MORPHOLOGY OF ADULT AND NYMPHAL INSTARS OF GUSTAVIA LONGISETA (ACARI: ORIBATIDA: GUSTAVIIDAE)

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ABSTRACT: The oribatid mite, Gustavia longiseta Mahunka, 1984 (Gustaviidae) is redescribed in details, on the basis of specimens from Ethiopia. Nymphal instars of this species are described and illustrated for the first time.

KEY WORDS: Oribatida, supplementary description, morphology, juvenile instars, ontogeny, Gustavia longiseta, Ethiopian region

INTRODUCTION

Gustavia Kramer, 1879 (Acari: Oribatida: Gustaviidae) comprises 16 species that are collectively distributed in the Holarctic and Paleotropical regions (Subías 2004, online version 2012). The species Gustavia longiseta was described by Mahunka (1984) from Tanzania. The original description of this species was based on the study of a single specimen (holotype) and was very incomplete. In the course of faunistic research on Ethiopian oribatids (Ermilov et al. 2012) we found several specimens (adult and nymphal instars) of G. longiseta. Our main objective is to provide a supplementary description account of its morphology and ontogeny. At present, the morphology of juvenile instars is known in detail for only one Gustavia species, G. microcephala (Nicolet, 1855) (Ermilov 2010).

MATERIALS AND METHODS

Material. Specimens of Gustavia longiseta were collected at the following locality: 6°38’ N, 39°43’ E, 1883 m a.s.l., Bale Mountains National Park, Harenna Forest (woody species, in particular, Hagenia abyssinica forming the canopy), in soil, 23.11.2009, coll. L.B. Rybalov. The field-collected material included: 23 adults, two protonymphs, four deutonymphs, four tritonymphs.

Methods of study. All specimens were mounted in lactic acid on temporary cavity slides for measurement and illustration. All body measurements are presented in micrometers (μm). Body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the gastronotum. Notogastral width refers to the maximum width in dorsal aspect. Lengths of body setae were measured in lateral aspect. Formulae for leg setation are given in parentheses according to the sequence trochanter–femur–genu–tibia–tarsus (famulus included). Formulae for leg solenidia are given in square brackets according to the sequence genu–tibia–tarsus.

General terminology used in this paper mostly follows that summarized by Norton and Behan-Pelletier (2009).

RESULTS

Supplementary description of adult Gustavia longiseta Mahunka, 1984

Figs 1–18

Dimensions. Body size: body length 597–664 (mean 629; n=11); notogaster width 464–514 (mean 482; n=11).


Prodorsum (Figs 1, 3, 6–9). Rostrum with deep indentation (ind; clearly visible in dorso-anterior view of mite). It near base of indentation as a triangular tubercle (tub; visible in lateral view of mite). Prolamellae (plam) with minute cusps, truncate or with one small tooth, bearing setiform, slightly barbed rostral setae (ro, 61–77). Distal part of prolamellae located lateral to rostral indentation. Lamellae (lam) about half length of prodorsum, slightly converging. Lamellar cusps distinct, separated from lamellae, truncate or with small tooth, bearing setiform, slightly barbed lamellar setae (le, 94–114). Translamella absent. Interlamellar setae (in, 172–192) longest prodorsal setae, about equal prodorsum in length, setiform, slightly
barbed. Sensilli \((ss, 131–147)\) elongate spindle-form, with long stalk and well developed head and flagellate tip, barbed in medio-distal part. Exobot-hridial setae \((ex, 4–8)\) setiform, thin, smooth. Turi-toria \((tu)\) long. Wide serrate \((ser)\) ledge present on each side of prodorsum.

**Notogaster** (Figs 1, 2, 4, 5, 10). Seven pairs of notogastral alveoli and three pairs of notogastral setae present. Alveoli of setae \(c\) vestigial, poorly visible; alveoli of setae \(la, lm, ip, h_1, h_2, h_3\) developed normally. Setae \(p_1\), longest setae on notogaster \((57–73)\), setiform, slightly barbed; setae \(p_2\) and \(p_3\) short \((4–6)\), thin, smooth. Lyrifissures \(ia, im, ip, ih\) and \(ips\) short, distinct. Opisthontal gland openings \((gla)\) present, but often poorly visible. Pedotecta I, II \((Pd I, Pd II)\), triangular discidia \((dis)\) and circumpedal carinae \((cp)\) well developed, morphology typical for genus. Notogastral posterior tectum well developed.

**Gnathosoma** (Figs 11–13). Morphology typical for genus (Grandjean 1957; Norton and Be-han-Pelletier 2009; Ermilov 2010). Subcapitulum “suctorial”, overall longer than wide \((164–168 \times 77–86)\). Subcapitular setae \(h\) \((49–65)\), \(m\) \((16–20)\)
Morphology of adult and nymphal instars of *Gustavia longiseta*

Figs 5–14. *Gustavia longiseta*, adult: 5 — posterior view of notogaster; 6 — rostral setae; 7 — lamellar seta; 8 — interlamellar seta; 9 — sensillus; 10 — notogastral seta p1; 11 — subcapitulum; 12 — palp; 13 — chelicera; 14 — genital seta g2. Scale bars 100 μm (5), 50 μm (6–9, 11, 13), 10 μm (10, 14), 20 μm (12).

Figs 15–18. *Gustavia longiseta*, legs of adult: 15 — leg I, left, antiaxial view; 16 — leg II, without trochanter, left, antiaxial view; 17 — leg III, right, antiaxial view; 18 — leg III, right, antiaxial view. Scale bar 50 μm.

**Epimeral region** (Figs 2, 3). Epimeral borders IV often poorly developed, straight, connected to lateral sides of genital aperture. Epimeral setae setiform, slightly barbed, differs in length: 1a, 1c, 2a, 3a, 3c, 4c 20–36; 1b, 3b, 4a, 4b 41–61.

**Anogenital region** (Figs 2, 4, 5, 14). Six pairs of genital (20–24), one pair of aggenital (ag, 28–32), two pairs of anal (an1, an2, 20–28) and three pairs of adanal (ad1–ad3, 32–49) setae present; all setiform, slightly barbed. Lyrifissures iad in preanal

Figs 19–22. *Gustavia longiseta*, juvenile instars: 19 — protonymph, dorsal view; 20 — tritonymph, dorsal view; 21 — deutonymph, lateral view of prodorsum and partially gastronomic region, legs IV, gnathosoma and epimeral setae not shown, only basal parts of leg I–III shown; 22 — deutonymph, lateral view of posterior part of gastronotum. Scale bars 100 μm (19, 21, 22), 200 μm (20).
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position, transversely oriented, often poorly visible.

**Legs** (Figs 15–18). Median claw only slightly thicker than lateral claws. Trochanters and femora III, IV with ventral ridges and dorsal porose areas (very poorly visible). Trochanters III and IV with dorso-distal tooth. Formulae of leg setation and solenidia: I (1–5–3–4–20) [1–2–2], II (1–5–3–4–16) [1–1–2], III (2–3–2–3–15) [1–1–0], IV (1–2–3–3–12) [0–1–0]; homology of setae and solenidia indicated in Table 1. Setae setiform, mostly slightly barbed. Famulus setiform, straight, blunt-ended. Solenidia setiform, mostly blunt-ended.

**Description of nymphs *Gustavia longiseta* Mahunka, 1984**

Figs 19–44


**Integument.** Body cuticle light brown. Microgranular cerotegument covers body and legs in all instars; granules small, spherical (diameter up to 4).

**Prodorsum** (Figs 19–21, 23–27). Relatively short, about half-length of gastronotic region in lateral view. Rostrum narrowly rounded. Distinct transverse ridge (r) present between bothridia. Rostral setae slightly thickened, setiform, barbed, inserted on tubercles. Lamellar setae shorter and thinner than latter, with sparse small barbs, inserted on small tubercles. Interlamellar setae minute, spiniform, blunt-ended, smooth, set near transverse ridge. Exobothridial setae setiform, barbed, inserted on tubercles. Sensilli elongate spindle-form, with well developed head and long flagellate tip, slightly barbed. Comparison of prodorsal setae measurements of juvenile instars given in Table 2.

**Gastronotic region** (Figs 19, 20, 22, 28, 29, 36–38). Covered with typical reticulate exuvial scalps, each with 9 pairs of gastronotical setae (Ermilov 2010). Twelve pairs of gastronotical setae
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present, lacking dorsocentral setae. Apophyses of setal pair \( c_1 \) united on single medial sclerite, same with pair \( h_1 \). All setae setiform, barbed. Setae \( c_3 \) and \( h_1 \) longest, \( c_2 \) shortest on dorsal side. Cupules \( ia, im, ip \) well visible.

**Gnathosoma** (Figs 31, 32). Similar to adult (see above) (see Ermilov 2010): subcapitulum “suctorial”; hypostomal setae \( h \) little longer than \( a \), and considerable than \( m \); palpal setation 0–2–1–3–8(ω); palpal eupathidium \( acm \) and solenidion \( ω \) attached in double horn; chelicerae styliform.


Figs 33–38. *Gustavia longiseta*, left half of epimeral (33–35) and left half of anogenital (36–38) regions of nymphs: 33, 36 — protonymph; 34, 37 — deutonymph; 35, 38 — tritonymph. Scale bars 50 μm (33–37), 100 μm (38).
Morphology of adult and nymphal instars of *Gustavia longiseta*

**Anogenital region** (Figs 36–38). Ontogenetic formulae (protonymph to tritonymph, respectively): genital 1–3–5, aggenital 0–1–1, anal 0–3–3, anal 0–0–2. All setae setiform, smooth. Cupules *ih, ips, iad* appearing in normal ontogenetic pattern. Opisthonotal gland opening small, poorly visible.

**Legs** (Figs 39–44). Formulae of leg setation and solenidia: protonymph I (0–2–3–4–16) [1–1–2], II (0–2–3–3–13) [1–1–1], III (1–2–2–2–13) [1–1–0], IV (0–0–0–0–7) [0–0–0]; deutonymph I (1–4–3–4–16) [1–2–2], II (1–4–3–4–13) [1–1–2], III (2–3–2–3–13) [1–1–0], IV (1–2–2–2–12) [0–1–0]; tritonymph: I (1–4–4–5–18) [1–2–2], II (1–4–4–5–15) [1–1–2], III (2–3–3–4–15) [1–1–0], IV (1–2–3–4–12) [0–1–0]; homology of setae and solenidia indicated in Table 1. Setae setiform, mostly slightly barbed. Famulus setiform. Solenidia setiform, blunt-ended. Tibia I–IV and genua I–III with coupled seta *d* and solenidion on dorsal side.

**REMARKS**

**Adult instar.** Our adult specimens fit well with the original description and illustrations of Mahunka (1984), but there are slight morphometrical differences. Interlamellar and epimeral setae are somewhat longer (versus shorter in Ethiopian specimens), notogastral setae *p₁* and *p₂* represented by alveoli (versus represented by short setae in...
Development of leg setation of *Gustavia longiseta* during ontogeny. Larva unknown; most setae of protonymph probably formed in larval instar (see Ermilov 2010)

<table>
<thead>
<tr>
<th>Character</th>
<th>Protonymph</th>
<th>Deutonymph</th>
<th>Tritonymph</th>
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<tbody>
<tr>
<td>Trochanter</td>
<td>–</td>
<td>d, bv''</td>
<td>d, bv''</td>
</tr>
<tr>
<td>Femur</td>
<td>–</td>
<td>d, bv''</td>
<td>d, bv''</td>
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<tr>
<td>Genu</td>
<td>d, (l)</td>
<td>d, (l)</td>
<td>d, (l)</td>
</tr>
<tr>
<td>Tibia</td>
<td>(fi, (tc), (p), (u), (a), s, (pv), (pl), e, φ, ω, φ')</td>
<td>(fi, (tc), (p), (u), (a), s, (pv), φ)</td>
<td></td>
</tr>
<tr>
<td>Tarsus</td>
<td>–</td>
<td>(it)</td>
<td>(it)</td>
</tr>
</tbody>
</table>

Roman letters refer to normal setae (e — famulus), Greek letters refer to solenidia, dσ and dφ — solenidia and seta coupled. One apostrophe (') marks setae on anterior and double apostrophe ("') setae on posterior side of the given leg segment. Parentheses refer to a pair of setae. Setae are listed only for the instar in which they first appear.

**Table 2.** Comparison of prodorsal setae measurements (in µm) of nymphal *Gustavia longiseta*

<table>
<thead>
<tr>
<th>Character</th>
<th>Protonymph</th>
<th>Deutonymph</th>
<th>Tritonymph</th>
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</thead>
<tbody>
<tr>
<td>Length of rostral seta</td>
<td>36–41</td>
<td>49–65</td>
<td>61–86</td>
</tr>
<tr>
<td>Length of lamellar seta</td>
<td>12–16</td>
<td>16–24</td>
<td>28–32</td>
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<tr>
<td>Length of interlamellar seta</td>
<td>2–4</td>
<td>4–8</td>
<td>4–8</td>
</tr>
<tr>
<td>Length of sensillus</td>
<td>90–110</td>
<td>106–135</td>
<td>131–143</td>
</tr>
<tr>
<td>Length of exobothridial seta</td>
<td>20–32</td>
<td>32–57</td>
<td>53–73</td>
</tr>
</tbody>
</table>

*Number of studied specimens

Ethiopian specimens). We believe these differences represent intraspecific (perhaps geographical) variability.

**Nymphal instars.** Nymphs of *G. longiseta* and *G. microcephala* (see Ermilov 2010) are similar in general appearance: body form; microgranular cerotegument on body and legs; spindle-form sensilli; rostral, lamellar and exobothridial setae setiform (*ro > ex > le*); interlamellar setae short, spiniform; gastronomic region covered with reticulate exuvial scalp(s); gastronomic region with 12 pairs of setae (dorsocentral setae absent); dorsal gastronomic setae long, excepting short *c*₂ (*e* and *h*₁ longest); apophyses of setal pairs *c*₁ and *h*₁ each united on single medial sclerite; paraproctal setae absent in proto- and deutonymphal instars; subcapitulum “suctorial”; palpal setation 0–2–1–3–8(+)ω; palpal eupathidium *acm* and solenidion attached in double horn; chelicerae styliform; setal formulae for epimeres: protonymph 3–1–2–1, deutonymph 3–1–3(2)–2, tritonymph 3–1–3–3; setal ontogenetic formulae for anogenital region:
Morphology of adult and nymphal instars of *Gustavia longiseta*

genital 1–3–5, aggenital 0–1–1, anal 0–3–3; development of leg setation and Solenidia (see Table 1); all tibia and genua I–III of legs with coupled setae *d* and solenidion.

This high level of similarity suggests that *Gustavia* can be included among those genera in which species are difficult to distinguish based on juvenile characteristics alone. Nymphs of *G. longiseta* can be distinguished from those of *G. microcephala* only by the length of notogastral setae *p* (protonymph: *p*₂ less than twice as long as *p*₁ versus *p*₂ more than twice as long as *p*₁ in *G. microcephala*; deuto- and tritonymph: *p*₂ not longer than *p*₁ versus *p*₂ longer than *p*₁ in *G. microcephala*).

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**REFERENCES**


