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Source: Integrative Systematics: Stuttgart Contributions to Natural History, 5(2) : 109-114

Published By: Stuttgart State Museum of Natural History

URL: <https://doi.org/10.18476/2022.457633>

RESEARCH ARTICLE

New species and records of Caeninae from Kenya (Insecta: Ephemeroptera: Caenidae)

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Abstract

Based on nymphal material, two new species of Caeninae from Kenya, *Afrocaenis minoculis* sp. n. and *Caenis clypeata* sp. n., are described herein. As in both cases last instar nymphs were available, their subimaginal genitalia could also be described. New diagnostic characters for *Afrocaenis* Gillies, 1982 are introduced and its generic diagnosis is accordingly modified. With this publication, there are now eight species of Caenidae reported from Kenya.

Keywords: *Afrocaenis*, *Caenis*, Kenya, new species.

Zusammenfassung

Mit *Afrocaenis minoculis* sp. n. und *Caenis clypeata* sp. n. aus Kenia werden zwei neue Arten der Caeninae beschrieben. Da in beiden Fällen männliche Nymphen im letzten Stadium verfügbar waren, konnten deren subimaginale Genitalien charakterisiert werden. Es werden neue diagnostische Merkmale für *Afrocaenis* Gillies, 1982 eingeführt und die Gattungsdiagnose entsprechend modifiziert. Mit dieser Publikation erhöht sich die Zahl der aus Kenia nachgewiesenen Caenidae auf acht Arten.

Introduction

Although numerous species of the subfamily Caeninae (Ephemeroptera: Caenidae) have been described from East Africa, only few of which are known from Kenya. The widely distributed species *Caenis berner* Kimmins, 1955 and *Caenis brevipes* Kimmins, 1956 were collected by BURMEISTER in the Masai Mara National Reserve (MALZACHER 1993); *Afrocaenis major* (Gillies, 1977) was found in the Rift Valley Province (MALZACHER 1993); and in 2014, MALZACHER described a new genus and species, *Provonshara spinifera* Malzacher, 2014, from Kakamega County. This contribution adds two newly described species that were collected in eastern Kenya in an area about 20–40 km south of the Mt. Elgon summit. Also added from the same locality is *Caenis oromo* Malzacher, 2021, which was recently described from Ethiopia (MALZACHER 2021). An additional species, *Caenis jinja* Kimmins, 1956, has been found south of Mt. Kenya in Sagana. With the species described herein, the number of Caenidae recorded from Kenya now amounts to eight species.

Material and methods

Specimens were collected in 2019 within the framework of an investigation of land use versus altitudinal shifts in the functional composition of macroinvertebrates in Mt. Elgon streams, which are part of the headwaters of the Nzoia River, Lake

Victoria Basin, Kenya (YEGON et al. 2021). The investigated material was preserved in formaldehyde and later transferred to 75% ethanol. It was examined with a Wild M3 binocular microscope. Line drawings were made with the aid of a Zeiss camera lucida on a Leitz Laborlux microscope and digitised with Photo Filtre 6.5.2. The material is stored at the State Museum of Natural History Stuttgart, Germany (SMNS).

Systematic account

Afrocaenis minoculis sp. n.
(Fig. 1a–f)

Material examined

Holotype. ♂ last instar nymph (on microslide): Kenya, Mt. Elgon, Kimurio, tributary 1, 00°54'08"N 34°35'51"E, 2437 m, 08.11.2019.

Paratypes. Same data as holotype, numerous nymphs at different developmental stages.

Other material. Kenya, Mt. Elgon, Kapkateny upstream, 00°53'45.28"N 34°35'56.28"E, 2293 m, 11.10.2019, 3 nymphs. – Kenya, Mt. Elgon, Chebirbel, 00°49'28.78"N 34°36'53.33"E, 1878 m, 12.10.2019, 1 nymph. – Kenya, Mt. Elgon, Chemugumiet, 00°49'29.8"N 34°36'27.6"E, 2317 m, 13.10.2019, 3 nymphs. – Kenya, Mt. Elgon, Teremi tributary 1, 00°54'32"N 34°34'00"E, 2380 m, 13.10.2019, numerous nymphs of different developmental stages. – Kenya, Mt. Elgon, Teremi upstream, 00°54'34"N 34°35'58"E, 2407 m, 13.10.2019, 1 nymph. – Kenya, Mt. Elgon, Kapkateny tributary 1, 00°54'04"N 34°36'01"E, 2350 m, 08.11.2019, 1 nymph. – Kenya, Mt. Elgon, Kibisi tributary 1, 00°54'10"N 34°37'03"E, 2246 m, 09.11.2019, 5 nymphs.

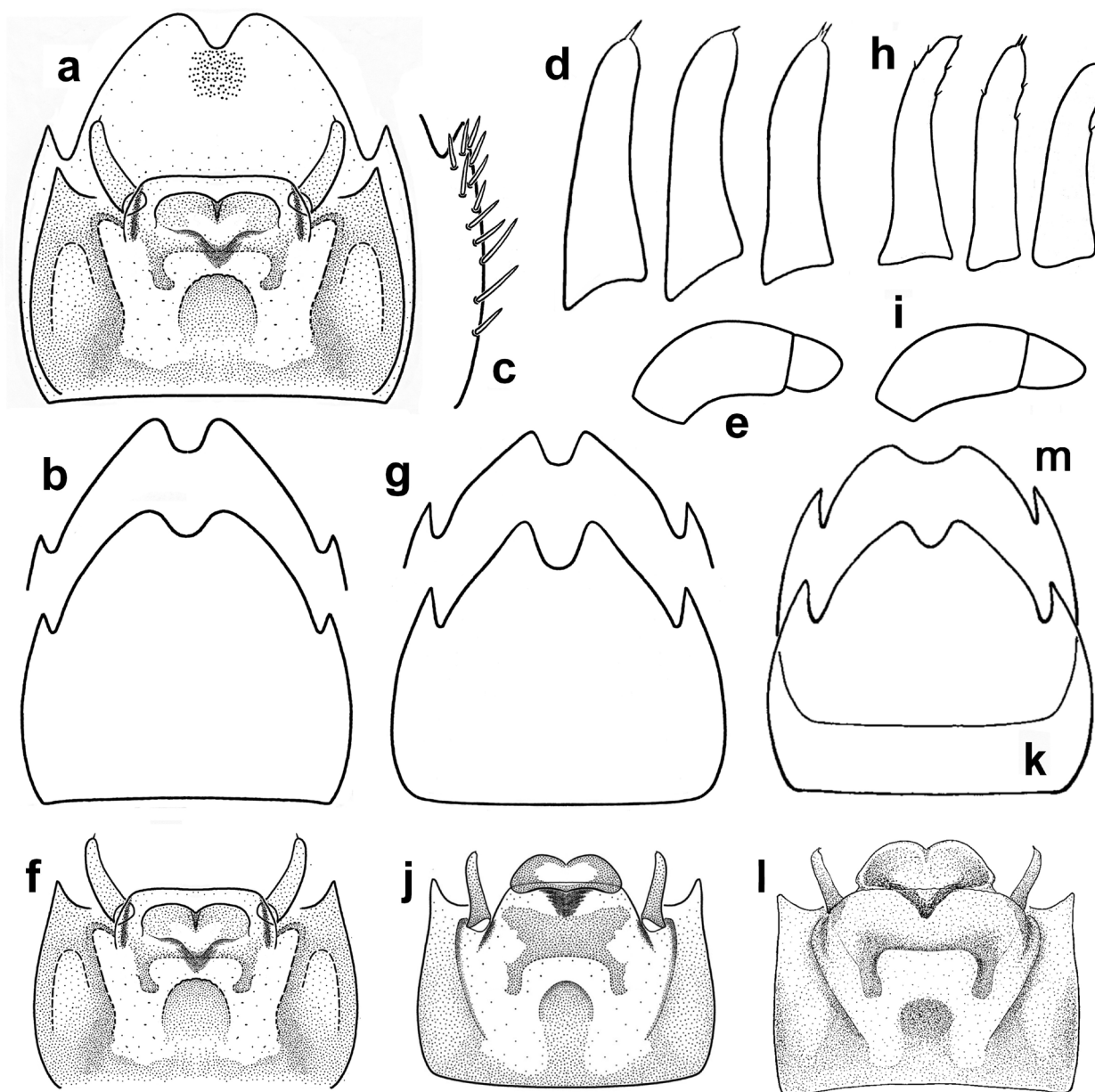


Fig. 1. *Afrocaenis* spp. – **a–f.** *Afrocaenis minoculis* sp. n. **a.** Sternum IX of nymph with subimaginal genitalia. **b.** Variation of nymphal sternum IX shape. **c.** Lateral margin of sternum IX. **d.** Variation of forcipes of subimaginal genitalia. **e.** Labial palp of nymph. **f.** Male sternum IX with genitalia. – **g–j.** *Afrocaenis major ginchica*. **g.** Sternum IX variation. **h.** Variation of forcipes. **i.** Labial palp. **j.** Sternum IX with genitalia. – **k–l.** *Afrocaenis major major*. **k.** Sternum IX. **l.** Sternum IX with genitalia. – **m.** *Afrocaenis browni*, sternum IX.

Etymology

The species epithet is a composed adjective from the Latin ‘minor’ = less and ‘oculi’ = eyes, referring to the small eyes of the new species in contrary to the large-eyed *Afrocaenis major*.

Description

Male

[The holotype and some paratypes are male last instar nymphs. The following subimaginal features are therefore visible:] Eyes not enlarged. Base of antennal flagellum not dilated. Prosternal triangle with concave lateral sides and rounded tip, often more or less narrowed. Segments of foretarsus without apical projections. Abdominal segments with very short posterolateral processes. Sternite IX and subimaginal genitalia as in Fig. 1f. Penis with a large, v-shaped lateral sclerite. Penis lobes short, broadly rounded. Apophyses of styliger sclerite long, broad and bent medially. Forceps relatively long and broad, apically rounded, with one or two short spines (Fig. 1d). Ratio of distance between the most lateral points of forceps bases to forceps length ranging between 1.8 and 2.3. For forceps size in relation to the whole genitalia, compare Fig. 1f, j and l.

Nymph

Measurements and colouration

Male nymph of last instar: body length 3.8–4.0 mm, length of cerci 3.0 mm. Female nymphs of last instar: body length 5.7–6.5 mm, length of cerci 3.5 mm. Cuticle brownish yellow. Epidermal pigmentation: Pigment pattern similar to that in *Afrocaenis major* (MALZACHER 2021; fig. 2), but lines and dashes on mesonotum narrower and often reduced, as is the pigmentation on the operculate gills and abdominal terga. Wing pads, on the other hand, clearly pigmented, even in younger nymphs.

Morphology

Cuticle: nearly smooth. Bristles of moderate length on different parts of body (see below). Most bristles broad, usually broader than the respective ones in *Afrocaenis major*, apically acute, referred to as specific bristles below (Fig. 1c).

Head: Genae not bulged, scarcely bowed. Mandibles with dorsolateral thin bristles. Labial palp with short, broadly rounded palpomere 3, palpomere 2 about 2.5–2.8 times as long as palpomere 3 (along the centre line).

Thorax: Sides of pronotum slightly convex, apically more or less diverging, with numerous, moderately long to long specific bristles. Similar bristles also sublaterally and on lateral sides of mesonotum and wing pads. Coxal processes forming inconspicuous ridges, laterally with moderate to long bristles (MALZACHER 2021; figs. 4g, 7). Forefemur on dorsal side with a transverse, medially interrupted row of about 10–14 strong, simple bristles of mode-

rate length, longer than in most *Caenis* Stephens, 1835 species; fore and hind margins densely provided with moderate to long bristles, specific ones apically on hind margin. Mid and hind femur marginally and on dorsal surface with numerous specific bristles of different lengths. Similar bristles also on inner and outer margins of hind tibia. Foretarsus ventrally with an inner row of 8–12 short to moderate specific bristles. Mid tarsus with an inner row of 8–10 short simple bristles. Hind tarsus with an inner row of 10–14 simple bristles, clearly stronger and longer than those on fore and mid tarsus, and an outer row of 7–10 narrow and slightly pinnate bristles. Simple bristles on all tarsi more or less bowed. Claws slender and elongated, fore and mid claws without denticulation; hind claw with a long row of microdenticles, with a strong, voluminous denticle on apical end of row [like in *A. major*; see MALZACHER (2021; figs. 4i, 8, 9, 10)].

Abdomen: Abdominal segments with short, acute posterolateral processes. Lateral margins of segments VIII and IX densely provided with short to moderate specific bristles; length of bristles increasing towards anterior segments. On ventral side besides lateral bristles few sublateral ones, often concentrated on posterolateral processes (Fig. 1c). Hind margin of tergum II with a very short, broadly triangular posteromedian process. Hind margins of terga VII–VIII with moderate to long bristles, terga IX–X with small denticles. Hind margin of sternum IX medially with a deep, rounded indentation. Posterolateral processes of segment IX short or very short (Fig. 1b), contrary to the two other species of the genus, *Afrocaenis major* (Fig. 1g, k) and *A. browni* Gillies, 1982 (Fig. 1m), with processes clearly longer, slightly bent medially (compare Fig. 1b with Fig. 1g, k, m). The large oval shagreen field on the dorsal side of sternite IX consists of small groups or short transverse rows of microdenticles (Fig. 1a).

Operculate gill on lateral margin with specific bristles of moderate length, similar to those on lateral margins of abdomen; bristles on hind margin long and thin, reaching about one third of length of operculate gill. Y-shaped ridges well developed; ridges with numerous specific bristles, dorsal surface scattered with similar bristles. Microtrichia on ventral side short, more or less circular. The row runs close to the margin, nearly reaching the posteromedian corner of the gill. Gill I nearly half as long as gill II.

Remarks

Afrocaenis minoculis sp. n. corresponds in most characters to the differential diagnosis of the genus *Afrocaenis* Gillies, 1982 (MALZACHER 2021). For characters distinguishing the new species from *Afrocaenis major* and the subspecies *Afrocaenis major ginchica* Malzacher, 2021, see Table 1. In samples with more than ten specimens of *Afrocaenis*, both species were always present, but one of the two was usually strongly dominant in any given sample.

Table 1. Differential diagnostic characters of *Afrocaenis major* and *Afrocaenis minoculis* **sp. n.**

		<i>Afrocaenis major</i> (incl. ssp. <i>ginchica</i>)	<i>Afrocaenis minoculis</i> sp. n.
1	Male, size of eyes	strongly enlarged	normal size, like in genus <i>Caenis</i>
2	Male, apophyses of styliger sclerite	straight (Fig. 1j, l)	bent medially (Fig. 1f)
3	Male, ratio distance between lateral points of forcipes bases to forceps length	2.7–3.5, forceps smaller (Fig. 1h, j, l)	1.8–2.3, forceps larger (Fig. 1d, f)
4	Nymph, palpomere 3 of labial palp	more or less triangular (Fig. 1i)	broadly rounded (Fig. 1e)
5	Posterolateral processes of sternite IX	moderate length, slightly bent medially (Fig. 1g, k)	short, not bent medially (Fig. 1a, b)

Enlarged male eyes were once considered as a differential diagnostic character of the genus *Afrocaenis*. GILLIES (1977) described the genus *Caenopsella* with the species *C. meridies* Gillies, 1977 and *C. major*. When he separated the latter species into a new genus, *Afrocaenis*, he also noted the enlarged eyes as a common character for both genera (GILLIES 1982), and this was interpreted as a synapomorphic character of *Afrocaenis* and *Caenopsella* by KLUGE (2004). As *Afrocaenis minoculis* **sp. n.** does not possess enlarged eyes, these statements are no longer valid.

Caenis clypeata **sp. n.**
(Fig. 2a–j)

Material examined

Holotype. ♂ last instar nymph (on microslide): Kenya, Mt. Elgon, Kibisi downstream, 00°47'50"N 34°38'44"E, 1624 m, 14.10.201.

Paratypes. Same data as holotype, 8 nymphs.

Other material. Kenya, Mt. Elgon, Kapkateny upstream, 00°53'45.28"N 34°35'56.28"E, 2293 m, 11.10.2019, 5 nymphs. – Kenya, Mt. Elgon, Teremi upstream, 00°54'34"N 34°35'58"E, 2407 m, 13.10.2019, 4 nymphs. – Kenya, Mt. Elgon, Masindeti, 00°49'35.66"N 34°44'30.79"E, 1676 m, 15.10.2019, 1 nymph. – Kenya, Mt. Elgon, Kimurio upstream, 00°53'28.8"N 34°35'21.2"E, 2239 m, 11.10.2019, 6 nymphs.

Etymology

The species epithet refers to the protruding clypeus.

Description

Male

[The holotype is a male nymph with subimaginal genitalia visible. The following features can therefore be observed:] Base of antennal flagellum slightly to moderately dilated. Prosternal triangle narrow, apically rounded, sides moderately convex. Abdominal segments with moderate to long posterolateral processes; processes on segment IX narrow and elongated, slightly bent laterally. Nymphal sternite IX with subimaginal genitalia as in Fig. 2a. Penis lobes short, triangular, apically broadly

rounded. Apophyses of styliger sclerite long and strong, apically broadly rounded, bent medially. Forcipes straight, basally broadened, apically with a tuft of long thin spines (Fig. 2b). Sclerites moderately coloured, forcipes and apophyses of styliger sclerite clearly stronger.

N y m p h

Measurements and colouration

Subadult male nymph, body length 4.0 mm. Colouration of cuticle pale yellowish brown. Epidermal pigmentation: a large trapezoid field on frons with an adjacent band between lateral ocelli brown pigmented. Pronotum medially with two small and laterally with two large pale fields, surrounded by brown pigments. Abdominal terga brown. Mesonotum and operculate gills conspicuously pale.

Morphology

Cuticle: densely granulated; surface setation sparse or lacking.

Head: Clypeus protruding beyond hind margin of labrum, in lateral view stepped from frons by an indentation (Fig. 2g, h). Genae clearly bulged (Fig. 2g). Mandibles with a dorsolateral band of long bristles. Labial palp with very short palpomere 3, palpomere 2 about 3.5 times as long as palpomere 3 (along the centre line) (Fig. 2i), in other species somewhat shorter (Fig. 2k). Maxillary palp elongated, particularly palpomeres 2 and 3 long and thin (Fig. 2j). In other *Caenis* species shorter and broader (e.g., *Caenis nervulosa* Malzacher, 1990 from Ethiopia—Fig. 2l).

Thorax: Sides of pronotum parallel or slightly diverging anteriorly; more or less convex fore corner with a group of moderate blunt bristles, more or less strongly bowed. Coxal processes of moderate length, triangularly rounded (mid leg, Fig. 2d) or tongue-shaped (hind leg, Fig. 2e). Forefemur on dorsal side with a transverse row of spatulate bristles. Mid and hind femora marginally with very short, blunt or spatulate bristles; dorsal surface of femora scattered with similar bristles, on hind femur only a few bristles basally. Similar bristles also on inner margin of tibiae. Fore and mid tarsi with an inner row of about five

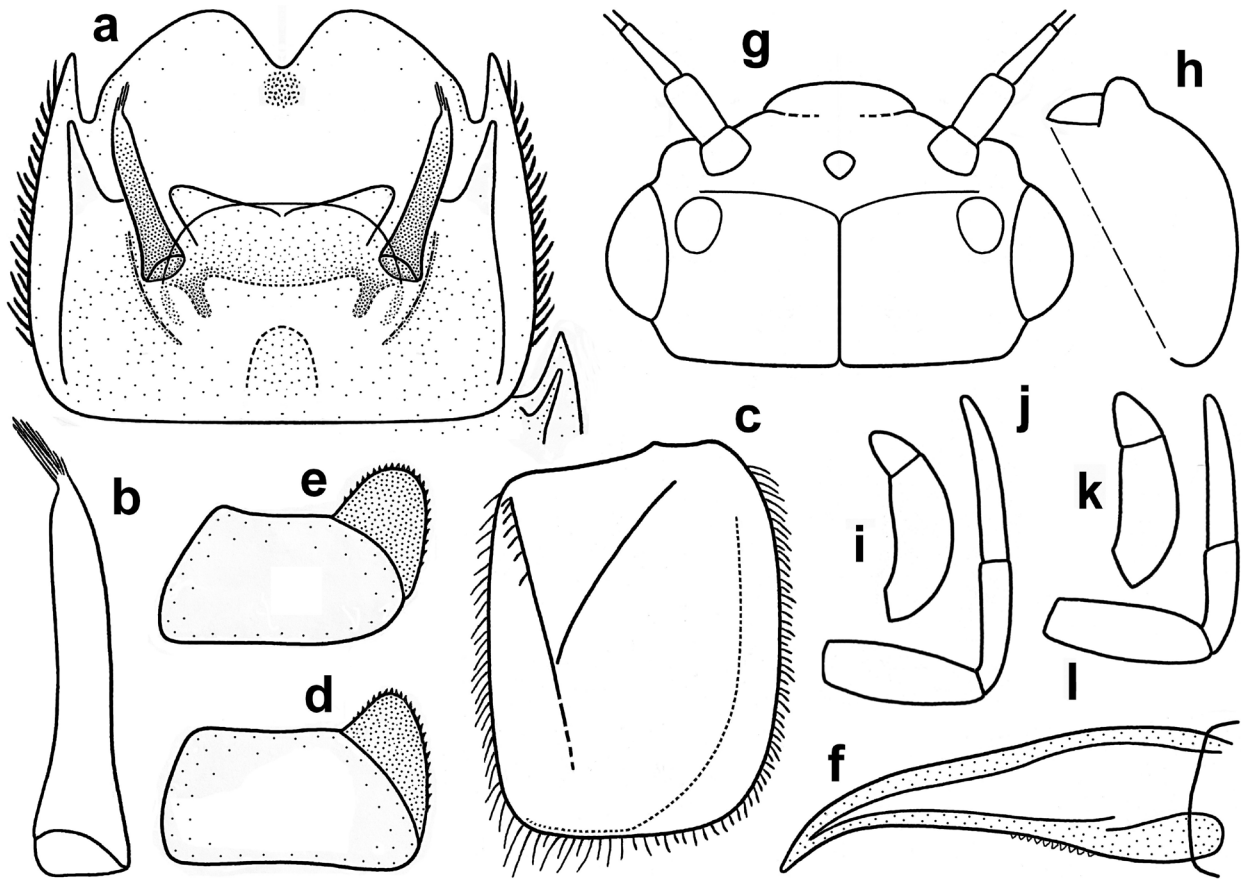


Fig. 2. *Caenis* spp. – a–j. *Caenis clypeata* sp. n., nymph. a. Sternum IX with subimaginal genitalia. b. Forceps of subimaginal genitalia. c. Operculate gill. d. Coxal process of mid leg. e. Coxal process from hind leg. f. Hind claw. g. Head, dorsal view. h. Outline of head, lateral view. i. Labial palp. j. Maxillary palp. – k–l. *Caenis nervulosa*, nymph. k. Labial palp. l. Maxillary palp.

short, pinnate bristles. Hind tarsus with an inner row of eight simple bristles and an outer one of six pinnate bristles. Claws small, triangular, only the tip slightly bowed, with 8–10 very small denticles (Fig. 2f).

Abdomen: Abdominal segments with triangular posterolateral processes of moderate length. Lateral margins of segments VIII and IX densely provided with short to moderate, blunt bristles, more or less bowed (Fig. 2a), on anterior segments consecutively replaced by longer, acute ones (and intermediate ones). Posteromedian process on tergum II short and broadly rounded, dorsally protruding. Hind margin of terga VII–VIII with very small denticles and few short, blunt bristles, terga IX–X with moderate denticles. Hind part of sternum IX shortened, hind margin broadly rounded, medially with a moderate, more or less flattened indentation (Fig. 2a). Shagreen field on dorsal side of sternite IX small, rounded (Fig. 2a).

Operculate gill (Fig. 2c) rectangular, on lateral margin densely provided with short to moderate, blunt bristles, on hind margin laterally more and more elongated

and thinned, inner margin with thin bristles of moderate length. Bristles on lateral margin densely arranged, altogether about 90–100 marginal bristles. Y-shaped ridges well-developed; inner ridge not reaching hind margin of gill, basally with 6–9 moderate, blunt bristles. Microtrichia on ventral side short, more or less circular. Row of microtrichia running far from lateral margin of gill, reaching the middle of the hind margin and proceeding from there with very small, nearly invisible microtrichia until postero-median corner of gill (Fig. 2c). Gill I about one third as long as gill II.

Remarks

The above description refers to the type specimens. All specimens mentioned under “other material” show more or less variable characters such as the length of abdominal posterolateral processes, the shape of sternite IX or the setation and denticulation of the hind margins of terga VII–X. Other diagnostic characters, however, are shared with the holotype, namely: the protruding clypeus, the

length and shape of the maxillary palp and the arrangement of microtrichia on the ventral side of the operculate gill.

Caenis oromo Malzacher, 2021

MALZACHER (2021: 11).

Material examined

Kenya, Mt. Elgon, Kapkateny upstream, 00°53'45.28"N 34°35'56.28"E, 2293 m, 11.10.2019, 2 nymphs. – Kenya, Mt. Elgon, Chemugumiet, 00°49'29.8"N 34°36'27.6"E, 2317 m, 13.10.2019, 1 nymph. – Kenya, Mt. Elgon, Teremi upstream, 00°54'34"N 34°35'58"E, 2407 m, 13.10.2019, 1 nymph. – Kenya, Mt. Elgon, Masindeti, 00°49'35.66"N 34°44'30.79"E, 1676 m, 15.10.2019, numerous nymphs at different developmental stages. – Kenya, Mt. Elgon, Kimurio upstream, 00°53'28.8"N 34°35'21.2"E, 2239 m, 11.10.2019, 4 nymphs. – Kenya, Mt. Elgon, Kapkateny midstream, 00°49'57.18"N 34°37'24.34"E, 1896 m, 12.10.2019, 3 nymphs. – Kenya, Mt. Elgon, Kibingei, 00°47'37.23"N 34°40'53.40"E, 1633 m, 14.10.2019, 4 nymphs. – Kenya, Mt. Elgon, Namboani, 00°49'50.28"N 34°45'45.54"E, 1662 m, 15.10.2019, 2 nymphs. – Kenya, Mt. Elgon, Kibisi upstream, 00°54'10"N 34°37'03"E, 2298 m, 09.11.2019, 8 nymphs. – Kenya, Mt. Elgon, Kibisi downstream, 00°47'50"N 34°38'44"E, 1624 m, 14.10.2019, 4 nymphs. – all leg. W. GRAF.

Remarks

The nymph of *Caenis oromo* shows a characteristic colouration. Other characteristics are a semicircular or nose-shaped projection on the anterolateral side of the mesonotum and marginally short, spatulate bristles. The species seems to be widely distributed in Ethiopia and Kenya. For a detailed description see MALZACHER (2021: 11; figs. 22–32a–k).

Caenis jinjana Kimmins, 1956

KIMMINS (1956: 84, sub *Caenodes jinjana*); THEW (1960: 199, sub *Caenodes jinjana*); DEMOULIN (1970: 157, sub *Caenodes jinjana*); MALZACHER (1993: 398); MALZACHER (2011: 53).

Material examined

Kenya, Sagana river near Karantina 0°40'12"S, 37°12'13"E, 16.10.18, 22 ♂♂.

Remarks

Caenis jinjana is a small species the male of which shows short forelegs, equal in length to the hind legs, long

straight forceps with an apical tuft of moderate spines and narrowed, pointed penis lobes. The species is so far known from Angola, Ethiopia, Guinea, Ivory Coast, Kenya, Mali, Senegal, South Africa, Uganda and Togo. For a detailed description see MALZACHER (2011: 53).

Acknowledgements

My special thanks go to WOLFRAM GRAF (University of Natural Resources and Life Sciences, Vienna) for leaving me the material for investigation, to ARNOLD STANICZEK (SMNS, Stuttgart) and an anonymous referee for their useful comments, and to DANIEL WHITMORE (SMNS, Stuttgart) for his thorough editing, all of which improved the manuscript considerably.

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ZooBank registration: <https://zoobank.org/References/6F494A7D-7134-45D2-9223-19FADEE9CBBC>

Manuscript received: 17.III.2022; accepted: 02.XII.2022.