

# A new genus of the tribe Clypeocaenini (Ephemeroptera: Caenidae: Caeninae)

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## Abstract

*Provonshara spinifera* **n. gen., n. sp.** (Ephemeroptera) from Kenya is described and its phylogenetic position within the tribe Clypeocaenini discussed.

**Key words:** Clypeocaenini, new genus, *Provonshara*, phylogeny, Kenya.

## Zusammenfassung

*Provonshara spinifera* **n. gen., n. sp.** (Ephemeroptera) von Kenia wird beschrieben und ihre phylogenetische Stellung innerhalb des Tribus Clypeocaenini diskutiert.

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## 1 Introduction

After the descriptions of *Clypeocaenis* by SOLDÁN (1978), *Amercaenis* by PROVONSHA & MCCAFFERTY (1985) and *Barnardara* by PROVONSHA & MCCAFFERTY (1995), the herein described new genus *Provonshara* is the fourth genus of Caeninae with long filtering setae on the fore legs. In 2013 MALZACHER united the so called brush-legged genera (PROVONSHA & MCCAFFERTY 1995) together with three others (*Callistellina* Sun & McCafferty, 2001, *Trichocaenis* Malzacher, 2009 and *Kalimaenis* Malzacher, 2013) into the new tribe Clypeocaenini. Now the phylogenetic position of *Provonshara* n. gen. within the Clypeocaninae has to be determined.

## Acknowledgements

I wish to thank Dr. HELEN BARBER-JAMES (Albany museum, Grahamstown, South Africa), for leaving me the here described specimen for investigation. Dr. ARNOLD STANICZEK (Stuttgart) and Dr. MICHEL SARTORI (Lausanne) kindly read the manuscript and provided valuable suggestions.

## 2 Systematic account

### Genus *Provonshara* **n. gen.**

Type species: *Provonshara spinifera* n. sp.

### Etymology

The new genus is dedicated to Dr. ARWIN PROVONSHA (West Lafayette, Indiana, USA), in recognition of his contributions to

**Tab. 1.** Differential-diagnostic characters of *Barnardara* and *Provonshara*.

Character	<i>Barnardara</i>	<i>Provonshara</i>
Cuticle	slightly granulated or smooth	with strong more or less fitted spines
Maxillary palp	two-segmented	three-segmented
Apical part of labial palp and paraglossa	densely covered with long bristles on ventral side only	densely covered with long bristles on ventral and dorsal side
Mid and hind tibiae	ventrally without long bristles	ventrally with long bristles about a fourth the length of fore leg filtering setae
Pinnate bristles on mid and hind tibiae	bipinnate	unipinnate, comb-shaped
Hind margin of sternum IX	with a broad and shallow indentation	indentation narrow and semicircular
Hind part of sternum IX, dorsal side	a few rows of microdenticles near the hind margin	large oval shagreen field of short irregular rows of microdenticles

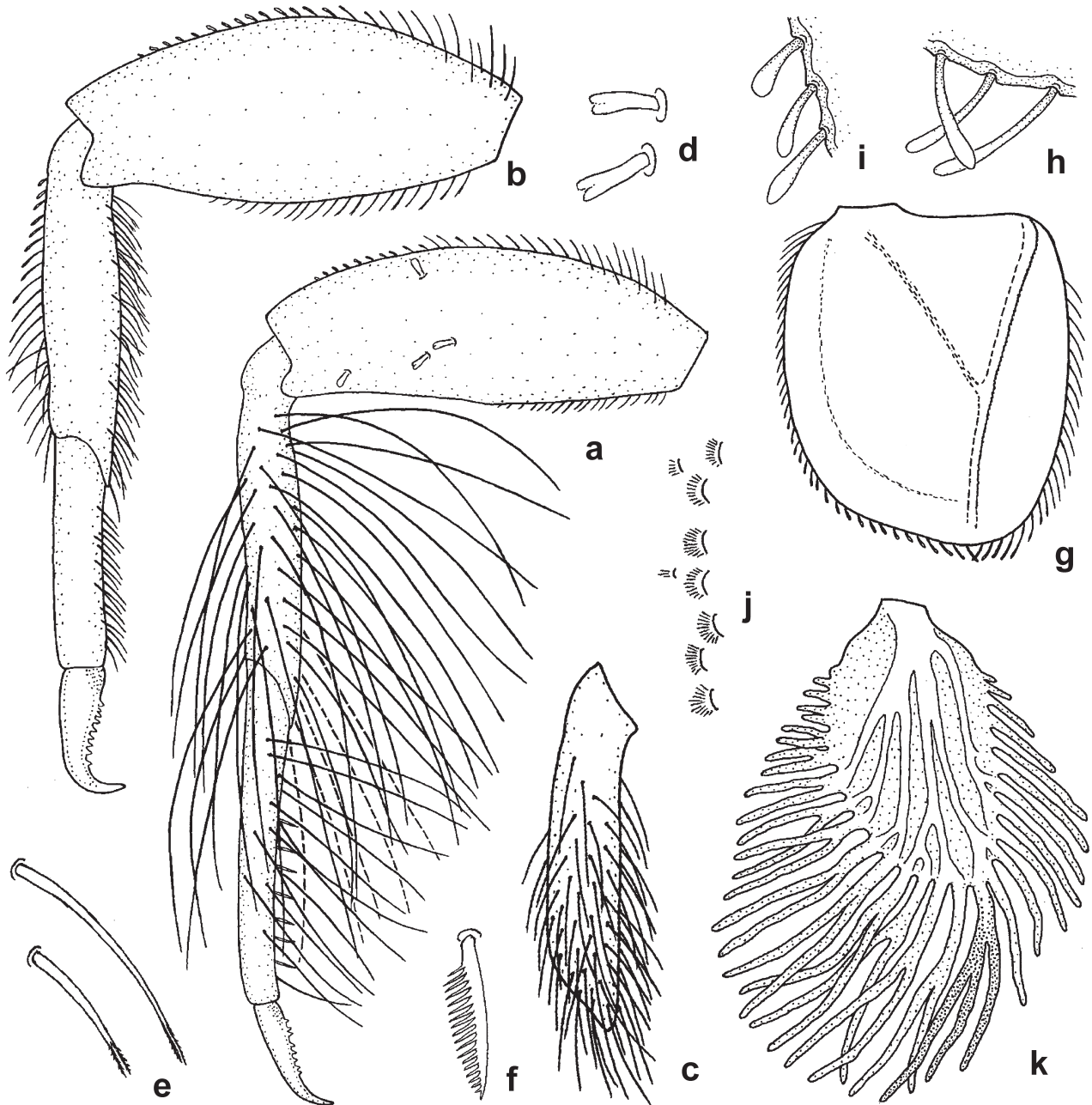
Caenidae, particularly the North American species of *Caenis* and *Amercaenis*. This dedication is also supposed to be a compensation, as I felt sorry when the genus *Provonshaka* had to be synonymised with *Madecocercus* (ELOUARD & SARTORI 2001).

#### Diagnosis

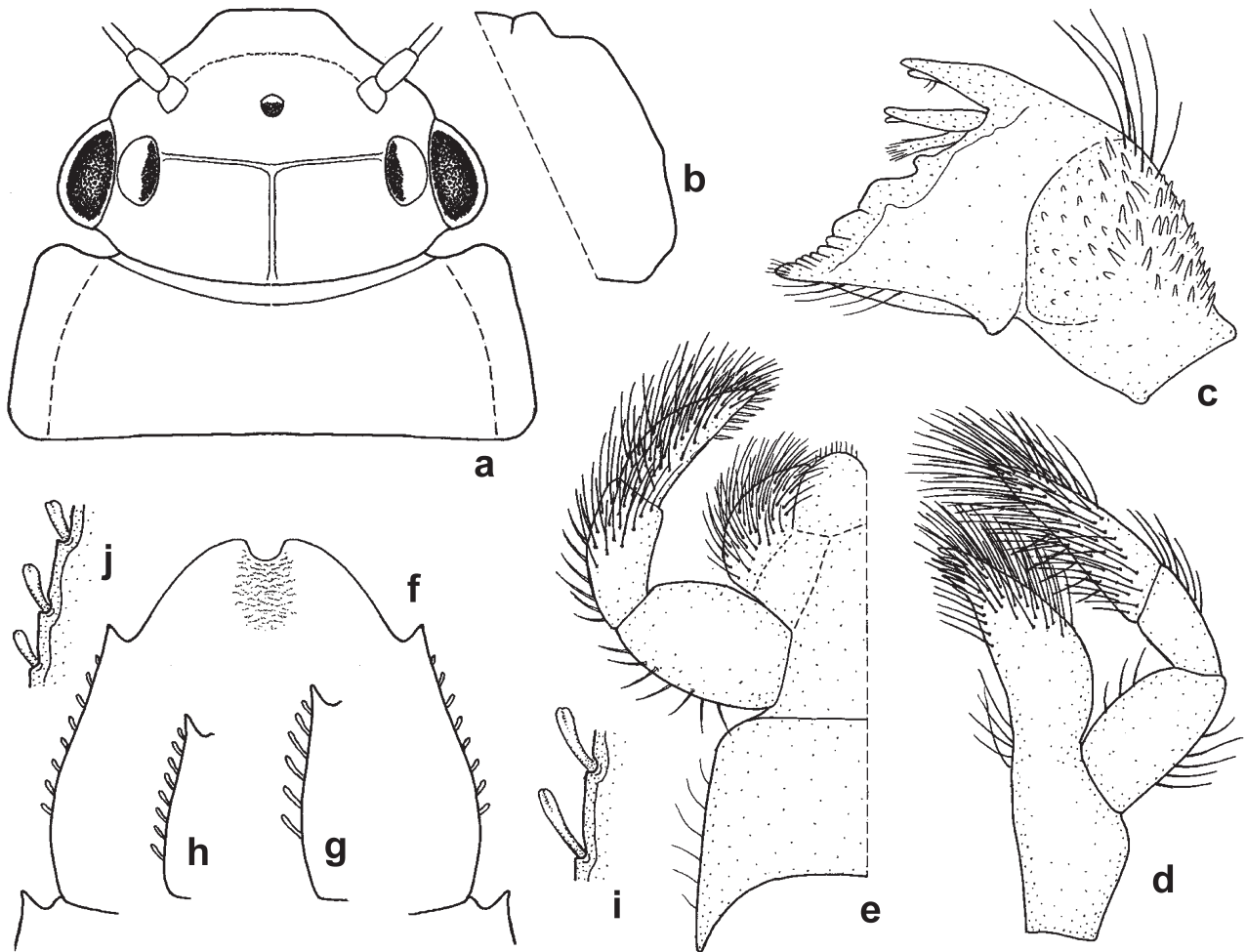
*Provonshara* n. gen. can be characterised and distinguished from all other genera of Caenidae by the follow-

ing combination of characters. From the similar genus *Barnardara* it can be separated by the characters provided in Tab. 1.

Larva: Dorsal cuticle covered with more or less fitted strong spines (Fig. 2c) and shield- or funnel-shaped microtrichia. – Thorax broadened (Fig. 2a). – Head without ocellar tubercles. – Outline of head with bulges in lateral view (Fig. 2b). – Clypeus moderately protruding anteriorly,



**Fig. 1.** *Provonshara spinifera* n. gen., n. sp., larva. – a. Fore leg, dorsal view. b. Hind leg, dorsal view. c. Mid tibia, ventral view. d. Bristles from fore femur. e. Marginal bristles from fore femur and fore tibia. f. Comb-shaped bristle from ventral side of hind tibia. g. Operculate gill, general view. h. Bristles from hind margin of operculate gill. i. Bristles from lateral margin of operculate gill. j. Microtrichia from ventral side of operculate gill. k. Gill III, general view.



**Fig. 2.** *Provonshara spinifera* n. gen., n. sp., larva. – **a.** Head and pronotum. **b.** Outline of head, lateral view. **c.** Right mandible, dorsal view. **d.** Maxilla, ventral view. **e.** Labium, left half, dorsal view. **f.** Sternum IX. **g.** Marginal setation of abdominal segment VI. **h.** Marginal setation of abdominal segment VII. **i.** Bristles from lateral margin of segment VI. **j.** Bristles from lateral margin of segment IX.

protrusion without setation (Fig. 2a). – Maxillary and labial palps three-segmented (Figs. 2d, e). – Fore tibia and fore tarsus with very long irregularly arranged bristles (Fig. 1a). – Mid and hind tibia ventrally with numerous long bristles (Fig. 1c). – Operculate gill ventrally with an irregular row of simple scale-shaped microtrichia, row does not reach hind margin of gill (Figs. 1g, j). – Nearly all filaments of gill III 1- or 2-branched, only 1(–3) filaments with 3 or more branches (Fig. 1k). – Lateral spines of abdomen not bent dorsally. – Posterior part of sternum IX dorsally with chagreen-field (Fig. 2f). – Abdominal terga VII–IX without mediolongitudinal ridge. – Hind margin of sternum IX without a bi-pointed process with concave margin between the points.

*Provonshara spinifera* n. sp.

(Figs. 1, 2)

Material examined

Holotype, ♀ larva (microslide), CAW 388B, Kenya, Isiuku Riv./Nzoia Riv./Lake Victoria, 100 km N Kisumu, 00°15'16"N, 34°44'58.8"E, 10.XI.2007. The holotype is stored in the Albany Museum, Grahamstown, South Africa.

Etymology

The species name refers to the long and strong spines that cover large parts of the dorsal cuticle of the larva.

## Larva

### Measurements and colouration

Subadult female larva, body length 3.3 mm, length of cerci 1.8 mm. Colouration of cuticle: tobacco brown; head, legs and abdomen lighter. Epidermal pigmentation: head and abdominal terga slightly greyish pigmented.

### Morphology

Cuticle: large parts, particularly dorsal side and femora covered with strong spines more or less fitting to the cuticle (like in Fig. 2e), often shield- or funnel-shaped microtrichia between them.

Head: Outline of head, bulged in lateral view (Fig. 2b), clypeus moderately protruding anteriorly (Fig. 2a). Genae slightly bulging out. Mandibles with few lateral bristles and a dorsal field with spines (as described above) (Fig. 2c). Maxillary palp three-segmented, relatively short and broad, segment III ventrally densely covered with long bristles (Fig. 2d). Segment III of labial palp as long as segment II; dorsal cuticle of segment III and apical half of segment II densely covered with long bristles. Postmentum broadly rectangular with long apophyses (Fig. 2e).

Thorax: Sides of pronotum straight, anteriorly converging (Fig. 2a), with notches. Fore tibia with at least 30 and fore tarsus with about 15 long filtering setae irregularly arranged (Fig. 1a); most of them are coming from the dorsal side, only about 6 tibial setae from the ventral side (broken lines in Fig. 1a) together with about 10 clearly shorter ones. Distal third of fore femur with about 4 short and apically broadened more or less bifurcate bristles (Figs. 1a, d). Coxal processes forming inconspicuous ridges. Mid and hind legs (Figs. 1b, c) with bristles of different length more or less bifurcate, the longer ones apically slightly frayed (Fig. 1e). Mid and hind tibiae ventrally with long bristles, about a fourth the length of fore leg filtering setae (Fig. 1c). Hind tibia with a longitudinal row of 4–5 conspicuous comb-shaped bristles (unipinnate bristles with very long pinnae) (Fig. 1f). A group of similar bristles, a little longer and with shorter pinnae, can be found apicomediaally on fore tibia. Fore tarsus medially with a row of about 6 simple bristles, mid and hind tarsus with a band of clearly longer and pointed bristles. Claws of fore legs moderately bowed (Fig. 1a), of mid and hind legs strongly hooked (Fig. 1b), with 8–10 denticles. Hind claws homodont (without additional row of very fine microdenticles).

Abdomen: Posterolateral processes very short, 0.1 length of posterior segments (Figs. 2f, g). Lateral margins with very short spatulate or club-shaped bristles (Figs. 2i, j). Posteromedian process of tergum II long, strong and pointed, slightly bowed in lateral view. Hind margin of terga VII–X with long spines, terga VII and VIII additional with a few moderate spatulate or club-shaped bristles. Hind margin of tergum IX with a semicircular indentation, in front of it a large shagreen field consisting

of short transverse rows of microdenticles (Fig. 2f). Gill I short, one-third to one-fourth the length of operculate gill. Lateral and hind margin of operculate gill (Fig. 1g) with club-shaped bristles longer and apically more broadened as those from lateral margin of abdomen (Figs. 1h, i), inner margin with thin pointed bristles. Medial ridge keeled, without bristles at the base, outer oblique ridge inconspicuous. On ventral side of operculate gill an irregular row of microtrichia running in regular distance from the lateral and hind margin, ending far from the latter (Fig. 1g). The row consists of simple scales and some clusters of spines (Fig. 1j). Gills III(–V) with only 1 filament with 3 branches (darker in Fig. 1k); all other filaments (about 30) simple or two-branched. Basal segments of cerci with apically rounded bristles.

## 3 Phylogenetic discussion

With the knowledge of the new genus and the reconsideration of some interpretations, the previous discussion of the phylogeny (MALZACHER 2013) has to be changed in some points (compare the following text, Fig. 3 and Tab. 2 with chapter 4, fig. 50 and tab. 2 in MALZACHER 2013). The discussion is based exclusively on larval characters.

The genera of the tribe Clypeocaenini share two synapomorphies:

(1) Gill III (first of the four respiratory gills) possesses at most 8 filaments (in most cases only one or two), each made up of three or more branches, in contrary to 15–25 filaments in the Caenini and Tasmanocoenini. In the outgroup Neophemeridae there are numerous filaments present, each with five and more branches, so that a reduction of filament branches can be regarded as apomomorphic for Clypeocaenini.

(2) Outline of head in lateral view with bulges, clypeus more or less protruding (MALZACHER 2013, figs. 13c–h). In the above mentioned outgroups and in Ephemerellidae the outline of the head in lateral view is evenly bowed (MALZACHER 2013, figs. 13a, b).

The sister group of Clypeocaenini is represented by the tribes Caenini + Tasmanocoenini (separated from the Clypeocaenini in bifurcation A), which share two synapomorphies:

(3) Row of microtrichia on ventral side of gill II (operculate gill) extending to hind margin of gill – for Caenini see MALZACHER (2009b, figs. 17, 20, 23) and for Tasmanocoenini see SUTER (1984, fig. 6), ALBA-TERCEDOR & SUTER (1990, fig. 19), SUTER (1993, figs. 16, 41, 68), and SUTER (1999, fig. 95). In Clypeocaenini, the row of microtrichia does not extend to hind margin of operculate gill. The distance from the end of the row to hind margin varies from  $\frac{1}{8}$  to  $\frac{1}{15}$  the length of gill II.

**Tab. 2.** Differential-diagnostic characters of the subfamily Caeninae, particularly the tribe Clypeocaenini.

	Character	Apomorphic state	Plesiomorphic state
1	Gill III	at last 8 filaments with 3 or more branches	more than 15, up to 25 filaments with 3 or more branches
2	Outline of head, lateral view	with bulges, clypeus $\pm$ protruding	evenly bowed, clypeus not protruding
3	Gill II, ventral row of microtrichia	reaching hind margin of gill	row not reaching hind margin, distance $\frac{1}{8}$ to $\frac{1}{15}$ length of gill II
4	Gill II	with regular row of complex scale-shaped microtrichia	with bands or irregular rows of spines, clusters of spines or simple scales
5	Gill III	nearly all filaments 1- or 2-branched, only 1–3 filaments with 3 or more branches	more than 8 filaments with 3 or more branches
6	Pronotum, Mesonotum	broadened, sides of pronotum $\pm$ converging, outline evenly curved	not broadened, sides of pronotum anteriorly not converging, outline $\pm$ irregular
7	Operculate gill	inner ridge keeled	not keeled
8	Legs	long and slender, femora narrowed, with parallel sides	all parts shorter, femora broad
9	Maxillary palp	elongated, segment 1 conical, segments 2+3 coiled	shorter and not coiled
10	Hind claw	with groups of fused microdenticles	homo- or heterodont, without groups of fused microdenticles
11	Fore leg	with filtering setae	without filtering setae
12	Maxillary palp	two-segmented	three-segmented
13	Filtring setae on fore leg	forming regular rows	irregularly arranged
14	Clypeus	strongly protruding, with long setae	not or only slightly protruding, without long setae
15	Head	with microscopic pits each with branched microtrichium	without those structures
16	Thoracic nota	with ridges or bulges	evenly bowed
17	Cuticle	with strong and long spines	without long spines
18	Mid and hind tibia, ventrally	with numerous long bristles	without long bristles

(4) Gill II with regular row of complex, very similar, scale-shaped microtrichia, which are semicircular or more or less elongated, consisting of 20–30, rather basally fused filaments (spines). In *Kalimaenis*, a similar arrangement is present, but this is regarded as a convergent development. The plesiomorphic character states in Clypeocaenini show very different developmental stages from a band of simple spines and clusters of spines up to scales with 5–20 filaments arranged in an irregular row (MALZACHER 2009b, figs. 3–5, 8, 10, 12). The most plesiomorphic state, simple spines and clusters of spines, can also be found in the outgroups Brachycercinae and Madecocercinae.

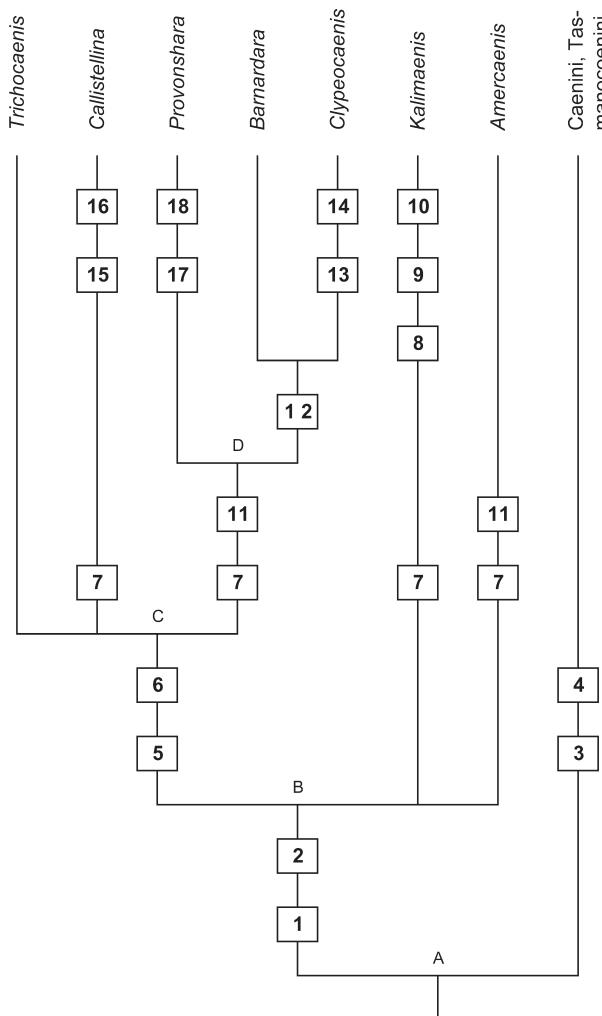
Within Clypeocaenini, the *Clypeocaenis* group s. str. with the genera *Clypeocaenis*, *Barnardara*, *Provonshara*, *Callistellina* and *Trichocaenis* (see trifurcation B) shares two apomorphies:

(5) In gill III nearly all filaments (up to 45) have one or two branches. Only one or two apical filaments which are situated at the apex of the gill show three or more branches. In *Amercaenis* and *Kalimaenis* there are 7–8 filaments with up to five branches and only about 20 reduced ones.

(6) Mesonotum broad. Pronotum broadly attached to the mesonotum, lateral sides of pronotum anteriorly more or less converging. Outline of body evenly curved. (e. g. MALZACHER 2013, fig. 47, MALZACHER 2009a, fig. 4, SUN & McCAFFERTY 2001, fig. 1). In *Amercaenis* and *Kalimaenis*, the pro- and mesonotum is much narrower.

(7) MALZACHER (2013) interpreted the presence of a keeled ridge on gill II as synapomorphic for the Clypeocaenis group s. str. (see MALZACHER 2013, figs. 9d, 43; PROVONSHA & McCAFFERTY 1995, fig. 7). However, this character is also present in *Kalimaenis*, *Amercaenis*, and in some taxa of Caenini. Consequently, this character cannot be upheld as synapomorphic for *Clypeocaenis* s. str. (see also discussion below under trifurcation C). It may be possible that this character has evolved independently in each of these groups, or even possible that it is present in the groundplan of Clypeocaenini s. lat. or even in Caeninae, but reduced in *Trichocaenis* and most Caenini.

*Kalimaenis* shows three well-defined apomorphies. For discussion of the characters (8)–(13) see MALZACHER (2013).



**Fig. 3.** Phylogeny of the tribe Clypeocaenini. – For explanation see phylogenetic discussion, section 3.

(8) Legs long and slender.

(9) Maxillary palps strongly elongated and narrowed with a conical segment I and s-shaped coiled segments II and III.

(10) Hind claws with about 7 groups of microdenticles fused together to larger denticles.

The phylogeny within the *Clypeocaenis* group s. str. remains partly unresolved with three branches (trifurcation C), namely *Trichocaenis*, *Callistellina*, and *Clypeocaenis* + *Barnardara* + *Provonshara*. The latter three genera show the following synapomorphy:

(11) Filtering setae on tibia and tarsus of fore leg.

*Amercaenis* also has filtering setae on tibia and tarsus of foreleg as present in *Provonshara* + (*Barnardara* +

*Clypeocaenis*), but this is regarded as a parallel development herein (opposite to KLUGE 2004).

*Provonshara* is the sister to *Clypeocaenis* + *Barnardara* (separated in bifurcation D), the latter are united by a single apomorphy:

(12) Maxillary palp two-segmented.

*Barnardara* is not defined by unique apomorphic characters, while *Clypeocaenis* shows two apomorphies:

(13) Filtering setae arranged in rows.

(14) Clypeus strongly protruding and provided with long setae.

*Callistellina* is also a well-defined monophyletic taxon:

(15) Head with microscopic pits each with a hand-shaped microtrichium.

(16) Thoracic notae with ridges or bulges.

*Provonshara* has two unique apomorphies:

(17) Body cuticle with strong and long spines (Fig. 2c). In all other Caeninae the cuticle is smooth, granulated, or has short microdenticles (in *Kalimaenis* strongly granulated or scaly).

(18) Mid and hind tibia with numerous long bristles on ventral side (Fig. 1c). In other genera those bristles are not present. If at all, long bristles occur only on dorsal side or on the margins of the tibia.

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