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WEST AFRICAN *TRIAENODES* MCLACHLAN (TRICHOPTERA: LEPTOCERIDAE). 1. INTRODUCTION AND SUBGENUS *TRIAENODELLA* MOSELY

Andersen, T. & R. W. Holzenthal, 2001. West African *Triaenodes* McLachlan (Trichoptera: Leptoceridae). 1. Introduction and subgenus *Triaenodella* Mosely. – Tijdschrift voor Entomologie 144: 225-246, figs. 1-55, table 1. [ISSN 0040-7496]. Published 1 December 2001.
Two new *Triaenodes* McLachlan species belonging to subgenus *Triaenodella* Mosely, *T. akosua* sp. n. and *T. amma* sp. n., are described and figured, and four previously described species, *T. dolobratus* Gibbs, *T. ghana* Kimmins, *T. proszynskii* (Marlier & Botosaneanu), and *T. serratus* Ulmer are redescribed and figured based on males collected in Ghana. The female of *T. proszynskii* as well as the female holotype of *T. palpalis* Banks from Cameroon are also redescribed and figured. Further, an additional new species, *T. kwadwo* sp. n., from Ghana is described and figured; this species does not readily fit into any subgenus. A key to the subgenera of West African *Triaenodes* males and a key to the males of subgenus *Triaenodella* are provided.
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The long-horned caddisfly genus *Triaenodes* McLachlan is cosmopolitan although the distribution in the Neotropical biogeographical region appears to be restricted to Central America and the northern part of the South American continent. In total, about 175 species have been described, of which 38 are known from the Afrotropical biogeographical region (Morse 1999). A key to the African *Triaenodes* species was given by Kimmins (1962). Until now, ten species had been described or recorded from West Africa. In a preliminary check-list of the caddisflies of Ghana, Kjærandsen & Andersen (1997) listed 17 species of *Triaenodes* from the country, of which nine were assumed to be undescribed. Later an additional new species was found, resulting in a total of ten new species from Ghana alone. Our intent is to redescribe and figure all previously described *Triaenodes* species occurring in West Africa, including *T. serratus* Ulmer and *T. elegantulus* Ulmer not recorded previously from West Africa. In the present paper, we treat species assigned to the subgenus *Triaenodella* Mosely. In addition we describe a species, *T. kwadwo* sp. n., which does not fit readily into any subgenus.

When erecting the genus *Triaenodella* Mosely for two East African species, *T. cheliferus* and *T. clavatus,* Mosely (1932a) stated that the genus was separated from *Triaenodes* mainly by the scent-organ apparatus in the male situated in the scape of each antenna. The scent organ takes the form of a tuft of specialized scent-hairs arising at the extreme base of the scape and is covered by a hinged flap. *Triaenodella* was subsequently treated as a subgenus of *Triaenodes* by Ross (1944), based on the presence, in *Triaenodella,* or absence, in *Triaenodes* sensu stricto, of a male antennal scape scent organ.

The tribe Triaenodini was erected by Morse (1981) for the genera *Adicella* McLachlan, *Allosetodes* Banks, *Erotesis* McLachlan, *Triaenodes* McLachlan, and *Ylodes* Milne, based on two synapomorphies: mesopleural katepisternum constricted dorsally and male tenth tergites fused dorsally. Recently, Andersen & Holzenthal (1999) placed *Allosetodes* as a synonym of *Triaenodes.* According to Morse (1981), the genera assigned to Triaenodini arose from an ancestor in which the cubital vein in the hind wing lost its apical fork.

Yang & Morse (1993) outlined the phylogeny of

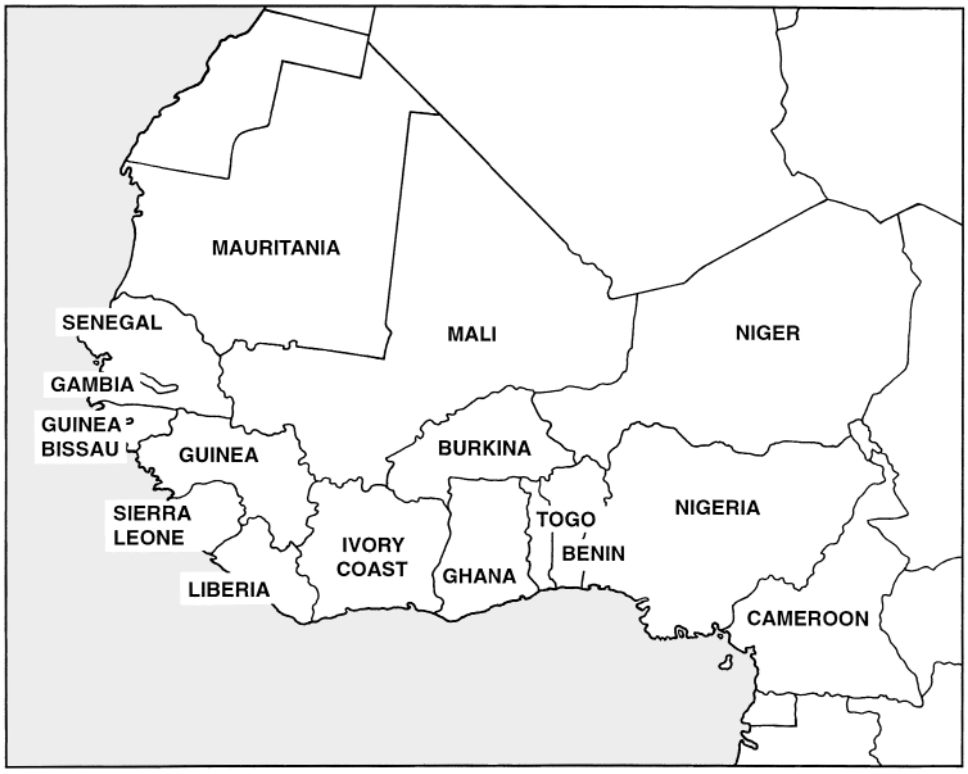


Fig. 1. Map of West Africa showing the countries included in the study.

the Triaenodini and divided *Triaenodes* into three subgenera, including their newly erected subgenus *Austrotriaena* for eight species occurring in the Oriental and Australian biogeographical regions. However, the placement of the Australian species was questioned by Neboiss & Wells (1997). When describing 44 new Australian species Neboiss & Wells (1998) discussed the characters used to delimit the subgenera, or, according to them, the 'true nature' of the structures associated with the inferior appendage. Instead of assigning their new species to subgenus, they placed the Australian species in two species groups and split the largest group into several species 'complexes'.

Two of the subgenera, *Triaenodes* sensu stricto and *Triaenodella,* occur in the Afrotropical biogeographical region. Yang & Morse (1993) redefined *Triaenodella,* stating that most *Triaenodes* species do have a male antennal scape scent organ. Subgenus *Triaenodella* Mosely sensu Yang & Morse is characterized in the males by the basal plate process of the inferior appendage secondarily absent and the mesal basodorsal process of the inferior appendage curved caudad and ventrad, with an enlarged apex which is either clavate, broadly truncate or subdivided into two processes. Subgenus *Triaenodes* sensu stricto is characterized in the males by an abbreviated basal plate of the inferior appendage with a long, slender, recurved process, and the phallus with distinctive lateral ridges for resting or guiding the slender process of the basal plate (Yang & Morse 1993).

Most West African species readily fit the subgeneric characteristics given by Yang & Morse (1993), but some of the species from West Africa belonging to subgenus *Triaenodes* sensu stricto have a rather short and stout or even clubshaped curved process originating from the abbreviated basal plate rather than a long, slender, recurved process. One of the newly described species, *T. kwadwo* sp. n., does not fit readily into any subgenus as the recurved process of the inferior appendage is lacking and the mesal basodorsal process of the inferior appendage is reduced. At present, we prefer not to assign this species to subgenus awaiting further studies on the phylogeny of the genus, thus leaving it unplaced to subgenus.

The present paper forms part of the scientific results of a joint project on freshwater entomology in Ghana established in 1991 between the Institute of Aquatic

Biology, C.S.I.R., Ghana; the Department of Zoology, University of Ghana; and the Museum of Zoology, University of Bergen, Norway. The new species of *Triaenodes* described in this paper are based on material collected in Ghana (see Kjærandsen & Andersen 1997). Further, all species belonging to subgenus *Triaenodella* previously described or recorded from the West African countries of Benin, Burkina (Upper Volta), Cameroon, Gambia, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, and Togo (fig. 1) are redescribed.

Material and methods

Methods used in preparing, examining, and illustrating genitalia are those that are commonly used in the study of Trichoptera (see Blahnik 1998). The terminology is adopted from Morse (1975), Schmid (1980, 1994), and Yang & Morse (1993). The measurements, in millimeters, are given as the range followed by the mean when more than three specimens are measured.

The description of the three new species as well as most of the redescriptions are based on Ghanaian material. However, one of the described species, *T. palpalis* Banks, was not taken in Ghana during the project and the redescription is based on the holotype housed in the Museum of Comparative Zoology, Harvard University, Cambridge.

Holotypes and paratypes of the species described below, as well as material of most of the species redescribed are deposited in the University of Minnesota Insect Collection, St. Paul, Minnesota, U.S.A.; paratypes and material of species redescribed are also deposited in the Museum of Zoology, University of Bergen, Norway and the National Museum of Natural History, Washington, D.C., U.S.A. If not otherwise stated, the specimens are preserved in alcohol.

The following codes are used to indicate the collections in which specimens are deposited:

- BMNH The Natural History Museum, London, England.
- ISNB Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium.
- MCZ Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, U.S.A.
- USNM National Museum of Natural History, Washington, D.C., U.S.A.
- UMSP University of Minnesota Insect Collection, St. Paul, Minnesota, U.S.A.
- ZFMK Zoologische Forschungsinstitut und Museum 'Alexander Koenig,' Bonn, Germany.
- ZMUB Zoological Museum, University of Bergen, Bergen, Norway.

Systematic part

Triaenodes McLachlan

Triaenodes McLachlan, 1865a: 110 [Type species *Leptocerus bicolor* Curtis, 1834, subsequent selection of Ross 1944].
Triaena McLachlan, 1865b: 34 [preoccupied] [Type species *Leptocerus bicolor* Curtis, 1834, subsequent selection of Fischer 1965: 78].
Allosetodes Banks, 1931: 421 [Type species *Allosetodes plutonis* Banks, 1931, monobasic]. – Andersen & Holzenthal 1999: 10 [as synonym].
Triaenodella Mosely, 1932a: 308 [Type species *Triaenodella chelifera* Mosely, 1932a, original designation]. – Ross 1944: 244 [as subgenus]. – Yang & Morse 1993: 162 [redefined as a valid subgenus].
Austrotriaena Yang & Morse, 1993: 164 [Type species *Triaenodes trifidus* Kimmins, 1957a, original designation, as a subgenus].

Diagnostic characters (adults)

Male scape with setose scent organ, covered with long flap (fig. 2). Forewing stem of M lacking or weak, fork II subtriangular (fig. 3); hind wing with forks I and II present (fig. 4). In males, basal plate of inferior appendage with long, slender, recurved process, with at most only few subapical setae (fig. 7); process can be secondarily reduced (figs. 5, 6).

The West African *Triaenodes* species are medium sized, with forewing lengths between 5.1 to 11.5 mm. Forewing colour varies from light yellowish-brown to dark brown, usually unicolourous, but some species appear to have distinct patterns. The antennae are more than three times the length of the forewing, and both males and females have a long antennal scape; the male scape has a setose scent organ, covered with a long flap. The maxillary palp is slightly shorter or about half the length of the forewing, segment IV is the shortest, segment V the longest, segments I, II, and III of approximately the same length or segment I somewhat shorter than segment II or III; in most species with inconspicuous setae, but in *T. proszynskii* (Marlier & Botosaneanu) and *T. palpalis* Banks with strong, marginal seta. Tibial spur formula is 1,2,2. In the forewing forks I, II, and V are present, fork II is basally subtriangular; discal cell is long, and broad apically; stem of M is lacking or incomplete (i.e., the thyridal cell is absent). In the hind wing forks I and II are present; stem of M is present or incomplete, and Cu is unbranched (i.e. fork V is absent).

In the male genitalia the abdominal segment IX is narrow to comparatively broad, tergum and pleura are well sclerotized to semimembranous, sternum is extended posteriad, with or without V-shaped ventrolateral excision. Preanal appendages are short to long, rounded, triangular or digitate, and setose. Upper part of tergum X is reduced or prominent, single or lobed, with or without setae or spine-like setae. Lower part of

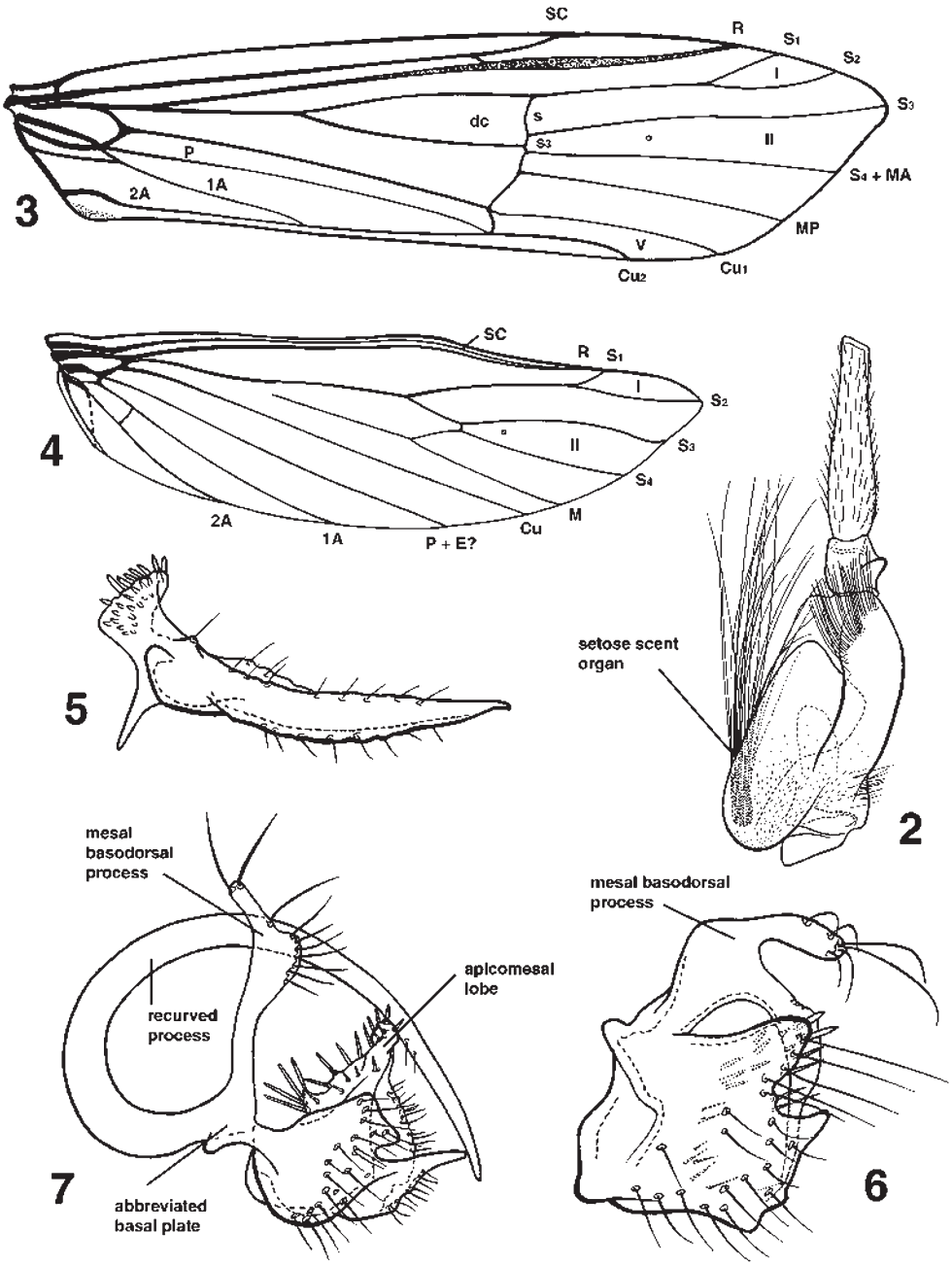


Fig. 2. *Triaenodes proszynskii* (Marlier & Botosaneanu), scape, pedicel and 1st flagellar segment. – Figs. 3, 4. *Triaenodes kwadwo* sp. n., wings. – 3, Forewing; 4, hindwing. – Figs. 5-7. Inferior appendages. – 5, *Triaenodes kwadwo* sp. n.; 6, *Triaenodes ghana* Kimmins; 7, *Triaenodes darfuricus* Mosely. – Abbreviations: A = anal vein; Cu = cubitus; dc = discoidal cell; E = empusal vein; M = media; MA = anterior media; MP = posterior media; P = plical vein; R = radius; S = sector; s = sectorial crossvein; SC = subcosta; I, II, V = primary apical cells, or 'forks', I, II, and V.

tergum X is reduced or prominent, single, lobed or cleft. Inferior appendages are uni-articulated and complex, with or without short spine-like setae, with or without seta-bearing papillae, with or without setose or papillose apicomesal lobe, with or without setose lateral basodorsal process, with or without setose mesal basodorsal process, and with an abbreviated basal plate not articulating with phallobase, with or without process extended caudad. Phallus is with or without lateral flanges, with or without paramere spines, and is lacking distinct phalicata.

Key to the subgenera of West African *Triaenodes* McLachlan males

1. Basal plate of inferior appendage with recurved process, (fig. 7) subgenus *Triaenodes* sensu stricto
– Basal plate lacking recurved process 2
2. Mesal basodorsal process of inferior appendage present, (fig. 6) .....subgenus *Triaenodella* Mosely
– Mesal basodorsal process of inferior appendage absent, (fig. 5)...incertae sedis (*T. kwadwo* sp. n.)

Subgenus *Triaenodella* Mosely

As defined by Yang & Morse (1993) the subgenus is characterized in the males by the lack of a basal plate with recurved process and by having the mesal basodorsal process of the inferior appendage curved caudad and ventrad, with an enlarged apex which is either clavate, broadly truncate, or subdivided into two processes.

Of the West Africa species, five previously described species apparently belong in this subgenus, Table 1. The male of *T. palpalis* Banks is not known. However, based on the female, the species appears to be closely related to *T. proszynskii* (Marlier & Botosaneanu), and the species should thus belong in subgenus *Triaenodella*. In addition two newly described species are assigned to this subgenus.

Key to the males of West African *Triaenodes* McLachlan, subgenus *Triaenodella* Mosely

The male of *T. palpalis* Banks is not known, but it will probably key to *T. proszynskii* (Marlier & Botosaneanu).

1. Large, brown species, wing length > 10 mm..... ..... *T. proszynskii* (Marlier & Botosaneanu)
– Smaller, yellowish- or reddish-brown species, wing length < 8 mm.....2
2. Mesal basodorsal process of inferior appendage deeply forked or distinctly bilobed.....3
– Mesal basodorsal process of inferior appendage digitate, slightly expanded subapically (fig. 8) .... *T. akosua* sp. n.
3. Upper part of tergum X short, bilobed.....4
– Upper part of tergum X with long, median process; distal one half subtriangular with strong, spine-like setae ventrally (figs. 16, 17)..... ..... *T. dolobratus* Gibbs
4. Inferior appendage with lateral basodorsal process (fig. 12) ..... *T. amma* sp. n.
– Inferior appendage lacking lateral basodorsal process 5
5. Lower part of tergum X slightly curved ventrad; phallus with asymmetrical dorsolateral flanges and brush of strong spines medially and apically (figs. 22, 25) ..... *T. ghana* Kimmins
– Lower part of tergum X with distal three quater strongly curved, spiny; phallus without brush of strong spines (figs. 42, 43, 45, 46) .... *T. serratus* Ulmer

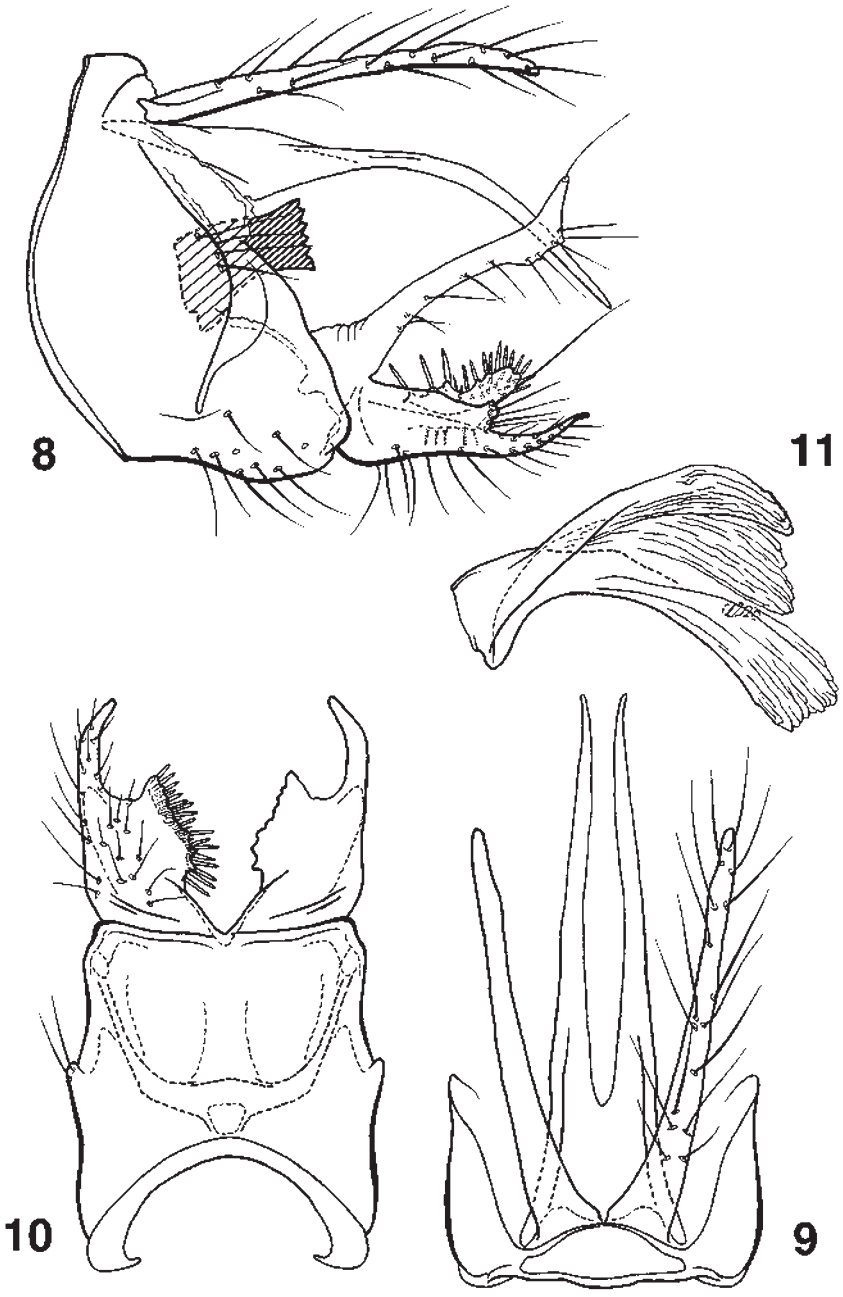
Table 1. Check-list of West African *Triaenodes* McLachlan species. Subgenus *Triaenodella* Mosely, and unplaced species.

Species	Distribution
Subgenus *Triaenodella*	
T. akosua sp. n.	Ghana, Ivory Coast
T. amma sp. n.	Ghana
T. dolobratus Gibbs, 1973	Ghana
T. ghana Kimmins, 1957	Ghana, Cameroon, Democratic Republic of the Congo, Ivory Coast
T. palpalis Banks, 1920	Cameroon
T. proszynskii (Marlier & Botosaneanu, 1968)	Ivory Coast, Ghana, Sierra Leone
T. serratus Ulmer, 1912	Sudan, Democratic Republic of the Congo, Ghana, Ivory Coast, Nigeria, Tanzania, Uganda, Zimbabwe
Incertae sedis	
T. kwadwo sp. n.	Ghana

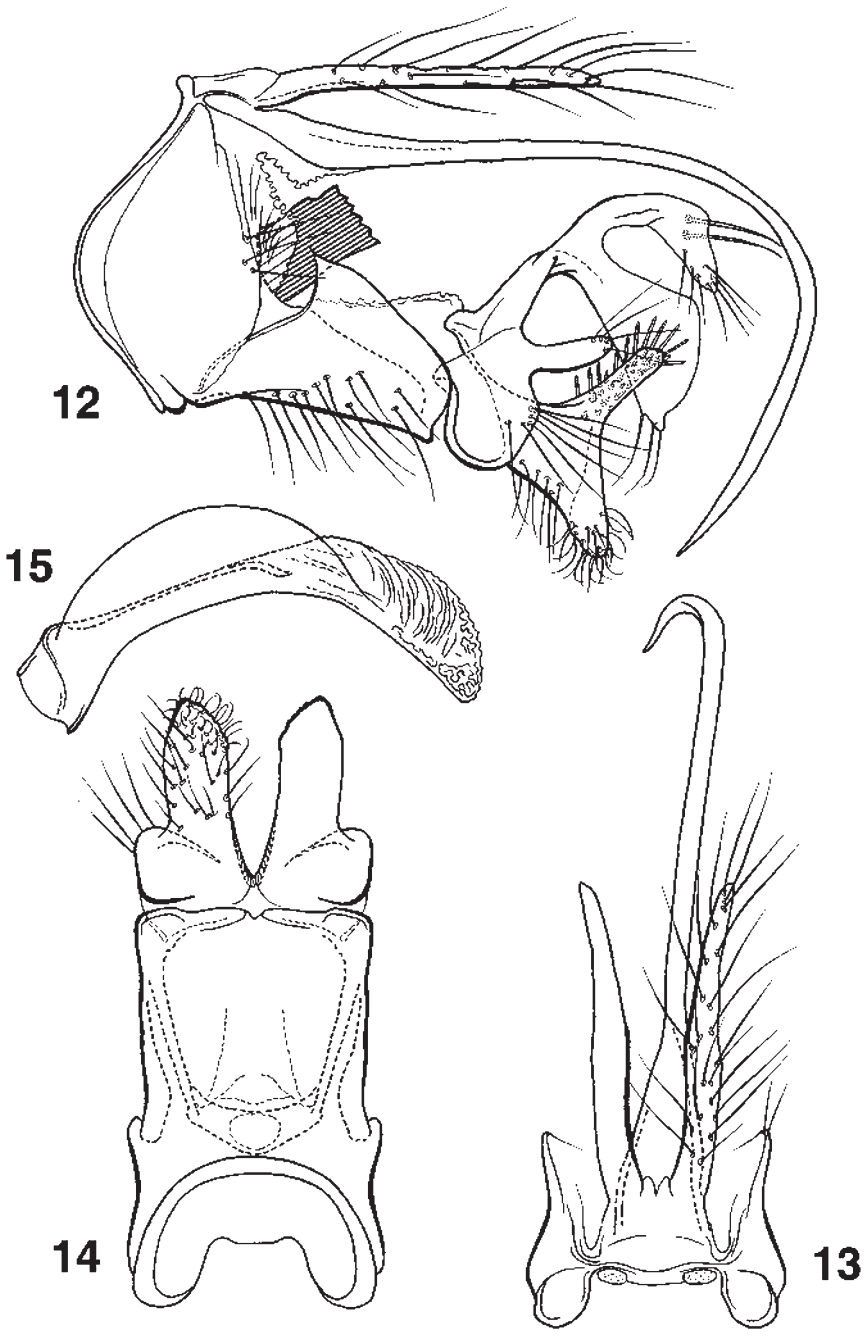
***Triaenodes akosua* sp. n.**
(figs. 8-11)

Type material. – Holotype ♂: GHANA: Brong Ahafo Region: Black Volta, New Longro, 8°9'N 2°2'W, 14.x.1994, at light, NUFU-project (UMSP). – Paratypes: 20♂, IVORY COAST: 25 km N Bouake, 27-30.x.1971, black light trap, J. A. Gruwell (USNM, ZMUB, UMSP).

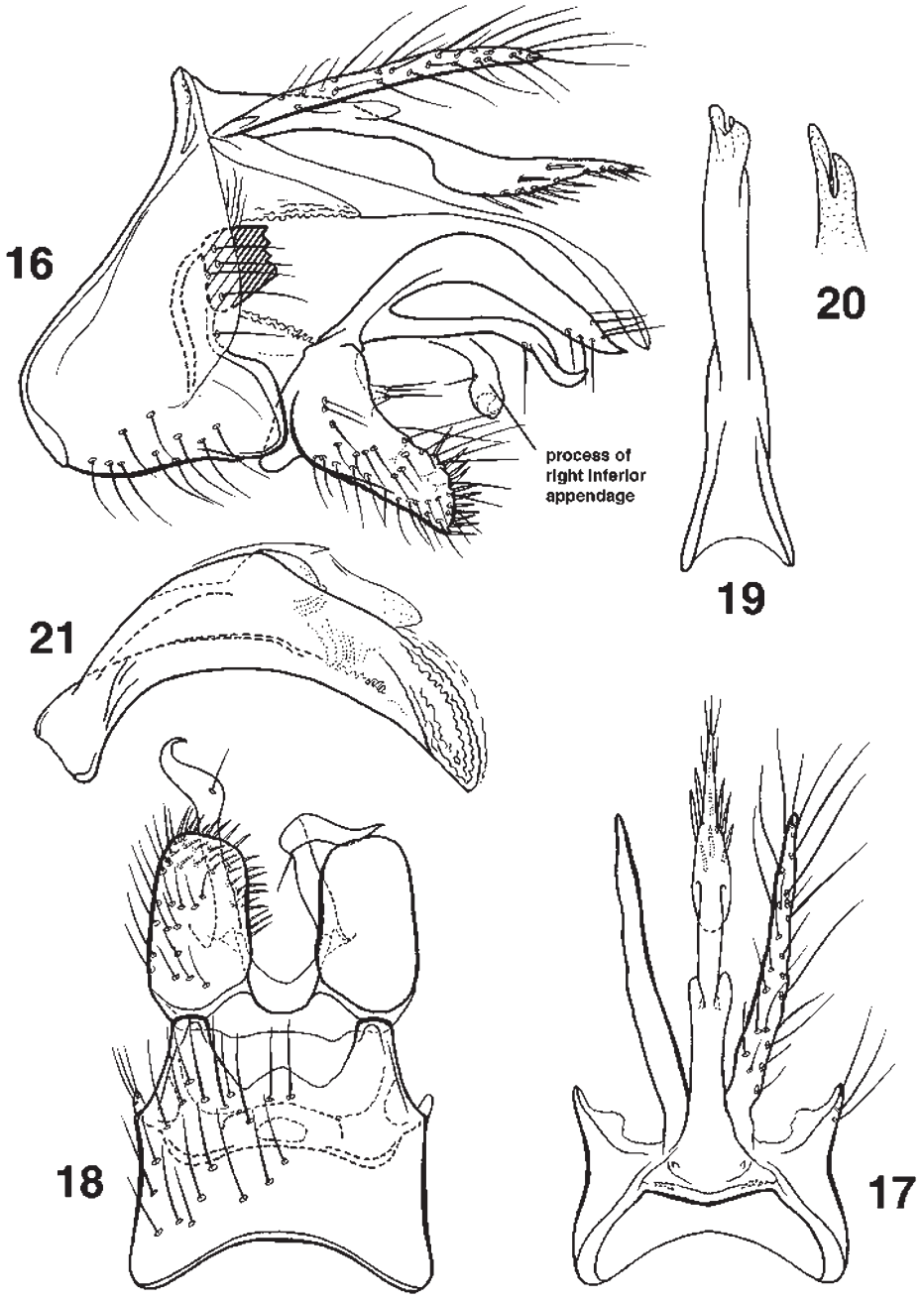
Etymology. – Twi, *akosua,* meaning a female born on Sunday; named in the Ashanti tradition of naming children after the day they are born, signifying that the species description was written on a Sunday; the name is a noun in apposition.



Figs. 8-11. *Triaenodes akosua* sp. n., ♂ genitalia. – 8, Lateral; 9, dorsal; 10, ventral; 11, phallus, lateral.



Figs. 12-15. *Triaenodes amma* sp. n., ♂ genitalia. – 12, Lateral; 13, dorsal; 14, ventral; 15, phallus, lateral.



Figs. 16-21. *Triaenodes dolobratus* Gibbs, ♂ genitalia. – 16, Lateral; 17, dorsal; 18, ventral; 19, lower part of tergum X, dorsal; 20, apex of lower part of tergum X, ventral; 21, phallus, lateral.

Diagnosis

The species shows similarities to *T. legonus* Mosely described from Kenya (Mosely 1939a) in the shape of the preanal appendages and the lower part of tergum X. However, the two species can easily be separated on the shape of the inferior appendages, which have a projecting, pointing apex in *T. akosua*, while the apex in *T. legonus* is broadly rounded.

Description

Male (n=10). – Forewing length 6.2-7.2, 6.8 mm; hind wing length 4.8-5.5, 5.1 mm. Eye 0.37-0.40, 0.38 mm wide. Antenna at least 15.9 mm long, including 0.49-0.58, 0.54 mm long scape; scape with well developed scent organ and brush of light reddish-brown seta. Maxillary palp segment lengths (in mm): 0.43-0.48, 0.46; 0.52-0.61, 0.56; 0.55-0.63, 0.59; 0.35-0.40, 0.38; 0.61-0.76, 0.71. Colour in alcohol overall light reddish-brown.

Male genitalia (figs. 8-11). Abdominal segment IX with rounded anterior margin; tergum narrow; pleural region broadly rounded, posterior margin setose; sternum triangular, produced posteriad. Preanal appendage long, narrow, setose. Upper part of tergum X apparently absent. Lower part of tergum X strongly sclerotized spine, slightly curved ventrad; in dorsal view divided almost to base. Inferior appendage subtriangular, with apex pointing, projecting dorsomesad, setose; apicomesal lobe triangular, dorsal margin scalloped, with strong spine-like setae mesally; lateral basodorsal process short, triangular, with long seta apically; mesal basodorsal process projecting posterodorsad, slightly sinuous, weakly enlarged subapically, with few strong seta along posterior margin and apically. Phallus curved, with large, symmetrical, membranous flange medially; phalotremae sclerite u-shaped; apex membranous, truncate.

Distribution and habitat

The species is known from the Brong Ahafo Region in Ghana and from Ivory Coast. The single male from Ghana was taken in a light trap at a large rather slow flowing river in the central part of the country.

Triaenodes amma sp. n.
(figs. 12-15)

Type material. – Holotype ♂: GHANA: Western Region: Ankasa Game Production Reserve, 16.xi.1995, at light, NUFU-project (UMSP).

Etymology. – Twi, *amma,* meaning a female born on Saturday; named in the Ashanti tradition of naming children after the day they are born, signifying that the species description was written on a Saturday; the name is a noun in apposition.

Diagnosis

The species shows similarities to *T. ghana* and to *T. kimilus* Mosely described from the Democratic Republic of the Congo (Mosely 1939b), in having long, narrow preanal appendages, and lower part of tergum X as a strong, narrow spine. However, in *T. amma* the lower part of tergum X is much longer and more strongly curved than in the two other species. It further differs from *T. kimilus* in having a mesal basodorsal lobe of inferior appendage, which is forked medially. From *T. ghana* it can also be separated by having a more complex inferior appendage with a clavate apicomesal lobe.

Description

Male (n=1). – Forewing length 5.1 mm, hind wing length 4.1 mm. Eye 0.31 mm wide. Antenna at least 16.4 mm long, including 0.33 mm long scape; scape with well developed scent organ and brush of dark-brown seta. Maxillary palp segment lengths (in mm): 0.37, 0.55, 0.57, 0.31, 0.70. Colour in alcohol overall dark, reddish-brown.

Male genitalia (figs. 12-15). Abdominal segment IX with anterior margin broadly rounded; tergum narrow; pleura with posterior margin rounded, membranous, with few seta; sternum subtriangular, strongly produced posteriorly; in ventral view with posterior margin truncate, shallowly notched medially. Preanal appendage long, narrow, setose. Upper part of tergum X paired, very small, triangular lobes. Lower part of tergum X long, strongly sclerotized, curved spine, pointing anteroventrad; in dorsal view slightly asymmetrical with apex pointing to the right. Inferior appendage complex; apicomesal lobe clavate with triangular, setose ventral process and digitate dorsal process with strong spine-like seta mesally; basodorsal process short, digitate, with few seta apically; mesal basodorsal process curved caudad, forked medially, dorsal process with triangular, setose apex, ventral process with enlarged apex, with few, curved setae posteroventrally. Phallus tubular, slightly curved, symmetrical, with long, rounded flange in basal two third, and membranous apex.

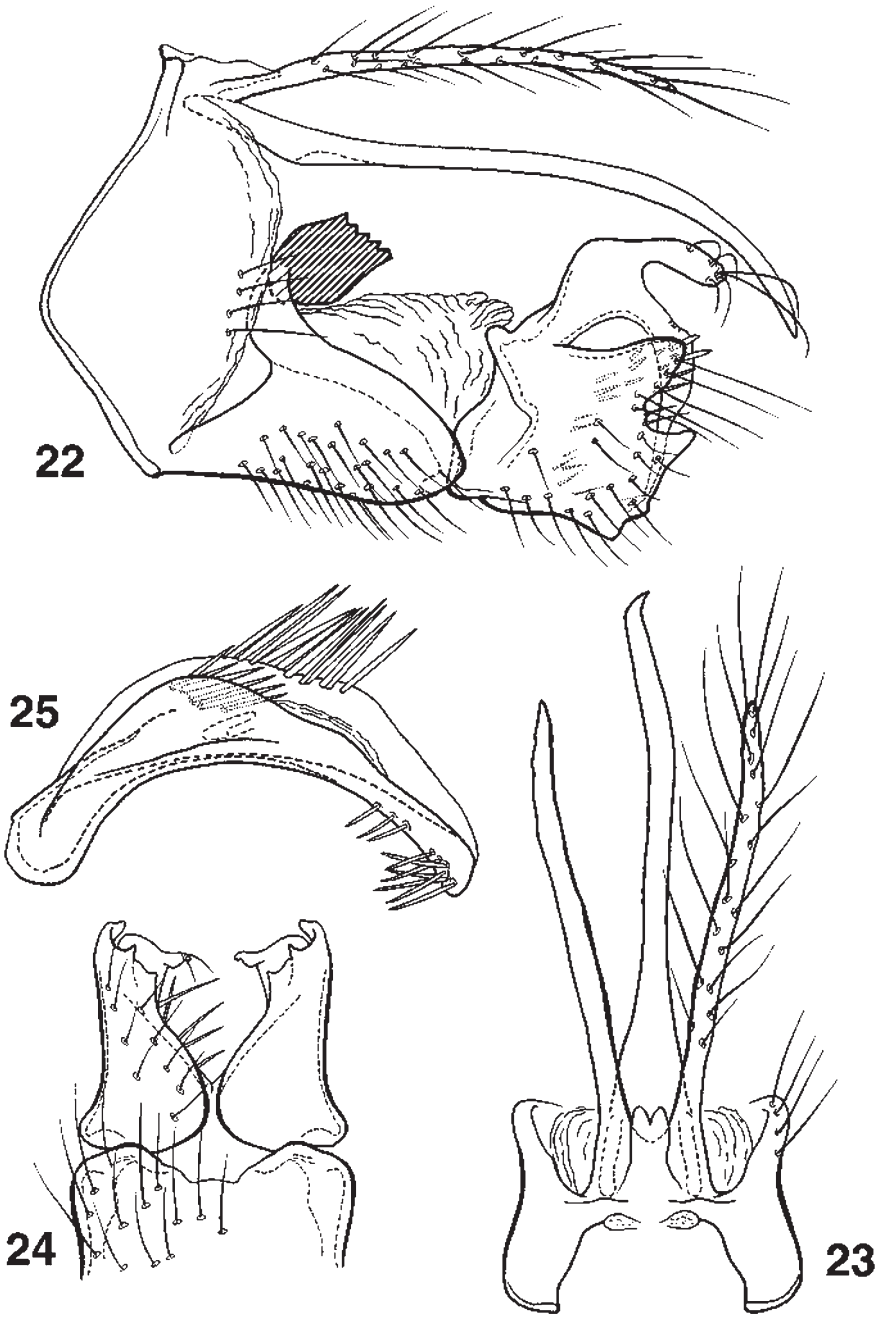
Distribution and habitat

The single specimen was taken at light at a small, moderately fast flowing river in the humid, coastal forests in southwest Ghana.

Triaenodes dolobratus Gibbs
(figs. 16-21)

Triaenodes dolobratus Gibbs, 1973: 402, figs. 116-118. Type locality: GHANA: Atewa Range; BMNH; ♂.

Triaenodes dolobratus Gibbs. – Kjærandsen & Andersen 1997: 247 [list]; Morse 1999 [electronic catalogue].



Figs. 22-25. *Triaenodes ghana* Kimmins, ♂ genitalia. – 22, Lateral; 23, dorsal; 24, ventral; 25, phallus, lateral.

Diagnosis

The species can easily be separated from other Afrotropical *Triaenodes* species on the distinct shape of the upper part of tergum X which in its distal half is triangular with strong, spine-like setae ventrally.

Redescription

Male (n=1). Forewing length 7.0 mm, hind wing length 5.5 mm. Eye 0.43 mm wide. Antenna at least 21.8 mm long, including 0.83 mm long scape; scape with well developed scent organ and brush of reddish-brown seta. Maxillary palp segment lengths (in mm): 0.60, 0.67, 0.83, 0.37, 0.89. Colour in alcohol overall reddish-brown.

Male genitalia (figs. 16-21). Abdominal segment IX triangular with broadly rounded anteroventral corner; tergum very narrow; pleural region slightly rounded, posterior margin setose; sternum quadrate, produced posteriad; in ventral view with posterior margin excised, and pronounced subquadragular, lateral corners. Preanal appendage long, narrow, setose. Upper part of tergum X with long, median projection; basal half tubular, medially with paired, short, rounded, lateral lobe; distal half triangular, pointed apically, with strong, spine-like setae ventrally. Lower part of tergum X narrowly triangular mesally, distal half slender, curved slightly ventrad; in dorsal view triangular basally, distal half slightly sinuous, apex bilobed, asymmetrical, with pebbly surface. Inferior appendage subrectangular, apicomesally with strong, spine-like setae; lateral basodorsal process small, setose; mesal basodorsal process prominent, deeply forked, left and right sides asymmetrical, left side with ventral process narrow, sinuous, with pointed apex projecting dorsad, with one strong setae subapically; in ventral view apex recurved mesad; right side in ventral view with ventral process subapically turned laterad, with pointing, slightly sinuous apex; dorsal process wider, curved, pointing caudad, setose subapically; right side with dorsal process slightly longer than left process. Phallus curved with asymmetrical, dorsomedial, membranous flange; left flange small, rounded; right flange longer, posteriorly triangular; with small, indistinct phallotremal sclerite.

Distribution and habitat

Gibbs (1973) recorded the species from the type locality in the Eastern Region in Ghana only. The present paper adds a record from the Volta Region, where a single specimen was taken in a light trap close to a small, moderately fast flowing stream.

Material examined. – GHANA: Volta Region: River Uwue south of Lipke Mate, 1♂, 6.xi.1995, at light, NUFU-project.

Triaenodes ghana Kimmins
(figs. 22-25)

Triaenodes ghana Kimmins, 1957b: 21, figs 13, 14. Type locality: GHANA (GOLD COAST): Dayi River, Kpandu-Hohoe Rd.; BMNH; ♂.

Triaenodes ghana Kimmins. – Jacquemart 1961: 10, fig. 4; Gibbs 1973: 399, 421; Kjærandsen & Andersen 1997: 247 [list]; Morse 1999 [electronic catalogue].

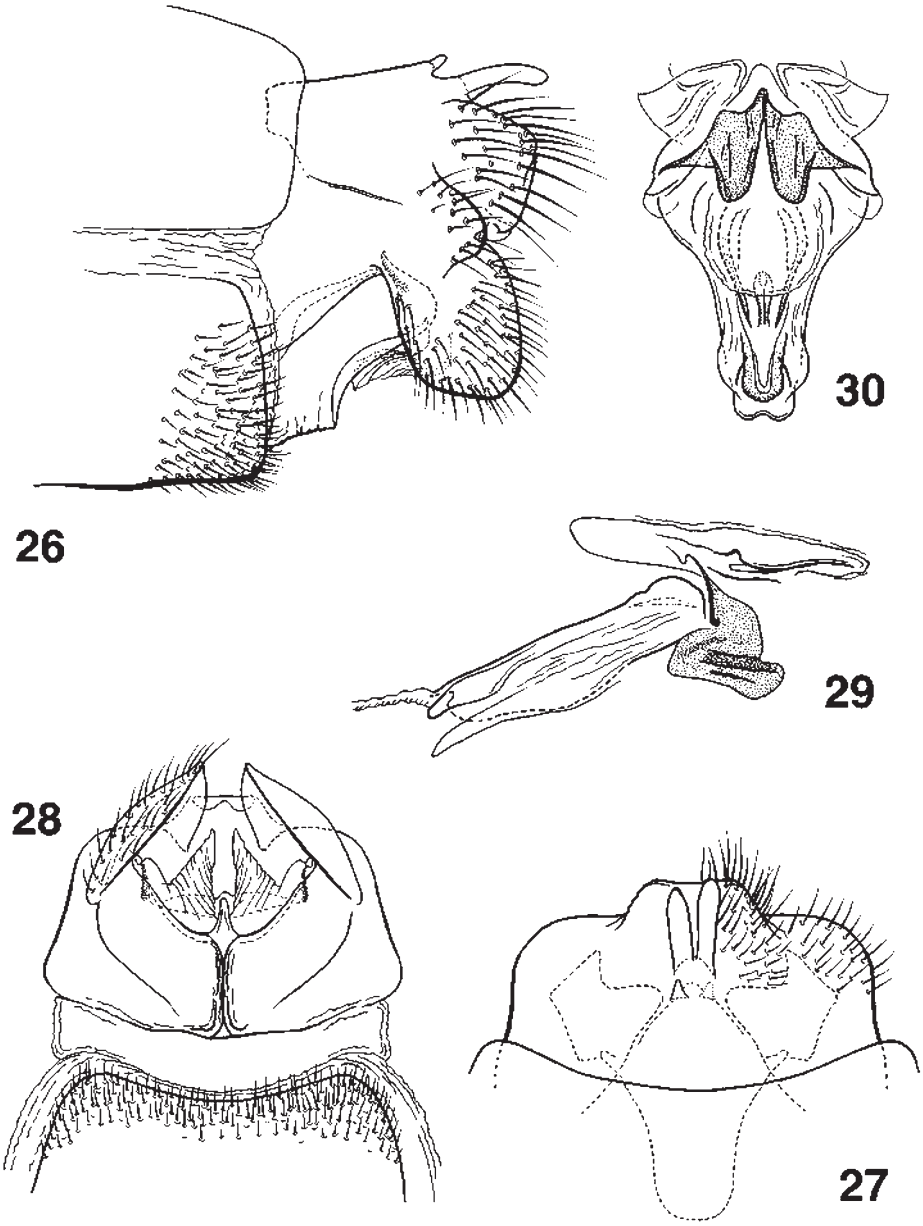
Diagnosis

The species shows similarities to *T. amma* n. sp. and *T. kimilus* Mosely from the Democratic Republic of the Congo, in having long, narrow preanal appendages, and lower part of tergum X as a strong, narrow, spine. However, *T. ghana* can easily be separated from the two by the groups of spine-like setae on the phallus. It further differs from *T. kimilus* in having a mesal basodorsal lobe of inferior appendage, which is forked medially. From *T. amma* it can also be separated by the lower part of tergum X being shorter and less curved, and by having a stout subquadrangular inferior appendage with a triangular apicomesal lobe.

Redescription

Male (n=10). Forewing length 7.0-7.8, 7.4 mm; hind wing length 5.3-6.0, 5.5 mm. Eye 0.40-0.48, 0.43 mm wide. Antenna at least 22.9 mm long including 0.70-0.80, 0.75 mm long scape; scape with well developed scent organ and brush of yellowish-brown setae. Maxillary palp segment lengths (in mm): 0.55-0.63, 0.58; 0.55-0.63, 0.58; 0.63-0.73, 0.67; 0.31-0.37, 0.34; 0.73-0.88, 0.81. Colour in alcohol overall yellowish-brown.

Male genitalia (figs. 22-25). Abdominal segment IX with anterior margin rounded; tergum narrow; pleural region rounded, membranous, posterior margin with few seta; sternum triangular, strongly produced posteriorly, in ventral view with concave apical margin. Preanal appendage long, narrow, setose. Upper part of tergum X short, bilobed. Lower part of tergum X a strong, narrow, spine, curved ventrad; in dorsal view slightly sinuous, with tapering apex curved to the left. Inferior appendage stout, subquadrangular, mesally excavated, with posterior triangular lobe curved mesad; apicomesal lobe triangular, apex rounded, with strong, spine-like setae mesally; mesal basodorsal process forked medially, ventral fork strongly curved ventrad, tapering, with two seta apically; dorsal fork narrowly ovate, with few, strong, curved seta, projecting caudad. Phallus curved, asymmetrical; with well developed dorsolateral flanges, flanges medially with group of strong, spine-like seta pointing caudad; subapically row of few strong, spine-like seta, apically with group of strong, spine-like seta pointing anteriad; phallotremal sclerite distinct.



Figs. 26-30. *Triaenodes palpalis* Banks, ♀ genitalia of holotype. – 26, Lateral; 27, dorsal; 28, ventral; 29, spermathecal sclerite, lateral; 30, spermathecal sclerite, ventral.

Distribution and habitat

The species was described from the Volta Region in Ghana by Kimmins (1957b), and was included in the check-lists from Ghana (Gibbs 1973, Kjærandsen & Andersen 1997). Jacquemart (1961) recorded the species from Upemba National Park in the Democratic Republic of the Congo. The present paper adds records from Ivory Coast and Cameroon. In Ghana the species has been taken in the Western, Greater Accra, Volta, and Eastern Regions where it was encountered frequently both at rather fast flowing streams and at larger, more slowly flowing rivers.

Material examined. – CAMEROON: Limbaba, 10 km E of Makak, 3♂, 11.ii.1974, black light, J. A. Gruwell (USNM). – GHANA: Volta Region: Agumatsa Waterfalls, Wli, 59♂, 16.-19.xi.1993, at light, NUFU-project; Volta Region: River Hule (Nubui) south of Fodome Xelu, 77♂, 7.xi.1995, at light, NUFU-project; Eastern Region: Taben by Kade to Asoum Road, 1♂, 25.xi.1995, at light, NUFU-project; Western Region: Tana River 5 km north of Elubo, 13♂, 19.xi. 1995, at light, NUFU-project; Western Region: Ankasa Game Production Reserve, 3♂, 5-9.xii.1993, at light, NUFU-project; Western Region: Ankasa Game Production Reserve, 13♂, 16.xi. 1995, at light, NUFU-project. – IVORY COAST: 25 km N Bouake, 1♂, 27-30.x.1971, black light trap, J. A. Gruwell (USNM).

Triaenodes palpalis Banks
(figs. 26-30)

Triaenodes palpalis Banks 1920: 352. Type locality: CAMEROON: Ja River, Bitze; MCZ, sex not stated.
Triaenodes palpalis Banks. – Ulmer 1931: 3 [list]; Mosely 1932b: 133 [list]; Kimmins 1956: 144 [list]; Fischer 1965: 101 [catalogue]; Fischer 1972: 75 [catalogue]; Gibbs 1973: 399, 421; Morse 1999 [electronic catalogue].

Diagnosis

The male is not known. However, character states of the female show that it is undoubtedly closely related to *T. proszynskii,* and should thus be placed in the subgenus *Triaenodella.* See *T. proszynskii* for diagnosis.

Redescription

Female (n=1). – Forewing length 12.9 mm; hind wing length 11.2 mm. Eye 0.83 mm wide. Antenna broken, scape 0.97 mm. Maxillary palp segment I-IV lengths (in mm), segment V missing: 1.27, 1.38, 1.51, 0.79. Colour uniformly light yellowish-brown in pinned specimen.

Female genitalia (figs. 26-30). Abdominal segment VIII with sternum densely setose posteriorly; in ventral view with posterior corners rounded, medially broadly concave. Segment IX with tergum broad, with two pairs of papillose lobes, anterior pair small, triangular; posterior pair digitate, extending caudad beyond tip of tergum X; pleuron rounded, setose. Tergum X setose, with right angled dorsal corner and straight posterior margin; in ventral view with lower margin of anal opening with rounded, median projection, not visible in dorsal view. Lamellae setose, subrectangular with rounded posteroventral corners. Spermathecal sclerite in ventral view with posterior two third subcircular, with posterolateral, subtriangular projections and strongly sclerotized median structure, with two rounded lobes projecting anterad and triangular, pointed projections pointing dorsolaterad; anterior one third narrowing, with weakly bilobed apex; in lateral view with dorsal part approximately one half of the length of ventral part.

Distribution

The species was described from Cameroon by Banks (1920). Gibbs (1973) recorded *T. palpalis* from the Eastern Region in Ghana and mentioned that there are four females of the species from Njala in Sierra Leone in the collection at BMNH. We have examined one of these females from Ghana and two of the females from Sierra Leone and found that they all belong to *T. proszynskii.* We thus conclude that there are no reliable records of *T. palpalis* except for the type material.

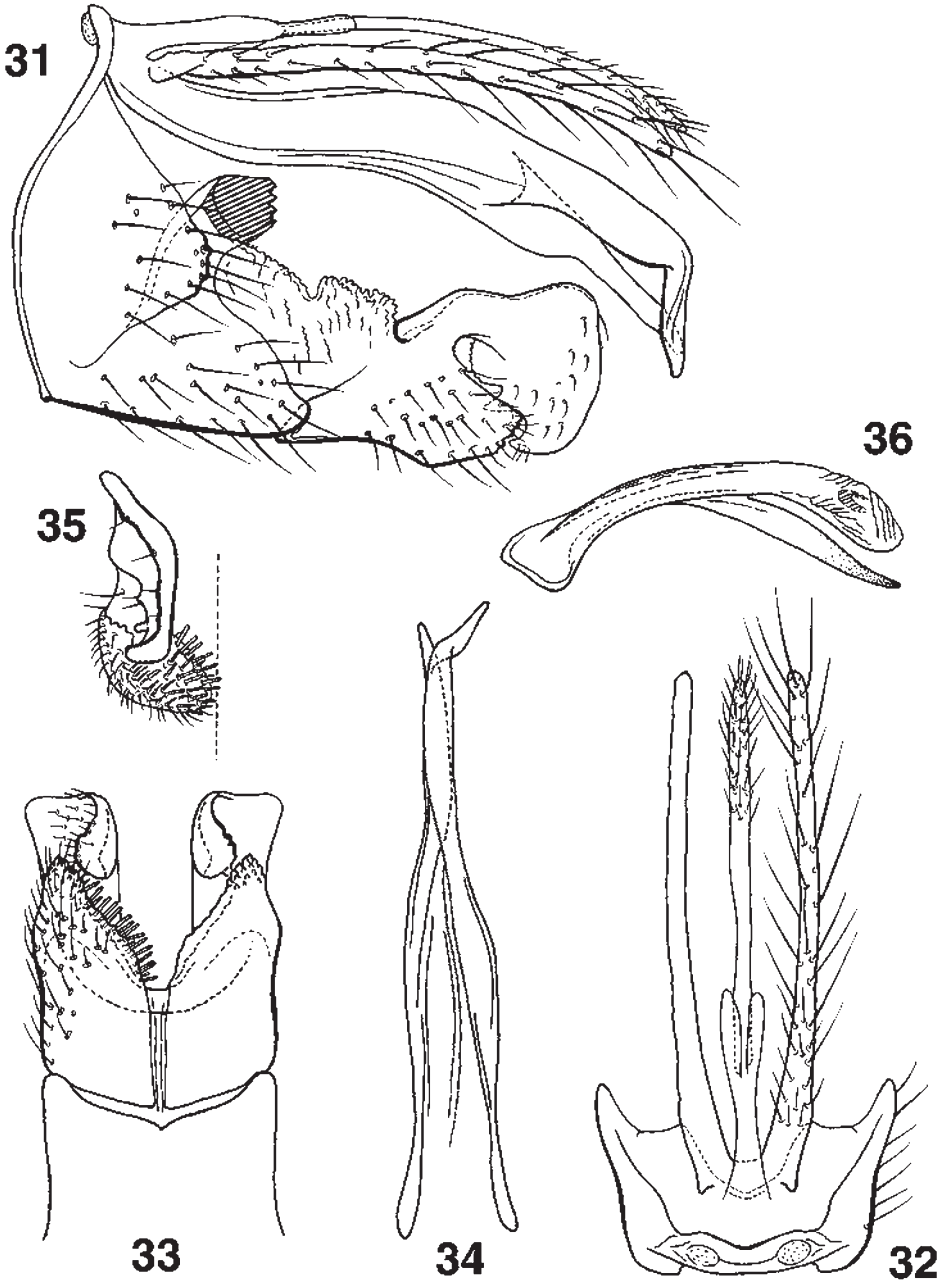
Material examined. – Holotype ♀, 'Bitze, Ga River, Cameroons Oct Nov. [handwritten on white unbordered label]; Triaenodes palpalis Bks type [handwritten on pink, double-red-bordered label]; Type 10825 [printed / handwritten on dark red, unbordered label]; N. Banks. [printed on white, unbordered label]'.

Triaenodes proszynskii (Marlier & Botosaneanu)
(figs. 2, 31-41)

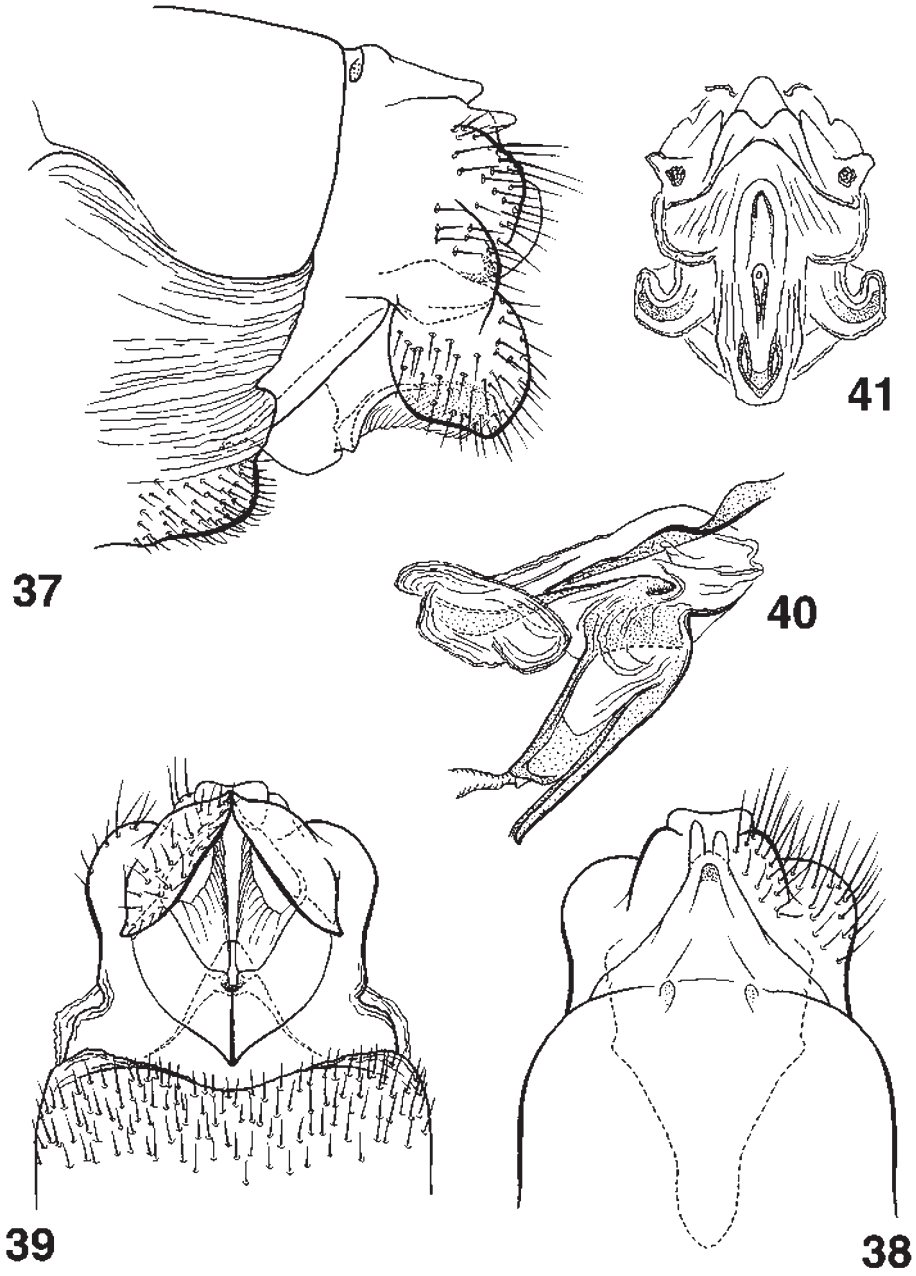
Triaenodella proszynskii Marlier & Botosaneanu 1968: 13, figs. 8-9. Type locality: IVORY COAST (COTE D'IVOIRE): provenance d'Abidjan; ISNB; ♂
Triaenodes proszynskii (Marlier & Botosaneanu). – Gibbs 1973: 399, 421; Kjærandsen & Andersen 1997: 247 [list]; Morse 1999 [electronic catalogue].

Diagnosis

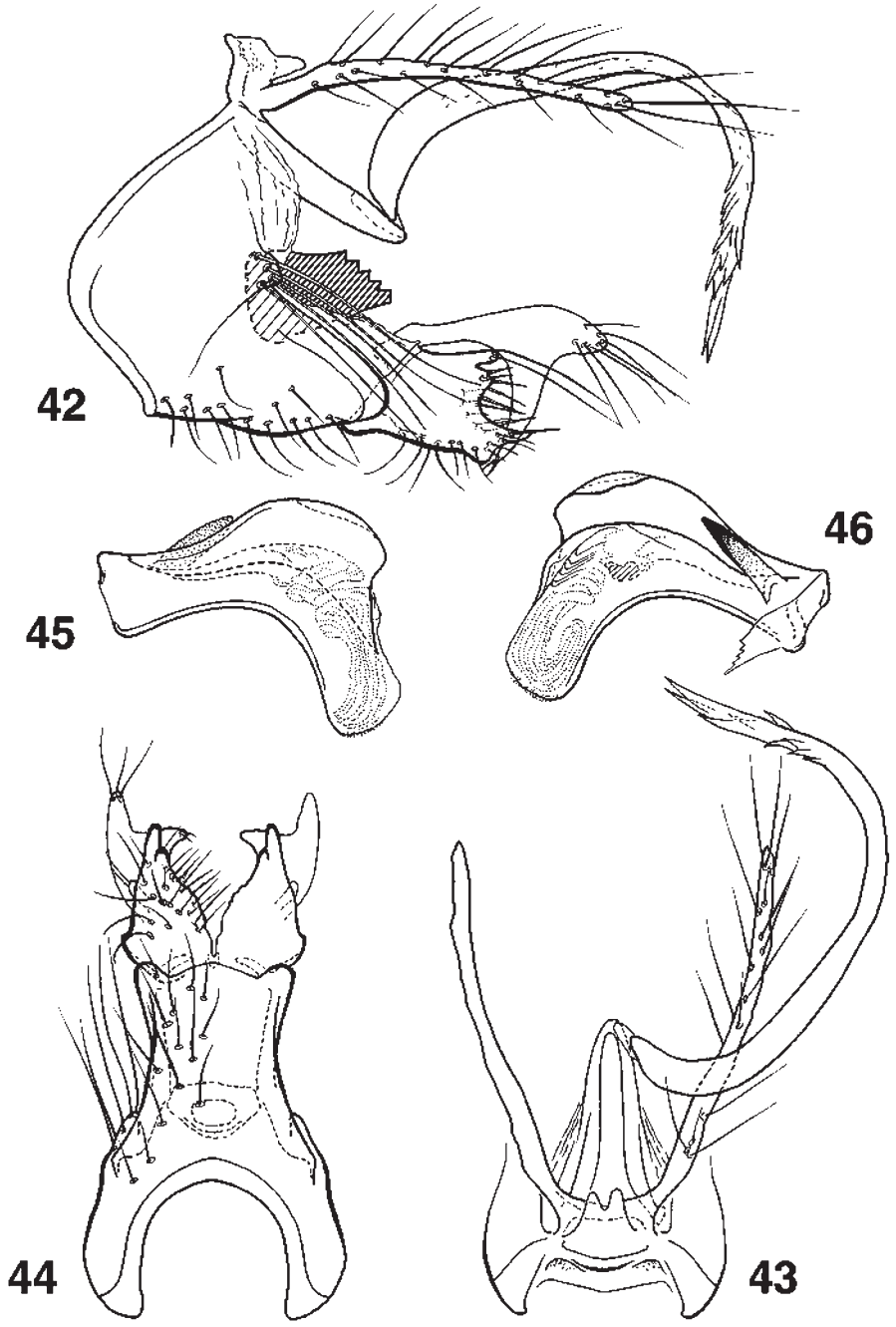
Triaenodes proszynskii and the female of *T. palpalis* can be easily recognized among the Afrotropical *Triaenodes* on their large size and the long maxillary palpi with dense, dark brown setae along dorsal and ventral margins. The male of *T. palpalis* is not known, but based on features in the female it could be rather similar to the male of *T. proszynskii.* The females of the two species can be separated on the shape of the lamellae which are subovate with slightly concave ventral margins in *T. proszynskii,* while subrectangular with rounded posteroventral corners in *T. palpalis,* and of the spermathecal sclerite which in ventral view is hexagonal, with curved anterolateral lobes and rounded anterior apex in *T. proszynskii,* while in *T.*



Figs. 31-36. *Triaenodes proszynskii* (Marlier & Botosaneanu), ♂ genitalia. – 31, Lateral; 32, dorsal; 33, ventral; 34, lower part of tergum X, dorsal; 35, left inferior appendage, caudal; 36, phallus, lateral.



Figs. 37-41. *Triaenodes proszynskii* (Marlier & Botosaneanu), ♀ genitalia. – 37, Lateral; 38, dorsal; 39, ventral; 40, spermathecal sclerite, lateral; 41, spermathecal sclerite, ventral.



Figs. 42-46. *Triaenodes serratus* Ulmer, ♂ genitalia. – 42, Lateral; 43, dorsal; 44, ventral; 45, phallus, left side lateral; 46, phallus, right side lateral.

palpalis the posterior two thirds is subcircular, with posterolateral, subtriangular projections and strongly sclerotized median structure, and with anterior one third narrowing, with weakly bilobed apex.

Redescription

Adults (male, female: n=10). – Forewing length 10.5-11.5, 10.9 mm (♂), 10.2-11.5, 10.7 mm (♀); hind wing length 8.5-9.6, 9.0 mm (♂), 8.3-9.8, 8.8 mm (♀). Eye 0.57-0.64, 0.61 mm wide (♂), 0.59-0.73, 0.65 mm wide (♀). Antenna at least 37 mm including scape 0.86-0.98, 0.93 mm long (♂); 35 mm including scape 0.76-0.94, 0.84 mm long (♀); male scapus with distinct scent organ and dense dark-brown brush (fig. 2). Maxillary palp segment lengths (in mm): 1.03-1.18, 1.11; 1.06-1.27, 1.14; 1.24-1.36, 1.30; 0.55-0.70; 0.66; 1.70-1.80, 1.73 (♂); 0.98-1.22, 1.08; 1.04-1.30, 1.21; 1.31-1.50, 1.39; 0.67-0.75, 0.71; 1.64-1.82, 1.69 (♀); both sexes with dense dark-brown setae along dorsal and ventral margins. Colour in alcohol overall dark greyish-brown.

Male genitalia (figs. 31-36). Abdominal segment IX with anterior margin slightly rounded; tergum narrow; pleural region bluntly triangular, setose; sternum triangular, strongly produced posteriorly, in ventral view with shallow v-shaped excision apically. Preanal appendage long, narrow, setose. Upper part of tergum X long, slender, pointed apically with short setae in apical one third; with pair of short, blunt, lateral projections at basal one quarter. Lower part of tergum X heavily sclerotized, slightly sinuous, split into two asymmetrical, spine-like processes two thirds from base; right process gradually tapering, curved slightly lateroventrad; left process bent ventrad subapically, with tapering apex projecting ventrolaterad. Inferior appendage stout, subtriangular, with short, spine-like setae apicomesally; mesal basodorsal process projecting posterodorsad; base prominent, forming heavily sclerotized bridge between left and right appendages; apically broadly triangular, slightly concave, with pair of tooth-like projections anteroventrally. Phallus slender, cylindrical, curved; with strong, tapering paramere ventrally; phallotremal sclerite u-shaped.

Female genitalia (figs. 37-41). Abdominal segment VIII with sternum setose posteriorly; in ventral view with posterior corners rounded, medially broadly concave. Segment IX with tergum broad, dorsally with short, rounded, median projection; with one pair of short, papillose lobes, not reaching tip of tergum X; pleuron broadly rounded, setose. Tergum X setose, with rounded dorsal corner; in ventral view with lower margin of anal opening broad, with rounded, lateral corners, weakly concave medially, clearly visible in dorsal view. Lamellae setose, subovate, with slightly concave ventral margin. Spermathecal sclerite in ventral view hexagonal, with curved anterolateral lobes and rounded anterior apex; in lateral view with dorsal part of approximately same length as ventral part.

Distribution and habitat

The type material includes one male from the Abidjan Region in the Ivory Coast and one male from Damongo Daboya in northern Ghana (Marlier & Botosaneanu 1968). Gibbs (1973) included the species in his check-list of Ghanaian Trichoptera based on the record given by Marlier & Botosaneanu (1968). Kjærandsen & Andersen (1997) gave a new regional record from Volta Region. The present paper adds records from the Eastern and Western Regions in Ghana.

Gibbs (1973) recorded two females of *T. palpalis* from Ghana. We have examined one of these females housed in BMNH and found that it belongs to *T. proszynskii*. Further Gibbs (1973) mentioned four females of *T. palpalis* from Njala in Sierra Leone. We have examined two of these females and found that they also belong to *T. proszynskii*.

Triaenodes proszynskii is thus taken in Ghana, Ivory Coast and Sierra Leone. In Ghana the species appears to be distributed mostly in the southern forested parts of the country where it has been trapped close to streams and moderately to fast flowing small rivers.

Material examined. – GHANA: Volta Region: Agumatsa Waterfalls, Wli, 2♂ 1♀, 7-16.iii.1993, Malaise trap, NUFU-project; Volta Region: Agumatsa Waterfalls, Wli, 3♂, 9-19.iii.1993, 3♂ 4♀, 16-19.xi.1993, at light, NUFU-project; Volta Region: River Menu, Kute 1♀ (pinned), 4.xi.1995, at light, NUFU-project; Eastern Region: Boti Falls, 3♂ 18♀, 14.xi.1994, at light, NUFU-project; Eastern Region: Taben by Kade to Asoum Road, 7♀, 25.xi.1995, at light, NUFU-project; Western Region: Ankasa Game Production Reserve, 2♀, 11.xii.1993, at light, NUFU-project; Western Region: Anksa Game Production Reserve, 1♀, 16.xi.1995, at light, NUFU-project; Western Region: 2°28'W 5°23'N, 1♀ xi. 65, at light, forest, L.R. Cole, *Triaenodes palpalis* Banks det. D.G. Gibbs (BMNH). – SIERRA LEONE: Njala, 1♀ 17.x.1928, E. Hargreaves, *Triaenodes* sp. det. M. E. Mosely (BMNH); Njala, 1♀ 21.viii.1930, E. Hargreaves, *Triaenodes* sp. det. M. E. Mosely (BMNH).

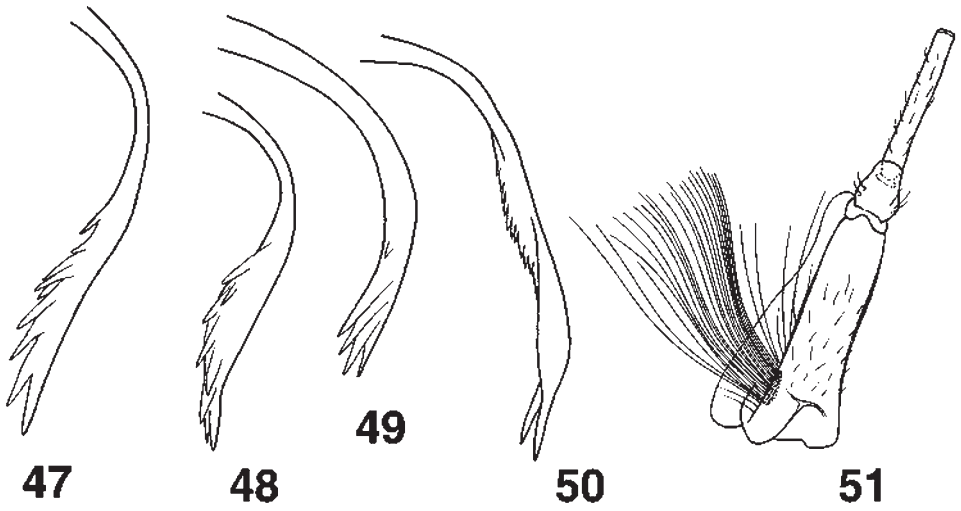
Triaenodes serratus Ulmer
(figs. 42-50)

Triaenodes serratus Ulmer 1912: 110-111, fig. 38. Type locality: SUDAN: Schilluk-Insel, ZFMK, ♂.

Triaenodes serratus Ulmer. – Lestage 1919: 317, 318, 329; Ulmer, 1923: 20; Ulmer 1931: 3; Mosely 1932b: 133 [list]; Lestage 1936: 186; Kimmins, 1956: 144 [list]; Kimmins, 1957b: 19-21, fig. 12; Fischer 1965: 103 [catalogue]; Jacquemart 1966a: 39-40, fig. 4; Fischer 1972: 76 [catalogue]; Johanson 1992: 135 [catalogue]; Morse 1999 [electronic catalogue].

Diagnosis

The species shows similarities to *T. bifidus* Jacquemart described from the Democratic Republic of the



Figs. 47-50. *Triaenodes serratus* Ulmer, variation in lower part of tergum X. – 47, 48, specimens from Nigeria; 49, specimen from Zimbabwe; 50, specimen from Ivory Coast. – Fig. 51. *Triaenodes kwadvo* sp. n., scape, pedicel and 1st flagellar segment.

Congo (Jacquemart 1966b), *T. falculatus* Kimmins from South Africa (Kimmins 1956), and *T. siculus* (Barnard) described from Namibia (Barnard 1934) in the shape of the lower part of tergum X, which is strongly sclerotized, with base projecting caudad and with strong, recurved spine-like process. But only in *T. siculus* does this process bear spines distally similar to those in *T. serratus.* However, the two species can apparently be separated on the length of the preanal appendages, which in *T. serratus* reaches well beyond the base of the lower part of tergum X, while in *T. siculus* it is shorter than the base of tergum X.

Redescription

Male (n=7-8). – Forewing length 7.0-7.3, 7.2 mm; hind wing length 5.2-5.6, 5.4 mm. Eye 0.39-0.47, 0.42 mm wide. Antenna at least 21.6 mm long, including 0.61-0.72, 0.69 mm long scape; scape with well developed scent organ and brush of yellowish-brown seta. Maxillary palp segment lengths (in mm): 0.47-0.58, 0.54; 0.50-0.61, 0.57; 0.60-0.66, 0.64; 0.35-0.39, 0.36; 0.68-0.84, 0.77. Colour in alcohol overall yellowish-brown.

Male genitalia (figs. 42-46). Abdominal segment IX with anterior margin broadly rounded; with tergum narrow, pleural region with posterior margin rounded, with small triangular projection medially bearing long setae; sternum subtriangular, produced posteriorly; in ventral view with rounded posterior corners and weakly convex posterior margin. Preanal appendage long, narrow, setose. Upper part of tergum X paired, very small, rounded lobes. Lower part of tergum X long, strongly sclerotized, base projecting caudad with strong, recurved spine-like process, projecting ventrad, with fine seta medially, spiny in distal one fourth, the number and shape of spines variable; in dorsal view with base narrowly triangular, with recurved spine-like projection often asymmetrically curved to the left. Inferior appendage with basal one half subquadrangular, posteroventrally with triangular, pointing projection, posterodorsal corner with short, thick spine-like seta mesally; mesal basodorsal process curved caudad, clavate, with ventral process narrowly triangular, slightly curved, pointing ventrad, with dorsal process rounded, projecting caudad, setose apically. Phallus large, curved, asymmetrical; with strong spine subbasally on right side; with large, rounded flange medially on left side; apex broad, trough-like with apical membranes and fine setae; phallotremal sclerite small.

Remarks

There is some variation in the number and size of the spines on the curved process of the lower part of tergum X (figs. 47-50). Some of the specimens from Ivory Coast have comparatively small and numerous spines, while the specimen from Zimbabwe had the inferior appendage more similar to that drawn by Kimmins (1957b: fig. 12A).

Distribution and habitat

The species was described from the Schilluk-Insel in Sudan by Ulmer (1912). The species was later recorded from Jinja in Uganda (Kimmins 1957b), and from

Garamba National Park in the Democratic Republic of the Congo (Jacquemart 1966a). The present paper adds records from Ivory Coast, Ghana, Nigeria, Tanzania and Zimbabwe. In Ghana the species was taken at light close to medium sized to large moderately fast flowing rivers in the northen parts of the country.

Material examined. – GHANA: Northern Region: Mole National Park, Mole River, 137♂, 16.xi.1996, at light, NUFU-project; Northern Region: White Volta at Daboya, 10♂, 21.xi.1996, at light, NUFU-project; Upper West Region: Black Volta at Dabo, 12♂, 18.xi.1996, at light, NUFU-project. – IVORY COAST: 25 km N Bouake, 8♂, 27-30.x.1971, black light trap, J. A. Gruwell (USNM). – NIGERIA: Samaru Lake, Saria, 1♂, 1.ii.1978, D. & M. Davis (USNM); Institute of Agricultural Research, 5 miles N of Mokwa, 2♂, 4-5.ii.1978, D. & M. Davis (USNM). – TANZANIA: Morogoro Region: Morogoro, Sokoine University of Agriculture, 1♂, 26.x.-11.xi.1990, light trap, T. Andersen. – ZIMBABWE (RHODESIA): Victoria Falls National Park, 2♂, 3-6.iv.1968, P. Spangler (USNM).

Incertae sedis

The wing venation (figs. 3, 4) and scape with distinct scent organ and brush of seta (fig. 51), places the following species, *T. kwadwo* sp. n., in *Triaenodes,* but the species does not fit in any of the subgenera as defined by Yang & Morse (1993). The lack of an abbreviated basal plate and curved process of the inferior appendage should place the species in subgenus *Triaenodella* or *Austrotriaena*. However, the lack of a mesal basodorsal process excludes the species from both subgenera (fig. 5). The species has a basodorsal process with strong spine-like setae, which in other Afrotropical *Triaenodes* species generally is associated with the apicomesal lobe, and we find it difficult to homologize this process with any of the processes defined by Yang & Morse (1993). The phallus with strong, paired spines appears to be unique in *Triaenodes*. The Neotropical *Triaenodes* species have a phallus with long, paired spines, but these species all have an abbreviated basal plate and curved process of the inferior appendage.

***Triaenodes kwadwo*, sp. n.**
(figs. 3-5, 51-55)

Type material. – Holotype ♂: GHANA: Volta Region: Agumatsa Waterfalls, Wli, 4-13.iii.1993, Malaise trap, NUFU-project (UMSP). – Paratypes: 1♂ same data as holotype except 11.iii.1993, at light; 2♂ same data as holotype except 16.xi.1993, at light; 1♂ same data as holotype except 9.xii.1993, at light; 1♂ Volta Region: River Menu at Kute, 4.xi.1995, at light, NUFU-project; 1♂ Volta Region: Togabe Falls, Woti, 9.xi.1995, at light, NUFU-project; 1♂ Volta Region: River Uwue south of Lipke Mate, 6.xi.1995, at light, NUFU-project; 1♂ Eastern Region: River Birim at Akim Apodom, 6°10.519'N 0°52.209'W, 9.xi.1996, at light, NUFU-project; 2♂ Western Region: Ankasa Game Production Reserve, 5.xi.1993, at light, NUFU-project (USNM, ZMUB, UMSP).

Etymology. – Twi, *kwadwo,* meaning a male born on Monday; named in the Ashanti tradition of naming children after the day they are born, signifying that the species description was written on a Monday; the name is a noun in apposition.

Diagnosis

The very simple male genitalia, lacking apicomesal lobe, lateral basodorsal process, mesal basodorsal process, and abbreviated basal plate with curved spine, and the phallus with two pairs of strong spines, renders the species distinct.

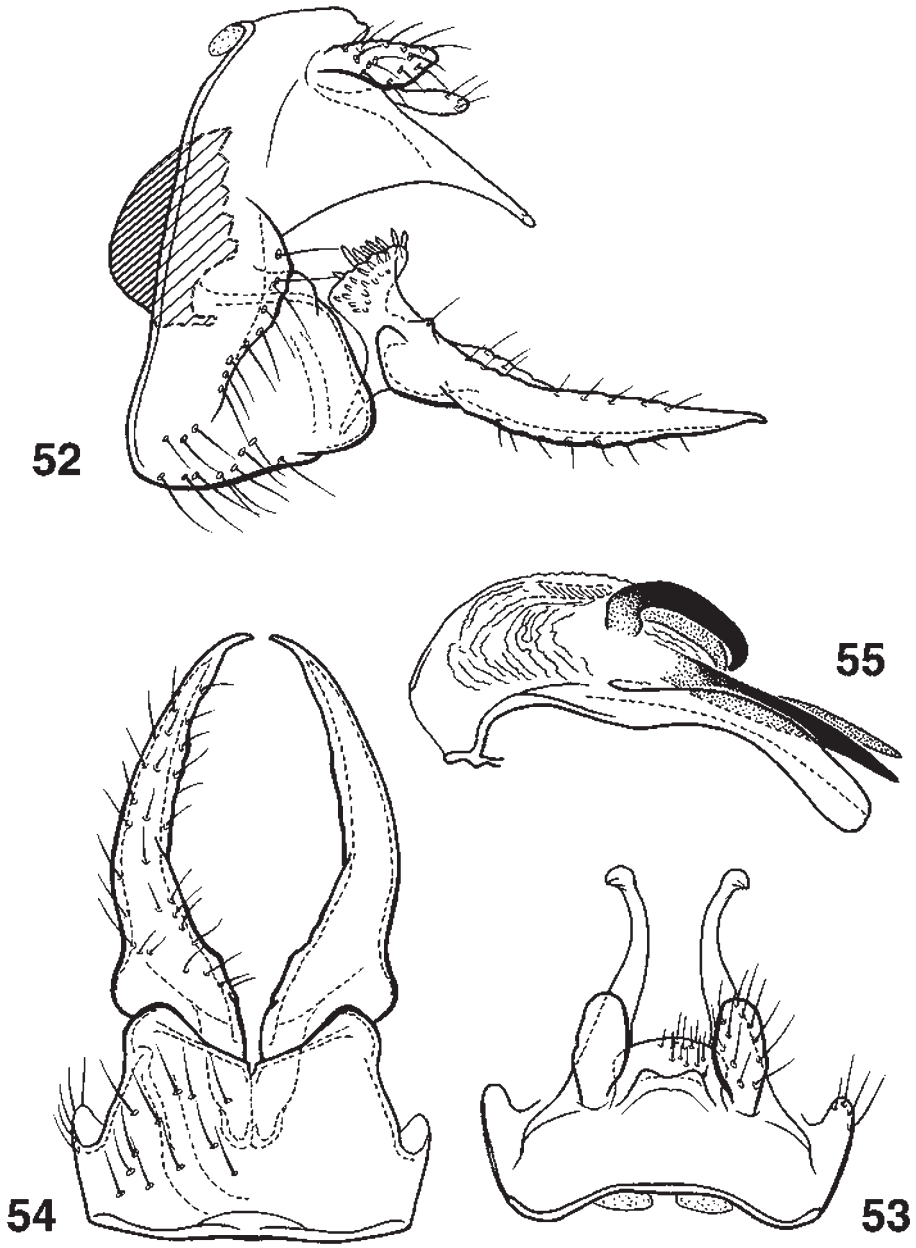
Description

Male. (n=8-9). – Forewing (fig. 3) length 5.4-6.1, 5.7 mm; hind wing (fig. 4) length 4.2-4.5, 4.3 mm. Eye 0.34-0.39, 0.36 mm wide. Antenna at least 17.5 mm long, including 0.68-0.77, 0.71 mm long scape; scape with well developed scent organ and brush of yellowish seta (fig. 51). Maxillary palp segment lengths (in mm): 0.43-0.45, 0.45; 0.48-0.56, 0.52; 0.47-0.56, 0.50; 0.29-0.34, 0.32; 0.53-0.60, 0.57. Colour in alcohol overall yellowish-brown.

Male genitalia (figs. 52-55). Abdominal segment IX with anterior margin straight; tergum narrow; pleural region rounded, setose; sternum broadly triangular, in ventral view posterior margin with rounded corners, shallowly v-shaped excavation mesally. Preanal appendage short, rounded, setose. Upper part of tergum X short, broad, setose, with small, rounded lobes basolaterally. Lower part of tergum X triangular in lateral view, with ventral margin concave; in dorsal view split to base, projections curved laterad apically. Inferior appendage long, narrow, tapering, apex pointed, weakly curved mesad; with low dorsomedian crest; with broad, triangular basal projection, bearing strong, spine-like setae. Phallus broad in basal two thirds; with sclerotized phallotremal sclerite dorsally; with two pairs of tapering spines medially, dorsolateral pair curved, with apex pointing ventromesad; dorsomesal pair straight, pointing caudad; distal part weakly curved, through-shaped, with broadly rounded apex.

Distribution and habitat

The species is known from the Western, Eastern and Volta Regions in Ghana, where it has been taken in light traps close to streams and small rather fast flowing rivers.



Figs. 52-55. *Triaenodes kwadvo* sp. n., ♂ genitalia. – 52, Lateral; 53, dorsal; 54, ventral; 55, phallus, lateral.

ACKNOWLEDGMENTS

We are indebted to Dr. P. Perkins, Museum of Comparative Zoology, Harvard University, Cambridge, for the loan of type material of *Triaenodes palpalis,* to Dr. P. Barnard, The Natural History Museum, London, for the loan of material of *T. proszynskii* from Ghana and Sierra Leone, and to Dr. O. S. Flint Jr., National Museum of Natural History, Washington, for loan of West African *Triaenodes* material.

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