THE MAYFLIES (EPHEMEROPTERA) OF THE UPPER RIVER SIGI, NORTH-EAST TANZANIA

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Origins of the study

Published studies of the insect fauna of tropical rivers are something of a rarity, and this is especially so in Africa. Even where surveys have been done, the coverage in terms of systematics is likely to be patchy and the time-span often restricted. Official funding is unlikely to be available, so that any information we have is dependent on the presence and enthusiasm of someone with specialised knowledge of a particular group and the time to carry out sustained collecting.

Thus the work reported here was not originally intended to be more than an exploratory look at a largely unknown fauna of tropical African mayflies. The material collected was consequently the product of a series of casual studies on both adults and larvae, made during 12 years residence in the East Usambaras at the Research Station at Amani (altitude ca. 900 m a.s.l.) in the 1950s and early 1960s. The only systematic observations were a series of catches from 12 UV light-traps, made at monthly intervals at the site of the former hydroelectric power station at Chemka (ca. 450 m a.s.l.).

Some 25-30 years later I was able to make several short-term visits to the area for the purposes of rearing the adults of as many baetid larvae as possible. Although the sample of the fauna obtained in this way was clearly incomplete, it provides a fuller picture of the rich mayfly fauna of the upper reaches of a tropical river than is normally to be had.

The River Sigi

Rising at 920 m in the East Usambara Mountains of northern Tanzania, the River Sigi (38°3'E, 5°5'S) follows a mainly easterly course for 70 km before flowing into the Indian Ocean just north of the town of Tanga (Figs 1 and 2). The uppermost 19 km of the river, above the junction with the River Kihuhwi and known as the Upper Sigi River, is steep and torrential (Fig. 3). Proximity to the Indian Ocean brings copious and well distributed rain to the East Usambara Mountains, and this may exceed 2 m per annum in the higher areas. Vegetation cover in the Upper Sigi Valley comprises dense forest interspersed with tea-estates and areas of traditional cultivation (Hamilton & Bensted-Smith 1989).

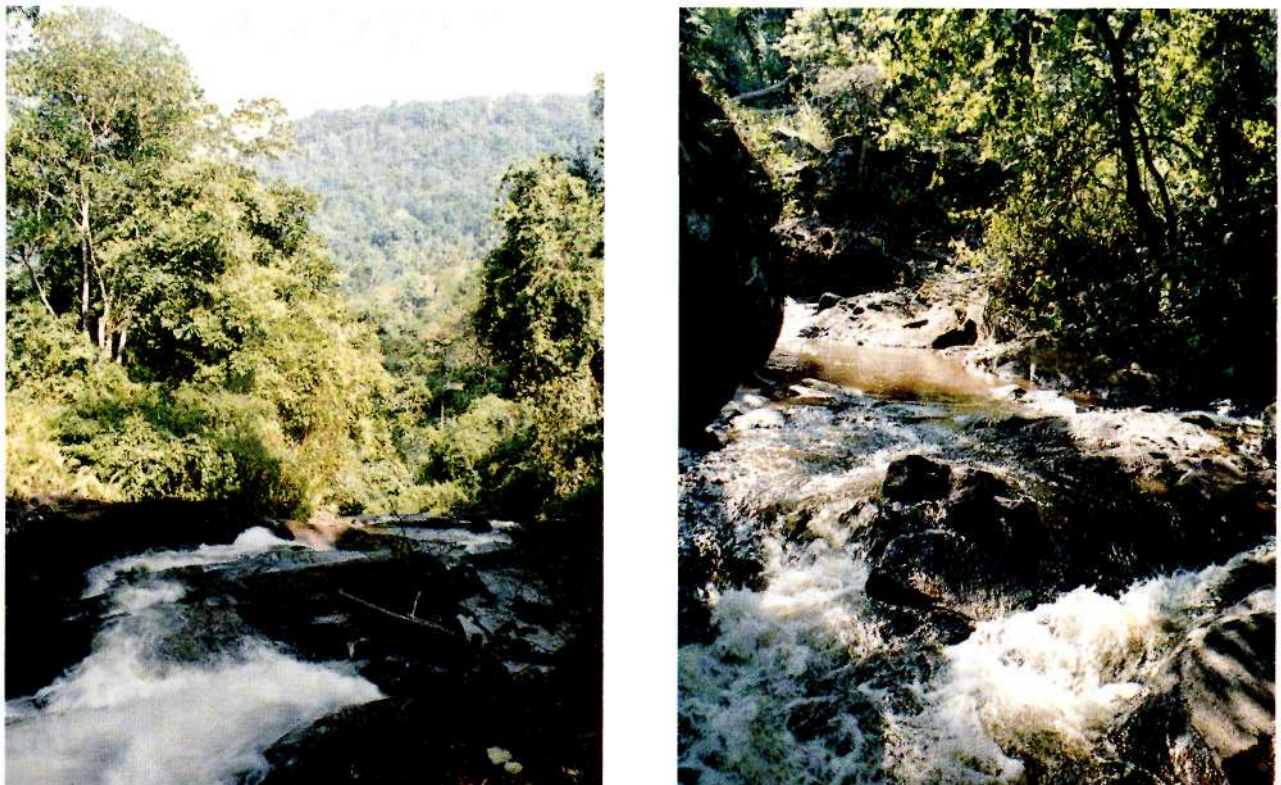

FIG. 1. River Sigi descending the forested slopes of the East Usambara Moiuntains, Tanga Province, Tanzania. Low-water conditions.

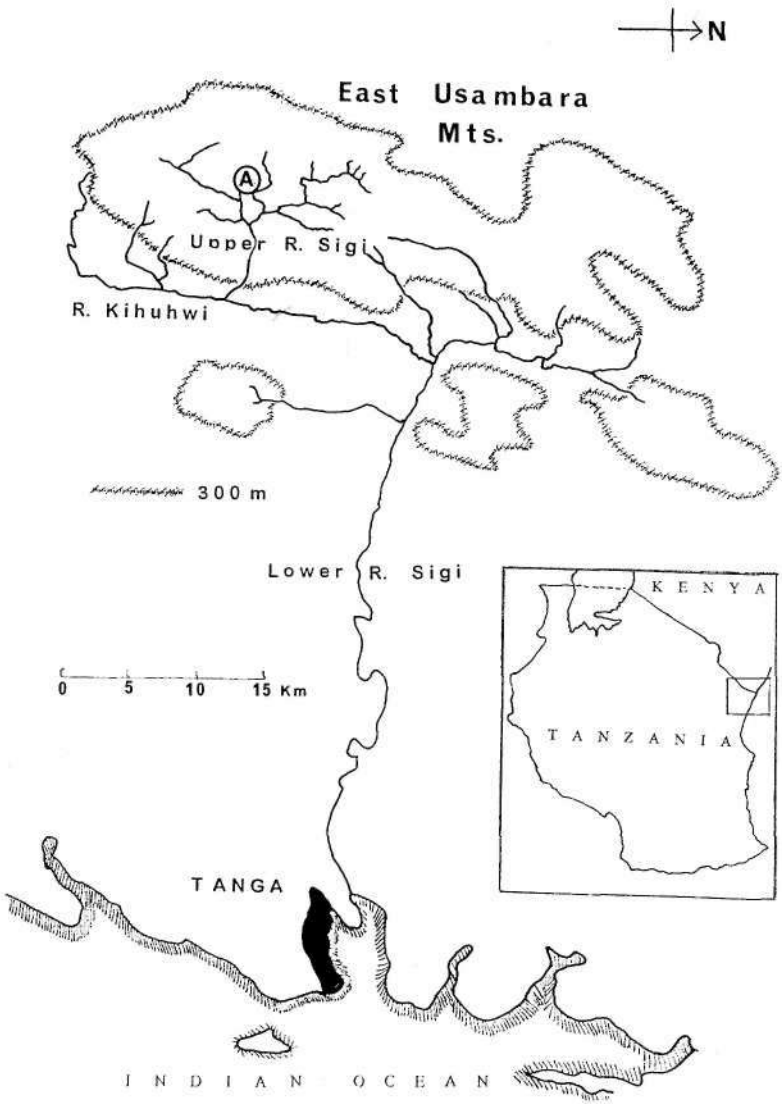

FIG. 2. Location of the River Sigi basin in the East Usambara Mountains, Tanga Province, Tanzania. The hatched line represents the 300 m contour. A indicates the site of the research station at Amani.

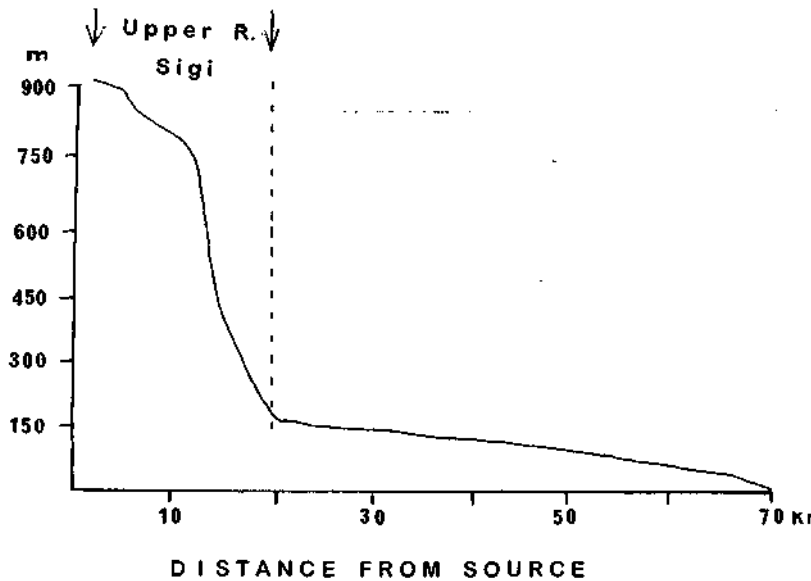

FIG. 3. Sectional elevation of the Sigi river system, showing the limits of the Upper River Sigi zone (modified from Hamilton & Bensted-Smith 1989).

Mean annual water temperature in the Upper Sigi was given by Hamilton & Bensted-Smith as 23.4°C, although records I kept in a forest stream at 900 m in 1953-54 gave an annual mean of 19.2°C and monthly means ranging from 16.9 to 21.2°C. Ionic content was very low; Hamilton & Bensted-Smith gave an average value of 54 (μS per cm for conductivity, and 22.0 mg per litre for calcium carbonate.

A list of mayflies from the Upper River Sigi

The faunal list I have compiled in Table 1 totals 45 species. As well as named species known to occur in the torrential section of the River Sigi it includes those that are distinct but insufficiently well defined at present to have been formally described. I have not attempted to separate the recently recognised baetid subfamily Afroptilinae Kluge from the subfamily Cloeoninae Kazlauskas.

For the sake of completeness, I have also included five species of *Cloeon* and one of *Procloeon* known to occur in ponds and pools formed by the damming

of end-streams in forest clearings. I have, however, excluded a species of *Tricorythus* s. str, the females of which appeared at light-traps at Amani on rare occasions, and which were believed to have been carried up into the mountains by cyclonic storms from rivers in the plains.

Descriptions of two species, referred to in the list as sp.n., will appear elsewhere (in preparation).

Table 1. List of 45 Ephemeroptera recorded from the Upper River Sigi, N.E. Tanzania. A = adult; L = larva. *The limits of these two subfamilies are still not clearly defined.

BAETIDAE		
Afroptilinae Kluge/Cloeoninae Kazlauskas*		
Afrobaetodes Demoulin	1. *A. berneri* (Kimmins)	L
	2. *A. pugio* Gillies	A, L
Afroptiloides Gillies	3. *A variegatum* Gillies, comb. nov.	A, L
	4. *A.* sp. A	A
	5. *A.* sp.B	A
Afroptilum Gillies	6. *A.* sp. (*sudafricanum* group)	A, L
Bugilliesia Lugo-Ortiz & McCafferty	7. *B. griseum* Gillies	A, L
Centroptiloides Lestage	8. *C. bifasciata* (Esben-Petersen)	A, L
	9. *C.* sp. n. (in prep.)	A, L
Cloeon Leach	10. *C. amaniensis* Gillies	A, L
	11. *C. perkinsi* Barnard	A, L
	12. *C. rhodesiae* Barnard	A, L
	13. *C. smaeleni* Lestage	A, L
	14. *C. tanzaniae* Gillies	A, L
Dabulamanzia Lugo-Ortiz & McCafferty	15. *D. tarsale* (Gillies)	A, L
	16. *D.* sp. n. (in prep.)	A, L
Dicentroptilum Wuillot & Gillies	17. *D. decipiens* (Gillies)	A, L
Platycloeon Gillies & Wuillot	18. *P. erepens* (Gillies)	A, L
Procloeon Bengtsson	19. *P. cylindroculum* Kimmins	A, L
Rhithrocloeon Gillies	20. *R. indicator* Gillies	A, L
	21. *R permirum* (Kopelke)	A, L
Baetinae sensu Kazlauskas		
Baetis Leach s. l.	22. *B. monikae* Kopelke	A, L
	23. *B. mtonis* Gillies	A, L
	24. *B. spatulatus* Gillies	A, L
	25. *B. tripunctatus* Gillies	A, L
Cloeodes Traver	26. *C.* sp.	L
Nigrobaetis Kaslauskas	27. *N.* sp.	L
Tanzaniella Gillies	28. *T. spinosa* Gillies	A, L
HEPTAGENIIDAE		
Afronurus Lestage	29. *A. gilliesi* Corbet	A, L
	30. *A.* sp.	A
Compsoneuria Eaton	31. *C.* sp.	L

LEPTOPHLEBIIDAE		
Adenophlebiodes Ulmer	32. *A.* sp. A	A
	33. *A.* sp. B	A
	34. *A.* sp. C	A
Choroterpes Eaton	35. *C. (Euthraulus) usambarae* Gillies	A, L
Thraulus Eaton	36. *T. (Masharikella) torrentis* (Gillies)	A, L
TRICORYTHIDAE		
Ephemerythinae Gillies		
Ephemerythus Gillies	37. *E. niger* Gillies	A
	38. *E. pictus* Gillies	A
Dicercomyzinae Demoulin		
Dicercomyzon Demoulin	39. *D. costale* Kimmins	A, L
	40. *D. femorale* Demoulin	A, L
CAENIDAE		
Caenis Stephens	41. *C. alicae* Malzacher	A
	42. *C. cibaria* Eaton ?	A
	43. *C. duodecima* Malzacher	A
	44. *C. noctivaga* Malzacher	A
PROSOPISTOMATIDAE		
Prosopistoma Fourcroy	45. *P. africanum* Gillies	A, L

Notes on some of the species listed in Table 1

(3.)Afwptiloides. The status of this genus is currently in dispute. (4.) Sp. A is a rather large species, known from a handful of adults only. The wing venation - with a line of crossveins in the outer part of the subcostal space - appears to be characteristic.

(10-14.) The five species of *Cloeon* recorded here were all collected in the margins of ponds in cleared areas of forest around Amani.

(21.) *Rhithrocloeon permirum* was originally described from Kivu Province, Eastern Congo (Zaire).

(22.) *Baetis monikae* was originally described from Kivu Province, Eastern Congo (Zaire).

(27.) *Nigrobaetis* sp. A larva examined by Dr N. Ya. Kluge was considered by him (in litt.) as virtually inseparable from that of *N. gracilis* (Bogoescu & Tabacaru) from Europe.

(35.) *Choroterpes usambarae* is the only common leptophlebiid occurring in the Upper Sigi. In slow-moving streams in the plains it is replaced by *C. tropicalis* Gillies.

(36.) *Thraulus torrentis* was very scarce in the Sigi. The species also occurs in the South Pare Mountains at altitudes of 1200 to 1500 m.

(39.) *Dicercomyzon costale.* The association of the larvae with leaves caught up in riffles was noted by Kimmins (1957).

(45.) Adults of that Old World curiosity, *Prosopistoma*, have rarely been seen. On the Upper Sigi they were only on the wing in the brief period between dawn and sunrise. The tiny limpet-like larvae are widely distributed in highland streams in East Africa, though apparently absent from streams on the geologically more recent slopes of Kilimanjaro. I have been unable to recognise more than the single species, *P. africanum*, originally described from the River Sigi, in collections from the following localities: River Mkulumuzi, Magila, Tanga Region, Tanzania; River Sassaneh, South Pare Mountains, Kilimanjaro Region, Tanzania; River Sonjo, near Kidatu, Morogoro Region, Tanzania; River Chirurumu, Kihihi, North Kigezi District, Uganda; River Namafumbale, Mount Elgon, Uganda (coll. T. R. Williams).

The diversity of the mayfly fauna

Until quite recently, the River Kihuhwi - a main tributary of the River Sigi (see Fig. 2) - was grossly polluted with evil-smelling waste from the processing of sisal plants. Hence, although not included in the present study, the middle and lower zones of the River Sigi would be expected to have a greatly impoverished macrofauna. By contrast, the diversity of species in the upper zone pointed to the relatively minor effects of such forest clearing as had occurred at that time.

The forests of the Usambara Mountains are renowned for the richness of the fauna and flora (Rodgers & Homewood 1982). In common with other isolated ranges of mountains, their proximity to the East African coast ensures a relatively high and well distributed rainfall, and this has contributed to the stability of the environment over prolonged periods of geological time (Kingdon 1990). In the rivers, the steepness of the terrain, with sharp differences in relief over short distances and consequent diversity of microhabitats, must be an important determinant of the number of species recorded from this small river system.

The prevalence of the Baetidae in the Afrotropical fauna was emphasised by Edmunds (1972), and is clearly shown in the studies summarised in Table 2. The study by Barber-James (1995), on two river systems in the North-East Cape Province of South Africa, shows a marked degree of congruence at the family level between the fauna of temperate South Africa and the equatorial zone of East Africa. While few species were common to the two regions, the number of species recorded is also much the same.

In the case of the Upper River Sigi, which constitutes a well-defined ecological zone (Fig. 3), I was unable to study streams that came from lower and less precipitous slopes. Had their fauna been included, there is little doubt that the total number of species recorded would have been appreciably greater than is presently known from comparable waters in temperate South Africa.

Table 2. A summary of the faunal lists of Ephemeroptera from seven Afrotropical rivers. 1 = Upper River Sigi, Tanzania (present study); 2 = Kalengo stream, East Zaire (Kopelke 1980, 1981); 3 = Lake Naivasha catchment streams, Kenya (Barnard & Biggs 1989); 4 = River Niandan, Guinea (Wuillot 1994); 5 = Rift Valley streams, Ethiopia (Harrison & Hynes 1988); 6 and 7 = River Mooi, South Africa (Crass 1947; Oliff & King 1964); 8 = North-east Cape, South Africa (Barber-James 1995).

Family	Rivers: 1	2	3	4	5	6/7	8
Baetidae	28	15	7	22	6	19	26
Oligoneuriidae	–	–	–	–	1	–	1
Heptageniidae	3	1	1	–	1	2	4
Leptophlebiidae	5	2	1	–	1	3	5
Tricorythidae	4	1	–	–	3	1	2
Caenidae	4	2	3	–	2	2	3
Prosopistomatidae	1	–	–	–	–	–	–
Polymitarcyidae	–	–	–	–	–	1	–
Euthyplociidae	–	–	–	–	–	1	–
Ephemeridae	–	–	–	–	–	1	–
Totals	45	21	12	22	14	30	41

Wolda & Flowers (1985) discussed the relative diversity of tropical Ephemeroptera compared with those from temperate climates. From the limited amount of available data on the former, they concluded that there was no convincing evidence for greater diversity in tropical rivers. Wuillot's studies (1994) in Guinea, however, showed that even a short length of the River Niandan supported a great number of baetid species. His results and those from East Africa, recorded here, show that the question is still very much open to discussion.

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