

## Descriptions of some Afrotropical Baetidae (Ephemeroptera) II. *Baetis* Leach, s.l., East African Species

M.T. GILLIES

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Descriptions are given of the adults and nymphs of 3 new species of *Baetis* from East Africa, together with a description of the nymph of *B. monikae* Kopelke, previously known only in the adult stage.

Keywords: Mayflies, *Baetis*, East Africa

M.T. GILLIES, Whitfeld, Hamsey, Lewes, Sussex, BN8 5TD, England.

### INTRODUCTION

With the exception of the nymphs of 2 species from the Sudan, described by Soldan (1977), and the adults of 4 species from Eastern Zaire, Kopelke (1980), studies of *Baetis* Leach in Africa south of the Sahara have been mainly confined to the fauna of South African rivers. In a recent publication, Gillies (1993), I described the nymphs and associated adults of 3 species of the genus from West Africa. In the present publication, I give an account of a further 3 species from Tanzania whose adults had been reared from the nymph, while a fourth reared species proved to be the nymph of *B. monikae* Kopelke, previously known from eastern Zaire as the adult only.

Like those described from West Africa, (Gillies, loc. cit.), these species are all placed in *Baetis* s.l. Reasons for this action are discussed below.

Descriptions of these species follow. The types of all new species have been deposited in the Natural History Museum, London.

### DESCRIPTIONS

Species of *Baetis* with spurless hind wings are an important feature of the Afrotropical fauna, no less than 10 out of 15 named species with hind wings being in this category. A new species from northern Tanzania is described here.

#### *Baetis mtonis* sp. n.

♂ *imago* (in spirit). A pale-bodied species. When viewed from below, the abdo-

men appears longitudinally striped, dark along the margins, pale down the middle.

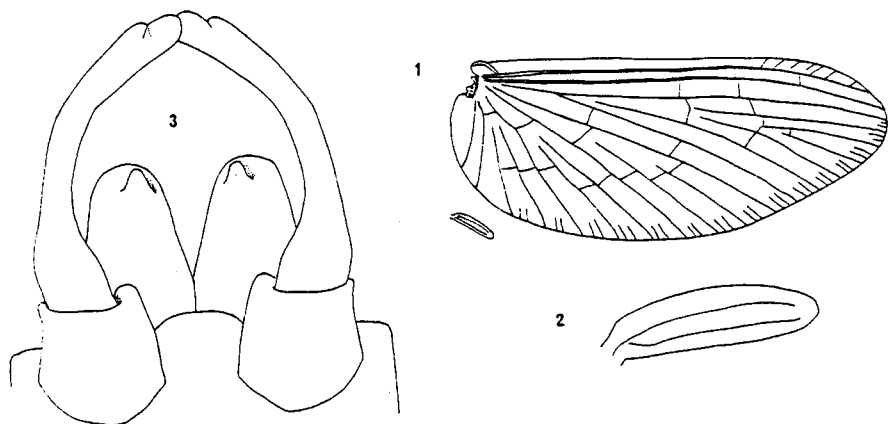
Turbinate eyes pale fawn, tall, rounded and contiguous. Thorax pale brown, pro- and mesonota fawn dorsally, metanotum broadly cream. All legs cream. Fore wing clear (Fig. 1), 4-6 incomplete, oblique stigmatic crossveins. Hind wing without costal spur, 2 longitudinal veins (Fig. 2). Abdominal terga translucent cream, narrowly but deeply pigmented dark red along part or all of posterior margins of I-VI; VII-X fawn, VII and VIII very narrowly red posteriorly. Sterna I-VI with a continuous, broad, lateral blood-red band, median area cream.

Basal half of forceps and inner, posterior area of forceps base tinged with brown, apical half white; paraproct of Xth segment with a rounded, inner apical spur (Fig. 3). Tails white.

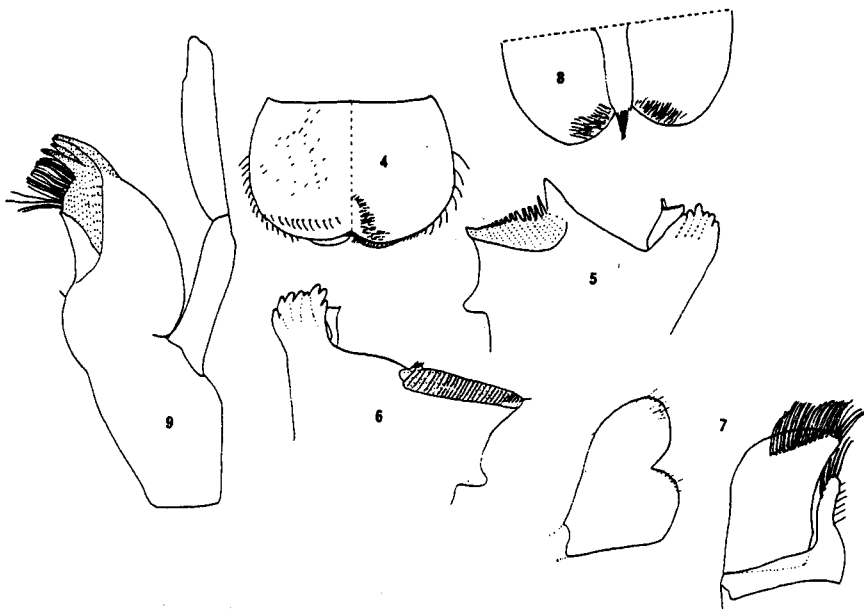
♀ *imago* (in spirit). Body generally orange. Terga III-VI broadly orange-brown at postero-lateral margins, VII-X the same colour. Legs and wings as in ♂.

Body: ♂ 6 mm, ♀ (slightly distorted) 5.5 mm; wing: ♂ 6 mm, ♀ 6.5 mm.

*Nymph*. Mouthparts (Figs. 4-9): upper surface of labrum with a transverse line of setae just behind the anterior margin; canines of mandibles fused, prosthecae of both sides broadly toothed; maxillary palps with two segments; ligula of hypopharynx with a stout, median tuft; paraglossae of labium large, about 5 times as wide as glossae, palps with 3 segments, the inner apical margin of 2nd segment projecting well beyond base of 3rd segment. Legs slender (Fig. 10): base of femora without villopore, denticles of claws stout. Gills broadly ovate (Fig. 11), being present on I-VII, those on I and VII 1/3-1/2 size of remainder, anterior margins finely serrate. Postero-lateral angles of terga (Fig. 12) not produced into spines except for multiple spines on VIII and IX; posterior margins of terga (Fig. 13) with coarse teeth; paraproct with numerous fine teeth on inner



Figs. 1-3. *B. mtonis*, adult. 1. Fore wing. 2. Hind wing, more highly enlarged. 3. ♂ terminalia.



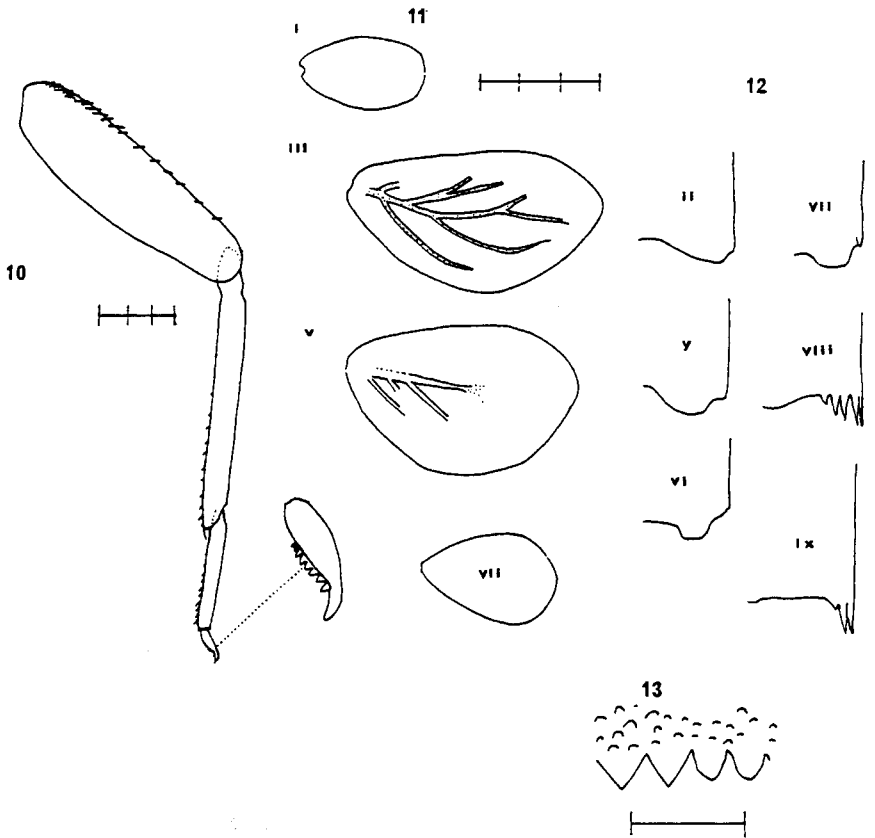
Figs. 4-9. *B. mtonis*, mouthparts. 4. Labrum. 5 and 6. Left and right mandibles. 7. Labium. 8. Hypopharynx. 9. Maxilla.

margin, becoming coarser towards apex. Terminal filament  $1/2$ - $2/3$  length of cerci, outer  $1/3$  filamentous and largely without hairs.

*Material.* TANZANIA: holotype ♂ and associated nymph skin, Ukungwi stream, Amani, Tanga, 4.iii.85., 1 ♂ with nymph skin, 28.ii.85; Dodwe stream, Amani, 2 ♂, 1 ♂ subimago with nymph skins, 6.iii.85, 7 ♂ from cobwebs, 19.vii.52; light trap by R. Sigi, Amani, 1 ♂, 8.x.61, 4 ♂, 11.xii.61, 1 ♂, 28.i.62, 7 ♂ 8.x.62; 1 ♀, Amani, 21.xi.51.

The nymph of *B. mtonis* differs from those of *B. bellus* Barnard and *B. lawrencei* Crass in the 2-segmented maxillary palp; from *B. cataractae* Crass, *B. monticola* (Crass) and *B. natalensis* (Crass) it differs in the great enlargement of the paraglossae and the inward projection of the apex of the 2nd palpal segment. The maxillary palps of *B. glaucus* Agnew and *B. quintus* Agnew have not been described, but *B. mtonis* differs by the absence of a rounded process on the inner border of the molar region of the right mandible and in the more rounded apical segment of the labial palp. This last character also distinguishes it from *B. latus* Agnew, the mouthparts of which have not otherwise been described. *B. insolitus* Kopelke and *B. kalengoensis* Kopelke are known from the adults only.

The male of *B. mtonis* differs from all described species except *B. kalengoensis* from eastern Zaire by the presence of a rounded spur or process on the paraproct



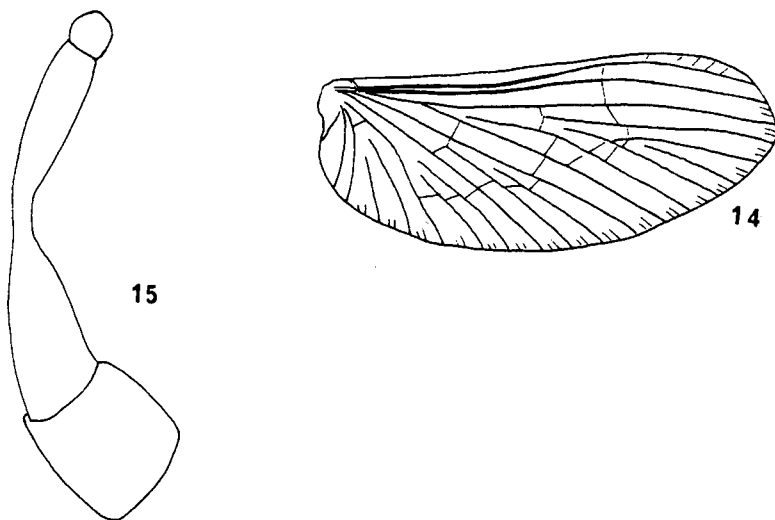
Figs. 10-13. *B. mtonis*, nymphal parts. 10. Fore leg, scale = 0.3 mm. 11. Gill lamellae, I, III, V, VII, scale = 0.3 mm. 12. Postero-lateral angles of terga II, V-IX. 13. Posterior margin of abdominal tergum, scale = 0.1 mm.

of the 10th segment. The abdominal markings in the two species, however, are quite different.

*Baetis spatulatus* sp. n.

♂ *imago* (in life). Body fawn, abdominal terga with spidery black tracheolar pattern. (In spirit, faded). Eyes pale lemon, body cream, legs and tails white. Fore wing clear (Fig. 14), paired marginal intercalaries present in all spaces up to CuA2 interspace, 4-5 incomplete stigmatic cross veins; hind wing absent. Basal segments of genital forceps fused (Fig. 15), 2nd segment markedly narrowed at base, terminal segment globular.

♂ body 3.5 mm, ♀ 4.5 mm; ♂ wing 4-4.5 mm, ♀ 5 mm.



Figs. 14-15. *B. spatulatus*, adult. 14. Fore wing. 15. ♂ forceps limb.

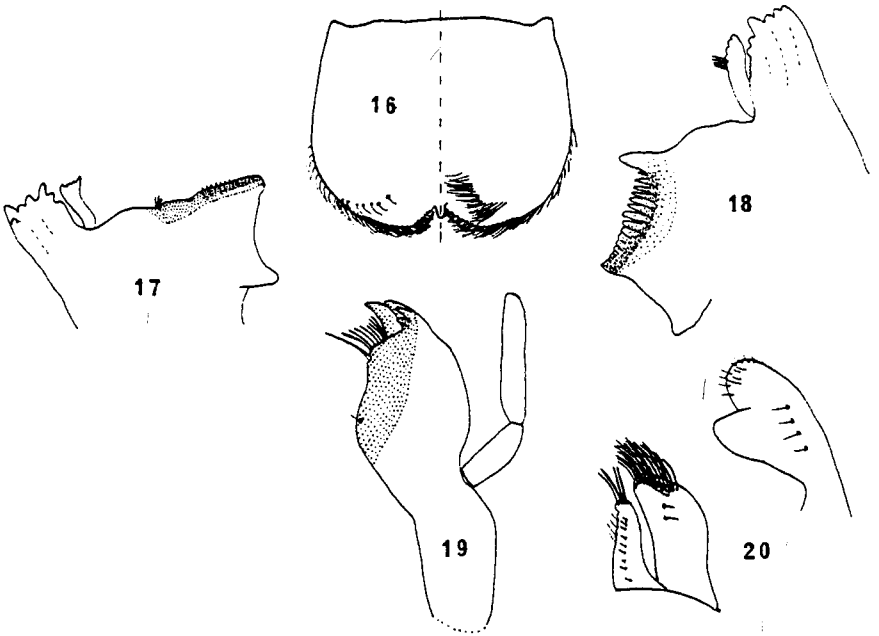
*Nymph.* Mouthparts (Figs. 16-20): canines of both mandibles fused, left prostheca with a tuft of stout spines at inner apex, maxillary palp with 2 segments, subapical tooth of galea-lacinia the largest of the 4; glossa of labium equal to about half size of paraglossa, with a line of short setae down ventral surface, apical medial process of 2nd palpal segment strongly developed.

Legs (Figs. 21, 22): posterior margin of femora with well separated stout, blunt setae, becoming blunter towards apex, villopore absent; posterior margin of tibia with a single, conspicuous, spatulate seta (sometimes double) at extreme apex; tarsal claws with 10-12 very fine teeth.

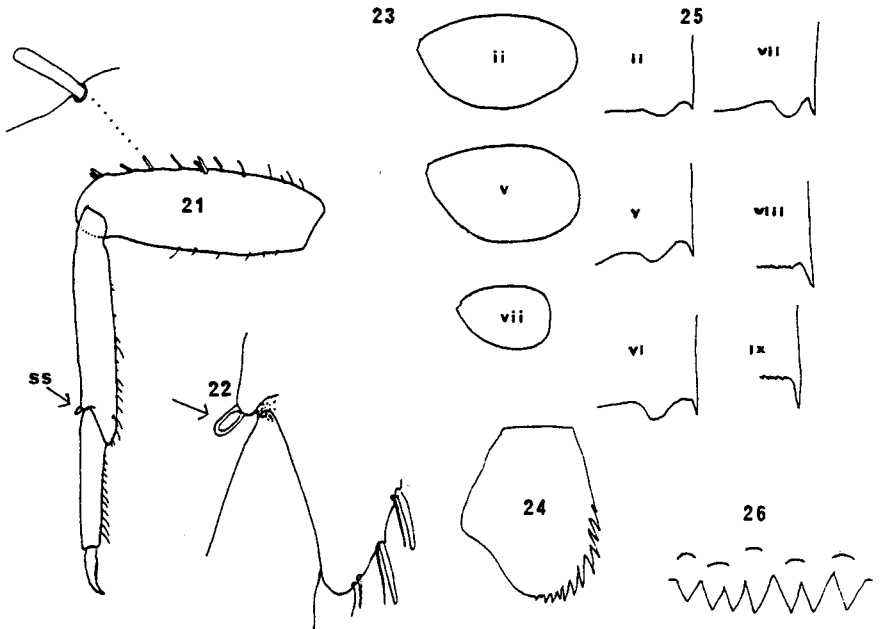
Abdomen: gills present on II-VII, lamellae broad, rounded and symmetrical (Fig. 23), finely dentate on both margins; paraproct with coarse teeth (Fig. 24); postero-lateral angles of terga II-IX with well developed spines, shortest on II, longest on VIII and IX (Fig. 25); posterior margins of terga with short, broad teeth (Fig. 26). Cerci and terminal filament subequal.

*Material.* TANZANIA: holotype ♂ imago with associated skin, Dodwe stream, Amani, 28.iv.62: ♀ subimago with nymph skin, same provenance, iv.62: 8 nymphs, Ukungwi stream, Amani, 17.ii.91: nymph, R. Sumbuguru, near Kidatu on road to Ifakara, Morogoro Province, 2.iii.91. GUINEA: ♂ subimago with nymph skin, tributary of R. Cavally, north of Mt. Nimba, near Ouéyakolé, 2.ii.88.

The adult of *B. spatulatus* is poorly differentiated from several other species in which the hind wing is lost. On the other hand the nymph is instantly recognizable by the spatulate seta on the apex of the tibia, from which the specific name is derived. In this the species is unique among the known *Baetis* fauna of Africa.



Figs. 16-20. *B. spatulatus*, mouthparts. 16. Labrum. 17 and 18. Right and left mandibles. 19. Maxilla. 20. Labium.



Figs. 21-26. *B. spatulatus*, nymphal parts. 21. Fore leg; inset, posterior femoral seta, more highly enlarged; ss, spatulate seta. 22. Apex of tibia showing spatulate seta, highly enlarged. 23. Gill lamellae, II, V, VII. 24. Paraproct. 25. Postero-lateral angles of terga II, V-IX. 26. Posterior margin of abdominal tergum more highly enlarged.

The collecting of this species in several widely separated river systems suggests that it may be of relatively common occurrence.

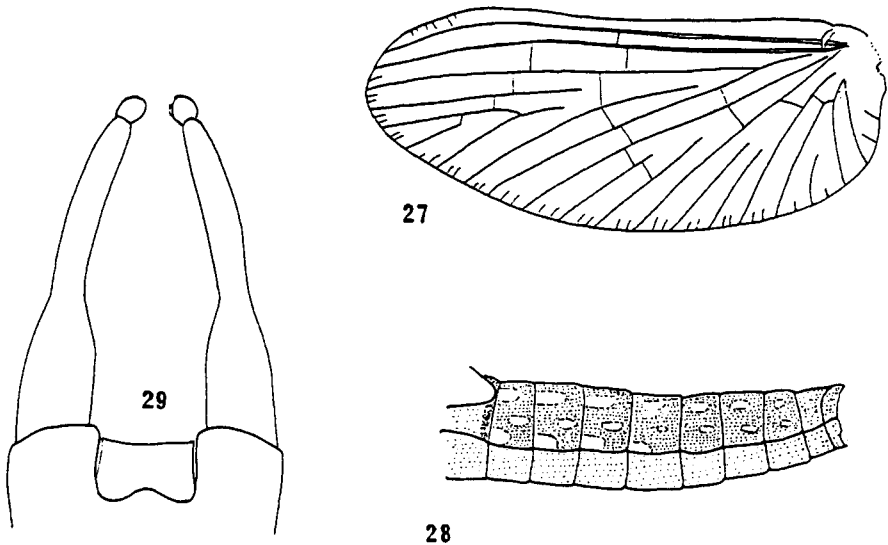
*Baetis tripunctatus* sp. n.

*Male imago* (in life). Eyes fawn, thorax and abdomen mahogany-brown, anterior abdominal terga with 3 pairs of pale markings; legs clear, fore legs somewhat darker.

(In spirit). Eyes well separated, more or less rounded, orange-brown. Thorax generally mahogany-brown, mesonotum with two sub-median pale lines. Legs cream, tarsi a little darker. Wings (Fig. 27) clear, marginal intercalaries single in 1st radial interspace, double as far back as CuA space, single in two following spaces; stigma with 4-6 incomplete, parallel crossveins. Abdomen dark brown, terga II-VII or VIII with paired, submedian and lateral pale streaks, on II-V an additional antero-lateral, pale area (Fig. 28); lateral margins of sterna II-VI narrowly dark brown; forceps dark brown (Fig. 29); between the basal segments there is a square-ended plate acting as 'penis-cover', the hind margin and sides of which are narrowly dark brown. Tails white.

Body 4.6 mm; wing 4.3 mm.

*Nymph*. Mouthparts (Figs. 30-35), canines of mandibles fused, left prostheca with medial tooth broad, tapering to a sharp point; maxillary palp with two segments; labial palp with apical medial process of 2nd segment strongly devel-



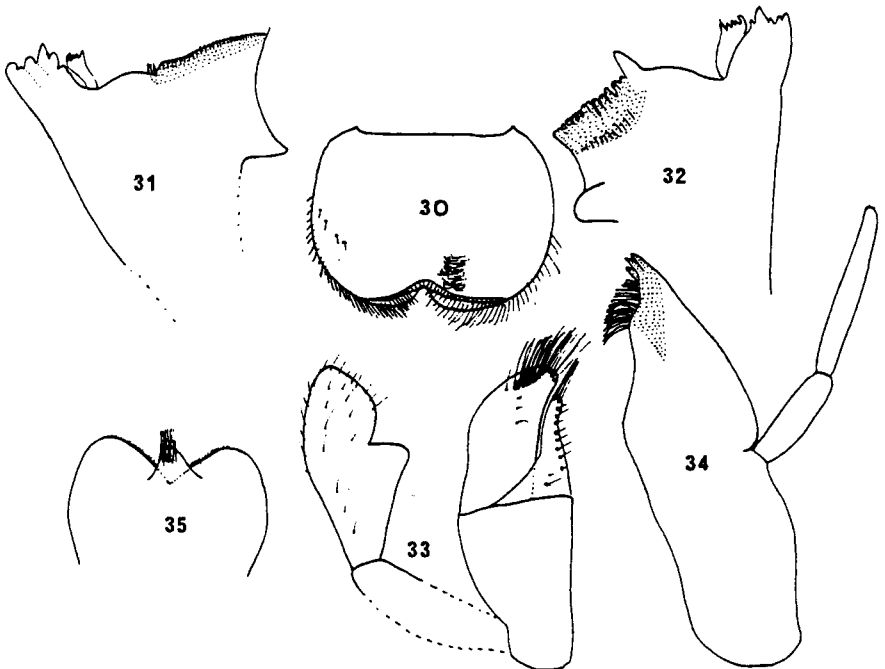
Figs. 27-29. *B. tripunctatus*, adult. 27. Fore wing. 28. ♂ abdomen lateral view, tails and terminalia omitted. 29. ♂ forceps.

oped. Legs (Fig. 36), femora with sparse, spine-like setae along anterior margin, tibiae and tarsi with numerous stout setae along posterior margin, tarsal claws stout with single row of 8-10 teeth. Gills present on II-VII (Fig. 37), obovate, that on III the largest; posterior margins of terga with spines of uniform size (Fig. 39), cuticular scales distributed at random; postero-lateral angles of all terga with a short apical spine, on VIII-IX merging with spines along posterior margin (Fig. 38). Tails with a median dark band, terminal filament about  $\frac{1}{2}$  length of cerci.

*Material.* TANZANIA. Holotype ♂ imago with associated nymph skin, Amani, Ukungwi stream, 6.iii.85. Paratype ♂ imago, Amani, Dodwe stream, 26.ii.85.

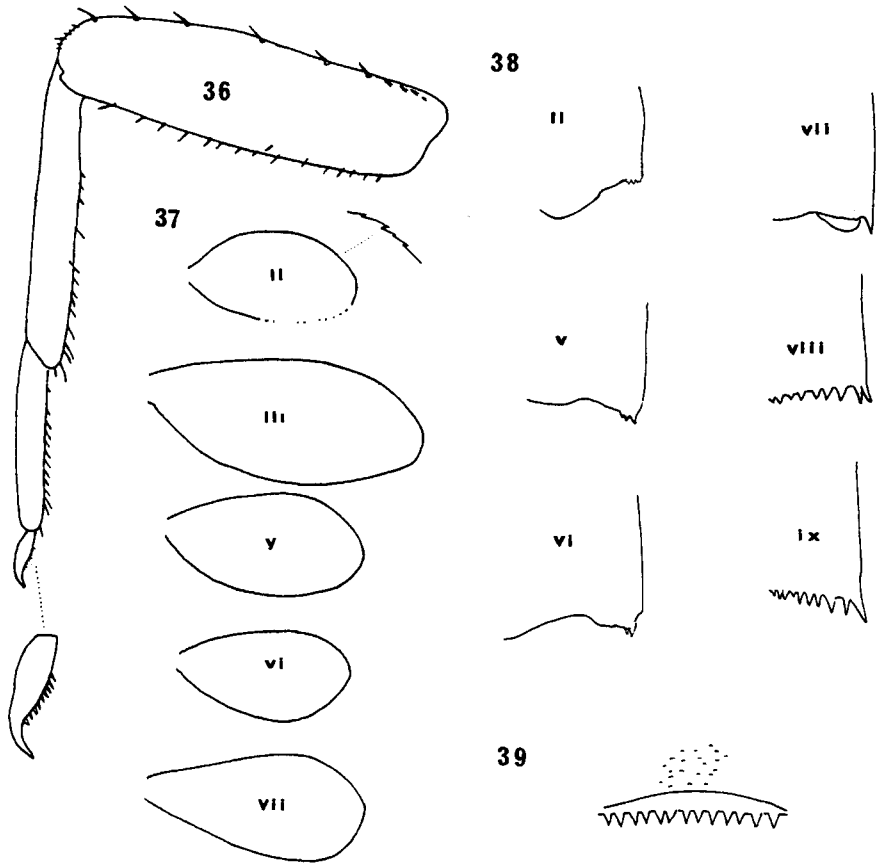
The ♂ of *B. tripunctatus* differs from all other species of *Baetis* s.l. that lack hind wings by the rectangular plate between the bases of the forceps limbs. A rather smaller plate has been described in the Nearctic species *Pseudcloeon etowah* Traver. Waltz and McCafferty (1987c) noted that similar plates are often present in *Acentrella*. The nymph generally resembles that of *B. spatulatus* but differs by the absence of the spatulate apical tibial spine of that species.

The adults of two reared nymphs from the River Sigi at Amani proved to be conspecific with *Baetis monikae* Kopelke, which was described from eastern



Figs. 30-35. *B. tripunctatus*, mouthparts. 30. Labrum. 31 and 32. Right and left mandibles. 33. Labium. 34. Maxilla. 35. Hypopharynx.





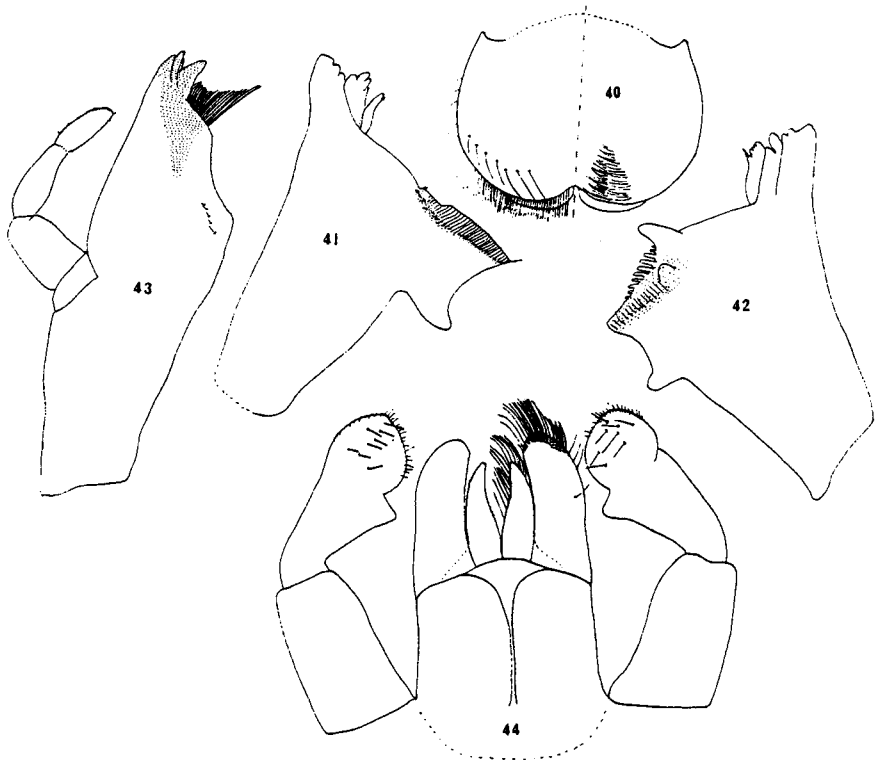
Figs. 36-39. *B. tripunctatus*, nymphal parts. 36. Fore leg. 37. Gill lamellae, II, III, V, VI. 38. Posterolateral angles of abdominal terga II, V-IX. 39. Posterior margin of abdominal tergum, more highly enlarged.

Zaire. I also have adults collected on the wing from the same area of Tanzania that enable me to add to the original account of the species.

### *Baetis monikae* Kopelke

*Baetis monikae* Kopelke, 1980. Entom. Abh. Mus. Tierk. Dresden 43: 104.

♂ *imago* (in life). Turbinate eyes brick-red, thorax fawn with 2 prominent pitch-brown spots below wing root. All femora and tibiae orange, except at extreme tip of latter, tarsi dusky-grey. In fore wing, extreme base of subcosta and radius 1 as far as costal brace strongly tinged with pitch-brown. Abdominal



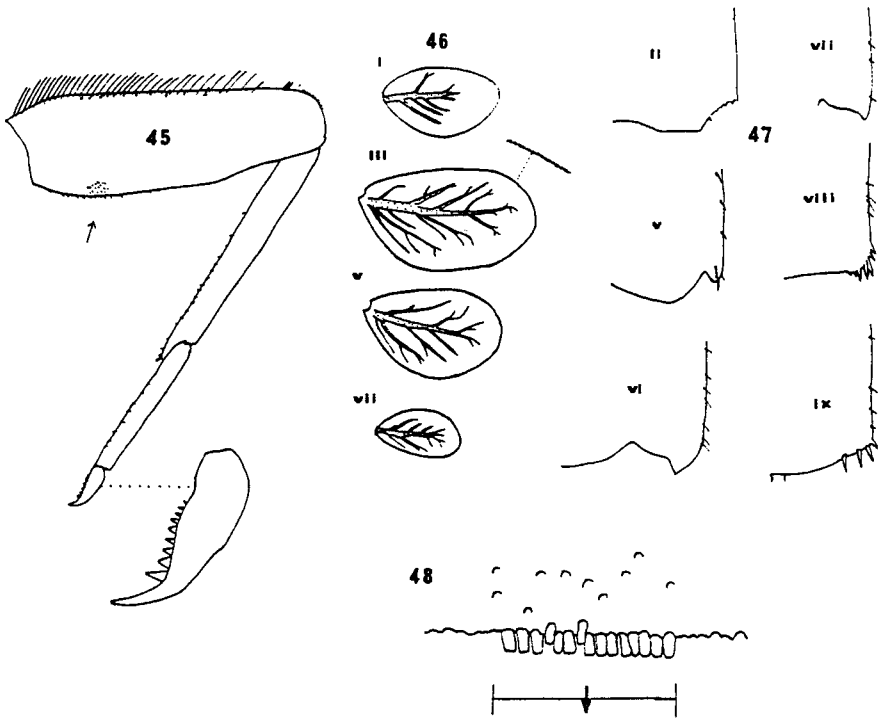
Figs. 40-44. *B. monikae*, mouthparts. 40. Labrum. 41 and 42. Right and left mandibles. 43. Maxilla. 44. Labium; palps displayed from two different angles.

segments II-VI clear tinged with orange posteriorly, VII-X orange. Basal 1/4 of tails orange, white distally with reddish-brown rings. The brown spots on the pleurae and the staining of the base of the subcosta and radius 1 can still be seen in preserved specimens.

♀ *imago*. A large, brown species. The dark brown tails are characteristic.

*Nymph*. Mouthparts (Figs. 40-44): labrum with a transverse line of long setae on upper surface; canines of both mandibles divided, right prostheca stout, divided at apex; maxillary palp shorter than galea-lacinia, with 3 segments; 3rd segment of labial palps globose, apical medial process of 2nd segment strongly developed. Legs (Fig. 45): villopore present on ventral aspect of femur near base; posterior femoral margin with a row of long setae; tarsal claws with a single row of 8-10 stout teeth.

Abdomen. 7 pairs of gills (Fig. 46), those of VII smallest; lateral margins of most abdominal terga with scattered spine-like setae (Fig. 47); postero-lateral angles of terga without a conspicuous terminal spine; posterior margins of terga



Figs. 45-48. *B. monikae*, nymphal parts. 45. Fore leg, arrow points to villopore. 46. Gill lamellae I, III, V, VII. 47. Postero-lateral angles of terga II, V-IX. 48. Posterior margin of tergum VIII, showing closely packed, spatulate spines; arrow points to posterior. Scale = 0.2 mm.

with closely packed, spatulate spines (Fig. 48). Terminal filament subequal to cerci.

*Material.* TANZANIA: Dodwe stream, Amani, 25.viii.54, 1 ♂, 21.xi.61, 1 ♀, 1 ♀ with associated nymph skin, 22.xii.61, 1 ♂; R. Sigi, Amani, 26.ix.59, 1 ♂, 2 ♀♀; Ukungwi stream, Amani, 5.iii.85, 2 ♂♂ with associated nymph skins.

As pointed out by Kopelke, the adult of *B. monikae* is well characterised by the basal segment of the ♂ forceps having subparallel sides and being at most half the width of the forceps base from which it arises. In this it differs from all other described species of *Baetis* from Africa. The nymph resembles that of *B. harrisoni* Barnard, but differs in possessing a maxillary palp with 3 segments. The spine-like setae along the lateral margins of the abdominal segments would also seem to be distinctive, although it resembles in this respect the Palaearctic species *B. rhodani* Leach. From the 2 species collected in the Sudan and described by Soldan (1977) from nymphal material, *B. harasab* and *B. pseudogemellus*,

it differs from the former by the presence of abdominal gills on 7 segments and from both by the divided canines of the mandibles.

## DISCUSSION

In northern parts of the world much detailed work on the genus *Baetis* and related genera has been carried out in recent years, notably in Europe, Müller-Liebenau, (1969), in Russia, Kluge (1981, 1982, 1983), Novikova and Kluge (1987) and in North America, Morihara and McCafferty (1979a, b), McCafferty and Waltz (1990) and Waltz and McCafferty (1987a, b). In Africa, critical studies of the *Baetis* group of genera have generally been lacking up till the present. I make no claim that the small number of species described here and in Gillies (1993) does much to change the situation.

The main diagnostic characters of these African species are summarised in Table 1. Of the 7 nymphs described, only one, that of *B. monikae* (no. 4 in the Table), can be placed in the genus *Baetis* s.str. with any confidence. The others either lack a larval femoral villopore, McCafferty and Waltz (1990), or as in the case of *B. boussoulius*, this structure is unusual in shape (Fig. 10) and its affinity with other species of *Baetis* s.str. uncertain. In all these species except *B. monikae*

Table 1. Showing adult and nymphal characters in *Baetis* s.l. species in East Africa.

<i>Baetis</i> s.l.	1	2	3	4	5	6	7
<b>Adult</b>							
Hind wing present	+	-	vest.	+	+	-	-
Hind wing with spur	-		-	+	-		
<b>Mouthparts</b>							
Segments on maxillary palps	3	2	2	3	2	2	2
Canines of mandibles fused	+	+	+	-	+	+	+
ratio paraglossae : glossae	3:1	7:1	3:1	2:1	5:1	2:1	3:1
outer margin paraglossa bare	1-2	+	+	-	+	+	+
hairs							
<b>Legs</b>							
Villopores on femora	±	-	-	+	-	-	-
Spatulate tibial spine	-	-	-	-	-	+	-
<b>Gills</b>							
Number	7	6	6	7	7	6	6
<b>Terga</b>							
Latero-apical spines	+	long	+	-	-	+	short
Acute spines on posterior margins	+	+	+	-	+	+	+
<b>Terminal filament</b>							
Length relative to cerci	subeq.		2/3	subeq.	1/2-2/3	subeq.	1/2

1 = *B. boussoulius* Gil. 2 = *B. elouardi* Gil. 3 = *B. gambiae* Gil. 4 = *monikae* Kopelke. 5 = *B. mtonis* nov. 6 = *B. spatulatus* nov. 7 = *tripunctatus* nov.

the paraglossae of the labium are considerably broadened in relation to the glossae, and the postero-lateral angles of the abdominal terga are produced backwards as spines.

The remaining 5 species cannot be ascribed to the North American genera of the *Baetis* group described by Waltz and McCafferty (1987a), namely *Acerpenna*, *Dipheter* and *Fallceon*, or *Barbaetis*, Waltz *et al.* (1985). Similarly, quite apart from the absence of a femoral villopore, there is little to suggest a common origin with the Palaearctic subgenera of *Baetis* recognised by Russian workers. Thus, the absence of short mandibular bristles as in subgen. *Nigrobaetis* Kazlauskas or of a mandibular setal tuft as in subgen. *Takobia* Novikova and Kluge or the development of the labial paraglossae, as in subgen. *Labiobaetis* Novikova and Kluge, further separate these African species.

Solution of this problem requires a more comprehensive study of the fauna than I have given here. In particular, the nymphs of the South African species need to be re-examined in the light of advances in our knowledge of the *Baetis* group of genera in other parts of Africa as well as elsewhere in the world.

A number of species of *Pseudocloeon* Klapálek have been described from Africa. Of these, Elouard *et al.* (1990) showed that *P. bertrandi* Demoulin and *P. maculosum* Crass belonged to *Pseudopannota* Waltz and McCafferty, while Gillies *et al.* (1990) placed *P. camerunense* Ulmer in *Ophelmatostoma* Waltz and McCafferty. In accordance with these authors' (1987b) action in restricting *Pseudocloeon* to the type species, I am referring all the other Afrotropical '*Pseudocloeon*' to *Baetis* s.l.

The following 31 Afrotropical species of *Baetis* s.l. are accordingly recognised at the present time:

ADULT WITH HIND WING. *B. bellus* Barnard, *B. boussoulius* Gillies, *B. capensis* (Barnard), *B. cataractae* Crass, *B. fastigatus* Kopelke, *B. glaucus* Agnew, *B. harrisoni* Barnard, *B. insolitus* Kopelke, *B. kalengoensis* Kopelke, *B. latus* Agnew, *B. lawrencei* Crass, *B. monikae* Kopelke, *B. monticola* (Crass), *B. mtonis* Gillies, *B. natalensis* (Crass), *B. parvulus* Crass, *B. permultus* Kopelke, *B. quintus* Agnew, *B. spatulatus* Gillies.

HIND WING VESTIGIAL. *B. gambiae* Gillies.

HIND WING ABSENT. *B. elouardi* Gillies, *B. grandiculus* (Kopelke), *B. inzingae* (Crass), *B. magae* (Barnard), *B. minutus* (Crass), *B. saxophilus* (Agnew), *B. tenuicritus* (Kopelke), *B. tripunctatus* Gillies, *B. vinosus* (Barnard).

ADULT NOT KNOWN. *B. harasab* Soldan, *B. pseudogemellus* Soldan.

## ACKNOWLEDGEMENTS

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