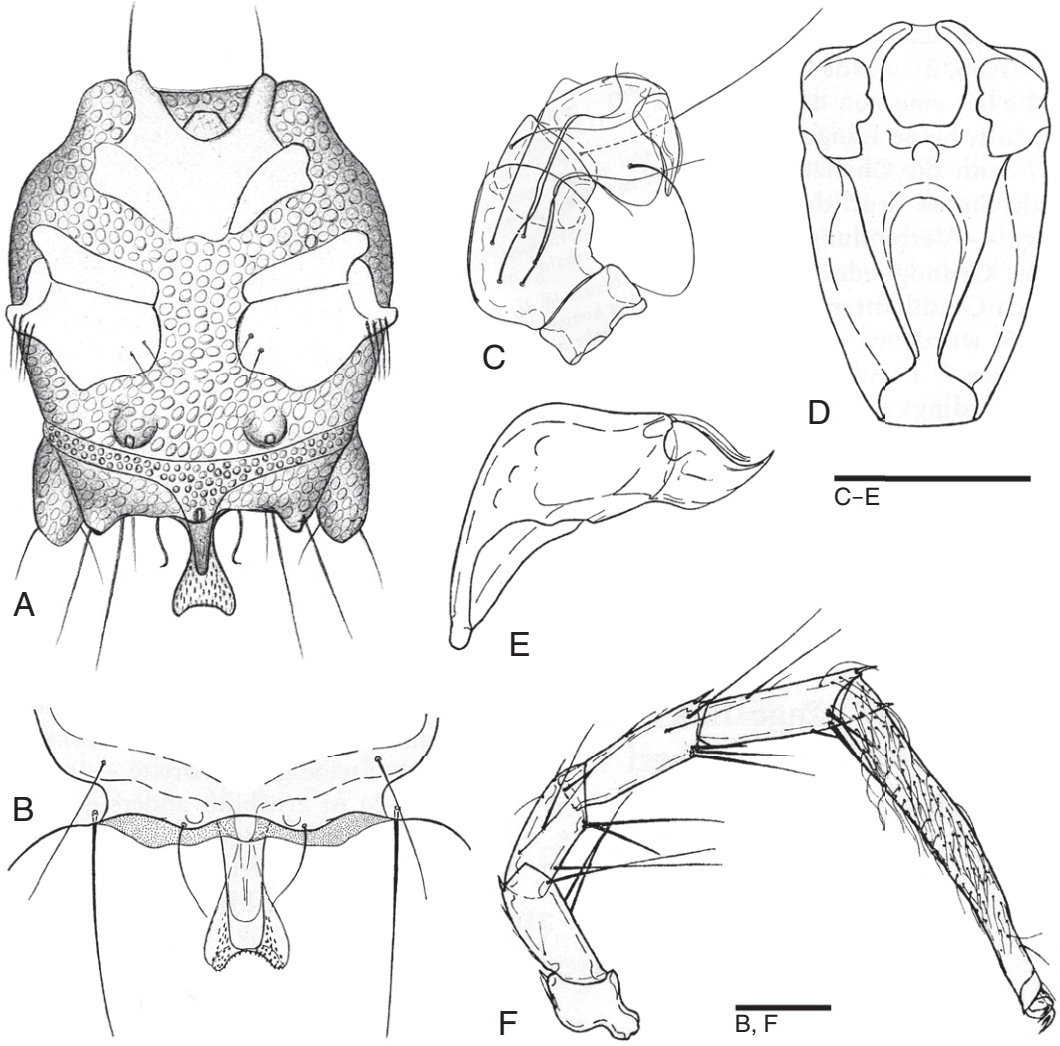


Fig. 2. *Allarrenurus pudens* ♂. **A.** Idiosoma, ventral view; **B.** petiole, dorsal view; **C.** palp, medial view; **D.** capitulum, dorsal view; **E.** chelicera, medial view; **F.** II-leg, anterior view (A: Koenike 1898, B–F: K.O. Viets 1961). Scale bars = 100 µm.

Swimming setae present, no data on number and distribution published.

Males (Fig. 2): Idiosoma L/W 1027–1090/780–830. Females (Fig. 3): Idiosoma L/W 1250–1330/1090–1100.

Distribution. NW and S Madagascar, endemic.

Habitat. Standing waters.

Genus *Arrenurus* Dugès, 1834

Diagnosis. Both sexes: Capitulum short, with well-developed proximal apodemes (as in Fig. 105F). Palp segments proximally not narrowed, P-2 to -4 setae more or less elongated, but not whip-like e. g. Fig. 5D). Males: I-/II-leg-6 not extremely elongated, more or less equal in thickness from base to tip, without particular fine setation.

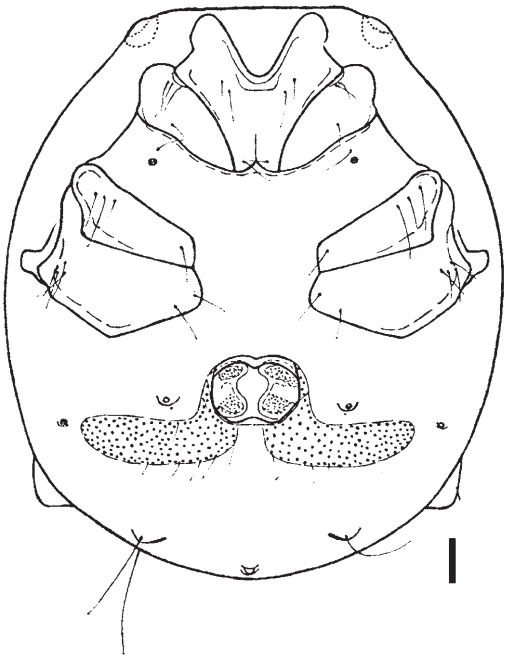


Fig. 3. *Allarrenurus pudens* ♀. Idiosoma, ventral view (K.O. Viets 1961). Scale bar = 100 µm.

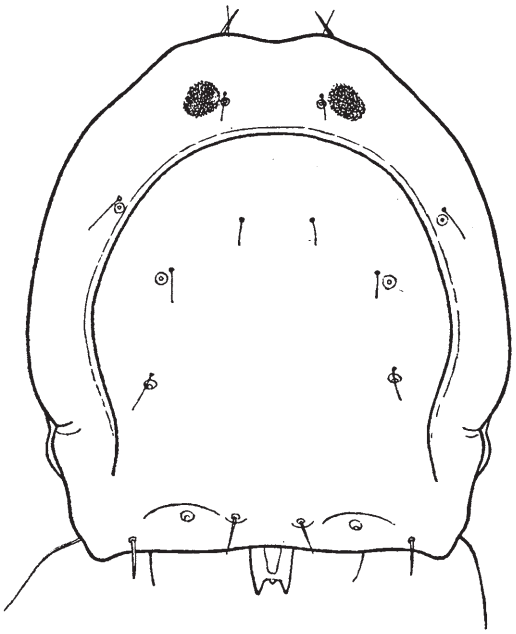


Fig. 4. *Arrenurus abruptus* ♂. Idiosoma, dorsal view (Lundblad 1946).

Subgenus *Arrenurus* s.s.

Diagnosis. See Smit (2020b).

***Arrenurus* (*Arrenurus*) *abruptus* Lundblad, 1946**
Fig. 4

Published record from Madagascar. Mahajanga (Majunga): no collection site details (Lundblad 1946), only known from one male.

Description (Male, Fig. 4; female unknown)

Colour greenish. Idiosoma L/W 552/514; egg-shaped; frontal margin concave, posterior margin truncate, nearly straight. Dorsal furrow incomplete (dorsal shield posteriorly fused to ventral shield); petiole with posteriorly converging lateral margins, its posterior margin concave, with a fine central projection. IV-leg-4 with a short spur, without apical setae; swimming setation not described. Capitulum elongated, with long proximal apodemes; shape of gnathosomal bay not depicted or described. P-2 with three mediodistal setae. P-4 dorsal and ventral margin subparallel.

Distribution. W Madagascar, endemic.

Habitat. Standing water.

***Arrenurus* (*Arrenurus*) *auritus* Koenike, 1898**
Figs 5–6

Published record from Madagascar. Mahajanga (Majunga): no collection site details (Koenike 1898).

Description

Both sexes: Idiosoma colour yellowish white, legs greenish. Wide interspaces between coxal plates. Gnathosomal bay V-shaped. Palp stout, P-2 with two mediodistal setae, P-4 stout, dorsal margin with a prominent hump in proximal part. Numerous swimming setae present.

Males (Fig. 5): Idiosoma egg-shaped, but posteriorly truncate, anterior margin between two projecting gland humps concave; posteromedially a blunt petiole, broad and elevated with convex posterior margin, bearing a pair of rounded lateral appendages. In lateral view dorsal margin strongly elevated, rounded. Tips of Cx-I slightly projecting beyond frontal margin.

Females (Fig. 6): Idiosoma with slightly projecting antero- and posterolateral humps; frontal margin concave, posterior margin slightly convex; in lateral view elevated, a small hump at anterior edge of dorsal shield. Tips of Cx-I slightly set off from frontal margin; genital field close to coxal area, go-

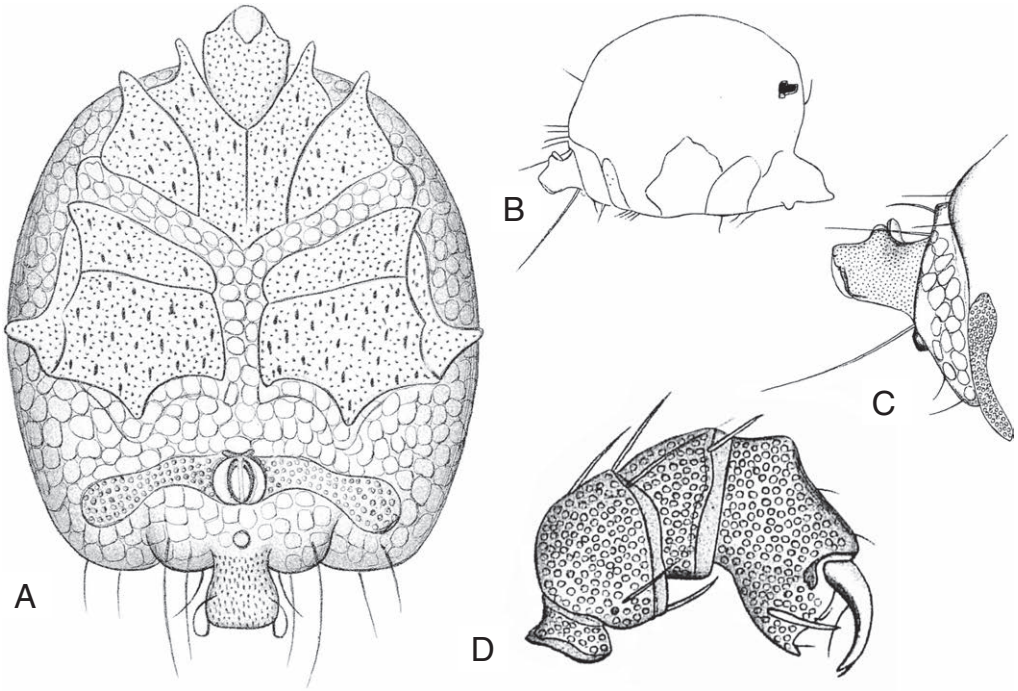


Fig. 5. *Arrenurus auritus* ♂. **A.** Idiosoma, ventral view; **B.** idiosoma, lateral view; **C.** petiole, lateral view; **D.** palp, medial view (Koenike 1898).

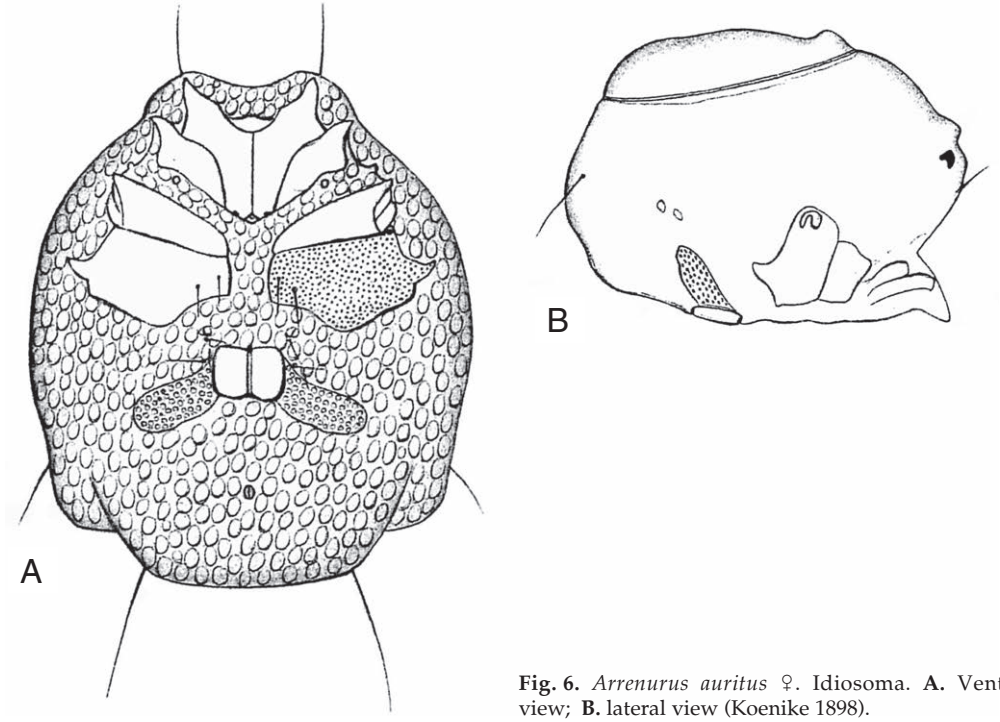


Fig. 6. *Arrenurus auritus* ♀. Idiosoma. **A.** Ventral view; **B.** lateral view (Koenike 1898).

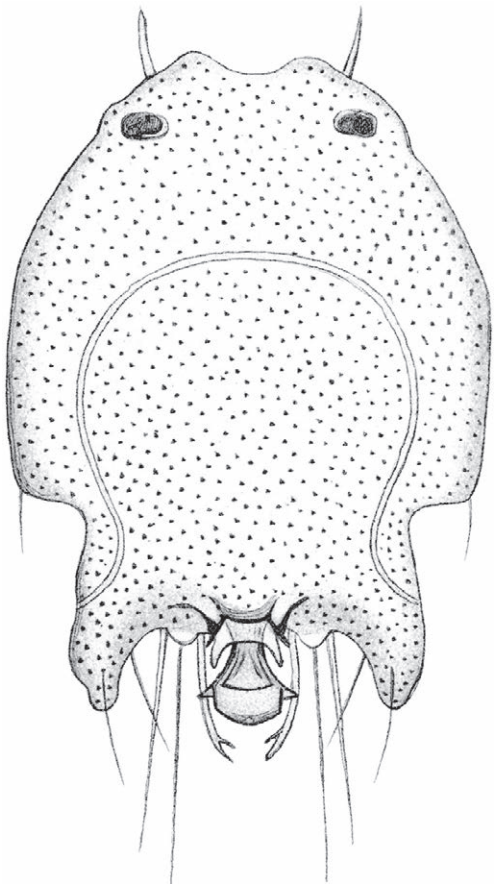


Fig. 7. *Arrenurus bidens* ♂. Idiosoma, dorsal view (Koenike 1898).

nopore field without sclerotized patches ("ohne jede Auszeichnung"); postgenital area long; acetabular plates rather narrow, equal in W from base to the rounded tips, in an obtuse angle to medial line.

Distribution. W Madagascar, endemic.

Habitat. Standing water.

Arrenurus (*Arrenurus*) *bidens* Koenike, 1898
Figs 7–8

Published records from Madagascar. Nossi-Bé: Lake Djabala (Koenike 1898, K.O. Viets 1974).

Description

Both sexes: Colour reddish-yellow. Shape of gnathosomal bay and swimming setation not reported. P-2 with three to four mediodistal setae, P-4 stocky, dorsal and ventral margin subparallel, distoventral edge far projecting, apically obtuse rounded.

Males (Fig. 7): Idiosoma L/W 680/750; frontal margin concave; cauda short and wide, but distinctly set off from anterior idiosoma, with subparallel lateral margins ending in two prominent, posteriorly directed pygal lobes; petiole proximally rather narrow, distally widened, posterior margin strongly projecting, convex; ligulate process enlarged and posteriorly convex, ending far anterior to petiole margin; petiole base dorsally covered by a hyaline membrane with concave margin between a pair of acute-angled lateral tips; associated setae strong, bifurcated. Dorsal furrow incomplete.

Females (Fig. 8): Idiosoma L/W 960/850 (K.O. Viets 1974: W 815) frontal margin concave; maximum W posterior to Cx-IV. Dorsal furrow complete; dorsal shield L/W 619/511; dorsocentral surface and posterior margin each with a pair of humps (more prominent than in *A. pectinatus*). Medial separation Cx-III+IV narrow, about half gonopore field W; mL Cx-IV > Cx-III; genital field close to coxal field; gonopore field L 160 (K.O. Viets 1974: L/W 152/160), without sclerotized patches; distance to posterior margin twice gonopore L; acetabular plates strongly oblique to median axis, laterally truncated, anterior margin straight, posterior margin convex, larger than in *A. pectinatus*.

Remarks. As concerns the female sex, the original description is extremely meagre, widely restricted to an observed similarity to *A. pectinatus* females in idiosoma shape, and to *A. concavus* in palp morphology. Characteristics given above are primarily based on the redescription of the female by K.O. Viets (1974), occasionally on Koenike's (1898) statements, using the original descriptions of the compared species and data in Lundblad (1946) on *A. pectinatus* females.

Distribution. N Madagascar, endemic.

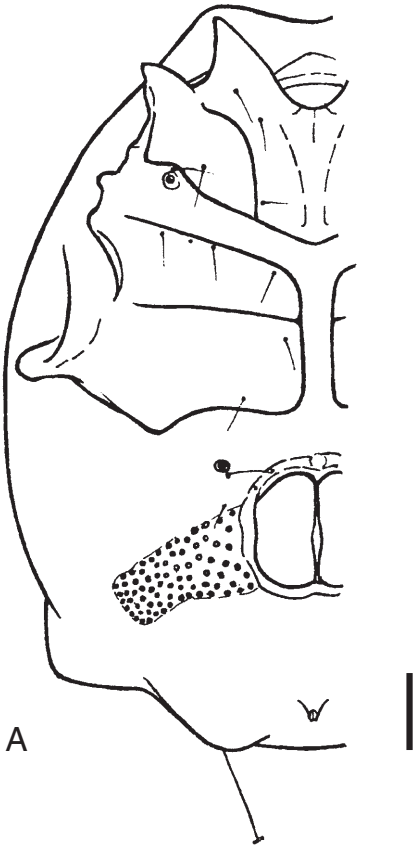
Arrenurus (*Arrenurus*) *capensis* Thor, 1902
Figs 9–11

Material examined. MNHN A 48 F, Toamasina (Tamatave), Bords du Lac Alaotra, xi. 1946, Mollotrec leg. (?), 5♂♂, 2♀♀, 3 dn. **MNHN E 17 J 6**, Taolanaro (Fort Dauphin) (eau douce); viii. 1948, Millot leg. 2♀♀ (*Arrenurus* sp.: Gerecke 2004).

No previous records from Madagascar.

Description (original description, data in parentheses from K.O. Viets (1965).

Both sexes: Colour "probably green" (Thor 1902). Gnathosomal bay flat, lateral margins convex. Swimming setation not reported in detail. P-2 with two



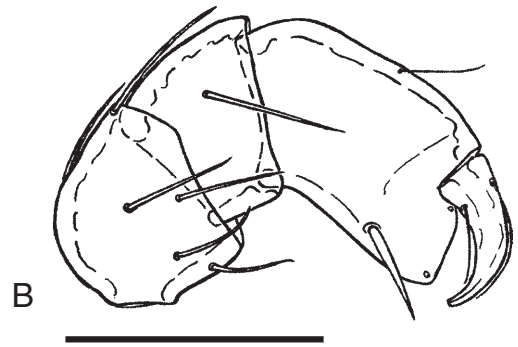


Fig. 8. *Arrenurus bidens* ♀. **A.** Idiosoma (partim), ventral view; **B.** palp (P-2-4), medial view (K.O. Viets 1974). Scale bars = 100 µm.

mediodistal setae, P-4 very short, dorsal and ventral margin subparallel (slightly diverging), distoventral edge rounded, subrectangular.

Males (Figs 9–10): Idiosoma L/W 1350/800 (1075–1295/652–726); frontal margin concave; lateral margins in anterior part convex, posteriorly with concave sector passing onto the subparallel caudal margins; posterior margin with little prominent pygal lobes and a pair of flat posteromedial humps, in medial part concave and bearing a petiole. Dorsal furrow incomplete, posteriorly running to pygal lobes; petiole L 140 (102–124), without ligulate process, posteriorly rounded, with equally converging lateral margins; anterior to its insertion, on dorsal surface a transverse, hyaline membrane with pointed, dorsally directed lateral ends; associated setae simple. In lateral view idiosoma rather high, H 750, in addition to the elevated posterolateral humps a pair of rather flat ones anterior to the dorsal furrow and a flat elevation in the centre of dorsal plate. Coxal field with relatively little distanced separated plates, mL Cx-III < Cx-IV, Cx-IV with subrectangular posteromedial edges and concave medial part of caudal margin; acetabular plates reaching lateral idiosoma margin, the setae flanking their tips visible in dorsal view. IV-leg-3–5 with dense swimming setation, IV-leg-4 with spur.

Female (Fig. 11): Idiosoma L/W 1220/1000; frontal margin with rounded edges flanking a concave medial part; maximum W posterior to Cx-IV; lateral margins equally convex, posteriorly ending in a pair of prominent, acute angled humps; posterior margin between a pair of posteromedial humps weakly convex. Dorsal furrow incomplete. Gnathosomal bay less deep than in males. Medial separation Cx-III + IV about half gonopore field W; mL Cx-III < Cx-IV; genital field about half gonopore field W away from coxal field; gonopore field L/W 120–125/172–174, without sclerotized patches; distance to posterior margin > twice gonopore L; excretory pore close to posterior margin; acetabular plates starting from gonopore field in an acute angle, in lateral part slightly curved to a weakly oblique angle to median axis and directed to lateral idiosoma margin anterior to posterolateral humps; anterior margin convex, posterior margin weakly convex, over most of the length equal in W.

Remarks. The males from Lac Alaotra agree in dimensions and widely also morphologically, with the original description and the redescription by K.O. Viets (1965). A minor difference concerns the more anterior position and more dorsal direction of the hyaline membrane – in ventral view, its pointed lateral edges can be seen flanking the petiole base in the specimens from South Africa (Fig. 9B), but not in the Madagascan specimens (Fig. 10B). The attribution of the Madagascan females is uncertain – they

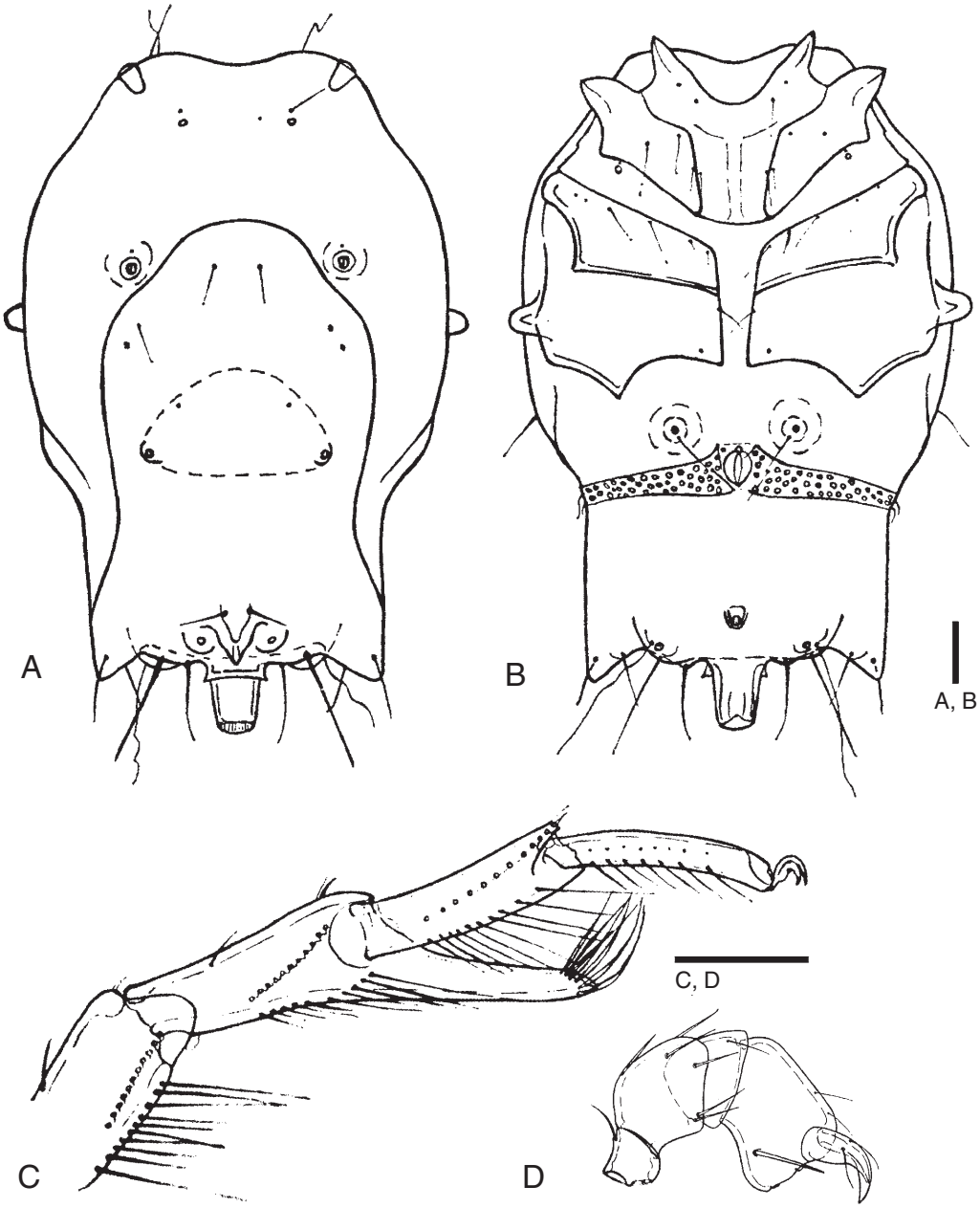


Fig. 9. *Arrenurus capensis* ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** IV-leg-4–6; **D.** palp, medial view (K.O. Viets 1965). Scale bars = 100 µm.

differ from the description by K.O. Viets (1965) in a less prominent frontal area and weakly developed or absent posteromedial humps. In these details, they agree with females reported coexisting at the type locality of *A. capensis*, but described as separate species, *A. meridionalis* Thor, 1902. Character states Thor (1902) considered as diagnostic for separating the latter species were a distinctly larger idiosoma size and a difference in shape of the distoventral seta of P-4. Later on, *Arrenurus meridionalis* was character-

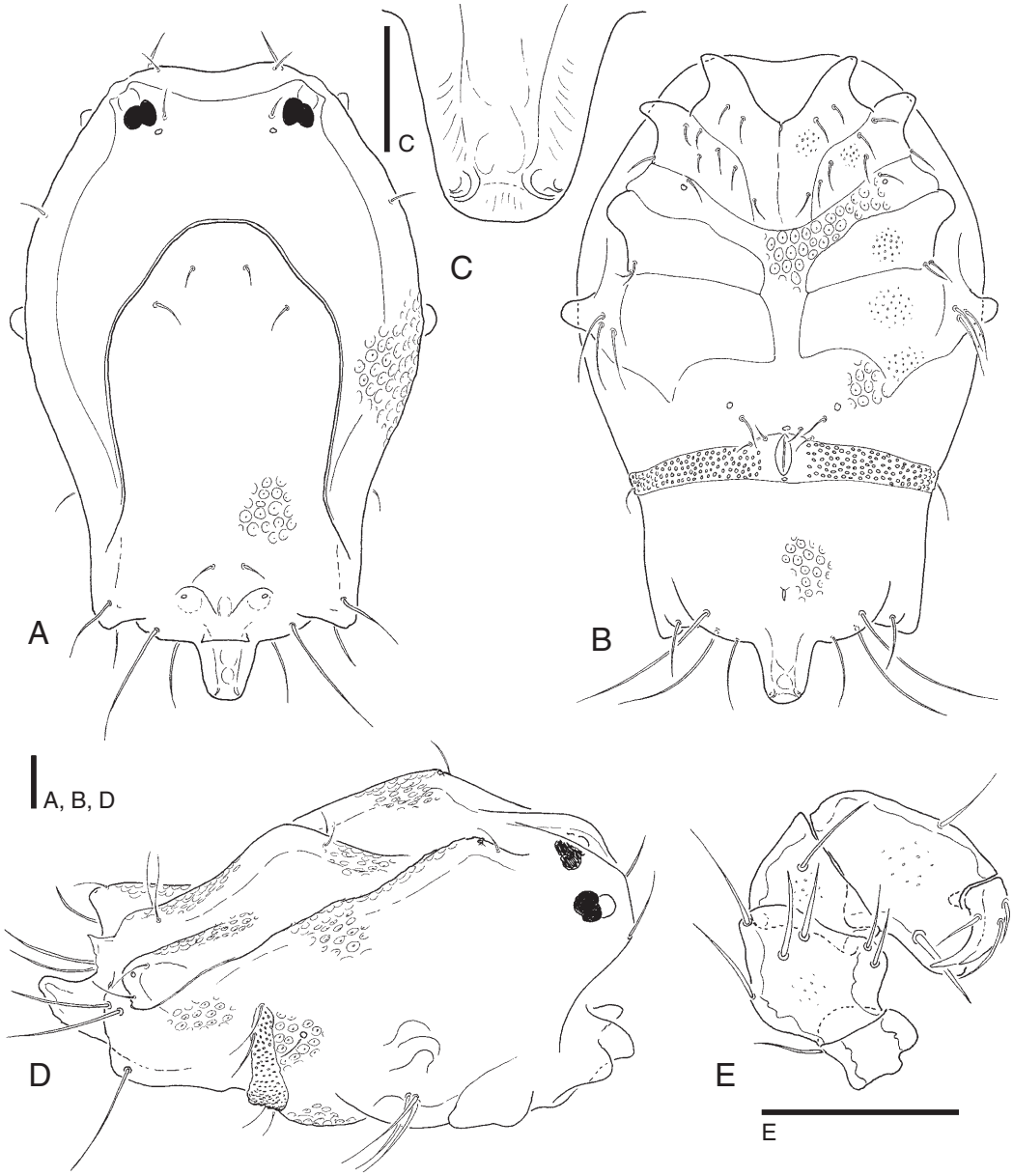


Fig. 10. *Arrenurus capensis* ♂ (MNHN A48F). **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** petiole, ventral view, detail; **D.** idiosoma, lateral view; **E.** palp, medial view. Scale bars = 100 µm.

ized in both sexes by K. Viets (1914) and K.O. Viets (1973) – the attributed male is very distinct, with a much longer, apically broadened petiole and long, pointed pygal lobes. One hypothesis to be checked is that the Madagascan population might represent a sister species of *A. capensis* with more distinct differences in the female sex than in the male. Alternatively, differences between continental and island males of *A. capensis* might be due to intraspecific variability, but the attribution of sexes by previous authors was erroneous and *A. meridionalis*-like females belong to *A. capensis*.

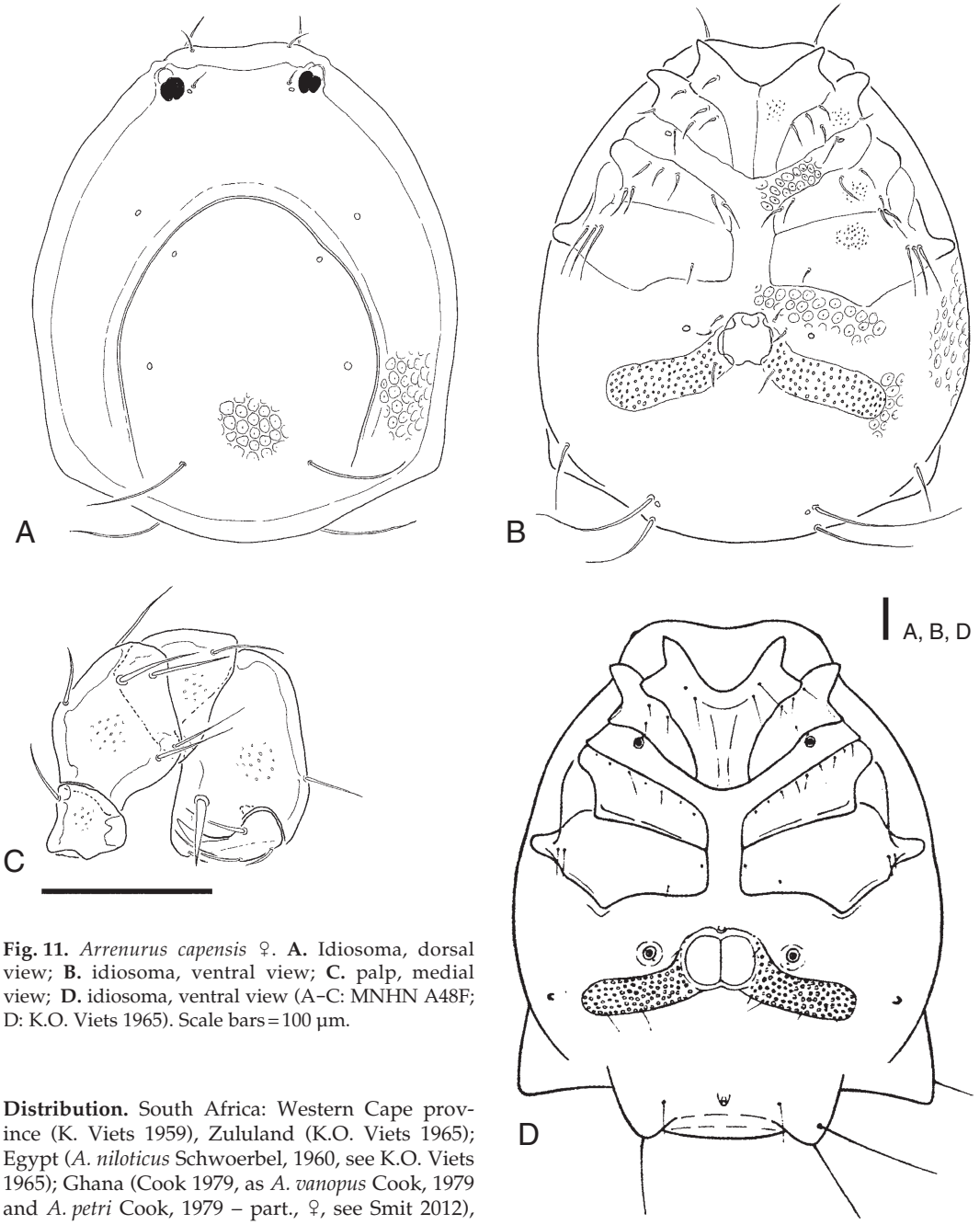


Fig. 11. *Arrenurus capensis* ♀. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** palp, medial view; **D.** idiosoma, ventral view (A–C: MNHN A48F; D: K.O. Viets 1965). Scale bars = 100 µm.

Distribution. South Africa: Western Cape province (K. Viets 1959), Zululand (K.O. Viets 1965); Egypt (*A. niloticus* Schwoerbel, 1960, see K.O. Viets 1965); Ghana (Cook 1979, as *A. vanopus* Cook, 1979 and *A. petri* Cook, 1979 – part., ♀, see Smit 2012), Ethiopia (Smit 2012), Madagascar (Centre: data presented here).

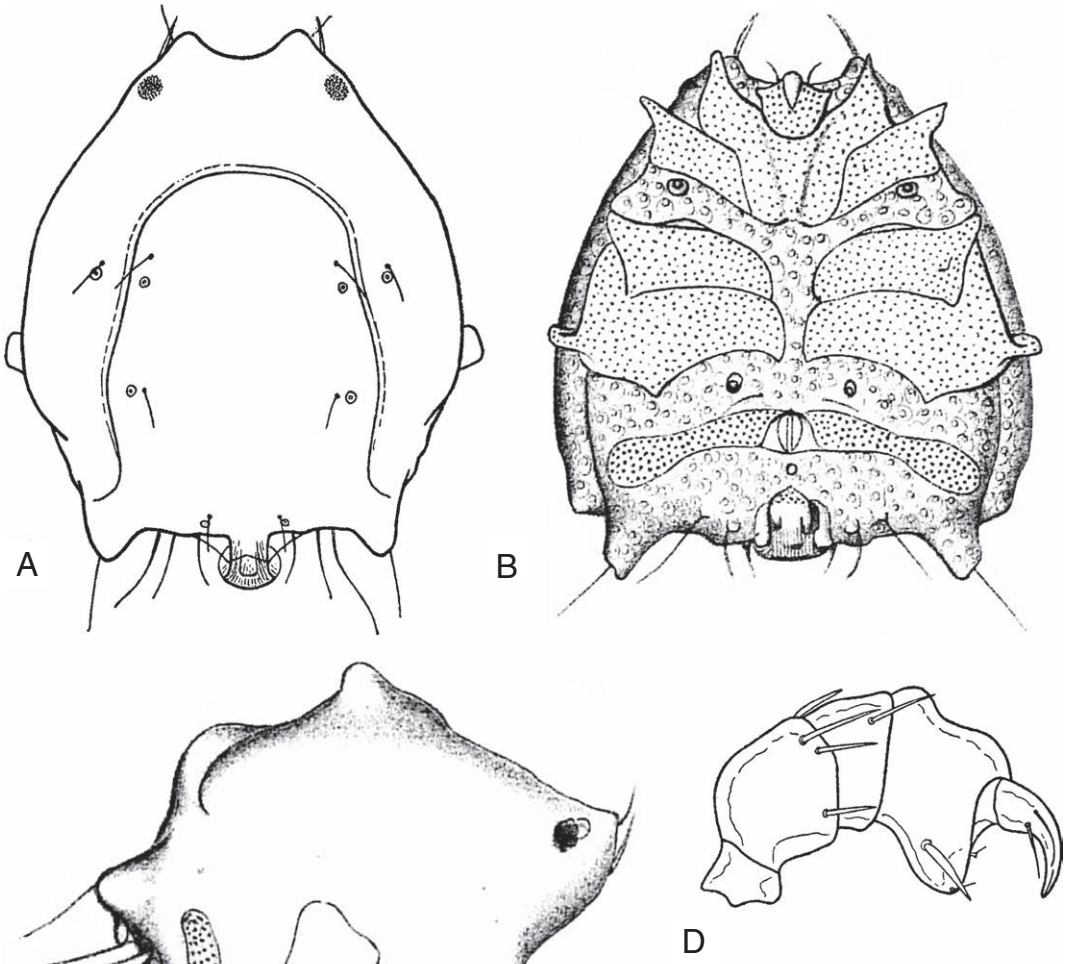


Fig. 12. *Arrenurus frustrator* ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** idiosoma, lateral view; **D.** palp, medial view (A, D: Lundblad 1946; B, C: Koenike 1898).

Arrenurus (*Arrenurus*) *frustrator* **Koenike, 1898**
Figs 12–13

Published records from Madagascar. Mahajanga (Majunga): no collection site details (Koenike 1898, Lundblad 1946); Nossi-Bé: Lake Djabala (Koenike 1898).

Material examined. MD 189, Montagne d'Ambre (Antsiranana), Lake Farihy Makery, Sakaramy, riparian area near outflow, 377 m a.s.l., 12°26'20.5"S, 49°14'20.9"E, 29-iii-2011, 1 ♂ slide mounted.

Diagnosis. Both sexes: Colour greenish to yellow. Gnathosomal bay U-shaped, flat. Palp very stout, P-4 shortened, dorsal margin with a hump in basal part and a deep central concavity, ventral margin S-shaped, proximally concave, distally convex distoventral edge acute angled.

Description

Males (Fig. 12): Idiosoma L/W 950/870; frontal margin concave; maximum W near posterior end; cauda set off from anterior idiosoma, but very little protruding, with a pair of prominent, pointed pygal lobes flanking a wide convex central part; petiole short and compact, in lateral view bent upwards, in dorsal view with a convex posterior margin ending in two acute angled lateral tips. Idiosoma in lateral view

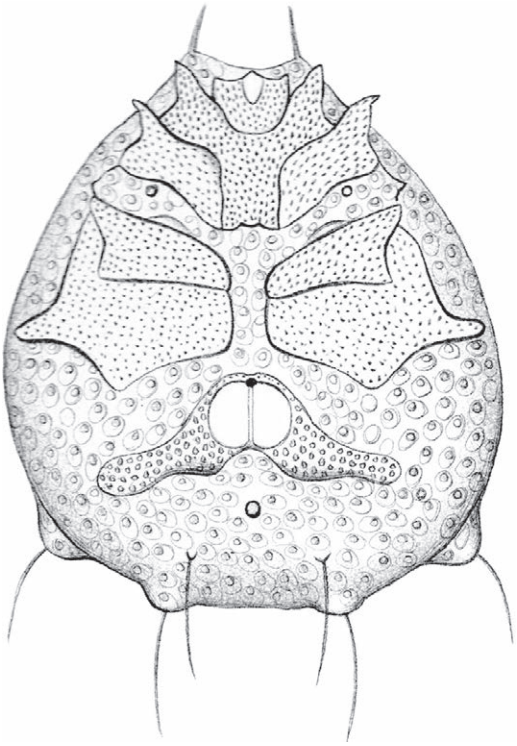


Fig. 13. *Arrenurus frustrator* ♀. Idiosoma, ventral view (Koenike 1898).

highly elevated, hood-shaped, with three pairs of prominent humps at anterior margin, dorsocentrally, and in posterior part. Acetabular plates laterally somewhat enlarged, in the middle narrowed, nearly extending to lateral idiosoma margin. Swimming setae of specimen MD 189: II-leg-3–5, 0/5; 0/10, 0/5; III-leg-4–5, 0/10, 0/16; IV-leg-3–5, 10/10, 10/7 (+5 shorter ones on spur), 10/20.

Females (Fig. 13): Idiosoma L/W 1300/1200 (Lundblad 1946: 1500/1483); frontal margin concave; maximum W posterior to Cx-IV. Dorsal shield relatively short (60% total L); dorsum with two paired humps at posterior margin and one pair of dorsal humps. Medial separation Cx-III+IV < half gonopore field W; genital field close to coxal field (about half gonopore field W), distance to posterior margin twice gonopore L; gonopore field L 144, no sclerotized patches reported or figured; acetabular plates directed posterolaterally, laterally strongly narrowed, posterior margin undulating.

Remarks. We cannot confirm the similarity stated by Koenike (1898) to *A. gibbus* Koenike, 1893, a species until present-day only known from a female from the island Muemba near Zanzibar. In genital field shape, the latter appears to be related to a *Brevicaudaturus* species. A representative of a species similar to *A. frustrator* is reported below under "*Arrenurus* (*Arrenurus*) sp. nov.?".

Distribution. N and W Madagascar, Zimbabwe (K.O. Viets 1972).

Habitat. Standing waters.

Arrenurus (*Arrenurus*) *obliquus* Koenike, 1898
Figs 14–18

Published record from Madagascar. Nossi-Bé: Lake Djabala (Koenike 1898, K.O. Viets 1974).

Material examined. MD 035, Ranomena (Fianarantsoa), stream NW from the 1.07 km-railway-tunnel, 19-viii-2001, 1 ♀; **MD 057**, Ranopiso (Tulear), spring stream NW Centre d'Information ANGAP, 280 m a.s.l., 2-ix-2001, 1 ♂, 1 ♀; **MD 060**, Tsimelahy (Tulear), Rivière Antarantsa downstream 'piscine naturelle', 200 m a.s.l., 5-ix-2001, 1 ♂, 2 ♀♀; **MD 061**, Tsimelahy (Tulear), Rivière Antarantsa, 'piscine naturelle', 200 m a.s.l., 5-ix-2001, 3 ♀♀; **MD 062**, Tsimelahy (Tulear), Analamatsaky, ditches near the village (dead branches of small stream), 100 m a.s.l., 06-ix-2001, 1 ♀; **MD 069b**, Andohahela (Tulear), Isaka, Western stream at the S National Park border (W RIP 118), 200 m a.s.l., 9-ix-2001, 1 ♀; **MD 074b**, Andohahela (Tulear), Isaka, stream crossing RIP 118 at km 32, 360 m a.s.l., pool, 11-ix-2001, 1 ♀. **MD 120d**, Maromandia (Mahajanga), Rivière Andranamalaza, 70 m a.s.l., 21-x-2001 2 ♀♀; **MD 121b**, Maromandia (Mahajanga), left affluent of Rivière Manongarivo, NW Mount Angorony, 70 m a.s.l., 22-x-2002, 2 ♂♂; **MD 122b**, Maromandia (Mahajanga), Rivière Manongarivo, 22-x-2001, 1 ♀ slide mounted; **MD 124b**, Ambohitsara (Antalaha, Antsiranana), Rivière Marolambo, downstream, 30 m a.s.l., 27-x-2001, 2 ♂♂.

Description

Both sexes: Colour yellowish to green. Gnathosomal bay U-shaped. Palp relatively long, P-4 slender, with subparallel dorsal and ventral margins.

Males (n=4; Figs 14–16): Idiosoma L/W 545–548/450–482. In lateral view with elevated, equally rounded dorsum, maximum H in centre. Genital field near posterior margin, directed posteroventrally; gonopore transformed to a tube-like extension encasing a bottle-shaped sclerite with a dorsally inserted, weakly curved thorn; the latter heavily sclerotized and turned to one side; some transverse or oblique structures visible inside the tube might be interpreted as a modified ejaculatory complex; acetabular plates medially narrowed, touching each other anterior to gonopore, slightly oblique and laterally enlarged, with straight anterior and convex posterior margins; anterior part of gonopore flanked by five to six

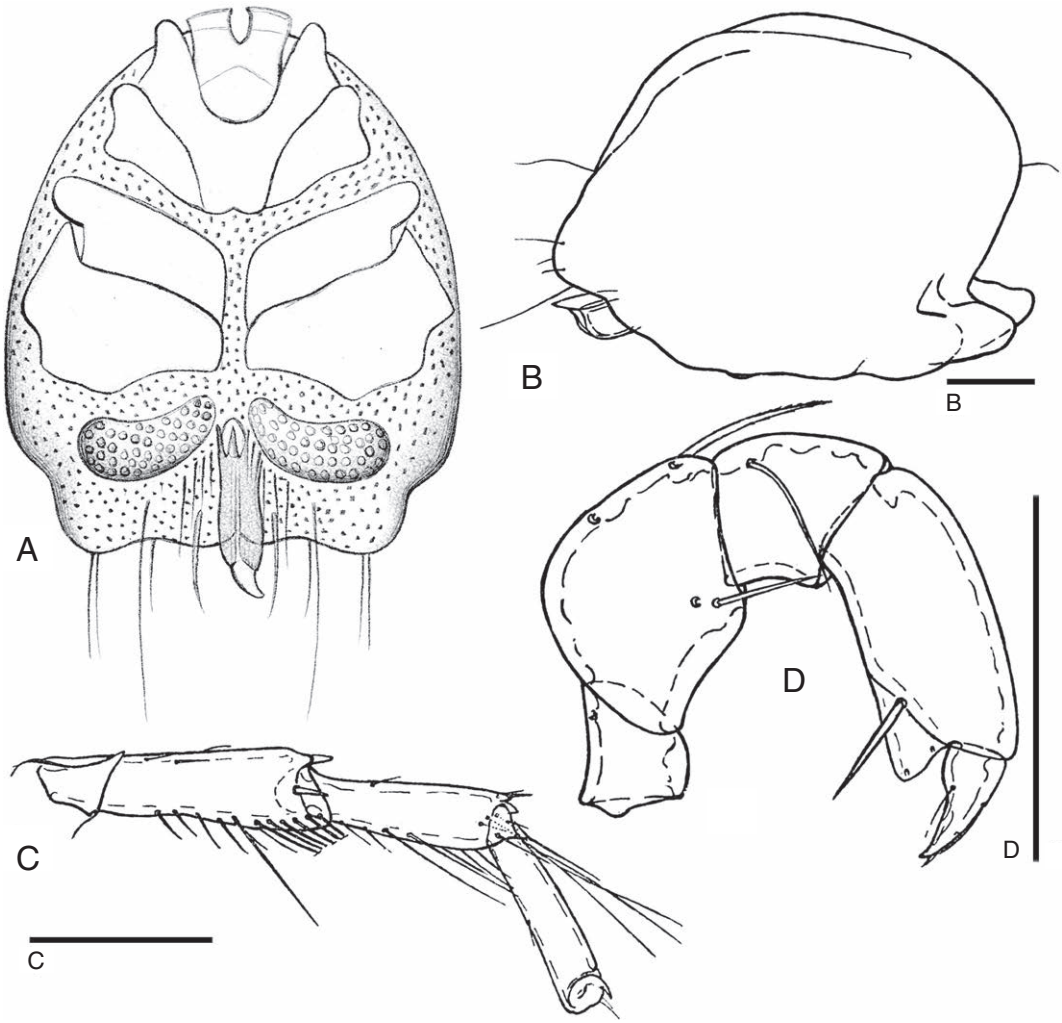


Fig. 14. *Arrenurus obliquus* ♂. **A.** Idiosoma, ventral view; **B.** idiosoma, lateral view; **C.** IV-leg-4–6, right; **D.** palp, medial view (A: Koenike 1898; B–D: K.O. Viets 1974). Scale bars = 100 µm.

pairs of long and strong setae. Swimming setae: II-leg-4, 0/3; II-leg-5, 0/2; III-leg-4, 0/5; III-leg-5, 0/5; IV-leg-3, 3/3; IV-leg-4, 8/4; IV-leg-5, 0/8.

Females (n = 13; Figs 17–18): Idiosoma L/W 670–730/600–644; oval in shape; frontal margin convex; maximum W at level of genital field. Dorsum without humps, in lateral view not elevated. Medial separation of Cx-III + IV about half W gonopore field, medial margin of Cx-III/-IV narrow, posterior margin Cx-IV oblique, directed posterolaterally; genital field close to coxal field (distance about half gonopore field W); gonopore field L 109, without sclerotized patches; acetabular plates very compact, barely longer than wide, laterally rounded, maximum W medially. Swimming setae: I-leg-5, 0/1; II-leg-4, 0/3; II-leg-5, 0/6; III-leg-3, 0/4; III-leg-4, 0/7; III-leg-5, 0/7; IV-leg-3, 3/3; IV-leg-4, 2/8; IV-leg-5, 0/8.

Remarks. Combined with a discussion of the first description of this species (Koenike 1898), K.O. Viets (1974) gave a detailed redescription, but both authors misinterpreted the particularity of the male genital field. In fact, the posteroventral extension in the male of *A. obliquus* is formed by the modified gonopore field and not a homologue of the petiole of other *Arrenurus* species (an unpaired extension inserted posterior to the excretory pore). If several specimens are compared, it becomes obvious that this appendage is movable, and its membranous parts are

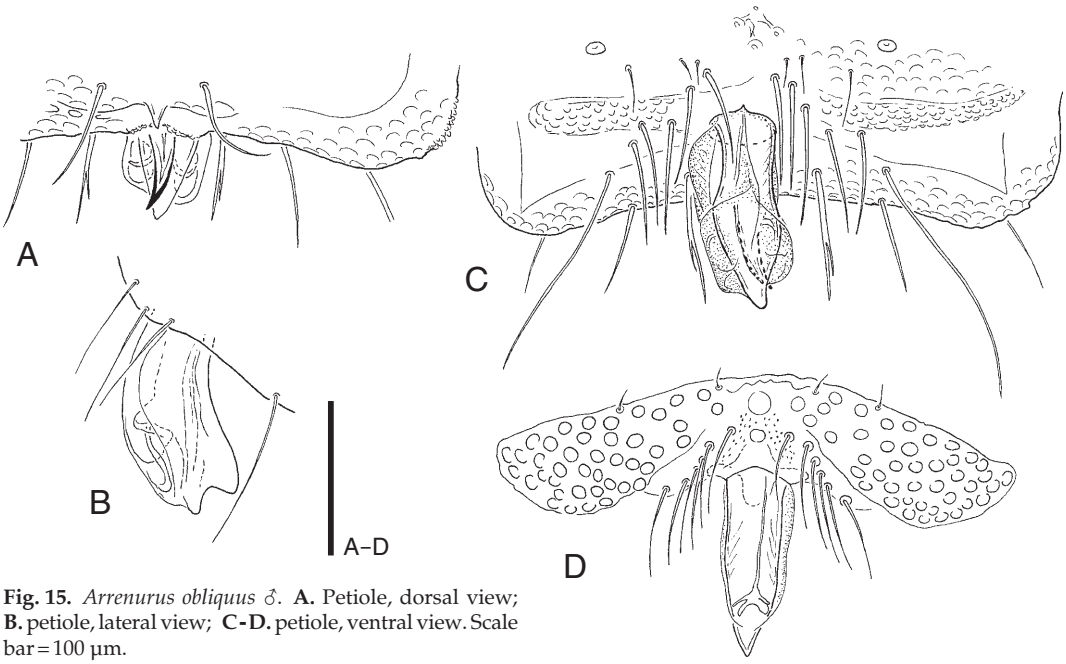


Fig. 15. *Arrenurus obliquus* ♂. **A.** Petiole, dorsal view; **B.** petiole, lateral view; **C-D.** petiole, ventral view. Scale bar = 100 µm.

easily deformed by external pressure. In one specimen we found it extended to nearly double length, indicating that the internal sclerotized structures may be telescope-like protruded. In an immature specimen (MD 069b), with still unsclerotized and irregularly-shaped posterior idiosoma margin, the formation of the acetabular plates and the origin of the appendage from the gonopore are particularly well visible, while the sclerotized thorn is not (yet?) developed. The similarity of this appendage as a whole with a petiole as it is found in other species of the genus is only superficial. The latter functions as a coupling apparatus during indirect sperm transfer. Instead, in view of the morphological position and shape of the appendage in *A. obliquus*, the hypothesis is possible that it is used for direct spermatophore transfer. Thus, we are confronted with an extreme and outstanding apomorphy. A further detail standing possibly in relation to the development of the penis-like genital appendage has not found appropriate consideration in previous publications: In addition to the four pairs of setae typically inserted at the posterior margin of the idiosoma in *Arrenurus* (in *A. obliquus* the medial ones bifurcate), five to six further strong setae flank the anterior part of the gonopore. In other *Arrenurus* species, only fine, hair-like setae are found in this area. Given the fact that the posterior appendage is not a petiole, the subgeneric assignment of *A. obliquus* is arbitrary.

Distribution. Madagascar, the whole island, endemic.

Habitat. Mostly streams at low altitude (the type locality on Nossy-Bé the only standing water site).

Arrenurus (*Arrenurus*) *rudiferus* Koenike, 1898
Figs 19–22

Published records. Madagascar: Mahajanga (Majunga): no collection site details (Koenike 1898, Lundblad 1946), Morondava (Koenike 1898); Antananarivo: no collection details (Walter & Bader 1953); Ivory Coast: Bandama (Walter 1935); Cameroon: Kunangcreek, Dibombe (K. Viets 1916); Ghana (female only, uncertain assignment): Smit (2012).

New records. MD 125d, Ambohitsara (Antalaha, Antsiranana), Rivière Ankavia upstream the village, pool, 25 m a.s.l., 27-x-2011, 1 ♂ (SMF – slide mounted); 3 ♀♀ (one slide mounted); **MD 129e**, Maromandia (Antalaha, Antsiranana), Rivière Ankavia near village, 40 m a.s.l., 30-x-2001, 1 ♀.

Description

Both sexes: Colour green. Gnathosomal bay V-shaped. Palp rather stout, P-2 with three mediodistal setae, P-4 short, with subparallel dorsal and ventral margins, distoventral edge rounded.

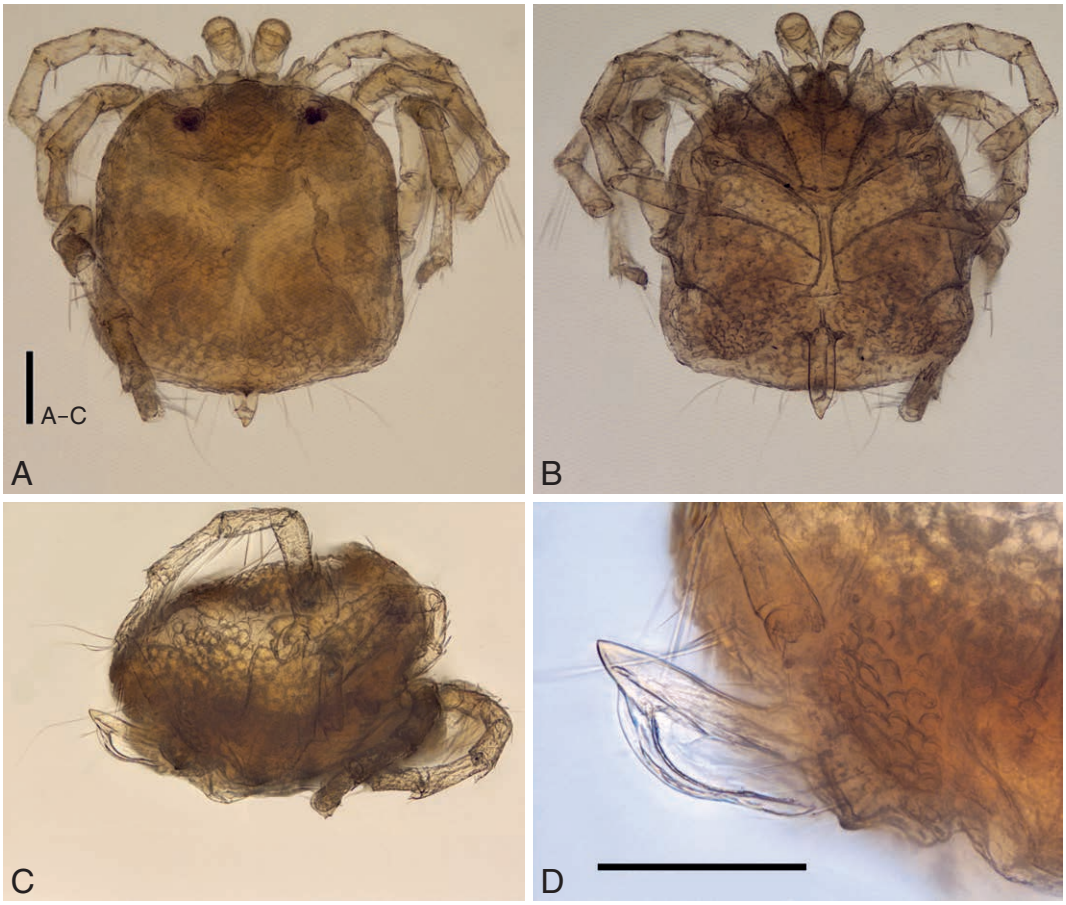


Fig. 16. *Arrenurus obliquus* ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** idiosoma, lateral view; **D.** petiole, lateral view. Scale bars = 100 µm.

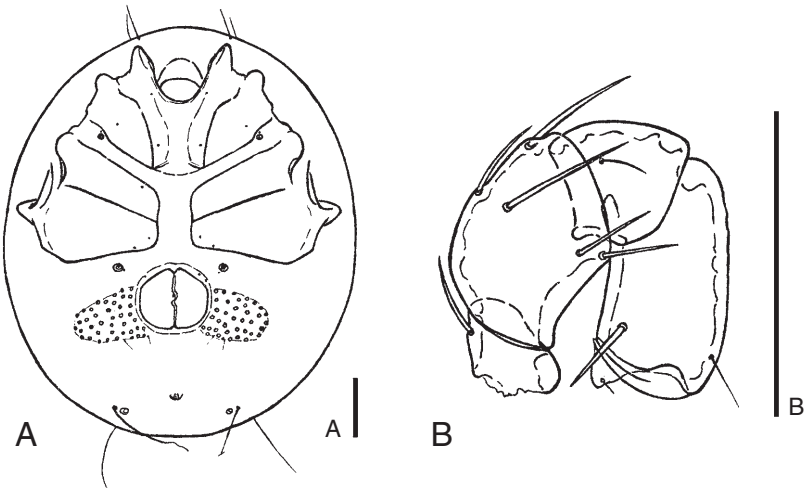


Fig. 17. *Arrenurus obliquus* ♀. **A.** Idiosoma, ventral view; **B.** palp, medial view (K.O. Viets 1974). Scale bars = 100 µm.

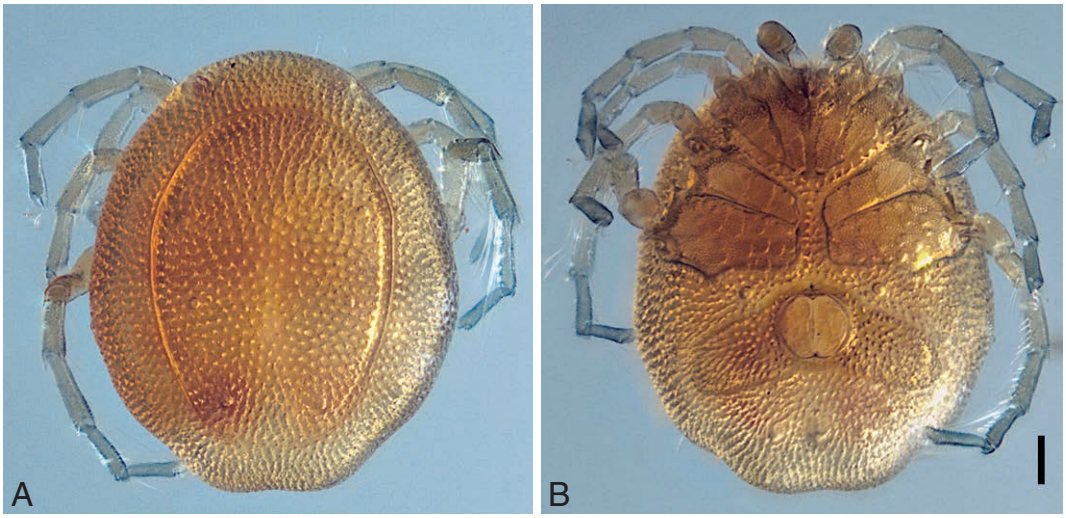


Fig. 18. *Arrenurus obliquus* ♀, idiosoma. **A.** Dorsal view; **B.** ventral view. Scale bar = 100 µm.

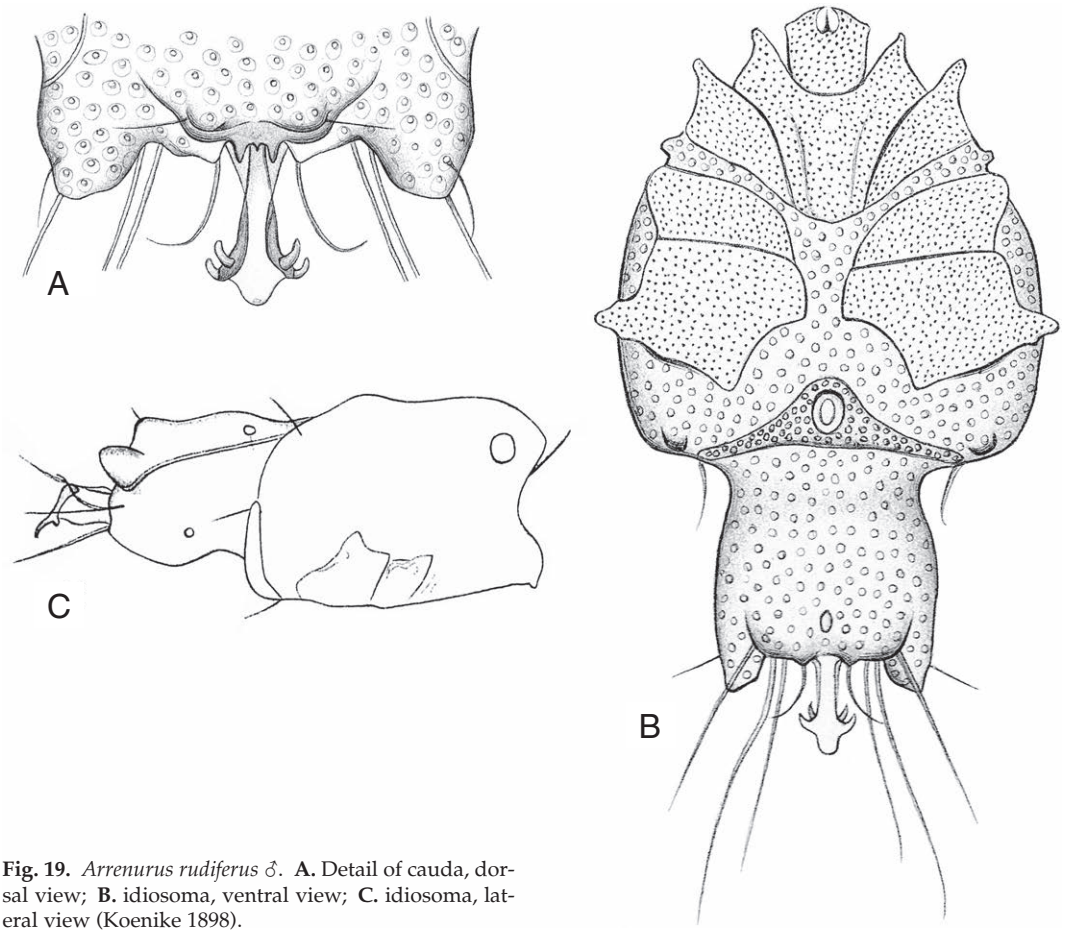


Fig. 19. *Arrenurus rudiferus* ♂. **A.** Detail of cauda, dorsal view; **B.** idiosoma, ventral view; **C.** idiosoma, lateral view (Koenike 1898).

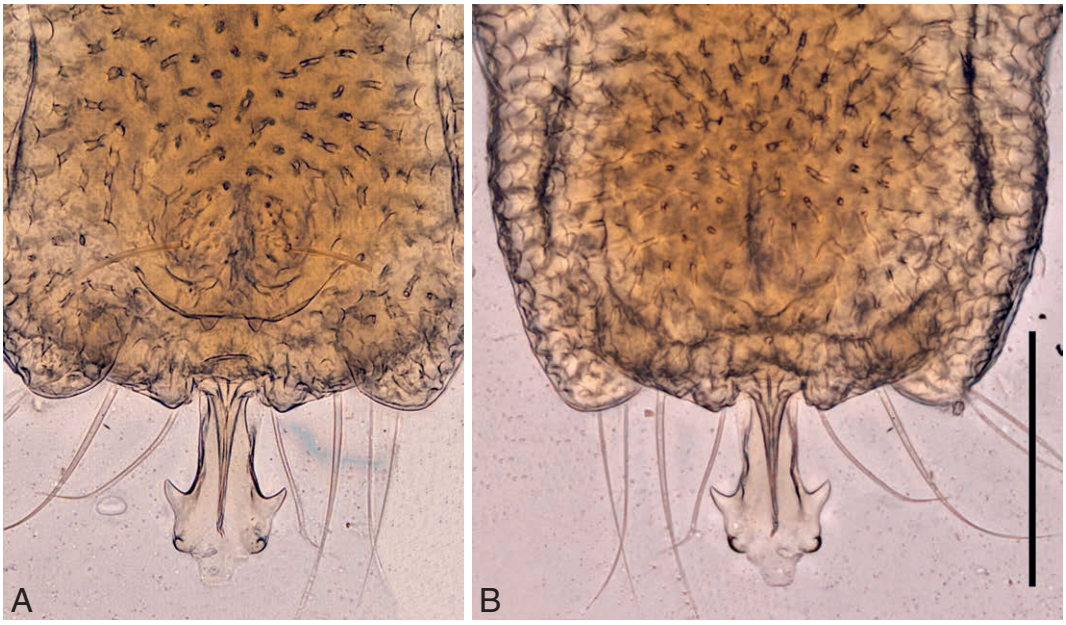


Fig. 20. *Arrenurus rudiferus* ♂, detail of cauda. **A.** Dorsal view; **B.** ventral view. Scale bar = 100 µm.

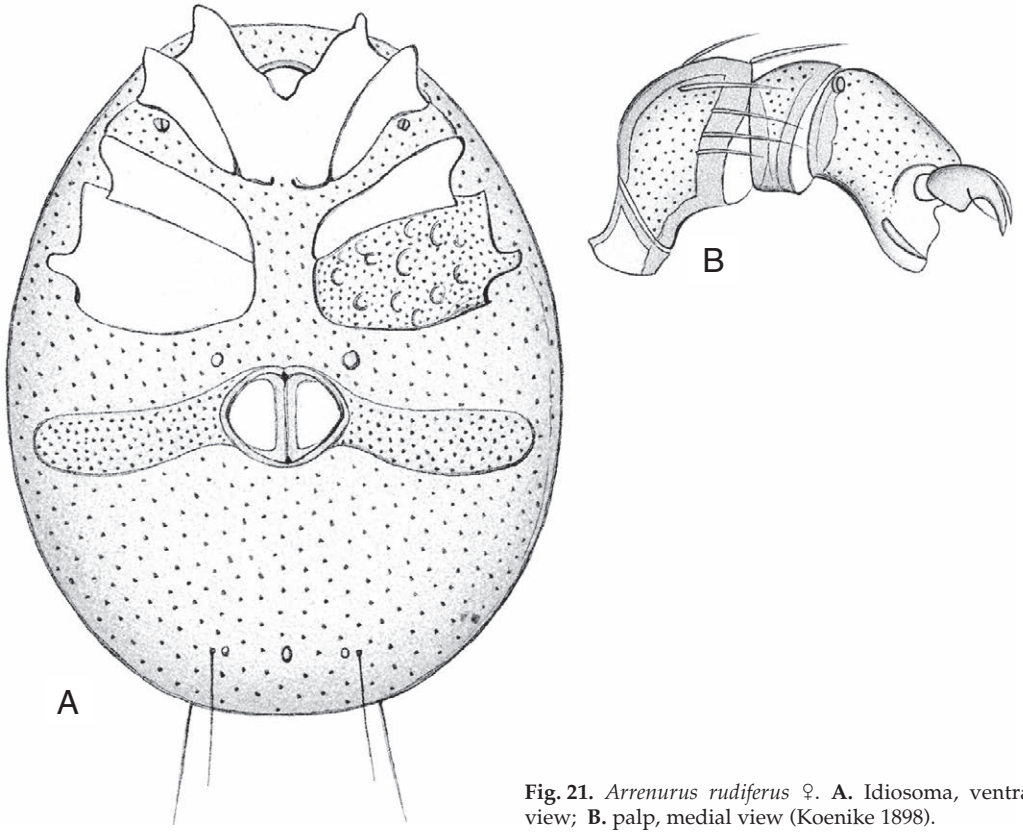


Fig. 21. *Arrenurus rudiferus* ♀. **A.** Idiosoma, ventral view; **B.** palp, medial view (Koenike 1898).

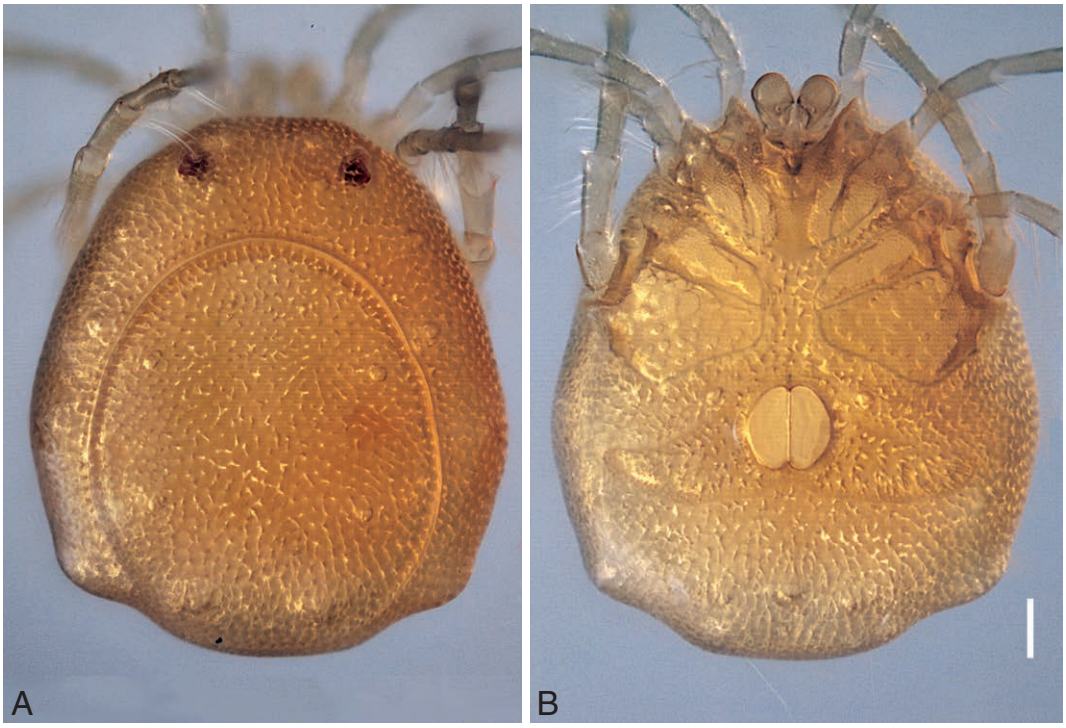


Fig. 22. *Arrenurus rudiferus* ♀, idiosoma. **A.** Dorsal view; **B.** ventral view. Scale bar = 100 µm.

Males (Figs 19–20): Idiosoma L/W 828/547 (Lundblad 1946); frontal margin concave, anterolateral margins rounded; cauda distinctly set off from anterior idiosoma, long, with slightly convex lateral margins ending in slightly protruding posterolateral tips, posterior margin convex; petiole long, with a narrow proximal part and a barbed, arrow-shaped tip. Dorsal furrow incomplete. Gnathosomal bay U-shaped. In lateral view a bluntly pointed elevation between the posterolateral tips of cauda. Swimming setae: III-leg-4, 0/8; III-leg-5, 0/8; IV-leg-3, 5/7; IV-leg-4, 7/11 (+8 on spur); IV-leg-5, 9/8.

Females (Figs 21–22): Idiosoma L/W 900/670 (Lundblad 1946); idiosoma oval in shape; without humps; frontal margin convex. In lateral view flat. Medial margin Cx-III << Cx-IV, medial separation Cx-III + IV > half gonopore field W; genital field close to coxal field (distance about half gonopore field W), far from posterior margin (about four times gonopore L); gonopore field without distinct sclerotized patches, narrow strips of sclerotization along anterior margin and gonopore lips; acetabular plates long and narrow, in lateral part slightly widened, nearly reaching lateral idiosoma margin. Gnathosomal bay in basal part more pointed than in male. Swimming setae: II-leg-3, 0/3; II-leg-4, 0/3; II-leg-5, 0/3; III-leg-3, 0/1; III-leg-4, 0/8; III-leg-5, 0/8; IV-leg-3, 5/5; IV-leg-4, 8/8; IV-leg-5, 0/7.

Remarks. While in the illustration of Koenike two pairs of hooks are depicted at the same level of the petiole, males from our collections (Fig. 20) bear one pair of prominent lateral hooks centrally at the petiole and additionally one dorsal and one ventral pair of (less prominent) hooks further distal at the petiole. The idiosoma of females from this study have indistinct posterolateral corners (absent according to the original description), and differ also in the shape of acetabular plates (more narrowed in lateral part) and gonopore (indistinct sclerotization only at the anterior and posterior margins, not along the gonopore lips).

Distribution. N, W and Central Madagascar; W Africa.

Habitat. Standing waters and stagnant areas of rivers and streams.

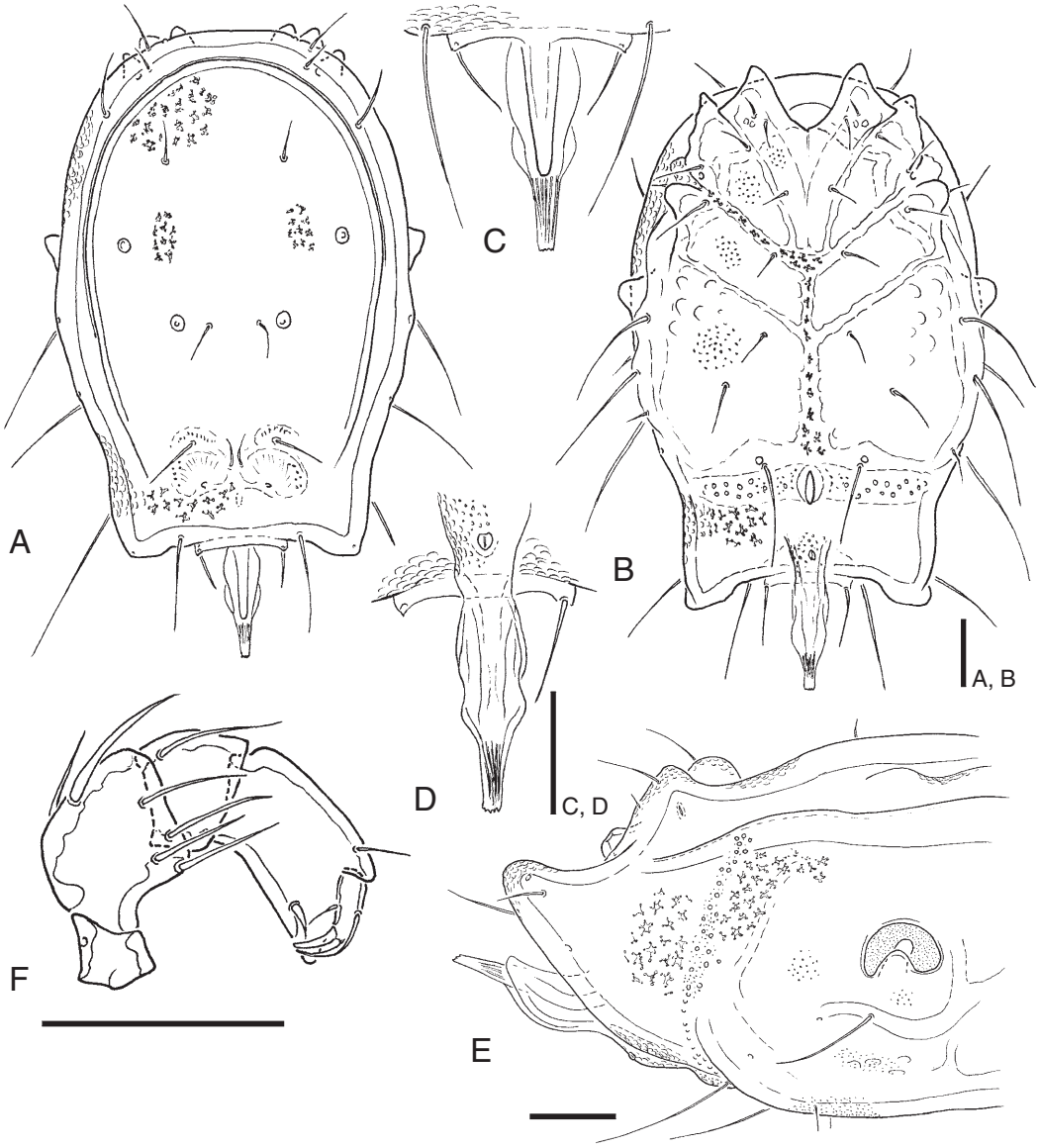


Fig. 23. *Arrenurus ambrensis* sp. nov. holotype ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** detail of petiole, dorsal view; **D.** detail of petiole, ventral view; **E.** posterior part of idiosoma, lateral view; **F.** palp, medial view. Scale bars = 100 µm.

Arrenurus (*Arrenurus*) *ambrensis* sp. nov.
Figs 23–25

Material examined. Holotype: ♂, **MD 174**, Montagne d'Ambre (Antsiranana), Ambohitra (Joffreville), Voie 100 arbres, temporary lake I, 1048 m a. s. l., 12°31'13.2"S, 049°10'31.6"E, 21-iii-2011 (SMF – gnathosoma and left palp, IV-leg on slide "MAD 28"; right palp, both I-/II-leg lacking, III-leg on one side lacking, on the other side terminal segment lacking). – **Paratypes:** Same data as holotype, 2 ♀♀ (SMF – gnathosoma and palps of 1 ♀ on slide "MAD 29").

Diagnosis. Both sexes: Interspaces between coxal plates very narrow, with fine porosity; Cx-IV with two long lateral setae; acetabular plates extending to lateral idiosoma. Gnathosomal bay flat, lateral mar-

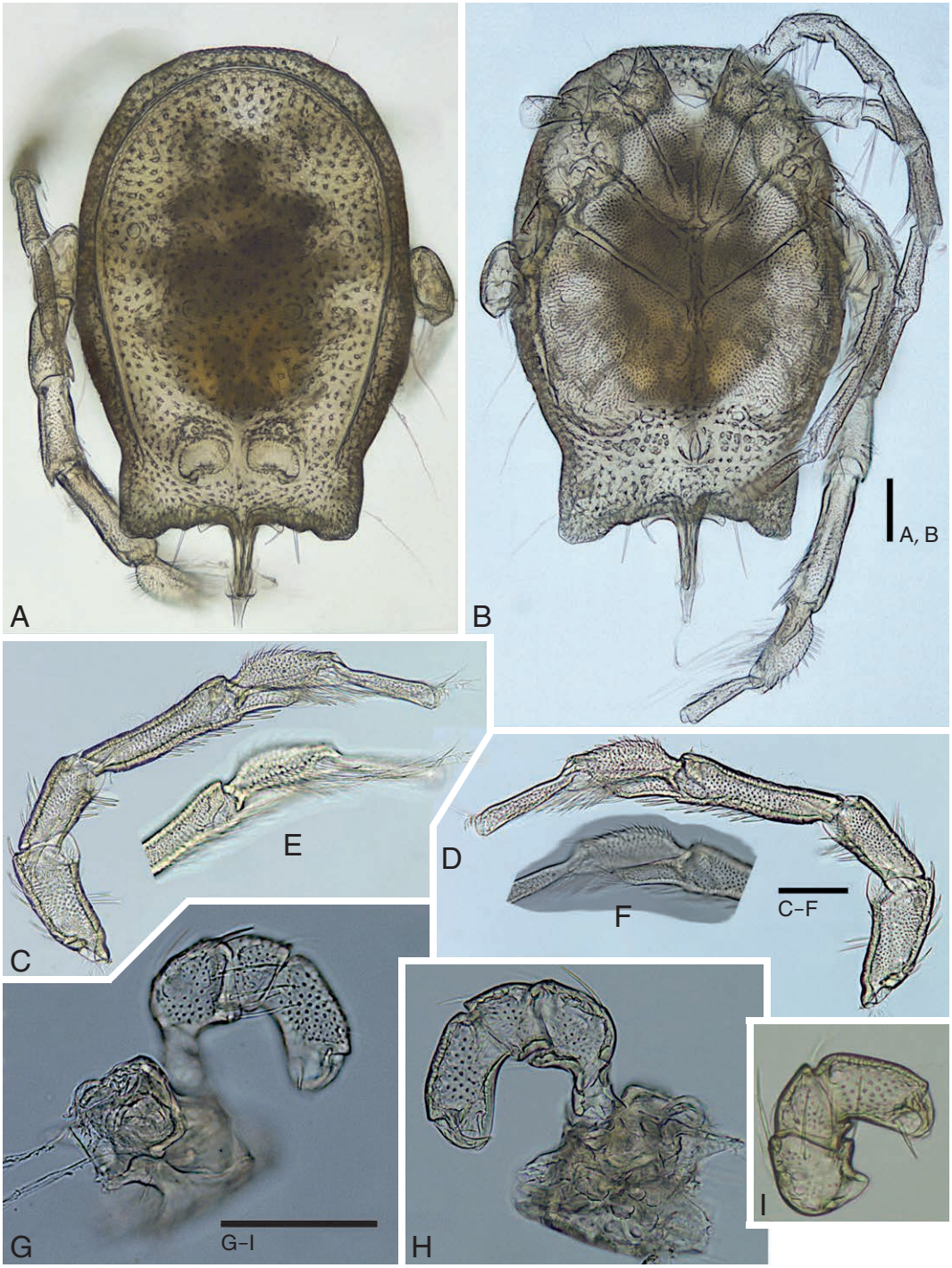


Fig. 24. *Arrenurus ambrensis* sp. nov. A–H = holotype ♂; I = paratype ♀. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** IV-leg-2–6, posterior view; **D.** IV-leg-2–6, anterior view; **E.** detail of IV-leg-5, posterior view; **F.** detail of IV-leg-5, anterior view; **G.** gnathosoma with left palp, medial view; **H.** gnathosoma with left palp, lateral view; **I.** left palp, medial view. Scale bars = 100 µm.

gins strongly diverging. P-2 with four mediodistal setae, P-4 dorsal and ventral margins subparallel.

Male: Cauda stout, not set off from anterior idiosoma, with a concave posterior margin; a long, weakly sclerotized petiole extending from posteroventral surface, consisting of a proximal, in lateral view bowed sheath, and a tubular centrepiece.

Females: Genital field close to posterior margin, gonopore field with two pairs of sclerotized patches, posterior ones larger than anterior ones; acetabular plates directed anterolaterally.

Description

Both sexes: Colour unknown (decoloured in ethanol). Frontal margin convex. Tips of Cx-I slightly expanding beyond the frontal margin. Idiosoma porosity rather fine and on coxae homogenous, with a few muscle insertion scars on Cx-IV.

Male (holotype, Figs 23, 24A–H): Idiosoma L/W 802/543. Dorsal furrow incomplete; dorsal shield large, posteriorly broadly fused with ventral shield, maximum W 466; Dgl-3 conus-like, in an area without idiosoma pores, associated setae on paired, in lateral view obtuse, posterodorsal humps; posterior margin between a pair of pointed lateral humps concave; in medial part with a slightly protruding hemline extending between a pair of setae; petiole inserted ventrally to this structure, in lateral view resembling a boat's bow, with a central tubular extension that is finely lineated and apically fringed; in dorsal view, a sclerotized internal rod is visible, in ventral view the excretory pore, located on the petiole base. Cx-IV large, with strongly oblique anterior, and medially indented posterior margins; gonopore field L 54; acetabular plates extending to lateral idiosoma margin (best visible in lateral view). IV-leg-4 with a spur, IV-leg-5 shortened and broad, dorsally with ten stout, short setae, ventrally with ten long setae. Swimming setae: III-leg-4, 0/1; III-leg-5, 0/1; IV-leg-3, 0/2; IV-leg-4, 0/9 on spur; IV-leg-5, 0/12. Leg measurements: L I-leg-4–6: 124, 130, 128; IV-leg-4–6: 247, 174, 166. Palp segment L P-1–5: 32, 72, 50, 80, 40.

Females (n = 2; Figs 24I, 25): Idiosoma L/W 778–794/616–632. Dorsal furrow complete, dorsal shield covering most of dorsum, L/W 705–721/535–543. Idiosoma in lateral view flat. Medial margin of Cx-IV much longer than medial margin of Cx-III; venter posterior to coxal field short, genital field away from coxal field (distance about Cx-IV mL), rather close to posterior margin; gonopore field L/W 104/162; acetabular plates long, in central part narrowed, extending anterolaterally onto lateral idiosoma margin. Swimming setae: II-leg-5, 0/2; III-leg-5, 0/3; IV-leg-3, 0/1; IV-leg-4, 0/2; IV-leg-5, 0/5. Leg segment L I-leg-4–6: 124, 126, 114; IV-leg-4–6: 166, 174, 132. Palp segment L P-1–5: 28, 72, 54, 74, 38.

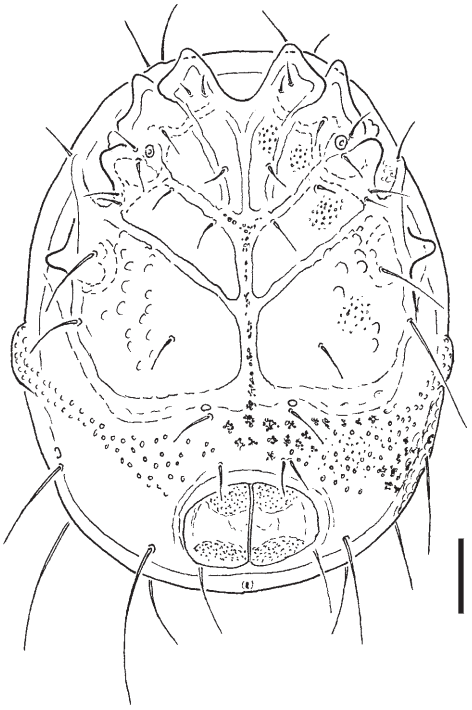


Fig. 25. *Arrenurus ambrensis* sp. nov. paratype ♀. Idiosoma, ventral view. Scale bar = 100 µm.

Etymology. Named after the Ambre Mountains, where the type locality is located.

Remarks. The particular formation of the petiole separates males of the new species from all known *Arrenurus* species. Females are characteristic in the gonopore field (with two pairs of large, sclerotized patches) in a subterminal position, but not far away from the coxal field (distance about gonopore L); they are similar to *A. bispatulatus* in the shape of the acetabular plates, but these plates are directed straight to the lateral idiosoma margin in the latter species. Moreover, a more or less similar shape of the genital field can be found in females of the subgenus *Rhinophoracarus*, e. g. *A. suehnensis* (Cook, 1966) and *A. lodus* (Cook, 1966) from Liberia. Females of the subgenus *Rhinophoracarus* differ in having a rotated palp. Both sexes are characteristic by the very narrow medial interspace between Cx-III + IV and a rather slender palp with a few, scattered distoventral setae.

Distribution. N Madagascar, endemic. Only known from the type locality.

Habitat. Temporary standing water.

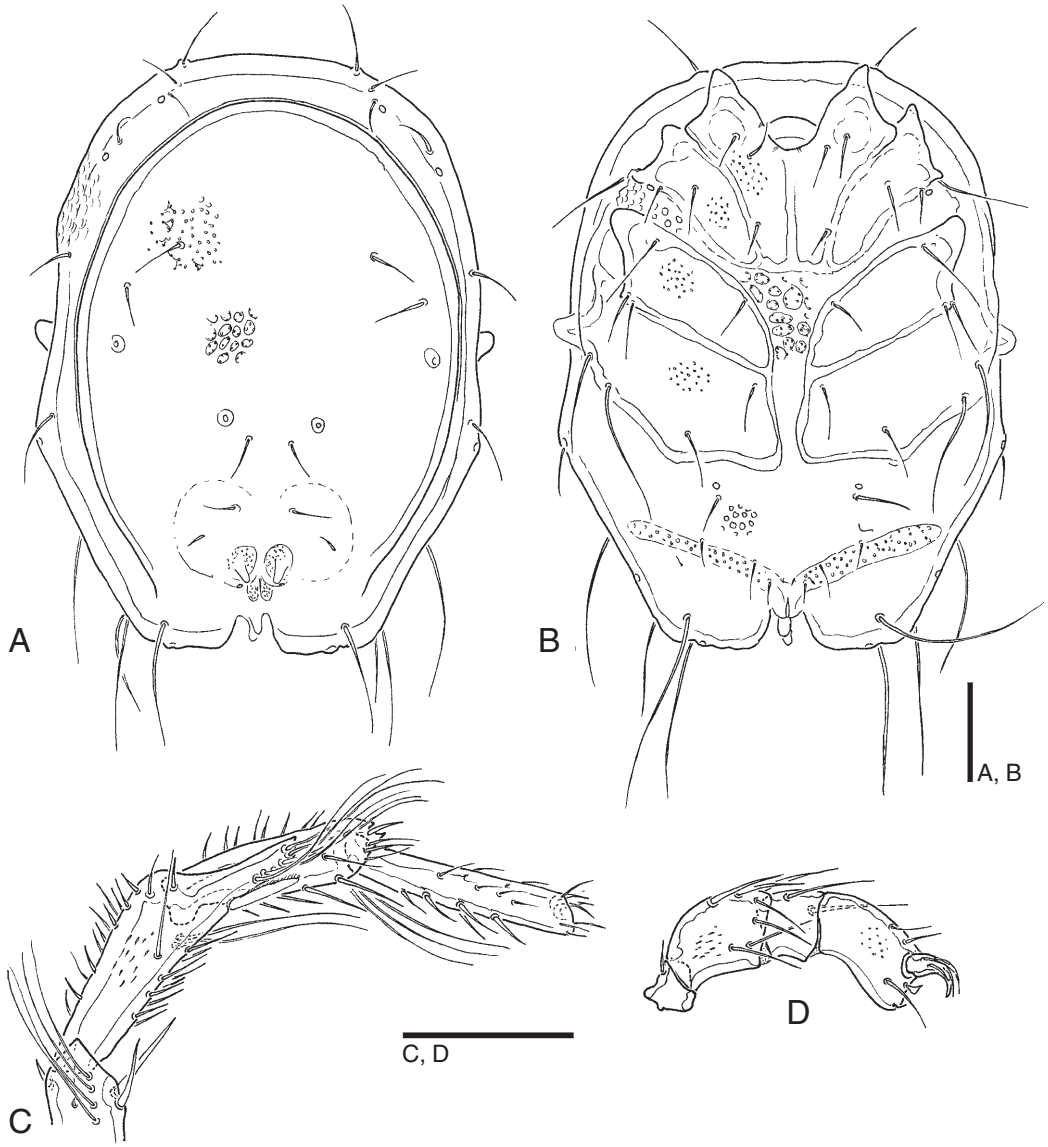


Fig. 26. *Arrenurus bispatulatus* sp. nov. holotype ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** IV-leg-4–6, anterior view; **D.** palp, medial view. Scale bars = 100 µm.

Arrenurus (*Arrenurus*) *bispatulatus* sp. nov.
Figs 26–29

Material examined. Holotype: ♂ (juv.), **MD 155a**, Montagne d'Ambre (Antsiranana), Ambohitra (Joffreville), Reserve Fontenay, left affluent Rivière de Manques, riffle, 600 m a. s. l., 17-xi-2001 (SMF – gnathosoma, palps, IV-leg on slide "MAD 17"). – **Paratypes:** Same data as holotype 1 ♂ (juv.), 2 ♀♀ (SMF – damaged gnathosoma, palps, IV-leg-3–6 of one ♀ on slide "MAD 18"); **MD 009**, Anjozorobe (Antananarivo), small stream at campsite near forest border, 1280 m a. s. l., 18-vii-2001, 1 ♂, 1 ♀ (RMNH); **MD 107c**, Ankaratra (Antananarivo), Reserve Manjakatompo, left affluent Rivière Mahiavona E Mount Mantsina, 1750 m a. s. l., pool, 8-x-2001, ♂, 3 ♀♀; **MD 112b**, Ankaratra (Antananarivo), Reserve Manjakatompo, affluent to station piscicole upstream road to Lac Froid, 1700 m a. s. l., 9-x-2001, 1 ♂ (SMF); **MD 161**, Montagne d'Ambre (Antsiranana), Ambohitra (Joffreville), Reserve Fontenay, riparian springs at Rivière de Manques, 730 m a. s. l., 20-xi-2001, 1 ♂ (SMF); **MD 168**, Tampoketsan Ankazobe (Antananarivo), W from R.N. 4

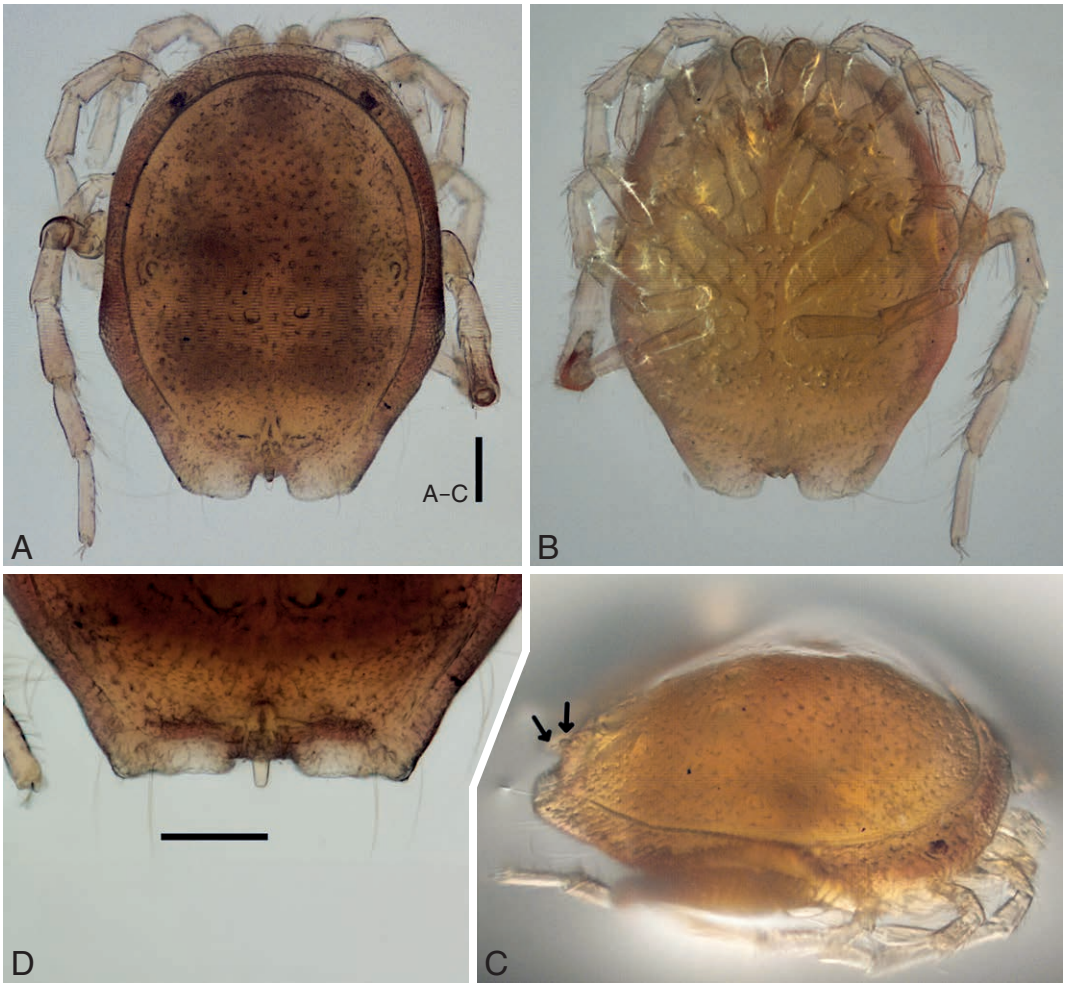


Fig. 27. *Arrenurus bispatulatus* sp. nov. holotype ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** idiosoma, lateral view (arrows pointing at the two equal parts of petiolus); **D.** posterior part of idiosoma, dorsal view, detail. Scale bars = 100 µm.

(km 157), spring exposed W, 1400 m a.s.l., 29-xi-2001, 1 ♀ (RMNH); **MD 169**, Tampoketsan Ankazobe (Antananarivo), Rivière Andranofeno Sud at bridge R.N. 4 (km 130), 1450 m a.s.l., 29-xi-2001, 1 ♂ (RMNH).

Other material. MD 023b, Ionilahy (Fianarantsoa), stream draining area Marosaro (S of Rivière Ionilahy), 220 m a.s.l., riffle, 12-viii-2001, 1 ♀; **MD 033**, Madiorano (Fianarantsoa), spring at the right border of the stream crossing the railroad at km 51.2 (MD 031), 650 m a.s.l., 18-viii-2001, 1 ♀.

Diagnosis. Both sexes: Idiosoma maximum W at level of posterior margin of Cx-IV; interspaces between coxal plates rather narrow; two to three pairs of long setae posterior to IV-leg insertion.

Males: Frontal margin straight; posterior dorsum with paired grooves from which digitiform extensions originate; posterior idiosoma margin straight, with a medial cleft bearing, dorsally, a double spatulate structure, in ventral part the posteroventrally-directed gonopore field.

Females: Frontal margin convex. Cx-III and Cx-IV nearly equal in medial L, medial margin straight; gonopore field subterminal, with two pairs of sclerotized patches; acetabular plates starting from gonopore field in anteriolateral direction, then directed perpendicular to medial line and nearly reaching lateral idiosoma margin.

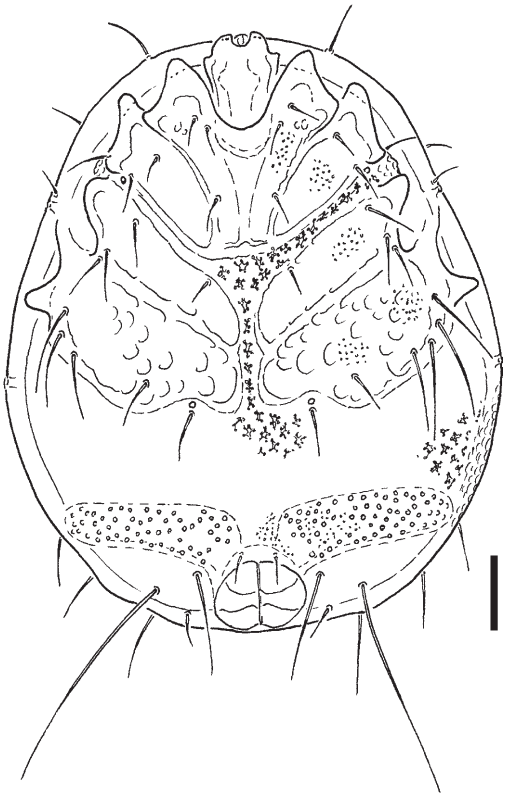


Fig. 28. *Arrenurus bispatulatus* sp. nov. paratype ♀. Idiosoma, ventral view. Scale bar = 100 µm.

Description

Both sexes: Colour yellowish (in juveniles) to reddish brown. Gnathosomal bay wide U-shaped. Palp rather slender; mediodistal margin of P-2 with three setae.

Males (holotype, in parentheses six paratypes; Figs 26–27): Idiosoma L/W 611 (575–729)/462 (454–565); lateral margin at point of maximum W obtuse-angled, posterior part inverse trapezoidal. Dorsal furrow incomplete, dorsal shield covering almost complete dorsum, dorsal shield maximum W 401 (389–551); near posterior margin a pair of slit organs flanking a membranous area with a pair of digitiform projections. Medial margin L Cx-III < Cx-IV; medial interspace between Cx-III + IV posteriorly converging; gonopore L > 20, positioned at anterior margin of median cleft; acetabular plates narrow, oblique, nearly reaching lateral idiosoma margin. IV-leg-4 and -5 with numerous stout setae, IV-leg-4 with a relatively short spur, its tip with a group of setae. Swimming setae: III-leg-4, 0/1; III-leg-5, 0/2; IV-leg-3, 4/0; IV-leg-4, 0/2 + 8–12 on spur; IV-leg-5, 0/8. Leg measurements: L I-leg-4–6: 70, 84, 84; IV-leg-4–6: 130, 124, 126. Palp segment L P-1–5: 26, 70, 34, 72, 32.

Females (n = 7; Figs 28–29): Idiosoma L/W 697 (676–794)/571 (518–680); oval in shape. Dorsal L 689 (583–802); dorsal furrow complete, dorsal shield covering most of dorsum, L/W 689 (616–737)/510 (518–591). Medial margin of Cx-IV longer than medial margin of Cx-III; medial distance between Cx-IV

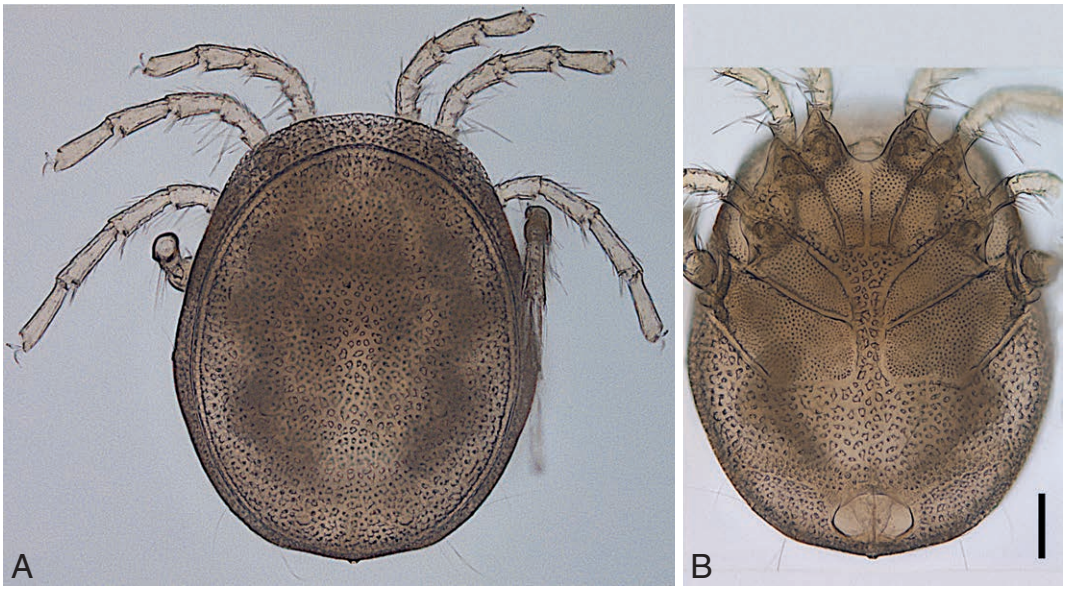


Fig. 29. *Arrenurus bispatulatus* sp. nov. paratype ♀, idiosoma **A.** Dorsal view; **B.** ventral view. Scale bar = 100 µm.

by far less than ½ gonopore field W; gonopore field L/W 88/122, close to posterior idiosoma margin; acetabular plates laterally narrowed. Swimming setae: III-leg-5, 0/4; IV-leg-3, 2/1; IV-leg-4, 2/2; IV-leg-5, 0/2. Leg segment L I-leg-4–6: 74, 84, 76; IV-leg-4–6: 144, 140, 136. Palp segment L P-1-5: 26, 70, 50, 72, 34.

Etymology. Named for the double spatulate petiole; *bi*, Latin – two and *spatula*, Latin – spatula.

Remarks. Males are unique within the genus in the formation of the caudal area, with a double spatulate structure and the posteroventrally-directed gonopore in a medial cleft. Females are characteristic in the gonopore field (with two pairs of large sclerotized patches) in a terminal position, far away from the coxal field (distance more than two times gonopore L). Both sexes are characteristic in rather narrow interspaces between the coxal plates and a slender palp with a few, scattered distoventral setae.

Distribution. N and Central Madagascar, endemic.

Habitat. Springs and spring streams.

Arrenurus (*Arrenurus*) *crenophilus* sp. nov.
Figs 30–33

Material examined. Holotype: ♂, **MD 030,** Ionilahy (Fianarantsoa), Vodraindry, spring in primary forest exposed W, 400 m a.s.l., 16-viii-2001 (SMF – gnathosoma, palps, IV-leg-4-6 on slide "MAD 4"; one palp incomplete). – **Paratypes:** Same data as holotype, 1♀ (SMF – palp: slide "MAD 5"); **MD 167**, Montagne d'Ambre (Antsiranana), Ambohitra (Joffreville), riparian rheocrenes at Rivière Antomboka downstream large cascade, 850 m a.s.l., 21-xi-2001, 6♂♂, 5♀♀ (3♂♂, 2♀♀ SMF, 3♂♂, 3♀♀ RMNH).

Other material. MD 010, Anjozorobe (Antananarivo), Ravoandrina, spring stream near water capturing for the village, 1350 m a.s.l., 19-vii-2001, 1♀; **MD 011**, Anjozorobe (Antananarivo), Ravoandrina, Rivière Ampanakamonty near campsite, 1280 m a.s.l., 21-vii-2001, 1♀; **MD 014**, Anjozorobe (Antananarivo), Ravoandrina, left affluent of Rivière Ampanakamonty upstream from MD 013, draining a forest clearing, 1230 m a.s.l., 24-vii-2001, 1♀; **MD 127a**, Ambohitsara (Antalaha, Antsiranana), left affluent Rivière Ankavia Northeast of Mount Ambohifalontsy, riffle, 100 m a.s.l., 29-x-2001, 1♀; **MD 148**, Andapa (Antsiranana), rheocrene near km 1 of R.N. 3b to Sambava, 600 m a.s.l., 11-xi-2001, 3♂♂, 4♀♀; **MD 154b**, Montagne d'Ambre (Antsiranana), Ambohitra (Joffreville), Rivière de Manques in Reserve Fontenay, 550 m a.s.l., roots, 17-xi-2001, 1♂; **MD 154c**, same site and date, cascade, 1♂; **MD 157**, Montagne d'Ambre (Antsiranana), Ambohitra (Joffreville), riparian springs at right affluent of Rivière de Manques in Reserve Fontenay, 650 m a.s.l., 18-xi-2001, 1♂; **MD 161**, Montagne d'Ambre (Antsiranana), Ambohitra (Joffreville), riparian springs at Rivière de Manques in Reserve Fontenay, 730 m a.s.l., 20-xi-2001, 2♂♂, 5♀♀; **MD 166**, Montagne d'Ambre (Antsiranana), Ambohitra (Joffreville), spring stream at right border of Rivière Antomboka downstream large cascade, 850 m a.s.l., 21-xi-2001, 5♂♂, 2♀♀; **MD 182**, Montagne d'Ambre (Antsiranana), Ambohitra (Joffreville), Cascade Sacrée, right riparian spring, hygropetric, 1043 m a.s.l., 12°31'17"S, 049°10'12"E, 23-iii-2011, 2♂♂, 1♀.

Diagnosis. Both sexes: Frontal margin weakly convex; idiosoma maximum W in posterior part. Suture lines Cx-III/-IV in an acute angle to medial line, medial separation of Cx-III+IV narrow. Palp: P-2 with five setae scattered over dorsal and medial surface and a dense group of four to six equally long setae at mediodistal edge.

Males: Posterior margin with a deep median cleft, an upright lamellar structure at its bottom, flanking corners pointed; posterior area of fusion of dorsal shield with a pair of elevated glandularia flanked by one to two spine-like structures.

Females: Idiosoma egg-shaped, anteriorly truncate. Acetabular plates extending anteriorly, slender and laterally narrowed, reaching lateral idiosoma margin, acetabula mostly lying anterior to the level of anterior gonopore edge; gonopore field closer to posterior margin than to coxal field, with two pairs of rounded sclerotized patches.

Description

Both sexes: Colour reddish to brownish. Gnathosomal bay shallow.

Males (holotype, in parentheses six paratypes; Figs 30-31): Idiosoma L/W 701/466 (733–786/502–522), slender. Dorsal furrow incomplete; dorsal shield W 389 (429–454), Dgl-3 on small humps; in the posterior area of fusion of dorsal shield apparently a group of short spines (on each side, two of these in reality the tube walls encompassing elevated glandularia); the medial extension on the bottom of the posterior cleft in dorsoventral view appearing needle-like, but in lateral view irregular lamellar (for alpinists, "Sciliar-shaped"; arrows in Fig. 30C), the paired, bluntly pointed extensions at the tips of the posterior corners hyaline; excretory pore subterminal anterior to the cleft. Gonopore field L 24; acetabular plates long and narrow, extending to lateral idiosoma margin (lateral ends not clearly recognizable). Swimming setae: II-leg-5, 0/2; III-leg-5, 0/3; IV-leg-3, 0/3; IV-leg-4, 0/2 (+10–12 shorter ones on spur); IV-leg-5, 0/10. IV-leg-4 distal margins extending to form a long spur (nearly 2/3 of IV-leg-5 L), IV-leg-5 distal margins forming little

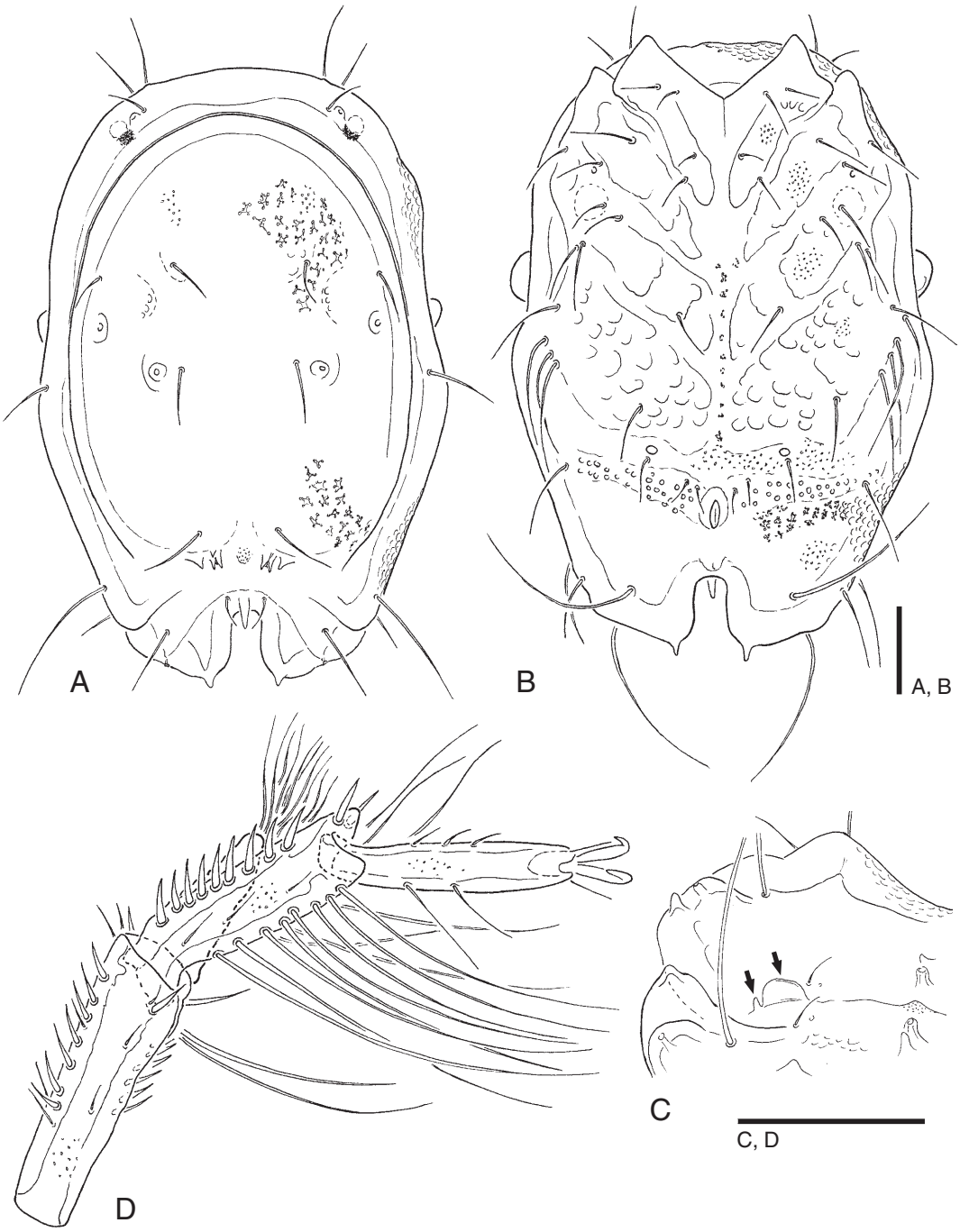


Fig. 30. *Arrenurus crenophilus* sp. nov. holotype ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** detail of cauda, lateral view (arrows pointing at larger and smaller part of petiolus); **D.** IV-leg-4–6, posterior view. Scale bars = 100 µm.

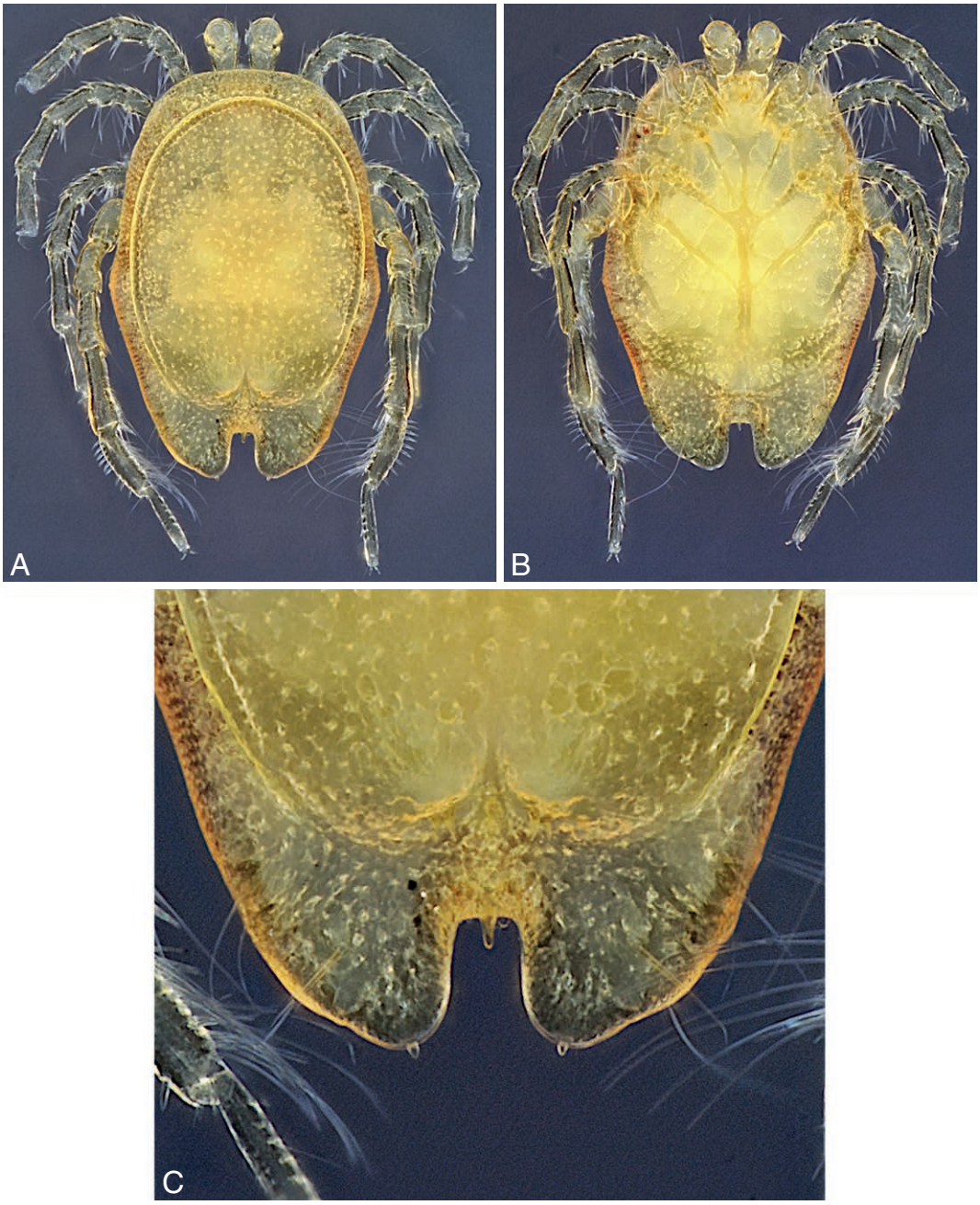
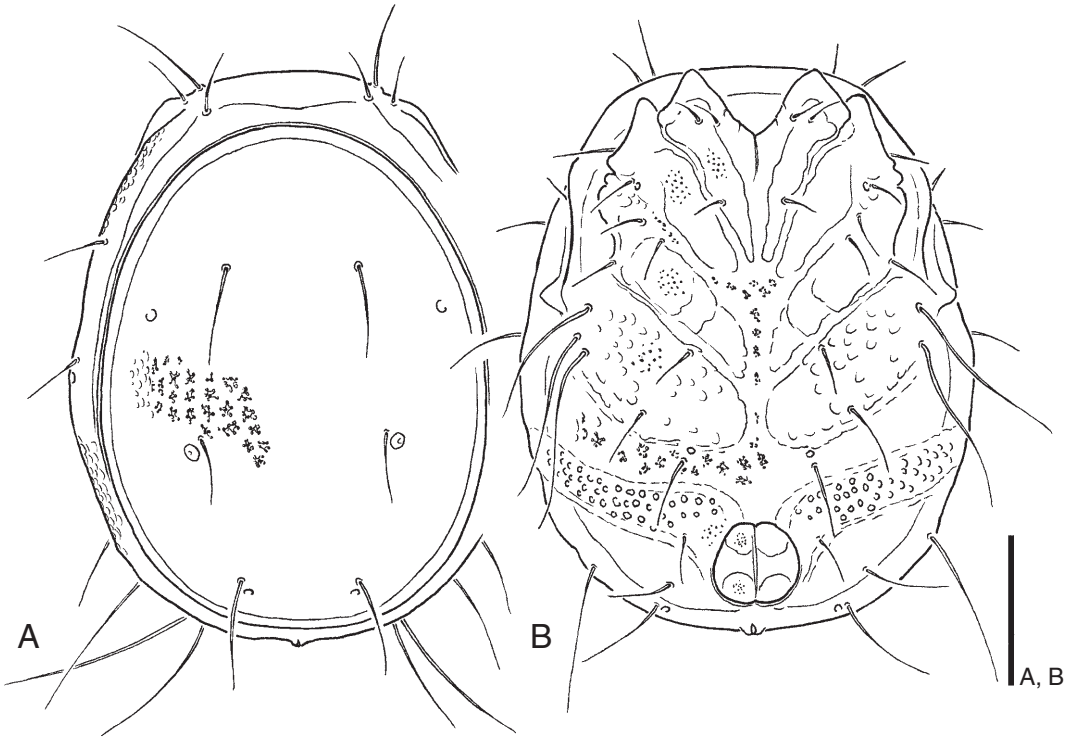


Fig. 31. *Arrenurus crenophilus* sp. nov. holotype ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** detail of cauda, dorsal view.

extending sheaths embracing the base of the terminal segment (no spur). Leg segment L I-leg-4–6: 80, 92, 107; IV-leg-4–6: 160, 136, 128. Palp segment L P-1–5: 26, 74, 56, 66, 34.

Females (paratypes, n = 5; Figs 32–33): Idiosoma L/W 656-855/551-684. Dorsal furrow complete; dorsal shield covering most of dorsum, L/W 583–794/478–616. Medial margin of Cx-IV longer than



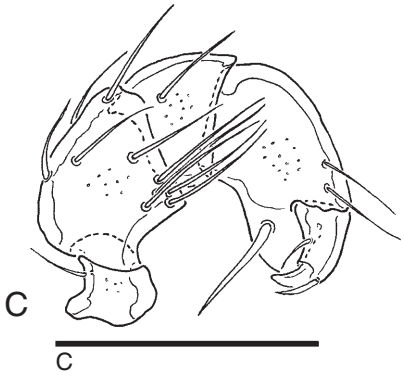


Fig. 32. *Arrenurus crenophilus* sp. nov. paratype ♀. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** palp, medial view. Scale bars = 100 µm.

medial margin of Cx-III; medial distance of Cx-IV less than half gonopore field W; gonopore field 84, sclerotized patches occasionally difficult to identify; acetabular plates laterally narrowed, in medial part strongly curved, in lateral part straight or slightly curved anteriorly, nearly reaching lateral idiosoma margin; acetabula scattered. Swimming setae: II-leg-5, 0/2; III-leg-5, 0/3; IV-leg-3, 0/1; IV-leg-4, 0/2; IV-leg-5, 0/3. Leg segment L I-leg-4–6: 92, 94, 90; IV-leg-4–6: 134, 136, 130. Palp segment L P-1–5: 32, 82, 66, 90, 50.

Etymology. A large part of the collecting sites are springs or spring brooks, but the species was also found in streams – thus, it has the typical habitat preference pattern of a crenophilous species.

Remarks. Males of the new species are unique within the genus in the formation of their petiole. *Arrenurus crenophilus* is somewhat similar to *A. bispatulatus* sp. nov., in males in the rhombic idiosoma shape, a narrow medial interspace between Cx-III+IV, and the presence of a caudal cleft, in females in the narrow acetabular plates, near gonopore field oblique, with a kink leading to the lateral part. Both sexes differ in more numerous medial setae on P-2, several of these arranged in a dense group at distoventral edge. Furthermore, males differ in a more slender idiosoma, a distinctly deeper median cleft, and the shape of the petiole (the dorsal part not laterally compressed, similar to the ventral part in *A. bispatulatus*), females in the position of the gonopore field (at posterior idiosoma margin in *A. bispatulatus*) and shape of the acetabular plates (in a more obtuse angle in *A. bispatulatus*). The sequenced specimens from site MD 182 are atypical in the posterolateral humps not bearing digitiform projections.

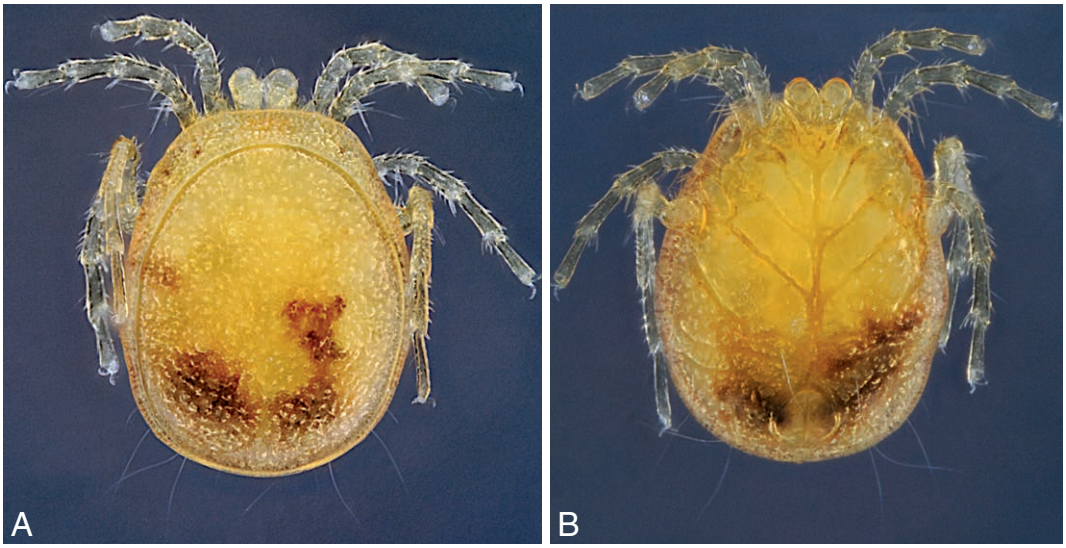


Fig. 33. *Arrenurus crenophilus* sp. nov. paratype ♀, idiosoma. **A.** Dorsal view; **B.** ventral view.

Distribution. N and Central Madagascar, endemic.

Habitat. Springs and spring streams at middle and high elevation (550–1750 m a. s. l.).

Subgenus *Brevicaudaturus* Smit, 1997

Diagnosis. See Smit (2020b).

Arrenurus (*Brevicaudaturus*) *dumazeri* Motaş, 1932

Figs 34–35

Arrenurus sp. indet. Gerecke (2004).

Published records. Madagascar, Toamasina (Tamatave): small unnamed stream affluent of Lac Ampitabi [in present-day maps Lac Ampitabe] about 60 km S Toamasina, 10 m a. s. l., 2 ♀♀ (Motaş 1932); South Africa: Zululand, 1 ♀ (K.O. Viets 1965).

Material examined. MNHN A 20 J, Antsiranana, NO Akarana, ix.1946 Millot J., 1 ♀ ("*Arrenurus* sp." Gerecke 2004).

Description (Female, Figs 34–35; male unknown)

Idiosoma L/W 1270/1140 (K.O. Viets 1965: 1240/1135); frontal margin in centre deep concave between a pair of rounded humps situated between the prominent lateral eye capsules; lateral parts more or less equally rounded, posterior margin truncate, with two paired humps – one forming prominent posterolateral edges, the other, less distinct, flanking the excretory pore on ventral side. Dorsal shield relatively short (67 % dorsal L), rhombic, L/W 720/720 (eventually measured in an oblique position, K.O. Viets 1965: 832/750). In lateral view elevated, hood-shaped, with pairs of prominent dorsal humps in anterior third (connected by a transverse bridge, perpendicular to longitudinal axis) and in posterior part of dorsal shield. Gnathosomal bay relatively narrow, in basal part rounded. Tips of Cx-I not reaching frontal margin or slightly projecting; medial separation of Cx-III + IV wide, slightly less than gonopore field W; gonopore field L/W 141/135, without sclerotized patches; acetabular plates long and slender, extending from posterior gonopore field margin and strongly curved, with concave anterior and convex posterior margins, narrowed only in distalmost part, laterally rounded; postgenital field L about threefold gonopore L, excretory pore close to posterior margin. Palp slender, P-2 with one distoventral seta (lacking in specimens from MNHN), P-4 with slightly diverging dorsal and ventral margins, its distoventral edge subrectangular, not very prominent.

Remarks. In addition to the original description, data on the morphology of this species were given by K.O. Viets (1965), based on a female from South Africa. The specimen recorded here from Ankarana agrees very well with the one from South Africa, and differs from the figures of the original description, in the shape of acetabular plates (laterally more extended), the coxal field (Cx-I more projecting) and

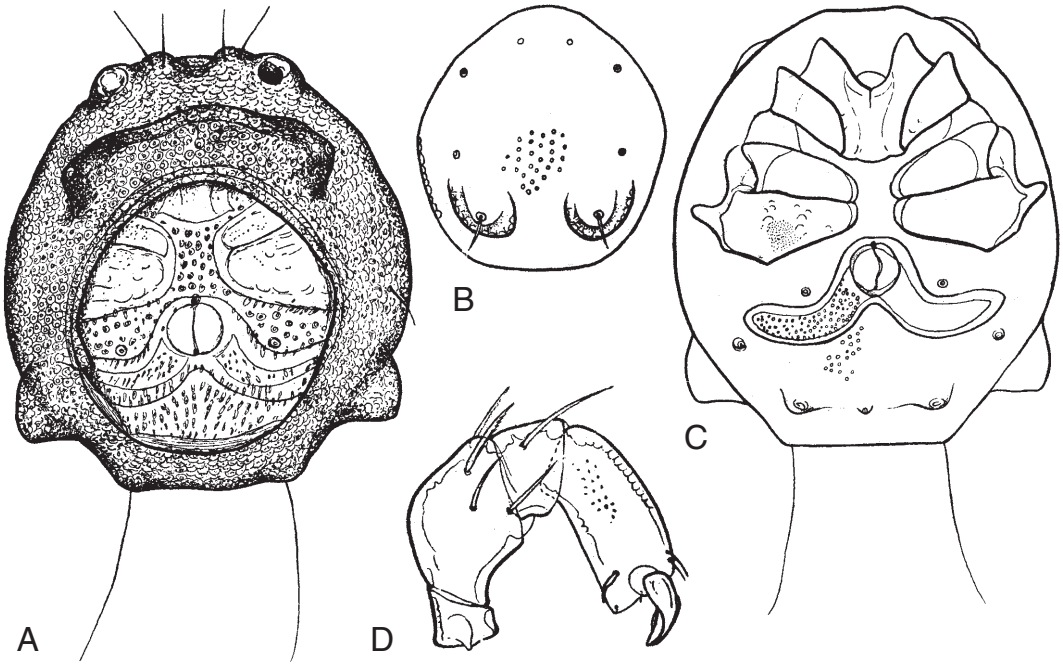


Fig. 34. *Arrenurus dumazeri* ♀. **A.** Idiosoma, dorsal view (without dorsal shield); **B.** dorsal shield; **C.** idiosoma, ventral view; **D.** palp, medial view (Motaş 1932).

the idiosoma margin (frontal margin convex, bases of antenniform setae not projecting; posteromedial humps barely projecting over level of posterolateral humps). The difference in shape of the genital field could be a case of intraspecific variation, differences in shape of the idiosoma contour are easily caused by different positions of the figured specimens – a little difference in inclination of the idiosoma may result in considerable change in visibility of humps. As *Arrenurus* females are in general distinctly larger than conspecific males (see the measurements published for *A. laticodulus* by Cook 1967), it is not likely that the specimen reported under the name of *A. laticodulus* from Madagascar (see below) represents the male of the by far smaller *A. dumazeri*.

Distribution. E and N Madagascar; South Africa (Zululand).

Habitat. Stream, stagnant water.

Arrenurus (*Brevicaudaturus*) *laticodulus* Piersig, 1898

Fig. 36

Published records from Madagascar. Mahajanga (Majunga): no collection site details (Lundblad 1946).

From Madagascar only the male is known, and given the discussion in the remarks below, we confine the description to this specimen.

Description

Male from Madagascar (Fig. 36): Colour greenish. Idiosoma L/W 1474/1090, cauda W 850. Dorsum with a pair of large anterior humps directed dorsally; dorsal furrow equally rounded, posterolaterally extended to ventral side, incomplete; cauda with convex lateral margins ending in bluntly pointed, barely protruding edges, posterior margin undulating, in central part flatly concave. In lateral view the anterior humps bluntly pointed, caudal part with a convex elevation and a pair of posterodorsally directed pointed humps. I-/II-leg-5 elongated and with dense fine setation, III-leg-6 elongated as well, but without fine setae; IV-leg without spur. Shape of gnathosomal bay not reported. P-2 with four mediodistal setae, P-4 slender, dorsal and ventral margins subparallel, distoventral edge acute-angled, distal margin with at least six fine setae.

Remarks. In the description of *A. laticodulus*, Piersig (1898, figures in Piersig 1903) gave for the first time the diagnosis of a male of a species group characterized, (1) in both sexes by conspicuous dorsal humps

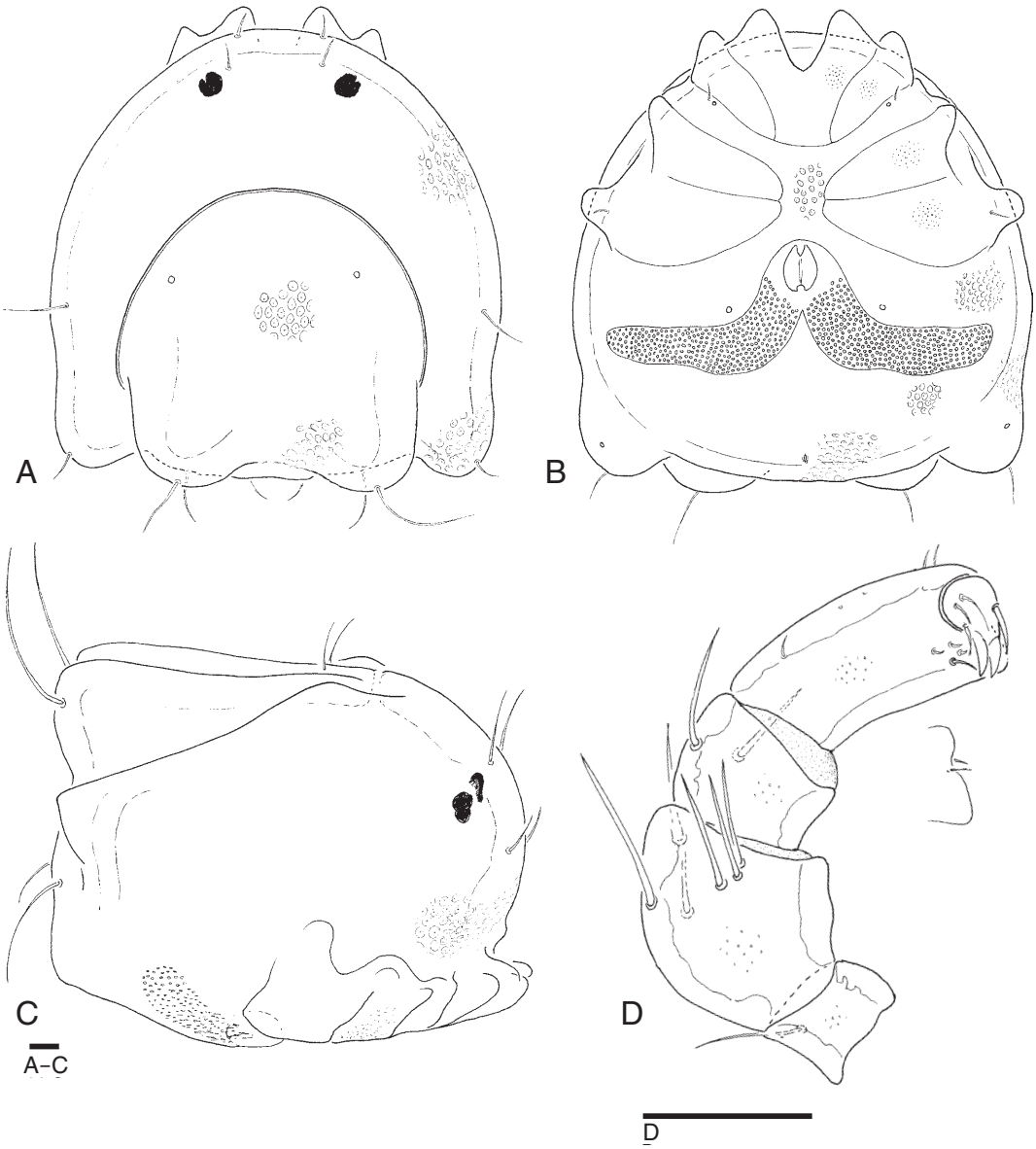


Fig. 35. *Arrenurus dumazeri* ♀ (MNHN A20J). **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** idiosoma, lateral view; **D.** palp, medial view (detail: setation of P-4 anterior margin). Scale bars = 100 µm.

associated with Dgl-1; (2) in males by a distinct, trapeziform cauda (in absence of a petiole), and (3) in females by narrow acetabular plates in a very distinct curved shape, gonopore field without sclerotized patches. This species group is here named after its first described species, *A. gibbus* Koenike, 1893 (Zanzibar, Tanzania, and Sudan). Further representatives in the Afrotropical region are: *A. palpebratus* Nordenskiöld, 1905 (Sudan), *A. dumazeri* Motaş, 1932 (Madagascar), as well as *A. odonatophilus* Münchberg, 1958 and *A. retroduobus* Münchberg, 1958 (both Congo). In addition to *A. gibbus*, also *A. dumazeri* and *A. retroduobus* are known in the female sex only.

Lundblad (1946) stated a good agreement of the male he reported from Madagascar with the original description. However, the humps on the dorsal surface of the cauda are directed posteriorwards, while these are directed dorsally in Piersig's

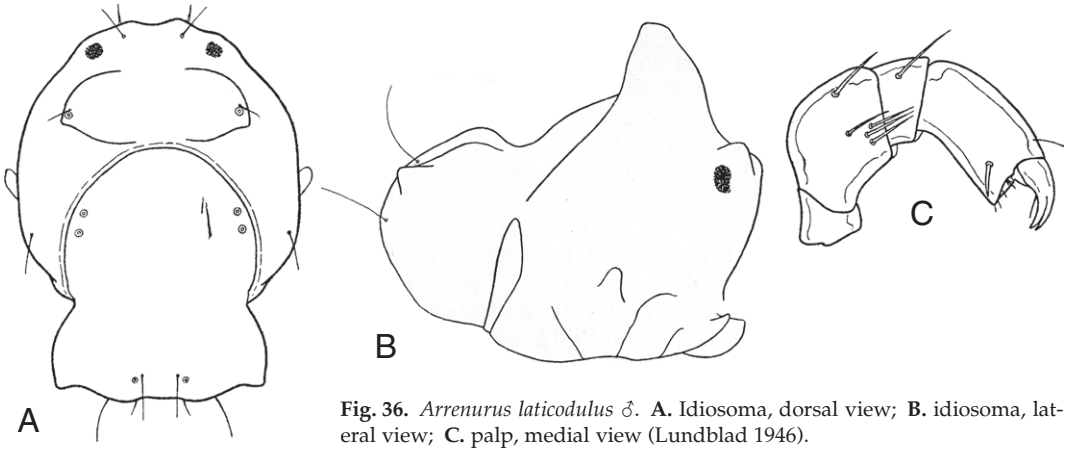


Fig. 36. *Arrenurus laticodulus* ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, lateral view; **C.** palp, medial view (Lundblad 1946).

description (Fig. 10, 1903). Furthermore, in dorsal view, the posterolateral edges are more rounded in the original description, but subrectangular in the specimen from Madagascar.

As it is defined at present, *Arrenurus laticodulus* is one of the most widespread water mite species (see below), but we cannot exclude that more than one species is involved. Comparing the various descriptions of males of this species, there is considerable variation in a number of characters: (1) dorsal shield posterior margin rounded or more truncated; (2) posterior margin of cauda straight or somewhat undulating; (3) pygal lobes various in size.

Distribution. W Madagascar (Majunga). Outside Madagascar reported from Pacific islands (Bismarck Archipelago, Yap, Fiji), Sumatra, Java, India, Malay Peninsula, and Australia (for an overview see Smit 2003).

Habitat. Stagnant waters.

Arrenurus (*Brevicaudaturus*) *tandroka* sp. nov.
Figs 37–40

Material examined. Holotype: ♂, **MD 060c**, Tsimelahy (Tulear), Rivière Antarantsa downstream 'piscine naturelle', pool, 200 m a.s.l., 5-ix-2001 (SMF – gnathsoma and palps on slide "MAD 2"). – **Paratypes:** Same data as holotype, 1♀ (SMF – gnathosoma and palps on slide "MAD 1"), 1♀ (RMNH); **MD 095**, Ranohira (Fianarantsoa), right affluent of Rivière Ihazofotsy near 'Isalo Ranch', stagnant areas, 750 m a.s.l., 25-ix-2001, 1♀ (SMF).

Diagnosis. Both sexes: Frontal margin in central part concave. Dgl-1 on strongly elevated, laterally flattened humps with a rounded projection at posterior margin that extends beyond the anterior dorsal shield margin; many other glandularia on protruding humps; dorsal furrow complete. Interspaces between coxal plates wide; acetabular plates elongated, surrounded by regularly-arranged fine setae. Gnathosomal bay equally U-shaped. Palp slender, P-2 with three to five scattered medial setae, P-4 dorsal and ventral margins slightly diverging distally, distal margin nearly straight.

Male: Dorsal furrow extending onto venter; cauda distinct, well set off from anterior idiosoma, on the level of its base a pair of dorsal humps without glandularia. Acetabular plates extending onto lateral idiosoma margin, their lateral tips visible in dorsal view.

Females: Gonopore field without sclerotized patches; acetabular plates strongly curved, with deeply concave anterior and equally rounded posterior margins.

Description

Both sexes: Idiosoma colour greenish to brownish. Medial margin of Cx-IV longer than medial margin of Cx-III; lateral margin of Cx-IV with a group of long setae (more numerous in males than in females).

Male (Figs 37–38): Idiosoma L/W 1397/1045; cauda wider than long, with prominent posterolateral tips, its posterior margin with two pairs of small extensions. Dorsal shield covering a relatively small part of dorsum, its anterior margin bluntly triangular, dorsal furrow extending onto venter – here, its posterior margin running posterior to the genital field. Gonopore field L 70, paired groups of setae flanking its anterior margin; acetabular plates in medial part relatively wide, extending to lateral idiosoma margin, their tips visible in dorsal view. Swimming setae: II-leg-3, 0/1; II-leg-4, 0/4; II-leg-5, 0/6; III-leg-3, 0/1; III-leg-4, 0/4; III-leg-5, 0/10;

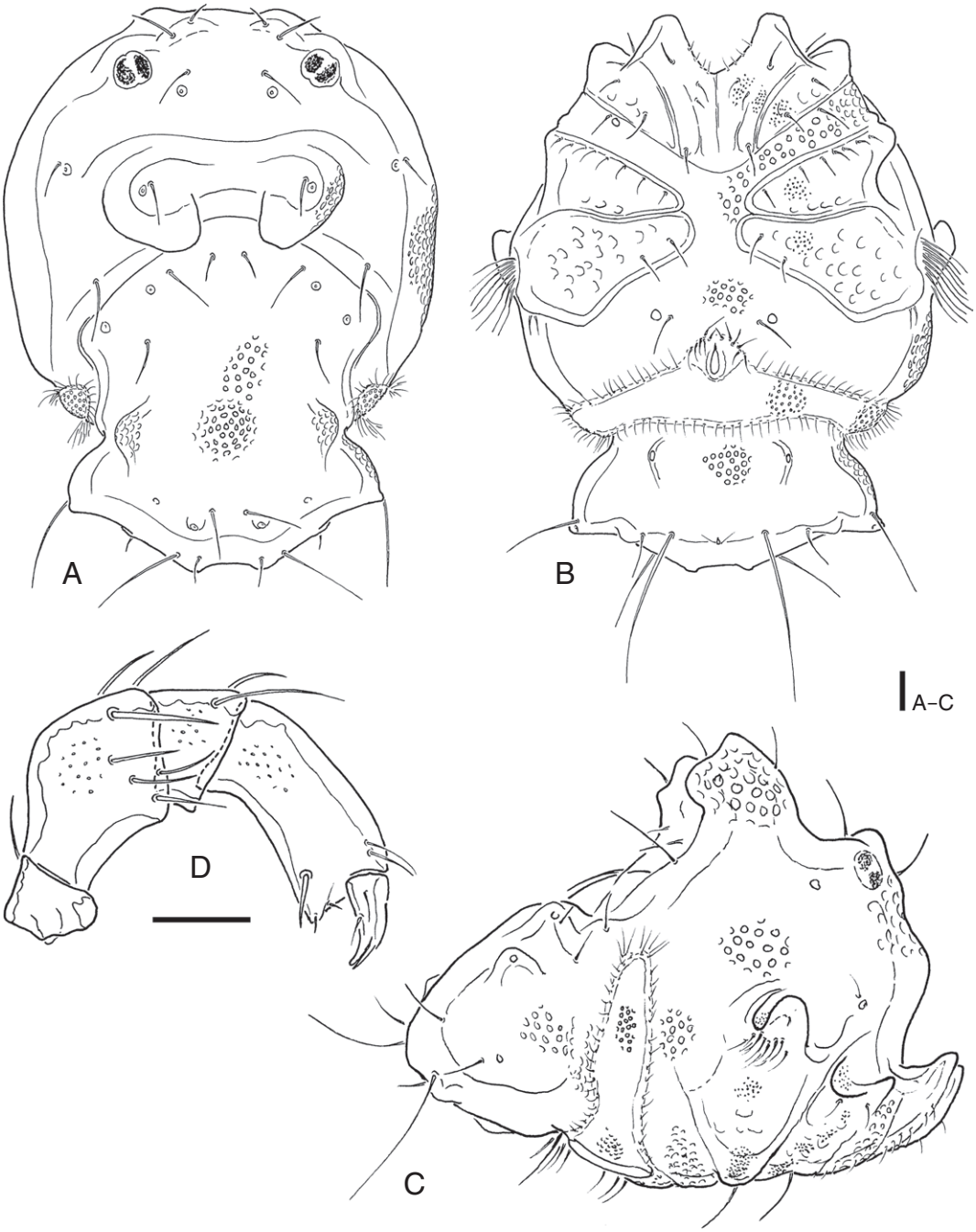


Fig. 37. *Arrenurus tandroka* sp. nov. holotype ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** idiosoma, lateral view; **D.** palp, medial view. Scale bars = 100 µm.

IV-leg-3, 21/16; IV-leg-4, 21/20; IV-leg-5, 9/20. Leg segment L I-leg-4–6: 194, 206, 356; IV-leg-4–6: 316, 219, 194. Palp segment L P-1–5: 36, 106, 53, 112, 52.

Females (paratype MD 060c, in parentheses paratype MD 095; Figs 39–40): Idiosoma L/W 1437/1327 (1367/1317). Dorsal L 1427 (1417); dorsal shield

Fig. 38. *Arrenurus tandroka* sp. nov. holotype ♂, idiosoma. **A.** Dorsal view; **B.** ventral view; **C.** lateral view. Scale bar = 100 µm.

oval, L/W 810/810 (778/729); Dgl-4, Lgl-4, and Vgl-2 on prominent humps; posterior idiosoma margin slightly concave. Medial distance between Cx-IV wider than gonopore field W; gonopore field L/W 175/175. The paratype female from MD 095 differs from the one from MD 060c in shorter and narrower acetabular plates. Swimming setae: II-leg-3, 0/2; II-leg-4, 0/7; II-leg-5, 0/7; III-leg-3, 0/4; III-leg-4, 0/7; III-leg-5, 0/11; IV-leg-3, 11/10; IV-leg-4, 12/10; IV-leg-5, 0/10. Leg segment L I-leg-4–6: 202, 219, 279; IV-leg-4–6: 300, 283, 202. Palp segment L P-1–5: 40, 112, 62, 128, 52.

Etymology. The Madagascan word "*tandroka*" means "horn". The name refers to the prominent humps associated with Dgl-1.

Remarks. The new species is most similar to *Arrenurus odonatophilus* Münchberg, 1958 from Congo in idiosoma shape with distinct posterolateral corners and strongly bowed female acetabular plates. Males of *A. odonatophilus* differ in a less laterally expanded cauda and the shape of dorsal shield (with rounded anterior, not triangular margin and straight, not concave lateral margins), females in more slender acetabular plates. Males of *A. laticodulus* (no females are described from Madagascar) are similar in colour and dimensions but differ in the shape of the humps associated with Dgl-1 (directed dorsally and not posteriorly extended), the dorsal shield (equally rounded, not rhombic), and a less projecting medial part of the posterior cauda margin. Females of *A. dumazeri* (unknown in the male sex; Figs 34–35)

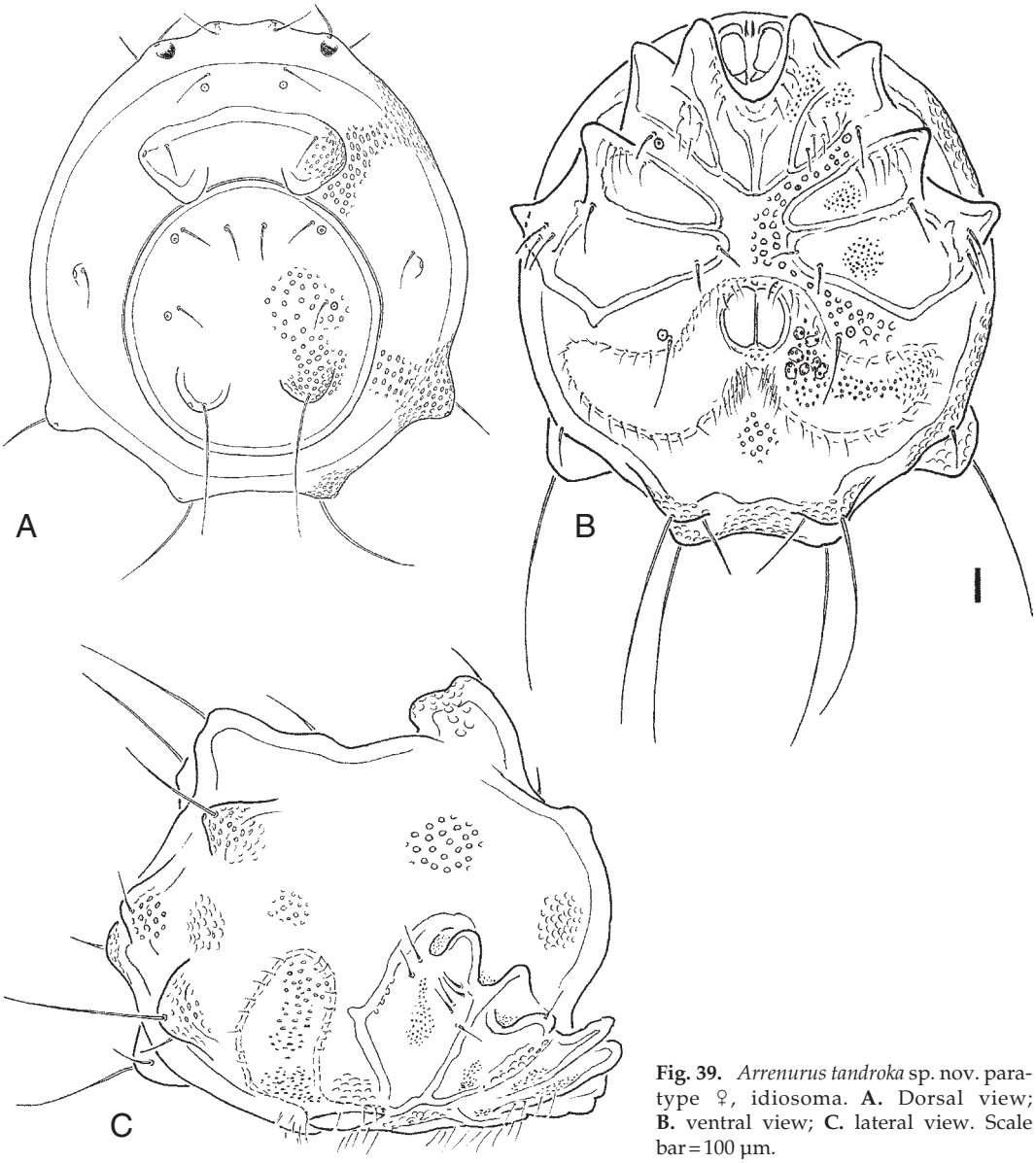


Fig. 39. *Arrenurus tandroka* sp. nov. paratype ♀, idiosoma. **A.** Dorsal view; **B.** ventral view; **C.** lateral view. Scale bar = 100 µm.

differ in their red colour; minor dimensions (idiosoma L 1270), simple and not posteriorly extended humps associated with Dgl-1, and equally narrow acetabular plates, not widened in central part.

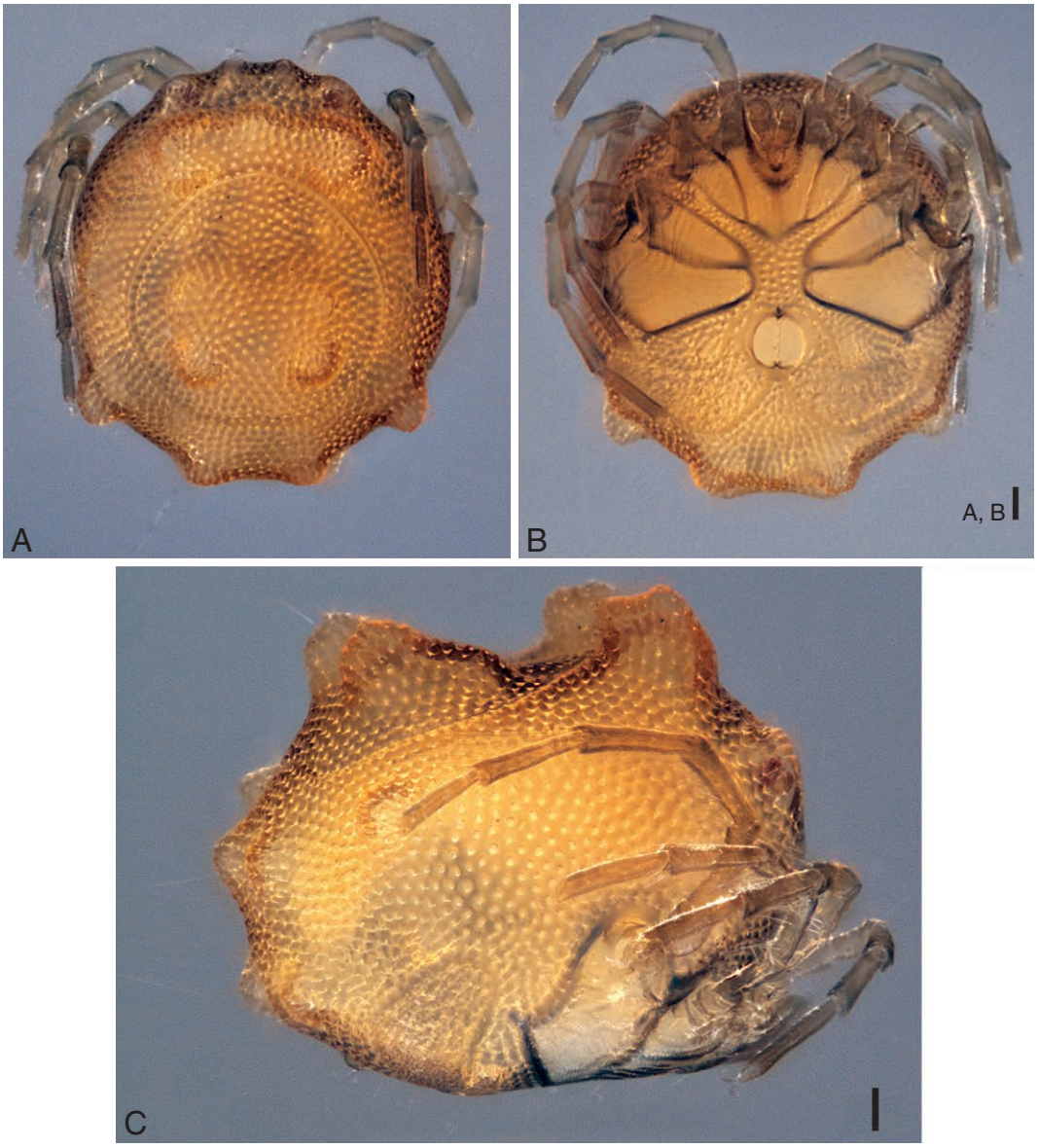


Fig. 40. *Arrenurus tandroka* sp. nov. paratype ♀, idiosoma. **A.** Dorsal view; **B.** ventral view; **C.** lateral view. Scale bars = 100 µm.

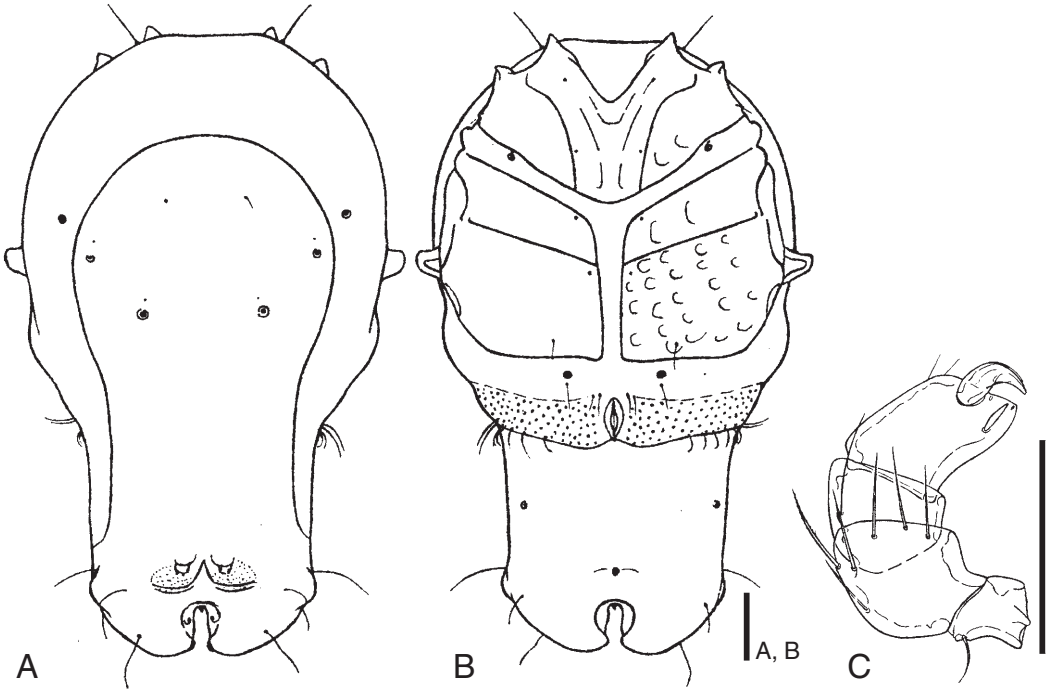


Fig. 41. *Arrenurus concavus* ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** palp medial view (K.O. Viets 1966). Scale bars = 100 µm.

Subgenus *Megaluracarus* K. Viets, 1911

Diagnosis. See Smit (2020b).

***Arrenurus* (*Megaluracarus*) *concavus* Koenike, 1893**
Figs 41–42

Syn.: *Arrenurus* sp. K. Viets, 1942; *A. ignotus* K. Viets, 1950: K.O. Viets (1966)

Published records from Madagascar. Mahajanga (Majunga): Amparangidro; Morondava (Koenike 1898).

Description

Both sexes: Colour green. Palp stout, P-2 with two to three distoventral setae; P-4 dorsal and ventral margin slightly converging, dorsoventral edge obtuse angled; P-5 strongly curved.

Males (Fig. 41): Idiosoma L/W 920–975/520–578; in dorsal view anterior part rounded, with straight to slightly convex frontal margin; cauda distinctly set off at the level of the genital field; lateral margins of cauda subparallel, posterior margin rounded, with a narrow, median cleft bearing a pair of curved setae at its lateral margins, and, at its most anterior point, a fine sclerotized tip (interpreted as petiole rudiment by K.O. Viets 1966). Dorsal surface anterior to the cleft with a pair of areas of fine porosity lying posterior to a pair of tubular extensions on flat humps; dorsal furrow incomplete, in anterior part equally rounded, in posterior part subparallel. In lateral view maximum H in anteriormost part, posteriorly equally flattened, with a pair of flat humps in posteriormost part. Medial distance Cx-III + IV narrow (about W gonopore field), medial margin of coxal plates posteriorly converging, mL Cx-III << mL Cx-IV, posterior margin Cx-IV perpendicularly to median axis, without projections. Swimming setae of I-III-leg not reported, IV-leg-3, 6–8/7–8; IV-leg-4, 5 on spur/6–7; IV-leg-5, 5–6/14–15.

Females (attribution uncertain, see below; Fig. 42): Idiosoma L/W 890/830 (original description). Dorsal furrow complete, dorsal plate L/W 735/570. Medial separation Cx-III + IV wide (about ¾ gonopore field W); gonopore field L/W 135/140, without sclerotized patches; acetabular plates long, maximum W medially, here starting in posterior direction and forming angled extensions posterior to gonopore, laterally strongly narrowed and only slightly oblique to median axis. Swimming setae not reported.

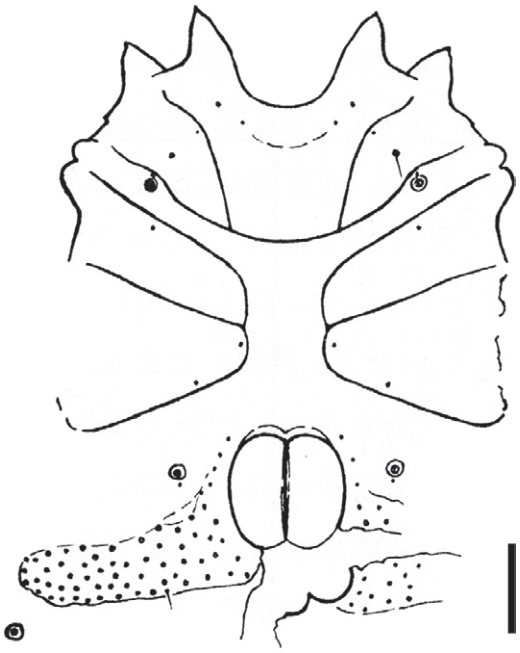


Fig. 42. *Arrenurus concavus* ♀, idiosoma. Coxae and genital field (K.O. Viets 1966). Scale bar = 100 µm.

Remarks. This species was first described after a single female from Tanzania (Koenike 1893). Later on, Koenike (1898) decided to attribute females from Madagascar to this species and gave the first description of a male from the same population, based on two specimens (both lost meanwhile, see K.O. Viets 1966 for details). In his detailed critical revision of the species, based on Malagasy material from the Koenike collection, K.O. Viets (1966) came to the statement that it was uncertain if the Madagascan populations indeed are conspecific with the holotype, a specimen lost during the Second World War. This question could be resolved only with fresh material from the area of the type locality. The description above is based mostly on data from Malagasy specimens taken from K.O. Viets (1966). His description of males differs markedly from Koenike's figures in less elevated posterodorsal humps, straight lateral margins of the cauda without posterolateral humps, a narrow medial separation of Cx-III + IV, and angular, not rounded posteromedial edges of Cx-IV. We follow the interpretation of K.O. Viets, that the rather small figures in Koenike's publication are not correct in these details. Furthermore, K.O. Viets (1966) placed in doubt if the males reported by Koenike (1898) under the name of *A. concavus* are really conspecific with the females found coexisting (three specimens, all heavily damaged). Differences in shape of Cx-IV (triangular in females, subrectangular in males) were already mentioned by Koenike, K.O. Viets (1966) highlights also the deeply rounded gnathosomal bay (more V-shaped in male), and a further important difference concerns the wide distance between Cx-III + IV (narrow in males). In summary, this is the Malagasy *Arrenurus* species attributed with the highest numbers of question marks, from many points of view.

Distribution. Tanzania: Bagamoyo (Koenike 1893); W Madagascar (Koenike 1898); Congo (Marlier 1958, Bader 1959). Two subspecies described: *Arrenurus concavus chutteri* K.O Viets, 1966 from South Africa (Cape Province), and *A. c. longifissus* Smit, 2012 from Botswana and Ghana.

Habitat. Stagnant waters.

Arrenurus (*Megaluracarus*) *geniculatus* Koenike, 1898

Figs 43–44

Published records from Madagascar. Nossi-Bé: Lake Djabala (Koenike 1898).

Material examined. MD 081a, Taolanaro (Tulear), Mandena (QMM area), lake situated inland from coastal lake at mouth of Rivière Amendano, 2 m a. s. l., riparian vegetation, 14-ix-2001, 2 ♂♂; **MD 081b**, same site and date, inner lake, 1 ♀. All slide-mounted.

Description

Both sexes: Colour dark green to yellow. L medial margin Cx-III < Cx-IV. Gnathosomal bay broad U-shaped. Palp stout, P-2 with two to three distoventral setae, P-4 dorsal and ventral margins slightly diverging, distoventral edge prominent, subacute.

Males (Fig. 43): Idiosoma L/W 900/480; slender in shape, in anterior part nearly globular; frontal margin deeply concave (acutely projecting in lateral view), cauda well set off from anterior idiosoma, in lateral view dorsally concave, ventrally convex, in dorsoventral view with rounded lateral, and concave posterior margins; posterodorsal part of cauda flattened to a shallow groove, no petiole remnant observed. Dorsal furrow complete; L/W dorsal shield 250/290. Tips of Cx-I/-II extending beyond frontal margin, Cx-III + IV medial distance about gonopore field W; acetabular plates broad (in our specimens medially broader than in Koenike's Fig. 50, reaching nearly twice gonopore L), reaching the lateral idiosoma margin and here with their ends visible in dorsal view, at base of cauda heavily tallied between the genital field and a bulging ruff (in our specimens not as prominent as in Koenike's

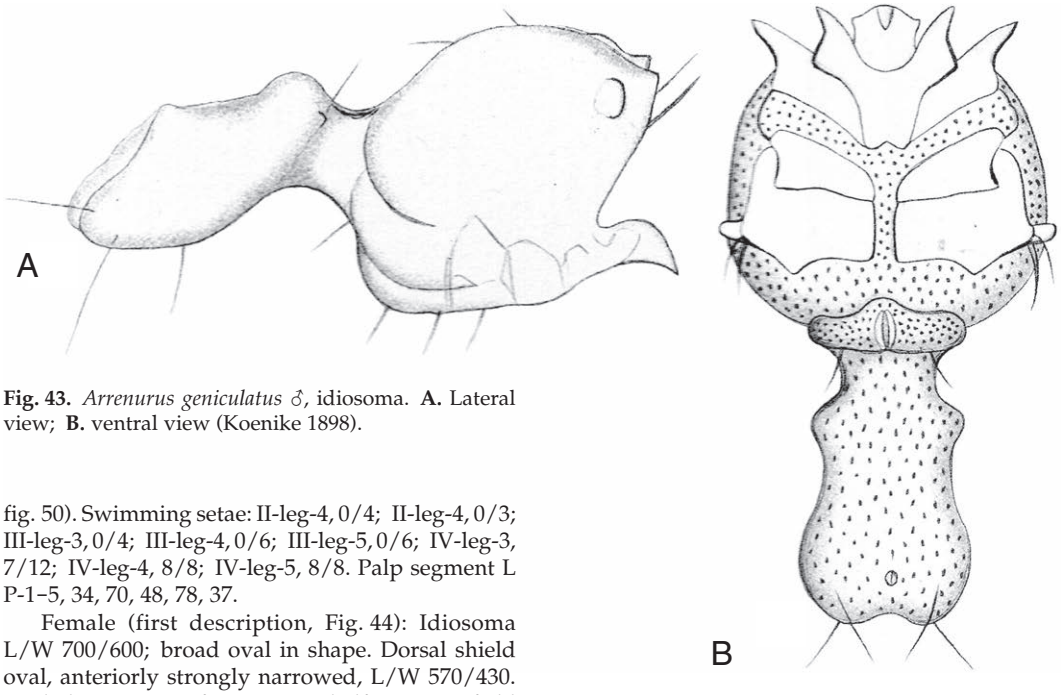


Fig. 43. *Arrenurus geniculatus* ♂, idiosoma. **A.** Lateral view; **B.** ventral view (Koenike 1898).

fig. 50). Swimming setae: II-leg-4, 0/4; II-leg-4, 0/3; III-leg-3, 0/4; III-leg-4, 0/6; III-leg-5, 0/6; IV-leg-3, 7/12; IV-leg-4, 8/8; IV-leg-5, 8/8. Palp segment L P-1–5, 34, 70, 48, 78, 37.

Female (first description, Fig. 44): Idiosoma L/W 700/600; broad oval in shape. Dorsal shield oval, anteriorly strongly narrowed, L/W 570/430. Medial separation of Cx-III + IV < half gonopore field W; genital field close to coxal field (distance << half gonopore field W); gonopore field L/W 100/110, without sclerotized patches; acetabular plates short, laterally strongly narrowed and with rounded edges, medially completely surrounding gonopore field with finely porose bridges (posteriorly narrow, anteriorly rather broad and bulging); excretory pore in terminal position. Swimming setae: II-leg-4, 0/3; II-leg-5, 0/3; III-leg-3, 0/2; III-leg-4, 0/7; III-leg-5, 0/6; IV-leg-3, 3/3; IV-leg-4, 3/5; IV-leg-5, 3/6. Leg segment L I-leg-4–6, 110, 115, 130; IV-leg-4–6, 160, 165, 155. Palp segment L P-1–5, 33, 70, 50, 80, 42.

Remarks. For a long time, this characteristic species was known only from a single male, published without a figure of the palp. Our findings from the southern mainland of Madagascar enlarge distinctly its distribution area and allow some additions to our knowledge of its morphology, including the first description of the female sex. The attribution of the latter is supported by high similarity in leg setation and palp morphology and setation.

A population reported under the name *A. geniculatus* from Ghana (Smit 2021) obviously represents a species new to science. The female differs from *A. geniculatus* in a wider medial distance of Cx-III + IV, the acetabular plates not extended to the area anterior to the gonopore field, and an incomplete dorsal furrow. Ghanaian males are expecting description – the only available information concerns the palp (P-4 anterior margin with a small extension in both sexes, not found in *A. geniculatus*).

Arrenurus damasi Lundblad, 1949, described in both sexes as a subspecies of *A. geniculatus* from Congo and reported by Cook (1966) from Liberia, was later on reported from Ghana and elevated to species rank by Smit (2012). The description of the female by Lundblad (1949) is not very detailed – a general similarity of the genital field is visible in Fig. 44E of the original description, but the particular shape of its anteromedial margin remains unclear, and the idiosoma contour line is irregular due to slight posterolateral and posteromedial humps.

Distribution. N and S Madagascar, endemic.

Habitat. Stagnant water.

Arrenurus (*Megaluracarus*) *pectinatus* Koenike, 1893

Figs 45–46

Published records from Madagascar. Mahajanga (Majunga): no collection site details (Koenike 1898, Lundblad 1946), Amparangidro (Koenike 1898); Antsiranana: NO Ankarana; Toamasina: Maroantsetra, Ambohivoangy (Gerecke 2004).

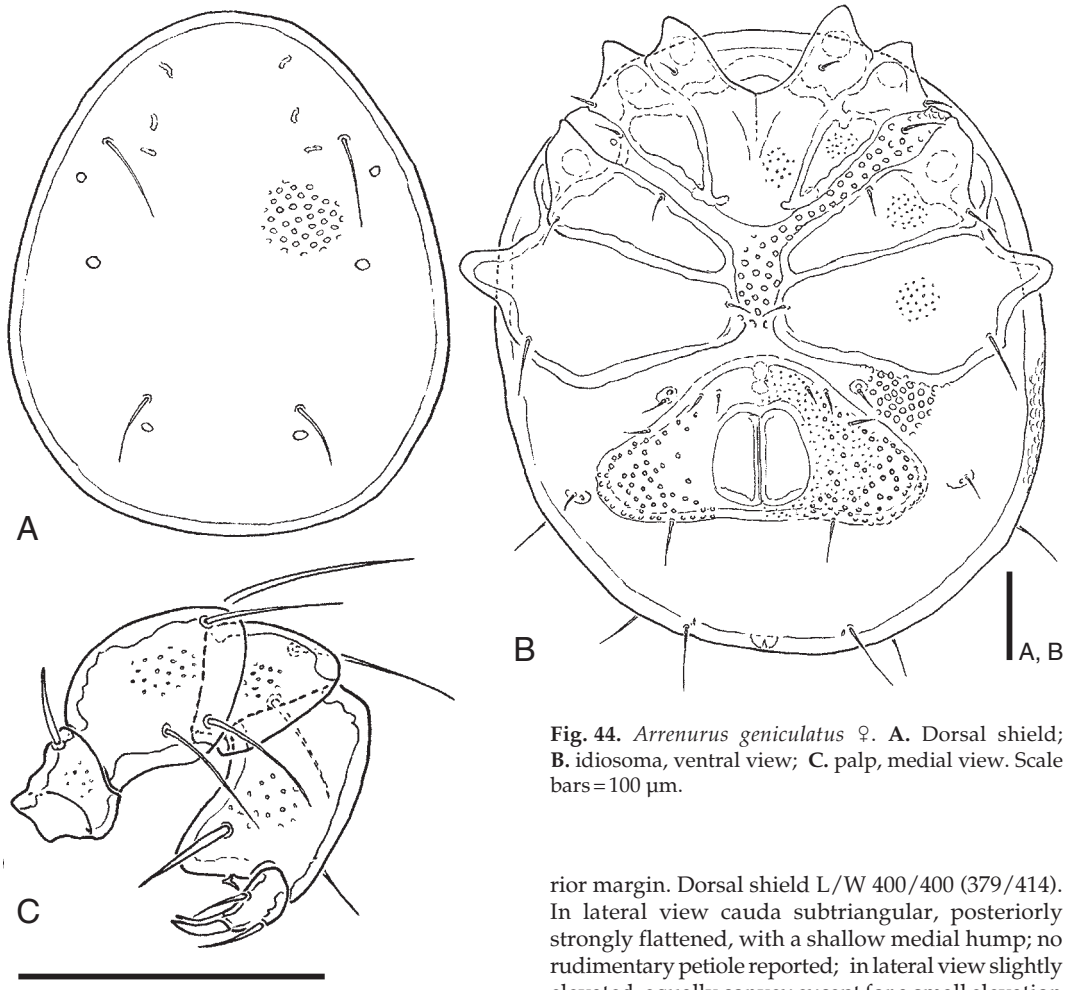


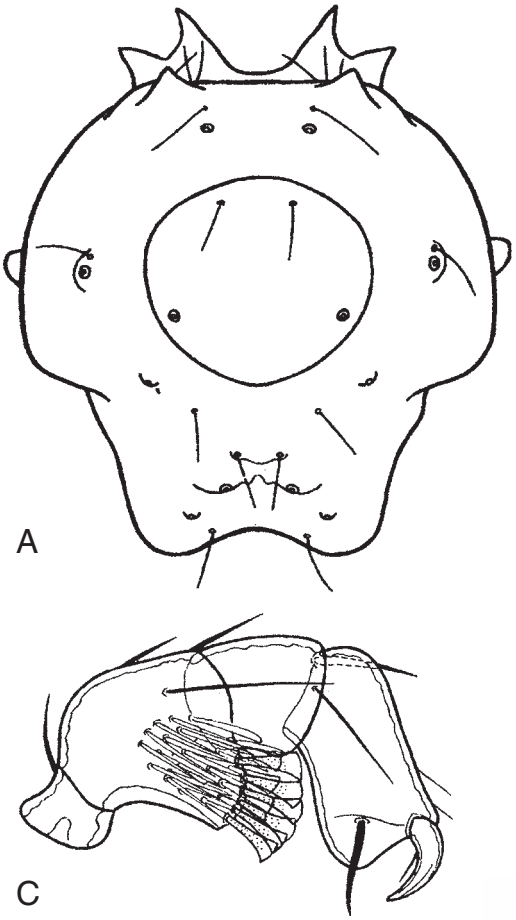
Fig. 44. *Arrenurus geniculatus* ♀. **A.** Dorsal shield; **B.** idiosoma, ventral view; **C.** palp, medial view. Scale bars = 100 µm.

Description (in parentheses: Lundblad 1946)**.**

Both sexes: Colour dark green, cauda and appendages yellow-green (blue). Dorsal furrow complete. Swimming setation not reported. Palp robust, P-2 mediodistally with a bristle of densely arranged setae – the proximal ones simple in shape, distalwards more and more hook-like curved and apically spatulate; P-4 with distally slightly diverging dorsal and ventral margins, distoventral edge bluntly protruding.

Males (Fig. 45): Idiosoma L/W 880/770 (888/810); frontal margin straight; lateral eyes on prominent projections; in dorsoventral view anterior part nearly semicircular, abruptly narrowed anterior to genital field; posterior part forming a stout cauda with slightly converging lateral margins, rounded posterolateral edges and a slightly concave posterior margin. Dorsal shield L/W 400/400 (379/414). In lateral view cauda subtriangular, posteriorly strongly flattened, with a shallow medial hump; no rudimentary petiole reported; in lateral view slightly elevated, equally convex except for a small elevation in idiosoma centre. Medial margins of Cx-III + IV close to each other, interspace posteriorly narrowing; posteromedial margins of Cx-IV extended to form acute angles, in touch with genital field; acetabular plates medially broad, but touching the gonopore field only in the anterior part, laterally narrowed, reaching the lateral idiosoma margin with their tips.

Females (Fig. 46): Idiosoma L/W 850–1000/750–900 (1120/1052) (data according to Koenike 1893, in brackets data of Lundblad 1946); egg-shaped; frontal and posterior margin convex; two distinct humps posterolaterally, anterior part distinctly narrowed, maximum W at level of genital field. Dorsal shield elongated. Coxal field covering less than half of the ventral surface; medial distance Cx-III + IV relatively narrow, < half gonopore field W, genital field close to coxal field, gonopore field without sclerotized patches; acetabular plates in a strongly oblique angle to longitudinal axis, directed to posterolateral



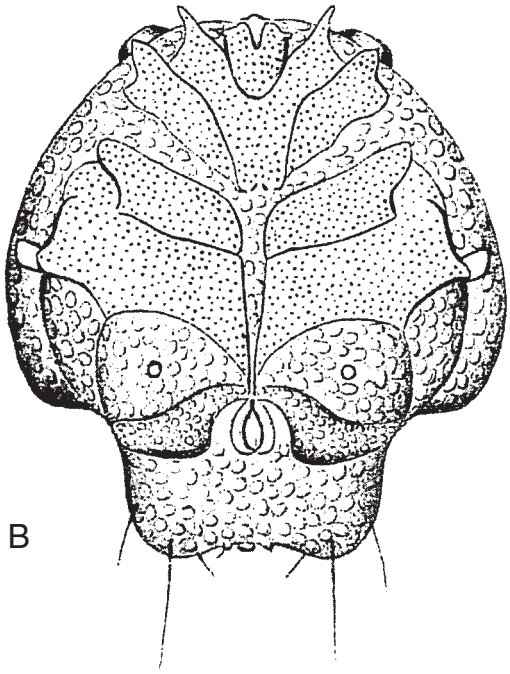


Fig. 45. *Arrenurus pectinatus* ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** palp, medial view (A, C: Cook 1966; B: Koenike 1898).

humps, broad and short, ending far from lateral idiosoma margins; distance genital-posterior margin > twice gonopore L.

Remarks. After the first description of this species from Zanzibar (in both sexes, but only a female venter illustrated) by Koenike (1893), important further details of Malagasy specimens were reported and depicted by Koenike (1898) and Lundblad (1946) – no reason was found to question the conspecifity of these and continental African populations.

Distribution. Ethiopian region (K.O. Viets 1964: South Africa; Cook 1966: Liberia; N, W and E Madagascar: Koenike 1898, Lundblad 1946, Gerecke 2004).

Habitat. Stagnant waters.

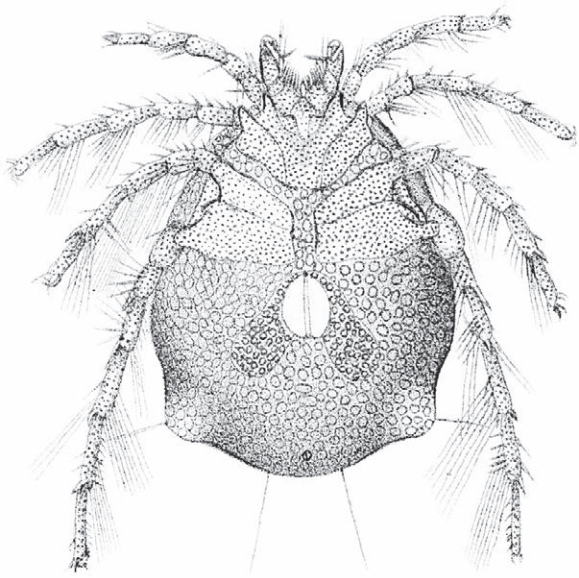


Fig. 46. *Arrenurus pectinatus* ♀. Idiosoma, ventral view (Koenike 1893).

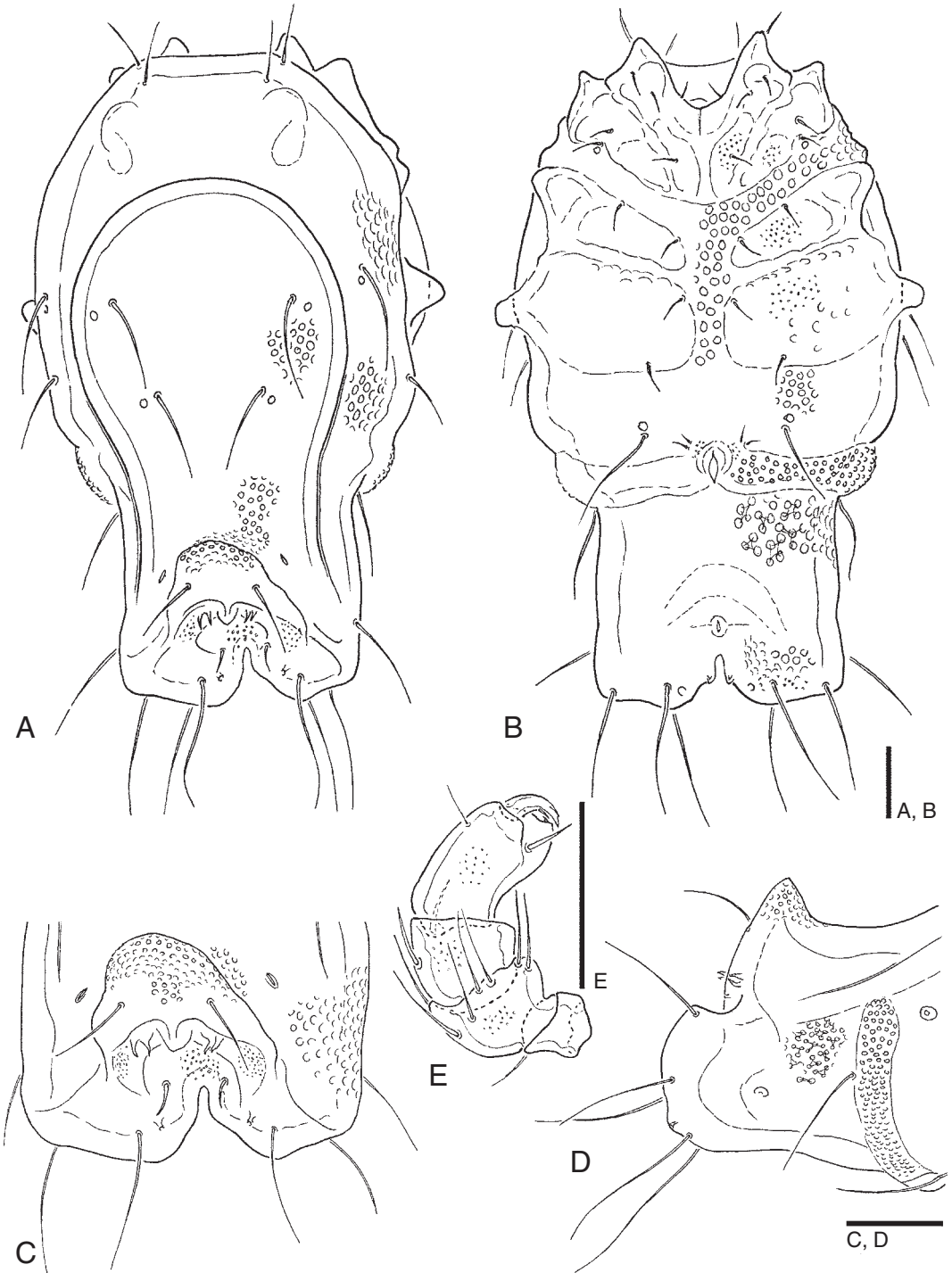


Fig. 47. *Arrenurus ambohitra* sp. nov. holotype ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** detail of cauda, dorsal view; **D.** detail of cauda, lateral view; **E.** palp, medial view. Scale bars = 100 µm.

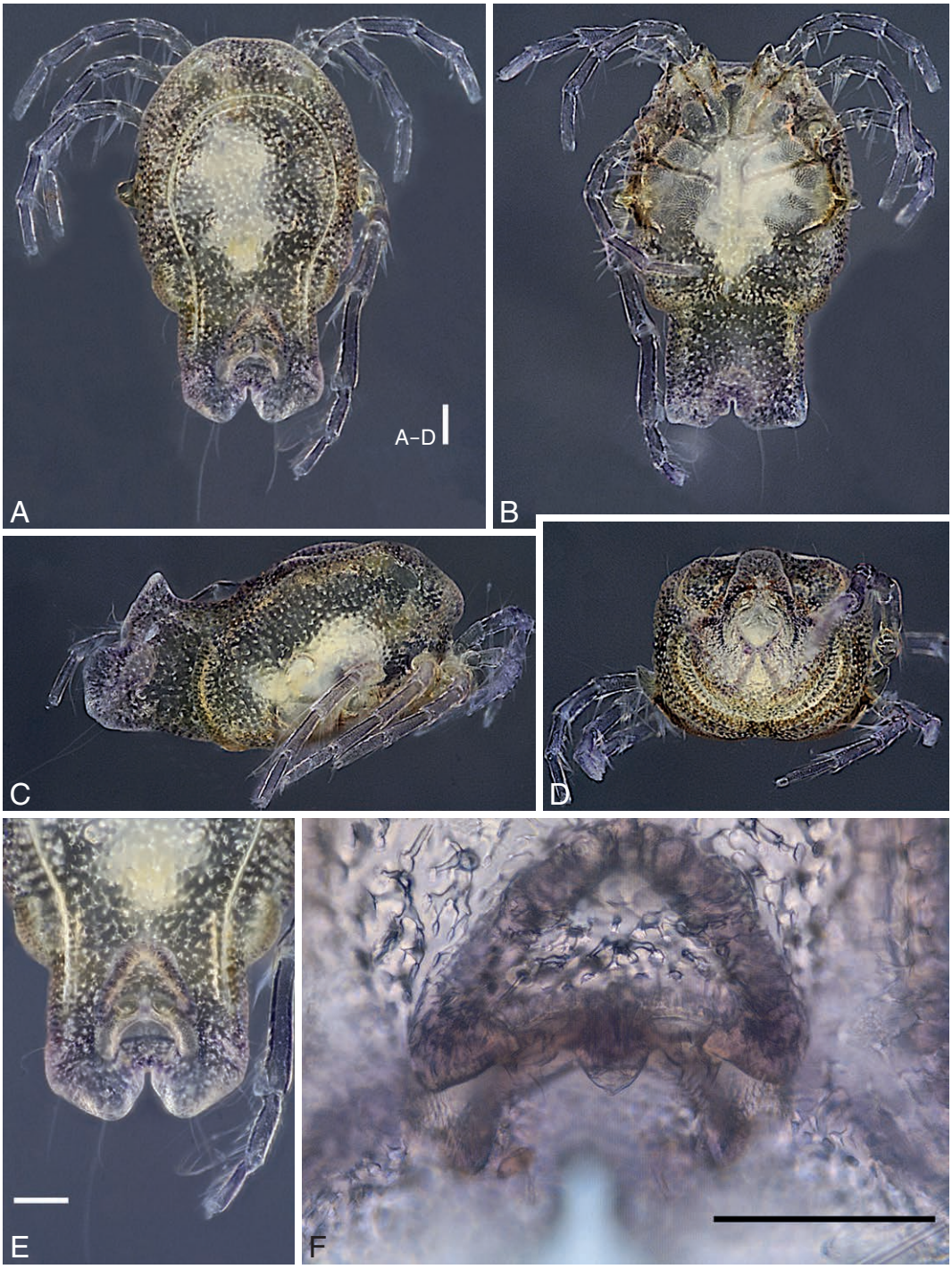


Fig. 48. *Arrenurus ambohitra* sp. nov. holotype ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** idiosoma, lateral view; **D.** idiosoma, posterior view; **E.** cauda, dorsal view; **F.** detail of cauda, dorsal view. Scale bars = 100 µm.

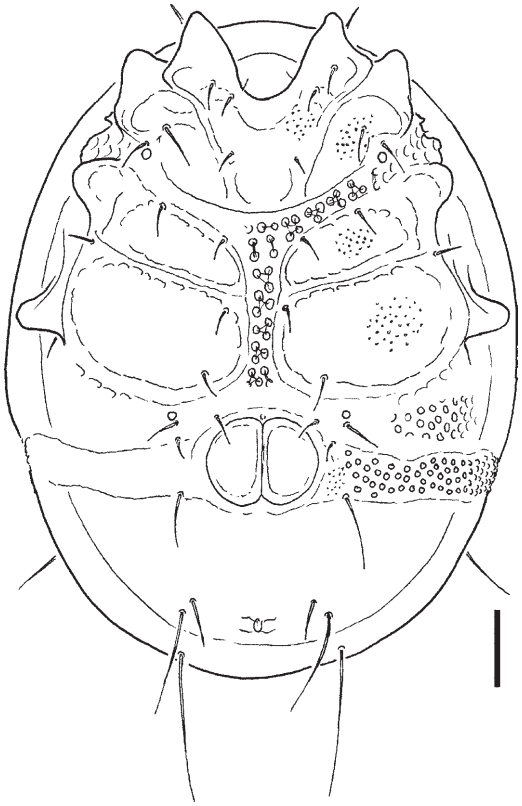


Fig. 49. *Arrenurus ambohitra* sp. nov. paratype ♀. Idiosoma, ventral view. Scale bar = 100 µm.

Arrenurus (*Megaluracarus*) *ambohitra* sp. nov.
Figs 47–50

Material examined. Holotype: ♂, **MD 180**, Montagne d'Ambre (Antsiranana), Ambohitra (Joffreville), Voie 100 arbres, temporary lake II, without outflow, 1050 m a.s.l., 12°31'12.2"S, 049°10'31.6"E, 22-iii-2011 (SMF – palps, IV-leg on slide "MAD 26"). – **Paratypes:** Same data as holotype, 2♀♀ (SMF – gnathosoma, palps, I-leg-4–6 on slide "MAD 27"), (RMNH).

Diagnosis. Both sexes: Interspaces between coxal plates wide. P-2 medial margin with three distoventral setae.

Male: Frontal margin straight; cauda subrectangular, posterior margin indented. Dorsal furrow extending onto cauda; posterodorsal surface with a central hump, posteriorly of this hump a cavity structured by two step-like ridges and a short, rounded central projection flanked by a pair of projecting gland openings.

Females: Frontal margin convex; gonopore field without sclerotized patches; acetabular plates relatively long and slender.

Description

Both sexes: Colour purplish to lilac. Anterior coxae extending just beyond anterior idiosoma margin; coxal plates with fine porosity; no long setae associated with leg insertions. P-2 medially with three setae and two setae anteroventrally.

Male (holotype, Figs 47-48): Idiosoma L/W 980/567; maximum W in anterior part; cauda relatively short but distinctly set off from anterior idiosoma, with subparallel lateral margins, posterior margin weakly projecting, with a deep median cleft; posterior surface of cauda with two deep cavities, the ventral one unpaired, the dorsal one medially subdivided by a suture (in dorsal view appearing like a pointed projection) flanked by two pairs of seta-like pointed projections (possibly the lips of a glandular opening). Dorsal L 972; dorsal furrow incomplete, in posterior part diverging and ending on cauda; dorsal shield W 429; Dgl-3 on a strongly elevated hump flanked by a pair of distinct slit organs. Gonopore field L 50; acetabular plates extending to lateral idiosoma margin; lateral ends of acetabular plates visible in dorsal view forming rounded elevations at the base of the cauda. Swimming setae: II-leg-3, 0/1; II-leg-4, 0/3; II-leg-5, 0/3; III-leg-3, 0/4; III-leg-4, 0/8; III-leg-5, 0/5; IV-leg-3, 5/5; IV-leg-4, 10/6; IV-leg-5, 6/4. Leg segment L I-leg-4–6, 138, 132, 122; IV-leg-4–6, 251, 148, 134; IV-leg-4 with a short spur. Palp segment L P-1–5, 26, 68, 30, 76, 34.

Females (two paratypes; Figs 49–50): Idiosoma L/W 899-944/672-684. Dorsal furrow complete; dorsal L 907–919; dorsal shield L/W 680–705/470–518. Medial margin of Cx-IV longer than medial margin of Cx-III; interspace between Cx-I + II and Cx-III + IV with coarse porosity, medial distance between Cx-III + IV less than half gonopore field W, posterior margin of Cx-IV slightly convex, posteromedial corners rounded; gonopore field L/W 120/150, close to coxal field, without distinct sclerotized patches, but a thickened border line along gonopore lips and anterior and posterior margins; acetabular plates long and narrow, anterior margin in medial part slightly bowed anteriorly, extending almost to lateral idiosoma margin and here slightly enlarged; excretory pore far posterior to genital field, subterminal. Swimming setae: II-leg-3, 0/4; II-leg-4, 0/3; II-leg-5, 0/4; III-leg-3, 0/6; III-leg-4, 0/6; III-leg-5, 4/2; IV-leg-3, 3/2; IV-leg-4, 6/2; IV-leg-5, 2/4. Leg segment L I-leg-4–6, 140, 132, 120; IV-leg-4–6: 180, 146, 126. Palp segment L P-1–5, 26, 68, 54, 76, 35.

Etymology. The name *ambohitra* refers to the town of Ambohitra in northern Madagascar, where the specimens of the type series have been found; it is a noun in apposition.

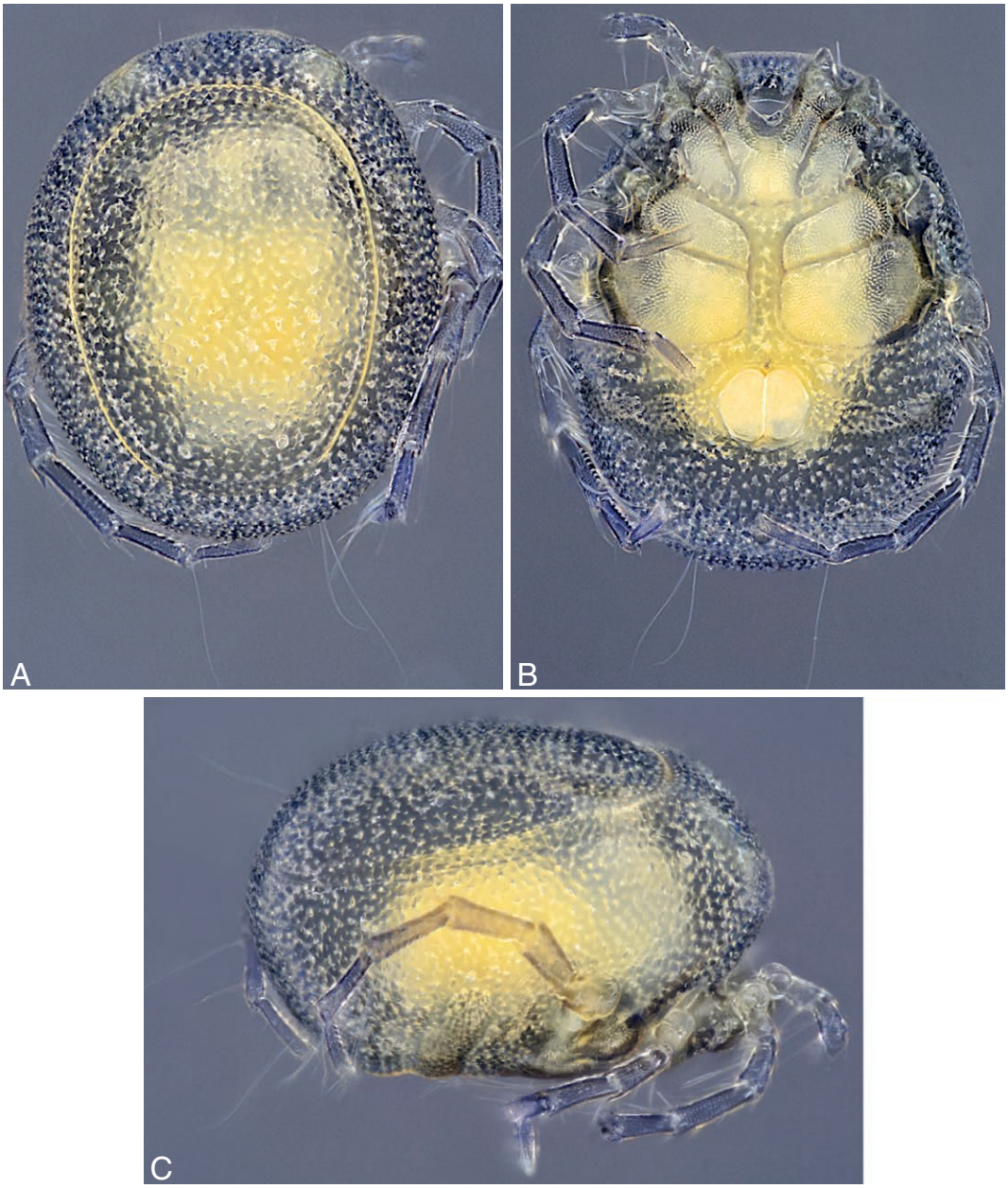


Fig. 50. *Arrenurus ambohitra* sp. nov. paratype ♀, idiosoma. **A.** Dorsal view; **B.** ventral view; **C.** lateral view.

Remarks. The male of *A. ambohitra* sp. nov. is unique within the genus in the shape of the cauda (with a deep posterior indentation and a dorsocaudal concavity with complicated structures as described and figured above). Among the Malagasy species, female *A. ambohitra* resemble *A. rudiferus* in the narrow acetabular plates directed perpendicular to the longitudinal axis. Furthermore, the thickened parts in the gonopore field could be interpreted as the similarly shaped sclerotized patches in the latter species. *Arrenurus rudiferus* females differ from *A. ambohitra* in a wider medial interspace between Cx-III + IV (> half gonopore field W) and acetabular plates which are laterally thickened and do not reach the lateral idiosoma.

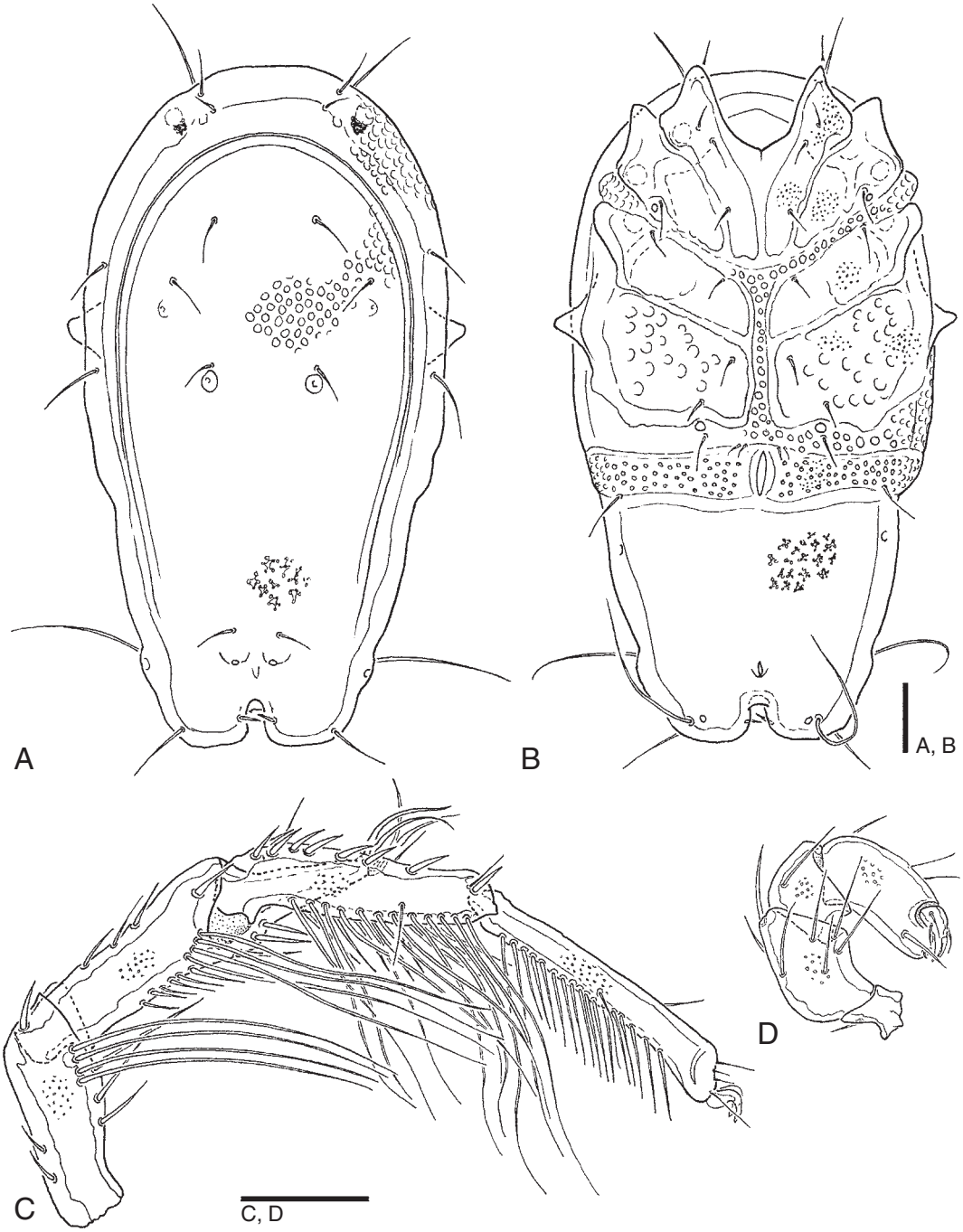


Fig. 51. *Arrenurus concavoides* sp. nov. holotype ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** IV-leg-3–6, posterior view; **D.** palp, medial view. Scale bars = 100 µm.

Distribution. N Madagascar, endemic.

Habitat. Temporary standing water.

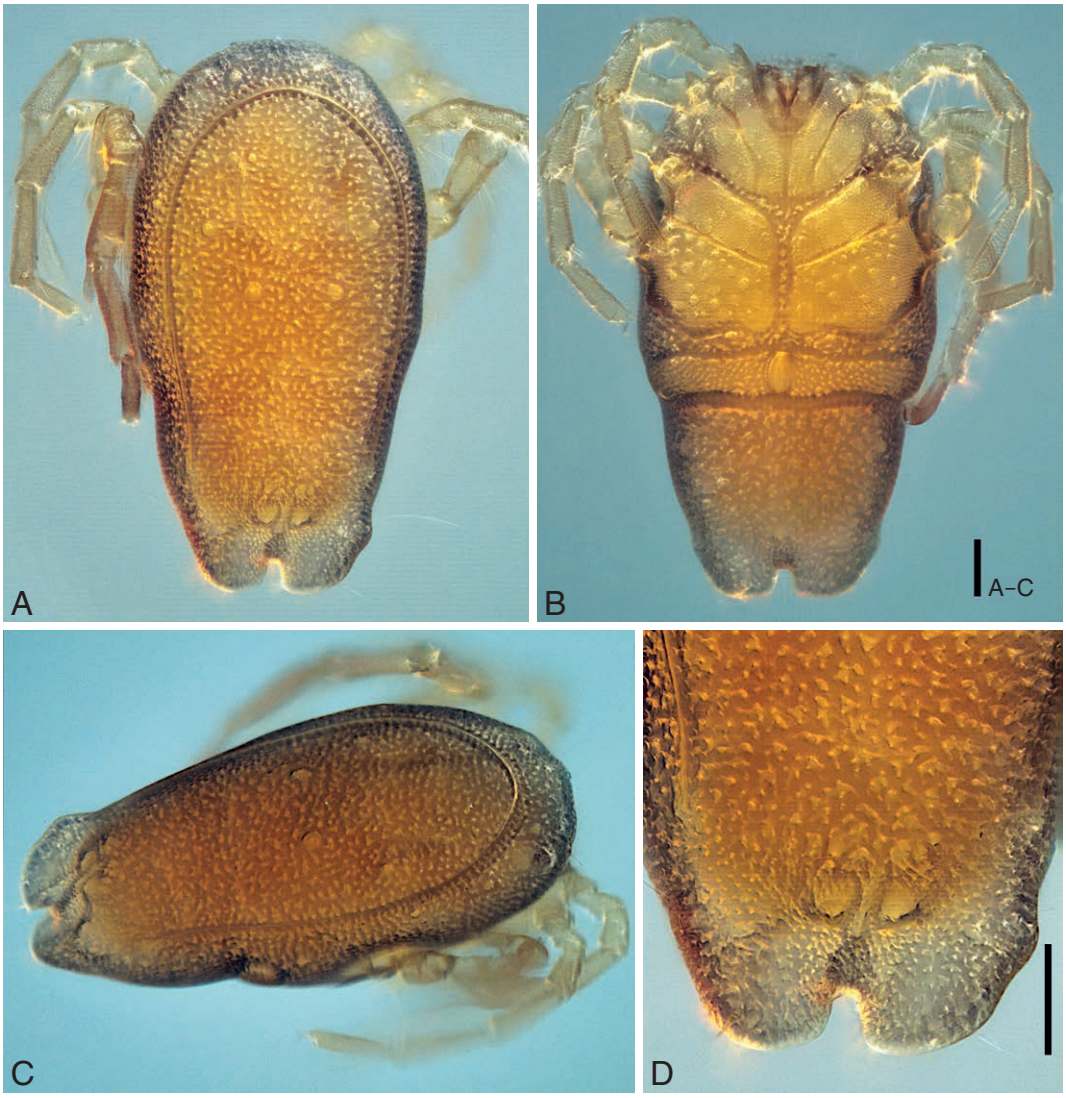


Fig. 52. *Arrenurus concavoides* sp. nov. holotype ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** idiosoma, lateral view; **D.** cauda, detail, dorsal view. Scale bars = 100 µm.

Arrenurus (*Megaluracarus*) *concavoides* sp. nov.
Figs 51–54

Material examined. Holotype: ♂, **MD 168,** Tampoketsan Ankazobe (Antananarivo), W from R.N. 4 (km 157), spring exposed W, 1400 m a.s.l., 29-xi-2001, (SMF – palps, I-leg, IV-leg-3–6 on slide "MAD 10"). – **Paratypes:** Same data as holotype, 3 ♀♀ (one juv.) (SMF – gnathosoma, palps, I-leg-3-6, IV-leg of 1 ♀ on slide "MAD 11"); 2 ♂♂, 2 ♀♀ (RMNH).

Diagnosis. Both sexes: Idiosoma elongated, setation weakly developed. Frontal margin convex. Outlines of coxal plates very distinct, suture lines Cx-II/-III and medial separation Cx-III/-IV narrow, Cx-IV with numerous rounded muscle insertion patches.

Males: Idiosoma very slender, maximum W in anterior part, caudal part not set off from anterior idiosoma; caudal margin with a median cleft.

Females: Genital field close to coxal field; gonopore field without sclerotized patches; acetabular plates straight, perpendicular to idiosoma axis, not reaching lateral idiosoma margin; postgenital idiosoma extended.

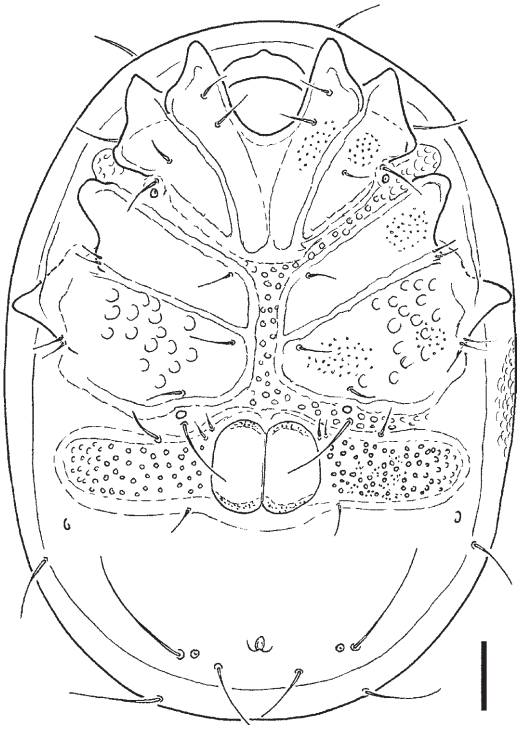


Fig. 53. *Arrenurus concavoides* sp. nov. paratype ♀. Idiosoma, ventral view. Scale bar = 100 µm.

Description

Both sexes: Colour brownish. Gnathosomal bay wide U-shaped; tips of Cx-I at level of, or slightly extending beyond, frontal idiosoma margin. P-2 with seven setae, five of these on medial surface (one dorsally, four scattered distoventrally); P-4 long, dorsal margin slightly convex, ventral margin nearly straight.

Males (holotype, two paratypes in parentheses; Figs 51–52): Idiosoma L/W 996 (900–1028)/543 (494–567); lateral margins slightly protruding at lateral ends of acetabular plates and at the insertions of a pair of glands near posterior end; posterior margin at both sides of the medial cleft weakly convex, a pair of spine-like bifurcated setae (a little prominent second tip about halfway between base and distal end) inserted at the lateral cleft margins. Dorsal furrow incomplete, dorsal shield W 441 (409–446), its lateral margin in posterior part nearly straight, equally converging. L medial margin Cx-IV > Cx-III; gonopore field L 64; acetabular plates straight, nearly equal in W from the centre to lateral ends at lateral idiosoma margin. Swimming setae: II-leg-5, 0/2; III-leg-4, 0/5; III-leg-5, 0/5; IV-leg-3, 4/4; IV-leg-4, 0/4 (+3 on spur); IV-leg-5, 0/12. Leg segment L I-leg-4–6, 140, 150, 134; IV-leg-4–6, 206, 210, 216; IV-leg-3 and -5 distal margins forming short, pointed sheaths, IV-leg-4 medial margin extending to form a long spur with an apical tuft of four setae; ventral margins of IV-leg-4-6, in addition to swimming setae, with numerous regularly-arranged setae, particularly evident like a comb on IV-leg-6. Palp segment L P-1–5, 34, 94, 62, 94, 41.

Females (five paratypes; Figs 53–54): Idiosoma L/W 919–1130/689–790; equally elliptical without posterolateral corners. Dorsal furrow complete, dorsal shield L/W 810–988/591–664. Medial margins of Cx-III/-IV nearly equal in L; medial distance of Cx-IV narrower than ¼ gonopore field W; genital field close to coxal field, gonopore field L 136, without distinct sclerotized patches, but strips of thickened sclerotization at anterior and posterior margins; acetabular plates perpendicular to idiosoma axis, equal in W over most of their length, laterally rounded, not reaching lateral idiosoma margin. Swimming setae: II-leg-2, 0/2; II-leg-3, 0/2; III-leg-3, 0/4; III-leg-4, 0/4; III-leg-5, 0/4; IV-leg-3, 4/2; IV-leg-4, 5/4; IV-leg-5, 0/5. Leg segment L I-leg-4–6, 154, 156, 120; IV-leg-4–6, 220, 212, 184. Palp segment L P-1–5, 38, 110, 69, 106, 44.

Etymology. Named for the similarity of males to *Arrenurus concavus* males. Derived from *concavus*, Latin – curved.

Remarks. In the male sex, *Arrenurus concavoides* sp. nov. resembles *A. concavus* (see above) in the elongated, posteriorly narrowed shape of the idiosoma, with a distinct, but narrow posteromedian cleft flanked by a pair of stout setae. *Arrenurus concavus* males differ in the formation of the cauda (more distinctly set off from anterior idiosoma, with subparallel lateral margins), and correspondingly in the shape of the dorsal furrow (not equally narrowed posteriorly, but with lateral margins more rounded in anterior, but subparallel in posterior part). In addition, the rudimentary petiole is not located on the posterodorsal surface, but at the bottom of the posterior cleft. Both sexes of *A. concavus* differ from *A. concavoides* sp. nov. in a stouter palp, particularly a quite stocky P-4. Following Koenike's description, female *A. concavus* would differ in laterally narrowed, slightly oblique acetabular plates with concave anterior margins, and Cx-IV subtriangular in shape – but see above concerning doubts about the attribution of sexes in *A. concavus*.

Distribution. Central Madagascar, endemic.

Habitat. Spring.

Fig. 54. *Arrenurus concavoides* sp. nov. paratype ♀, idiosoma. **A.** Dorsal view; **B.** ventral view; **C.** lateral view. Scale bar = 100 µm.

Arrenurus (*Megaluracarus*) *felix* sp. nov.
Figs 55–56

Material examined. Holotype: ♂, **MD 080**, Taolanaro (Tulear), Mandena (QMM area), coastal lake at mouth of Rivière Amendano, 1 m a.s.l., 14-ix-2001 (SMF – gnathosoma, palps, IV-leg on slide "MAD 16").

Diagnosis. Male (female unknown): Idiosoma rhombic, maximum W posterior to Cx-IV. Frontal margin straight to slightly concave; posteromedial part of dorsal shield with a fine, obtuse projection. Separation of coxal plates wide; acetabular plates medially very large, anteriorly extending far beyond anterior gonopore edge, laterally ending far from lateral idiosoma margin. Palp stout, P-2 medially in ventral part with two setae only (one in centre, one at distal end).

Description

Male (holotype; Figs 55–56): Colour blue. Idiosoma L/W 753/587. Dorsal furrow incomplete, posteriorly diverging, dorsal shield slender, maximum W 340, in posterior part with a finely porose medial area from which a small pointed extension emerges between a pair of small setae; Lgl-1 shifted to dorsolateral surface. Gnathosomal bay wide U-shaped; anterior

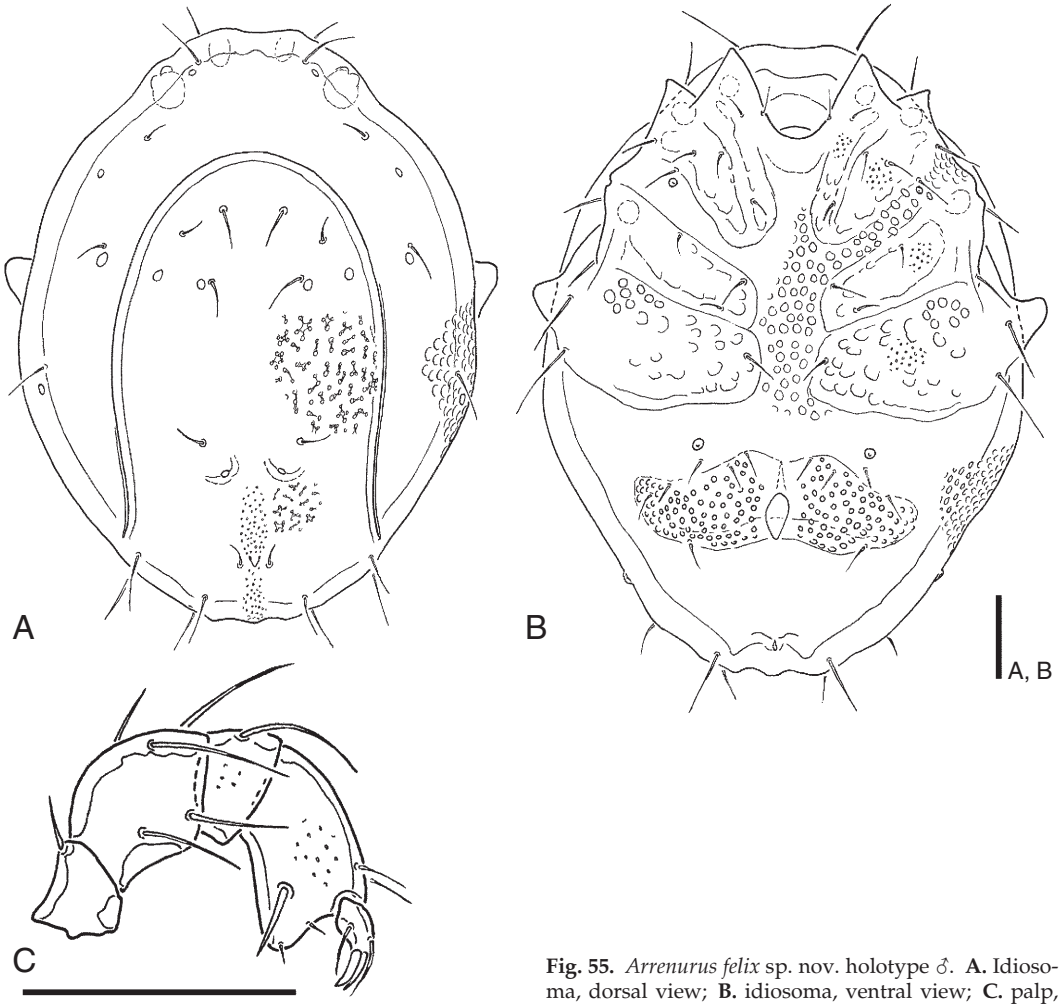


Fig. 55. *Arrenurus felix* sp. nov. holotype ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** palp, medial view. Scale bars = 100 µm.

tips of Cx-I at level of frontal idiosoma margin; separation of coxal plates wide, porosity extending also medially between Cx-I + II; medial margin of Cx-IV slightly protruding medially, longer than medial margin of Cx-III; genital field compact, gonopore field L 38; acetabular plates "moustache-shaped": posterior margins convex, anterior margins concave, maximum W (about two times gonopore L) medially; anterior and posterior margins slightly undulating. IV-leg-4 without a spur. Swimming setae: III-leg-3, 0/5; III-leg-4, 0/7; III-leg-5, 0/6; IV-leg-3, 0/4; IV-leg-4, 0/6; IV-leg-5, 0/5, those of IV-leg-4 very strong and long, reaching almost anterior margin of IV-leg-5. Leg segment L I-leg-4–6, 101, 104, 102; IV-leg-4–6, 168, 146, 148. Palp segment L P-1–5, 30, 64, 44, 68, 35. P-2 medially with three setae, two in ventral half.

Female: Unknown.

Etymology. Named after Felix Rakotondraparany in appreciation of his help during the collecting trips in 2001 and 2011; the name is a noun in apposition.

Remarks. In the rhombic shape of the idiosoma, the inversely U-shaped dorsal furrow, the rather short, laterally narrowed acetabular plates, and the shape and setation of the palp, *Arrenurus felix* sp. nov. is similar to males of the South-African species *Arrenurus brevigenitalis* K.O. Viets, 1965 and *A. longigenitalis* K.O. Viets, 1965. Both differ from the new species in a more enlarged dorsal shield with more rounded lateral margins and a deeper indentation of the posterior idiosoma margin, *A. longigenitalis*, furthermore, in more slender acetabular plates which extend in medial part only slightly over the anterior

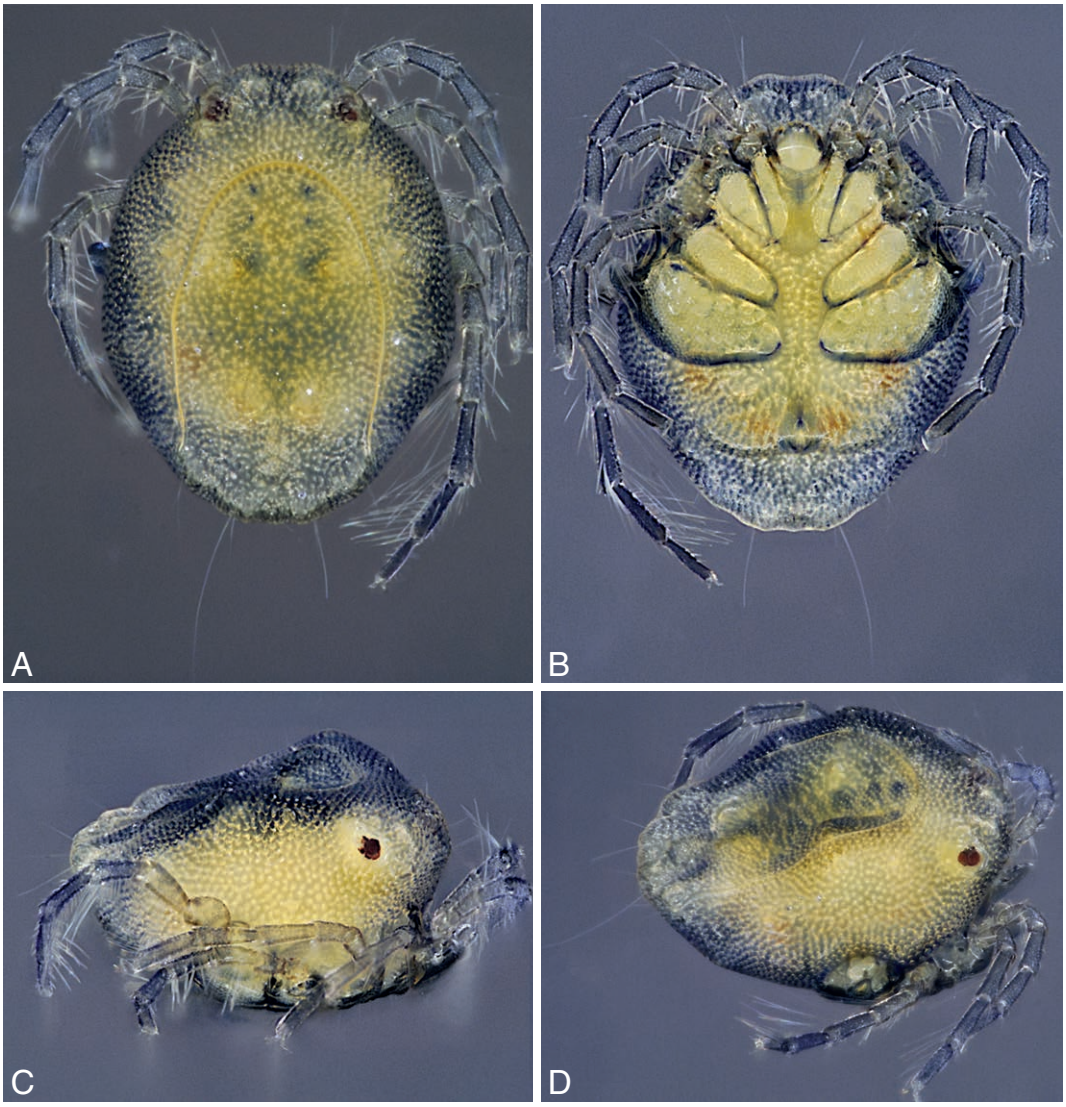


Fig. 56. *Arrenurus felix* sp. nov. paratype ♂, idiosoma. **A.** Dorsal view; **B.** ventral view; **C.** lateral view; **D.** dorso-lateral view.

margin of the gonopore. *Arrenurus brevigenitalis* is rather similar to *A. felix* in the shape of the genital field, but differs, in addition to a very deep posterior indentation of the idiosoma, also in a narrower medial distance between Cx-III + IV. Males of *A. purcelli* Thor, 1902, a further South African species similar to the discussed species above in a rhombic idiosoma shape, differ from *A. felix* in a deeper posteromedial idiosoma indentation and narrower, in medial part not enlarged acetabular plates.

Distribution. S Madagascar, endemic.

Habitat. Stagnant water.

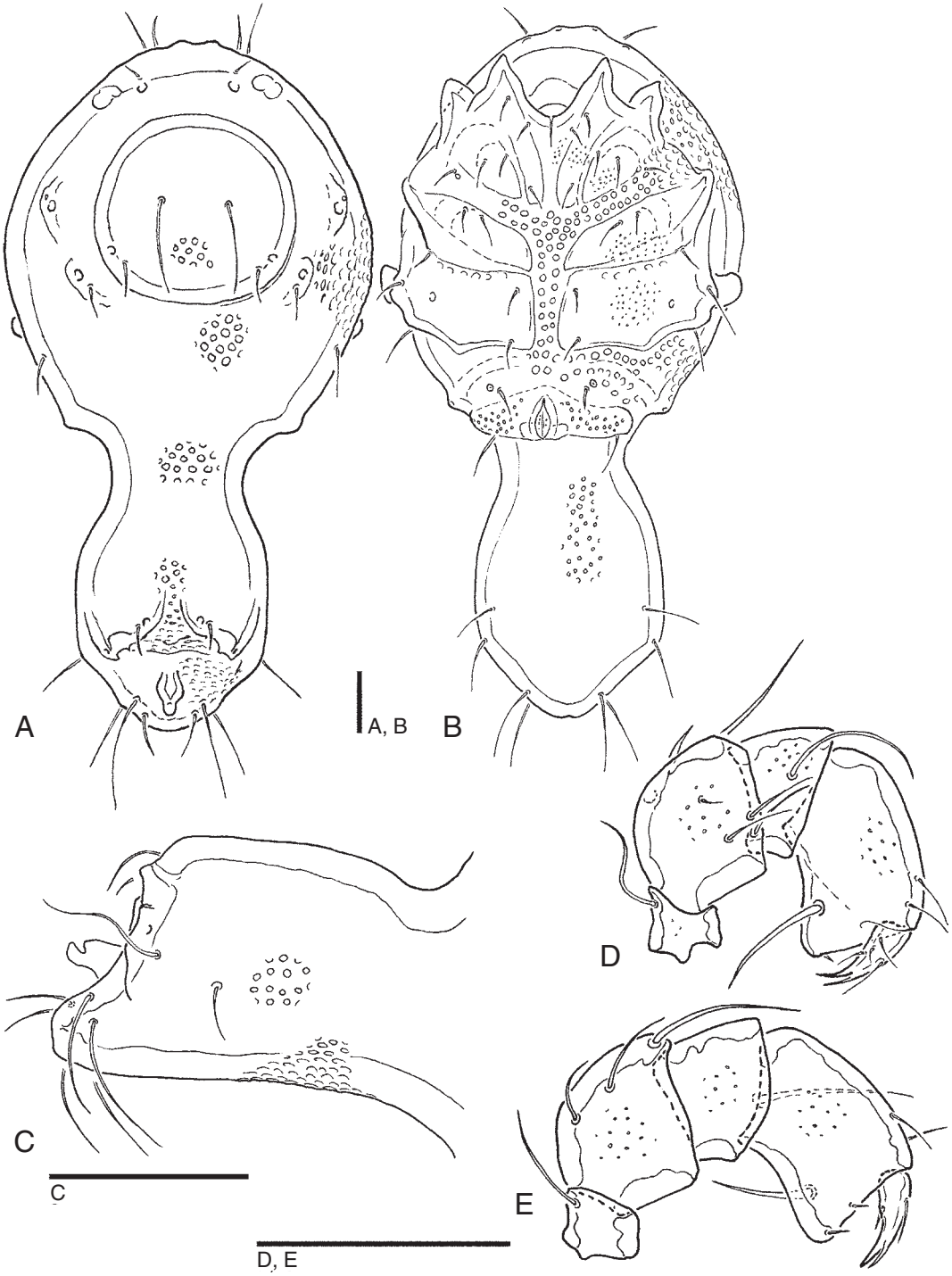


Fig. 57. *Arrenurus uncipetiolatus* sp. nov. holotype ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** cauda, lateral view; **D.** palp, medial view; **E.** palp, lateral view. Scale bars = 100 µm.

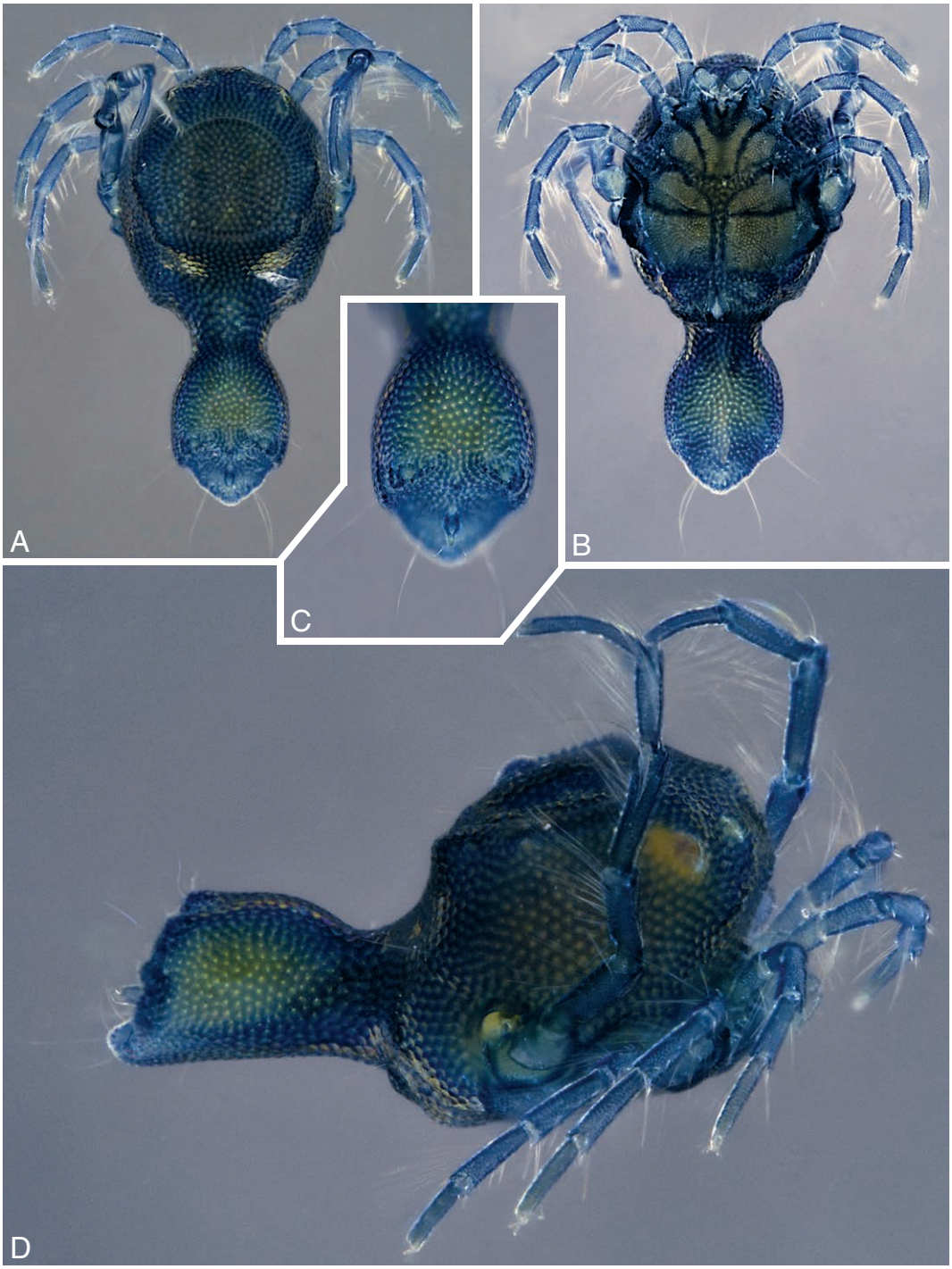


Fig. 58. *Arrenurus uncipetiolatus* sp. nov. holotype ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** cauda, dorsal view, detail; **D.** idiosoma, lateral view.

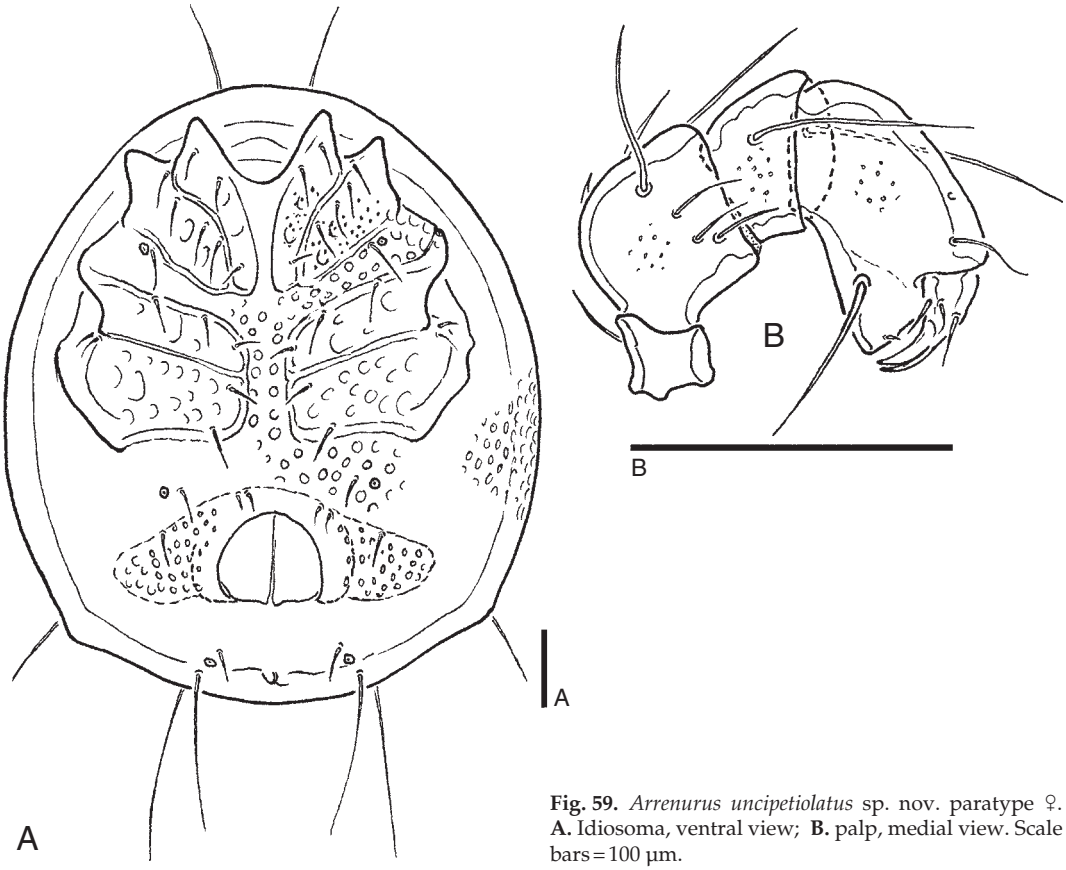


Fig. 59. *Arrenurus uncipetiolatus* sp. nov. paratype ♀. **A.** Idiosoma, ventral view; **B.** palp, medial view. Scale bars = 100 µm.

***Arrenurus* (*Megaluracarus*) *uncipetiolatus* sp. nov.**
Figs 57–60

Material examined. Holotype: ♂, **MD 081a**, Taolanaro (Tulear), Mandena (QMM area), lake situated inland from coastal lake at mouth of Rivière Amendano (MD 080), 2 m a.s.l., 14-ix-2001 (SMF – dorsal shield, gnathosoma and palps on slide "MAD 1"). – **Paratypes:** Same data as holotype, 1 ♂, 2 ♀♀ (SMF – gnathosoma and palps of 1 ♀ on slide "MAD 31"), 3 ♂♂, 6 ♀♀ (RMNH, palps and IV-leg of 1 ♂ on slide "MAD 22"); **MD 083**, Taolanaro (Tulear), Mandena (QMM area), pond with *Nepenthes* near road from pepinerie to coastal lake (MD 080), 5 m a.s.l., 14-ix-2001, 1 ♂ (RMNH), 3 ♂♂, 3 ♀♀ (SMF – 2 ♂♂, 2 ♀♀ slide mounted).

Diagnosis. Both sexes P-2 mediodistally with three relatively short setae, one fine seta mediocentrally.

Males: Idiosoma strongly tailored posterior to genital field; cauda posterodorsally with a petiole (hook-like in lateral view) posterior to a subtriangular groove. Dorsal shield small and round, wider than long.

Females: Dorsal furrow incomplete (dorsal shield in posterior part broadly fused to ventral shield); idiosoma posterolaterally with one pair of little prominent humps. Medial distance of Cx-III + IV less than half gonopore field W; gonopore field without sclerotized patches; acetabular plates short, nearly perpendicular to longitudinal axis, laterally strongly narrowed.

Description

Both sexes: Colour blue. Gnathosomal bay U-shaped; tips of Cx-I ending slightly proximal to level of frontal margin. Palp stout.

Males (holotype, in parentheses ten paratypes; Figs 57–58): Idiosoma L/W 1154 (1102–1211)/603 (575–640); frontal margin convex, with a slight central concavity between a pair of glandular humps; maximum W in anterior third; cauda distinctly set off from anterior idiosoma; lateral margins in central part parallel and straight, posterolateral margins slightly concave, posterior margin rounded, posterodorsally with two diverging ridges flanking

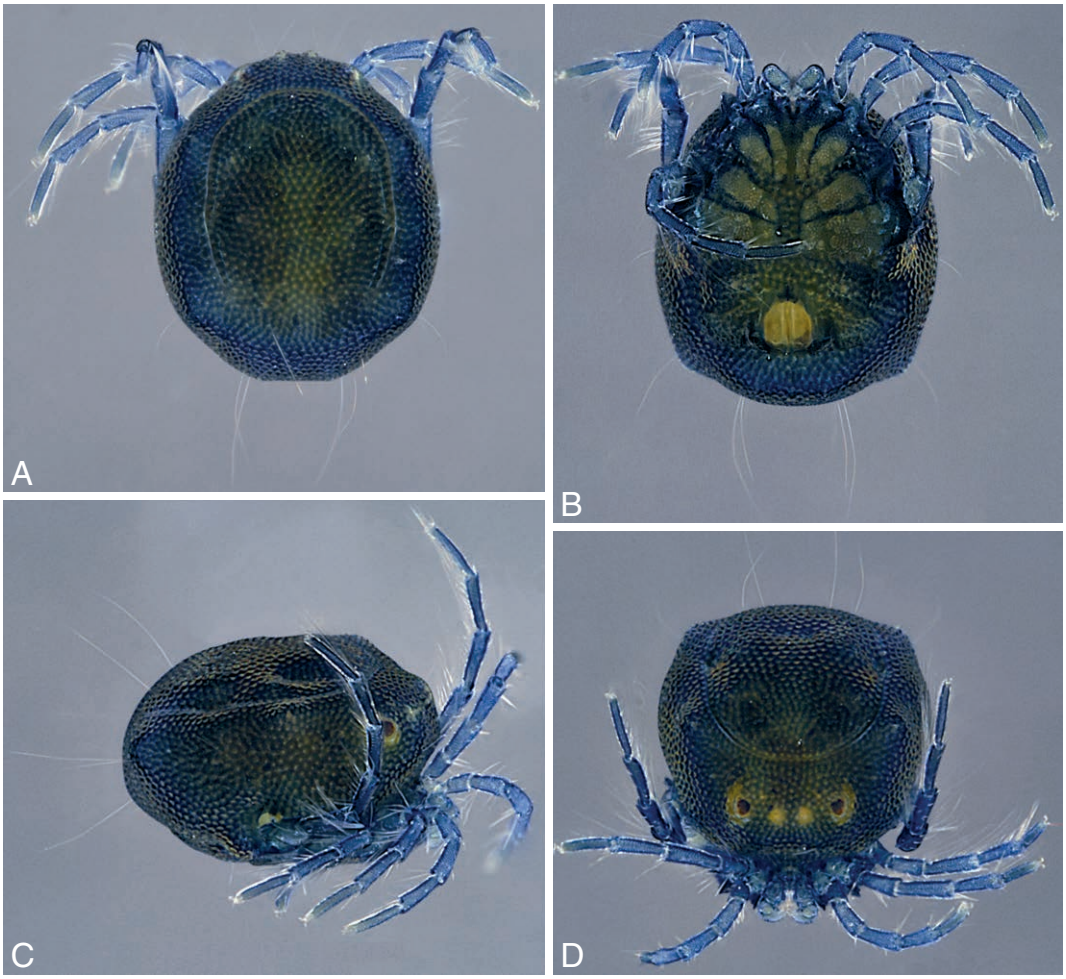


Fig. 60. *Arrenurus uncipetiolatus* sp. nov. paratype ♀, idiosoma. **A.** Dorsal view; **B.** ventral view; **C.** lateral view; **D.** anterior view.

a subtriangular groove; between this groove and posterior end a small petiole (apically narrowed in dorsal view, hook-like in lateral view). Dorsal shield rounded, L/W 316 (292–360)/348 (300–365) bearing the postocularia and glandularia Dgl-3. Cauda in lateral view separated from anterior idiosoma by a deep dorsal incision and with a strongly oblique posterior margin. Ventral L 1085 (1029–1118); stripes of coarse porosity separating coxal plates laterally and medially; gonopore field L 60; acetabular plates laterally distinctly narrowed, ending at lateral idiosoma margin; excretory pore terminal. Swimming setae: II-leg-3, 0/4; II-leg-4, 0/6; II-leg-5, 0/7; III-leg-3, 0/6; III-leg-4, 0/9; III-leg-5, 0/9; IV-leg-3, 4/11; IV-leg-4, 7/12; IV-leg-5, 10/14; IV-leg-4 without a spur, IV-leg-6 bowed. Leg segment L I-leg-4–6, 130, 128, 120; IV-leg-4–6, 170, 170, 190. Palp segment L P-1–5, 24, 64, 50, 70, 40.

Females (16 paratypes; Figs 59–60): Idiosoma L/W 753–838/656–721; frontal margin broadly convex, posterior margin convex between little prominent posterolateral corners. Dorsal furrow incomplete, dorsal shield maximum W 381–470. Ventral L 770–834; L medial margin Cx-IV > Cx-III; medial distance of Cx-III + IV narrower than half gonopore field W; gonopore field L 114; acetabular plates laterally distinctly narrowed, not reaching lateral idiosoma margin. Swimming setae: II-leg-3, 0/4; II-leg-4, 0/7; II-leg-5, 0/7; III-leg-3, 0/6; III-leg-4, 0/10; III-leg-5, 0/7; IV-leg-3, 4/10; IV-leg-4, 6/11; IV-leg-5, 0/10. Leg segment L I-leg-4–6, 130, 126, 132; IV-leg-4–6, -, 146, 154. Palp segment L P-1–5, 24, 64, 40, 78, 40.

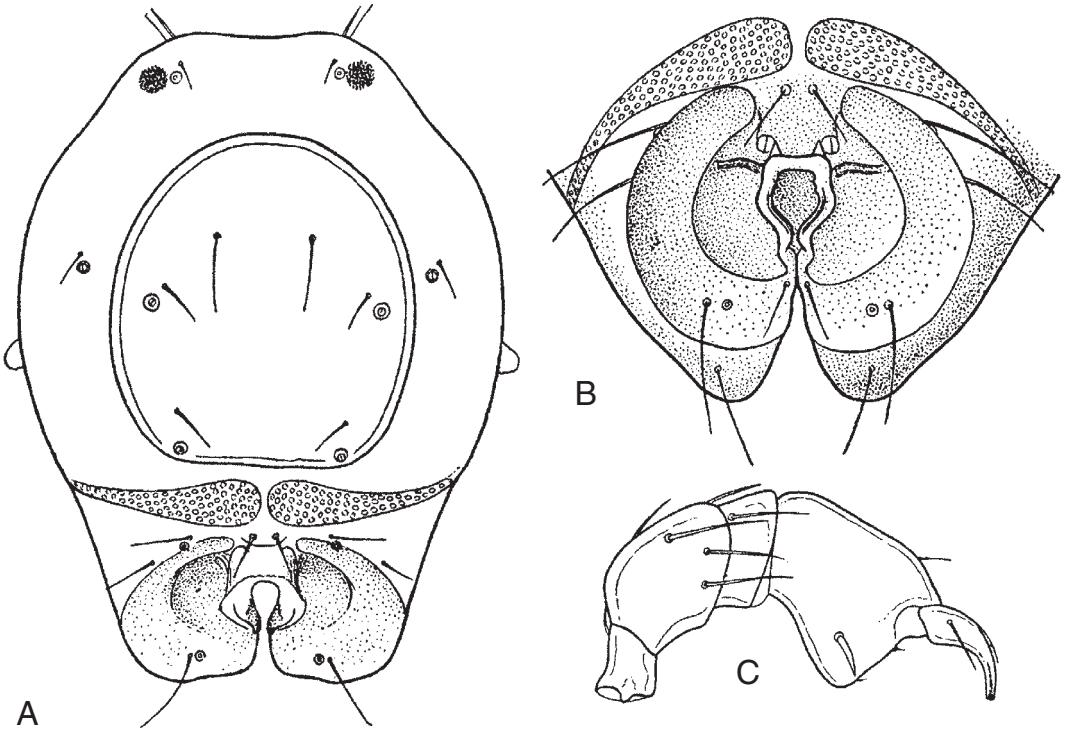


Fig. 61. *Arrenurus dentifer* ♂. **A.** Idiosoma, dorsal view; **B.** detail of cauda, postero-dorsal view; **C.** palp, medial view (Lundblad 1946).

Etymology. Named for the hook-shaped petiole, derived from *uncus*, Latin – hook and *petiolus*, Latin – stem.

Remarks. The male of *A. uncipetiolatus* sp. nov. differs from all known species of the subgenus in the hook-shaped petiole. Among Malagasy species of the genus, the female is similar to *A. geniculatus* and *A. sarcinatus* Koenike, 1898 (the latter not known in the male sex) in rather short acetabular plates. *Arrenurus geniculatus* differs in strongly developed lateral extensions of Cx-IV extending over the lateral idiosoma margin and the medially prominent anterior margin of the genital field, *A. sarcinatus* has a distinctly wider medial separation of Cx-III+IV, acetabular plates with posterolateral ends extending over the level of posterior margin of gonopore field, and a by far longer postgenital area (with the excretory pore about halfway between gonopore field and posterior idiosoma margin).

Distribution. S Madagascar, endemic.

Habitat. Standing water at sea level.

Subgenus *Micruracarus* K. Viets, 1911

Diagnosis. See Smit (2020b).

Remarks. The assignment of *A. sarcinatus* Koenike, 1898 to this subgenus, proposed by Daday (1910) and taken over by all later authors, is not supported – see below under "*Arrenurus* (subgen.?) *sarcinatus*".

Arrenurus (*Micruracarus*) *dentifer* Lundblad, 1946

Figs 61–66

Published record from Madagascar. Mahajanga (Majunga): no collection site details (Lundblad 1946).

Material examined. MD 082, Taolanaro (Tulear), Mandena (QMM area), swamp with *Sphagnum* near road from pepinerie to coastal lake (**MD 080**), 5 m a.s.l., 14-ix-2001, 11♂♂, 6♀♀ (7♂♂, 3♀♀ SMF, of these 4♂♂ slide mounted; 5♂♂, 3♀♀ RMNH).

Description

Both sexes: Colour greenish to blue-green. Dorsal furrow complete. Gnathosomal bay broad U-shaped. Swimming setae: II-leg-4, 0/6; II-leg-5, 0/5; III-

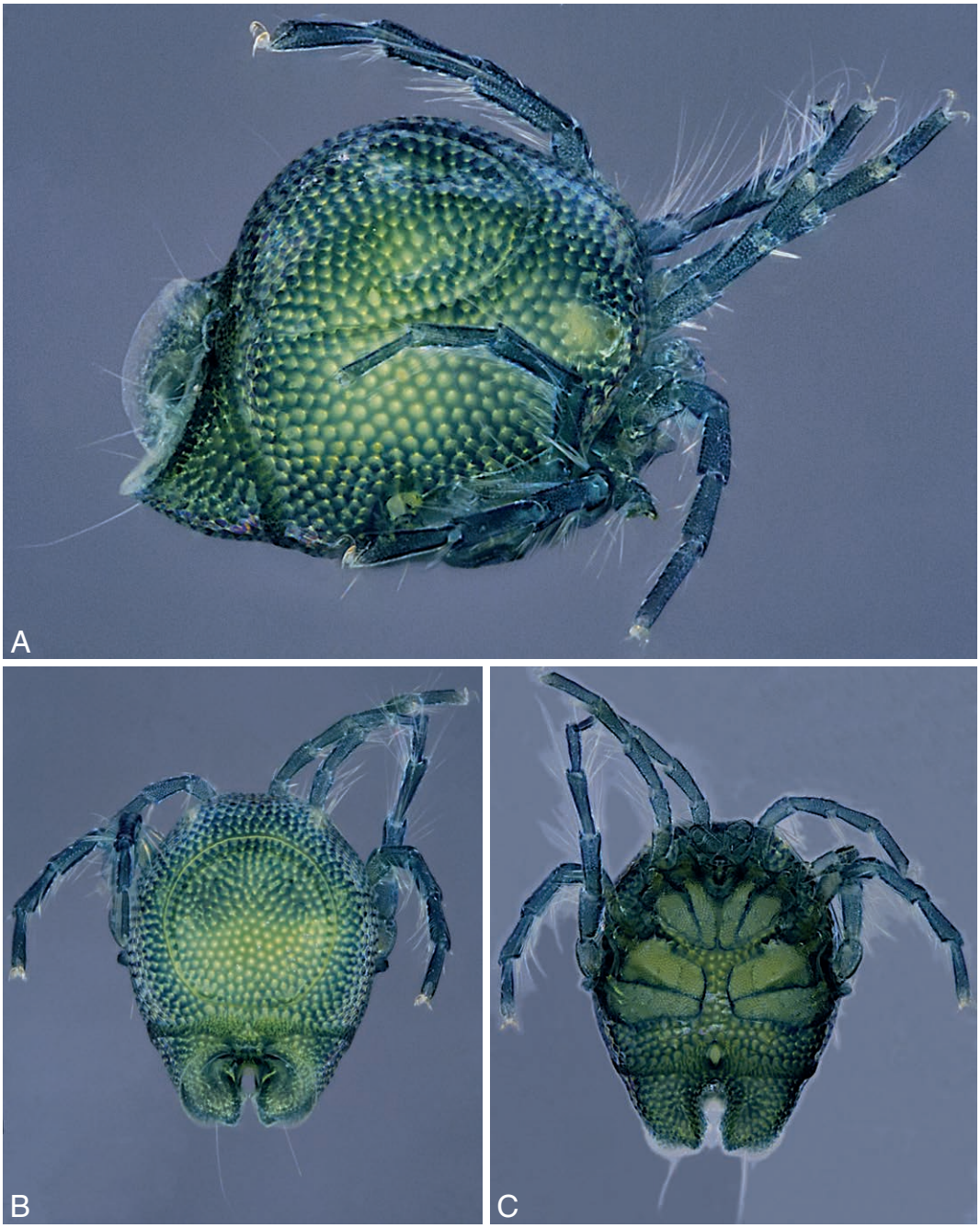


Fig. 62. *Arrenurus dentifer* ♂, idiosoma. **A.** Dorso-lateral view; **B.** dorsal view; **C.** ventral view.

leg-3, 0/5–7; III-leg-4, 0/8; III-leg-5, 0/6-8; IV-leg-3, 4/7–8; IV-leg-4, 5–8/8–11; IV-leg-5, 0/7–10. Palp stout; P-2 with two mediodistal setae, P-4 dorsal and ventral margins distally strongly diverging, distoventral edge subrectangular, rounded.

Males (Figs 61–63): Idiosoma L/W 870/656; frontal and anterolateral parts slightly concave, lateral margins equally rounded, smoothly passing over

Fig. 63. *Arrenurus dentifer* ♂. **A.** Idiosoma, anterior view; **B.** idiosoma, posterior view; **C.** cauda, posterior view, detail. Scale bar = 100 µm.

to the cauda with nearly straight, equally converging lateral margins; posterior margin slightly concave, with a deep, keyhole-shaped median cleft. Dorsal shield L/W 443/419, its posterior margin truncated; cauda with a posteriorly directed dorsal groove surrounding a tube-shaped central part embedded in a membranous frill, by Lundblad interpreted as petiole; wall of this tube ventrally longer and more sclerotized, forming a pair of bluntly pointed tips flanking a longitudinal slit that opens the tube to ventral, dorsally shortened and membranous – in consequence, its terminal end oblique to dorsal surface; inside the tube, no unpaired cone-shaped structure observed; at "petiole" base a pair of widely separated, dorsally-directed spines. Tips of Cx-I/-II elongated and pointed; tips of Cx-III short, rounded; acetabular plates long and narrow, extending onto dorsal surface – here slightly enlarged and nearly in touch. IV-leg-4 without spur.

Females (Figs 64–66): Idiosoma L/W 795/760; approximately egg-shaped; frontal margin concave, posterior margin rounded (in juveniles – Fig. 66), or undulating, with paired lateral humps in mature specimens (Fig. 65), maximum W at level of genital field; two distinct humps posterolaterally, posterior margin convex. Dorsal shield L/W 603/515. Coxal field covering less than half of the ventral surface; medial distance Cx-III + IV half gonopore field W,

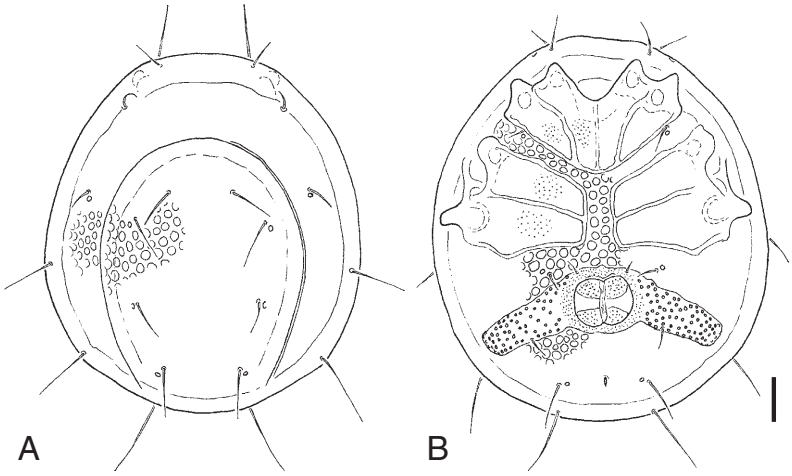


Fig. 64. *Arrenurus dentifer* ♀, idiosoma. **A.** Dorsal view; **B.** ventral view. Scale bar = 100 µm.

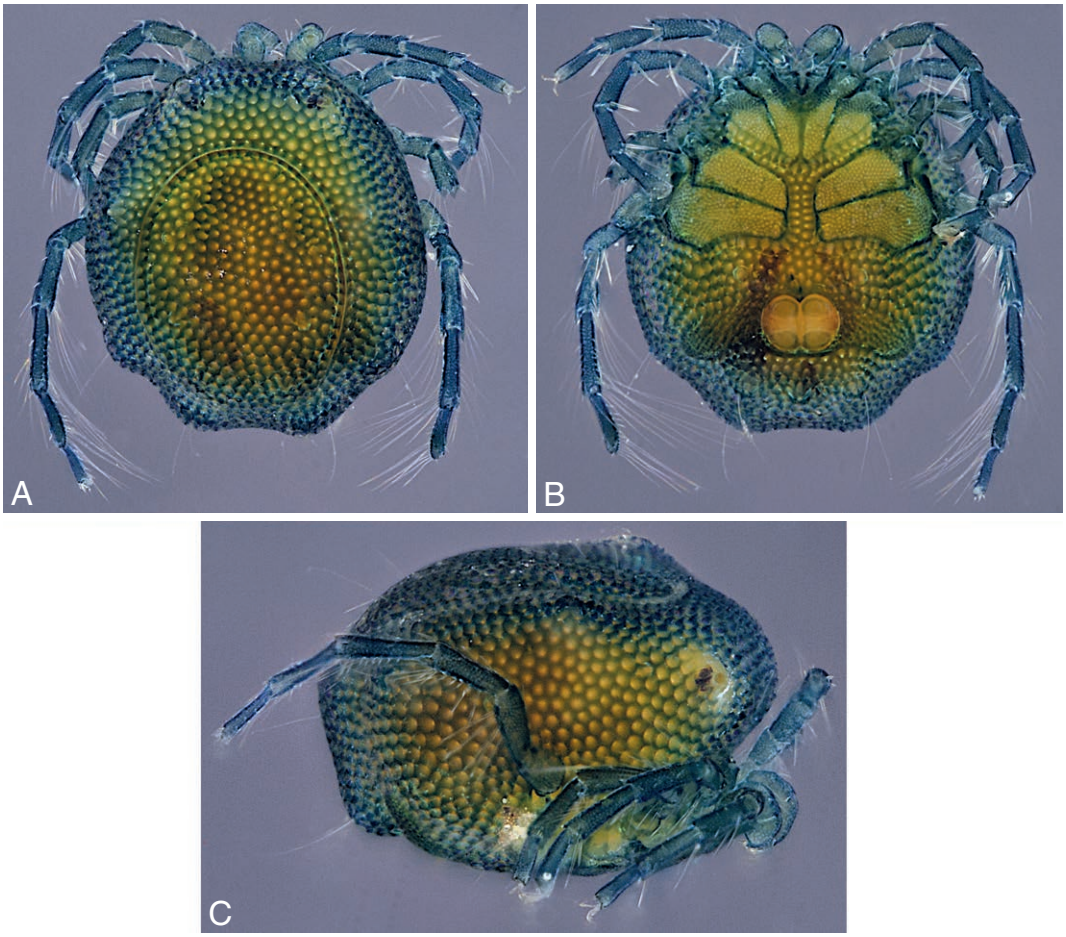


Fig. 65. *Arrenurus dentifer* ♀, idiosoma. **A.** Dorsal view; **B.** ventral view; **C.** lateral view.

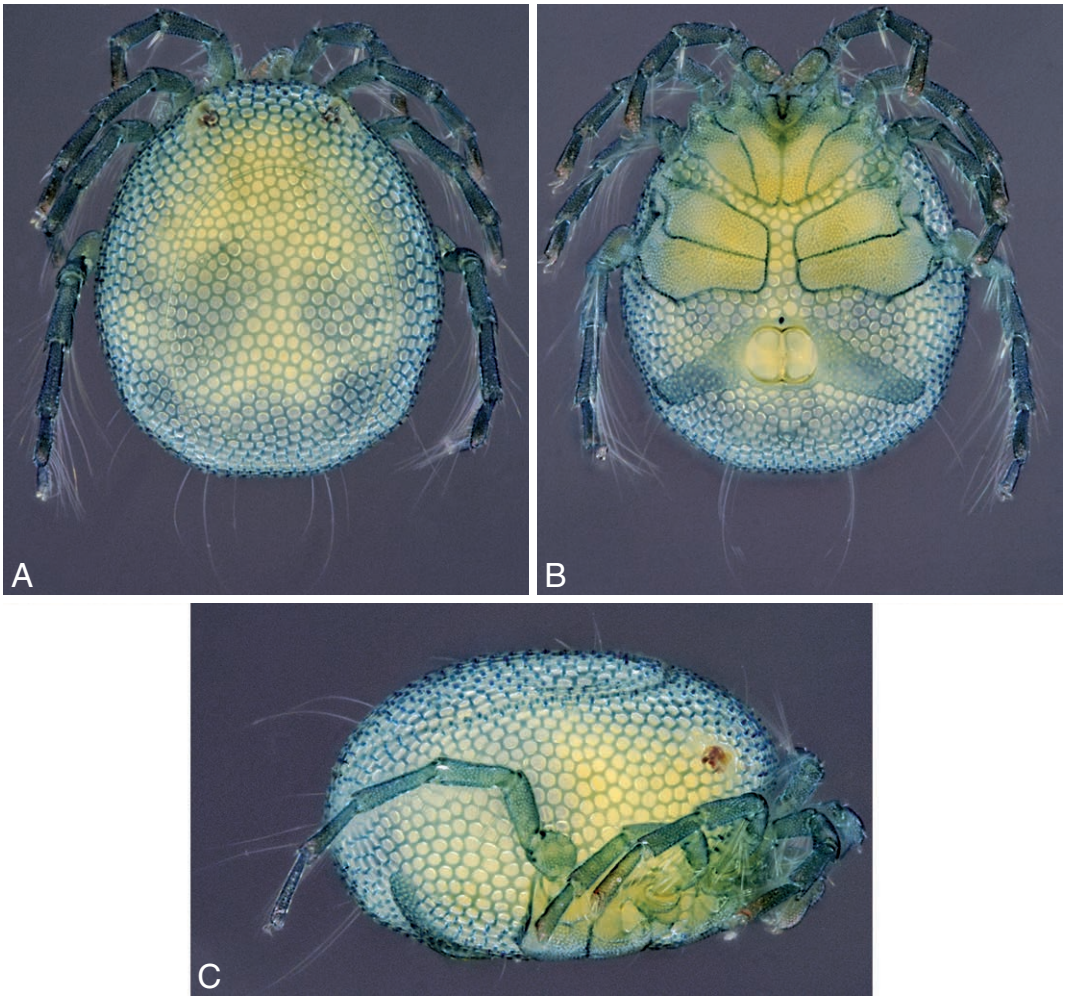


Fig. 66. *Arrenurus dentifer* ♀, idiosoma. **A.** Dorsal view; **B.** ventral view; **C.** lateral view.

medial margin L Cx-III > Cx-IV; gonopore field with two pairs of large rounded sclerotized patches; acetabular plates in an oblique angle to longitudinal axis, directed to posterolateral humps, distally slightly narrowed, ending far from lateral idiosoma margins; distance gonopore field-posterior margin < twice gonopore L.

Remarks. In juveniles, the dorsal shield posterior margin may be difficult to observe and the dorsal furrow may appear incomplete (Fig. 66).

Distribution. W and S Madagascar, endemic.

Habitat. Standing water.

Arrenurus (*Micruracarus*) *limbatus* Koenike, 1898
Fig. 67

Published records from Madagascar. Mahajanga (Majunga): no collection site details (Koenike 1898, Lundblad 1946).

Description

Males (Fig. 67; female unknown): Colour greenish, appendages brownish. Idiosoma L/W 690–724/578–621; frontal margin concave, lateral margins equally rounded, at the level of acetabular plates with a slight kink passing over to the cauda; cauda with slightly convex lateral margins, posterior margin truncated, straight, with a deep median cleft closed by its

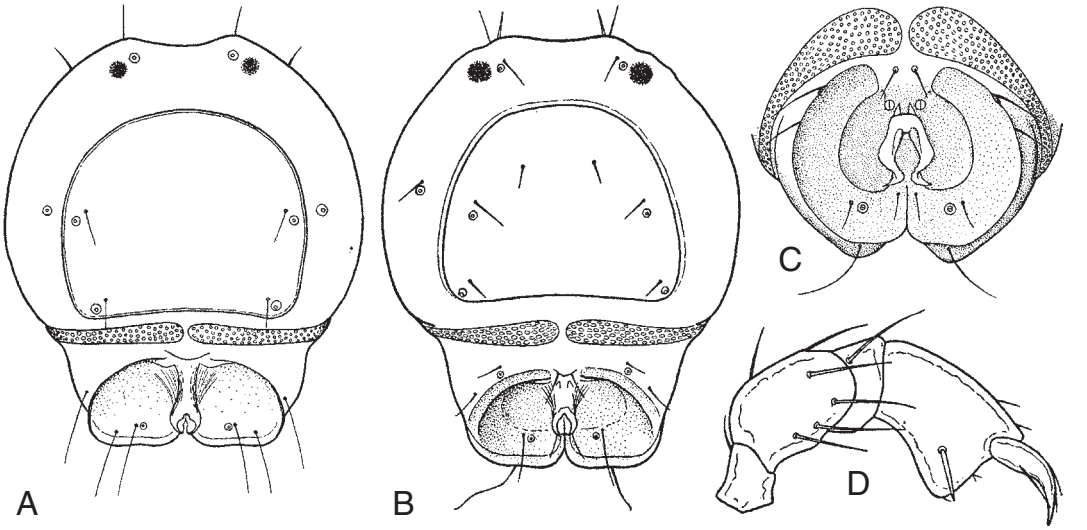


Fig. 67. *Arrenurus limbatus* ♂. **A.** Idiosoma, dorsal view, holotype; B–C material published by Lundblad 1946; **B.** idiosoma, dorsal view; **C.** detail of cauda, posterior view; **D.** palp, medial view (Lundblad 1946).

touching lateral margins; cauda with a posteriorly-directed dorsal groove surrounding a tube-shaped, dorsally strongly sclerotized but ventrally open central part embedded in a membranous frill, by Lundblad (1946) interpreted as petiole; inside the tube, no unpaired cone-shaped structure observed; at the base of this structure a pair of dorsally-directed spines located close to each other. Dorsal furrow complete; dorsal shield L/W 325-362/378–427, with subrectangular posterolateral edges and a slightly concave posterior margin. Tips of Cx-I/-II elongated and pointed, tips of Cx-III short, rounded; acetabular plates long and narrow, extending to dorsal surface – here slightly enlarged and nearly in touch. IV-leg-4 without spur. Swimming setae not reported. Gnathosomal bay broad U-shaped. Palp stout; P-2 with three mediodistal setae, P-4 dorsal and ventral margins distally strongly diverging, distoventral edge subrectangular, rounded.

Remarks. Until today, this species is known in the male sex only. In addition to the holotype, at least two specimens from the area of the type locality (no exact indication of specimen numbers) were reported by Lundblad (1946) who redescribed also the holotype and gave an overview on similar species from continental Africa.

Distribution. W Madagascar, endemic.

Habitat. Standing water.

Arrenurus (*Micruracarus*) *pronominatus* K. Viets, 1942

Figs 68

Arrenurus plenipalpis Koenike, 1898 nec Koenike, 1893 – K. Viets (1942).

Published records. Madagascar. Nossi-Bé: Lake Djabala; Mahajanga (Majunga): no collection details; Morondava (Koenike 1898).

Description

Both sexes: Colour yellowish green, appendages shiny green. Swimming setation not reported. Gnathosomal bay broad U-shaped. Palp stout; P-2 with three mediodistal setae (away from distal margin); P-4 dorsal and ventral margins strongly diverging, distoventral edge prominent, rounded.

Males (Fig. 68A–B): Idiosoma L/W 800/570; approximately rhombic in shape, maximum W at level of Cx-IV posterior margin; frontal margin slightly concave between a pair of very flat anterolateral edges, lateral margins rounded, in part of cauda nearly straight and strongly converging; posterior margin slightly undulating, with a medial cleft flanked by posteriorly slightly projecting lips; cauda in lateral view strongly flattened, with a wide, semicircular medial groove embracing a pair of triangular areas of fine porosity, and in centre the area of the posterior cleft; the latter closed in posterior part, more anteriorly widened to form a round hole; this hole located posterior to a pair of spines originating from a common socket and in anterior part covered

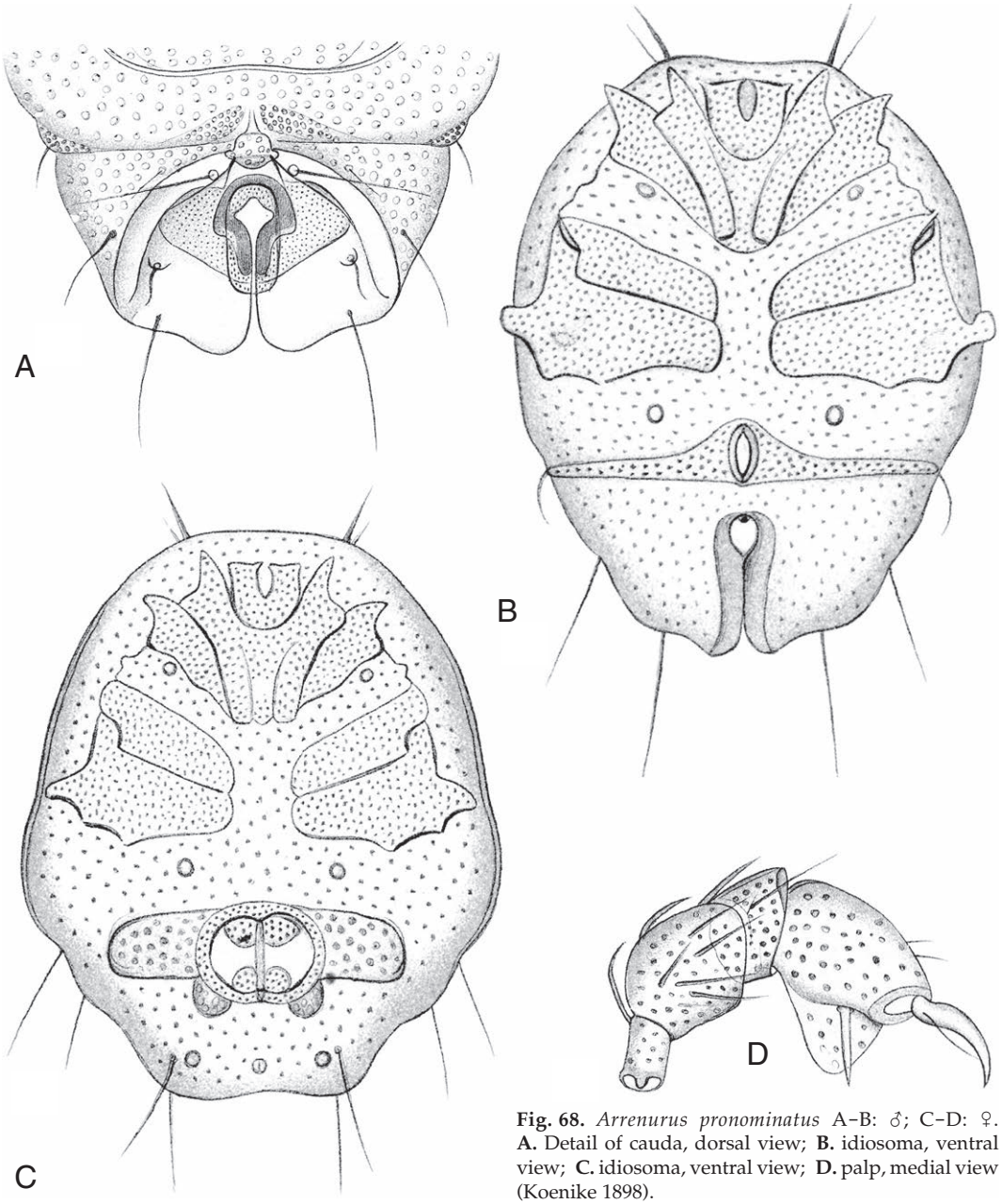


Fig. 68. *Arrenurus pronominatus* A–B: ♂; C–D: ♀. **A.** Detail of cauda, dorsal view; **B.** idiosoma, ventral view; **C.** idiosoma, ventral view; **D.** palp, medial view (Koenike 1898).

by a membranous extension, distally extended to build the walls of a posterodorsally-directed tube embracing a paired, "petiolus-like" (Koenike 1898) sclerotized extension. In lateral view anterior idiosoma elevated, with a pair of humps flanking the posterior margin of the dorsal shield. Coxal plates widely separated (medial separation Cx-III + IV corresponding to mL Cx-IV); mL Cx-III < Cx-IV; acetabular plates narrow, extending onto dorsal surface, here extremely narrowed, but near ends enlarged, nearly in touch. IV-leg-4 without spur.

Females (Fig. 68C–D): Idiosoma L/W 800/650; rhombic in shape, maximum W between coxal and acetabular plates; frontal margin slightly convex;

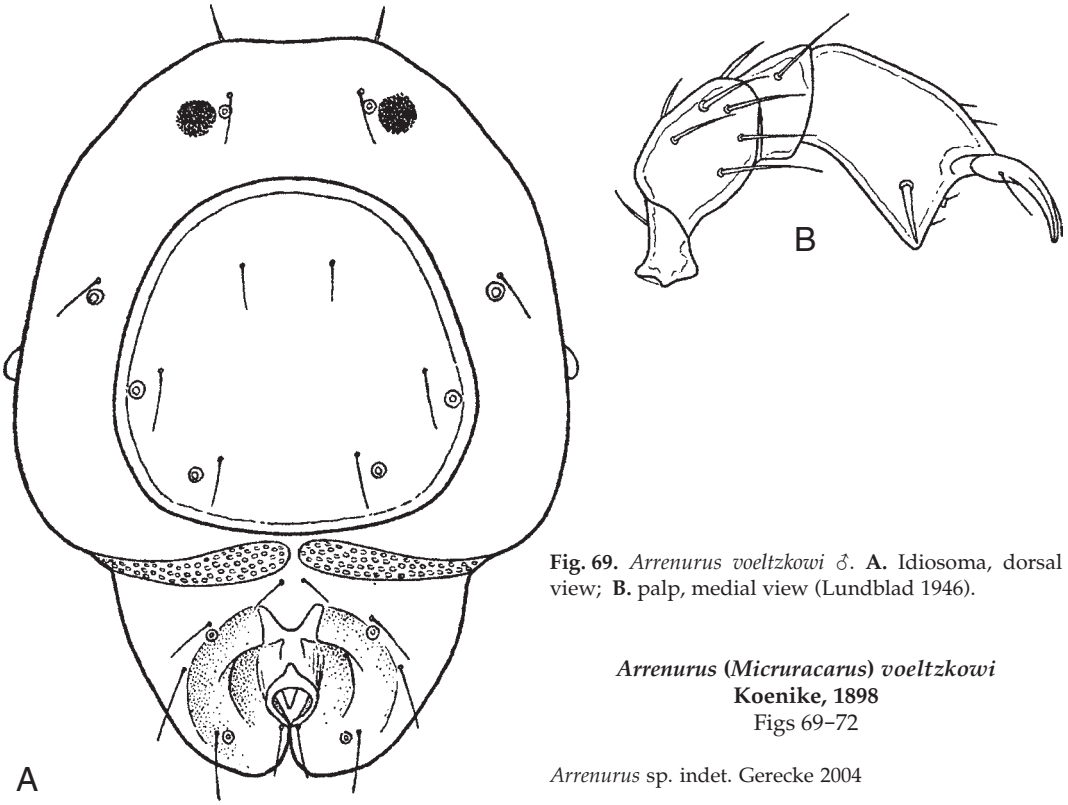


Fig. 69. *Arrenurus voeltzkowi* ♂. **A.** Idiosoma, dorsal view; **B.** palp, medial view (Lundblad 1946).

posterolateral margins with flat posterolateral and posteromedial humps. Dorsal furrow complete, dorsal shield L 600 (¾ idiosoma L). Medial separation Cx-III + IV wide (> half gonopore field W), mL Cx-III = Cx-IV; distance coxal field-genital field about gonopore L; gonopore field L 120, with two paired sclerotized patches; acetabular plates short and wide, perpendicular to longitudinal axis, rounded laterally, ending far from lateral idiosoma margin; a posteromedial extension as figured by Koenike (1898, Fig. 40) not developed in mature, well sclerotized specimens, obviously a characteristic of juveniles; postgenital area in L corresponding to gonopore L.

Remarks. Koenike (1898) assigned the above-mentioned records erroneously to *A. plenipalpis* Koenike, 1893 (K. Viets 1942). The latter is only known from a female collected at Quelimane in Mozambique, its subgenus assignment is thus unclear.

Distribution. N and W Madagascar, endemic.

Arrenurus (*Micruracarus*) *voeltzkowi* Koenike, 1898

Figs 69–72

Arrenurus sp. indet. Gerecke 2004

Published records from Madagascar. Antananarivo: no collection site details (Walter & Bader 1953), Tsimbazaza (Gerecke 2004); Antsiranana: NO Ankarana, Bas Sambirano (Gerecke 2004); Mahajanga (Majunga): Morondava (Koenike 1898), no collection site details (Lundblad 1946); Toamasina (Tamatave): S Moramanga (Walter & Bader 1953).

Material examined. MD 046, Betroka (Tulear), Rivière Mangoky upstream from the village, 800 m a.s.l., 24-viii-2001, 1 ♂; **MD 055**, Ifotaka (Tulear), Morafena (left affluent Rivière Mandrare upstream village), stagnant pools near mouth, 65 m a.s.l., 1-ix-2001, 4 ♂♂, 3 ♀♀; **MD 060**, Tsimelahy (Tulear), Rivière Antarantsa downstream 'piscine naturelle', 200 m a.s.l., 5-ix-2001, 2 ♀♀, 1 slide mounted ("cf. *voeltzkowi*"); **MD 062**, Tsimelahy (Tulear), Analamatsaky, ditches near the village (dead branches of small stream), 100 m a.s.l., 6-ix-2001, 1 ♂, 1 ♀; **MD 124a**, Ambohitsara (Antalaha, Antsiranana), Rivière Marolambo, 30 m a.s.l., 27-x-2001, upper part, 1 ♀; **MD 124b**, same site and date, lower part, 2 ♂♂; **MD 129e**, Maromandia (Antalaha, Antsiranana), Rivière Ankavia near village, 40 m a.s.l., 30-x-2001, 1 ♂; **MD 171b**, Analavory (Antananarivo), Rivière Mazy near Aragonite geyser Carrieres de Monloup, 900 m a.s.l., 1-xii-2001, 1 ♂; **MD 236** (**MNHN** no number), Antsalova, gorges de Manambolo, viii 1949, leg. Paulian, 1 ♀ slide mounted ("cf. *voeltzkowi*"); **MNHN B 10 I**, Bas Sambirano massaban A; Sept. 1945, leg. Millot, 2 ♂♂, 1 ♀,

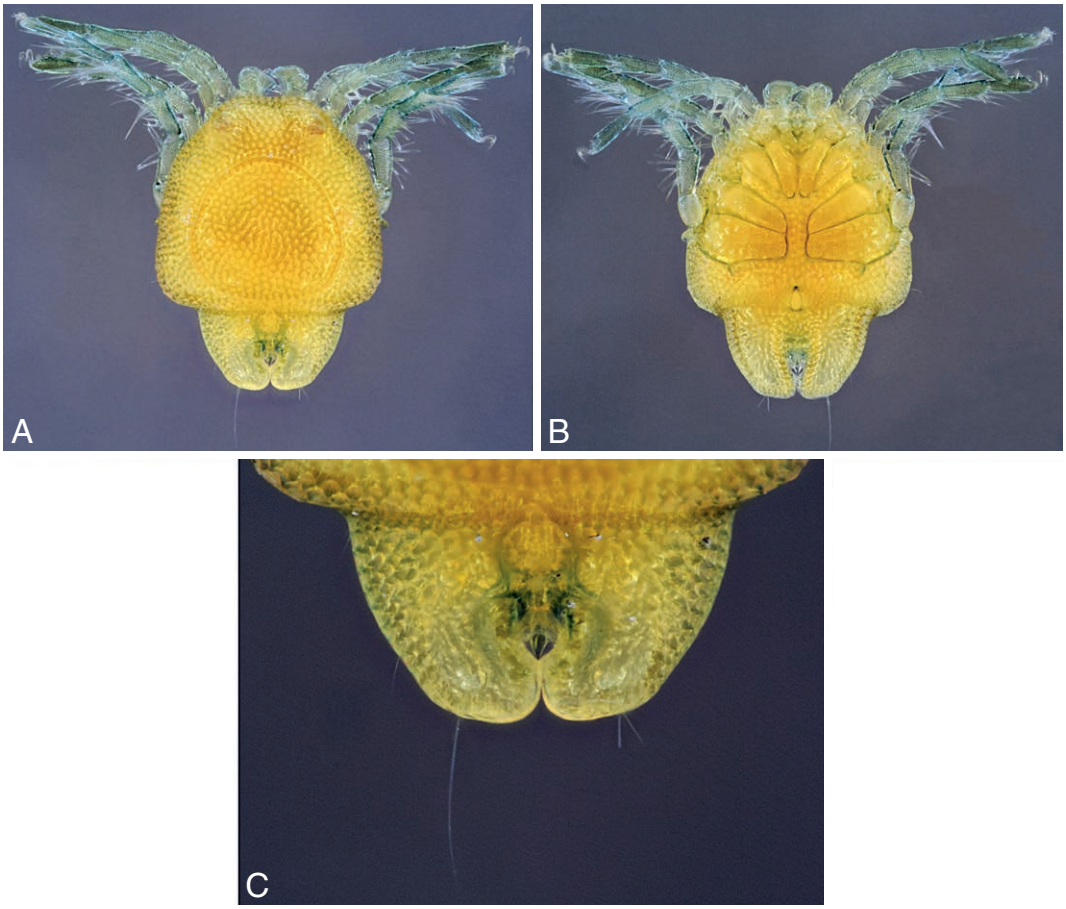


Fig. 70. *Arrenurus voeltzkowi* ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** detail of cauda, dorsal view.

1 dn; **MNHN E 14 K**, Ambato, Boeni, marais province de Maevatanana; no date, leg. Waterlot, 1 ♀ ("*Arrenurus* sp." Gerecke 2004); **MNHN E 14 M**, Marais Marovoay près Majunga; no date, leg. Waterlot, 1 ♀ ("*Arrenurus* sp." Gerecke 2004).

Description

Both sexes: Colour yellow to greenish. Dorsal furrow complete. Swimming setae: II-leg-3, 0/2–3; II-leg-4, 0/5; II-leg-5, 0/6; III-leg-3, 0/3-5; III-leg-4, 0/7; III-leg-5, 0/6–8; IV-leg-3, 2–3/3; IV-leg-4, 2–5/7; IV-leg-5, 0/4–8. Gnathosomal bay broad U-shaped. Palp stout; P-2 with three to five mediodistal setae, P-4 dorsal and ventral margins distally strongly diverging, distoventral edge subrectangular, rounded.

Males (Figs 69–70): Idiosoma L/W 733–865/550–636 (Koenike 1898 and Lundblad 1946); frontal margin straight to slightly concave, lateral margins equally rounded, on the level of acetabular plates with a kink passing over to the cauda; cauda with convex lateral and posterolateral margins in medial part with obtuse angles passing over to a median cleft. Dorsal shield L/W 353/367, with convex posterior margin; caudally with a posteriorly directed dorsal groove surrounding a tube-shaped, distally thin-walled central part (Lundblad 1946: "petiole") that is embedded in a membranous frill – inside the tube, an unpaired cone-shaped structure; at base of this structure a pair of dorsally-directed spines located close to each other. Tips of Cx-I/-II elongated and pointed, tips of Cx-III short, rounded; acetabular plates long and narrow, extending onto dorsal surface – here slightly enlarged and nearly in touch. IV-leg-4 without spur.

Females (Figs 71–72): Idiosoma L/W 880/640 (1034/793 Lundblad 1946); approximately egg-shaped, maximum W at level of Cx-IV; frontal mar-

gin between lateral eyes projecting, straight to weakly convex; posterior margin with two pairs of humps, posterolaterally and posteromedially. Dorsal shield elongated, L/W 828/534. Medial distance Cx-III + IV relatively narrow (< half gonopore field W); genital field close to coxal field, gonopore field with two pairs of rounded sclerotized patches; acetabular plates in an oblique angle to longitudinal axis, directed to posterolateral humps, not very broad and rather equal in W, not reaching lateral idiosoma margin; distance genital-posterior margin > twice gonopore L.

Remark. *Arrenurus voeltzkowi* is the first described representative of a species group in the following reported from many parts of the African continent.The wide distribution of this species and the taxonomic definition of its relatives merit a re-examinationd in a revisional study at its own.

Distribution. Madagascar: all parts of the island (Koenike 1898, Lundblad 1946, Walter & Bader 1953, K.O. Viets 1974, Gerecke 2004, the present data); nearly the whole African continent: Tanzania (Daday 1910); Cameroon (K. Viets 1916); Kenia (Walter & Bader 1952); Congo (Lundblad 1949); Chad (Walter 1939); South Africa (K.O. Viets 1968); Ruanda (Bader 1968, 1976); Botswana (Smit 2012).

Habitat. Standing water.

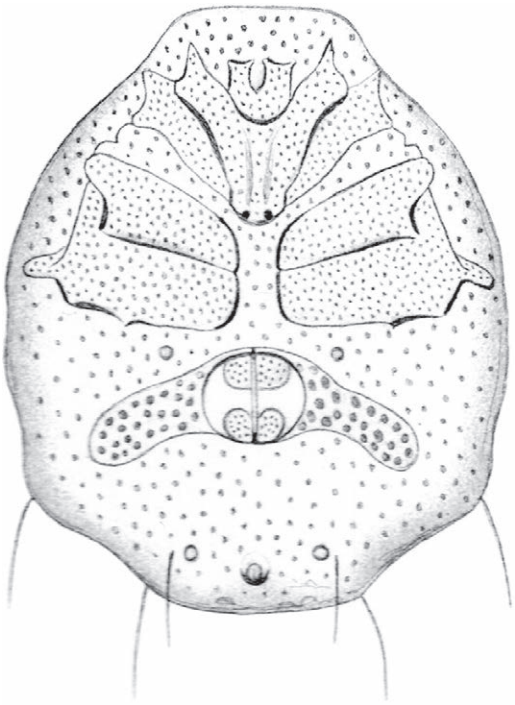


Fig. 71. *Arrenurus voeltzkowi* ♀. Idiosoma, ventral view (Koenike 1898).

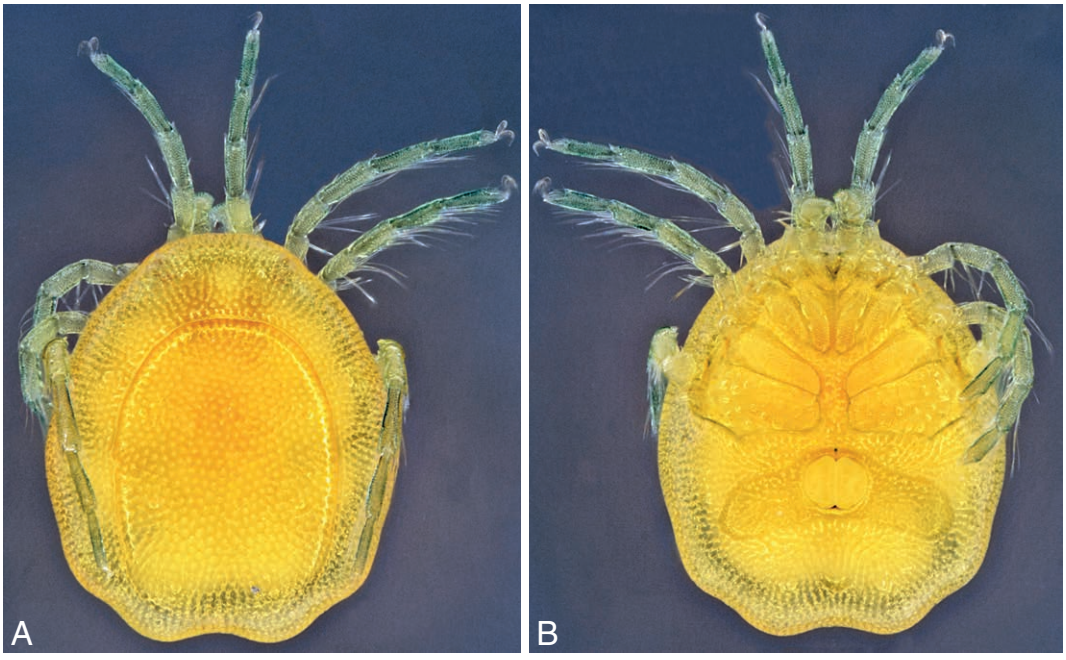


Fig. 72. *Arrenurus voeltzkowi* ♀, idiosoma. **A.** Dorsal view; **B.** ventral view.

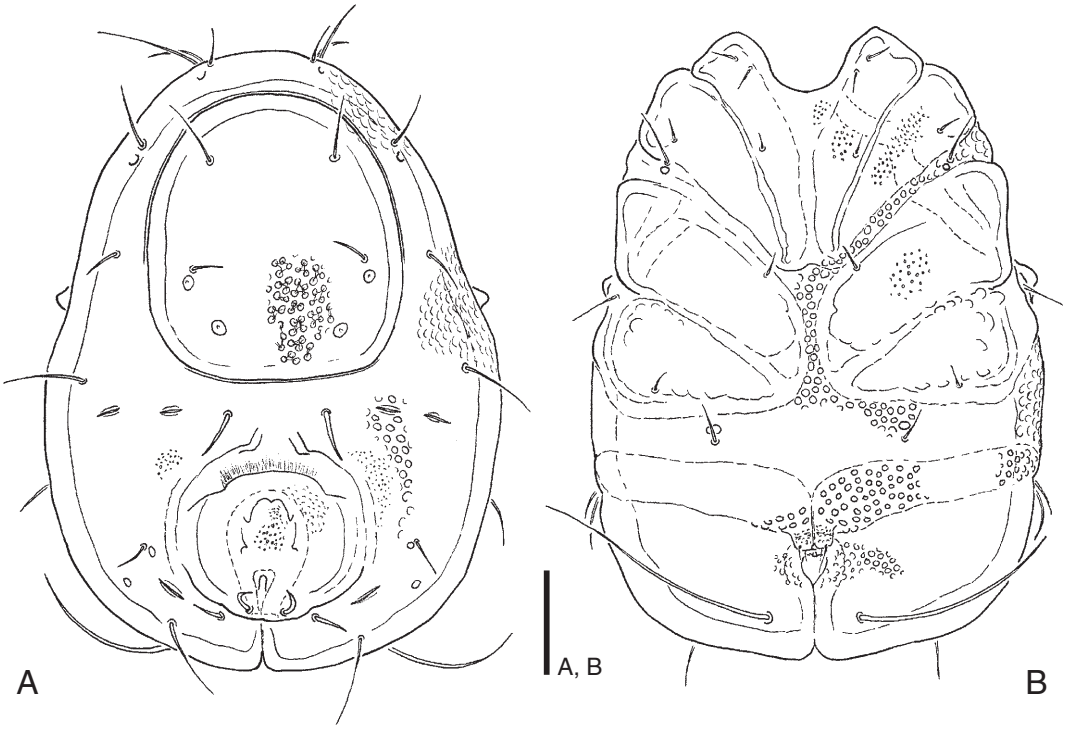


Fig. 73. *Arrenurus aethes* sp. nov. holotype ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** palp, medial view. Scale bars = 100 µm.

***Arrenurus* (*Micruracarus*) *aethes* sp. nov.**
Figs 73–74

Material examined. Holotype: ♂, **MD 050**, Betroka (Tulear), helocrene exposed E, hill E Naninora, 870 m a.s.l., 26-viii-2001 (SMF – palps, II-leg-2-5, III-leg on slide "MAD 25").

Diagnosis. Male (female unknown): Idiosoma anteriorly strongly narrowed, maximum W in posterior half; frontal margin convex. Dorsal shield restricted to the strongly narrowed anterior half of idiosoma; posterior idiosoma with a deep, funnel like concavity reaching with its ventral tip the bottom of a posteroventral cleft; the wall of this funnel structured by several concentric ridges; three pairs of large slit organs surrounding the concavity. Acetabular plates bent caudally in medial part; gonopore directed caudally. Legs without swimming setae. Palp slender, distoventral part of P-2 bearing only two setae.

Description

Male (holotype, Figs 73–74): Colour reddish-brown. Idiosoma L/W 616/462; pear-shaped, maximum W in posterior third. Dorsal furrow complete, dorsal shield small (L/W 300/259), restricted to anterior half of idiosoma, with Dgl-2 and -3 in posterior half, posterior margin nearly straight; posterior idiosoma with a large, rounded, funnel-like concavity ending at its deepest point like a sink, connected to the bottom of a posteroventral cleft; the wall of this concavity structured by several, posteriorly open, concentric ridges locally forming obtuse- or acute-angled projections; this concavity with a pair of strongly curved setae at posterior margin and surrounded by three pairs of large slit organs (two antero-, one posterolaterally); dorsally from gonopore field the excretory pore at the base of the widely closed posterior cleft. Gnathosomal bay wide U-shaped; coxal plates with fine porosity, separated from each other by narrow stripes of coarse porosity;

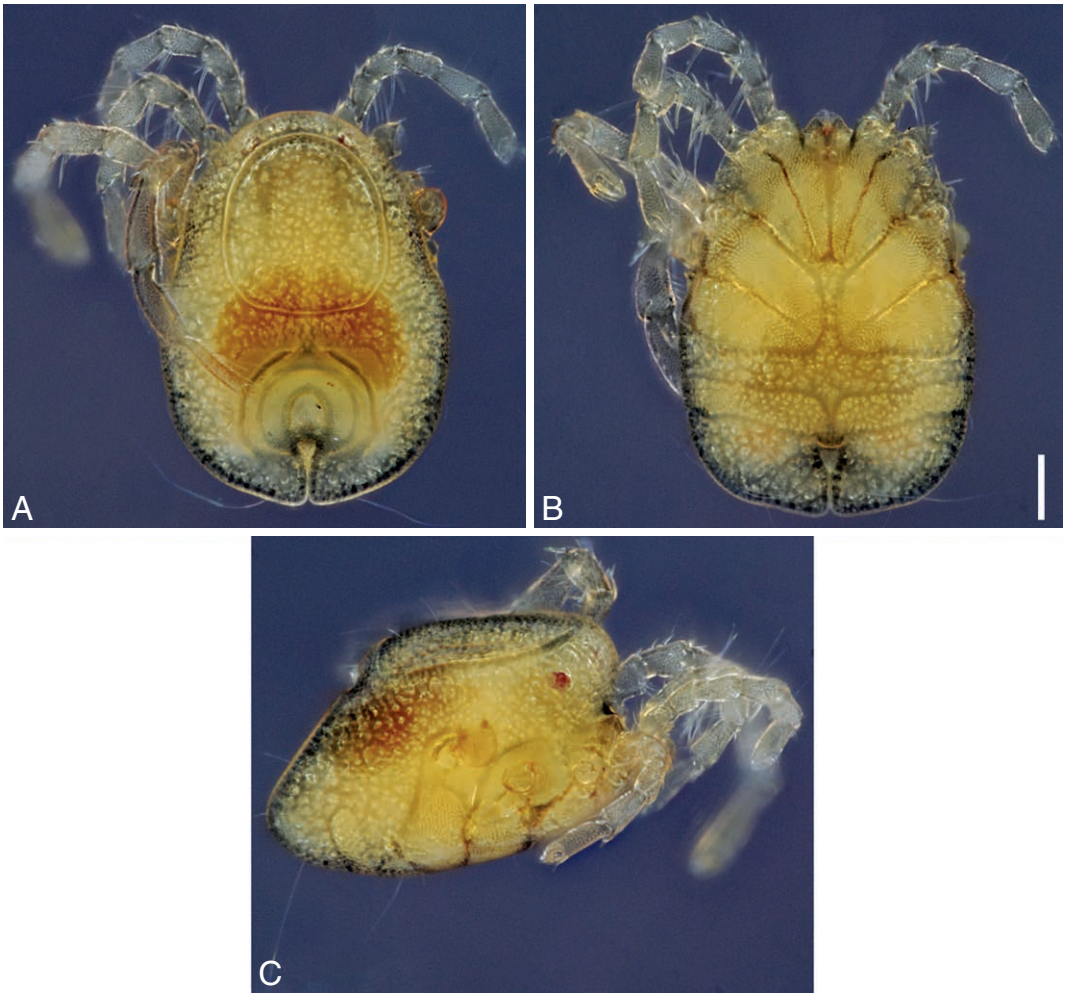


Fig. 74. *Arrenurus aethes* sp. nov. holotype ♂, idiosoma. **A.** Dorsal view; **B.** ventral view; **C.** lateral view. Scale bar = 100 µm.

medial margin of Cx-III + IV formed exclusively by Cx-III (Cx-IV triangular, medially pointed); gonopore opening to posterior margin, neither visible in ventral nor in dorsal view, flanked by two pairs of hair-like setae; acetabular plates narrow, in medial part bent caudally, their lateral ends near lateral idiosoma margin. A pair of spectacular long whip-like setae flanking the posteromedial ridge. Many long, stiff setae on I-leg-3, II-leg-3-4, IV-leg-5 and -6 (not on III-leg!), but no swimming setae. Leg segment L I-leg-4–6, 90, 92, 80; IV-leg-5–6, 142, 126. IV-leg-4 with a spur. Palp rather slender, P-2 medially with two setae in dorsal part, and two setae in ventral part, P-4 weakly curved, with regularly converging dorsal and ventral margins. Palp segment L P-1–5, 30, 68, 56, 74, 33.

Females: Unknown.

Etymology. The name is derived from the Greek ἀήθης – *aethes* – strange, for the unique morphology of the posterior idiosoma.

Remarks. The following very unusual character combination is not found in males of any other *Arrenurus* species: (1) dorsal shield restricted to the anterior half of the idiosoma; (2) on posterior idiosoma, a deep, funnel-shaped excavation with several concentric ridges; (3) gonopore opening directed caudally.

Distribution. S Madagascar, only known from type locality, endemic.

Habitat. Weakly seeping spring in open grassland.

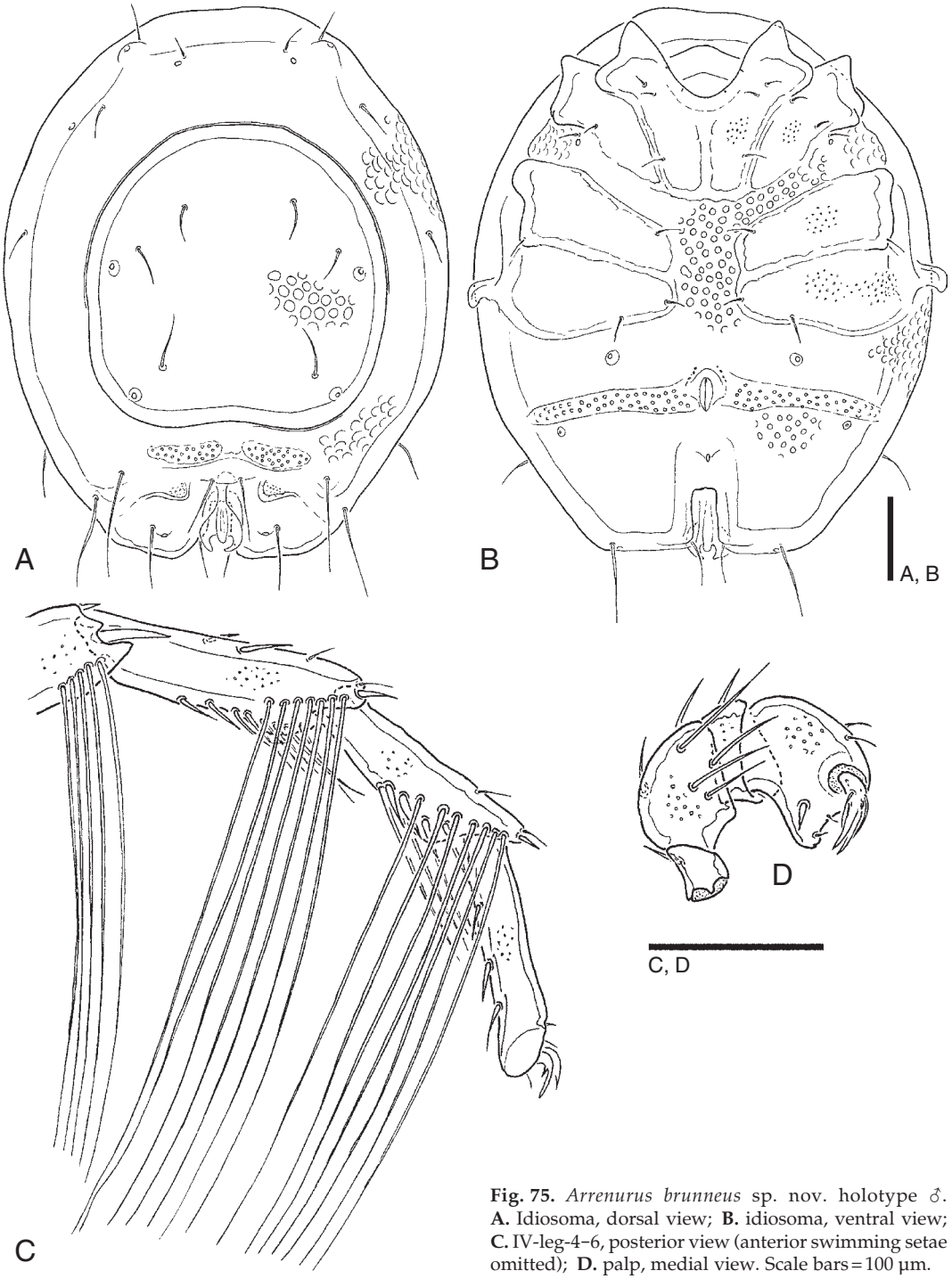


Fig. 75. *Arrenurus brunneus* sp. nov. holotype ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** IV-leg-4–6, posterior view (anterior swimming setae omitted); **D.** palp, medial view. Scale bars = 100 µm.

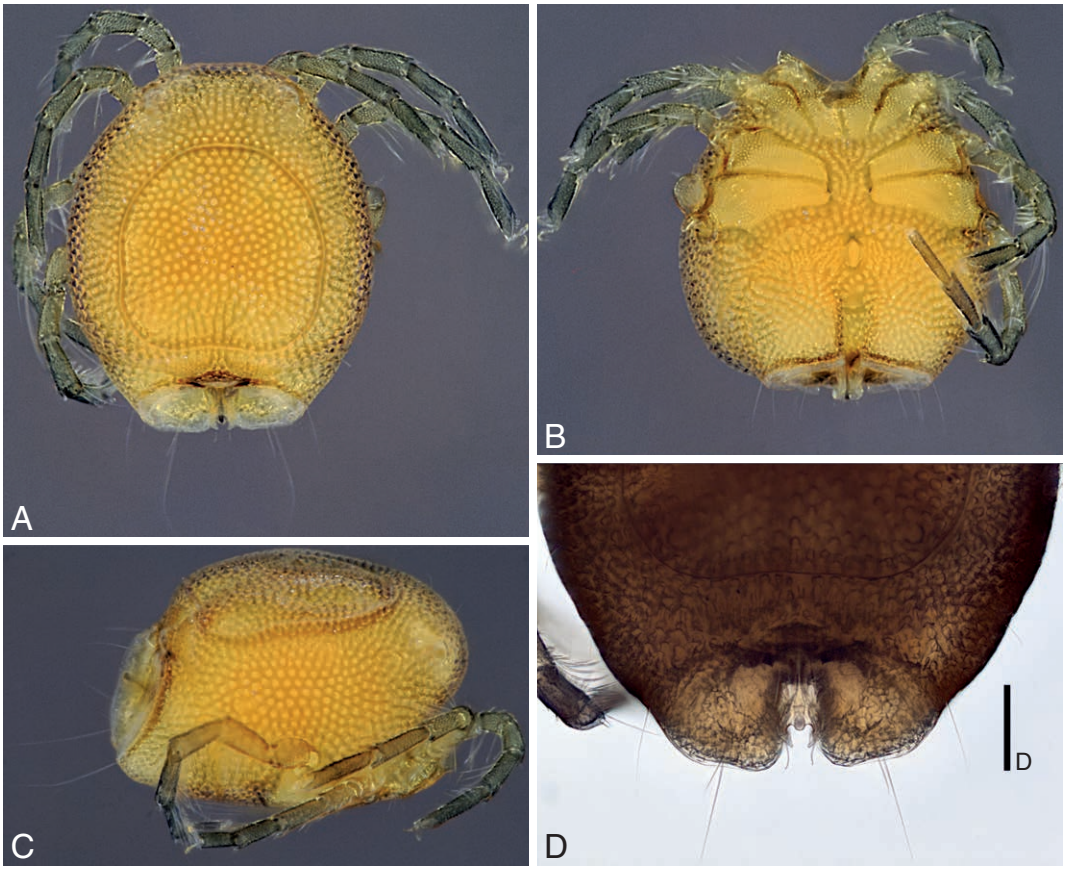


Fig. 76. *Arrenurus brunneus* sp. nov. holotype ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view (inclined); **C.** idiosoma, dorso-lateral view; **D.** cauda, dorsal view, detail. Scale bar = 100 µm.

Arrenurus (*Micruracarus*) *brunneus* sp. nov.
Figs 75–77

Material examined. Holotype: ♂ **MD 124b**, Ambohitsara (Antalaha, Antsiranana), Rivière Marolambo, 30 m a.s.l., 27-x-2001 (SMF – gnathosoma, palps, IV-leg: slide "MAD 24"). – **Paratypes: MD 180**, Montagne d'Ambre (Antsiranana), Ambohitra (Joffreville), voie 100 arbres, temporary lake II, without outflow, 1050 m a.s.l., 12°31'12.2"S, 49°10'31.6"E, 22-iii-2011, 1 ♂ (RMNH), 1 ♀ (sequenced and slide mounted, SMF).

Other material. Same data as holotype, 1 ♂ (juv., not sclerotized) (SMF). **MD 189**, Montagne d'Ambre (Antsiranana), Sakaramy, lake Farihy Makery, riparian area near outflow, 12°26'20.5"S, 49°14'20.9"E, 377 m a.s.l., 29-iii-2011, 1 ♂ (juv., not sclerotized, sequenced and slide mounted) (all SMF).

Diagnosis. Both sexes: Dorsal furrow complete. P-2 with three to four mediodistal setae, P-4 stout, dorsal and ventral margins strongly curved, distally diverging.

Males: Idiosoma irregularly rounded; frontal margin straight; cauda not set off, posterior margin with a medial cleft; posterodorsally a forceps-shaped petiole, its base flanked by paired subrectangular hyaline projections. Between dorsal shield and petiole, a pair of transverse acetabula-bearing areas. IV-leg not modified.

Females: Genital field close to coxal field (distance < gonopore field W), gonopore field surrounded by a broad porose area, with two pairs of large round sclerotized patches; acetabular plates in an oblique angle to medial line, laterally narrowed, ending far from lateral idiosoma margin.

Description

Both sexes: Colour brown. Areas laterally separating Cx-II/-III and medially Cx-III+IV from each other broad.

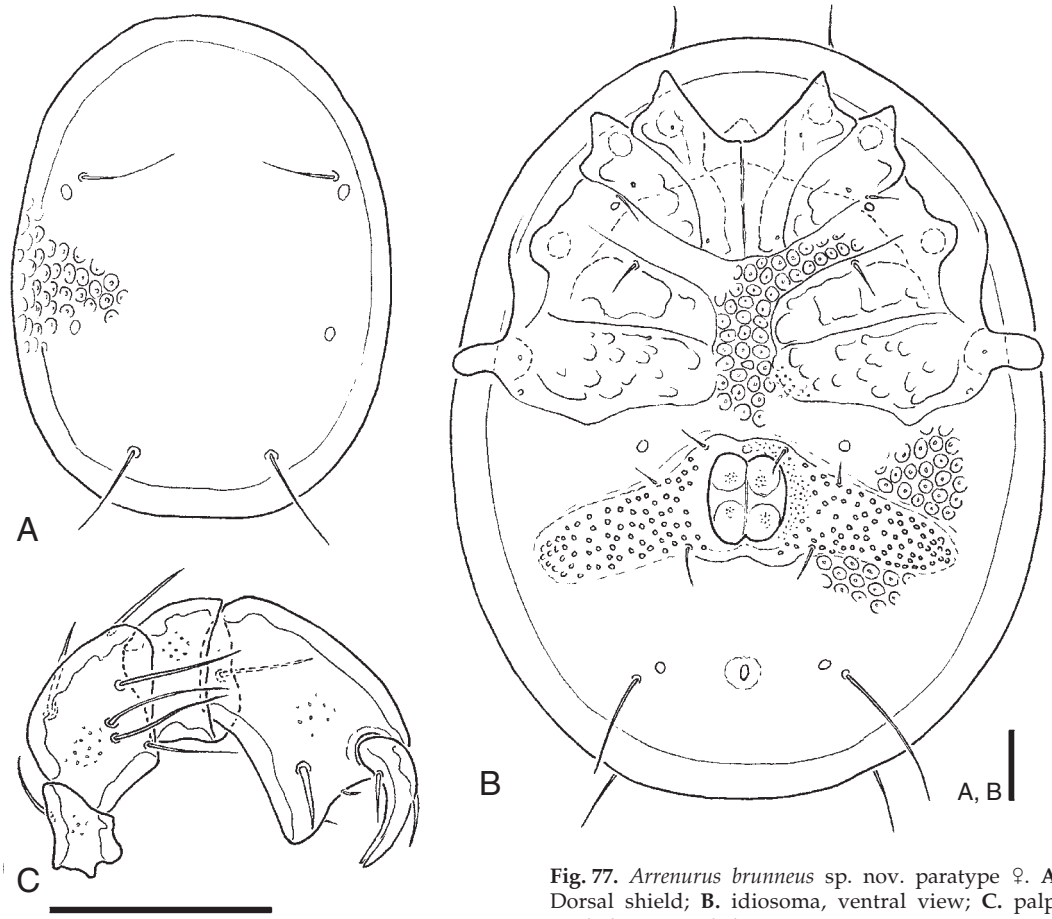


Fig. 77. *Arrenurus brunneus* sp. nov. paratype ♀. **A.** Dorsal shield; **B.** idiosoma, ventral view; **C.** palp, medial view. Scale bars = 100 µm.

Males (holotype, in parentheses paratype; Figs 75–76): Idiosoma L/W 770 (794)/640 (672); irregularly rounded, anterior and posterior margins straight; posterodorsally a tongue-shaped petiole with a narrow base, distally with a blunt central extension, its lateral margins sheath-like extending dorsally, these sheaths possibly continuous with a subrectangular cleft visible in ventral view; lateral to petiole base paired hyaline membranes present, forming medially subrectangular edges. Dorsal shield L/W 421 (437)/417 (450), anteriorly and laterally rounded, posteriorly straight or slightly concave. Gnathosomal bay hyperbole-shaped; tips of Cx-I reaching level of frontal margin or nearly so, suture line Cx-III–IV in an obtuse angle to longitudinal axis; medial margin L Cx-III > Cx-IV; acetabular plates narrow, slightly oblique, nearly reaching lateral idiosoma margin; W of the isolated acetabula-bearing dorsal plates about 80. IV-leg not particularly modified. Swimming setae: (on posterior side of I-leg-4–5 and II-leg-3–5, several hair-like setae, away from distal margin); III-leg-3, 0/4; III-leg-4, 0/7; III-leg-5, 0/7; IV-leg-3, 3/5; IV-leg-4, 5/6; IV-leg-5, 0/7. Leg segment L I-leg-4–6, 110, 108, 122; IV-leg-4–6, 164, 140, 116. Palp segment L P-1–5, 30, 74, 44, 80, 47; P-2 medial surface with two distoventral setae, P-4 stocky.

Females (paratype, Fig. 77): Idiosoma L/W 1050/850; egg-shaped, maximum W posterior to Cx-IV; frontal margin equally rounded. Dorsal shield egg-shaped with nearly straight anterior margin, L/W 720/540. Medial distance Cx-III + IV 80; genital field close to coxal field, gonopore field relatively small (L/W 140/140); acetabular plates total W 610, in a slightly oblique angle to longitudinal axis, equally narrowed from medial to the rounded lateral ends, ending far from lateral idiosoma margin; distance genital-posterior margin long, about three

times gonopore L. Swimming setae: III-leg-4, 0/5; III-leg-5, 0/5; IV-leg-3, 3/3; IV-leg-4, 6/12; IV-leg-5, 0/5. Palp segment L P-1–5, 38, 80, 55, 110, 60.

Etymology. Named for its brown colour; *brunneus*, Latin – brown.

Remarks. Among the Malagasy *Arrenurus*, the new species is similar to *A. voeltzkowi* in the shape of the petiole-like structure, but the latter has the inner anterior margin of the petiole with an unpaired cone-shaped extension which is lacking in the new species, and its cauda is distinctly set off from the anterior idiosoma. Also *A. pronominatus* a species with petiole similar in shape, has a cauda distinctly set off from the anterior idiosoma; furthermore, a hyaline membrane is lacking. Females of *A. brunneus* resemble *A. dentifer* in location and formation of the gonopore (close to coxal field) and acetabular plates (oblique to longitudinal axis, ending far from lateral margins). The latter differ from *A. brunneus* in a minor size (idiosoma L < 850, dorsal shield L < 650) and a shorter postgenital area (< twice gonopore L). Furthermore, mature *A. dentifer* females differ in the shape of the posterior idiosoma margin (not equally rounded but with posterolateral humps).

Distribution. N Madagascar, endemic.

Habitat. Stagnant water of stream, temporary standing water.

Arrenurus (*Micruracarus*) *dobomponina* sp. nov.
Figs 78–79

Material examined. Holotype: ♂, **MD 180**, Montagne d'Ambre (Antsiranana), Ambohitra (Joffreville), Voie 100 arbres, temporary lake II, without outflow, 1050 m a.s.l., 12°31'12.2"S, 49°10'31.6"E, 22-iii-2011 (SMF – gnathosoma and palps on slide "MAD 30"). – **Paratypes:** Same data as holotype, 1♂ (RMNH); **MD 189**, Montagne d'Ambre (Antsiranana), Sakaramy, lake Farihy Makery, riparian area near outflow, 12°26'20.5"S, 49°14'20.9"E, 377 m a.s.l., 29-iii-2011, 1♂ (SMF).

Diagnosis. Males (females unknown): Frontal margin straight; caudal idiosoma set off from anterior idiosoma, laterally rounded, posteriorly with a deep median cleft, in ventral part inversely U shaped, towards dorsal side forming a triangular funnel posteriorly closed by thin extensions of the posterior idiosoma margin; dorsal part of the funnel framed by complicatedly wrinkled structures; dorsal surface anterior to the cleft with oblique ridges. Dorsal shield small, with straight posterior margin.

Description

Males (Figs 78–79; holotype, in parentheses two paratypes): Colour uncertain, probably greenish. Idiosoma L/W 887 (883–903)/713 (684–713); dorsal L 948 (932–956); lateral margins equally rounded; caudal part with rounded lateral margins, set off in the area where the acetabular plates reach the lateral idiosoma margin. Dorsal shield small, anteriorly and laterally rounded, posteriorly truncate, L/W 429 (421–429)/450 (429–454); posterodorsally, on the level of the lateral tips of the acetabular plates, a pair of isolated, oval, acetabula-bearing patches; caudal idiosoma margin with a median cleft, in ventral part inversely U-shaped and with the excretory pore at its bottom (about 200 anterior to posterior margin), towards dorsal side forming a triangular funnel posteriorly closed by footboard-like thin extensions of the posterior idiosoma margin; dorsal part of the funnel in its central part widened, laterally framed by paired bulges meeting each other anteriorly from a pair of setae, anteriorly with a hyaline, medially pointed structure; dorsal idiosoma surface anterior to the cleft with weakly rounded protrusion bearing a pair of setae, flanked by three pairs of oblique ridges, the middle one with knob-like medial extensions. Coxal plates well separated by large strips of coarse porosity (medial distance Cx-III + IV, about 70); tips of Cx-I not reaching level of anterior idiosoma margin; medial margins of Cx-III and Cx-IV nearly equal in L; no setae near IV-leg insertions, posterior margin of Cx-IV "submerging" under the porose postcoxal idiosoma surface; acetabular plates laterally very narrow (one to two acetabula wide), with their tips extending onto lateral idiosoma margin; gonopore field L 56. Swimming setae: II-leg-3, 0/4; II-leg-4, 0/6; II-leg-5, 0/6; III-leg-3, 0/6; III-leg-4, 0/6; III-leg-5, 0/6; IV-leg-3, 0/6; IV-leg-3, 0/6; IV-leg-4, 0/10; IV-leg-5, 0/8. Leg segment L I-leg-4–6, 150, 146, 140; IV-leg-4–6, 168, 147, 136. Gnathosomal bay with strongly diverging lateral margins. Palp stout, P-2 medially with four setae, P-4 stout, dorsal and ventral margins diverging, distoventral edge subrectangular, P-5 relatively slender. Palp segment L P-1–5, 36, 68, 56, 102, 44.

Female: Unknown.

Etymology. The name is formed from the Malagasy words *dobo* – pond and *mponina* – inhabitant; named for its occurrence in a (temporary) lake.

Remarks. Males of the new species resemble *A. dentifer*, *A. brunneus*, *A. limbatus*, *A. voeltzkowi* and the following species, *A. mandrarensis*, in the shape of their petiole-like structure. Of these species, only *A. brunneus* has isolated acetabula-bearing patches on the dorsum. The new species differs from the

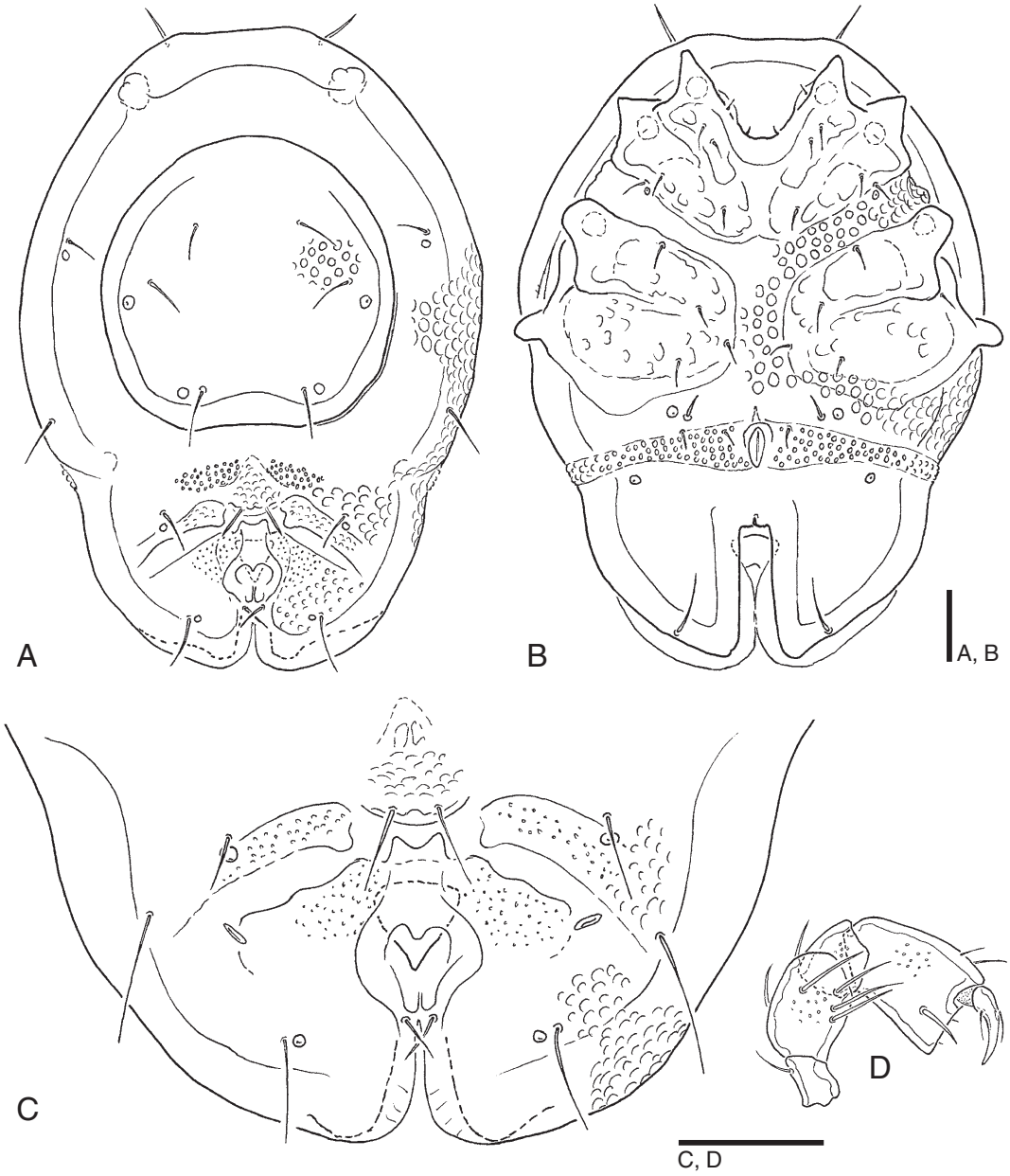


Fig. 78. *Arrenurus dobomponina* sp. nov. holotype ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** detail of cauda, dorsal view; **D.** palp, medial view. Scale bars = 100 µm.

latter in the cauda distinctly set off from the anterior idiosoma margin (not set off in *A. brunneus*) and the relatively long reversed U-shaped indentation of the venter (short in *A. brunneus*).

Distribution. N Madagascar, endemic.

Habitat. Temporary and permanent standing waters.

Fig. 79. *Arrenurus dobomponina* sp. nov. holotype ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** idiosoma, lateral view; **D.** detail of cauda, dorsal view.

Arrenurus (*Micruracarus*) *mandrarensis* sp. nov.
Figs 80–81

Material examined. Holotype: ♂, **MD 055**, Ifotaka (Tulear), Morafena (left affluent Rivière Mandrare upstream village), stagnant pools near mouth, 65 m a.s.l., 1-ix-2001 (SMF – gnathosoma, palps, IV-leg on slide "MAD 20").

Diagnosis. Male (females unknown): Frontal margin slightly concave. Dorsal shield as wide as long; cauda slightly set off from anterior idiosoma, with a dorsocentral pit anterior to a dorsoventral tube formed by the complicatedly wrinkled inner margins of a pair of posteriorly converging, and posteriorly broadly fused caudal extensions. Interspaces between coxal plates wide; acetabular plates long and narrow, extending onto dorsum and here nearly in touch. P-2 with four scattered medial setae.

Description

Male (holotype; Figs 80–81): Colour yellow to greenish. Idiosoma L/W 737/575, ventral L 729, maximum

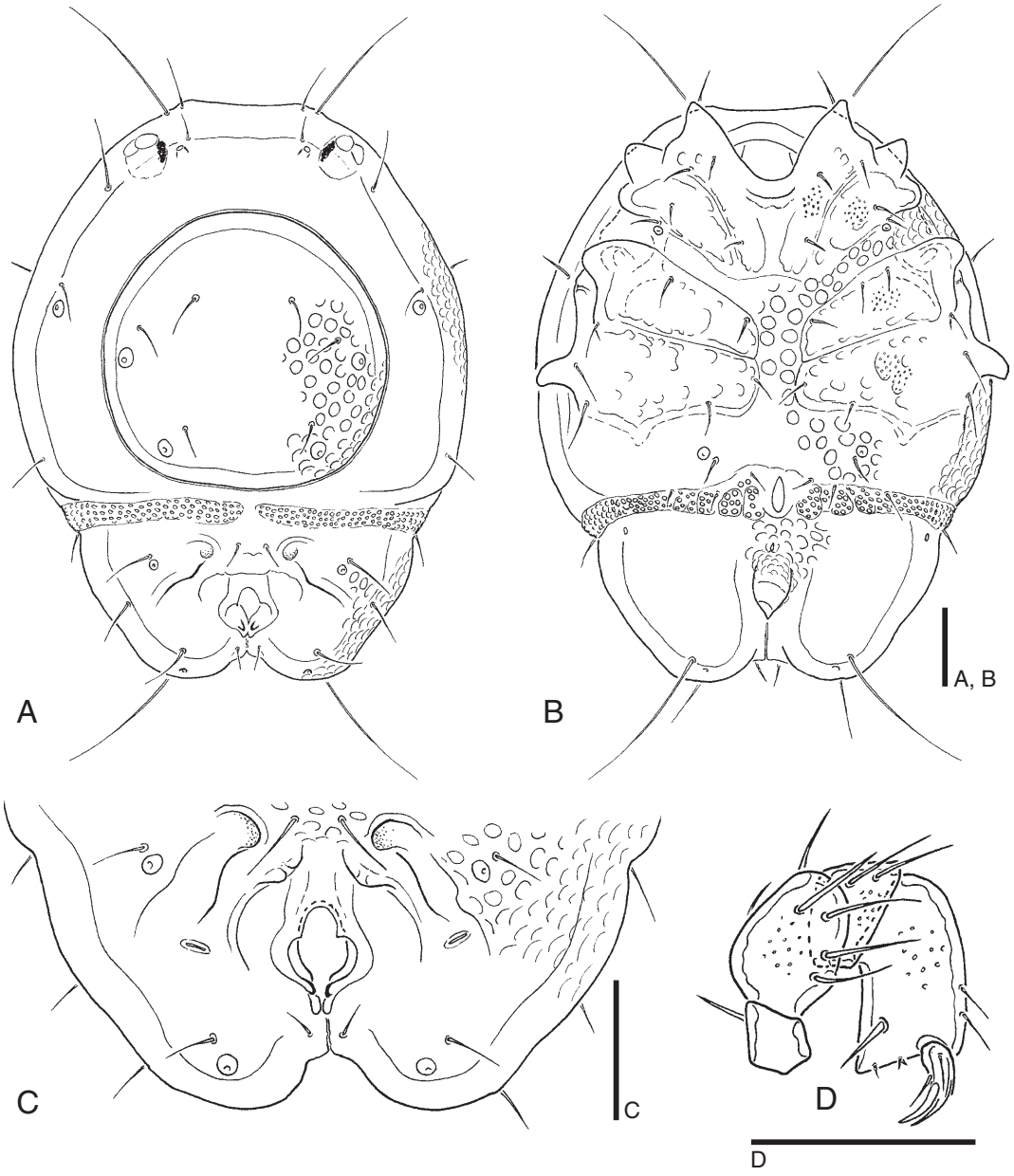


Fig. 80. *Arrenurus mandrarensis* sp. nov. holotype ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** detail of cauda, dorsal view; **D.** palp, medial view. Scale bars = 100 µm.

W in centre; cauda slightly set off from anterior idiosoma, slightly tailoring posterior to acetabular plate level, and posteriorly converging lateral margins; posterior margin with convex lateral parts flanking a medial concavity; posterior cauda consisting of paired parts which converge medially and come in touch over a long line posterior to a deep, funnel-shaped dorsoventral tube, the ventral opening of this tube posteriorly pointed, at anterior margin the excretory pore; the dorsal opening laterally widened, the inner walls of the tube with complicated concentric structures; dorsal surface of cauda

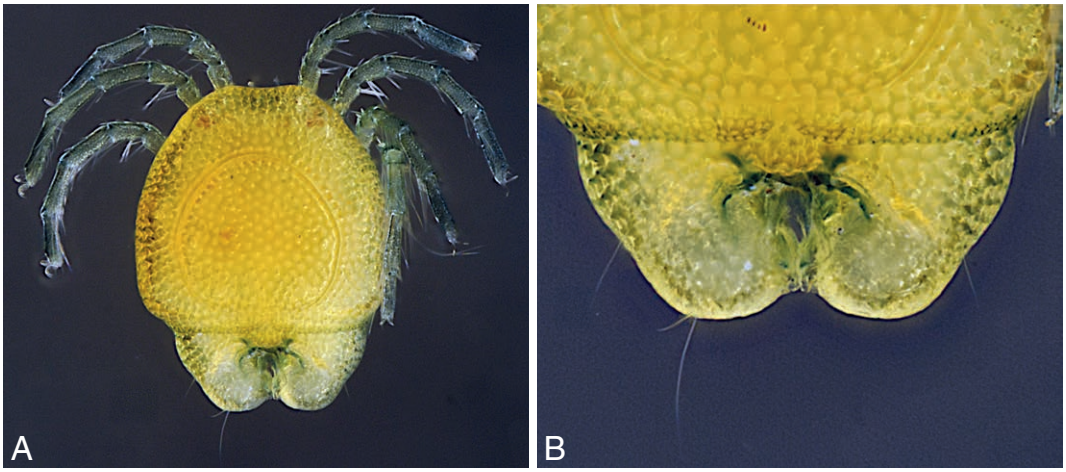


Fig. 81. *Arrenurus mandrarensis* sp. nov. holotype ♂. **A.** Idiosoma, dorsal view; **B.** detail of cauda, dorsal view.

anterior to the tube opening forming a pit flanked by a pair of laterally opened indentations. Dorsal furrow complete, dorsal shield L/W 365/365, with anterior and lateral margins equally rounded, posterior margin straight. Gnathosomal bay U-shaped; L medial margin Cx-IV > Cx-III; gonopore field L 50. Swimming setae: II-leg-3, 0/3; II-leg-4, 0/4; II-leg-5, 0/4; III-leg-3, 0/4; III-leg-4, 0/7; III-leg-5, 0/6; IV-leg-3, 3/5; IV-leg-4, 6/7; IV-leg-5, 0/6. Leg segment L I-leg-4–6, 108, 114, 122; IV-leg-4–6, 164, 140, 136. Palp: P-4 with subparallel dorsal and ventral margins, distoventrally acute angled; segment L P-1–5, 30, 68, 48, 86, 44.

Female: Unknown.

Etymology. Named after the type locality, the stream Mandrare.

Remarks. The new species is most close to *Arrenurus dentifer*. The male of the latter species differs in a straight posterior idiosoma margin,with an open cleft and the elongated shape of the dorsal shield (longer than wide). The South African *A. fistulifer* K.O. Viets, 1965 has a closed cleft too, but the posterior cauda margin is straight and the medial margin of Cx-IV is shorter than the medial margin of Cx-III (K.O. Viets 1965).

Distribution. S Madagascar, endemic.

Habitat. Stagnant water of stream.

Subgenus *Truncaturus* Thor, 1901

Diagnosis. See Smit (2020b).

Remark. These are the first records of *Truncaturus* species from Madagascar.

Arrenurus (*Truncaturus*) *cuspidipes* sp. nov.

Figs 82–85

Material examined. Holotype: ♂, **MD 162a**, Montagne d'Ambre (Antsiranana), Ambohitra (Joffreville), Rivière de Manques in Reserve Fontenay, 580 m a.s.l., 20-xi-2001 (SMF – gnathosoma, palps, IV-leg-3–6 on slide "MAD 6"). – **Paratypes:** same data as holotype, 1 ♂ (SMF – gnathosoma, palps, III-IV-legs on slide); **MD 163a**, Montagne d'Ambre (Antsiranana), Ambohitra (Joffreville), Rivière de Manques in Reserve Fontenay, 730 m a.s.l., 20-xi-2001, 1 ♂ (RMNH – palp, III-IV-legs on slide MAD 32); **MD 048a**, Betroka (Tulear), right affluent of Rivière Mangoky about 1 km NE village, 830 m a.s.l., 25-viii-2001, 1 ♂, (RMNH – palp, III-IV-legs on slide MAD 33); **MD 058**, Tsimelahy (Tulear), Rivière Antarantsa about 1 km upstream from village, 300 m a.s.l., 4-ix-2001, 1 ♂, 2 ♀ (SMF – palp, III-IV-legs of ♂ on slide MAD 34; palps, both III-legs, I-II-IV-legs of one side of ♀1 on slide "MAD 23", palp, gnathosoma, palps and IV-leg of ♀2 on slide MAD 35); **MD 074a**, Andohahela (Tulear), Isaka, stream crossing RIP 118 at km 32, 360 m a.s.l., 11-ix-2001 (SMF – gnathosoma, palps, IV-leg on slide "MAD 12"), 1 ♂; **MD 136a**, Marofinaritra (Antalaha, Antsiranana), Rivière Andranomenaheli upstream confluence with Rivière Ankavia (right affluent below MD 135), 70 m a.s.l., 4-xi-2001, 1 ♂ (SMF – palps, II-IV-legs on slide MAD 36).

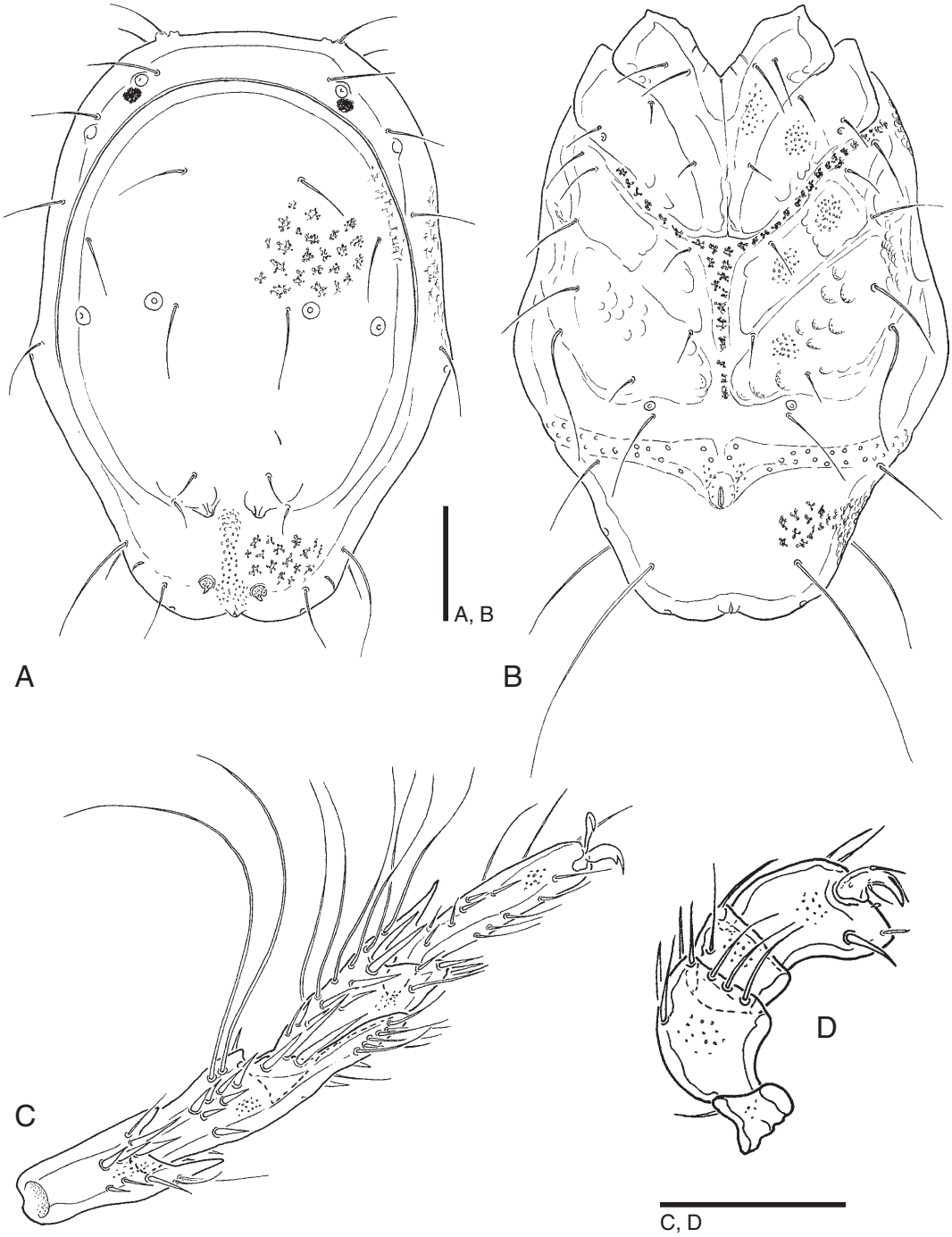


Fig. 82. *Arrenurus cuspidipes* sp. nov. holotype ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** IV-leg-4-6, ventral view; **D.** palp, medial view. Scale bars = 100 µm.

Fig. 83. *Arrenurus cuspidipes* sp. nov. holotype ♂, idiosoma. **A.** Dorsal view; **B.** ventral view.

Other material. MD 020a, 11-viii-2001 Ionilahy (Fianarantsoa), first left affluent of Rivière Ionilahy upstream railroad bridge to Manakara, 200 m a.s.l., riffle, 11-viii-2001, 1 ♀, slide mounted; **MD 056**, Ranopiso (Tulear), stream NW Centre d'Information ANGAP (right affluent of the stream from Tsimelahy), 260 m a.s.l., 2-ix-2001, 1 ♀; **MD 060c**, Tsimelahy (Tulear), Rivière Antarantsa downstream 'piscine naturelle', 200 m a.s.l., pool, 5-ix-2001, 1 ♀; **MD 063d**, Andohahela (Tulear), Isaka, stream exposed W 1 km N from the village, 250 m a.s.l., captured spring, 7-ix-2001, 1 ♀; **MD 065**, Andohahela (Tulear), Fenoevo, right affluent of the turbid water stream (MD 064) at N margin of forest (clear water), 330 m a.s.l., 8-ix-2001, 1 ♀; **MD 069b**, Andohahela (Tulear), Isaka, W stream at the S National Park border (W RIP 118), 200 m a.s.l., 9-ix-2001, 1 ♀; **MD 118a**, Maromandia (Majunga), left affluent of Rivière Andranamalaza, about 1 km E from main road, 100 m a.s.l., riffle, 21-x-2001, 1 ♂ (RMNH – gnathsoma, palps, III-IV-legs on slide MAD 37).

Diagnosis. Both sexes: Idiosoma small (L < 540) and slender; frontal margin weakly convex; maximum W in posterior part. Suture lines Cx-III/-IV in an acute angle to longitudinal axis, medial margins of Cx-III and Cx-IV similar in L, medial separation of Cx-III+IV narrow; genital field with acetabula in low number; excretory pore terminal. Palp with three dorsodistal and two or three mediodistal setae.

Males: Idiosoma L/W ratio 1.3–1.5; cauda not set off from anterior idiosoma; posterior margin straight to slightly concave. Dorsal furrow incomplete. Posterodorsally a pair of lamellar structures laterally flanking Dgl-4 in the area of posterior fusion of the dorsal shield, anterior to the excretory pore a pair of wart-like extensions. IV-leg-4 with a strong, finger-like spur, IV-leg-5 with a pointed extension on the opposite side.

Females: Idiosoma L/W ratio 1.2-1.3. Dorsal furrow complete. Gonopore field with two pairs of sclerotized patches; acetabular plates extending anterolaterally, laterally narrowed.

Description

Both sexes: Colour probably yellow to brownish. Swimming setae: III-leg-5, 0/2–4; IV-leg-4, 0/2–3; IV-leg-5, 0/3–8). Gnathosomal bay shallow, V-shaped.

Males (holotype, in parentheses 7 paratypes; Figs 82–83): Idiosoma L/W 527 (470–551)/365 (332–381); dorsal L 503 (446–530); rhomboid in shape,

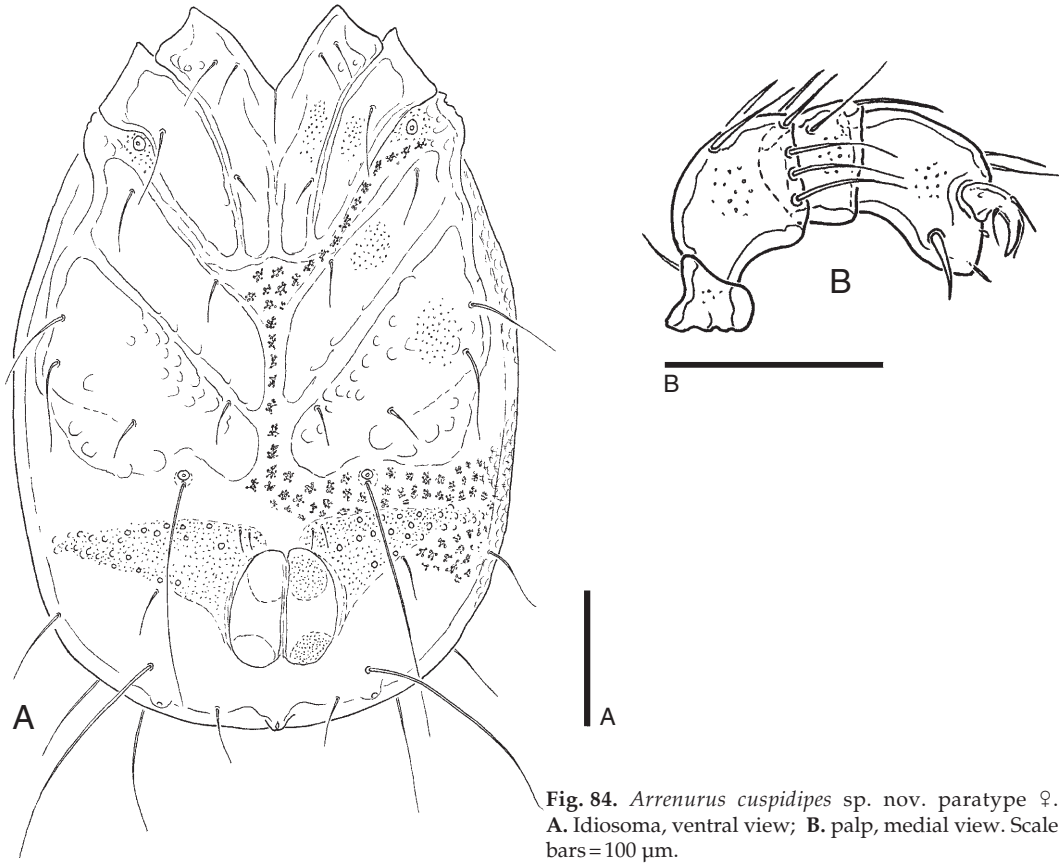


Fig. 84. *Arrenurus cuspidipes* sp. nov. paratype ♀. **A.** Idiosoma, ventral view; **B.** palp, medial view. Scale bars = 100 µm.

lateral margins smoothly projecting on level of Cx-IV. Dorsal shield maximum W 316 (263–319), covering a large part of dorsum; Dgl-2 and Dgl-3 more or less at same level, associated setae of Dgl-3 well separated from glandularia, Dgl-4 located in porose areas between a shallow, posteriorly widening median cleft and a pair of fine, oblique ridges. Near IV-leg insertion two setae, a shorter anterior one and a long posterior one. Gonopore field L 22 (22–30); acetabular plates long and narrow, extending to lateral idiosoma margin or ending at short distance from it, two paired fine setae at anteromedial margin. III-leg-5 and IV-leg-3–5 with extended medial sheaths – for these, "L max." means the total length including these extensions; swimming setae on III-leg-5 (2–4), IV-leg-4 (2) and IV-leg-5 (4–8). Leg segment L I-leg-4–6, 62–72, 66–86, 72–92; III-leg-2–5, 40–50, 50–58, 68–78, 95–108 (L max. 105–120); IV-leg-2–6, 75–93 (L max. 88–103), 68–83 (L max. 100–143), 85–115 (L max. 168–198), 88–118 (L max. 130–170), 113–115 (L max. 125–150). Palp segment L P-1–5, (23–28, 60–75, 30–35, 51–60, 33–35). P-2 mediodistal setae concentrated near distoventral edge.

Females (one paratype, in parentheses 6 further specimens; Figs 84–85): Idiosoma L/W 510 (480–530)/389 (373–404); egg-shaped; dorsal L 486 (449–516). Dorsal furrow complete, dorsal shield almost completely covering dorsum, L/W 437 (418-471)/332 (319–359). Medial margin of Cx-IV shorter than medial margin of Cx-III; medial distance of Cx-IV narrower than half gonopore field W; genital field located halfway between coxae and posterior idiosoma margin; gonopore field L/W 80/96, with two pairs of sclerotized patches; acetabular plates wing-shaped, extending anterolaterally, in lateral part strongly narrowed (ends not clearly recognizable), with rather few, scattered acetabula. Leg segment L (as usual, dorsal L, "L max." = total L, including longest distal extensions) L I-leg-4–6, 66, 74, 58; IV-leg-4–6, 100 (L max. 110), 116 (L max. 120), 102 (L max. 123). Palp segment L P-1–5, (23–24, 50–55, 35–38, 52–53, 28–33); P-2 mediodistal setae equidistant along distal margin.

Etymology. Named for the dorsodistal pointed extensions of the male IV-leg; *cuspis*, Latin – tip; *pes*, Latin – foot.

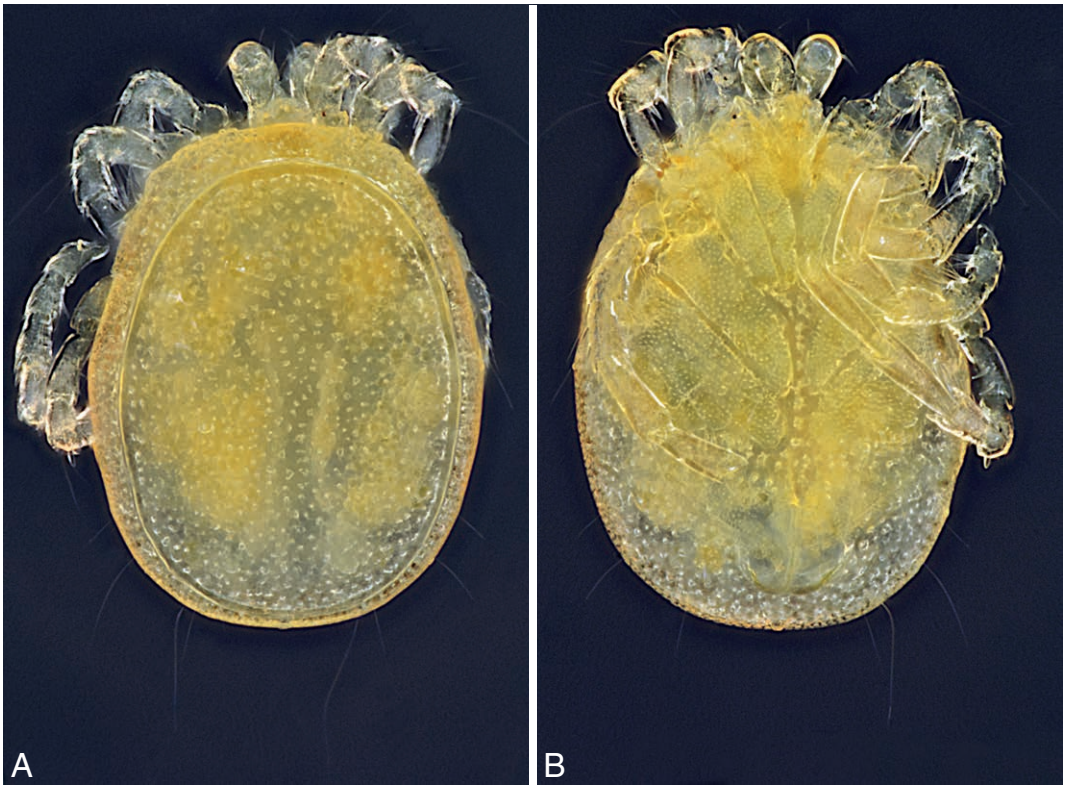


Fig. 85. *Arrenurus cuspidipes* sp. nov. paratype ♀, idiosoma. **A.** Dorsal view; **B.** ventral view.

Remarks. There are few species of the subgenus *Truncaturus* in the Afrotropical region: K.O. Viets (1970) mentioned in his overview of African water mites only *A. schizopetiolatus* Cook, 1966 from Liberia; four more species were described since then (see Smit 2012). Out of these, *A. schizopetiolatus*, *A. uncus* K.O. Viets, 1972, *A. rivalis* K.O. Viets, 1974 and *A. bowmakeri* Rensburg, 1974 have the posterior idiosoma margin with a deep median cleft, *A. flavus* Smit, 2012 from the Comoros differs in a straight posterior margin.

Distribution. N and Central Madagascar, endemic.

Habitat. Streams.

Arrenurus (*Truncaturus*) *delocercus* sp. nov.
Fig. 86

Material examined. Holotype: ♂, **MD 118a**, Maromandia (Majunga), left affluent of Rivière Andranamalaza, about 1 km E from main road, 100 m a.s.l., 21-x-2001 (RMNH). – **Paratypes: MD 057**, Ranopiso (Tulear), spring stream NW Centre d'Information ANGAP, 280 m a.s.l., 2-ix-2001 (SMF; idiosoma and capitulum lost; – palps, I-leg, IV-leg on slide "MAD 13"), 1♂; **MD 048a**, Betroka (Tulear), right affluent of Rivière Mangoky about 1 km NE village, 830 m a.s.l., 25-viii-2001, 1♂ (RMNH); **MD 149a**, Maroambihy (Sambava, Antsiranana), left affluent Rivière Lokoho upstream from the village, 90 m a.s.l., riffle, 12-xi-2001, 1♂ (SMF).

Diagnosis. Male (female unknown): Idiosoma L< 600; maximum W in posterior part, abruptly constricted posterior to the level of acetabular plates; frontal margin straight to weakly convex. In the area of posterior fusion of dorsal shield, a pair of short, oblique lamellae. Porose interspaces Cx-II/-III and medial interspace between Cx-III+IV narrow; suture lines Cx-II/III and Cx-III/IV oblique. Palp stout, P-2 with four setae scattered over the mediodistal surface.

Description

Males (holotype, in parentheses three paratypes; Fig. 86): Colour reddish. Idiosoma L/W 583 (518–591)/365 (348–377); dorsal L 558 (502–543); lateral margin posterior to the acetabular plates constricted, posteriorly converging; posterior margin mostly convex, near the terminal excretory pore straight to

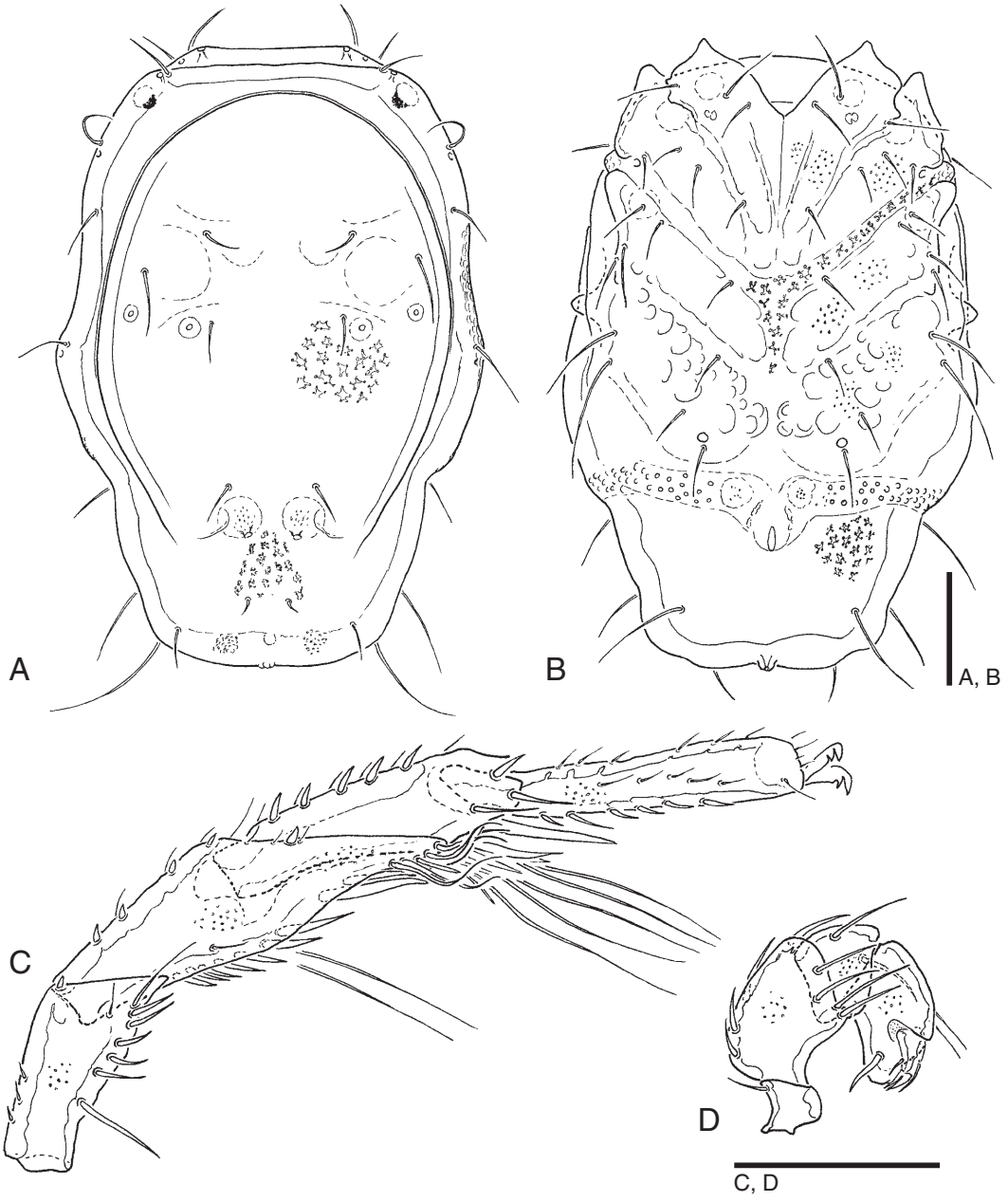


Fig. 86. *Arrenurus delocercus* sp. nov. holotype ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** IV-leg-3–6, anterior view; **D.** palp, medial view. Scale bars = 100 µm.

weakly concave. Dorsal furrow incomplete, dorsal shield W 308 (292–308); paired glandularia in the area of posterior fusion of dorsal shield laterally flanked by short, oblique lamellar projections. Medial interspace between Cx-IV very narrow, partly without porosity; genital field close to coxal field, acetabular plates anterior to level of gonopore, in lateral part slightly bowed posteriorly and reaching lateral idiosoma margin. Dorsodistal extensions of IV-leg-4/-5 relatively short; spur of IV-leg-4 with a group of setae at its tip; IV-leg-5 with numerous stout setae, at base of spur two large, stout setae.

Swimming setae: I-leg-5, 0/1; II-leg-5, 0/2; III-leg-5, 0/3-4; IV-leg-4, 0/2; IV-leg-5, 0/6-7. Leg segment L I-leg-4–6, 84, 90, 90; IV-leg-4–6, 106, 136, 164. Gnathosomal bay V-shaped. Palp segments L P-1–5, 22, 73, 42, 56, 30; P-2 with five setae at distoventral corner.

Female: Unknown.

Etymology. Named for the distinct separation of the cauda, after the Greek δῆλος – *delos* – evident, clear and κέρκος – *kerkos* – tail.

Remarks. Males of *A. delocercus* sp. nov. are most similar to *A. cuspidipes* sp. nov. in the shape of the idiosoma. In comparison to the latter, the cauda is more distinctly set off from the anterior idiosoma. Moreover, the posterior idiosoma margin is straight in *A. delocercus* sp. nov., but with a kink in *A. cuspidipes* sp. nov. The differences with mainland Afrotropical *Truncaturus* species mentioned under *A. cuspidipes* sp. nov. are also applicable to this species.

Distribution. N and S Madagascar, endemic.

Habitat. Streams.

Arrenurus (*Truncaturus*) *gigas* sp. nov.
Figs 87–90

Material examined. Holotype: ♂, **MD 106b**, Ankaratra (Antananarivo), Reserve Manjakatompo, Montagne Ambohimirandrana, spring area exposed SE (drainage Rivière Mahiavona), 2280 m a.s.l., 7-x-2001 (SMF – palps, IV-leg on slide "MAD 7"). – **Paratypes:** Same data as holotype, 1♀ (SMF – gnathosoma and palps on slide "MAD 8"); **MD 105**, Ankaratra (Antananarivo), Reserve Manjakatompo, rheohelocrene at SW border of Lac Froid, 1640 m a.s.l., 6-x-2001, 2♂♂, 5♀♀ (SMF); **MD 109**, Ankaratra (Antananarivo), Reserve Manjakatompo, riparian spring exposed SE at spring stream N deviation to Analamitana (MD 108), 1850 m a.s.l., 8-x-2001, 1♀ (RMNH); **MD 111**, Ankaratra (Antananarivo), Reserve Manjakatompo, right branch of the affluent to station piscicole, 1750 m a.s.l., 9-x-2001, 1♂, 6♀♀ (SMF – gnathosoma and right palp of 1♀ [idiosoma lost] on slide "MAD 9"); same site and date, 1♂ (RMNH).

Other material. MD 040, Ranomena (Fianarantsoa), spring at right margin of the stream NW from the 1.07 km-railway-tunnel (MD 035), 950 m a.s.l., 21-viii-2001, 1♂, 1♀.

Diagnosis. Both sexes: Interspaces between coxal plates very narrow, coxal plates of one side may be completely fused; Cx-IV anterolaterally with a group of densely-arranged rounded muscle insertions. Palp stout, P-2 with eight distomedial setae.

Male: Idiosoma L > 800, L/W ratio 1.4; concave lateral margins in posterior quarter, posterior margin straight. Cx-IV with four long lateral setae. IV-leg-4 with a spur bearing three large and stout basal, and six fine apical setae.

Female: Idiosoma L > 750, equally rounded. Dorsal shield large, covering most of the surface. Genital field far away from Cx-IV; gonopore field directed posteroventrally, without sclerotized patches; acetabular plates bowed, laterally narrowed.

Description

Both sexes: Colour yellowish to brown. Dorsal shield covering large part of the dorsum. Cx-IV on anterolateral surface with a patch of rounded muscle insertion grooves. Palp stout; P-2 medially with eight setae, five of them anteroventrally; P-4 in the centre of distal margin with a fine triangular seta, distoventral margin obtuse, but little protruding.

Males (holotype, in parentheses six paratypes; Figs 87–88): Idiosoma L/W 907 (802–883)/628 (575–612); dorsal L 891 (810–883); frontal margin straight to weakly convex. Dorsal furrow incomplete, maximum W dorsal shield 510 (478–510); Dgl-2 slightly anterior to Dgl-3 or both on the same level. Gnathosomal bay shallow, forming an obtuse angle; suture lines Cx-II/III and Cx-III/IV oblique; Cx-IV bearing four long posterolateral setae; acetabular plates wing-shaped, with convex anterior and concave posterior margins, extending to lateral idiosoma margin, anteromedially with two pairs of short setae; gonopore field L 36; excretory pore subterminal. Swimming setae: IV-leg-4, 2/0 (+8 on spur); IV-leg-5, 8/2. III-leg extremely robust and with numerous strong setae in dense arrangement, III-leg-3–5 stout, distally strongly expanded and forming triangular pointed sheaths covering the base of the next following segments; IV-leg-3–5 with pointed lateral extensions, IV-leg-4 distally extending to form a long, digitiform spur having at its base three strong setae, and apically a line of six fine setae; IV-leg-5 with a line of eight to nine large ventral setae. Leg segment L I-leg-4–6, 114, 130, 96; L IV-leg-4–6, 192, 200, 212. Palp segment L P-1–5, 38, 118, 80, 102, 58.

Females (n = 13; Figs 89–90): Idiosoma L/W 818 (737–1012)/628 (632–851); dorsal L 838 (753–1037); frontal margin convex. Dorsal shield complete, covering most of dorsum, L/W 778 (688–936)/624 (567–765). Gnathosomal bay deeper than in male, with rounded posterior margin; all coxae of each side densely fused, medial separation between Cx-III + IV a bit wider than in males, narrower than half gonopore field W; medial margin Cx-IV longer than, or as long as, medial margin Cx-III; genital field far away from Cx-IV (distance posteromedial edge of Cx-IV to gonopore 200); gonopore field directed caudoventrally, flanked by two pairs of longer setae and two pairs of short anterior setae,

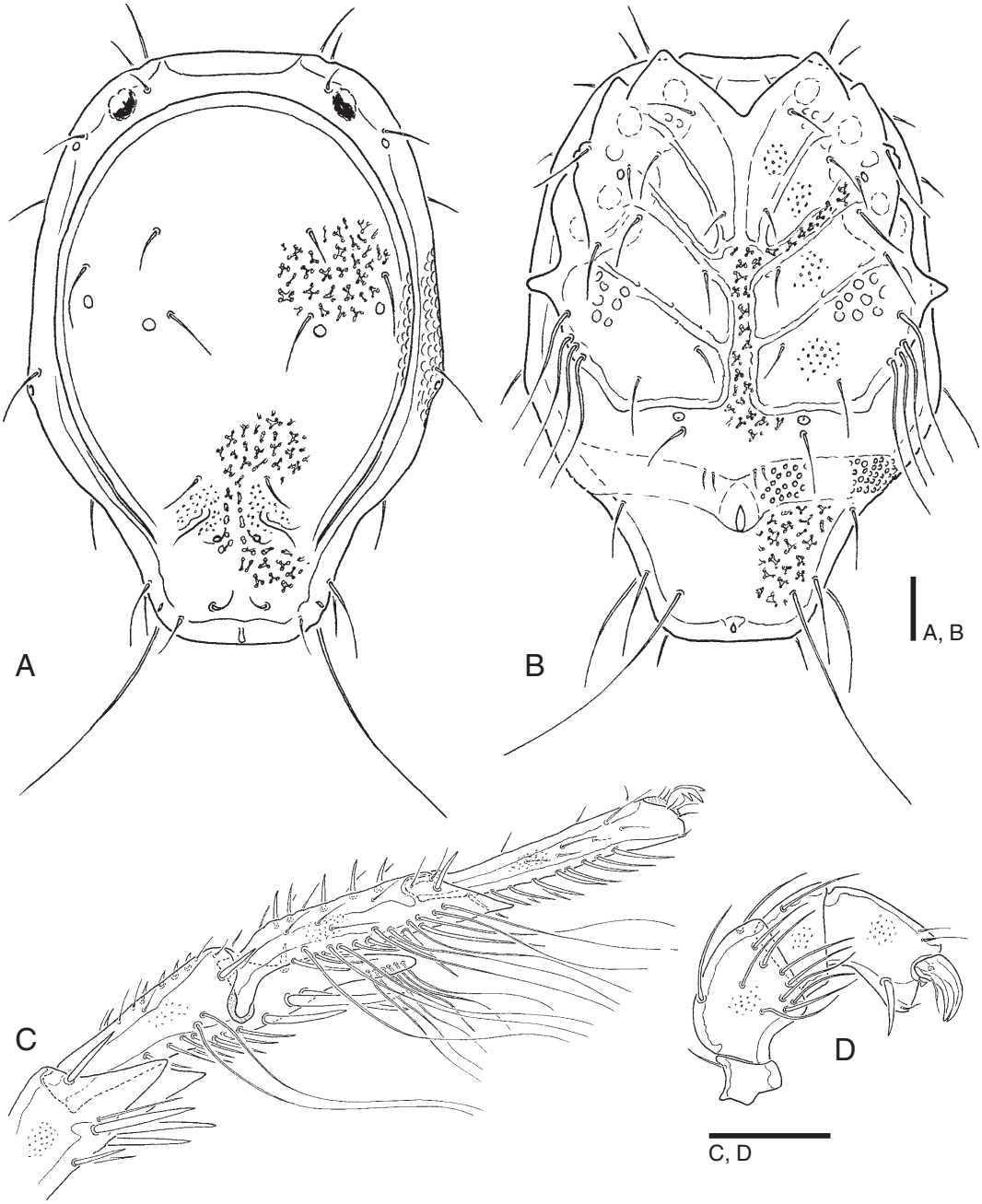


Fig. 87. *Arrenurus gigas* sp. nov. holotype ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** IV-leg-3–6, posterior view; **D.** palp, medial view. Scale bars = 100 µm.

L 110, gonopore lips without distinct structures, but all over the surface covered by fine porosity (like finely sclerotized); acetabular plates wing-shaped, with convex anterior and concave posterior margins, laterally narrowed, ending at lateral idiosoma margin, but not visible in dorsal view; excretory pore terminal. Legs slender and without the particularities described for males. Swimming setae:

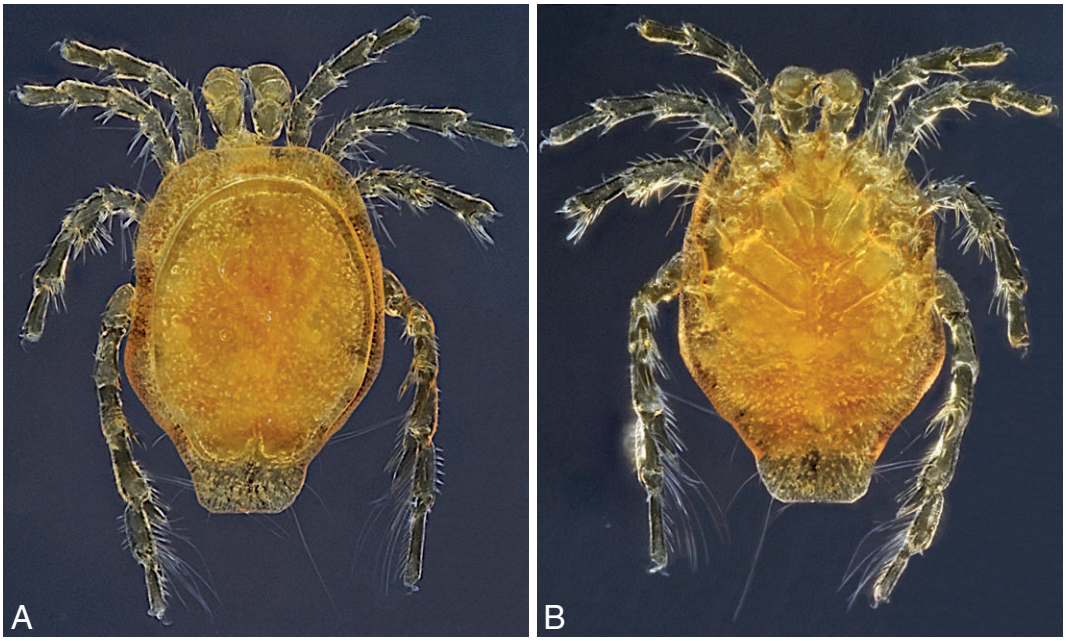


Fig. 88. *Arrenurus gigas* sp. nov. holotype ♂, idiosoma. **A.** Dorsal view; **B.** ventral view.

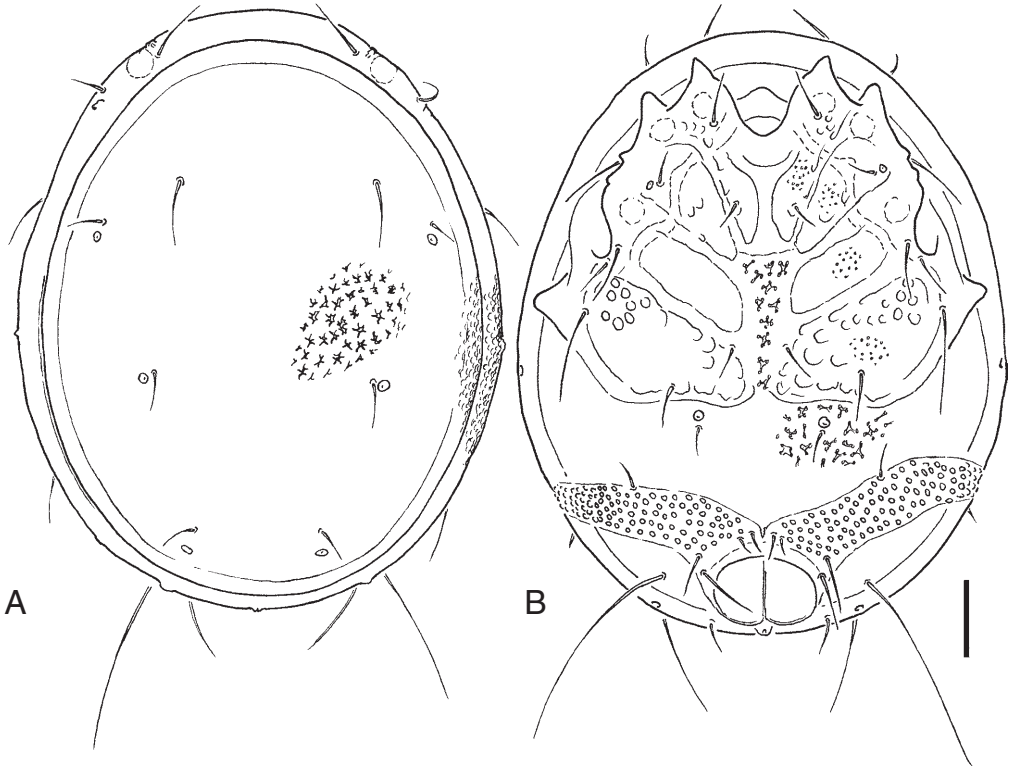


Fig. 89. *Arrenurus gigas* sp. nov. paratype ♀, idiosoma. **A.** Dorsal view; **B.** ventral view. Scale bar = 100 µm.

Fig. 90. *Arrenurus gigas* sp. nov. paratype ♀, idiosoma. **A.** Dorsal view; **B.** ventral view.

III-leg-3, 0/2; III-leg-4, 0/3; III-leg-5, 0/5; IV-leg-3, 0/3; IV-leg-4, 0/3; IV-leg-5, 0/4. Leg segment L I-leg-4–6, 88, 105, 100; L IV-leg-4–6, 154, 162, 142. Palp segment L P-1–5, 32, 84, 52, 86, 36.

Etymology. Named for its relatively large size. Derived from *gigas*, Latin – giant.

Remarks. The long setae of Cx-IV, not found in other *Truncaturus* species, and the large size are diagnostic for the male of the new species. The combination of relatively large size, dorsal shield covering nearly complete dorsum, a gonopore field without sclerotized patches and wing-shaped acetabular plates is diagnostic for the female. Females of the new species show a large variation in size, but no morphological differences were found between the smallest and largest specimens.

Distribution. Central and E Madagascar, endemic.

Habitat. Springs at higher elevations (950–2280 m a.s.l.).

Arrenurus (*Truncaturus*) *porphyrus* sp. nov.
Figs 91–94

Material examined. Holotype: ♂, **MD 078b2**, Taolanaro (Tulear), Mandena (QMM area), Rivière Amendano, 0.5 km upstream road bridge, pool upstream, 12 m a.s.l., 15-ix-2001 (SMF – palps, IV-leg on slide "MAD 14"). – **Paratypes:** Same data as holotype, 5 ♂♂, 6 ♀♀ (3 ♂♂, 4 ♀♀ SMF – palp, IV-leg-4–6 of 1 ♀ slide "MAD 15", 2 ♂♂, 2 ♀♀ RMNH); **MD 077**, Taolanaro (Tulear), Mandena (QMM area), ditch at right border of Rivière Amendano, 10 m a.s.l., 13-ix-2001, 2 ♀♀ (SMF); **MD 078a1**, Taolanaro (Tulear), Mandena (QMM area), Rivière Amendano, 0.5 km upstream road bridge, riffle, 12 m a.s.l., 15-ix-2001, 1 ♀ (SMF); **MD 078a2**, Taolanaro (Tulear), Mandena (QMM area), Rivière Amendano, 0.5 km upstream road bridge, 12 m a.s.l., riffle upstream, 15-ix-2001, 3 ♂♂, 3 ♀♀ (RMNH).

Diagnosis. Both sexes: Frontal margin straight to very weakly convex. Interspaces between coxal plates narrow, posterior margin of Cx-IV oblique; two to three long setae posteromedially to IV-leg insertions (longer in males than in females). Palp stout, P-2 medially with two distoventral setae.

Male: Cauda short, with an obtuse medial indentation bearing the excretory pore; Vgl-2 on posterodorsal margin of cauda.

Female: Gonopore field with two pairs of large sclerotized patches; acetabular plates curved, in medial part directed anteriorly, in lateral part perpendicular to longitudinal axis, not reaching lateral idiosoma margin.

Description

Both sexes: Colour deep blue to violet. Maximum idiosoma W in posterior half. Gnathosomal bay V-shaped; coxal plates separated by narrow strips of coarse porosity; medial margin of Cx-IV distinctly longer than medial margin of Cx-III; Cx-IV, in addition to fine porosity, with numerous large, ring-shaped muscle insertions. P-4 curved, dorsal and ventral margins slightly converging distally.

Males (holotype, in parentheses five paratypes; Figs 91–92): Idiosoma L/W 521 (494–526)/365 (348–393); dorsal L 502 (494–527); cauda short, distinctly set off from anterior idiosoma, posterior margin with two small extensions flanking an obtuse medial indentation with the excretory pore. Dorsal furrow

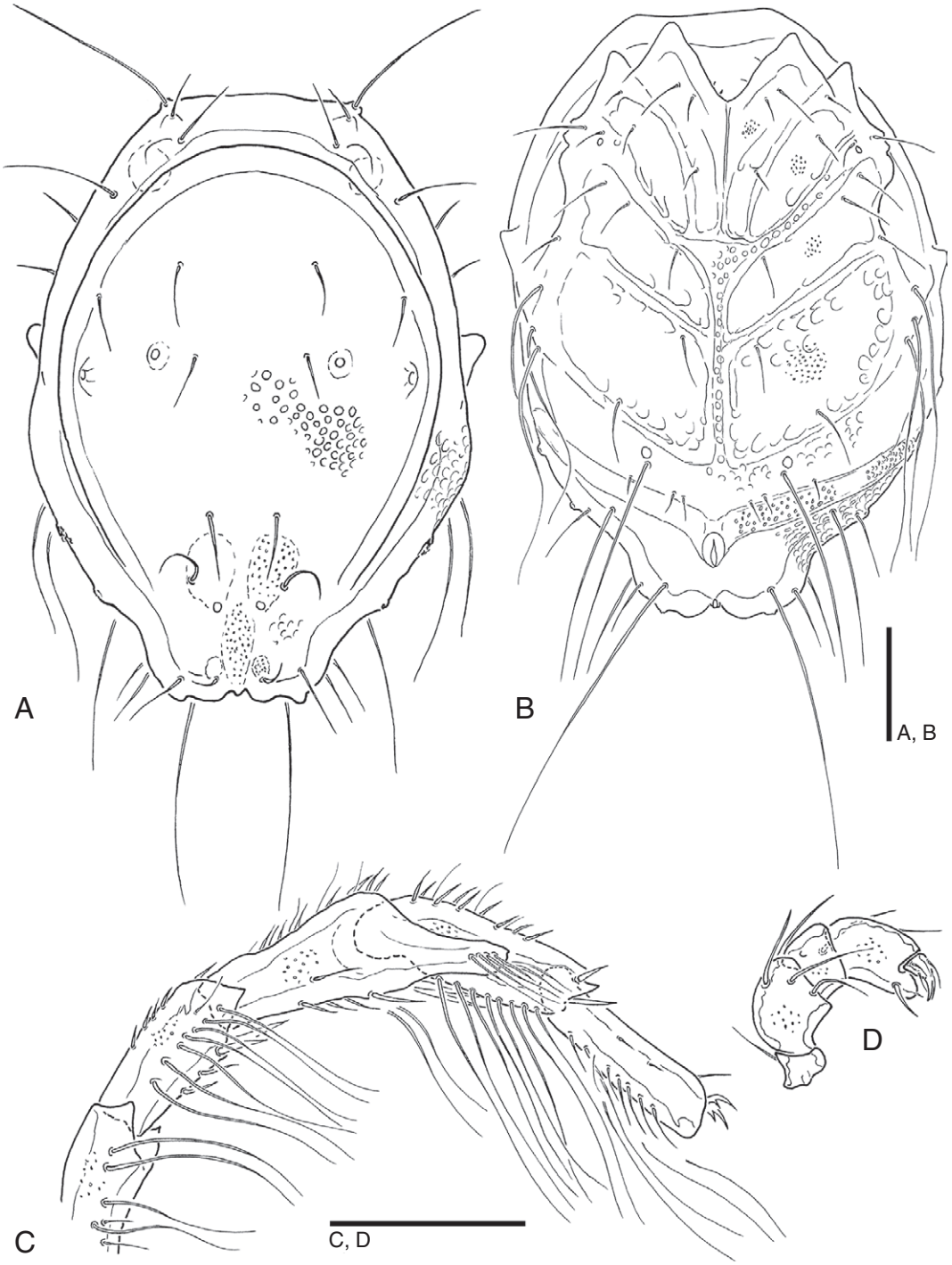


Fig. 91. *Arrenurus porphyrus* sp. nov. holotype ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** IV-leg-4–6, anterior view; **D.** palp, medial view. Scale bars = 100 µm.

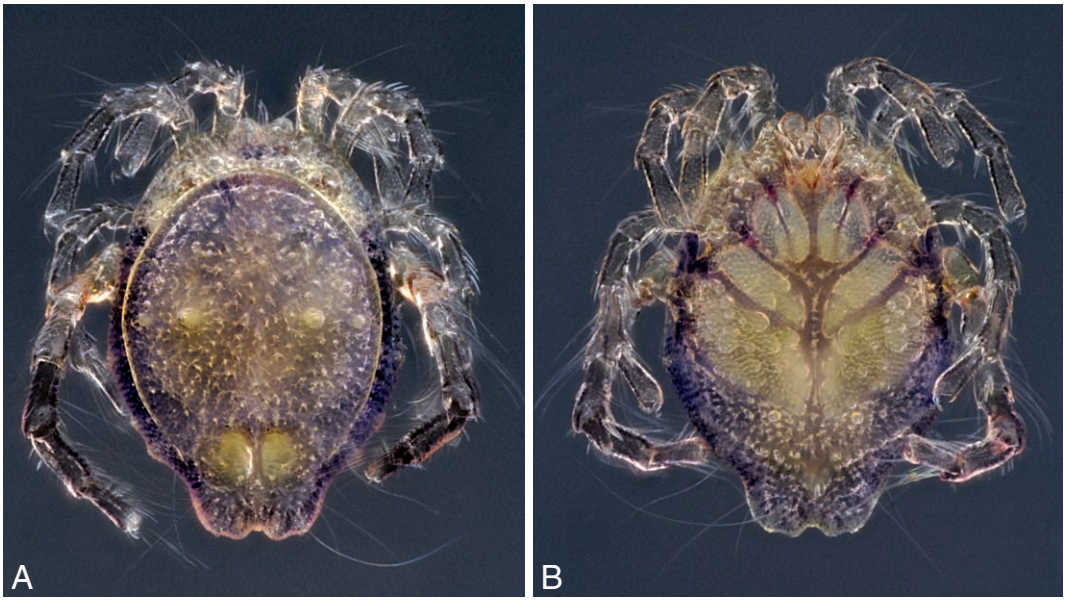


Fig. 92. *Arrenurus porphyrus* sp. nov. holotype ♂, idiosoma. **A.** Dorsal view; **B.** ventral view.

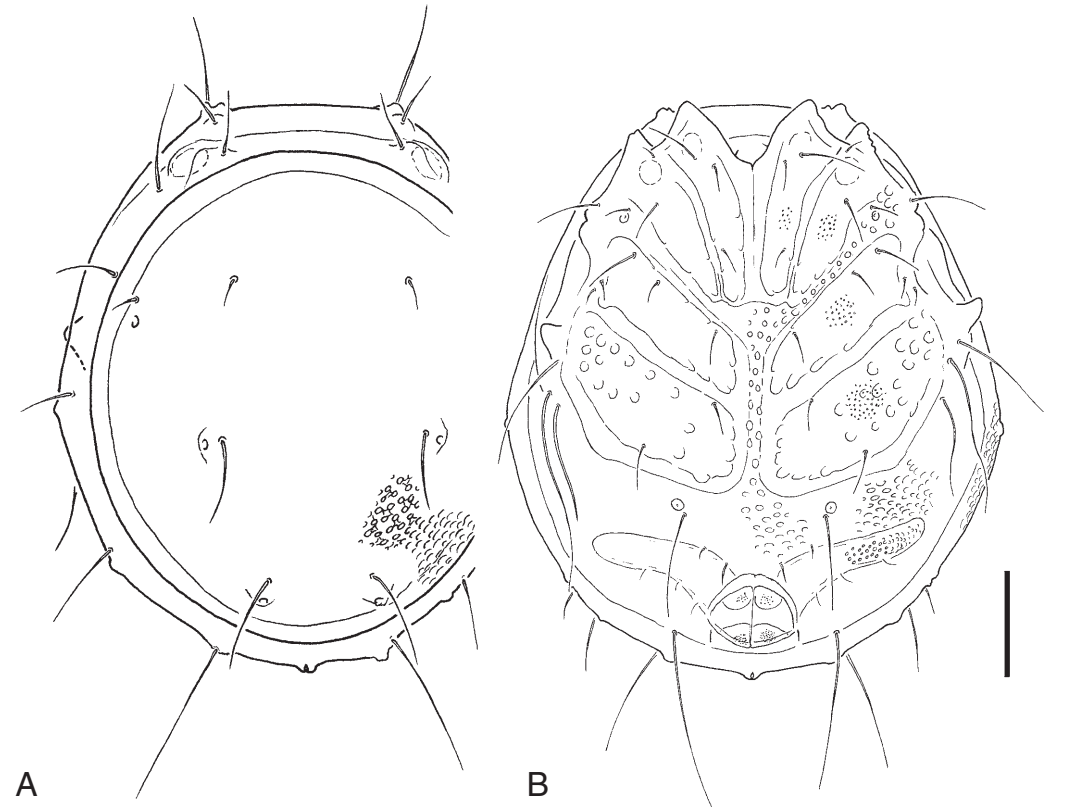


Fig. 93. *Arrenurus porphyrus* sp. nov. paratype ♀, idiosoma. **A.** Dorsal view; **B.** ventral view. Scale bar = 100 µm.

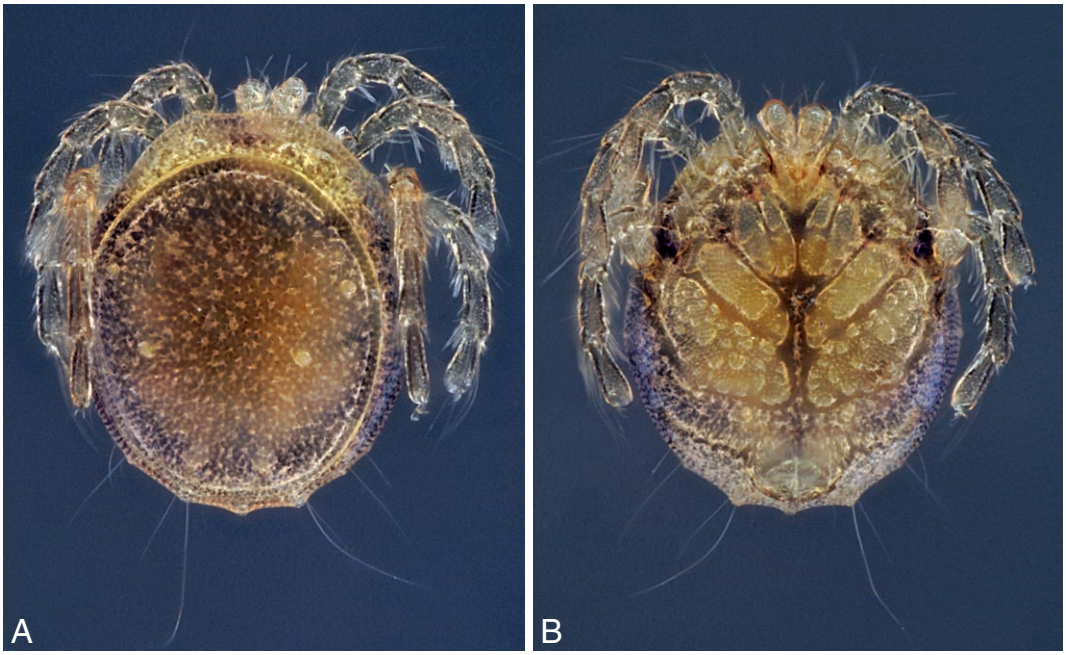


Fig. 94. *Arrenurus porphyrus* sp. nov. paratype ♀, idiosoma. **A.** Dorsal view; **B.** ventral view.

incomplete, dorsal shield maximum W 324 (308–332); Dgl-3 located on the level of cauda base, at the posterior end of a pair of finely-porose shallow grooves; Vgl-2 close together, flanking a posterodorsal strip of fine porosity. Setae inserted posteromedially from IV-leg insertions with their tips reaching level of gonopore; gonopore field L 24; acetabular plates narrow and straight, with their tips reaching the lateral idiosoma margin; setae associated with Vgl-2 and Vgl-4 very long. Setation of IV-leg better illustrated than described, spur of IV-leg-4 with an apical tuft of setae. Swimming setae: III-leg-5, 0/4; IV-leg-2, 0/6; IV-leg-3, 5/7; IV-leg-4, 0/2 (+7 on spur); IV-leg-5, 0/8. Leg segment L I-leg-4–6, 68, 80, 78; L IV-leg-4–6, 108, 120, 100. Palp segment L P-1–5, 20, 49, 36, 48, 24.

Females (n = 14; Figs 93–94): Idiosoma L/W 474–551/397–462; dorsal L 458–535. Dorsal furrow complete, dorsal shield covering most of the surface, L/W 397–470/365–405. Medial distance of Cx-IV by far less than half gonopore field W; genital field close to posterior idiosoma margin, gonopore field L 74; acetabular plates narrow, curved, not reaching lateral idiosoma margin; excretory pore terminal. Swimming setae: III-leg-5, 0/6; IV-leg-3, 0/2; IV-leg-4, 0/4; IV-leg-5, 0/12. Leg segment L I-leg-4–6, 70, 72, 78; IV-leg-4–6, 104, 104, 102. Palp segment L P-1–5, 22, 56, 40, 51, 24.

Etymology. Named for its purplish colour. Derived from πορφυροῦς – *porphyrus*, Greek – purple.

Remarks. Most species of the subgenus differ from *A. porphyrus* in a pale or brownish colour. No other *Truncaturus* species is known to have, in males, a cauda that is short, but well set off from the anterior idiosoma, and with a posterior indentation, and a group of long setae medially from IV-leg insertions. In females, the presence of sclerotized patches in the gonopore field is characteristic – a character state unique in *Truncaturus*, typically found in species of the subgenus *Micruracarus*.

Distribution. S Madagascar, endemic.

Habitat. Streams.

Arrenurus (*Truncaturus*) *riparius* sp. nov.
Figs 95–96

Material examined. Holotype: ♂, **MD 045**, Andrambovato (Fianarantsoa), riparian spring at stream E railway-tunnel 4 (about 1 km W of the village), 800 m a.s.l., 22-viii-2001 (SMF – palps lost after study, IV-leg-4–6 on slide "MAD 19").

Diagnosis. Male (female unknown): Idiosoma maximum W posterior to middle; frontal margin very weakly convex. Dorsal furrow incomplete;

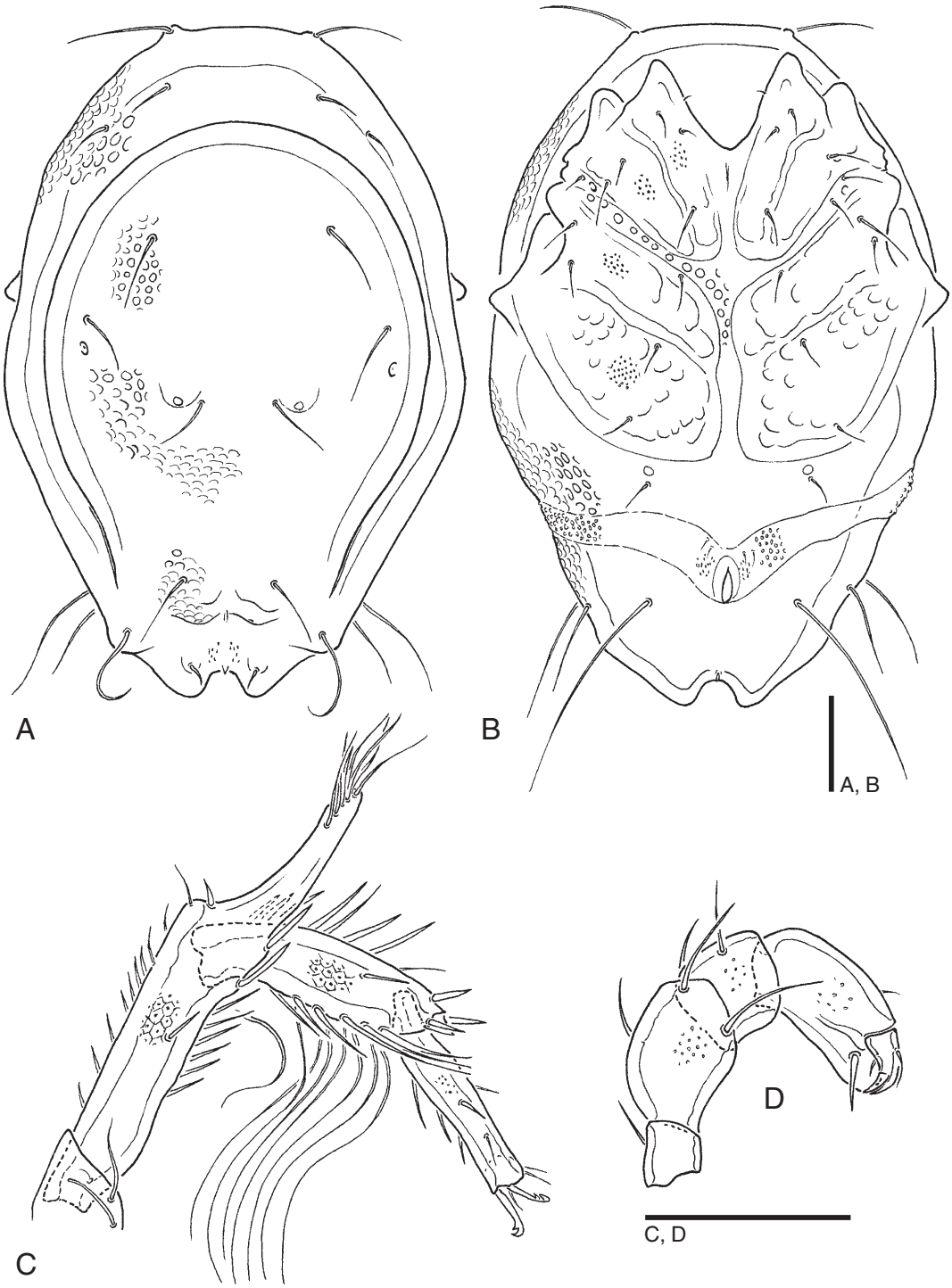


Fig. 95. *Arrenurus riparius* sp. nov. holotype ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view; **C.** IV-leg-4–6, anterior view; **D.** palp, medial view. Scale bars = 100 µm.

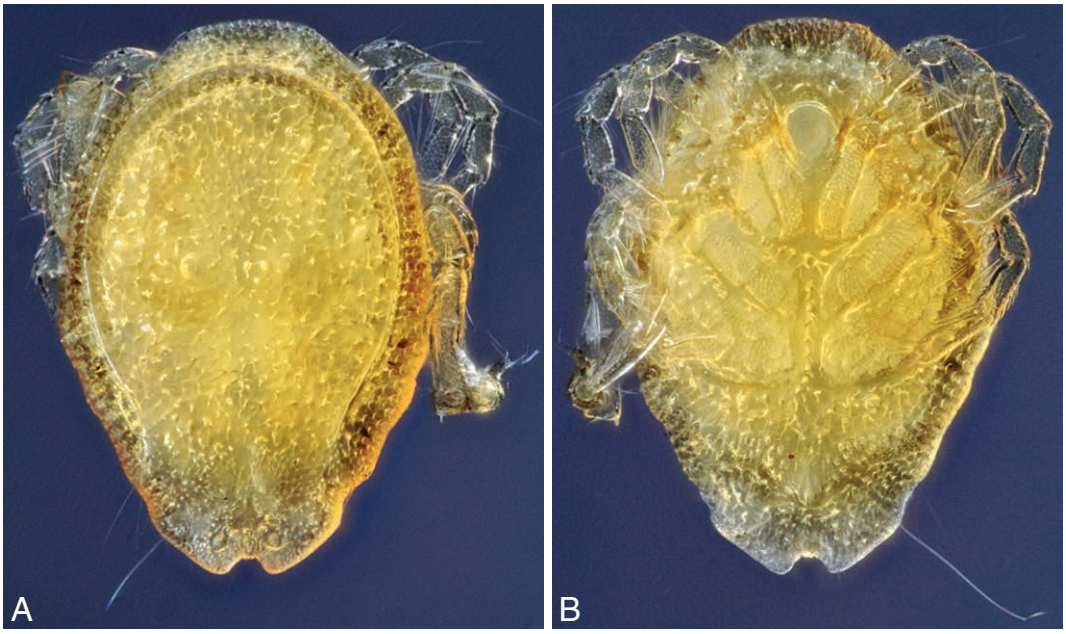


Fig. 96. *Arrenurus riparius* sp. nov. holotype ♂, idiosoma. **A.** Dorsal view; **B.** ventral view.

posterior idiosoma margin with slightly prominent lateral extensions and a fine pointed projection in a shallow median cleft. Medial margin Cx-III shorter than Cx-IV; interspace between posterior coxal plates very narrow. Gnathosomal bay parabola-shaped. P-2 bearing only two medial setae, P-4 with convex distal margin.

Description

Male (holotype; Figs 95-96): Colour yellowish. Idiosoma L/W 703/470; pear-shaped, maximum W posterior to IV-leg insertions. Dorsal L 680; dorsal shield covering most of dorsum, maximum W 390, in anterior part. Medial margin Cx-III shorter than Cx-IV, posterior margin Cx-IV equally rounded; gonopore L 40; acetabular plates long and narrow, extending to lateral idiosoma margin. IV-leg-4 with a long distal spur with a tuft of setae. Swimming setae: III-leg-5, 0/3; IV-leg-4, 0/0 (+6 on spur); IV-leg-5, 0/6. Leg segment L I-leg-4–6, 68, 77, 68; IV-leg-4–6, 162 (not including spur), 120, 106. Palp rather slender, bearing very few setae, P-4 equally curved, with subparallel dorsal and ventral margins, distal margin protruding and rounded. Palp segment L P-1–5, 28, 62, 40, 68, 30.

Female: Unknown.

Etymology. Named after the habitat of the type locality. Derived from *ripa*, Latin – bank, shore.

Remarks. In the idiosoma shape and the very reduced palp setation, *A. riparius* is similar to *A. brevigenitalis* K.O. Viets, 1965 from South Africa. The latter differs from *A. riparius* in very short, in their medial part enlarged acetabular plates and a rather large dorsal shield, with maximum W > 450 anterior to middle, and Dgl-3 farther distanced from each other. *Arrenurus latigenitalis* K.O. Viets, 1965, a further species from South Africa and similar in idiosoma shape, agrees in Dgl-3 located rather close to each other, but has a palp with a higher number of setae on P-4; its acetabular plates are longer, but do not reach the lateral idiosoma margin. For the males of these two species, no dorsocaudal spine is reported to be located in the caudal cleft.

Distribution. E Madagascar, only known from the type locality, endemic.

Habitat. Spring.

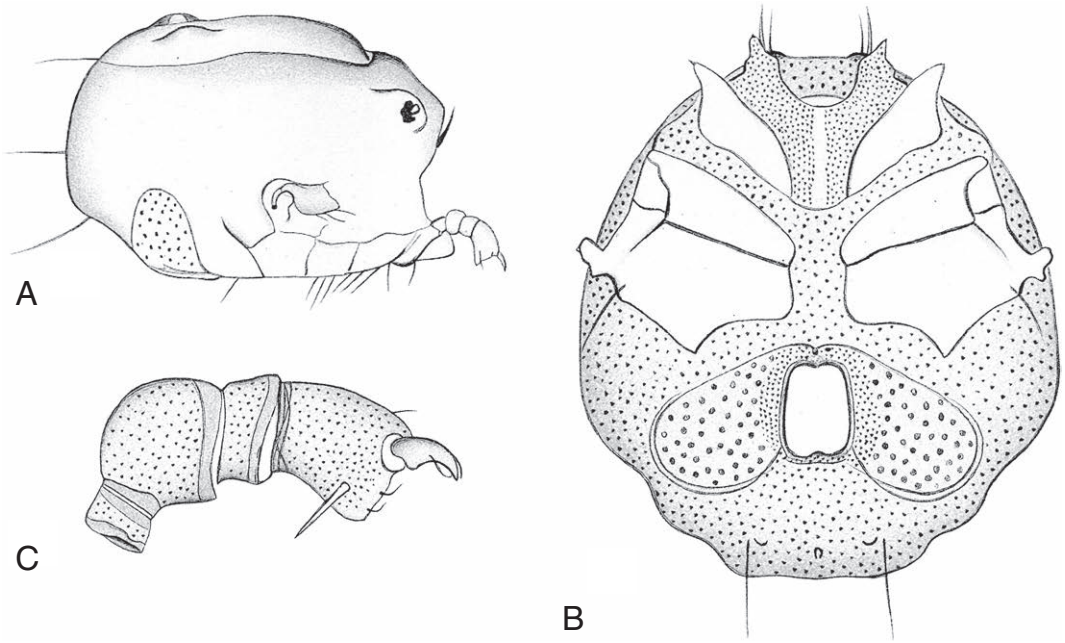


Fig. 97. *Arrenurus cupitor* ♀. **A.** Idiosoma, lateral view; **B.** idiosoma, ventral view; **C.** palp, medial view (Koenike 1898).

Species of unknown subgeneric assignment

***Arrenurus* (subgen.?) *cupitor* Koenike, 1898**
Fig. 97

Published record. Madagascar. Mahajanga (Majunga): Morondava (Koenike 1898).

Uncertain record. MD 026c, Ionilahy (Fianarantsoa), Rivière Ionilahy, 200 m a. s. l., sand, 11/13-viii-2001, 1 ♀, slide mounted.

Description

Female (Fig. 97; male unknown): Colour not reported. Idiosoma L/W 700/650; oval in general shape, but idiosoma margin slightly irregular due to small extensions in anterior and posterior part; frontal margin prominent, but between frontal setae concave. Dorsal furrow complete, dorsal shield L 460 (2/3 idiosoma L). In lateral view elevated, dorsum convex, with slightly prominent humps in posterior part. Medial separation Cx-III+IV very wide (about W of gonopore field), L medial margin Cx-III<<Cx-IV, suture Cx-III/IV slightly oblique; distance coxal field-genital field narrow (<half gonopore field W); gonopore field L 100, presence/absence of sclerotized patches unclear due to loss of genital flaps, no such patches found in the specimens from MD 026c (see below); acetabular plates oblique to longitudinal axis, very wide, maximum W in centre, posterior margin convex, anterior margin straight, laterally equally rounded, not reaching lateral idiosoma margin but nearly so; postgenital area short (1.3 fold gonopore L). Swimming setation not reported. Gnathosomal bay broad U-shaped. Palp stout; P-2 mediodistal margin with several setae (lost during preparation); P-4 dorsal and ventral margins diverging.

Remarks. *Arrenurus cupitor* is a little known species with the holotype female being the only certain record. It is distinguished from all other known Madagascan *Arrenurus* species known in the female sex by the large acetabular plates in oblique position to the longitudinal axis.

The specimen from site MD 026c fits this diagnosis, but differs in the following points: (1) dorsal furrow incomplete; (2) frontal margin convexly protruding; (3) medial distance of Cx-III+IV narrow (<half gonopore field W); (4) acetabular plates with strongly convex posterior margins; (5) P-4 dorsal and ventral margins subparallel, ventral part distally pointed. This specimen represents with high probability an undescribed species, possibly a sister species of *A. cupitor*.

Distribution. E Madagascar, with certainty only known from the type locality, endemic.

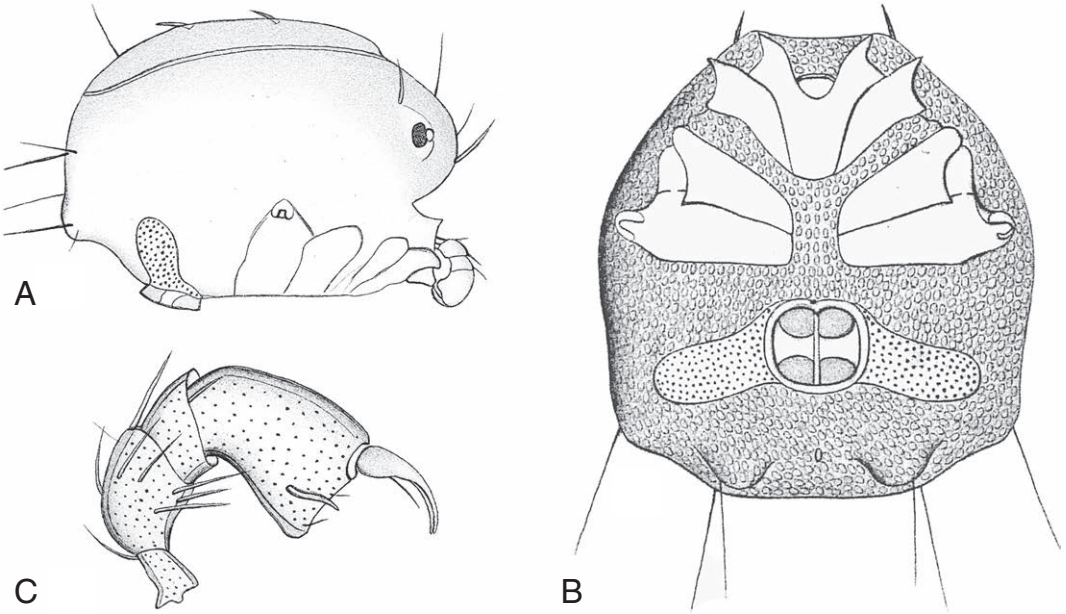


Fig. 98. *Arrenurus farsilis* ♀. **A.** Idiosoma, lateral view; **B.** idiosoma, ventral view; **C.** palp, medial view (Koenike 1898).

Arrenurus (subgen.?) *farsilis* Koenike, 1898
Fig. 98

Published record. Madagascar. Nossi-Bé: Lake Djabala (Koenike 1898).

Uncertain record. MNHN E 14 E, Nossi-Bé L. Djabol-Bé; Sept. 1947, Millot, 1 ♀.

Description

Female (Fig. 98; male unknown): Colour of dorsum blue-green, venter greenish yellow. Idiosoma L/W 880/800; stout; frontal margin slightly concave. Dorsal furrow complete; dorsal shield L 680 (¾ idiosoma L); with prominent posterolateral and posteromedial humps. In lateral view elevated, dorsum equally convex. Medial separation Cx-III+IV wide (half W gonopore field), medial margins Cx-III/Cx-IV equal in L, posterior margin Cx-IV straight; distance coxal field-genital field narrow (about half gonopore field W), gonopore field L 150, with two pairs of sclerotized patches; acetabular plates rather long, weakly oblique, middle sized in W; postgenital area long (twice gonopore L). Swimming setation "rich", details not reported. Gnathosomal bay broad U-shaped. Palp stout; P-2 medially with three distoventral setae; P-4 dorsal and ventral margins strongly diverging.

Remarks. Following Koenike (1898), *Arrenurus farsilis*, described after a single female (and a deutonymph), is similar to *A. pronominatus* (sub nom. *A. plenipalpis*, see above), but differs in a relatively longer P-4. The female specimen MNHN E 14 E, collected at the type locality, agrees well with the original description, except for a more shallow gnathosomal bay. As differences to other Madagascan *Micruracarus* are weakly defined, it is possible that *A. farsilis* is a junior synonym of *A. voeltzkowi*.

Distribution. N Madagascar, Nossi-Bé, only known from the type locality, endemic.

Arrenurus (subgen.?) *sarcinatus* Koenike, 1898
Fig. 99

Published record from Madagascar. Mahajanga (Majunga): no collection site details (Koenike 1898).

Uncertain record. MD 062, Tsimelahy (Tulear), Analamatsaky, ditches near the village (dead branches of small stream), 100 m a.s.l., 6-ix-2001, 1 ♀.

Description

Female (Fig. 99; male unknown): Colour greenish-yellow. Idiosoma L/W 2000/1700; oval in shape; frontal margin convex. Dorsal furrow complete; dorsal shield L 1440 (72 % idiosoma L); with prominent

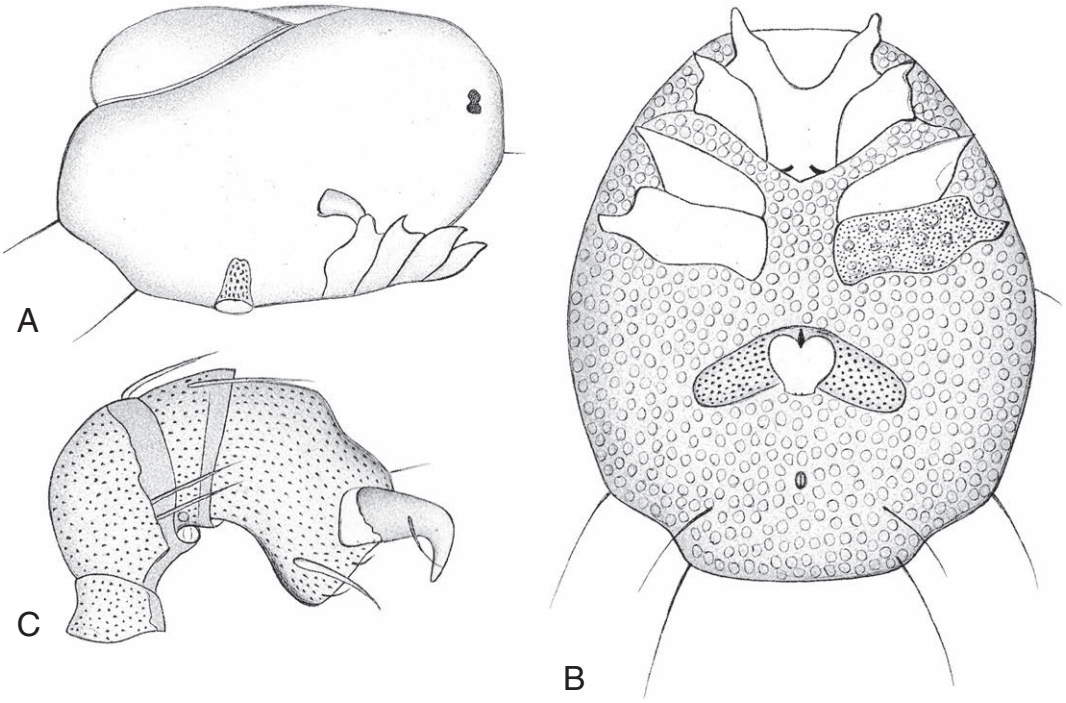


Fig. 99. *Arrenurus sarcinatus* ♀. **A.** Idiosoma, lateral view; **B.** idiosoma, ventral view; **C.** palp, medial view (Koenike 1898).

posterolateral humps. In lateral view high, dorsum in posterior part pillow-like elevated. Medial separation Cx-III+IV wide (>W gonopore field), medial margin Cx-III<Cx-IV; distance coxal field-genital field about gonopore L; structure of gonopore field not described ("damaged during preparation", Koenike 1898), no sclerotized patches in the specimen from MD 062 (as in the two related species *A. auritus* and *A. frustrator*); acetabular plates short, maximum W medial (=L gonopore), weakly oblique, narrowed and rounded laterally; postgenital area very long (about four times gonopore L). Swimming setation "rich", details not reported. Gnathosomal bay proximally rounded, in distal part with diverging lateral margins. Palp stout; P-2 with three mediodistal setae; P-4 dorsal margin with a strong central concavity.

Remarks. *Arrenurus sarcinatus* is similar to *A. auritus* and *A. frustrator* in the concavity of the dorsal margin of P-4. It differs from both species in the frontal margin convex in shape and the wide medial separation of Cx-III+IV.

Daday (1910) stated to have detected this species at two sites in Congo and gave a first description of males under this name, collected along with *sarcinatus*-like females. There is indeed a certain similarity between his figure of a female (plate XVII, 12) and the figure published by Koenike (1898, plate XXVII, 142). However, in view of the generally low number of features of importance for species definition in *Arrenurus* females, minor differences are sufficient to suggest that his species attribution is not correct. The specimens Daday (1910) described differ in the following character states from *A. sarcinatus*: (1) idiosoma shape more compact (L/W 1.1); (2) frontal margin slightly concave, not convex; (3) medial distance of Cx-III+IV narrower (<gonopore field W). Furthermore, if we suppose that his attribution of males and females was correct (Daday figured the palp of the male only), the populations from Congo differ distinctly in the equally convex shape of the P-4 dorsal margin. As the male described by Daday does not represent *A. sarcinatus*, the attribution of this species to the subgenus *Micruracarus* (taken over by all authors since Daday's publication), is not supported as well. The populations reported from Congo by Daday (1910) represent another, possibly undescribed species, the only ascertained record of the species is the holotype from Mahajanga. A female specimen found at site MD 062 is similar to *A. sarcinatus* in the shape of P-4 (dorsal margin concave, with a hump in proximal part), combined

with a wide medial separation of the coxal plates Cx-III + IV. However, it differs from the description of *A. sarcinatus* in the shape of the idiosoma contour (frontal margin concave between a pair of prominent glandularia, presence of four pairs of prominent humps, laterally on anterior idiosoma, and medially in the centre and posterior part of dorsum).

Distribution. W Madagascar, with certainty only known from the type locality, endemic.

Habitat. Standing water.

Arrenurus (subgen.?) *vigorans* Koenike, 1898

Published record. Madagascar: Nossi-Bé: Lake Djabala (Koenike 1898).

Remarks. A species name introduced for a deutonymph from Lake Djabala (Nossi-Bé) – later on, Daday (1910) published a record of a further, "completely corresponding" deutonymph from Congo. As relevant specific characters are unknown at this developmental stage in *Arrenurus*, there is no chance to understand diagnostic features of *A. vigorans*, and to relate the described deutonymph to any adults. This species must be considered a 'species incerta'.

Arrenurus sp. nov.?

In the following we give short characterizations of specimens which do not fit the diagnoses of any of the species treated above. At present it is impossible to decide about their taxonomic state. The reported females might belong to one of the species unknown in female sex or be representatives of species so far unrecorded from the island.

Arrenurus (*Arrenurus*) sp. nov.?
Fig. 100

MNHN A 1 D, Ankarana; ix. 1946, leg. Millot, 1 ♂.

In the idiosoma margin in lateral view, the specimen resembles *A. frustrator*, but the petiole is longer, with a straight, not rounded posterior margin, one of the long flanking setae is bifurcated and the posterolateral extensions are less prominent.

This male was reported along with five (conspecific?) females in Gerecke (2004): "Antsiranana Ankarana (marais), ix.1946, leg. Millot, 1 ♂, 5 ♀♀ MNHN A 1 D"; the material could not be investigated again.

Arrenurus (subgen.?) spp.

MD 020b, Ionilahy (Fianarantsoa), first left affluent of Rivière Ionilahy upstream railroad bridge to Manakara, 200 m a.s.l., pool, 11-viii-2001, 1 ♀, slide mounted; **MD 022,** Ionilahy (Fianarantsoa), spring stream in area Marosaro (S from Rivière Ionilahy), 300 m a.s.l., 12-viii-2001, 1 ♀, slide mounted; **MD 034c**, Ranomena (Fianarantsoa), river NW from the 1.07 km-railway-tunnel, 950 m a.s.l., pool, 19-viii-2001, 1 ♀, slide mounted; all in SMF.

These three females collected in streams and spring streams in the Ionilahy catchment combine an irregular idiosoma margin (frontal margin projecting and concave between antenniform humps, posterolateral edges slightly concave) with a coxal plate Cx-III + IV characteristic in shape (medial margin mostly formed by Cx-IV, these medially distinctly more projecting than Cx-III, medial distance of Cx-IV << half gonopore field W). Further characteristics: Idiosoma with narrow pores rather distant from each other. Gonopore field large, without sclerotized patches; acetabular plates short, ending far from lateral margins, perpendicular or slightly oblique to longitudinal axis; excretory pore near posterior margin; dorsal and ventral margins of P-4 diverging distally, its distoventral edge subacute. As the specimens differ from each other in more or less slender idiosoma shape and inclination of acetabular plates, they might represent more than one species.

MD 076, Fort Dauphin (Tulear), Mandena (QMM area), pond at right bank of Rivière Amendano, 10 m a.s.l., 13-ix-2001, 1 ♀, slide mounted.

Idiosoma margin slightly irregular (frontal margin straight, posterolaterally concave sectors, posteromedial margin nearly straight). Idiosoma porosity very coarse. Cx-I + II with pointed tips extending over frontal/lateral margin; Cx-III/IV medially equal in L, medial distance about half gonopore field W; gonopore field wider than long, acetabular plates equally narrowed from medial part to lateral end, oblique to longitudinal axis and slightly curved caudally in lateral part, their posterior margins posterior to gonopore field connected by a characteristic bridge of fine porosity. Dorsal furrow complete. Swimming setation extremely reduced: only two swimming setae on IV-leg-4/-5 each. Palp stout; P-2 with three medial setae, no one of these near distoventral margin; P-4 dorsal and ventral margins diverging, distoventral edge broadly rounded. The character combination of this specimen, in particular the shape of the acetabular plates, is not found in any of the species so far described from Madagascar.

MD 126, Ambohitsara (Antalaha, Antsiranana), Rivière Ranovato near Amboditsoha, 70 m a.s.l., 28-x-2001, 1 ♀; slide mounted.

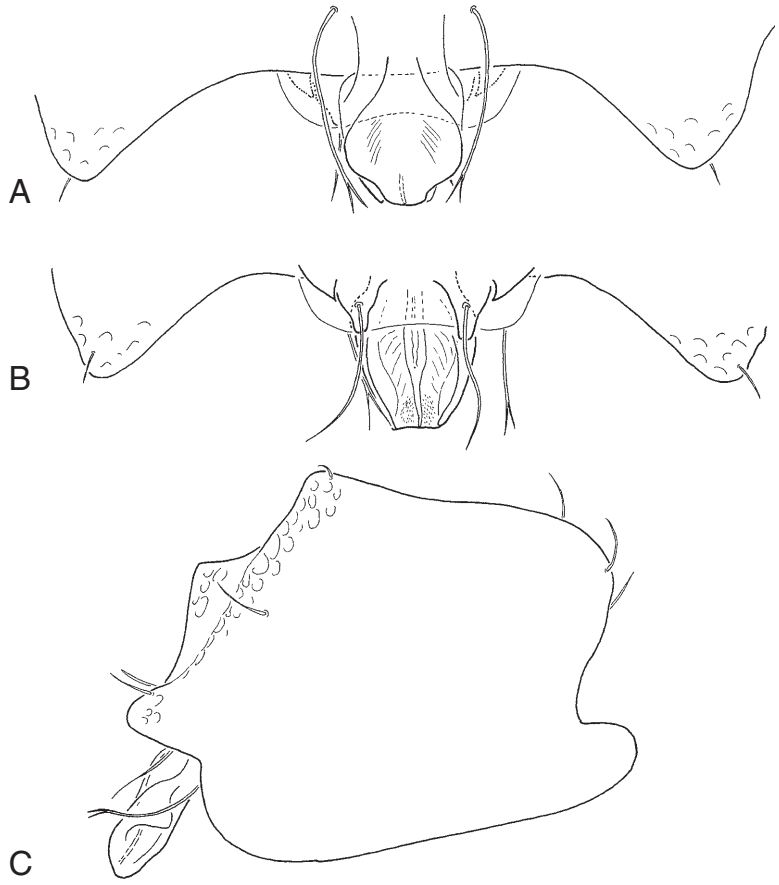


Fig. 100. *Arrenurus* sp. nov.? ♂, MNHN A1D. **A.** Cauda, ventral view, detail; **B.** cauda, dorsal view, detail; **C.** idiosoma, lateral view.

Idiosoma contour equally round in anterior part, posterior margin forming an obtuse triangle with rounded medial end. Dorsal furrow incomplete. Gnathosomal bay obtuse triangular; tips of Cx-I distinctly projecting beyond frontal margin; Cx-III with extended, rounded medial margins, in central part nearly in touch; Cx-IV triangular; distance of medial tips about half gonopore field W; gonopore field distinctly wider than long, anterior and posterior margins of gonopore lips with crescent-shaped sclerotized patches; acetabular plates extremely narrowed to fine strips (only two Ac in W over most of the length), reaching lateral margins. Palp slender, P-2 with two to three mediodistal setae, P-4 dorsal and ventral margins equally converging, distoventral edge very prominent, rounded. This specimen is very distinct and does not resemble to any of the species described above.

Arrenurus (subgen.?) sp.

Published records of undetermined *Arrenurus* species from Madagascar. Antananarivo, Tsimbazaza (rizière), x.1947, leg. Millot, 1 ♀ MNHN B 15 E (Gerecke 2004)

Antsiranana, N Sambirano 1 (0/1/0) date? leg. Millot J. MNHN B 15 I (Gerecke 2004)

Forest S Moramanga, 20.ii.1931, leg. Durry, 1 dn (Walter & Bader 1953).

Genus *Wuria* K. Viets, 1916

Diagnosis. See Smit (2020b).

A genus known from the Ethiopian, Oriental and Australasian regions (Smit 2020b). Thus far, two species were known from the Ethiopian region.

***Wuria milloti* Gerecke, 2004**
Figs 101–103

Published records. Madagascar: Antsiranana: Ankarana (Gerecke 2004).

Material examined. MD 084, Taolanaro (Tulear), Pic St. Louis, stream exposed E, 70 m a.s.l., 17-ix-2001, 1 ♀.

Description

Both sexes (Figs 101–103): Coxal field with stripes of idiosoma surface with large pores extending between the medial margins of Cx-III + IV, between the facing margins of Cx-II and Cx-III, and the area separating coxal field and genital field; Cx-IV subtriangular in shape, mL Cx-III > Cx-IV, acetabular plates in a 45° angle to longitudinal axis, laterally enlarged. Gnathosomal bay shallow. P-2 dorsal margin protruding in proximal part. Swimming setation not reported in original description, here given for the female from MD 084: II-leg-5, 0/2; III-leg-4, 0/2; III-leg-5, 0/4; IV-leg-3, 0/2; IV-leg-4, 0/6; IV-leg-5, 0/6.

Distribution. N and S Madagascar, endemic.

Habitat. Streams.

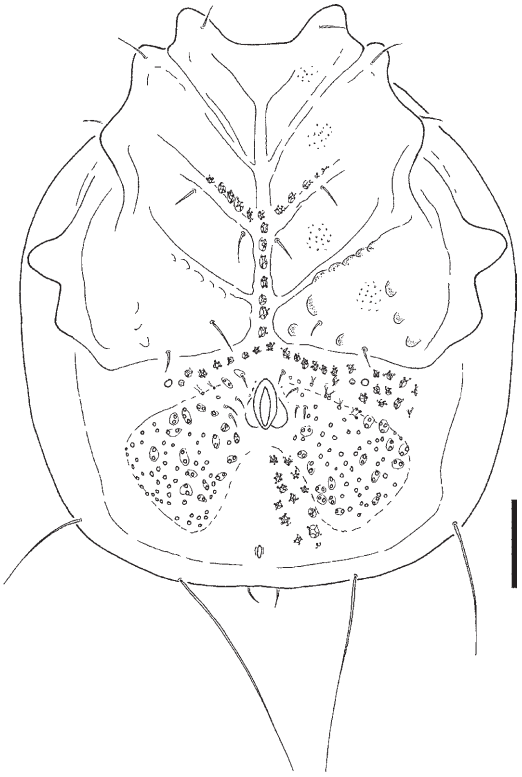


Fig. 101. *Wuria milloti* ♂. Idiosoma, ventral view (Gerecke 2004). Scale bar = 100 µm.

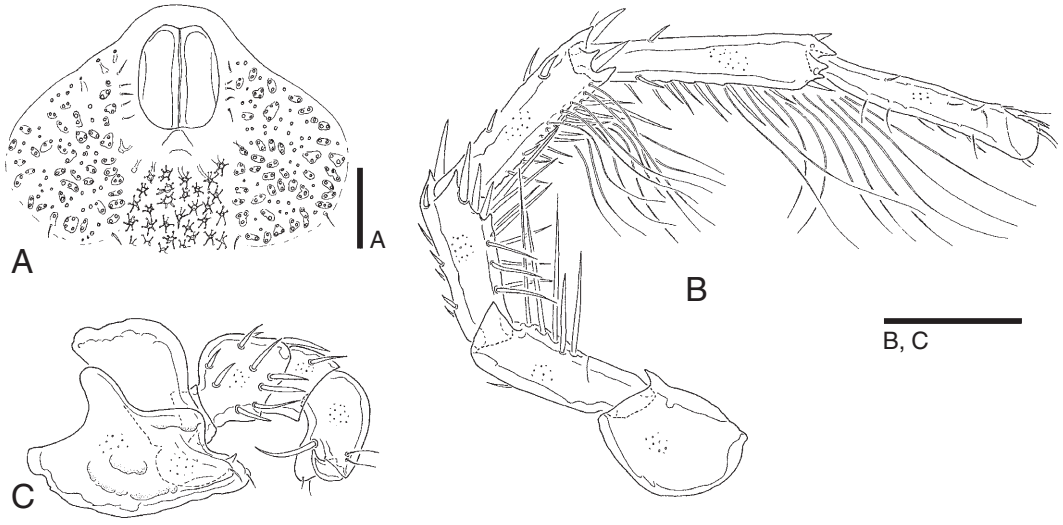


Fig. 102. *Wuria milloti* ♀. **A.** Genital field; **B.** IV-leg, posterior view; **C.** capitulum and palp, medial view (Gerecke 2004). Scale bars = 100 µm.

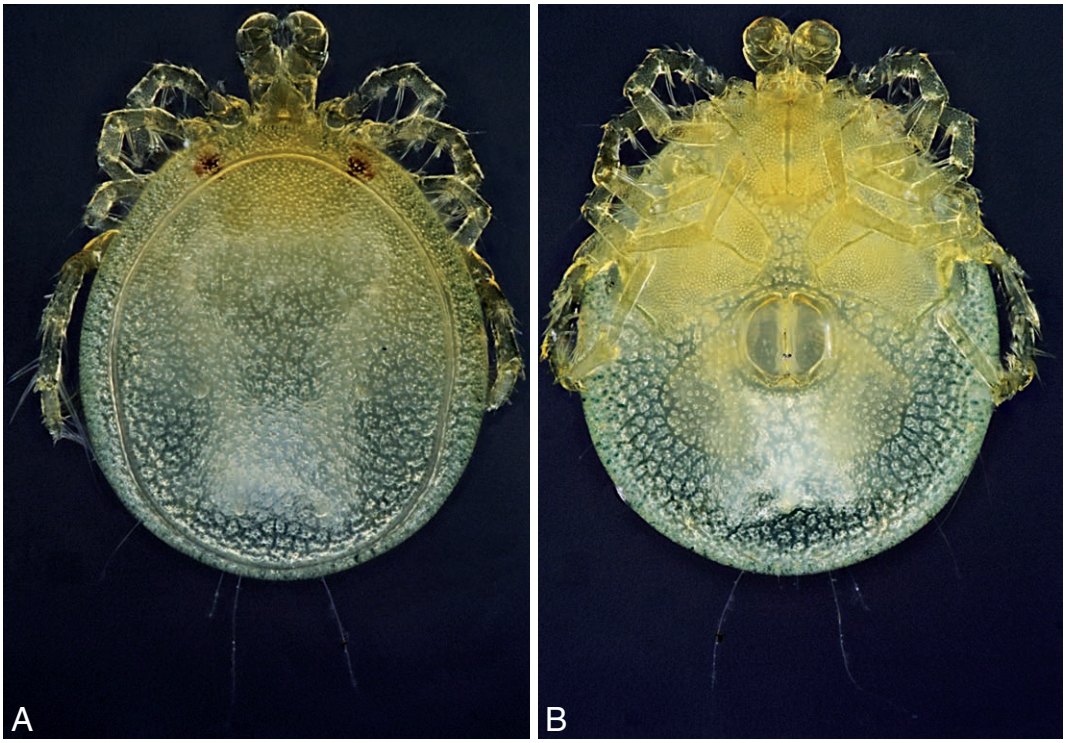


Fig. 103. *Wuria milloti* ♀ idiosoma. **A.** Dorsal view; **B.** ventral view.

Wuria ferrumequorum sp. nov.
Fig. 104

Material examined. Holotype: ♂, **MD 163a**, Montagne d'Ambre, (Antsiranana), Ambohitra (Joffreville), Rivière de Manques in Reserve Fontenay, 580 m a. s. l., 20-xi-2001 (SMF – slide mounted). – **Paratype:** Same data as holotype, 1 ♂ (RMNH, slide mounted).

Diagnosis. Male: The medial margins of Cx-II and -III closely in touch, not separated by idiosoma porosity; medial margins of Cx-III and Cx-IV equal in L, medially separated from each other by a stripe of coarse porosity; genital field in medial part close to coxal field; acetabular plates narrow, laterally not enlarged, strongly bent posteriorly. P-2 dorsal margin not protruding in proximal part, distoventral edge of P-4 angular.

Female: Unknown.

Description

Male (Fig. 104; female unknown): Colour unknown. Idiosoma L 527, W uncertain (specimen somewhat squashed), maximum W in centre; frontal margin bluntly pointed. Dorsal furrow incomplete; dorsal shield posteromedially fused to posteroventral sclerotization over a narrow bridge), dorsal shield L/W 462/308 (454/308). Gnathosomal bay shallow; all coxae laterally fused, Cx-III+IV medially separated from each other by a distinct suture with porose surface; medial margins of Cx-III and Cx-IV equal in L; gonopore field L 92; acetabular plates forming a horseshoe-shaped figure, with narrow, posteriorly directed distal parts. IV-leg with pointed extensions at distal margins of segments 1–5. Swimming setae: IV-leg-3, 1/1; IV-leg-4, 2/5; IV-leg-5, 5/0. Leg segments L IV-leg-4–6, 106, 108, 120. Palp stout, P-2 dorsal margin equally rounded, with four dorsal and three mediodistal setae; P-4 with slightly converging dorsal and ventral margins, distoventral edge subrectangular. Palp segments L P-1–5, 22, 54, 38, 64, 24.

Female: Unknown.

Etymology. *ferrum equorum*, Latin – horseshoe, for the shape of the male genital field.

Remarks. The two *Wuria* species known from the African continent and Madagascar, *W. falciseta* K. Viets, 1916 and *W. milloti* Gerecke 2004, have laterally strongly widened, subtriangular acetabular plates. Furthermore, *Wuria milloti* differs in the medial margin of Cx-IV distinctly shorter than the

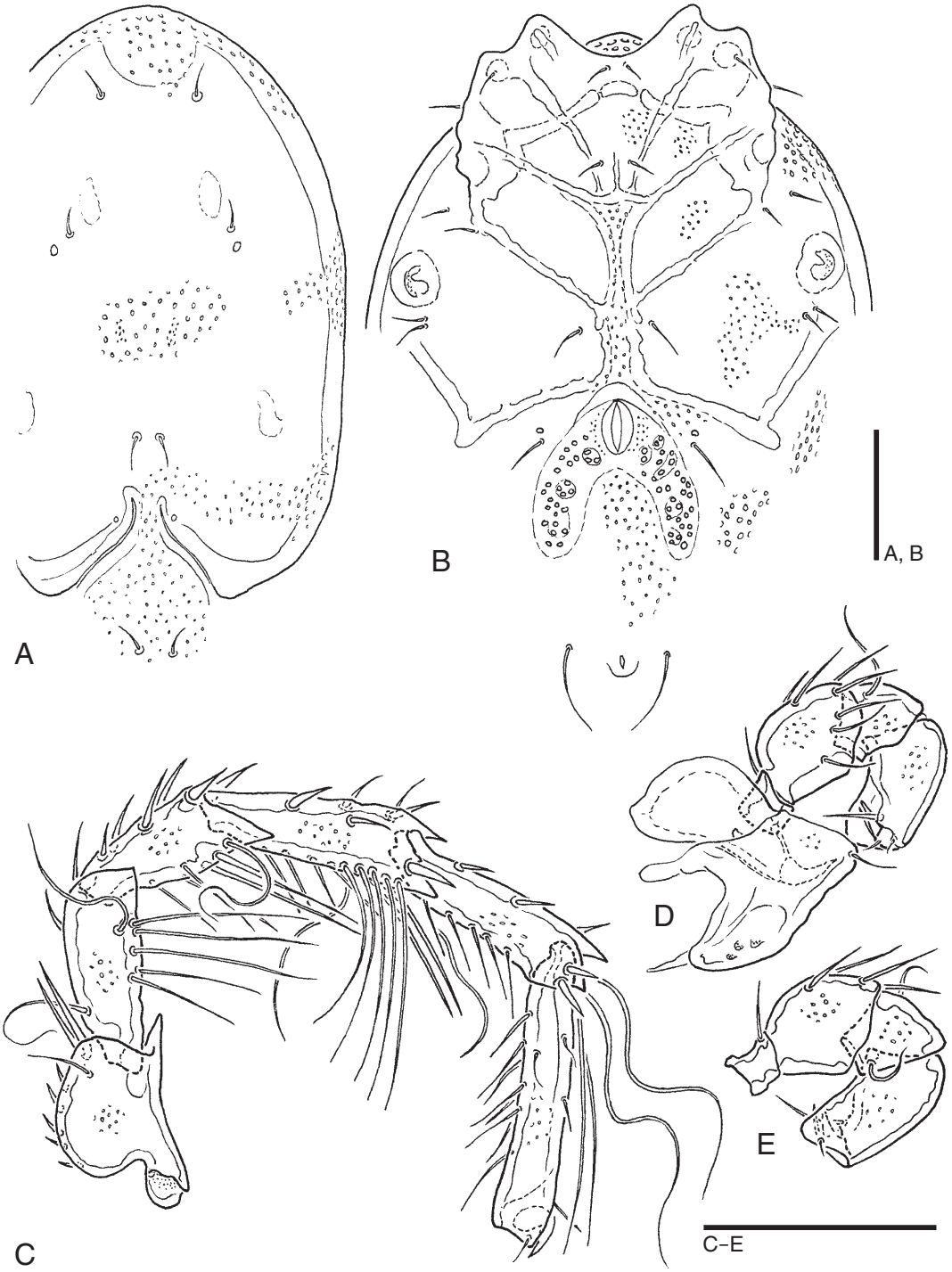


Fig. 104. *Wuria ferrumequorum* sp. nov. holotype ♂. **A.** Idiosoma, dorsal view (partim); **B.** idiosoma, ventral view (partim); **C.** IV-leg, posterior view; **D.** capitulum and palp, medial view; **E.** palp, lateral view. Scale bars = 100 µm.

medial margin of Cx-III and the protruding proximodorsal margin of P-2, *W. falciseta* in a stouter P-4 with equally rounded distoventral margin.

Distribution. N Madagascar, endemic, only known from the type locality.

Habitat. Streams.

Genus *Volobibikely* gen. nov.

Typus generis: *Volobibikely primum* sp. nov.

Diagnosis. Female (male unknown): Characters of the family Arrenuridae (see above). Idiosoma oval, frontal margin with a nose-shaped central protrusion. Interspace between coxal plates wide; medial margin of Cx-III+IV formed exclusively by Cx-III, Cx-IV triangular, medial edge retracted; acetabular plates short and broad, in an acute angle to longitudinal axis, four pairs of cupula-shaped short setae flanking gonopore. Legs with very dense setation, II-leg-4–5; III-leg-3–5 and IV-leg-3–5 with swimming setae. Capitulum short and stout; chelicera basal segment straight; P-1 narrow, P-2-4 with narrow segment base; P-2 medial margin distoventrally with eight long, whip-like setae; P-3 slender, with convex dorsal and ventral margins, bearing one long, whip-like distolateral seta; P-4 axe-shaped, distal margin indented, medially with one long whip-like seta; P-5 long and slender, sickle-shaped.

Etymology. The genus name means "furry mite" in Malagasy; composed of the Malagasy words *volo* – hairy, referring to the many long setae on P-2 and legs, and *bibikely* – small animal in general, as well used for 'mite'. The gender of the new species is neuter.

Remarks. As this is the first known species, we include into the diagnosis of the genus also several character states that might be species-specific when more representatives of the genus come to our knowledge (shape of idiosoma and coxae, formation of genital field). *Volobibikely primum* gen. nov., sp. nov., differs from all species of *Arrenurus* in the formation of the palp: (1) presence of long, whip-like setae on P-2 and P-3; (2) segments P-2-4 with a very narrow base, in particular the nearly triangular P-4; (3) segment P-5 long and sickle shaped.

The presence of long whip-like setae on palp segments is a character state found also in the monotypic genus *Allarrenurus*, endemic as well in Madagascar. *Allarrenurus pudens* differs, among others, in the elongate shape of the capitulum, a chelicera with a bowed basal segment, and stout palp segments which are not narrowed basally. Furthermore, the long setae of P-2 are scattered all over the segment, not concentrated at the mediodistal margin.

In the shape of the palp of *V. primum* gen. nov., sp. nov., we find a certain similarity to species of the monotypic family Harpagopalpidae. In the latter family, palp segments are basally narrowed and the P-4 may be subtriangular and with a sometimes-indented distal margin. However, harpagopalpid palps have never long whip like setae and their P-5 is distally narrowed. In addition, *Harpagopalpus* K. Viets, 1924 species are characteristic in many family-specific properties such as the skeleton-like capitulum, a chelicera with enormous claw, and the anteriorly-shifted IV-leg insertions.

Volobibikely primum sp. nov.

Figs 105-106

Material examined. Holotype: ♀, **MD 168**, Tampoketsan Ankazobe (Antananarivo), W from R.N. 4 (km 157), spring exposed W, 1400 m a.s.l., 29-xi-2001 (SMF – gnathosoma and palps, I-leg, IV-leg on slide "MAD 21").

Diagnosis. Female (male unknown): With the character states given for the genus.

Description

Female (holotype; Figs 105–106): Colour yellow-brown. Idiosoma L/W 850/688; dorsal L 810. Dorsal furrow complete, dorsal shield covering almost complete dorsum, L/W 753/624, with a characteristic pair of slit organs posterolaterally. Gnathosomal bay shallow; a narrow strip of porosity separating Cx-I+II from Cx-III+IV, W of medial separation between Cx-III about half gonopore field W; separation between coxae and genital field very narrow, anterior margin of gonopore field anterior to Vgl-4; gonopore field L/W 144/148 wide, no sclerotized patches visible; acetabular plates oblique, with straight anterior and strongly rounded posterior and lateral margins; acetabula very small; excretory pore near posterior margin. Legs with a very dense setation, with numerous long ventral setae on segments 2–4, particularly densely arranged on IV-3–6. Swimming setae: II-leg-4, 0/4; II-leg-5, 0/3; III-leg-4, 0/4; III-leg-5, 0/5; IV-leg-3, 0/1; IV-leg-4, 0/4; IV-leg-5, 0/6. Leg segment L I-leg-4–6, 96, 122, 140; IV-leg-4–6, 154, 188, 174. Palp segment L P-1–5, 30, 70, 112, 102, 82.

Male: Unknown.

Etymology. This is the first species of the genus. Derived from *primus*, Latin – first.

Remarks. See discussion of the genus.

Distribution. Central Madagascar, endemic.

Habitat. Spring.

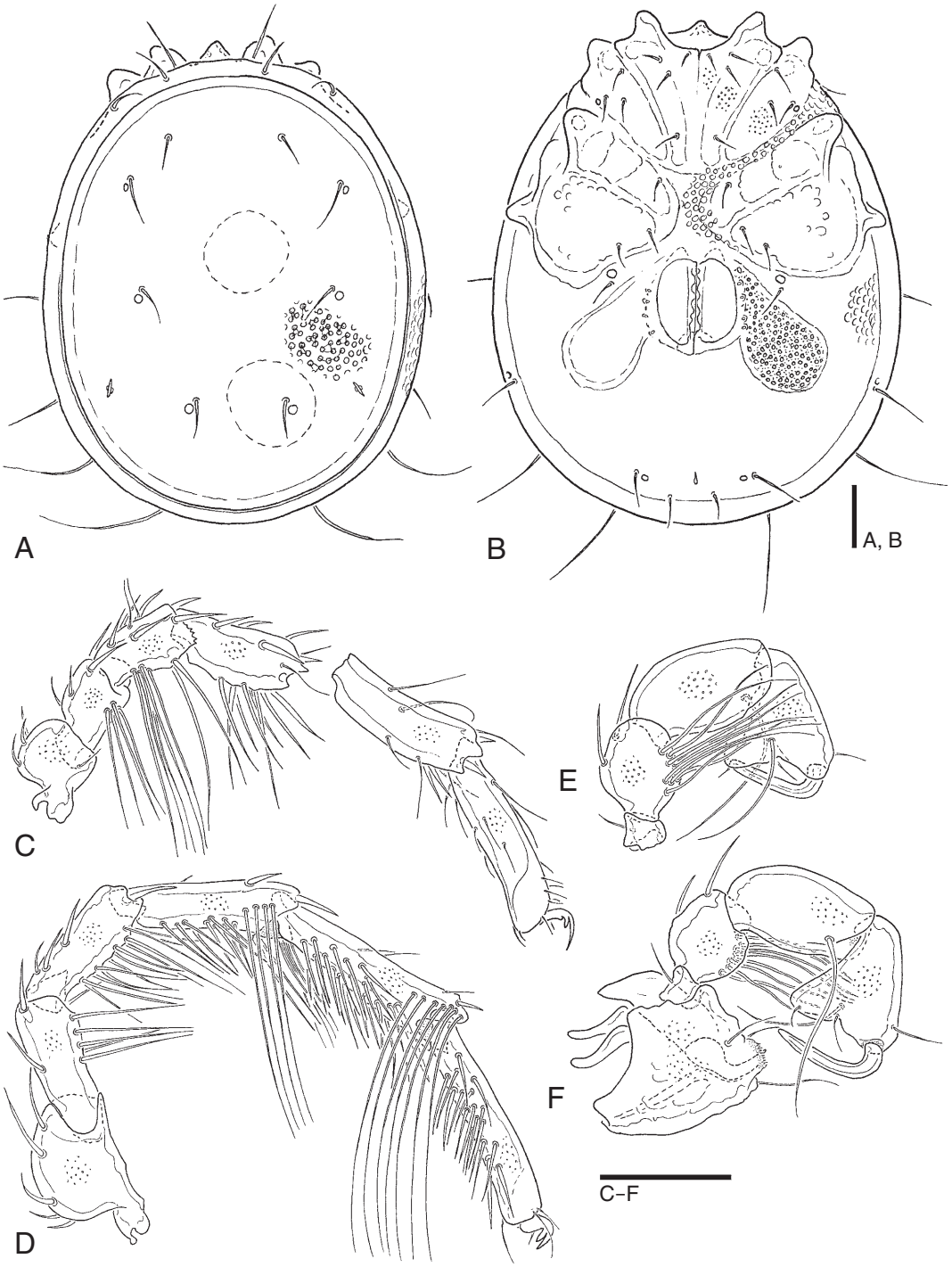


Fig. 105. *Volobibikely primum* gen. nov., sp. nov. holotype ♀. **A.** Idiosoma, dorsal view; **B.** ventral view; **C.** I-leg, posterior view; **D.** IV-leg, posterior view; **E.** palp, medial view; **F.** gnathosoma and palp, lateral view. Scale bars = 100 µm.

Fig. 106. *Volobibikely primum* gen. nov., sp. nov. holotype ♀, idiosoma. **A.** Dorsal view; **B.** ventral view.

Discussion

Also after this revision, the arrenurid fauna of Madagascar remains extremely insufficiently known – not only as concerns faunistic documentation, but also from a taxonomical point of view. Seven *Arrenurus* species are known in the male sex only, three *Arrenurus* species and *Volobibikely primum* are known only from females, Koenike (1898) even described one species after a deutonymph (here considered a nomen dubium as it is impossible to link a deutonymph to adults). Furthermore, Koenike (1898) assigned three species from Madagascar (*A. concavus*, *A. pectinatus*, *A. plenipalpis*) to species he had previously described from East Africa in the female sex only (Koenike 1893) – all these attributions are doubtful. In addition, in our collection there are several females which could not be assigned to a known male.

These facts suggest that the number of *Arrenurus* species from Madagascar is certainly much higher than known thus far. Furthermore, Fig. 1 shows dramatically the restrictedness of our faunistic knowledge of Malagasy arrenurids: The whole western part of the island is widely undocumented – except for a few samples made around Morondava, Mahajunga, Ankarana and on the Island of Nossi-Bé (all without appropriate geographical documentation), from parts away from the coast there are only three single specimen records, plus our data from four sites near Moramandia. Our own sampling activities in the southwest (surroundings of Tulear, 2001) did not produce records of arrenurid mites. A somewhat better documentation of the far north, selected parts of the eastern half of the island, and the upper mountains in the Centre was possible due to the recent field work presented in this paper. However, most of the higher mountain chains and many large catchments in the eastern part remain completely undocumented as well, including the highest elevations of the island (Tsaratanana massive) and most of the important primary forest remnants. Field work done in 2011 in the Andringitra National Park South of Fianarantsoa did not produce records of arrenurids.

Human activities brought extended parts of Central Madagascar to a state far away from natural conditions. Under this point of view, our findings (including the detection of a genus new to science) in the Tampoketsan Ankazobe area (sites MD 168–170) are of particular significance for nature conservation. The extended plateaus northeast of Antananarivo harbour incised valleys where an oasis-like vegetation allows permanent flow of springs and rivulets.

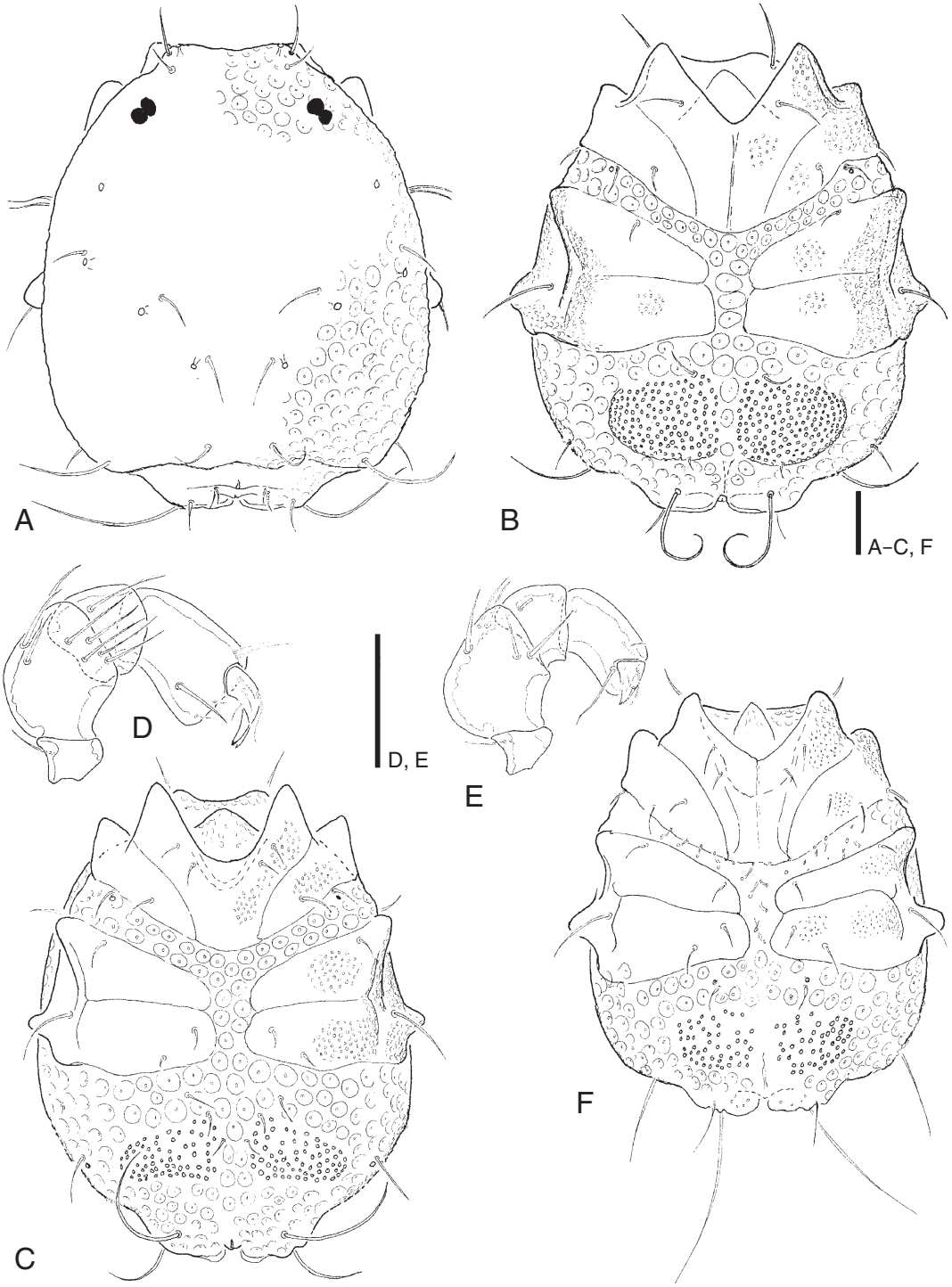


Fig. 107. *Thoracophoracarus*. A–B: *T. cooki* ♂; C–D: *T. silvarum* ♂; E–F . *T. felix* ♂. **A.** Idiosoma, dorsal view; **B.** idiosoma, ventral view **C.** idiosoma, ventral view; **D.** palp, medial view; **E.** palp, medial view; **F.** idiosoma, ventral view (Gerecke 2009). Scale bars = 100 µm.

Key to the arrenurid species known from Madagascar

The following species are not known in both sexes: Only males described: *Arrenurus abruptus*, *A. aethes* sp. nov., *A. delocercus* sp. nov., *A. felix* sp. nov., *A. limbatus*, *A. mandrarensis* sp. nov., *A. riparius* sp. nov., *Thoracophoracarus silvarum*, *Wuria ferrumequorum* sp. nov.; only females described: *Arrenurus cupitor*, *A. farsilis*, *A. sarcinatus*, *Volobibikely primum* sp. nov. As female *Arrenurus* lack in many cases distinct characters, the key presented below is preliminary for this sex.

1. Dorsal furrow absent (Fig. 107A). .... Genus *Thoracophoracarus* ... 2

– Dorsal furrow present, separating at least partly a dorsal shield from the remaining idiosoma sclerotization (Fig. 4). 4

2. Gnathosomal bay U-shaped, P-2 with more than four medial setae (Fig. 107B–C). .... *Thoracophoracarus silvarum* Gerecke, 2009

– Gnathosomal bay V-shaped, P-2 with less than four medial setae (Fig. 107D–F). 3

3. Acetabular plates with more than 100 pairs of acetabula in both sexes (Fig. 107D). .... *Thoracophoracarus cooki* Gerecke, 2009

– Acetabular plates with less than 100 pairs of acetabula in both sexes (Fig. 107E). .... *Thoracophoracarus felix* Gerecke, 2009

4. Setae of palp, including antagonistic bristle, extremely long and whip-like (Figs 2C, 105E–F). 5

– Setae of palp shorter, not whip-like (Figs 10E, 104D–E). 6

5. Gnathosoma long, without proximal apodemes (Fig. 2D). Palp segments robust, basally thick (Fig. 2C). Male I-/II-leg with extremely elongated terminal segments (>twice L preceding segment, Fig. 2F). .... Genus *Allarrenurus*, *Allarrenurus pudens* (Koenike, 1898)

– Gnathosoma short, with paired proximal apodemes (Fig. 105F). Palp segments basally very narrow, P-5 long and hook-like (Fig. 105E–F); Male unknown. .... Genus *Volobibikely* gen. nov., *Volobibikely primum* sp. nov.

6. Acetabular plates short, bent posteriorly, indistinct; gnathosomal bay very shallow (Figs 101, 102A, 103B, 104B). ..... Genus *Wuria* ... 7

– Acetabular plates various in shape, in general projecting laterally and distinct; gnathosomal bay deeper, U- or V-shaped (Figs 5A, 10B, 11B, 14A). ..... Genus *Arrenurus* ... 8

7. Acetabular plates broad, medial margin of Cx-IV shorter than medial margin of CxIII (Figs 101, 103B). ..... *Wuria milloti* Gerecke, 2009

– Acetabular plates narrow, medial margin of Cx-IV longer than medial margin of Cx-III (Fig. 104B). ..... *Wuria ferrumequorum* sp. nov.

8. Gonopore field narrow, anteriorly and posteriorly forming pointed edges. Sex-specific modifications at posterior idiosoma (e. g. medial projections or indentations) (Fig. 10B) and IV-leg (often with a spur at IV-leg-4) (Fig. 9C): Males. 9

– Gonopore field broad, anterior and posterior margins rounded. Posterior idiosoma various in shape, but without modifications in medial part; IV-leg-4 without modification (Fig. 11B): Females. 40

9. Idiosoma strongly elongated (L/W ratio >1.7). If a petiole present, it is short and uniform, or developed as a hardly visible pit (Figs 41A–B, 43A–B, 47A–B, 51A–B, 57A–B). 10

– Idiosoma various in shape, but not strongly elongated (L/W <1.7). A distinct petiole may be present (Figs 14A, 19B, 23A). 14

10. Posterior margin with a median cleft (Figs 41A, 47A–C, 51A–B, 52A–D). 11

– Posterior margin without a median cleft (Figs 43B, 57B). 13

11. Dorsal surface of cauda with a prominent, pointed hump anterior to a groove (Figs 47C–D, 48C). Posterolateral margins of cauda subrectangular (Fig. 47AC). .... *Arrenurus ambohitra* sp. nov.

– Dorsal surface of cauda without a prominent projection. Posterolateral margins of cauda rounded (Figs 41A, 43A, 52C, 57B–C). 12

12. Lateral margins of cauda subparallel (Figs 41A–B). Palp segments rather stout (Fig. 41C). .... *Arrenurus concavus* Koenike, 1893

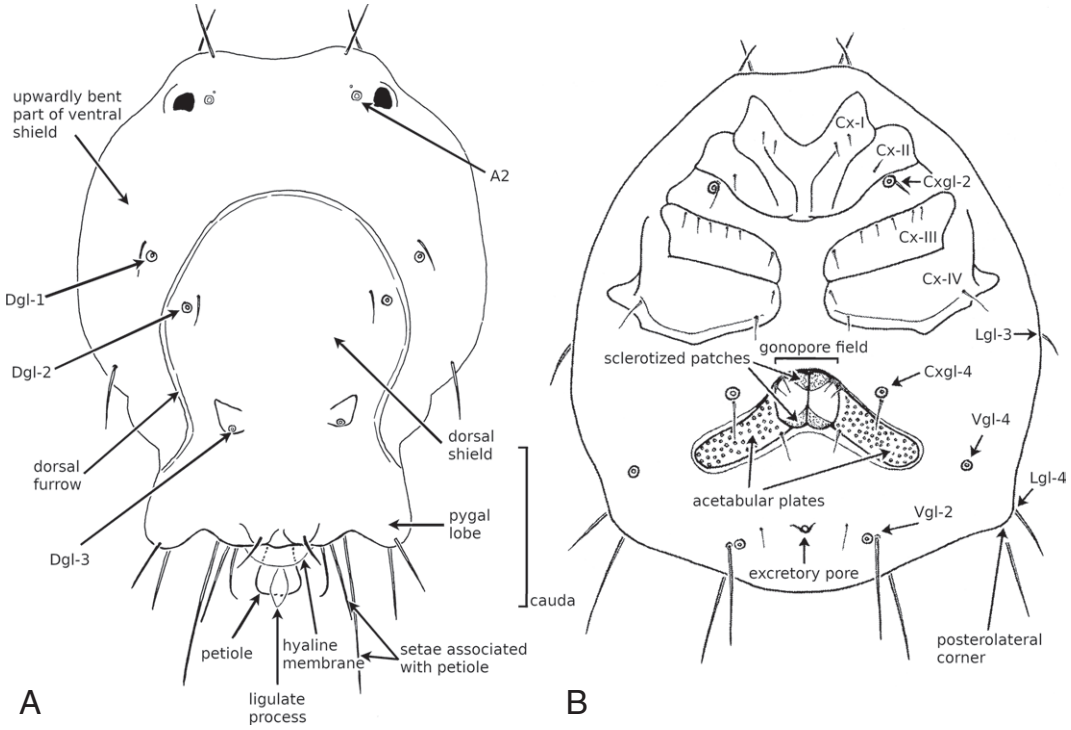


Fig. 108. Schematic overview explaining the major morphological terms used in *Arrenurus* (Gerecke et al. 2016, modified). Idiosoma. **A.** ♂, dorsal view; **B.** ♀, ventral view.

– Lateral margins of cauda posteriorly converging (Figs 51A–B, 52A–B). Palp segments more slender (Fig. 51D). ..... *Arrenurus concavoides* sp. nov.

13. Lateral margins of cauda basally with a pair of lateral humps, posterior margin concave, without a petiole (Fig. 43A–B). .... *Arrenurus geniculatus* Koenike, 1898

– Lateral and posterior margins of cauda convex, basally without humps (Fig. 57B), with a hook-shaped petiole (Fig. 57C). .... *Arrenurus uncipetiolatus* sp. nov.

14. Gonopore enlarged, directed posteroventrally, giving rise to a bluntly pointed penis-like protrusible structure (Figs 14A, 15A–D, 16D). .... *Arrenurus obliquus* Koenike, 1893

– Gonopore narrow, directed ventrally, without a penis-like structure. 15

15. Posterior margin medially with a prominent petiole various in shape (Figs 4, 7, 67A–B, 69A). 16

– Posterior margin without a prominent petiole (a denticle-shaped, small structure occasionally present on posterodorsal surface may be interpreted as petiole remnant) (Figs 68A–B, 73A, 78A–C, 79A, 80A–C). 28

16. Petiole tiny, sometimes tubular, located in a median cleft (Figs 30A–B, 31A–C, 61A, 67A–B, 69A). 17

– Petiole larger, elongated or enlarged, a median cleft present or not (Figs 7, 10A–D, 19A–B, 23A–D). 21

17. Acetabular plates extending far onto dorsal surface. Petiole tubular, located in a deep posterodorsal groove (Figs 61A–B, 67A–B, 69A). 18

– Acetabular plates ending near lateral margin. Posterior idiosoma without a deep groove. Petiole laterally compressed, bipartite (Figs 26A–B, 27A–D, 30A–B, 31A–C). 20

18. Posterior margin of dorsal shield convex; cauda with posterolateral and posterior margin equally rounded. An arrow-shaped central tip extend-

ing from the petiole tube (Figs 69A, 70A–C). . ..... *Arrenurus voeltzkowi* Koenike, 1898

– Posterior margin of dorsal shield straight; cauda with straight, converging lateral margins, rounded posterolateral angles, and posterior margin in medial part straight or slightly concave. No sclerotized structure extending from the petiole tube (Figs 61A, 62B, 67A–B). 19

19. Idiosoma more compact (L/W 1.2). Dorsal shield broader than long. Petiole tube narrow (Figs 67A–C). ..... *Arrenurus limbatus* Koenike, 1898

– Idiosoma more slender (L/W 1.3). Dorsal shield longer than broad. Petiole tube wider (Figs 61A–B, 62B). ..... *Arrenurus dentifer* Lundblad, 1946

20. Idiosoma elongated (L/W 1.5). Medial interspace between coxal plates narrow. Posterior cleft deep, flanking idiosoma ends pointed (Figs 30A–B, 31A–C). Petiole in lateral view consisting of a large dorsal and a small ventral unit. ..... *Arrenurus crenophilus* sp. nov.

– Idiosoma more compact (L/W 1.3). Medial interspace between coxal plates wider. Posterior cleft shallow, flanking idiosoma ends straight (Fig. 26A–B). Petiole in lateral view consisting of two equal units. .... *Arrenurus bispatulatus* sp. nov.

21. Petiole slender, distinctly longer than wide (Figs 19A–B, 20A–B). 22

– Petiole not longer than wide (Figs 4, 7, 12A, 75A). 24

22. Petiole distally with one or two paired hooks (Fig. 19A). ..... *Arrenurus rudiferus* Koenike, 1898

– Petiole distally narrowed, without hooks (Figs 10C, 23A–D). 23

23. Medial separation of Cx-III + IV narrow (Fig. 23B). Petiole distally digitiform and fluted, in proximal part surrounded by a membranous sheath (Figs 23A–D, 24A–B). .... *Arrenurus ambrensis* sp. nov.

– Medial separation of Cx-III + IV wider (Figs 9B, 10B). Petiole equally narrowed from base to tip, without a membranous sheath (Fig. 10C). .... *Arrenurus capensis* Thor, 1902

24. Idiosoma with a pair of posterolateral pygal lobes (Figs 7, 12A–B). 25

– Idiosoma posterior margin straight or convex, without distinct pygal lobes (Figs 4, 75A–B). 26

25. Cauda distinctly set off from anterior idiosoma, petiole long, flanked by a pair of bifurcate setae (Fig. 7). P-4 dorsal margin convex (as in the female, Fig. 8B). ..... *Arrenurus bidens* Koenike, 1898

– Caudal part not distinctly set off from anterior idiosoma, petiole short, flanking setae not bifurcate (Fig. 12A–B). P-4 dorsal margin concave (Fig. 12D). ..... *Arrenurus frustrator* Koenike, 1898

26. Petiole with posteriorly converging lateral margins, its posterior margin concave with a fine medial pit. (Fig. 4). .... *Arrenurus abruptus* Lundblad 1946

– Petiole posteriorly enlarged. 27

27. Petiole extending from a posterior cleft, tongs-shaped (Figs 75A–B, 76D). A pair of genital patches on posterodorsal idiosoma (Fig. 75A). P-4 dorsal margin convex (Fig. 75D). .... *Arrenurus brunneus* sp. nov.

– Petiole posterior margin between a pair of "ear-shaped" lateral extensions convex (Fig. 5A). P-4 dorsal margin concave (Fig. 5D). .... *Arrenurus auritus* Koenike, 1898

28. Posterior idiosoma with a groove various in shape; posterior margin with a median cleft (Figs 68A–B, 73A, 78A–C, 79A, 80A–C). 29

– Posterior idiosoma without a groove; posterior margin convex, straight or slightly indented, but not forming a cleft (Figs 36A, 37A, 55A). 32

29. Idiosoma pear-shaped, with maximum W in posterior part. Posterior idiosoma with a spectacular funnel-shaped groove narrowing from dorsal to ventral and here ending at the base of posterior cleft where the gonopore opens in posterior direction (Figs 73A, 74A). Legs without swimming setae. ..... *Arrenurus aethes* sp. nov.

– Idiosoma maximum W in anterior part or centre. Groove on posterior idiosoma not funnel-shaped; gonopore directed ventrally (Figs 68B, 78B, 80B). Legs with swimming setae. 30

30. In ventral view, posterior cleft open, forming a longish, rectangular bay with parallel margins (Fig. 78B). ..... *Arrenurus dobomponina* sp. nov.

– In ventral view, posterior cleft closed, its lateral margins in touch in posterior part (Figs 68B, 80B). 31

31. Closed part of posterior cleft long, its posterior end flanked by a pair of prominent tips of the posterior idiosoma (Fig. 68A–B). Distoventral margin of P-4 rounded (as in the female, Fig. 68D). ..... *Arrenurus pronominatus* K. Viets, 1942

– Closed part of posterior cleft shorter, posteriorly ending in a flat concave bay flanked by rounded posterior parts of the idiosoma margin (Fig. 80B–C). Distoventral margin of P-4 acute-angled (Fig. 80D). .... *Arrenurus mandrarensis* sp. nov.

32. Very large in size (idiosoma L >1200). Anterior idiosoma with spectacular dorsal humps. Cauda trapezoidal in shape (Figs 36A–B, 37A–C). 33

– Small to moderate in size (idiosoma L <1200). Idiosoma without strongly developed humps. Cauda with converging lateral margins (Fig. 55A). 34

33. Anterodorsal humps in lateral view with equally concave posterior margin. Posteromedial margin of cauda only slightly projecting (Fig. 36A–B). ..... *Arrenurus laticodulus* Piersig, 1898

– Anterodorsal humps in lateral view with convexly protruding posterior margin. Posteromedial margin of cauda more projecting (Fig. 37A–C). ..... *Arrenurus tandroka* sp. nov.

34. Idiosoma broad (L/W 1.1); cauda subrectangular, abruptly set off from the anterior idiosoma (Fig. 45B). Palp segment P-2 distoventrally with a brush of densely arranged, strong and curved setae (Fig. 45C). ..... *Arrenurus pectinatus* Koenike, 1893

– Idiosoma more slender (L/W > 1.2); lateral margins posteriorly gradually tapering, cauda with converging lateral margins (Fig. 55B). Palp segment P-2 distoventrally with a few scattered long and slender setae (Fig. 55C). 35

35. Idiosoma relatively compact (L/W 1.3). Medial separation of Cx-III+IV wide (corresponding to medial L Cx-IV). Acetabular plates short (not reaching lateral margin) and compact (Fig. 55B). ..... *Arrenurus felix* sp. nov.

– Idiosoma more elongate (L/W 1.4–1.6). Medial separation of Cx-III+IV narrow (< half medial L Cx-IV). Acetabular plates long (reaching lateral margin) and narrow (Figs 86B, 87B). 36

36. Posterior margin medially straight (Figs 86A, 87A). Gonopore field closer to coxal field than to posterior margin (Figs 86B, 87B). 37

– Posterior margin medially indented (Fig. 95A). Position of gonopore variable. 38

37. Idiosoma large (L/W > 800/600). Cauda conspicuously narrowed, with distinctly concave lateral margins (Fig. 87A). .... *Arrenurus gigas* sp. nov.

– Idiosoma minor (L/W < 600/400). Lateral margins of cauda straight or convex (Fig. 86A). .... *Arrenurus delocercus* sp. nov.

38. Posterior indentation deep. Anterior margin of dorsal shield away from frontal margin (Fig. 95A). Idiosoma large (L/W > 600/450). Swimming setae present on III-leg-5 and IV-leg-4-5 (Fig. 95C). ..... *Arrenurus riparius* sp. nov.

– Posterior indentation shallower. Anterior margin of frontal shield closer to frontal margin (Figs 82A, 91A). Idiosoma smaller (L/W < 550/400). Swimming setae present or absent. 39

39. Gonopore closer to coxal field than to posterior margin. Lateral margins of cauda weakly concave (Fig. 82A–B). Legs without typical swimming setae on III-leg-5 and IV-leg-2-3. Colour yellow to brown. .... *Arrenurus cuspidipes* sp. nov.

– Gonopore closer to posterior margin than to coxal field. Lateral margins of cauda strongly concave (Fig. 91A–B). Legs with typical swimming setae on III-leg-5 and IV-leg-2-5 (Fig. 91C). Colour deep blue (Fig. 92A–B). ....*Arrenurus porphyrus* sp. nov.

40. Gonopore field with two pairs of rounded sclerotized patches (Fig. 28). 41

– Gonopore field without paired sclerotized patches (Fig. 11D), a small band of sclerotization may be visible along anterior margins and gonopore lips (Fig. 21). 50

41. Acetabular plates extending anterior to gonopore field (Figs 28, 84A). Genital field rather far away from coxal field (distance > ½ gonopore field W, often > gonopore field L); Idiosoma rounded, without prominent humps; frontal margin convex (Figs 29A, 84A, 93A–B); minor in size (idiosoma L 470–800). 42

– Genital field close to coxal field (distance ½ gonopore field W or less); acetabular plates extending lateral or posterior to gonopore field (Figs 68C, 71). Idiosoma often with prominent humps; frontal margin straight to concave; major in size (idiosoma L 800–1050). 46

42. Gonopore far away from coxal field, in subterminal position (Fig. 28). .... *Arrenurus bispatulatus* sp. nov.

– Gonopore closer to coxal field, leaving a stripe of ventral sclerotization with the excretory pore at its posterior margin (Figs 25, 32B, 84A, 93B). 43

43. Distal ends of plates reaching lateral idiosoma margin (Figs 25, 32B). 44

– Acetabular plates not extended to lateral idiosoma margin. 45

44. Palp segment P-2 with a group of five long distoventral setae (Fig. 32C); Cx-IV medial margin relatively short, posterior margin oblique (Fig. 32B). .... *Arrenurus crenophilus* sp. nov.

– Palp segment P-2 with three to four, more scattered setae (Fig. 24I); Cx-IV medial margin relatively long, posterior margin perpendicularly to longitudinal axis (Fig. 25). .... *Arrenurus ambrensis* sp. nov.

45. Colour violet to deep blue (Fig. 94A–B); idiosoma more roundish; medial margin Cx-III < Cx-IV (Figs 93A–B). .... *Arrenurus porphyrus* sp. nov.

– Colour yellowish to brownish (Fig. 85A–B); idiosoma more slender; medial margin Cx-III > Cx-IV (Fig. 84A). .... *Arrenurus cuspidipes* sp. nov.

46. Posterior idiosoma cauda-like protruding; acetabular plates perpendicular to longitudinal axis, a pair of rounded extensions at posterolateral margin of gonopore field (Fig. 68C). .... *Arrenurus pronominatus* K.Viets, 1949

– Posterior idiosoma more rounded; acetabular plates slightly oblique to longitudinal axis, directed posteriorly; no posterolateral extensions at gonopore field (Fig. 71). 47

47. Frontal margin between lateral eyes protruding (Fig. 72A). ..... *Arrenurus voeltzkowi* Koenike, 1898

– Frontal margin not protruding (Fig. 98B). ...48

48. Postgenital area extended (about three times gonopore L: Fig. 77B); posterior idiosoma margin rounded. .... *Arrenurus brunneus* sp. nov.

– Postgenital area shorter (two times gonopore L or less: Figs 64B, 98B); posterior idiosoma margin rounded or (in mature specimens) with humps. 49

49. Acetabular plates more oblique to median axis, not narrowed in their lateral parts (Fig. 98B). ..... *Arrenurus farsilis* Koenike, 1898

– Acetabular plates forming a stronger angle to median axis, in their distal parts more narrowed (Fig. 64B). ..... *Arrenurus dentifer* Lundblad, 1946

50. Idiosoma large (L 1100–2000). 51

– Idiosoma smaller (L < 1100). 57

51. Acetabular plates sickle shaped: strongly curved, with deeply concave anterior, and equally rounded posterior margins (Figs 34C, 39B). 52

– Acetabular plates straight or slightly bent, not strongly curved in form of a sickle (Figs 6A, 11B, 13, 99B). 54

52. Frontal margin more equally convex (Fig. 34A). P-2 with one mediodistal seta (Fig. 34D). .... *Arrenurus dumazeri* Motaş, 1932

– Frontal margin projecting, with a concave central part between projecting glandularia (Fig. 39A). P-2 with 3–4 mediodistal setae (as in males, Fig. 37D). 53

53. Idiosoma smaller (L < 1500). .... *Arrenurus tandroka* sp. nov.

– Idiosoma larger (L > 1500) [females of this species not recorded from Madagascar]. .... *Arrenurus laticodulus* Piersig, 1898

54. P-4 dorsal margin straight or convex (Fig. 11C). ..... *Arrenurus capensis* Thor, 1902

– P-4 dorsal margin in central part concave, with a proximal hump (Fig. 99C). 55

55. Frontal margin convex. Medial separation of Cx-III + IV wide (> W gonopore field) (Fig. 99B). ..... *Arrenurus sarcinatus* Koenike, 1898

– Frontal margin concave. Medial separation of Cx-III + IV narrower (< half W gonopore field). 56

56. Acetabular plates laterally narrowed. Posterior margins straight, in medial part forming projections posterior to gonopore field (Fig. 13). .... *Arrenurus frustrator* Koenike, 1898

– Acetabular plates medially and laterally equal in W. Posterior margins convex, not forming posteromedial projections (Fig. 6A). .... *Arrenurus auritus* Koenike, 1898

57. P-2 distoventrally with a shrub of dense, strong and curved setae (as in male, Fig. 45C). Acetabular plates short and large, directed posterolaterally (Fig. 46). ..... *Arrenurus pectinatus* Koenike, 1893

– P-2 distoventrally with at maximum 10 setae, these setae long and slender (as in male, Fig. 87D). Acetabular plates various. 58

58. Gonopore field subterminal, distance coxal field-gonopore field about two times gonopore L; excretory pore terminal. Acetabular plates extending anterolaterally from gonopore field (Fig. 89B). ..... *Arrenurus gigas* sp. nov.

– Gonopore field and excretory pore away from posterior margin, closer to coxal field. Shape and extension of acetabular plates various. 59

59. Minor in size (idiosoma L < 850). Acetabular plates compact, not remarkably longer than maximum W (Figs 17A, 44B, 97B). 60

– Major in size (idiosoma L > 850). Acetabular plates more slender, longer than maximum W (Figs 8A, 21A, 42, 53). 63

60. Anterior to gonopore field, acetabular plates forming a broad, convexly protruding bridge (Fig. 44B). ..... *Arrenurus geniculatus* Koenike, 1898

– Acetabular plates separate from each other, or anteromedially to gonopore field unified by a narrow bridge (Fig. 97B). 61

61. Acetabular plates laterally wider than near gonopore field, with rounded posterior margins (Fig. 97B). ..... *Arrenurus cupitor* Koenike, 1898

– Acetabular plates with maximum W in proximal part near gonopore field, laterally gradually narrowed (Figs 17A, 59A). 62

62. Dorsal furrow incomplete (Fig. 60A). Medial margin of Cx_IV > medial margin of Cx-III (Fig. 59A). .... *Arrenurus uncipetiolatus* sp. nov.

– Dorsal furrow complete (Fig. 18A). Medial margin of Cx-IV < medial margin of Cx-III (Fig. 17A). ..... *Arrenurus obliquus* Koenike, 1898

63. Acetabular plates in an obtuse angle to longitudinal axis, their posterolateral edges distinctly posterior to level of gonopore field posterior margin (Figs 8A, 42). 64

– Acetabular plates perpendicular to longitudinal axis, their posterolateral edges on level of gonopore field posterior margin (Figs 21A, 49, 53). 65

64. Medial separation of Cx-III+IV wide, >½ gonopore W; acetabular plates in medial part curved, in lateral part directed laterally, with concave anterior margin (Fig. 42). .... *Arrenurus concavus* Koenike, 1893

– Medial separation of Cx-III+IV narrow, <½ gonopore W; acetabular plates slightly curved posteriorwards, with straight anterior margin (Fig. 8A). ..... *Arrenurus bidens* Koenike 1898

65. Acetabular plates rather wide over most of their extension, ending far from lateral idiosoma margin (Fig. 53). .... *Arrenurus concavoides* sp. nov.

– Acetabular plates narrower, ending near to, or reaching, lateral idiosoma margin (Figs 21A, 49). 66

66. Medial separation of Cx-III+IV wide, >½ gonopore W; acetabular plates in lateral part slightly enlarged, not reaching lateral idiosoma margin (Fig. 21A). ..... *Arrenurus rudiferus* Koenike, 1898

– Medial separation of Cx-III+IV narrow, <½ gonopore W; acetabular plates equal in W all over their length, extended to lateral idiosoma margin (Fig. 49). .... *Arrenurus ambohitra* sp. nov.

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