RESEARCH ARTICLE

# New records and taxa of Caenidae (Insecta: Ephemeroptera) from Ethiopia, with particular regard to the River Awash region

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Abstract

Four new species of *Caenis* and a new subspecies of *Afrocaenis major* are described from Ethiopia: *Afrocaenis major ginchica* **ssp. n.** (imagines and larvae), *Caenis gretathunbergae* **sp. n.** (imagines and larvae), *Caenis oromo* **sp. n.** (larvae), *Caenis grafi* **sp. n.** (larvae) and *Caenis afrocaenoides* **sp. n.** (imagines), as well as the larval stages of the formerly described *Caenis nervulosa* Malzacher, 1990. Additionally, a few males of the Palaearctic species *Caenis horaria* (Linnaeus, 1758) are recorded for the Afrotropical Region. A larval key to the five Ethiopian species with known larvae is provided.

Keywords: *Afrocaenis*, *Caenis*, Ethiopia, mayflies, new species, new subspecies.

Zusammenfassung

Vier neue Arten von *Caenis* und eine neue Unterart von *Afrocaenis major* aus Äthiopien werden beschrieben: *Afrocaenis major ginchica* **ssp. n.** (Imagines und Larven), *Caenis gretathunbergae* **sp. n.** (Imagines und Larven), *Caenis oromo* **sp. n.** (Larven), *Caenis grafi* **sp. n.** (Larven) und *Caenis afrocaenoides* **sp. n.** (Imagines), wie auch die Larve der bereits beschriebenen *Caenis nervulosa* Malzacher, 1990. Ebenso wird anhand männlicher Imagines die paläarktische Art *Caenis horaria* für die afrotropische Region nachgewiesen. Ein larvaler Bestimmungsschlüssel für die fünf äthiopischen Arten mit bekannten Larven wird beigefügt.

## Introduction

Of the 23 species of Caenidae so far known from East Africa, nine can be found in Ethiopia: *Afrocaenis major* Gillies, 1977, *Caenis brevipes* Kimmins, 1956, *Caenis cibaria* Eaton, 1879, *Caenis ghibana* Malzacher, 1990, *Caenis jinjana* Kimmins, 1956, *Caenis nervulosa* Malzacher, 1990, *Caenis margherita* Malzacher, 1990, *Caenis pallida* Malzacher, 1990, and *Caenis scotti* Ulmer, 1930.

In this contribution, four new species of *Caenis* from this region are described. Also described is a new subspecies of *Afrocaenis major* as well as the previously unknown larva of *Caenis nervulosa*. Finally, *C. horaria* is recorded for the first time for the Afrotropical region. Thus, together with the species described herein, the number of Ethiopian Caenidae now adds up to 14. A key to the five Ethiopian species with known larvae is provided.

### Material and methods

Specimens were collected by WOLFRAM GRAF and the LARIMA team (YONAS TEREFE, ASCHALEW LAKEW, OLYAD DEREJE, GENANAW TESFAYE, ALEMAYEHU WUBIE, GERNOT ENGLMAIER, PAUL MEULENBROEK, and HERWIG WAIDBACHER), within the framework of ecological investigations of the River Awash area, Ethiopia (ENGLMAIER et. al. 2020). The type specimens and all other material are deposited at Musée Cantonal de Zoologie, Lausanne, Switzerland.

Incorporated in the present investigation was also material collected in 1996 in the Semien Mountains by VERENA LUBINI, which is held at SMNS. Material from Lake Wonji collected in 1962 by D. S. BROWN (GILLIES 1982), and the type specimens of *Afrocaenis major* and *Afrocaenis browni* from Tanzania, are held by the Natural History Museum, London.

The investigated material was previously preserved in formaldehyde and is currently stored in 75% ethanol. Specimens used for SEM were dehydrated through a stepwise immersion in ethanol and then dried by critical point drying. The mounted material was coated with a 20 nm Au layer, and examined and photographed with a Zeiss EVO LS 15 scanning electron microscope. Macrophotographs were taken with a Leica Z16APO Macroscope and processed with Leica Application Suite™ Version 3.1.0 to obtain combined photographs with extended depth of field. Digital photographs were enhanced in Photo Filter 6.5.2.

## Systematic account

### Genus *Afrocaenis* Gillies, 1982

#### Remarks

Diagnostic characters of *Afrocaenis* are very variable even in the same population, e.g., the forcipes, particularly in their apical part, can be very different in shape and length (Fig. 4d). In the larvae there is also some variability in the shape of sternum IX (Figs. 4j–m) (see Discussion). Therefore, the investigated populations of the Ginchi Region, which seem to differ from previously-described

specimens from the locus typicus in Tanzania, are here described as a new subspecies, *Afrocaenis major ginchica*. The diagnosis of the genus can be expanded as follows:

Differential diagnosis

*Afrocaenis* can be characterised and distinguished from all other genera of Caenidae by the following combination of characters:

Larva. Eyes in male enlarged (Figs. 2–3). Claws slender and elongated; fore and mid claws without denticulation (Fig. 8), hind claw with long row of microdenticles and with a strong, voluminous denticle at apical end of row (Figs. 4i, 9–10). Coxal processes forming long, bowed ridges, laterally with long thin bristles (Figs. 4g, 7). Long bristles on lateral margin of pronotum, mesonotum and on wing pads. Margins of lateral processes of abdomen densely provided with moderate to long bristles; ventral side with a couple of sublateral bristles besides the lateral ones. Hind margin of sternum IX with a medial indentation, in most cases deep and rounded (Figs. 4j–m, 14). Without ocellar tubercles. Clypeus not strongly protruding anteriorly. Maxillary and labial palps three-segmented. Foreleg without long filtering setae. Ventral side of operculate gill with a regular row of complex, scale-shaped microtrichia. Without gill basket. Gill III with at most 8 filaments with 3 or more branches.

Male. Eyes strongly enlarged (Fig. 1). Penis with short, broadly-rounded lobes and a large, v-shaped lateral sclerite (Figs. 4a–b, 5). Styliger sclerite with large, apically more or less broadened apophyses (Figs. 4a–c, 5–6). Forcipes small, apically rounded or with 1 to few short spines or bumps, without longitudinal grooves (Fig. 4d). Prosternum narrow, with a prosternal triangle (Fig. 4f).

*Afrocaenis major ginchica* **ssp. n.**
(Figs. 1–14)

Material examined

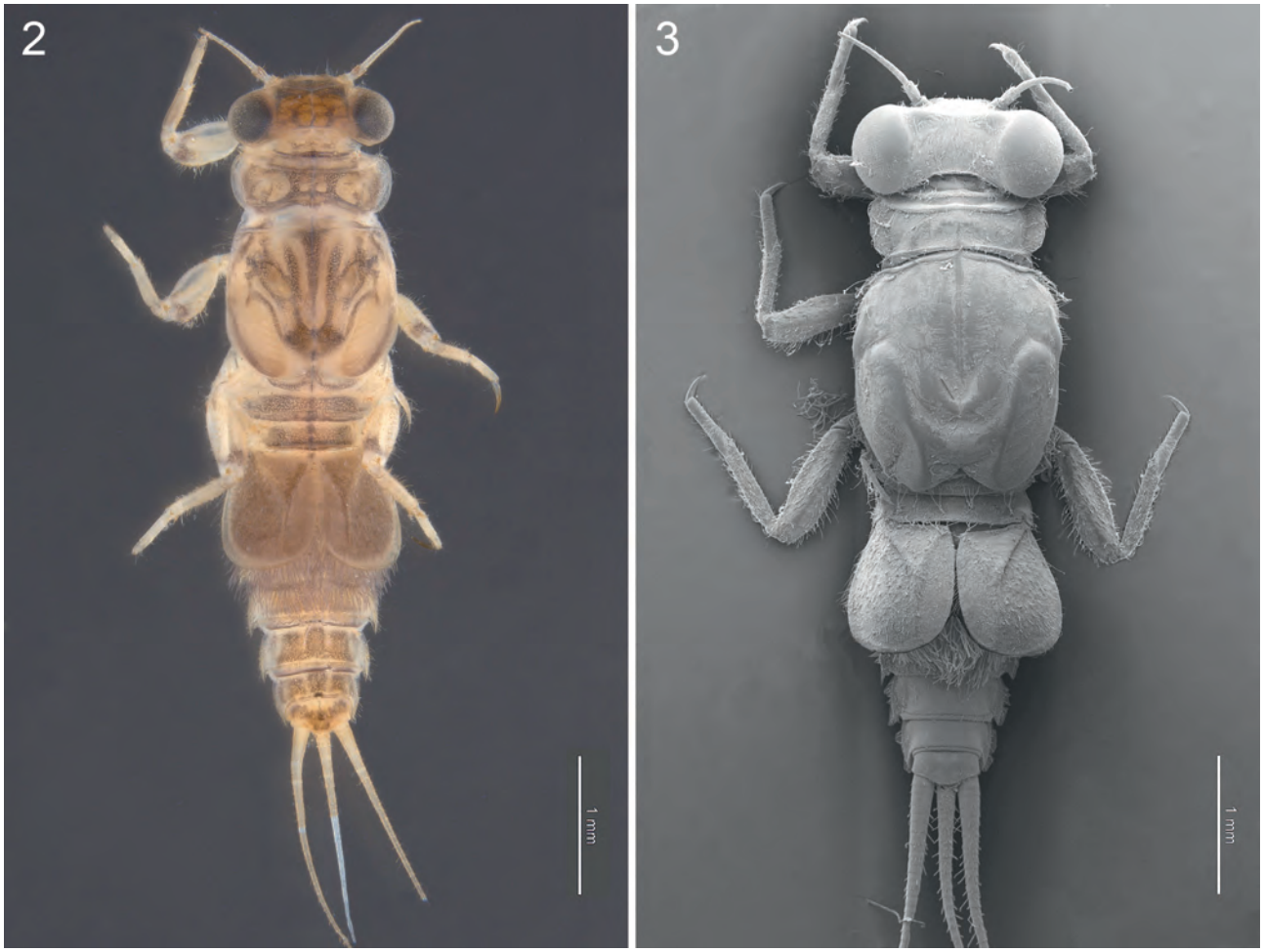
Holotype. ♂ (on microslide): Ethiopia, Ginchi, Gare-Arera, N9°02′23.42″, E38°06′58.49″, 2244 m, 15.01.2018.

Paratypes. Same data as holotype, 3♂♂ (15.01.2018) and 11♂♂ (06.11.2017).

Other material. Ethiopia, Chilimo Forest, N9°4′1.05″, E38°8′9.02″, 05.11.2017, 2♂♂. – Ethiopia, Chilimo Forest (S 1), N9°4′1.05″, E38°8′9.02″, 06.11.2017, 1 La. – Ethiopia, Chilimo Forest, N9°5′19.00″, E38°9′13.01″, 04.08.2018, 4 La. – Ethiopia, Awash Kunture, Chilimo Forest, 06.11.2017, 7 La. – Ethiopia, Chilimo Forest, N9°5′19.00″, E38°9′13.01″, 04.08.2018 – Ethiopia, Chilimo Forest (sample no. AW1), N9°05′19″, E38°09′13″, 2484 m, 19.02.2018, numerous larvae of different developmental stages. – Ethiopia, Chilimo Forest (sample no. AW2), N9°04′07″, E38°08′23″, 2459 m, 19. 02.2018, numerous larvae of different developmental stages. – Ethiopia, Uper Awash, Ginchi, Chilimo Forest, 6.11.2017, 6 La. – Ethiopia, W of Ginchi (sample no. AW3), N9°02′21.72″, E38°05′52.21″, 2254 m, 20.02.2018, numerous larvae of different developmental stages. – Ethiopia, S of Ginchi (sample no. AW4), N9°00′45.27″, E38°08′46.01″, 2208 m, 19.02.2018, numerous larvae of different developmental stages. – Ethiopia, SSE of Ginchi (sample no. AW5), N9°00′08.94″, E38°09′23.26″, 2181 m, 19. 02.2018, few larvae, – Ethiopia, Awash-Kunture, N8°42′21.94″, E38°36′18.78″, 2003 m, 6.11.2017, 1 La. – Ethiopia, Korkada, N8°30′2.78″, E39°33′7.41″, 10.01.18, few larvae. – all leg. LARIMA team.

Ethiopia, Lake Wonji, 08.04.1962, 14 ♂♂. 7 ♀♀, 6 La, 9 La Ex. – all leg. Brown.


**Fig. 1.** *Afrocaenis major ginchica* **ssp. n.**, male imago, habitus.




**Figs. 2–3.** *Afrocaenis major ginchica* **ssp. n.**, habitus of male larva. – **2**. Young larva, macro photograph. **3**. Older larva, SEM.

*Afrocaenis major major* (sub *Caenopsella*): Holotype ♂. Tanzania: Lushoto, Western Usambara Mountains (38° 20′ E, 4° 50′ S), 1400 m, 28.10.61. – Paratypes. Same data as holotype, 11♂♂. – all leg. GILLIES.

*Afrocaenis major*: Ethiopia, Semien Mt., Jinbar, near source, 3500 m, 02.02.1996, 14 larvae. – Ethiopia, Semien Mt., Jinbar, above Gich village, 3400 m, 31.01.1996, 17 larvae. – Ethiopia, Semien Mt., Jinbar-Tributaries, 3500 m, 16.01.1996, 22 larvae, 31.01.1996, 17 larvae. – Ethiopia, Semien Mt., Kaba Wenz. 3020 m. 17. 01. 1996, 1 larva. – all. leg LUBINI.

### Etymology

The name of the subspecies refers to the Ethiopian town Ginchi, near which the new subspecies was found.

### Male imago

### Measurements, ratios and colouration

Body length: 4.0–4.5 mm; wing length: 3.5–4.0 mm; length of foreleg: 3.5–3.9 mm. Ratio of forefemur : foretibia = 0.52–0.58; ratio of foretibia : foretarsus = 1.07–1.20; ratio of foreleg : hind leg = 1.56–1.70; ratio of 1st segment of the foretarsus : 2nd : 3rd : 4th : 5th = 1 : 3.5–4.5 : 1.8–2.1 : 1.8–2.1 : 1.7–1.8.

Colouration of cuticle (Fig. 1). Head and pronotum brown. Mesonotum dark brown, scutellum and sutures dark brown to blackish, pleura a little lighter brown, sternum yellowish-brown. Other parts light brownish.

Epidermal pigmentation. Head: frons and anterior part of vertex strongly pigmented, posterior part lighter. Pronotum with two sublateral lighter areas. Abdominal terga evenly shaded with greyish-brown, terga I and II a little darker.

### Morphology

Habitus. See Fig. 1.

Head. Eyes strongly enlarged. Head between eyes relatively narrow, b = 2.1–2.3x a (see Fig. 4e). Base of antennal flagellum slightly dilated, dilated part about 0.25 as wide and about 0.7 times as long as the elongated pedicel.

Thorax. Prosternal triangle narrow and apically broadly rounded, sides often nearly parallel (Fig. 4f).

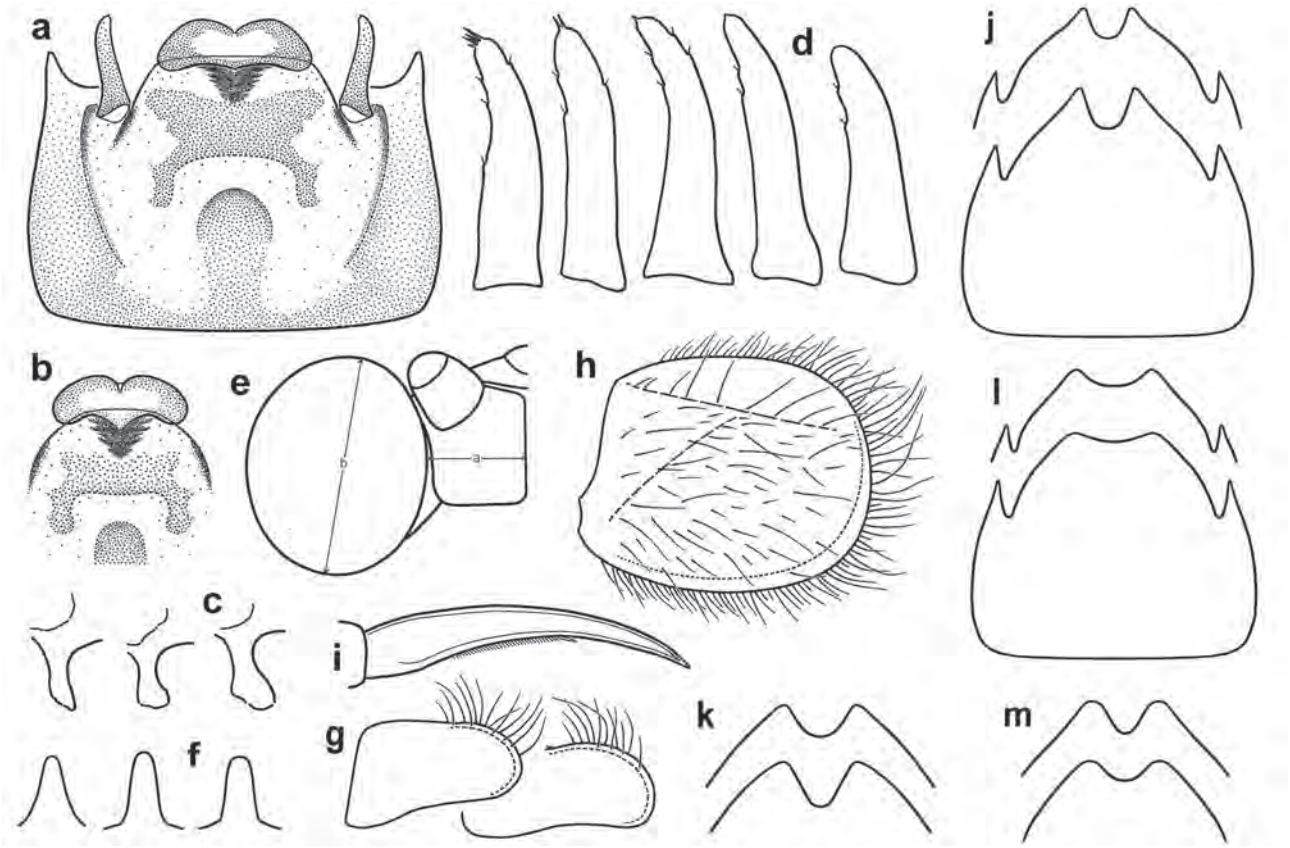



**Fig. 4.** *Afrocaenis* spp. **a–k.** *Afrocaenis major ginchica* **ssp. n. a–f.** Male imago. – **a**. Sternum IX with genitalia. **b**. Styliger and penis, another shape. **c**. Apophyses of styliger sclerite, different shape. **d**. Different shape of forcipes. **e**. Head, left half. **f**. Different shape of prosternal triangle. **g–k.** Larva – **g**. Coxal processes from mid leg (right) and hind leg (left). **h**. Operculate gill. **i**. Hind claw. **j–k.** Sternum IX, different shapes of hind margin. **l–m.** *Afrocaenis* sp. from Semien Mountains, sternum IX, different shapes of hind margin.

Abdomen. Tergum II without a finger-like process. Lateral filaments short or very short.

Genitalia and sternum IX as in Figs. 4a–b and 5. Penis apically rounded with a median indentation and a large, median, v-shaped sclerite; penis lobes short and broadly rounded (Figs. 4a–b, 5–6). Apophyses of styliger sclerite long, apically more or less broadened and rounded (for variability see Figs. 4a–c, 5–6). Lateral sclerites short and oblique. Forcipes small and of moderate length (Fig. 4d), apex very variable, rounded or with 1 to few short spines or bumps. Distance between extreme lateral points of forceps base 2.5–2.8x forceps length. Colour of forcipes, sclerites, and lateral parts of sternum IX brown, of different intensities, forming a characteristic pattern also visible in male last instar larvae (Figs. 5–6).

### Egg

Chorion nearly smooth, sometimes a very fine honeycomb-like structure is visible. One long and thin micropyle. One epithema of the coiled-rope type, with about 10 threads running from the egg pole; only few terminal knobs. Epithemata already uncoiled within female abdomen; the characteristic loops of the threads can be observed (see MALZACHER 2011: p. 65, fig. 13).

### Larva

#### Measurements and colouration

Male larva of last instar: body length 4.7–5.2 mm (Semien Mountains about 6.0 mm), length of cerci 3.0–3.2 mm. Female larvae of last instar: body length 6.2–6.5 mm (Semien Mountains 7.3–8.3 mm), length of cerci 4.0 mm.

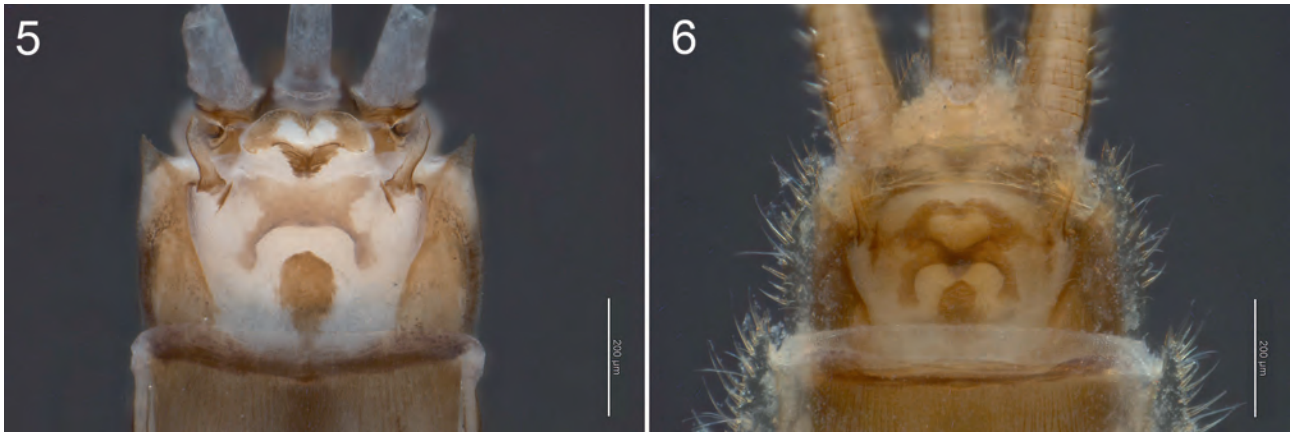
Colouration of cuticle brownish, more intense on vertex.

Epidermal pigmentation. Particularly in younger larvae there is a conspicuous pigment pattern as in Fig. 2.

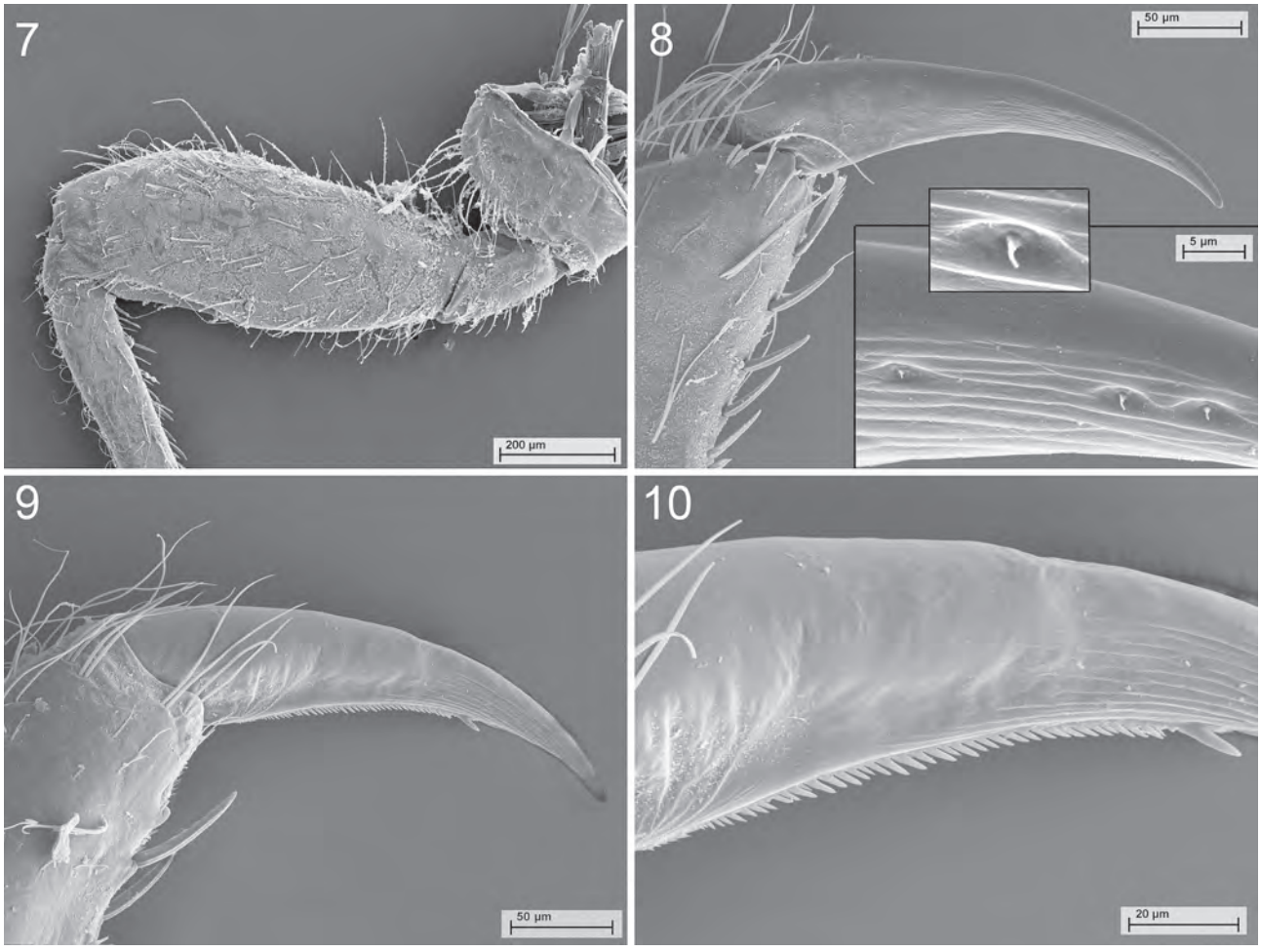
#### Morphology

Habitus. See Figs. 2–3.

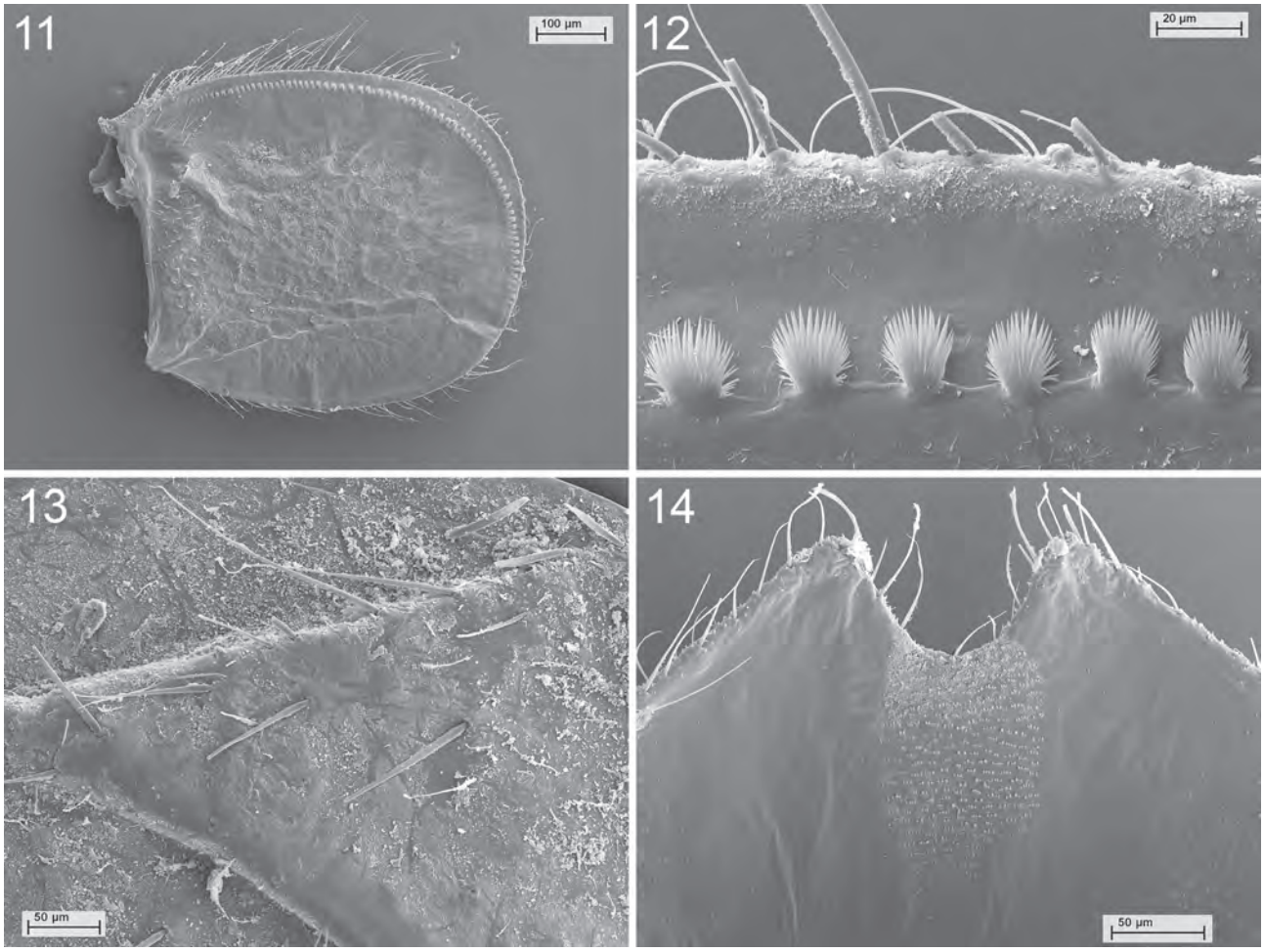
Cuticle. Smooth. Long, thin bristles on different parts (see below). Those bristles are basally broadened, of different width and length and continuously becoming thinner towards the tip. The longest are apically hair-like (Fig. 13).




**Figs. 5–6.** *Afrocaenis major ginchica* **ssp. n.**, male, macro photographs. – **5**. Imaginal genitalia. **6**. Subimaginal genitalia, larva.




**Figs. 7–10.** *Afrocaenis major ginchica* **ssp. n.**, larva, SEM. – **7**. Mid leg, femur, trochanter, and coxa. **8.** Foreleg, claw, showing subapical row of sensilla; frames: sensilla at higher magnifications. **9**. Hind claw. **10**. Hind claw, detail showing row of microdenticles.




**Figs. 11–14.** *Afrocaenis major ginchica* **ssp. n.**, larva, SEM. – **11**. Operculate gill, ventral view. **12**. Microtrichia from ventral side of operculate gill. **13**. Operculate gill, bristles on dorsal side. **14**. Sternum IX, shagreen field on dorsal side of posterior protrusion.

Head. Dorsal side with few thin bristles. Genae not bulged, scarcely bowed. Mandibles with a large dorsolateral field of thin bristles. Segment 3 of labial palp short, segment 2 about 2.3 times as long as segment 3 (along the centre line).

Thorax. Sides of pronotum convex, with numerous long, thin bristles. Those bristles also sublateral and on hind margin as well as on lateral sides of mesonotum and on wing pads. Coxal processes forming long, bowed ridges, laterally with long, thin bristles (Figs. 4g, 7). Forefemur on dorsal side with a transverse row or irregular band of about 10–12 strong, simple bristles of moderate length, medially separated and thus ordered into two groups of 6–7 and 4–6 bristles; fore and hind margins densely provided with moderately long to long bristles of different thickness. Mid and hind femora with similar marginal setation and on dorsal surface with numerous bristles that are a little wider and of different length; longer bristles apically very thin and hair-like, shorter ones more or less blunt (Fig. 7). Short to moderately stronger bristles also on inner margin of tibiae. Foretarsus ventrally with an inner row of about 10 short bristles, often with a reduced outer row of 2–3 smaller ones. Mid and hind tarsus with an inner row of 7–13 and an outer row of 5–7 simple bristles, on hind tarsus two or three apical ones often pinnate. Claws slender and elongated, fore and mid claw without denticulation (Fig. 8). Hind claw with a long row of microdenticles, with a strong, voluminous denticle at apical end of row (Figs. 4i, 9–10).

Abdomen. Abdominal segments with acute posterolateral processes of moderate length. Lateral margins densely provided with moderate to long bristles; length and density increasing anteriorly. Ventral side with a few sublateral bristles besides lateral ones. Hind margin of tergum II forming a straight, slightly embossed ridge; no posteromedian process visible. Hind margins of terga VII–VIII with long thin bristles, terga IX–X with very small denticles. Hind margin of sternum IX with a deep, rounded

medial indentation; the laterally bordering parts are posteriorly protruding, forming more or less pointed triangles (Fig. 4j–k). The large oval shagreen field on the dorsal side of sternum IX consists of small groups or short transverse rows of some hundreds of microdenticles (Fig. 14). Marginal setation of operculate gill similar to that of lateral margins of abdomen; the longest bristles on hind margin reach more than one third of length of operculate gill. Y-shaped ridges well developed; ridges with numerous long bristles; setation on dorsal surface like that on femora (Figs. 4h, 13). Microtrichia on ventral side short, more or less circular (Fig. 12). The row is close to the margin, nearly reaching the posteromedian corner of the gill (Figs. 4h, 11). Gill I half as long as gill II.

## Genus *Caenis* Stephens, 1835

### *Caenis gretathunbergae* **sp. n.**
(Figs. 15–21)

#### Material examined

H o l o t y p e . ♂ (on microslide): Ethiopia, Ginchi, Gare-Arera, N9°02′23.42″, E38°06′58.49″, 2244 m, 15.01.2018.

P a r a t y p e s . Same data as holotype, about 35♂♂.

O t h e r M a t e r i a l . Ethiopia, Chilimo forest, (sample no. AW1), N9°05′19″, E38°09′13″, 2484 m, 19.02.2018, 1 La. – Ethiopia, Chilimo forest, (sample no. AW2), N9°04′07″, E38°08′23″, 2459 m, 19.02.2018, 1 La. – Ethiopia, W of Ginchi (sample no. AW3), 9°02′21.72″, E38°05′52.21″, 2254 m, 20.02.2018, numerous larvae of different developmental stages. – Ethiopia, SSE of Ginchi (sample no. AW5), Ginchi, N9°00′08.94″, E38°09′23.26″, 2181 m, 19.02.2018, numerous larvae of different developmental stages; – all leg. LARIMA team. – Ethiopia, Semien Mt., Jinbar, Nariya, 1510 m, 28.01.1996, 19 larvae, leg. Lubini.

#### Etymology

The species is dedicated to Greta Thunberg. Her activities for climate protection will also keep mayflies in good stead.

#### M a l e i m a g o

##### Measurements, ratios and colouration

Body length: 2.8–3.3 mm; wing length: 3.0–3.4 mm; length of foreleg: 2.2–2.4. Ratio of forefemur/foretibia = 0.51–0.64; ratio of foretibia : foretarsus = 1.36–1.59; ratio of foreleg : hind leg = 1.55–1.69; ratio of first segment of the foretarsus : 2nd : 3rd : 4th : 5th = 1 : 2.4–3.4 : 1.7–2.2 : 1.1–1.6 : 1.0.

Colouration of cuticle (Fig. 15). Mesonotum maroon, scutellum and sutures dark brown to blackish, pleura a little lighter brown, sternum yellowish-brown. Other parts pale, with intense brown microstriation.

Epidermal pigmentation. Head intense blackish-brown. Pronotum with sublateral lighter areas. Greyish-brown pigments covering the whole abdomen dorsally and ventrally, most intense on posterior segments, with black paratergal dashes, including those on genitalia (see below).

##### Morphology

Habitus. See Fig. 15.

Head. Very broad, about 3.7 times as broad as its median length. Fore margin between lateral and frontal


**Fig. 15.** *Caenis gretathunbergae* **sp. n.**, male, habitus.

ocelli straight (Fig. 15). Base of antennal flagellum dilated, dilated part about 1.3–1.5 times as long and half as wide as pedicel (Fig. 18d).

Thorax. Pronotum broad and medially very short. Metanotum more or less elongated (Fig. 15). Process on mesonotal membrane in lateral view triangular, pointed (shark-fin-shaped). Prosternal triangle isosceles, with slightly concave sides. Segment 5 of foretarsus very short, as long as segment 1.

Abdomen. Tergum II without a finger-like process. Lateral filaments VII–IX short triangular or very short, the anterior ones lacking.

Genitalia and sternum IX as in Fig. 18a–b. Posterolateral processes of segment IX long, narrow and acute. Penis lobes moderately long to long, apically rounded, fore margin slightly convex, hind margin more or less concave. Apophyses of styliger sclerite moderate to long, apically often slightly broadened, straight, not or only slightly bent medially. Central sclerite broad, more or less triangular. Forcipes very long and slender, subapically waisted (between second and third third), with a tuft of long, strong spines (Fig. 18c). Forcipes and sclerites yellowish-brown. Strong black pigmentations on lateral margin and along basolateral sclerites. Forcipes and penis also with more or less intense pigmentation (Fig. 18a, right half).

## Larva

### Measurements and colouration

Male larva of last instar: body length 3.2–3.5 mm, length of cerci 1.6–1.8 mm. Female larvae of last instar: body length 4.2–4.6 mm, length of cerci 3.0 mm.

Colouration: see Fig. 16.

Abdominal sterna often more or less pigmented.

### Morphology

Habitus. See Figs. 16–17.

Cuticle: granulated (head, thorax) or denticulated (operculate gills, femora). Large parts of dorsal surface provided with shield-shaped microtrichia (Fig. 19).


**Figs. 16–17.** *Caenis gretathunbergae* **sp. n.**, habitus of larva. – **16**. Macro photograph. **17**. SEM.

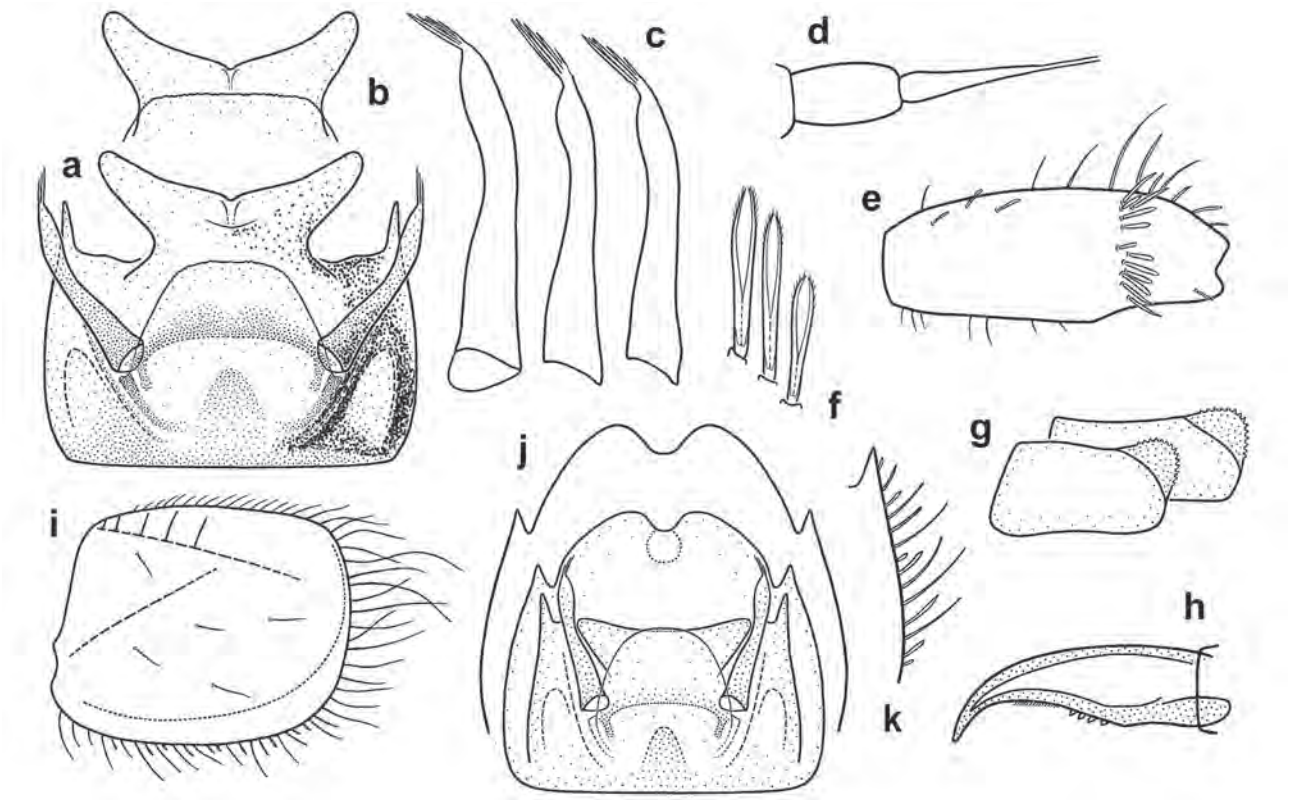



**Fig. 18.** *Caenis gretathunbergae* **sp. n. a–d.** Male imago. – **a–b**. Sternum IX with genitalia. **c**. Different shapes of forcipes. **d**. Antennal pedicel and base of flagellum. **e–k.** Larva. – **e**. Setation of forefemur. – **f**. Bristles of transverse row on forefemur. **g**. Coxal processes from mid (right) and hind (left) legs. **h**. Hind claw. **i**. Operculate gill. **j**. Sternum IX with subimaginal genitalia. **k**. Bristles on lateral margin of segment VII.

Head. Genae more or less semi-elliptical, bulged. Mandibles with a dorsolateral band of long, acute bristles. Segment 3 of labial palp short, segment 2 about 2.5 times as long as segment 3 (along the centre line).

Thorax. Sides of pronotum slightly convex, diverging anteriorly, smooth, sometimes with one or two bristles besides the anterolateral group of short blunt ones. Coxal processes semi-circular or more or less triangular, margin denticulated, without bristles, not reaching basal margin of coxae (Fig. 18g). Forefemur on dorsal side with a dense transverse row or irregular band of about 9–15 (6–10 + 4–6) spatulate bristles, apically broadened and slightly pinnate (Figs. 18e–f). On hind margin, at level of transverse row, there are long acute bristles, becoming blunt and spatulate apically (Fig. 18e). Mid femur on hind margin with a couple of long acute bristles and blunt shorter ones, fore margin with few bristles or without; dorsal surface basally and submarginally with few moderate, blunt bristles. Setation of hind femur similar, some more bristles on fore margin, on dorsal surface only two or three submarginal spatulate bristles. Moderate blunt or acute bristles also on inner margin of fore and mid tibiae and on inner and outer margins of hind tibia. Fore and mid tarsus ventrally with an inner row of 4–5 short to very short, inconspicuous, simple bristles. Hind tarsus with an inner row of about 7 bristles, the two or three apical ones pinnate, and a reduced outer row of 2–3 pinnate bristles. Claws relatively short, denticulation inconspicuous. Fore and mid claws with 2–5 small denticles. Hind claw additionally with a short row of inconspicuous microdenticles, clearly shorter than basal denticles (Fig. 18h).

Abdomen. Abdominal segments with short or moderate posterolateral processes, provided with moderate to long bristles, the longest acute, the shorter ones blunt, between them few short and spatulate ones (Fig. 18k). Posteromedian process on tergum II short, triangular and pointed. Hind margins of terga VII–VIII with long bristles, terga IX–X with denticles. Hind part of sternum IX moderately protruding, more (male) or less (female) broadly rounded with a semicircular, not very deep medial indentation (Fig. 18j). Shagreen field on dorsal side of sternum IX circular, consisting of about 10 irregular transverse rows (or pairs) of small denticles. Operculate gill (Figs. 18i, 20) on lateral margin with moderate to

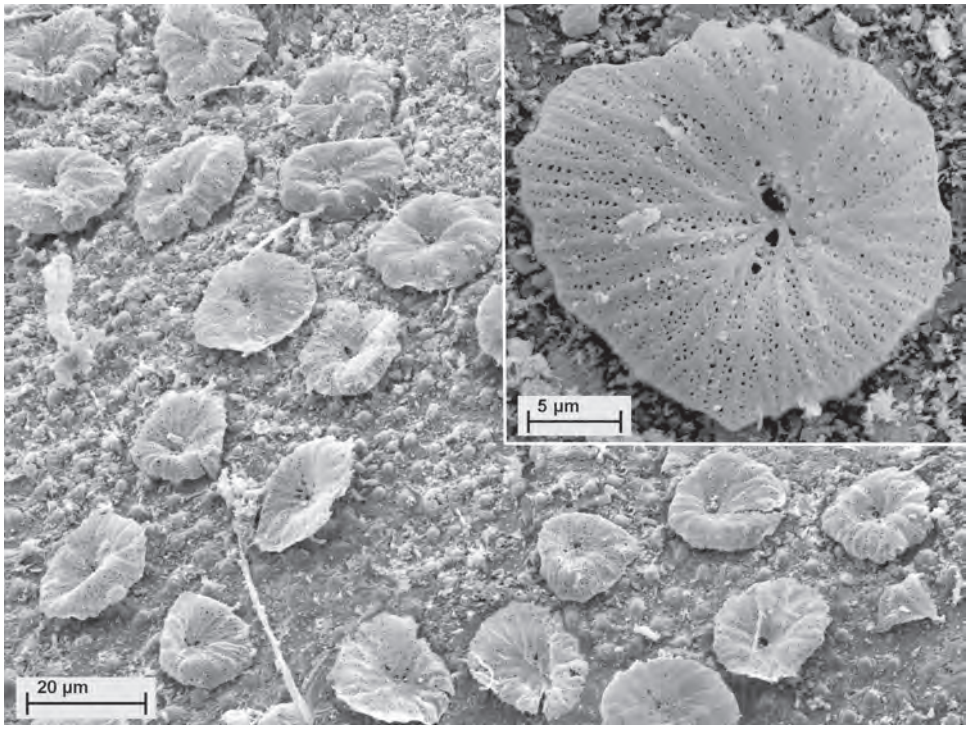
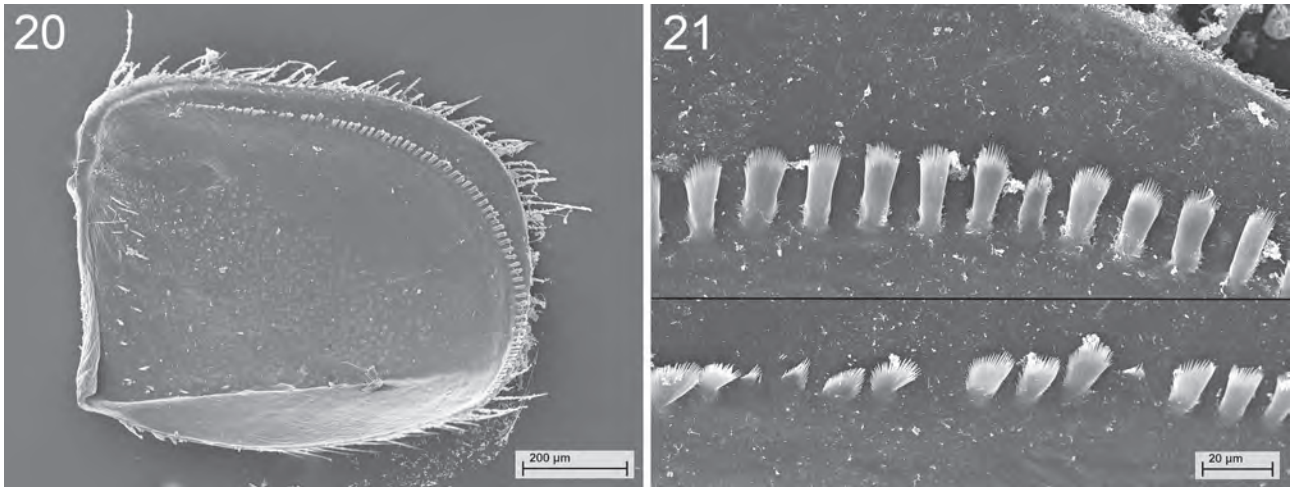



**Fig. 19.** *Caenis gretathunbergae* **sp. n.**, larva, shield-shaped microtrichia on cuticle of mesonotum; frame: single microtrichium at high magnification.

long, more or less blunt bristles and short spatulate bristles between them; bristles on hind margin long to very long, acute or hair-like, on inner margin short or moderate, acute; altogether with 60–80 bristles. Y-shaped ridges well developed; inner ridge with about 5 strong blunt bristles of moderate length; dorsal surface with few moderate thin bristles, often rubbed off. Microtrichia on ventral side elongated, on basal part of row shorter (Fig. 21), forming a row very close to hind margin, reaching to posteromedian corner of gill. Gill II about 2.5 length of gill I.




**Figs. 20–21.** *Caenis gretathunbergae* **sp. n.**, larva. – **20**. Operculate gill, ventral view. **21**. Microtrichia on ventral side of operculate gill.

*Caenis oromo* **sp. n.**
(Figs. 22–31, 32a–f)

Material examined

H o l o t y p e . ♂ Larva (on microslide): Ethiopia, SSE of Ginchi (sample no. AW5), N9°00′08.94″, E38°09′23.26″, 2181 m, 19.02.2018.

P a r a t y p e s . Same data as holotype, numerous larvae of different developmental stages.

O t h e r M a t e r i a l . Ethiopia, Awash Kunture, Chilimo Forest, 06.11.2017, 1 La. – Ethiopia, Sulula, N8°39′56.83″, E38°58.81″, 07.11.2017, 4 La. – Ethiopia, Chilimo forest, (sample no. AW1), N9°05′19″, E38°09′13″, 2484 m, 19.02.2018, 1 La. – Ethiopia, W of Ginchi (sample no. AW3), N9°02′21.72″, E38°05′52.21″, 2254 m, 20.02.2018, numerous larvae of different developmental stages. – Ethiopia, S of Ginchi (sample no. AW4), N9°00′45. 27″, E38°08′46.01″, 2208 m, 19.02.2018, numerous larvae of different developmental stages – all leg. LARIMA team.

Etymology

The species epithet is a noun in apposition and refers to the Ethiopian Oromo people, who live in central and southern Ethiopia and northern Kenya.

M a l e i m a g o

The holotype and some other specimens are male last instar larvae. The following subimaginal features are therefore visible:

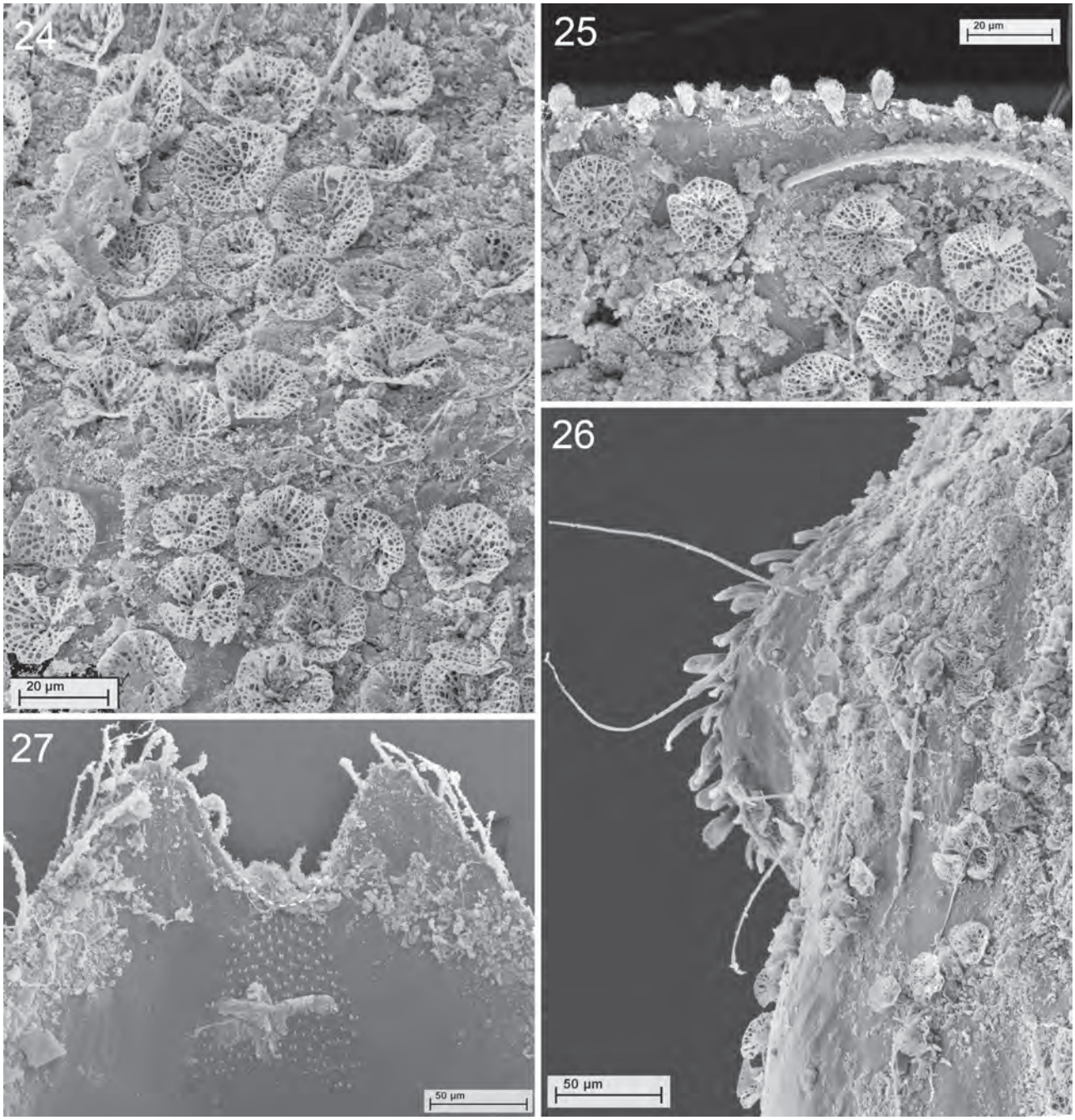
Base of antennal flagellum dilated, dilated part about half as wide as pedicel (like in Fig. 18d). Prosternal triangle with concave lateral sides and rounded tip, often more or less narrowed (Fig. 32c). Segments of foretarsus without apical projections. Abdominal segments with very short posterolateral processes. Sternum IX and subimaginal genitalia as in Fig. 32a. Penis lobes strongly elongated. Inconspicuously rounded apophyses on styliger sclerite. Forcipes slightly bowed, basally broadened, with a tuft of thin spines of moderate length (Fig. 32b).

L a r v a

Measurements and colouration

Male larva of last instar: body length 3.7–4.0 mm, length of cerci 2.3–2.5 mm. Female larva of last instar: body length 5.2–5.7 mm, length of cerci 3.0 mm.


**Figs. 22–23.** *Caenis oromo* **sp. n.**, habitus of larva. – **22**. Macro photograph. **23**. SEM.




**Figs. 24–27.** *Caenis oromo* **sp. n.**, larva, SEM. – **24**. Shield-shaped microtrichia on cuticle of operculate gill. **25**. Pronotum, lateral side. **26**. Mesonotum, lateral side, nose-shaped projection. **27**. Sternum IX, shagreen field on dorsal side of posterior protrusion.

For colouration see Fig. 22. Diagnostic character: mesonotum with a rounded v-shaped pale mark (along inner margins of wing pads) and two paramedial longitudinal dashes in front of it (together appearing like a smiling face).

Morphology

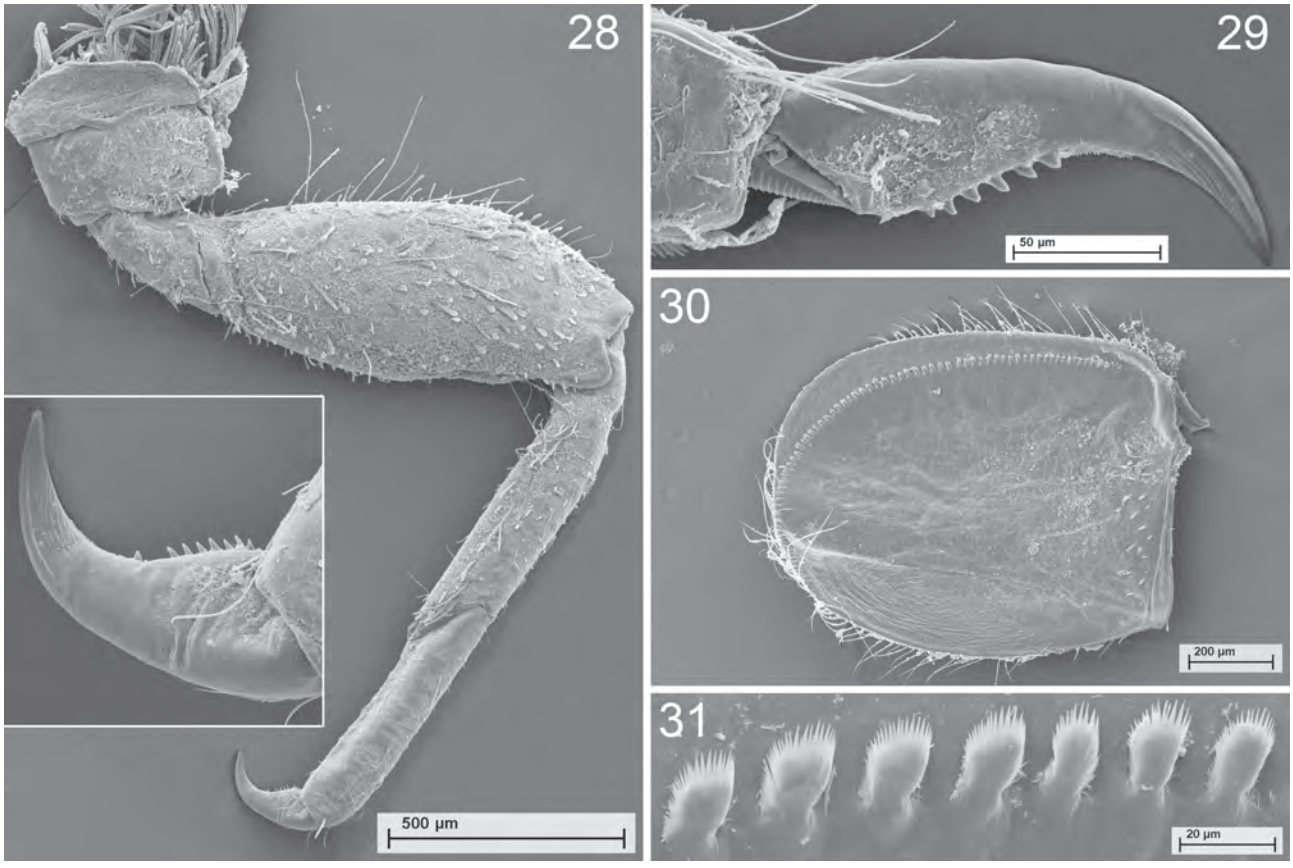
Cuticle. Granulated; great parts densely provided with shield- or funnel-shaped microtrichia, in places very dense, touching each other (Figs. 24–26).

Head. Genae slightly bulged. Mandibles with a dorsolateral group of moderate to long bristles. Segment 3 of labial palp short, segment 2 about 2.2–2.4 times as long as segment 3 (along the centre line).

Thorax. Sides of pronotum convex, slightly diverging anteriorly, smooth with very small, more or less spheroidal microtrichia (Fig. 25). Sides of mesonotum anterolaterally with a semicircular or nose-shaped projection (Fig. 23, arrow), densely provided with short spatulate bristles and few long and thin ones (Fig. 26). Coxal processes similar to those in *C. gretathunbergae* sp. n. but shorter, scarcely denticulated and with few long bristles. Forefemur on dorsal side with a dense transverse row of spatulate bristles (Fig. 32e), similar to the one in *C. grafi* sp. n. Marginal setation also as in the latter species, but no further bristles on dorsal surface. Mid and hind femora marginally with short to moderate blunt or spatulate bristles and few long hair-like ones; dorsal surface scattered with short spatulate bristles (Fig. 28). Foretarsus ventrally with an inner row of about 6–8 short simple bristles. Mid tarsus with an inner row of about 7–10 simple bristles. Hind tarsus with two rows of bristles: an inner row of 8–10 simple bristles and an outer one of 3–5 bristles, the apical two pinnate. Fore claw moderately bowed, mid and hind claws more strongly bowed, with 6–10 basal denticles (Fig. 28, frame). Hind claw additionally with a short row of very short, tiny microdenticles, often invisible under light microscope (Figs. 29, 32d).

Abdomen. Abdominal segments with short posterolateral processes. Lateral margins of segments VIII and IX provided with short spatulate bristles only, on anterior segments more and more replaced by longer acute ones (and intermediate stages). Posteromedian process on tergum II triangular and pointed. Hind margins of terga VII–VIII with long hair-like bristles, terga IX–X with denticles. Hind part of sternum IX medially with a deep, basally more or less rounded indentation (Figs. 27, 32a). Shagreen field on dorsal side of sternum IX rounded, triangular, consisting of single denticles, two or three of them often fused together (Fig. 27).

Operculate gill (Figs. 30, 32f) on lateral margin with moderate to long bristles, posteriorly with few short spatulate ones between them; bristles on hind margin clearly longer, hair-like, on inner margin moderate or short




**Figs. 28–31.** *Caenis oromo* **sp. n.**, larva, SEM. – **28**. Mid leg. Frame: Mid claw in higher magnification. **29**. Hind claw. **30**. Operculate gill, ventral view. **31**. Microtrichia on ventral side of operculate gill.

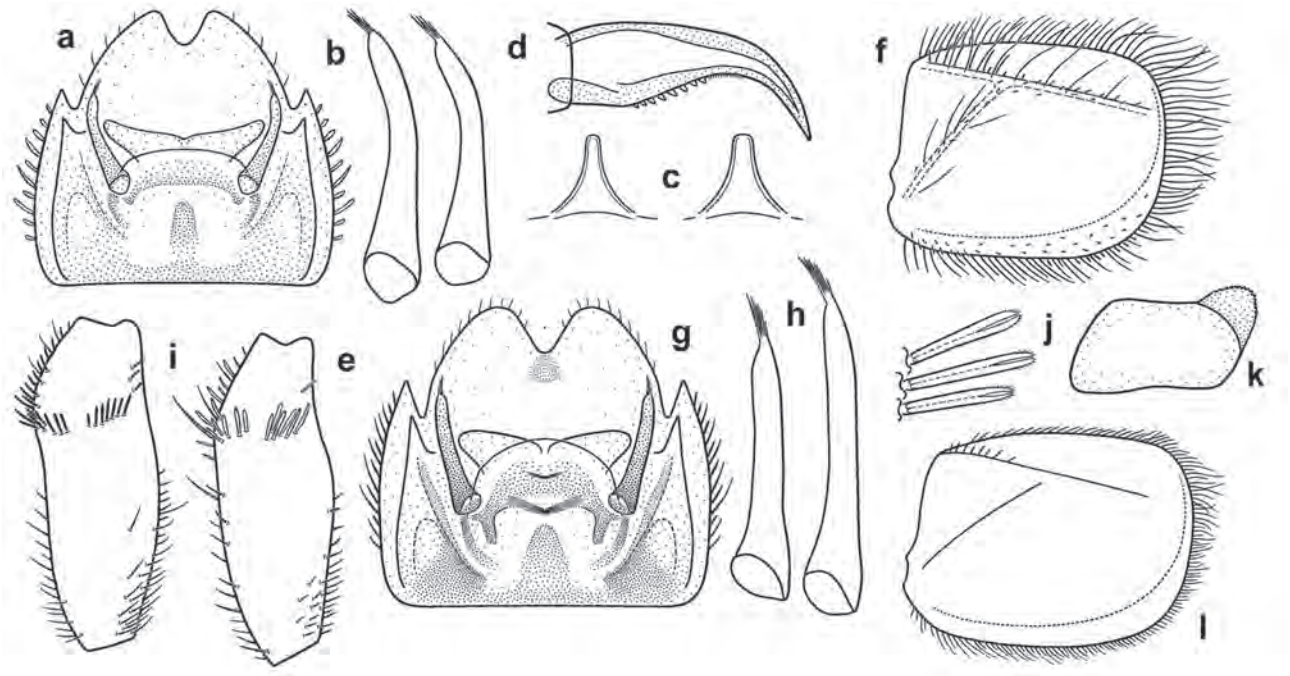



**Fig. 32.** *Caenis* spp., larvae. **a–f.** *Caenis oromo* **sp. n.** – **a**. Sternum IX with subimaginal genitalia. **b**. Different shapes of forcipes. **c**. Different shapes of prosternal triangle. **d.** Hind claw. **e**. Forefemur. **f**. Operculate gill. **g–l.** *Caenis nervulosa* Malzacher, 1990. – **g**. Sternum IX with subimaginal genitalia. **h**. Different shapes of forcipes. **i**. Forefemur. **j**. Bristles of transverse row on forefemur. **k**. Coxal process on mid leg. **l.** Operculate gill.

(basally); bristles on inner margin about as long as those on lateral margin (in most other species clearly shorter); gill about 4 times as long as longest bristle from hind margin. Marginal bristles densely arranged, more than 90–110 altogether. Y-shaped ridges well developed; inner ridge embossed, nearly reaching hind margin of gill, basally with about 5 moderate to long, blunt bristles. Additionally, both ridges with two different sorts of bristles: long, acute and hair-like, and short spatulate, the latter also in sublateral area (Fig. 32f). Microtrichia on ventral side short, more or less circular or oval (Fig. 31). Row of microtrichia reaching posteromedian corner of gill, running very close to hind margin, as a rule not overlapping it (Fig. 30). Gill I more than half as long as gill II.

### *Caenis nervulosa* Malzacher, 1990
(Figs. 32g–l, 33–40)

*Caenis nervulosa* Malzacher, 1990: Malzacher 1990: 26.

#### Material examined

Ethiopia, Chilimo Spring, N9°04′07″, E38°08′23″, 2389 m, 04.08.2017, numerous larvae of different developmental stages. – Ethiopia, Chilimo Forest, N9°5′19.00″, E38°9′13.01″, 04.08.2018, numerous larvae of different developmental stages. – Ethiopia, Awash Kunture, Chilimo Forest, 06.11.2017, numerous larvae of different developmental stages. – Ethiopia, Chilimo forest, (sample no. AW1), N9°05′19″, E38°09′13″, 2484 m, 19.02.2018, numerous larvae of different developmental stages. – Ethiopia, Chilimo forest, (sample no. AW2), N9°04′07″, E38°08′23″, 2459 m, 19.02.2018, numerous larvae of different developmental stages. – Ethiopia, W of Ginchi (sample no. AW3), N9° 02′21.72″, E38°05′52.21″, 2254 m, 20.02.2018, numerous larvae of different developmental stages. – all leg. LARIMA team. – Ethiopia, Semien Mt., Jinbar-Tributaries, 3500 m, 1.01.1996, 2 larvae. – Ethiopia, Semien Mt., Tillik Wenz, Dirni, 2740 m, 23.01.1996, 25 larvae. – Ethiopia, Semien Mt., Dirni-Amba Ber, 2740 m, 24.01.1996, 14 larvae. – Ethiopia, Semien Mt., Serek Wenz, Dirni-Amba Ber, 2540 m, 24.01.1996, 9 larvae. – all leg V. Lubini.

#### Male imago

Some specimens are male last instar larvae. The following subimaginal features are therefore visible and correspond to those of the original description by Malzacher (1990):

Base of antennal flagellum dilated (like in Fig. 18d). Prosternal ridges forming a more or less narrow isosceles triangle with concave lateral sides. Segments of foretarsus without apical projections. Abdominal segments with posterolateral processes of moderate length. Sternum IX and subimaginal genitalia as in Fig. 32g. Penis with triangular lobes of moderate length and median sclerites on ventral and dorsal sides. A narrow oval field on anterior margin of styliger sclerite pale. Forcipes straight, basally broadened,

tuft of spines of moderate length, ratio of shaft to spines 4.5–5.3 (Fig. 32h).

L a r v a

Measurements and colouration

Male larva of last instar: body length 4.0–4.2 mm, length of cerci 3.0 mm. Female subadult larva: body length 5.0 mm, length of cerci 4.0 mm.

Colouration. See Fig. 33. Abdominal sterna often more or less pigmented. Intensity of pattern variable.

Morphology

Cuticle. Granulated, with very small shield- or funnel-shaped microtrichia, scattered on pronotum, mesonotum, femora and operculate gill (Fig. 34); nearly invisible under light microscope.

Head. Bulge of genae semicircular, conspicuous (Fig. 33). Mandibles with a dense dorsolateral group of bristles, often bifid, the basal one very strong. Segment 3 of labial palp short, segment 2 about 2.4–2.8 times as long as segment 3 (along the centre line).


**Fig. 33.** *Caenis nervulosa* Malzacher, 1990, larva, habitus, macro photograph.

Thorax. Sides of pronotum clearly convex and anteriorly diverging, slightly denticulated. Coxal processes tongue-shaped, denticulated, not reaching basal margin of coxa (Fig. 32k). Forefemur on dorsal side with a dense transverse row of about 13–15 (6–9 + 5–6) short and narrow, spatulate bristles; similar bristles on hind margin, at same level as transverse row, very short ones apically; hind margin bulging out at this level (Fig. 32i). Mid and hind femora marginally with short or moderate, blunt or spatulate bristles; blunt and spatulate bristles also on dorsal surface, on hind femur often only basal and submarginal (Figs. 35). Foretarsus ventrally with an inner row of 6–7 bristles, 3–4 basal ones simple. Mid tarsus with an inner row of about 7 pinnate bristles, basal 2–4 often small and simple, and a short outer row of 1–3 pinnate bristles. Hind tarsus with two rows each with 7–8 bristles, most of them pinnate, 1–3 basal ones short or very short and simple (Fig. 36). Fore and mid claws slightly bowed, with 5–8 small or very small basal denticles, often nearly invisible. Hind claw additionally with a row of microdenticles that are often hardly distinguishable from the basal denticles (Fig. 37).

Abdomen. Abdominal segments with moderate posterolateral processes, segments VIII and IX with short, blunt bristles (Fig. 32g), longer ones on the following anterior segments. Posteromedian process on tergum II short, triangular with rounded tip; hind margin denticulated. Hind margins of terga VII–VIII with moderately long to long bristles, terga IX–X with denticles. Hind part of sternum IX medially with a deep, rounded indentation (Figs. 32g, 40). Shagreen field on dorsal side of sternum IX more or less triangular, consisting of single denticles (Fig. 40). Operculate gill (Figs. 32l, 38) marginal, with short to moderately blunt bristles (in some populations bristles slightly longer, as in Fig. 32l), particularly those on posteromedian corner; the longest ones 1/5 the length of operculate gill. Altogether, 110–150 bristles. Y-shaped ridges well developed; inner ridge basally with 6–9 short, blunt bristles. Microtrichia on ventral side moderately elongated (Fig. 39). Row of microtrichia nearly reaching posteromedian corner of gill, located close to hind margin. Gill I about a third as long as gill II.

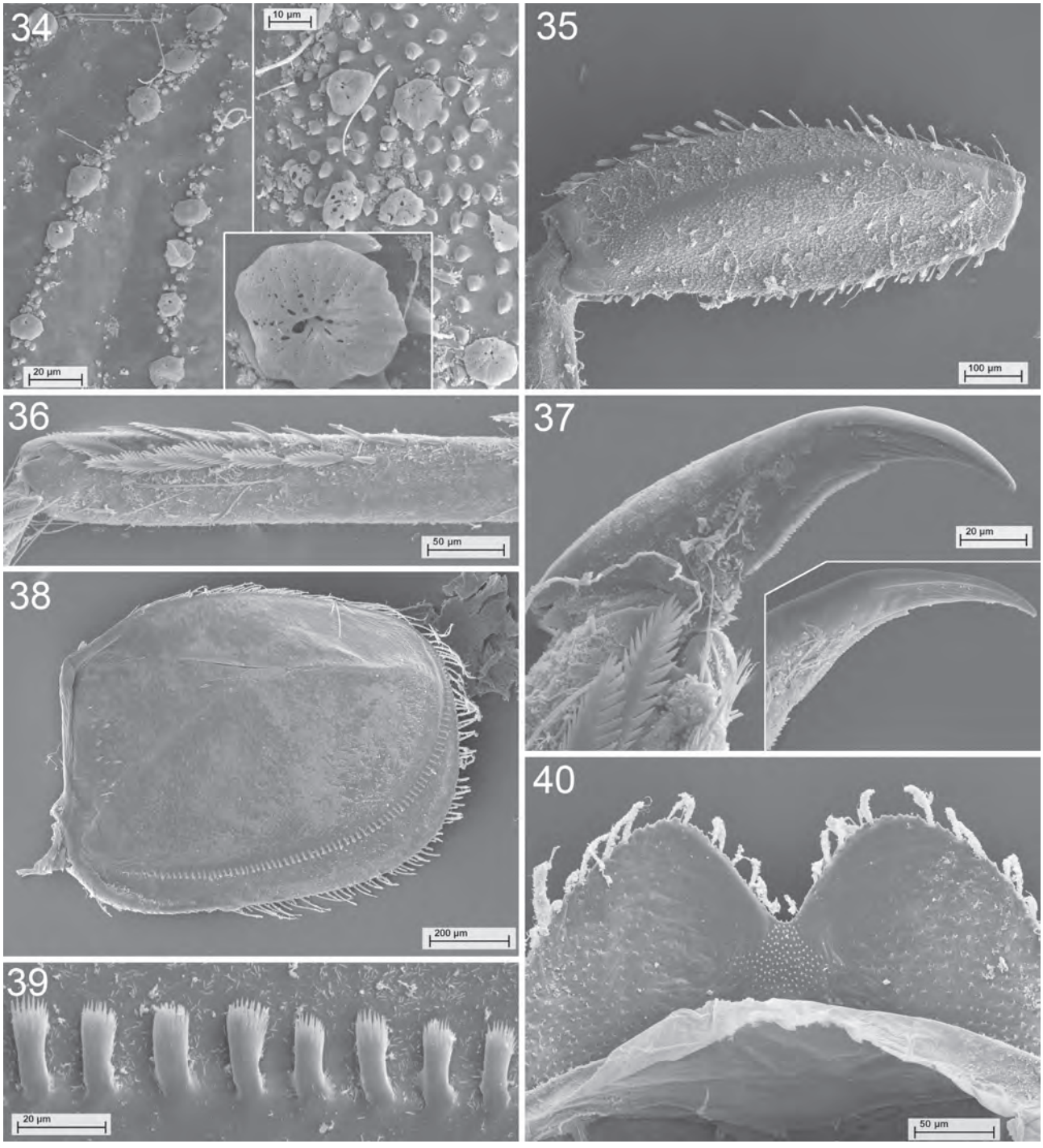
## *Caenis grafi* **sp. n.**
(Figs. 41–47)

Material examined

H o l o t y p e . ♂ La. (on microslide): Ethiopia, S of Ginchi, (sample no. AW4), N9°00′45. 27″, E38°08′46.01″, 2208 m, 19.02.2018.

P a r a t y p e s . Same data as holotype, numerous larvae of different developmental stages.

O t h e r M a t e r i a l . Ethiopia, Awash Kunture, Chilimo Forest, 06.11.2017, numerous larvae of different developmental stages. – Ethiopia, W of Ginchi (sample no. AW3), N9°02′21.72″,




**Figs. 34–40.** *Caenis nervulosa* Malzacher, 1990, larva, SEM. – **34**. Shield-shaped microtrichia on cuticle of operculate gill (right) and wing pads (left); frame: single microtrichium at higher magnification. **35**. Hind femur. **36**. Hind tarsus. **37**. Hind claw; frame: other shape of tip with denticulation. **38**. Operculate gill, ventral view. **39**. Microtrichia on ventral side of operculate gill. **40**. Sternum IX, shagreen field on dorsal side of posterior protrusion.

E38°05′52.21″, 2254 m, 20.02.2018, numerous larvae of different developmental stages. – all leg. LARIMA team. – Ethiopia, Semien Mt. Dirni-Amba Ber, 2740 m, 24.01.1996, 14 larvae. – Ethiopia, Semien Mt., Jinbar, Nariya, 1510 m, 28.01.1996, 14 larvae, leg. V. LUBINI.

Etymology

The species is dedicated to WOLFRAM GRAF, its collector and leader of the Ethiopian Awash project.

Male imago

The holotype and some paratypes are male last instar larvae. The following subimaginal features are therefore visible:

Base of antennal flagellum dilated, dilated part about half as wide as pedicel (like in Fig. 18d). Prosternal ridges forming a more or less narrow isosceles triangle with concave lateral sides (Fig. 43d). Segments of foretarsus without apical projections. Posterolateral processes on abdominal segments short. Sternum IX and subimaginal genitalia as in Fig. 43a–b. Penis with short triangular lobes and median sclerites on ventral and dorsal sides. No pale field on anterior margin of styliger sclerite. Conspicuous apophyses on styliger sclerite with lateral margin stepped (Fig. 43a–b). Forcipes moderately bowed, medially more or less waisted, tuft of thin spines of moderate length (Fig. 43c).

Larva

Measurements and colouration

Male larva of last instar: body length 3.5–3.8 mm, length of cerci 2.0 mm. Female larva of last instar: body length 6.0 mm, length of cerci 3.5 mm.

Colouration. See Fig. 41.

Morphology

Cuticle with small granules or denticles, sometimes two or more pointed (operculate gill, Fig. 45, frame) and


**Figs. 41–42.** *Caenis grafi* **sp. n.**, habitus of larva. – **41**. Macro photograph. **42**. SEM.

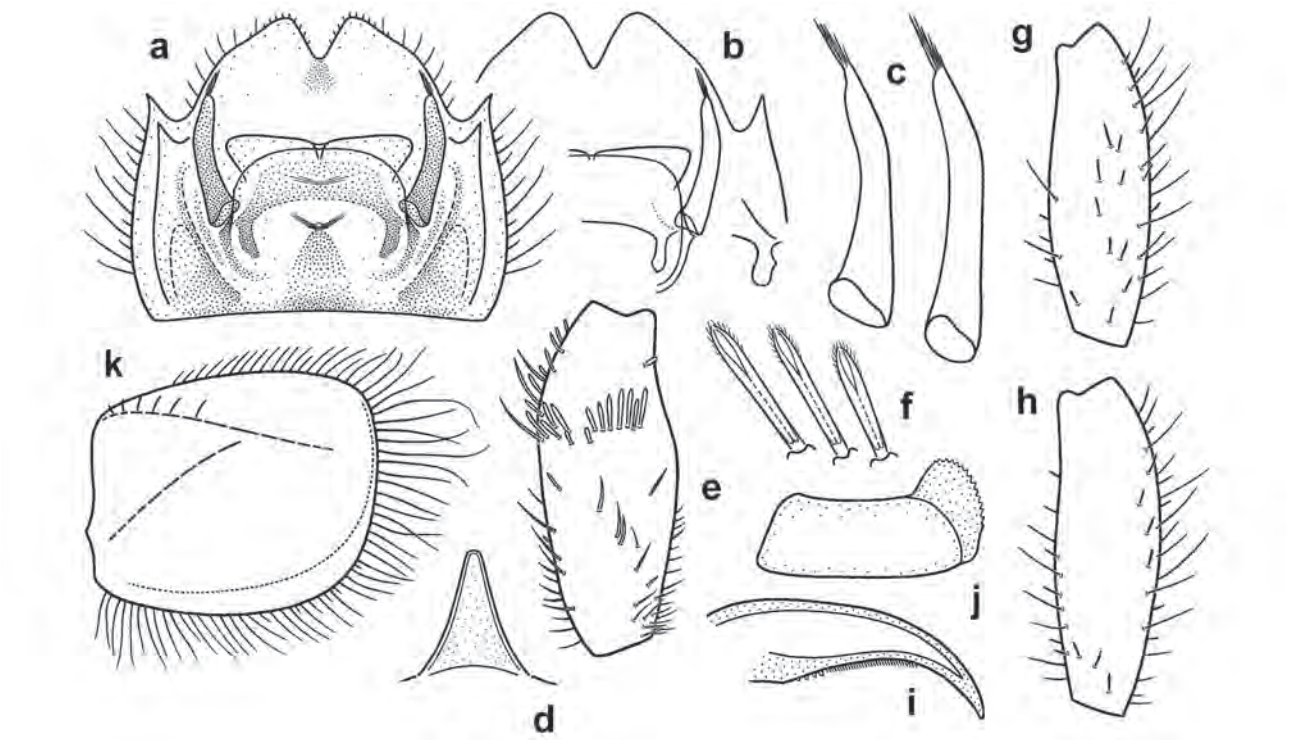



**Fig. 43.** *Caenis grafi* **sp. n.**, larva. – **a–b.** Sternum IX with subimaginal genitalia. **c**. Different shapes of forcipes. **d**. Prosternal triangle. **e**. Setation of forefemur. **f**. Bristles of transverse row on forefemur. **g**. Mid femur. **h**. Hind femur. **i**. Hind claw. **j**. Coxal processes on mid leg. **k**. Operculate gill.

small shield- or funnel-shaped microtrichia (scattered on pronotum, mesonotum and operculate gill, Figs. 44–45).

Head. Genae slightly bulged. Mandibles with a dorsolateral irregular row or band of strong bristles, the apical ones densely provided with short, very thin branches. Segment 3 of labial palp short, segment 2 about 2.3–2.7 times as long as segment 3 (along the centre line).

Thorax. Sides of pronotum slightly convex or nearly straight, anteriorly more or less diverging, smooth with very small rounded microtrichia (often rubbed off). Sides of mesonotum anterolaterally slightly bulged. Coxal processes tongue-shaped, denticulated, reaching basal margin of coxa (Fig. 43j). Forefemur on dorsal side with a dense, transverse row of about 10–15 (6–8 + 4–6) moderate, relatively narrow, spatulate bristles (Fig. 43f). Few long acute bristles on hind margin, on level with transverse row; short, blunt bristles between them and apically (Fig. 43e). Mid and hind femora marginally and submarginally with long thin bristles, between them few short and blunt ones; blunt and spatulate bristles also on dorsal surface, on hind femur only basal and submarginal (Fig. 43g–h). Foretarsus ventrally with an inner row of about 5 pinnate bristles. Mid tarsus with an inner row of about 7 pinnate bristles, basal ones often very small and simple. Hind tarsus with two rows of bristles, basally more or less irregular and confluent, both rows altogether with about 12 bristles, most of them pinnate, few basal ones short or very short and simple. Fore and mid claws slightly bowed, with few small or very small basal denticles, often nearly invisible. Hind claw additionally with a row of microdenticles as long as basal denticles (Fig. 43i).

Abdomen. Abdominal segments with short or moderate posterolateral processes, provided with moderate to long acute bristles, between them short blunt or spatulate ones (Fig. 43a); number of bristles on posterior segments about 10 to 20. Posteromedian process on tergum II very short, in dorsal view nearly invisible. Hind margins of terga VII–VIII with moderate to long bristles, terga IX–X with denticles. Hind part of sternum IX medially with a deep, V-shaped indentation (Figs. 43a–b, 47). Shagreen field on dorsal side of sternum IX triangular, consisting of single denticles (Figs. 43a, 47). Operculate gill (Fig. 43k) on lateral margin with moderate to long bristles, with few short spatulate ones posteriorly between them; bristles on hind margin long to very long, hair-like, the longest nearly half as long as gill, on inner margin moderate or short (basally). Altogether, 70–100 bristles. Y-shaped ridges well developed; inner ridge basally with about 5 short, strong and blunt bristles. Microtrichia on ventral side elongated, with very fine apical filaments, often with

lateral filaments more or less fused, laminary (Fig. 46). Row of microtrichia reaching the posteromedian corner of gill, running very close to hind margin; microtrichia protrude beyond hind margin by half of their length (Fig. 46, above). Gill I nearly half as long as gill II.

### *Caenis afrocaenoides* **sp. n.**
(Fig. 48a–e)

#### Material examined

Holotype. ♂ (on microslide): Ethiopia, S of Ginchi, (sample no. AW4), N9°00′45. 27″, E38°08′46.01″, 2208 m, 19.02.2018. – Paratypes. Same data as Holotype, 4 ♂♂; leg. LARIMA team.

#### Etymology

The species epithet refers to the similarity of its genitalia with those of *Afrocaenis.*

#### Male imago

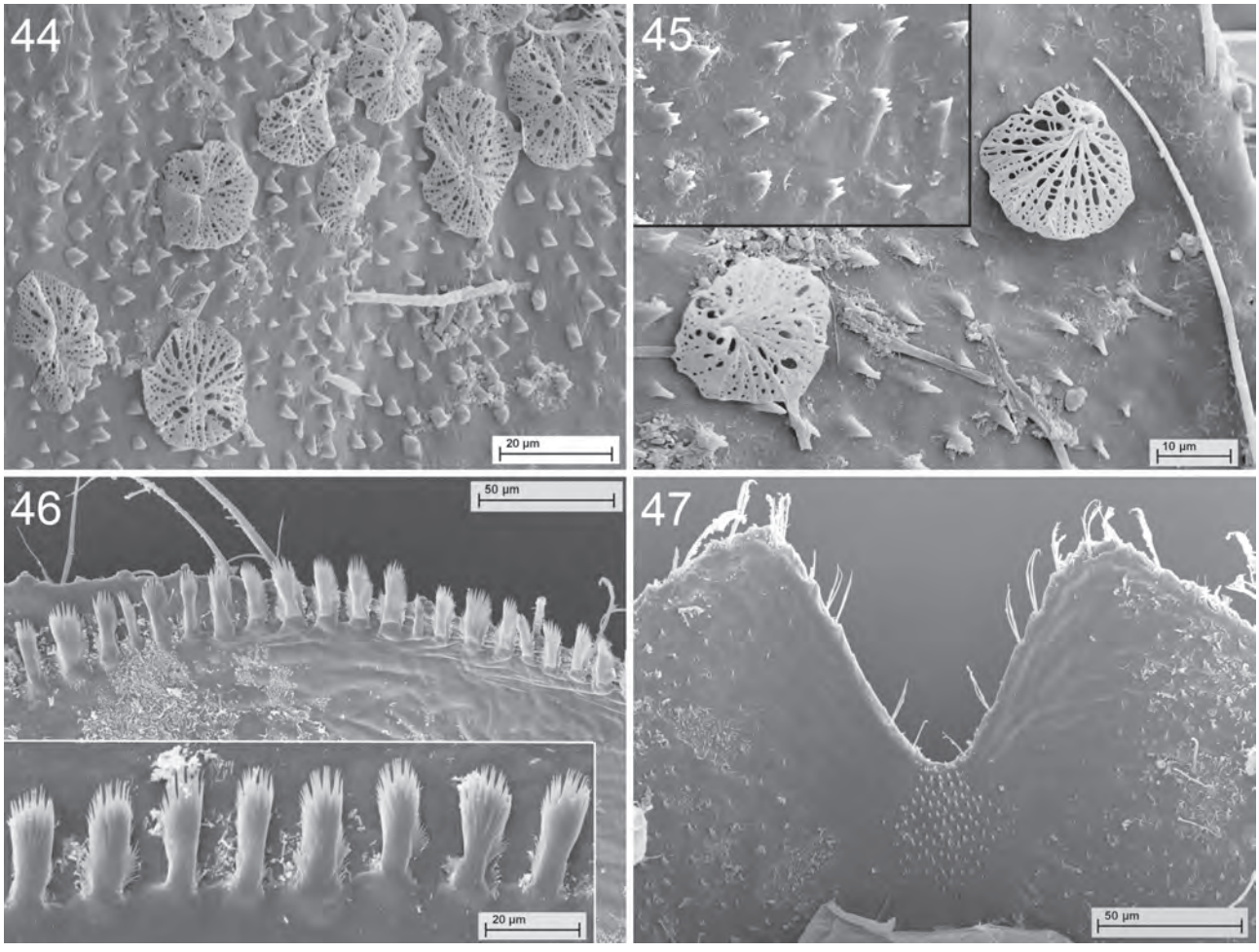
#### Remarks

Specimens were contained in a large sample of larvae and are thus partly damaged; possibly, they also drifted for a longer time in the water. However, diagnostic characters such as the base of the antennal flagellum, shape of prosternal ridges, lateral filaments on the abdomen and of course the structures of sternum IX and the genitalia are clearly visible.

#### Measurements, ratios and colouration

Body length: 4.0–4.7 mm; wing length: 3.8–4.0 mm; length of foreleg: as there are no whole forelegs available, only ratio forefemur/foretibia of three forelegs could be identified: 0.43–0.47; foretibia more than twice as long as forefemur.

Colouration not preserved.




**Figs. 44–47.** *Caenis grafi* **sp. n.**, larva, SEM. – **44**. Shield-shaped microtrichia on cuticle of mesonotum. **45**. Shield-shaped microtrichia on cuticle of operculate gill; frame: denticles with two or more tips. **46**. Microtrichia on ventral side of operculate gill. **47**. Sternum IX, shagreen field on dorsal side of posterior protrusion.

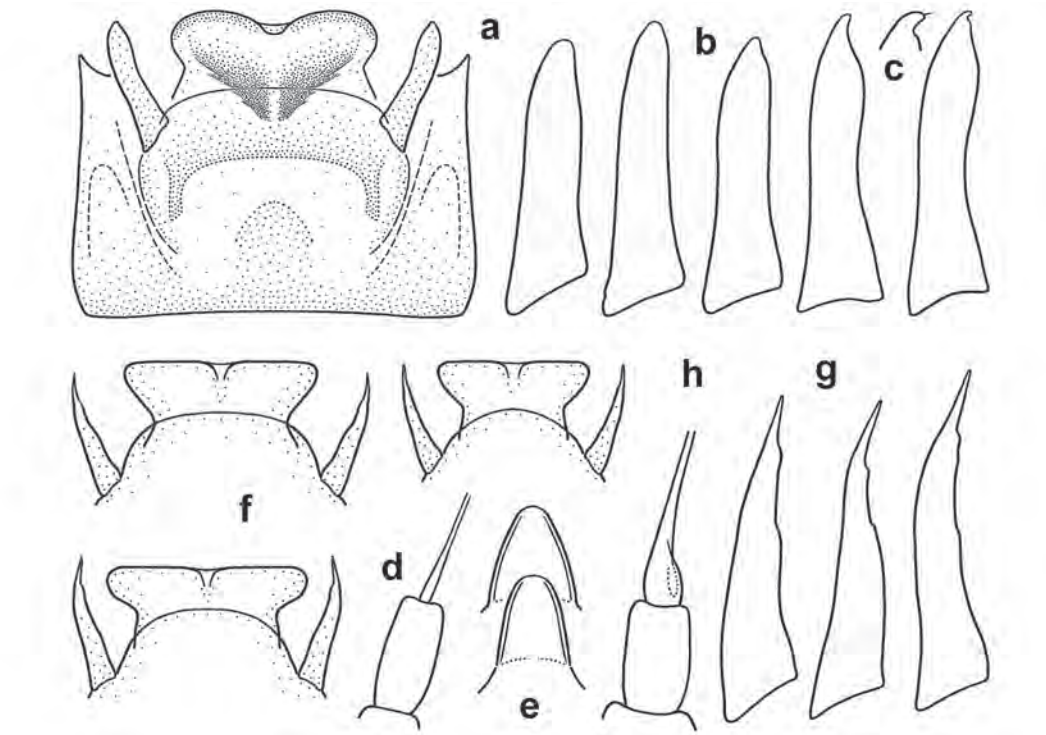



**Fig. 48.** *Caenis* spp., males. **a–e.** *Caenis afrocaenoides* **sp. n.** – **a**. Sternum IX with genitalia. **b–c**. Different shapes of forcipes (c also showing tip at higher magnification). **d**. Antennal pedicel and base of flagellum. **e**. Prosternal triangle. **f–h.** *Caenis horaria* (Linnaeus, 1758). – **f**. Styliger and penis, different shapes. **g**. Different shapes of forcipes. **h**. Antennal pedicel and base of flagellum.

Morphology

Head. Short, anterior margin flat, lateral ocelli scarcely protruding; eyes small; base of antennal flagellum not dilated (Fig. 48d).

Thorax. Prosternal triangle apically broadly rounded (Fig. 48e).

Abdomen. Tergum II without a finger-like process. Lateral filaments short.

Genitalia and sternum IX as in Fig. 48a. Posterolateral processes of segment IX short, acute. Hind margin of penis biconvex, lobes short and broadly rounded. Ventrally with a large, v-shaped, brownish sclerite. Apophyses of styliger sclerite long, parallel-sided. Forcipes of moderate length, apically rounded or with stepped structures (Fig. 48b), sometimes with a very short and thin apical spine (Fig. 48c).

*Caenis horaria* (Linnaeus, 1758)
(Fig. 48f–h)

*Caenis horaria* (Linnaeus, 1758): Linnaeus 1758: 547; Stephens 1835: 61; Eaton 1871: 95; Malzacher 1986: 3.

Material examined

Ethiopia, sample no. AW4, S of Ginchi, N9°00′45. 27″, E38°08′46.01″, 2208 m, 19.02.2018, 5 ♂♂; leg. LARIMA team.

Male imago

Remarks

The specimens were contained in a large sample of larvae and are thus partly damaged; possibly, they also drifted for a longer time in the water before collecting. However, diagnostic characters, e.g., the base of the antennal flagellum, shape of prosternal ridges, lateral filaments on the abdomen, and of course the structures of sternum IX and the genitalia are clearly visible (see Malzacher 1984: table 1, figs 1–3; table 8, figs 1–4; table 10, figs 3–4).

Measurements, ratios and colouration

Body length: 3.3–3.5 mm; wing length: 3.0–3.3 mm; length of foreleg: as there are no whole forelegs available, only ratio forefemur: foretibia of two legs could be measured: 0.59–0.61 (ratio in Palearctic specimens usually 0.53–0.58).

Colouration not preserved.

Morphology

Head. Base of antennal flagellum asymmetrically dilated; dilated part with a longitudinal hollow on lateral side (Fig. 48h).

Thorax. Prosternal triangle isosceles, with concave sides, tip acute.

Abdomen: Tergum II with a finger-like process of moderate length. Lateral filaments moderate.

Genitalia as in Fig. 48f. Penis anvil-shaped. Sclerites hardly visible. Forcipes straight, of moderate length, sides posteriorly converging, ending in a long, sclerotized tip (Fig. 48g).

### Key to known larvae of Ethiopian Caeninae

**1** Hind margin of sternum IX without an indentation (MALZACHER 1984: table 21, fig. 2). Lateral margin of pronotum clearly diverging anteriorly, medially more or less concave and bent (MALZACHER 1984: table 13, fig. 7). Ventral side of operculate gill with a sublateral band consisting of transverse rows of about 4 microtrichia (MALZACHER 1984: table 18, fig. 11) ..... ***Caenis horaria***

\- Hind margin of sternum IX with a rounded or v-shaped indentation (e.g., Figs. 18j, 43a–b). Lateral margin of pronotum convex or straight (e.g., Figs. 22–23, 41–42). Ventral side of operculate gill with a sublateral row of single microtrichia (e.g., Figs. 30, 46)..... **2**

**2** Claws more or less slender and elongated; fore and mid claws without denticles; hind claw with a long row of microdenticles and a strong, voluminous denticle at apical end of row (Figs. 8–10). Ventral side of abdominal segments, besides lateral bristles, with few sublateral bristles. Eyes of male larvae more or less enlarged (Figs. 2–3) ..... ..... ***Afrocaenis major ginchica* ssp. n.**

\- Claws not elongated (e.g., Figs. 18h, 29). Hind claw without an apical voluminous denticle. Ventral side of abdominal segments without sublateral bristles..... **3**

**3** Sides of mesonotum anterolaterally with a semicircular or nose-shaped projection, densely provided with short spatulate bristles and few long and thin ones (Figs. 23, 26). Both Y-ridges on operculate gill with long, acute, hair-like and short, spatulate bristles (Fig. 32f). Mesonotum with a v-shaped pale mark (along inner margins of wing pads) and two paramedial longitudinal dashes in front of it (Fig. 22)... ..... ***Caenis oromo* sp. n.**

\- Mesonotum without a semicircular or nose-shaped projection. Y-shaped ridges without two different sorts of bristles ..... **4**

**4** Margin of operculate gill with 100–150 bristles; bristles short; length of gill about 6–7 times length of longest bristles from hind margin (Fig. 32l). Short, more or less blunt bristles also on lateral margins of abdominal segments VIII and IX and on margins of mid and hind femora (Fig. 35). Posteroapical margin of fore femur with short, blunt bristles (Fig. 32i). Genae strongly bulged..... ***Caenis nervulosa***

\- Margin of operculate gill with 60–100 bristles; bristles longer; the longest nearly half as long as gill (Fig. 18i). Lateral margins of abdominal segments VIII and IX and margins of mid and hind femora also with longer, more or less acute bristles (Fig. 43g–h). Posteroapical margin of fore femur with short, blunt bristles and other ones of different length, the longest acute (Fig. 43e). Genae moderately or slightly bulged ..... **5**

**5** Hind margin of sternum IX with a deep, v-shaped indentation (Fig. 43a–b). Lateral margin of abdominal segments VIII and IX with long, acute bristles (Fig. 43a). Operculate gill on dorsal side only with few short, blunt bristles on base of median Y-ridge. Bristles on lateral margin longer, only few short blunt bristles on posterolateral corner (Fig. 43k). Most bristles on ventral side of tarsi pinnate. Hind claw with few very short basal denticles and a long row of microdenticles as long as the basal ones (Fig. 43i) ... ***Caenis grafi* sp. n.**

\- Hind margin of sternum IX with a moderate, rounded indentation (Fig. 18j). Lateral margin of abdominal segments VIII and IX with bristles more or less blunt. Operculate gill on dorsal side with longer bristles on base of median Y-ridge and additionally with few thin bristles on surface. Bristles on lateral margin of moderate length, with numerous short blunt ones between them (Fig. 18i). Number of bristles on ventral side of tarsi often reduced, most of them short or very short and simple. Hind claw with a short row of microdenticles and basal denticles about twice as long as these (Fig. 18h)..... ***Caenis gretathunbergae* sp. n.**

## Discussion

### *Afrocaenis*

As already mentioned above, diagnostic characters of the genus *Afrocaenis* are very variable. Hence it is difficult to assess the taxonomic status of populations from different regions.

Males are available from River Awash, Lake Wonji, and from Tanzania (types of *Afrocaenis major*). The genitalia are unsuitable for diagnosis because of a high variability of the characters, e.g., the shape of the forcipes. Fig. 4d shows examples from one population. There is, however, a differentially diagnostic character that distinguishes Ethiopian males from Tanzanian ones, namely the ratio of the longest diameter of the eye to half the distance between the eyes (b/a in Fig. 4e), which is 2.0–2.4 in Ethiopian specimens and 1.6–1.8 in Tanzanian ones [compare Fig. 4e with fig. 1a in MALZACHER (1993)]. Based on this character, the males from Lake Wonji, collected by D. S. BROWN in 1962, can be assigned to the herein described subspecies *Afrocaenis major ginchica*.

The larva of *Afrocaenis browni* (the males of which are unknown) can be distinguished from all other larvae by the very short bristles on the femora and operculate gills (see GILLIES 1982; MALZACHER 1993). All other larval characters are highly variable. The hind margin of sternum IX of all *Afrocaenis* larvae shows a median indentation that can be deep and relatively narrow, which is the main shape in *Afrocaenis major ginchica* (Fig. 4j), or broad and flat as in most larvae from the Semien Mountains (Fig. 4l). However, this character is also highly variable and a few intermediate stages can be found in *Afrocaenis major ginchica* (Fig. 4k) as well as in the Semien Mountains specimens (Fig. 4m).

### *Caenis*

The Semien Mountains are located about 500 km north of the Ginchi area. The extensive larval material available from there was indeterminable so far, but with this investi-

gation *Caenis gretathunbergae* **sp. n.**, *Caenis grafi* **sp. n.**, and *Caenis nervulosa* could be identified. These three species seem to be widely distributed in Ethiopia.

Including some recently described species from Angola (MALZACHER & BARBER-JAMES, in print) and the species mentioned in this contribution, altogether 53 species of *Caenis* are presently known from Africa. Of these, 31 species belong to the group with a combination of apical **t**uft of spines on forcipes, **p**enis lobes laterally protruding and more or less triangular, and base of **a**ntennal flagellum dilated (TPA-group). The here newly-described species *Caenis gretathunbergae* **sp. n.**, *Caenis oromo* **sp. n.**, and *Caenis grafi* **sp. n.**, as well as *Caenis nervulosa*, belong to this group. There are only few larvae of this group known so far. Together with the here-described ones, the number adds up to eight. These larvae show a combination of three characters: cuticle beside other structures with shield- or funnel-shaped microtrichia; third segment of labial palpus very short, second segment 2–3 times as long as third; hind margin of sternum IX with a deep or moderate indentation. Possibly, the larvae of all species in the TPA-group share these characters.

*Caenis horaria*, with its apically acute forcipes, is a Palaearctic species. Its occurrence in Ethiopia can be regarded as an introgression into the Afrotropical realm. BARBER-JAMES et al. (2008) gave a roundup of examples of species' introgressions, but without cases from the Palaearctic to the Afrotropical realm. For the genus *Caenis*, at least one case of an introgression from the Palearctic to the Oriental realm is known (MALZACHER 2015).

The two remaining species with different shapes of forceps are *Caenis ghibana* and the herein described *Caenis afrocaenoides*. The forcipes of both species are apically rounded, a plesiomorphic character in *Caenis*. The apex is slightly stepped and sclerotized in *Caenis ghibana* (MALZACHER 1990: fig. 5) and variable, sometimes with a small spine, in *Caenis afrocaenoides* (Fig. 48c). The two species also share penes with short or very short, broadly rounded lobes and a slightly indented hind margin. *Caenis afrocaenoides*, however, possesses a large, strongly coloured, v-shaped sclerite on the ventral side of the penis and long, conspicuous apophyses on the styliger sclerite, like in *Afrocaenis*. Altogether, the genitalia of *Caenis afrocaenoides* could represent an antecedent evolutionary stage compared to the genitalia of *Afrocaenis*.

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