Systematics of Rhithrocloeoninae with new species from Uganda

Систематика Rhithrocloeoninae с описанием новых видов из Уганда

Nikita J. Kluge
Н.Ю. Клюге

Department of Entomology, St. Petersburg State University, Universitetskaya nab., 7/9, St. Petersburg 199034, Russia. E-mail: kluge@FK13889.spb.edu. Website: http://www.insecta.bio.pu.ru

KEY WORDS: systematics, Ephemeroptera, Baetidae, Protopatellata, Rhithrocloeon, Kivuiops, Bugilliesia, new species.

ABSTRACT. The new subfamily Rhithrocloeoninae is described. The taxon Rhithrocloeoninae (or Rhithrocloeon fg1) includes a plesiomorphon Bugilliesia and a holophyletic taxon Rhithrocloeon fg2, which is divided into Rhithrocloeon fg3 and Kivuiops. Rhithrocloeon (Kivuiops) insuetum, Rh. (K.) munyagae sp.n. and Rh. (K.) elgonensis sp.n. are described as imagoes and subimagines reared from larvae in Uganda. Comments on some species of Rhithrocloeon fg3 and Bugilliesia from Uganda, Tanzania, Mali and Sudan are given.

РЕЗЮМЕ. Описывается новое подсемейство Rhithrocloeoninae. Таксон Rhithrocloeoninae (или Rhithrocloeon fg1) включает плезиоморфон Bugilliesia и голофилетический таксон Rhithrocloeon fg2, который подразделяется на Rhithrocloeon fg3 и Kivuiops. По имаго и субимаго, выведенных из личинок, описываются Rhithrocloeon (Kivuiops) insuetum, Rh. (K.) munyagae sp.n. и Rh. (K.) elgonensis sp.n. из Уганда. Приведены замечания о некоторых видах Rhithrocloeon fg3 и Bugilliesia из Уганда, Танзании, Мали и Судана.

Introduction

All Baetidae s.str., or Turbanoculata Kluge, 1997, are divided into a plesiomorphon Protopatellata Kluge & Novikova, 2011 and a holophyletic taxon Anteropatellata Kluge, 1997. The taxon Protopatellata is characterized by retaining the same primitive position of patella-tibial suture, which occurs in most Ephemeroptera: in all stages of both sexes this suture is developed on middle and hind legs, but absent on fore legs; in selected taxa patella-tibial suture is reduced on all legs, but it never appears on fore legs. The taxon Anteropatellata is characterized by an autapomorphy: patella-tibial suture is restored on fore legs, which become similar to middle and hind legs; only in male subimago and imago fore legs lack patella-tibial suture (see Table 1).

Table 1. Presence of patella-tibial suture in Protopatellata and Anteropatellata

<table>
<thead>
<tr>
<th></th>
<th>male</th>
<th>female</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>fore leg</td>
<td>middle leg</td>
</tr>
<tr>
<td>plesiomorphon</td>
<td>–</td>
<td>+</td>
</tr>
<tr>
<td>Protopatellata</td>
<td></td>
<td></td>
</tr>
<tr>
<td>larva</td>
<td>–</td>
<td>+</td>
</tr>
<tr>
<td>subimago</td>
<td>–</td>
<td>+</td>
</tr>
<tr>
<td>imago</td>
<td>–</td>
<td>+</td>
</tr>
<tr>
<td>Anteropatellata</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>larva</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>subimago</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>imago</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

The plesiomorphon Protopatellata is distributed mainly in Ethiopian Region, a few species are distributed in Asia and America [Kluge, 2011]. Among others, to this plesiomorphon belongs a holophyletic taxon Rhithrocloeon fg1 described here; its distribution is limited by Ethiopian Region.

Here are used principles of cladoendesis [Kluge & Novikova, 2011; Kluge, in press] and rank-free hierarchical nomenclature [Kluge, 2004]. Morphological terms used here, are explained in the previous paper [Kluge & Novikova, 2011]. All material, including holotypes and paratypes of new species, is permanently deposited in the Zoological Institute of Russian Academy of Sciences (Saint Petersburg, Russia); temporarily locates in the Department of Entomology of Saint Petersburg State University. In the lists of material examined, the following arbitrary signs are used: L-S-1♂ — male imago reared from larva, with larval and subimaginal exuviae; L-S/1♂ — male imago extracted from subimago reared from larva, with larval exuviae; L/S/♂ — male subimago...
extracted from mature larva; L-S-I\(s\) — female imago reared from larva, with larval and subimaginal exuviae.

Taxa discussed here form the following classification:

1. Rhithrocloeon/fg1
   1.1. Rhithrocloeon/fg2
   1.1.1. Rhithrocloeon/fg3
   1.1.1-1. Rhithrocloeon/fg3 sp.1
   1.1.1-2. Rhithrocloeon/fg3 sp.2
   1.1.2. Kivuiops/g(1), or Kivuiops
   1.1.2-1. Kivuiops/g(1) insuetum [Cloeon]
   1.1.2-2. Kivuiops/g(1) elouardi [Rhithrocloeon]
   1.1.2-3. Kivuiops/g(1) munyagae sp.n. [Rhithrocloeon]
   1.1.2-4. Kivuiops/g(1) elgonensis sp.n. [Rhithrocloeon]
   1.2. Plesiomorph Bugilliesia/g(1), or Bugilliesia
   1.2-1. Bugilliesia/g(1) sp.1
   1.2-2. Bugilliesia/g(1) sp.K
   1.2-3. Bugilliesia/g(1) biloba [Bugilliesia]
   1.2-4. Bugilliesia/g(1) notable [Cloeon perminum (Opkele, 1980 (design. orig.))]
   1.2-5. Bugilliesia/g(1) sudanense [Centroptilum]
   1.2-6. Bugilliesia/g(1) griseum [Afrotiplum]

System of Rhithrocloeon/fg1

1. Rhithrocloeon/fg1
   (Figs 1–46)

Hierarchical typified name: Rhithrocloeon/fg1 (incl. Bugilliesia/g(1) and reported by Gillies [1997] for one species of Bugilliesia/g(1) — griseum [Afrotiplum].)
Possible rank-based names:
— tribe Rhithrocloeonini; — subfam. n.

Composition.

1. Male genitalia have unique structure: distal segment of gonostyli is lost (see 1.1), larval protogonostyli are brought together (see 1.3).

1.1. Structure of gonostyli (Figs 12–18, 31, 40–42).

1.1.1. Gonostyli [which initially for Libereneata has integral 1\(st\)-2\(nd\) segment and articulated 3\(rd\) (distal) segment] is «ankylosed»: it lacks distal segment and consists of a single 1\(st\)-2\(nd\) segment of composite shape: its proximal part (initial 1\(st\) segment) is strongly projected medially-ventrally; its distal part (initial 2\(nd\) segment) has inner side either straight (Fig. 42), or soft (Fig. 15). Unlike Rhithrocloeon/fg1, in all other Libereneata distal segment of gonostyli is retained; 2\(nd\) segment is often arched medially, so that its inner side is concave.

1.1.2. Structure of penis (Figs 12–18, 31, 40, 42).

Protogenoves are completely fused with penial bridge; gonoducts open at the middle of the integral penis. In other respects penis structure is variable: in some species it retains a form of integral sclerotized bridge, movable articulated with latero-apical angles of abdominal segment IX (Figs 12–18, 31, 45); in some species it is partly fused with protogenostyli to form a composite construction (Figs 40–42). Complete fusion of genoveses with penial bridge, besides Rhithrocloeon/fg1, independently occurs in Anteropatellata-Cloeon/fg1.

1.1.3. Larval protogenostyli (Figs 1, 46).

1.1.3.1. Larval protogenostyli brought together (unlike other Turbanoculata, whose protogenostyli are widely separated): in mature larva buds of subimaginal gonostyli, developed under larval cuticle, are entirely convergent, to that their apices are brought together. This character is known for three examined species of Kiviops and for Bugilliesia/g(1) sudanense [Centroptilum]. Unlike Rhithrocloeon/fg1, in all other Protopatellata, as well as in Anteropatellata-non-Baetovectata, buds of 2\(nd\) segments of subimaginal gonostyli are divergent.

1.1.3.2. Maxillary palp has 2\(nd\) segment widened and flattened toward apex; 3\(rd\) segment somewhat narrower, short and triangular, separated from 2\(nd\) segment by oblique suture (Figs 27–28).

Characters of unclear phylogenetic status.

1. Maxilla of «Cloeon-type), i.e. its three canines and distal dentista are pointed and bent to the same direction (Fig. 27).
2. Larval legs of «Cloeon-type), i.e. slender, with femora parallel-sided (Fig. 5); claws slender, slightly arched, denticles on inner side small or absent. Claw either retains both rows of denticles (in plesiomorph Bugilliesia), or has one row (see below, Rhithrocloeon/fg2 (2)).
3. Tergalii able to rhythmic respiratory movements. This was observed by me for all examined species of Kiviops/g(1) and reported by Gillies [1997] for one species of Bugilliesia/g(1) — griseum [Afrotiplum]. Judging by the same paper [Gillies, 1997: Table 1], Rhithrocloeon/fg3 has immobile tergalii; but this conclusion was based on observation of a single individual of Rhithrocloeon sp., and can be an error.
4. Hind wings, if present, of «Centroptilum-type), narrow, with two longitudinal veins, with simple (not bipointed) hooked costal process (Fig. 43). Hind wings are retained in plesiomorph Bugilliesia, but absent in Rhithrocloeon/fg2.
5. In subimago of both sexes all segments of all tarsi are covered by pointed microlepidies. This is true for species examined (see below). The same in all other examined Protopatellata, Anteropatellata-non-Baetovectata and some Baetovectata (unlike some Baetovectata, which have blunt microlepidies).

Plesiomorphies.

In all stages of both sexes patella-tibial suture is present on middle and hind legs, being absent on fore leg (as characteristic for the plesiomorph Protopatellata — Table 1) (Figs 5, 6). Fore wing with one marginal intercalary in each space (Fig. 21) (unlike Baetovectata).

Composition.

1.1.1. Rhithrocloeon/fg1 includes the following taxa: (1) holophyletic taxon Rhithrocloeon/fg2; (2) plesiomorph Bugilliesia/g(1); (3) Mutelocloeon Gillies & Elouard, 1990 with two species — type species Mutelocloeon Kivuiops corbeti; (4) Adnotiopum Gillies & Elouard, 1990 with two species — type species Adnotiopum: Mutelocloeon Kivuiops corbeti Gillies & Elouard, 1990; (5) Redescriptions of Rhithrocloeon/fg2 and Bugilliesia/g(1) are given below. The taxa Mutelocloeon and Adnotiopum have been described basing on non-reared material, so their diagnosis are not reliable enough; both have hind wings reduced, and in this respect differ from Bugilliesia/g(1) [Gillies & Elouard, 1990; Gilliatti & Monaghan, 2010].

1.1.1.1. Rhithrocloeon/fg2
   (Figs 1–37)

Hierarchical typified name: Rhithrocloeon/fg2 (sine Bugilliesia; incl. Kiviops).
Possible rank-based names:
In circumscription fits:

Autapomorphies.

1. Apical setae of paraglossa are shifted to ventral side, so that apical margin is free from setae (Fig. 10) (unique
apomorphy); apical setae always form 3 regular rows. Shape of labium is characteristic and identical in all species: paraglossa is widened apically; labial palp has 2\textsuperscript{nd} segment bluntly projected medially (unlike sharply projected in \textit{Bugilliesia}).

(2) Larval claw [slender – see \textit{Rhithrocloeon/fg1} (4)] has one row of denticles (Fig. 7) (instead of initial two rows). The same in some other taxa of Protopatellata and in Anteropatellata-Baetungulata.

(3) Hind wings absent; larva has no vestiges of hind protoptera (non-unique apomorphy).

\textbf{Characters of unclear phylogenetic status.}

(4) Each tergalius I–VII [able to respiratory movement — see \textit{Rhithrocloeon/fg1} (5)] is bordered by integral marginal rib, whose whole distal part (including apex of tergalius) bears a regular row of small oblique seta-bearing denticles. The same in many other taxa, but not in \textit{Bugilliesia}, whose tergalii have apex soft and non-denticulate. In \textit{Rhithrocloeon/fg2} shape of tergalii individually varies from oval to lanceolate, symmetric or slightly asymmetric [Gillies, 1988: Figs 40–42].

\textbf{Composition.} \textit{Rhithrocloeon/fg2} is divided into \textit{Rhithrocloeon/fg3} and a \textit{Kivuiops/g1}.

1.1.1. \textit{Rhithrocloeon/fg3} (Figs 11, 24, 37)

Systematic position: pm.Protopatellata—\textit{Rhithrocloeon/fg1}—\textit{Rhithrocloeon/fg2}—\textit{Rhithrocloeon/fg3}.

Hierarchical typified name: \textit{Rhithrocloeon/fg3} (sine \textit{Kivuiops}).

Possible rank-based names:

— gen. \textit{Rhithrocloeon};
— subgen. \textit{Rhithrocloeon} in gen. \textit{Rhithrocloeon}.

In circumscription fits:


\textbf{Autapomorphy.}

(1) Prostheca of right mandible slender, seta-like, without denticles [Gillies, 1988: Figs 34, 36] (unlike prostheca of left mandible, which is wide and dentate, as in all \textit{Rhithrocloeon/fg1}). This differs both from \textit{Kivuiops} (whose right prostheca is widened) and from \textit{Bugilliesia} (whose right prostheca is plesiomorphically moderately narrow and dentate [Gillies, 1990: Figs 71–73]).

\textbf{Character of unclear phylogenetic status.}

(2) Labrum has uniform structure in both species: widened distally, with median incision small; in the specimen examined, dorsal surface with one pair of latero-distal setae and a pair of submedian setae (Fig. 24).
Plesiomorphy.

Unlike Kivuiops, maxilla [of Cloeon-type] — see Rhithrocloeon/fg1 (3) retains more than one seta in inner-dorsal row.

Composition. Rhithrocloeon/fg3 includes 2 species: permirum Kopelke, 1980 [Cloeon] and indicator Gillies, 1985 [Rhithrocloeon]. For both species imagoes were reared from nymphs; male imagoes have different shape of gonostyli, but for larvae “specific identification is presently not possible” [Gillies, 1988: 56]. Two larval specimens are examined.
1.1.1-1. Rhithrocloeon/fg3 sp. 1 (Figs 11, 24)


1.1.1-2. Rhithrocloeon/fg3 sp. 2 (Fig. 37)

MATERIAL. UGANDA, Rwenzi mountains, Kasese district, stream in forest — tributary of river Mubuku above Ruboni, 8.VIII.2007, N. Kuge: 1 immature larva.

Larva. Head narrower than in Kivuiops, antennae brought together, froms between them forms a longitudinal kiel. Mandibles with incisor+kinetodontium more slender than in Kivuiops, right prostheca slender [as in Gillies, 1988: Figs 33–36]. Caudal unicolor, without dark band (unlike Kivuiops).

1.1.2. Kivuiops/g(1), or Kivuiops (Figs 1–10, 12–23, 25–36)


Possible rank-based names:
— subgen. Kivuiops in gen. Rhithrocloeon;
— gen. Kivuiops.

In circumscription fits:

Autapomorphies.
(1) Prostheca of right mandible widened, stout and dentate, similar to prostheca of left mandible (Fig. 30). This differs both from Rhithrocloeon/fg3 (whose right prostheca is seta-like [Gillies, 1988: Figs 34, 36]) and from Bugilliesia (whose right prostheca is plesiomorphically narrow and dentate [Gillies, 1990: Figs 71–73]).

(2) On maxilla [of «Cloeon-type] — see Rhithrocloeon/fg1 (3)], inner-dorsal row of setae (which represents continuation of the row of dentisetae) consists of a single stout seta, which is especially long (much longer than dentisetae) and bent proximally (Fig. 27); rarely one smaller seta locates proximad to it. Unlike Kivuiops, in Rhithrocloeon/fg3 and Bugilliesia the inner-dorsal row retains several setae, which are not so long and not bent proximally.

(3) On labium [modified — see Rhithrocloeon/fg2 (1)] setae on inner side of glossae are short and stout (Fig. 10) (unlike Rhithrocloeon/fg3, whose setae are longer and thinner — Fig. 11).

(4) Larval paraprop has numerous small fine denticles, directed perpendicular to its margin (Fig. 36) (unlike Rhithrocloeon/fg3, whose paraprop has fewer oblique denticles — Fig. 37)

Characters of unclear phylogenetic status.

(5) On cuticle of subimaginal wing each microtrichion arises from center of a large brown round spot on colorless background (Fig. 22). Examined species of Bugilliesia have no such spots. Subimagines of Rhithrocloeon/fg3 are not described, so it is unclear, if this apomorphy belongs to Kivuiops/g(1), or to Rhithrocloeon/fg2 in general.

(6) All species have similar shape of gonostyli (Figs 12–18, 20, 31), different from gonostyli of each two species of Rhithrocloeon/fg3. Possibly, plesiomorphy.

Composition. Kivuiops/g(1) includes 4 species: insuetum Kopelke, 1980 [Cloeoon]; elouardi Gillies, 1989 [Rhithrocloeon]; munyagae sp.n. [Rhithrocloeon (Kivuiops)]; and elgonensis sp.n. [Rhithrocloeon (Kivuiops)].

Comments. Lugo-Ortiz and McCafferty [1996] established the genus Kivua (later renamed to Kivuiops) and separated it from the genus Rhithrocloeon basing on a single character: in Kivuiops gonostylus apex is “blunt”, while in Rhithrocloeon it is “pointed”. Basing on this single character, these authors regarded Rhithrocloeon to be sister group of Bugilliesia, but not of Kivuiops. Actually, gonostylus of Rhithrocloeon/fg1 tends to be sclerotized along the whole outer side, being membranose at distal part of inner side (Fig. 15); in this case, in ventral or dorsal view it can look as “blunt” or “pointed” depending on fixation (Fig. 20).

Key to male imagos of Kivuiops

(1) Middle and hind tarsus with two thorns: on 1+2nd and 3rd segments (Fig. 32). Median projection of penis has simple trapezoid shape, without finger-like process (Fig. 31) .....................

— gen. Kivuiops sp.n. [Rhithrocloeon].

(2) Middle and hind tarsus with one thorn, on 3rd segment only (Fig. 4). Median projection of penis has composite shape, with a finger-like process (Figs 12, 20).

(3) Wing widest in middle or distal half. West Africa. [Gillies, 1989: Fig. 1; Gattolliat, 2006: Fig. 20] ..............

— gen. Kivuiops sp.n. [Rhithrocloeon].

(4) Wing widest in proximal half (Fig. 21). East Africa.

(5) Median projection of penis has trapezoid proximal part longer than finger-like process (Fig. 12) ..................

— gen. Kivuiops sp.n. [Rhithrocloeon].

(6) Median projection of penis has trapezoid proximal part shorter than finger-like process (Fig. 20) ..................

— gen. Kivuiops sp.n. [Rhithrocloeon].

Key to larvae of Kivuiops

Larvae of elouardi [Rhithrocloeon] unknown.

(1) Posterior margin of metanotum in median part bears a regular row of dark stout pointed denticles (Fig. 23), which are much longer than denticles on 1st abdominal tergum and similar to denticles on last abdominal terga ............................

— insuetum [Cloeoon] and munyagae sp.n. [Rhithrocloeon].

(2) Posterior margin of metanotum in median part bears a few irregular small denticles (Fig. 25), which are not larger than vestigial denticles of 1st abdominal tergum ............................

— elgonensis sp.n. [Rhithrocloeon].

1.1.2-1. Kivuiops/g(1) insuetum [Cloeoon] (Figs 1–10, 12–18)

Systematic position: Rhithrocloeon/fg1 — Rhithrocloeon/fg2 — Kivuiops/g(1).

Original binomen: Cloeoon insuetum Kopelke, 1980.

Possible binomina:
— Rhithrocloeon (Kivuiops) insuetum;
— Kivuiops insuetum.

REFERENCES. Cloeoon insuetum Kopelke, 1980 (male imago).


Larva. Cuticular coloration: Cuticle of head and thorax brown with lighter blanks. Legs light, nearly unicolor; fore tarsus can be slightly darkened, for femur can have
systematics of Rhithrocloeinae with new species from Uganda

indistinct darkening. Abdominal terga I–IX nearly uniformly brown, laterally lighter; tergum IX sometimes with a pair of lighter round medioposterior sigilla. Abdominal sterna I–IX brown, somewhat lighter than terga, laterally lighter; small paired fields of dentate protuberances light. Abdominal segment X light. Caudalii have proximal parts light, middle parts dark brown, apices light; swimming setae brown.

Hypodermal coloration: Mature male larva has abdominal terga VII–IX darker than others, as in imago.

Shape and setation: Frons from between antennal bases rather narrow and elevated (Fig. 3). Labrum relatively long, narrowing distally, with median incision narrow and deep; dorsal surface with 2 pairs of lateral-distal setae and a pair of submedian setae; ventral surface with a pair of long regular rows of stout setae along lateral margins; lateral setae absent (as in Fig. 26). Both mandibles with incisor and kinetodentum stout and fused, prostheca widened [see Kivuiops (1)], with setae between prostheca and mola (as in Figs 29, 30).

Maxilla as in Fig. 27 [see Rhithrocloeon/lg1 (3) and Kivuiops (2)]. Labium as in Fig. 10 [see Rhithrocloeon/lg2 (1) and Kivuiops (3)]. Pronotum relatively short, mesonotum strongly convex (Fig. 8). Tergum and pleura of metasternal part nearly entirely covered with scales of the same structure as scales on abdomen (as in Fig. 33); a few such scales on epistemum of mesothorax. Posterior margin of metanotum in median part bears a regular row of dark stout pointed denticles (as in Fig. 23); they are much longer than denticles on 1st abdominal tergum and similar to denticles on last abdominal terga. Lateral-posterior margins of metanotum smoothly rounded, without any vestiges of hind proptera. Legs slender (Figs 5–6). Femora of fore and middle legs have subequal length, femur of hind leg longer; femur of fore leg thickest in proximal part, femora of middle and hind legs more slender and parallel-sided. Tibia+tarsus of fore and middle legs have subequal length, tibia+tarsus of hind leg longer; on fore leg tibia and tarsus have subequal length, on middle and hind legs tibia longer than tarsus. Patella short, on fore legs not expressed. Outer margin of each femur with sparse short stout spine-like setae, not forming regular rows; apex of femur with two such setae. Inner margin of fore femur with many pointed spine-like setae; inner margin of middle and hind femora without them. Anterior side of fore femur without spine-like setae; anterior side of middle femur with many pointed spine-like setae; anterior side of hind femur with fewer pointed spine-like setae. Posterior side of all femora with a few smaller blunt spine-like setae near inner margin (not shown in Figs 5–6). Tibiae of all legs with irregularly situated pointed spine-like setae; spine-like setae on outer margin of each tibia numerous, occupy whole its length. Tarsi of all legs with a regular row of pointed spine-like setae and a fewer spine-like setae on posterior side near inner margin (not shown in Figs 5–6). Femora, tibiae and tarsus of all legs densely covered by scales similar to scales on metathorax and abdomen, but smaller. Claw slender, with a single row of small oblique denticles (Fig. 7). Abdomen without lateral or posterolateral spines. Abdominal tergum I medially deeply emarginate (as in Fig. 25). Abdominal terga and sterna covered by scales in wide nests with operculate corners, hind margins with regular pointed denticles (as in Fig. 33): tergum I with vestigial denticles; terga II–IX with well-developed denticles longest on posteriormost segments; tergum X with thinner pointed denticles of the same length. Sterna I–IV lack denticles; sternum V with vestigial denticles; sterna VI–VIII with well-developed denticles; sternum IX of female with similar denticles, of male as in Fig. 1, with protogenostylus brought together [see Rhithrocloeon/lg1 (1.3)]. Paraprostom with numerous small denticles directed perpendicular to its margin (as in Fig. 36) [see Kivuiops (4)]. Tergalii able to make rhythmic respiratory movements. Tergalii of all 7 pairs elongate (length twice or more exceeds width), oval or lanceolate, either nearly symmetric or slightly asymmetric (costal margin more convex in distal part and/or anal margin more convex in proximal part), tergalii of middle pairs 1/4–1/3 times larger than tergalii of first and last pairs. Each tergalus has entire margin armed with fine rib; its distal part, including extreme apex, bears small oblique seta-bearing denticles. Paracercus as long as cerci (with characteristic cuticular coloration — see above). Primary swimming setae well developed on all segments of caudalii, except 1–5 apical segments. Posterior margin of each segment of caudalii bears a regular row of pointed denticles (similar to denticles on posterior margins of abdominal terga) and a regular row of contiguous scale nests close to it (each scale nest is twice smaller than scale nest of abdominal terga).

Subimago. Cuticular coloration: Cuticle of thorax brown; membranous areas of pleura ligh, sclerites brown; postsubalar sclerite as in Fig. 9. Mesonotum brown, medio-parapsidal suture contrastingly light, other sutures (anterior region of parapsidal, lateroparapsidal, lateroparapsidal and others) dark brown. Wings look brown due to brown rings surrounding each microtrichion base (as in Fig. 22). Cuticle of legs light brownish, with darker maculae: fore femur with longitudinal macula at distal 1/3 of posterior side; tibia of each leg with darkened base and apex; tibia of middle and hind leg with longitudinal macula at proximal 1/3 of outer side. Cuticle of abdomen brown.

Hypodermal coloration: Male subimagi has abdominal terga VII–X dark, as in imago.

Texture: All tarsi covered with pointed microlepides. Other body parts nearly entirely covered with dark microrichia.

About genital structure — see characteristics of male imago.

Imago, male. Head, thorax and abdominal segment I entirely brown. Turban eyes dark red. Anteronotal protuberance prominent and rounded (Fig. 2). Mesoscutum strongly convex (Fig. 2), with median suture projected as a convex
ridge. Fore wing widest in proximal part (as in Fig. 21) [Kopelke, 1980: Fig. 39]; veins brownish, costal brace and bases of Sc and R diffusively darkened. Legs light ocher. On middle and hind legs 1st+2nd tarsomere has no apical thorn, only 3rd tarsomere has apical thorn (Fig. 4). Abdominal segments II–VI colorless, hind margins of each tergum narrowly lined by dark brown, lateral tracheal trunks bordered by brown; terga VII–X brown, sternum VII–IX lighter brown. Unistyligers at most brown; gonostylus brown, distally colorless; penial sclerites brown. Penial bridge [fused with gonovectes — see Rhithrocloeon/fg1 (1)] has median projection in a form of rather long angulate trapeze with a shorter finger-like median process (Figs 12, 15, 17, 18). Male subimagino has trapezoid portion as long as in imago, and finger-like median process thicker than in imago; most part of subimaginal penis colorless and membranose, hemispheric apex of median projection brown and sclerotized (Figs 14, 16).

Imago, female. Head, thorax and abdomen entirely brown. On fore leg 1st and 2nd tarsomeres have no apical thorns, only 3rd tarsomere has apical thorn. On middle and hind legs 1st+2nd tarsomeres have no apical thorn, only 3rd tarsomere has apical thorn as in male.

Egg. Oval, surface without regular relief. DIMENSION. Fore wing length 4–6 mm.

1.1.2-3. Kivuiops/g(1) munyagae sp.n. [Rhithrocloeon] (Figs 19–23)

Systematic position: Rhithrocloeon/fg1 — Rhithrocloeon/fg2 — Kivuiops/g(1). Original binomen: Rhithrocloeon (Kivuiops) munyagae Kluge, sp.n.

Possible binomina: — Rhithrocloeon (Kivuiops) munyagae; — Kivuiops munyagae.


Larva. Structure is the same, as in insuetum [Cloeon] (see above), including presence of dark stout pointed denticles at median part of posterior margin of metanotum (Fig. 23). Spine-like setae on outer margin of tibiae variable: either numerous and occupy the whole length of tibia (as in insuetum [Cloeon] — Figs 5–6), or few are located only in distal part of tibia (as in elgonensis [Rhithrocloeon]).

Subimago. Cuticular coloration, hypodermal coloration and texture as in insuetum [Cloeon] (see above). About genital structure — see characteristics of male imago.

Imago, male. Coloration as in insuetum [Cloeon] (see above). Fore wing widest in proximal part (Fig. 21). On middle and hind legs 1st+2nd tarsomere has no apical thorn, only 3rd tarsomere has apical thorn (as in Fig. 4). Penis brown; penial bridge [fused with gonovectes — see Rhithrocloeon/fg1 (1)] has median projection in a form of very short angulate trapeze with a longer finger-like median process.

Described as male imagoes from Côte d’Ivoire [Gillies, 1989; Gattolliat, 2006]. Tarsus of middle and hind leg has a single thorn on 3rd segment only (as in Fig. 4) (Gattolliat, personal communication). Larvae unknown.

systematics of Rhithrocloeninae with new species from Uganda

(Fig. 20). Male subimago has trapezoid portion as short as in imago; instead of the finger-like process it has a wider and shorter protuberance; most part of subimaginal penis colorless and membranose, hemispheric apex of median projection brown and sclerotized (Fig. 19).

Female, imago. Judging by subimaginal tarsi, visible in mature larva, on fore leg 1st and 2nd tarsomeres have no apical thorns, only 3rd tarsomere has apical thorn; on middle and hind legs 1rst, 2nd tarsomere has no apical thorn, only 3rd tarsomere has apical thorn, as in male (as in Fig. 4).

Figs 24–30. 24 — Rhithrocloeon/fg3 sp.1, labrum (in left — ventral view, in right — dorsal view); 25–30 — larva of Rhithrocloeon/fg2-Kivuiops/g1 elgonensis sp.n. [Rhithrocloeon]; 25 — left half of median part of hind margin of metanotum and fore margin of first abdominal tergum; 26 — labrum (in left — ventral view, in right — dorsal view); 27 — maxilla, ventral view; 28 — third segment of maxillary palp; 29–30 — left and right mandibles (26–27 — holotypus).

Рис. 24–30. 24 — Rhithrocloeon/fg3 sp.1, верхняя губа (слева вентрально, справа дорсально); 25–30 — Rhithrocloeon/fg2-Kivuiops/g1 elgonensis sp.n. [Rhithrocloeon]; 25 — левая половина медиальной части заднего края метанотума личинки и переднего края первого тергита брюшка; 26 — верхняя губа (слева вентрально, справа дорсально); 27 — максиля, вентрально; 28 — третий членник максиллярного щупика; 29–30 — левая и правая мандибулы (26–27 — гомотип).
Egg: Oval, surface without regular relief.

DIMENSION. Fore wing length 4.5 mm.

COMPARISON. By genital structure the East-African species *mynvagae* sp.n. [*Rhithrocloeon*] is similar to the West-African species *elouardi* [*Rhithrocloeon*]; differs by shape of fore wing, which in *mynvagae* sp.n. [*Rhithrocloeon*] is widest in proximal part (Fig. 21), and in *elouardi* [*Rhithrocloeon*] is widest in distal part [Gillies, 1989: Fig. 1; Gattolliat, 2006: Fig.20].

1.1.2-4. Kivuiops/g(1) *elgonensis* sp.n. [*Rhithrocloeon*]

(Figs 25–36)

Systematic position: [*Rhithrocloeon*]fg1—[*Rhithrocloeon*]fg2—Kivuiops/g(1).

Original binomen: [*Rhithrocloeon*] (Kivuiops) *elgonensis* Kluge, sp.n.

Possible binomina:
— [*Rhithrocloeon*] (Kivuiops) *elgonensis*;
— Kivuiops *elgonensis*.

Figs 31–37. [*Rhithrocloeon*]fg2: 31–36 — [*Rhithrocloeon*]fg2-Kivuiops/g1 *elgonensis* sp.n. [*Rhithrocloeon*]; 31 — genitals of male imago, ventral view (sterno-styligeral muscles, left gonostylar muscle and right penial muscles shown by interrupted lines; gonoducts shown by dotted lines); 32 — tarsus of imaginal middle leg; 33 — hind margin of larval andoninal tergum IX; 34 — subimaginal exuviae of penis and right unistyliger with gonostylus; 35 — penis of subimagino, extracted from mature larva; 36 — larval paraproct (31–34, 36 — holotypos); 37 — [*Rhithrocloeon*]fg3 sp.2, distal margin of larval paraproct; gs — gonostylus; us — unistyliger; 1+2 — fused 1st and 2nd tarsomeres.

Рис. 31–37. [*Rhithrocloeon*]fg2: 31–36 — [*Rhithrocloeon*]fg2-Kivuiops/g1 *elgonensis* sp.n. [*Rhithrocloeon*]; 31 — гениталии самца имаго, вентрально (стерно-стилигеральная мышца, левая гоностиллярная мышца и правые мышцы пениса показаны прерывистыми линиями; гонодутики показаны пунктиром); 32 — лапка средней ноги имаго; 33 — задний край IX тергита брюшка личинки; 34 — субимагинальный экзувий пениса и правого единистилигера с гоностилем; 35 — пенис субимаги, отпрепарированный из зрелой личинки; 36 — парапрокт личинки (31–34, 36 — голотип); 37 — [*Rhithrocloeon*]fg3 sp.2, дистальный край парапрокта личинки; gs — гоностиль; us — единистилигер; 1+2 — слитые 1-й и 2-й тарсомеры.
systematics of Rhithrocloeinae with new species from Uganda


**Larva.** Structure is the same, as in *insuetum* [Cloeon] (see above), with the following differences: (1) Posterior margin of metanotum in median part bears a few irregular small denticles (Fig. 25), which are not larger than vestigial denticles of 1st abdominal term. (2) Spine-like setae on outer margin of each tibia are few, occupy only its distal part, sometimes restricted to extreme end of tibia.

**Subimago.** Cuticular coloration, hypodermal coloration and texture as in *insuetum* [Cloeon] (see above). About genital structure — see characteristics of male imago.

**Imago.** Coloration as in *insuetum* [Cloeon] (see above). Fore wing widest in proximal part (as in Fig. 21). On middle and hind legs 1st–2nd tarsomere has apical thorn, as well as 3rd tarsomere; thus, tarsus has 2 apical thorns (Fig. 32). Penis brown; penial bridge [fused with gonovestex — see Rhithrocloeon/fgl (1)] has median projection in a form of trapeze evenly narrowing toward apex (Fig. 31). Male subimago has colorless and membranose, with apex brown and sclerotized, as wide as apex of imaginal median projection (Fig. 34, 35).

**Imago, female.** Judging by subimaginal tarsi, visible in mature larva, on fore leg 2nd tarsomere has apical thorn, as well as 3rd tarsomere; on middle and hind legs 1st–2nd tarsomere has apical thorn, as well as 3rd tarsomere (as in male — Fig. 32); thus, each tarsus has 2 apical thorns.

**Egg.** Oval, surface without regular relief.

**DIMENSION.** Fore wing length 5 mm.

**COMPARISON.** Adults (imago and subimago) of both sexes differ from all other three species of *Kivuiops (insuetum [Cloeon], eteuardi [Rhithrocloeon], and munyagae [Rhithrocloeon])* by presence of apical thorn on 1st+2nd tarsomere. Male imago differs from all other three species of *Kivuiops* by absence of finger-like process on median penial projection. Larva differs at least from *insuetum* [Cloeon] and *munyagae* [Rhithrocloeon] by absence of long denticles on metanotum and by less numerous spine-like setae on outer side of tibia. Mature larva, which has subimaginal parts developed under cuticle, can be determined by presence of apical thorn on 1st+2nd tarsomere.

1.2. Plesiomorphon **Bugilliesia**/g(1), or **Bugilliesia** (Figs 38–46)

Systematic position: pm/Protopatellata—Rhithrocloeon/fgl—pm/*Bugilliesia*(g1)

Hierarchical typified name: Bugilliesia/g1 (g: *Bugilliesia* Lugo-Ortiz & McCafferty, 1996; type species *Afroptilum guineense* Gillies, 1990 [desig. orig.]).

Possible rank-based names:
— gen. *Bugilliesia*;

In circumscription fits:
— group *sudanense*: Gillies, 1990;

**Characters of unclear phylogenetic status.**
(1) In species, whose larvae are known, labrum lacks a pair of submedian setae, and latero-distal setae form rather long rows. The same in some other Turbanoculata.

**Plesiomorphies.**
(2) Hind wings developed, of «Centrotipilum-type» [see Rhithrocloeon/fgl (6)].
(3) Larval claw [slender — see Rhithrocloeon/fgl (4)] retains both rows of denticles.
(4) Unlike *Kivuiops*, maxilla [of «Cloeon-type» — see Rhithrocloeon/fgl (3)] retains more than one seta in inner-dorsal row.

**Composition.** 7 species belong here for certain, being known as male images, which have characteristic genital structure [see Rhithrocloeon/fgl (1.1)] and hind wings; these are: *biloba* Gattollati, 2006 [*Bugilliesia*] (see below); *cavaliensis* Gattollati, 2006 [*Bugilliesia*]; *griseum* Gillies, 1990 [*Afroptilum (Afroptilum)*] (see below); *guineense* Gillies, 1990 [*Afroptilum (Afroptilum)*]; notable Kimmens, 1956 [*Centrotipilum*] (see below); sudanese Ulmer, 1916 [*Centrotipilum*] (see below); *truncata* Gattollati, 2006 [*Bugilliesia*]. Among them, larvae associated with imago by bearing, are known for *griseum* [*Afroptilum*], *guineense* [*Afroptilum*] and *sudanense* [*Centrotipilum*] (Gillies, 1990).

Gillies [1990] attributed to the “*Afroptilum sudanense* group” also *nitudum* Ulmer, 1916 [*Centrotipilum*] (= *niroalbum* Navas, 1932 [Cloeon]; = *bredoanum* Navas, 1933 [Cloeon]), known as adults. Later this species, together with other species of the *sudanense* group, was moved to the genus *Bugilliesia* [Lugo-Ortiz & McCafferty, 1996]. Genitals of *nitudum* [*Centrotipilum*] are unknown [Demoulin, 1957], so there is no reason to place it to *Bugilliesia*. Structure of its female fore tibia have not been described, so it is unclear if it belongs to *Protopatellata* or *Anotropatellata*. This species should be regarded as *Turbanoculata incertae sedis*.

Gattollati and Barber-James described *margaratea* Gattollati & Barber-James, 2009 [*Bugilliesia*] and attributed *mirande* Lugo-Ortiz & McCafferty, 1997 [*Cheleocloeon*] to the genus *Bugilliesia*. Both species are described as larvae only; possibly they are conspecific with some species described as images [Gattollati et al., 2009].

1.2-1. **Bugilliesia/g(1) sp.N** (Figs 40–44)

Systematic position: Rhithrocloeon/fgl—pm.*Bugilliesia*(g1).


**Imago, male.** Head and thorax pale ocher. Turban eyes orange. Legs pale ocher, only rotating sclerite on apex of fore tibia brownish. Fore wing colorless, veins light, only basal parts of Sc and RA brown (Fig. 44). Hind wing as in Fig. 43. Abdomen colorless with darkened lateral tracheal trunks. Genitals entirely colorless. Penial bridge fused with unistyligers, its median part with gonopore turned ventrally (Figs 40–42). Cerci colorless. Fore wing length 5.5 mm.

1.2-2. **Bugilliesia/g(1) sp.K**

Systematic position: Rhithrocloeon/fgl—pm.*Bugilliesia*(g1).


**Imago, male.** Fore wings with basal parts of Sc and RA brown, crossveins bordered by brown. Hind wing very narrow, with one longitudinal vein, costal brochus hooked. Proximal widening of styliger with additional lateral projection. Penial bridge with long and thin median projection. Fore wing length 8 mm.

1.2-3. **Bugilliesia/g(1) biloba** [*Bugilliesia*] (Fig. 45)

Systematic position: Rhithrocloeon/fgl—pm.*Bugilliesia*(g1).


Possible binomina:
— Rhithrocloeon (*Bugilliesia*) biloba;
— *Bugilliesia* biloba.

REFERENCES. *Bugilliesia biloba* Gattollati, 2006 (male and female imago).

MATERIAL. MALI, Bafing bei Tinko, 1.X.1991, coll. D. To-bias: 1 I.°
Figs 38–46. Rhithrocloeon/fg1-Bugilliesia/g(1): 38–39 — *notabile* [*Centroptilum*], color pattern of III–VI abdominal terga of winged male and female; 40–44 — sp.N; 40 — genitals of male imago, median section; 41 — the same, lateral view; 42 — the same, ventral view (sterno-styliger muscle, left gonostylar muscle and left penial muscle shown by interrupted lines); 43 — hind wing; 44 — brown pigmentation at base of fore wing; 45 — *biloba* [*Bugilliesia*], genitals of male imago (ventral view); 46 — *sudanense* [*Centroptilum*], posterior margin of IX abdominal sternum (protogonostyles) of mature male larva; gd — gonoduct; gs — gonostylus; m.gv — muscle of gonovectis; m.s — median sterno-styliger muscle; m.IX-X — intersegmental ventral muscle; us — unistyler.
1.2-4. Bugilliesia/g(1) notabile [Centroptilum] (Figs 38, 39)

Systematic position: Rhithrocloeon/g1—pm.Bugilliesia/g(1). Original binomen: Centroptilum notabile Kimmins, 1956. Possible binomina:
— Rhithrocloeon (Bugilliesia) notabile;
— Bugilliesia notabile.


Adults have characteristic color pattern on abdominal terga (Figs 38–39). Larvae unknown.

1.2-5. Bugilliesia/g(1) sudanense [Centroptilum] (Fig. 46)

Systematic position: Rhithrocloeon/g1—pm.Bugilliesia/g(1). Original binomen: Centroptilum sudanense Ulmer, 1916.

Possible binomina:
— Rhithrocloeon (Bugilliesia) sudanense;
— Bugilliesia sudanensis.


1.2-6. Bugilliesia/g(1) griseum [Afroptilum] (Fig. 48)


Possible binomina:
— Rhithrocloeon (Bugilliesia) griseum;
— Bugilliesia grisea.


ACKNOWLEDGEMENT. This investigation was supported by the Russian Federal Program for Support Leading Scientific Schools, grant No. 332.2010.4.

References


