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West African Ephemeroptera. The Genus *Machadorythus* (Tricorythidae)

by

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After giving redescriptions of *Tricorythus maculatus* Kimmins, 1949, hitherto known only in the adult stage, and of *Machadorythus palanquim* Demoulin, 1959, known only from the nymph, it is shown that they represent one and the same species. The taxon should therefore be known as *Machadorythus maculatus* (Kimmins). Distribution maps are given together with notes on its ecology and biology.

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In his revision of the Ephemeroptera of the Ethiopian and Malagasy Regions (Afrotropical Region) Demoulin (1970) placed the genus *Machadorythus* Demoulin in the subfamily Machadorythinae. The subfamily was created for the single genus and species, *Machadorythus palanquim* Demoulin, 1959. According to this author the adult was unknown, but from examination of the wing buds in the last instar nymph he was able to show that the venation resembled that of the Tricorythinae. The hind wings appeared to be absent.

In recent years we have examined a number of males and females of *Tricorythus maculatus* Kimmins, which has led us to conclude that this species, known only in the adult stage, is in fact the imago of *Machadorythus.*

As part of a general revision of West African Ephemeroptera we are completing here the description of the nymph and adult of *Machadorythus maculatus.* Further, we list the characters that allow us to establish the synonymy of the two species, described previously in different stages of the life cycle.

Machadorythus maculatus (Kimmins), 1949 comb. nov.

1949 *Tricorythus maculatus* Kimmins, Ann.mag.nat.Hist. (12) 1: 834.
1959 *Machadorythus palanquim* Demoulin, Bull.Ann.Soc.roy.Ent.Belg. 97: 252. S y n. n o v.

Nymph. We refer the reader to Demoulin (1959) for a detailed description of the nymph, quoting here only those passages describing the most distinctive characters:

Body elongate, slightly depressed, a median protuberance on the pronotum and others on the 8th and 9th abdominal terga; legs fine, those of the last two pairs moderately long; three tails, bare; 5 pairs of gills on segments II-VI, the first being the largest with the upper lamella thickened (fig. 1a).

Head orthognathous; eyes conspicuous, almost pedunculated, set in a vertical V on the dorsum of the head (fig. 1b). The abdominal terga are produced vertically in the form of two fences, as it were, increasing in size from before backwards and closer together behind than in front, between which the gills are hidden. In this way the terga form a sort of box, whose lid is formed by the protective upper lamellae of the first pair of gills.

To Demoulin's description we would add that the mouthparts are very different from those of the Tricorythinae. The labial palps have two segments, the distal perpendicular to the basal; glossae and paraglossae fused into a single rounded structure (fig. 2b). Maxillae moderately narrow, palp long and 2-segmented. The maxillae apically with long hairs reinforced by 2-3 strong tooth-like spines in addition to the apical tooth (figs. 2 c-f). The mandibles robust, of the grinding type, canine weakly developed (fig. 2g, h). Hypopharynx without distinctive features. (fig. 2a).

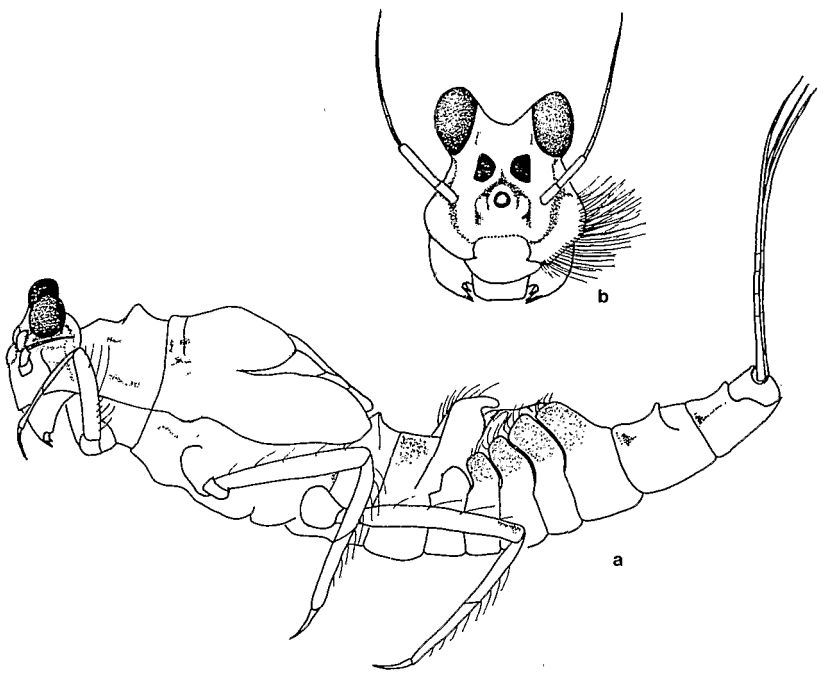

Fig. 1. Nymph of *Machadorythus maculatus (= M. palanquim).* a, lateral view; b, head from in front.

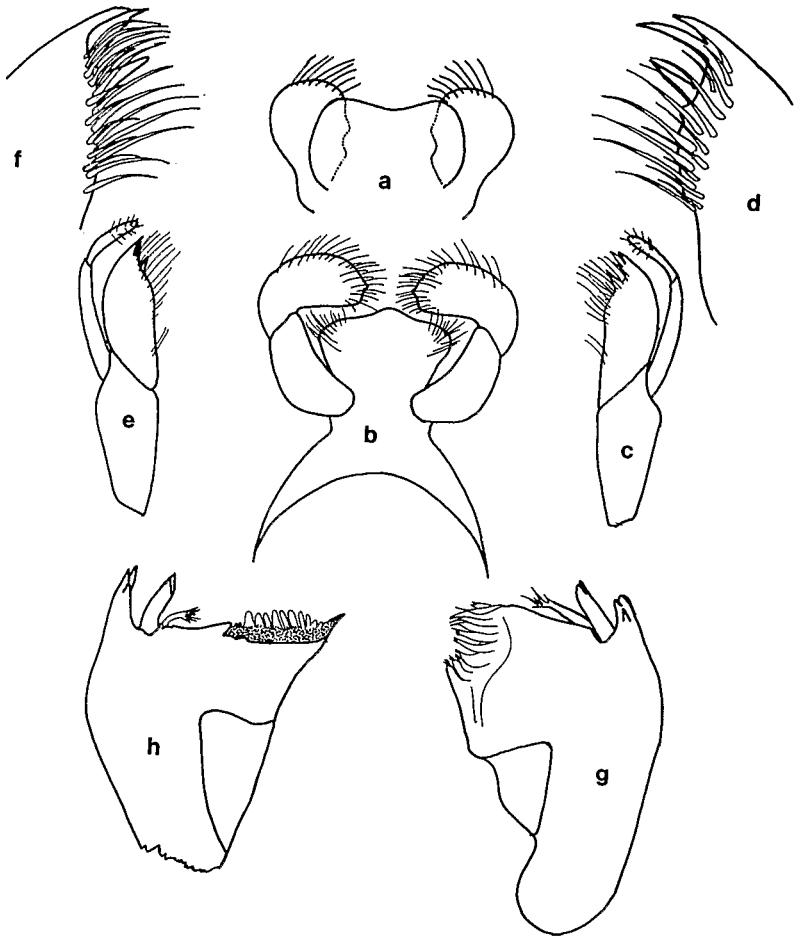

Fig. 2. Mouthparts of *Machadorythus maculatus.* a, hypopharynx; b, labium; c, d, left maxilla; e, f, right maxilla; g, left mandible; h, right mandible.

It should be added that the antennae are relatively long in comparison with those in other Tricorythidae, the flagellum being 2.5 times as long as the pedicel, which is itself drawn out and narrow.

It should also be mentioned that although the tibio-tarsal separation is well marked, the joint appears to be fused. The tarsi are composed of a single segment with a terminal, articulated claw (figs. 6a, b, c), that on the fore leg with 4 transparent teeth on the inner surface (fig. 6d) while the mid and hind claws are bare.

Nymphal material. MALI, Senegal basin, R. Bagoye at Kokofata. GUINEA. Niger basin, R. Niandan at Sassambaya; R. Milo at Boussoulé. IVORY COAST, Niger basin, R. Bagoé at Kouto; Bandama basin, R. Bandama at Niakaramandougou, R. Maroué at Danagoro, R. N'zi at Timbé; Comoé basin, R. Comoé at Gansé, R. Léraba at Pont routier; Sassandra basin, R. Sassandra at Sémien. (All collections made by the Laboratoire d'Hydrobiologie de l'ORSTOM). TANZANIA, Pangani basin, R. Kiku Letwa, Arusha Chini, Moshi (M. T. Gillies).

Adult. The imagines and subimagines were well described by Kimmins (1949, 1960). The species is relatively large in relation to other species of *Tricorythus.* Eyes and bases of ocelli black, head and thorax dark brown (fig. 3), the antennal flagellum being 2.5 times as long as the pedicel (fig. 4a). Legs slender and relatively large. Hind wings absent, fore wings hyaline, neuration typical of the Tricorythinae except for a great reduction in vein IMP. Neither Kimmins (1949) nor Demoulin (1954) represent this vein, and it is obsolete in some of our specimens. On the other hand, Demoulin depicts it in outline in his figure of the nymphal wing of *Machadorythus* but without indicating its density. We have made two preparations of wings from mature nymphs of *Machadorythus.* Where it exists vein IMP is very poorly developed, less so than other veins, and it could be confused with a fold in the wing.

The first two abdominal terga are greenish black (fig. 3). On terga III-VII the markings are reduced to small greenish black spots, which are elongated on VI and VII. Tails a little longer than the body. Penis lobes fused for the greater part of their length, stout, half as long as forceps, separated at the distal end; forceps white with two segments, the basal one short and stout (fig. 5).

Adult material. MALI, Senegal basin, R. Bakoye at Kokofata, 21.vii.86, 1 ♂ subimago, 1 ♀ subimago. GUINEA, Niger basin, R. Niger at Kouroussa, 2.ii.87, 2 ♂♂, R. Niandan at Sassambaya, 20.iv.86, 10 ♂♂, 5 ♂ and 3 ♀ subimagines, R. Milo at Boussoulé, 2.iv.86, 2 ♀ subimagines, R. Sankarani, Route Yanfolila-Kankan, 28.v.86, 1 ♂; Konkouré basin, R. Konkouré at Konkouré, 29.i.87, 3 ♂♂; Kolenté basin, R. Kolenté, 10.ii.86, 1 ♂; Little Scarcies basin, R. Kaba, 7.ii.84, 2 ♂. GHANA, Volta basin, R. Asukawkaw, 22.xi.85, 1 ♂. TOGO, R. Mono at Kpessi, 30.xi.85, 1 ♂. (All collections made by Laboratoire d'Hydrobiologie de l'ORSTOM). SENEGAL, Gambia basin, R. Gambia at Kédougou, 22.vi.81, 1 ♂, 1 ♀ (L. Ferrara).

Our grounds for regarding the adult of *T. maculatus* and the nymph of *M. palanquim* as different stages of the same taxon are the following:

- Similarity of the antennae (figs. 1b, 8a, b). In both the flagellum is 2-2.5 times as long as the pedicel. Moreover the latter is long and narrow compared with *Tricorythus* and *Neurocaenis,* in which it is short and squat.
- Legs (figs. 6 and 7). Long and fine in both, compared with *Tricorythus* in which they are broad and stout.
- Wing venation. Vein IMP in the wing of *T. maculatus* and in the wing bud of *M. palanquim* is small and often poorly defined.
- Coloration generally the same, especially in the abdominal markings.
- In profile, the abdomen in both adult and nymph bears projecting spines on terga VIII and IX, although more pronounced in the nymph than in the adult. Such spines are absent in other Tricorythidae.
- Finally, the orthognathous head and the dorsal position of the eyes are the

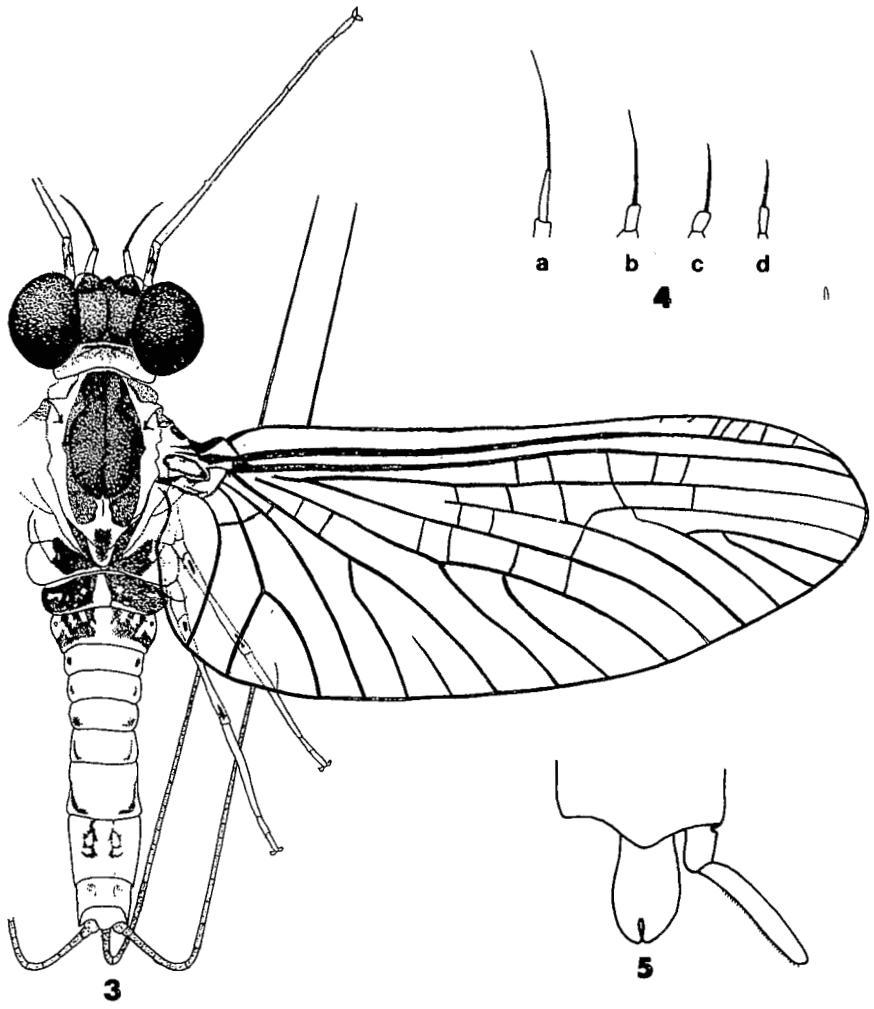

Fig. 3. Adult male *Machadorythus maculatus* (= *Tricorythus maculatus*).
Fig. 4. Adult antennae in Tricorythidae. a, *Machadorythus maculatus;* b, *Tricorythus longus* Ulmer; c, *Tricorythus lanceolatus* Kimmins; d, *Neurocaenis* sp.
Fig. 5. Male genitalia, *Machadorythus maculatus.*

same in both. This resemblance is particularly marked in the female.

The specific name *maculatus* Kimmins has priority over *palanquim.* However, the highly unusual derived characteristics of the nymph (general body shape, branchial chamber, dorsal position of the eyes, mouthparts), as well as certain distinctive characters of the adult (form of legs and antennae, obsolescence of vein IMP, dorsal position of the eyes), amply justify the retention of *Machadorythus* as a distinct genus.

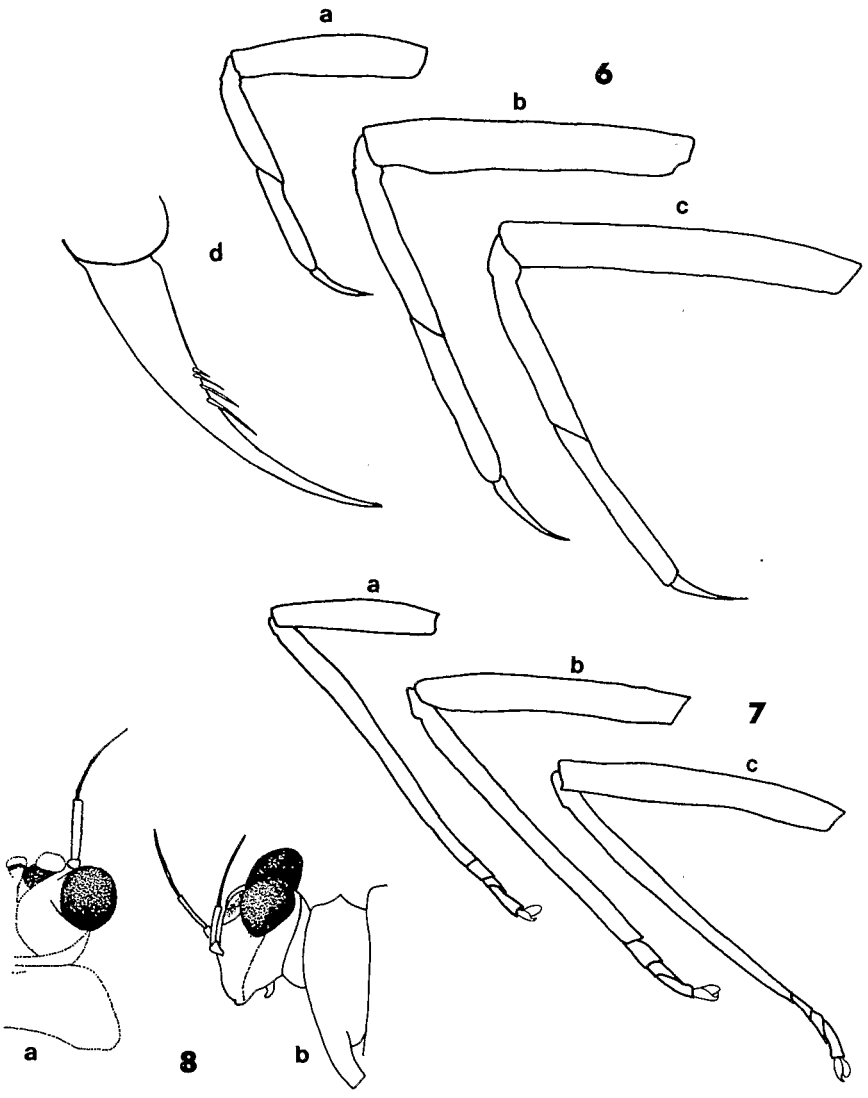

Fig. 6. Nymphal legs of *Machadorythus maculatus*. a, b, and c, fore, mid and hind legs; d, fore claw.
Fig. 7. Adult legs of *Machadorythus maculatus*. a, b, and c, fore, mid and hind legs.
Fig. 8. Head of female *Machadorythus maculatus*.

Is there more than one species of *Machadorythus*? All the nymphs that we have examined from West Africa are the same and correspond remarkably closely with the description of Demoulin. On the other hand, they differ in certain details from the specimen from Zaire figured by Edmunds et al. (1963). In this specimen the lateral border of the Xth abdominal segment is shown as having an angular projection in the middle. In mature nymphs from West Africa this projection is much less developed and appears as a simple sinuosity in the margin of the segment, as was described by Demoulin. On the other hand, we have seen the form figured by Edmunds et al., although less accentuated, among young specimens from West Africa. A specimen from Tanzania also shows the same character. It seems possible, therefore, that the nymph described by Edmunds et al. may also have been a young specimen.

This hypothesis is reinforced by differences in the tergal expansions that form the branchial chamber. In our specimens, and as drawn by Demoulin, the upper borders are rounded, whereas Edmunds et al. figure a more angular and pointed margin. Again, we have seen young specimens from West Africa in which these terga approach the form described by the latter authors.

The adults from West Africa that we have examined are all very similar to Kimmins's description, with the exception of vein IMP which he did not figure. Remembering that in some of our specimens this vein is extremely fine, he could very well have omitted it. This seems all the more likely since he mentioned in a later article (1960) that the specimen was not in a good state.

From the fact that adults collected from all parts of Africa are similar we conclude that the genus *Machadorythus* is monospecific. The differences observed in the nymphs would appear to be attributable to the age of the specimens.

BIOLOGY AND ECOLOGY

The mid and hind legs of the nymphs are long and slender, a characteristic shared with another species from West African rivers, *Cloeon dentatun* Kimmins, (Gillies, 1988). Both inhabit waters where the current is slow or absent and the bed of the river unstable. Moreover, in the case of *Machadorythus* the dorsal position of the eyes as well as the protected nature of the branchial chamber both suggest adaptation to a way of life partly submerged in a shifting substrate (sand, silt or organic detritus). In fact, we have found the nymphs on the bed of large rivers in West Africa in depressions in the sand or among the detritus formed by decomposing leaves.

One of the most striking features of the nymph of *Machadorythus* is the elevation of the eyes to a dorsal position on top of the head, their bases so close together that they could almost function as a single organ. Their position suggests that they could act as a sort of periscope enabling the insect to detect moving objects in its vicinity while still remaining concealed in the detritus on the river bed. The ability to do this could facilitate a predatory way of life.

Predaceous mayflies are known in the Siphlonuridae, Baetidae, Heptageniidae, and Prosopistomatidae (Edmunds, 1957a; Demoulin, 1970; McCafferty and Provonsha, 1986). They all have modified mouthparts, the molar region of the mandibles being replaced by structures for piercing or tearing and the maxillae having stout spines. *Machadorythus* has retained the usual grinding molar surface but the maxillae have powerful spines for grasping or tearing as in other carnivorous nymphs. Some Siphlonuridae, such as *Ameletopsis* (Edmunds, 1957b) have long thread-like labial palps that presumably serve in the location of prey. In *Machadorythus,* on the other hand, long range detection of its victims would be achieved by the visual sense. Moreover, the exceptional shortness of the fore legs (figs. 1, 6) and the presence of toothed claws suggests that they could function as much for grasping prey as for locomotion. Confirmation of its predatory habits has not so far been provided by examination of gut contents, all of which have been composed of organic debris only. The question of carnivory in *Machadorythus* must therefore remain unanswered at the present time.

Young nymphs are frequently found in collections in drift-nets. Sampling was regularly carried out in the River Niandan and the Milo (afferents of the Niger in Guinea) from February 1986 to February 1987 during the low-water season (December to June). Nymphs of *M. maculatus* were abundant in February and March in the Niandan and in April and May in the Milo. It appeared that recruitment of larvae occurred principally during the period of falling water

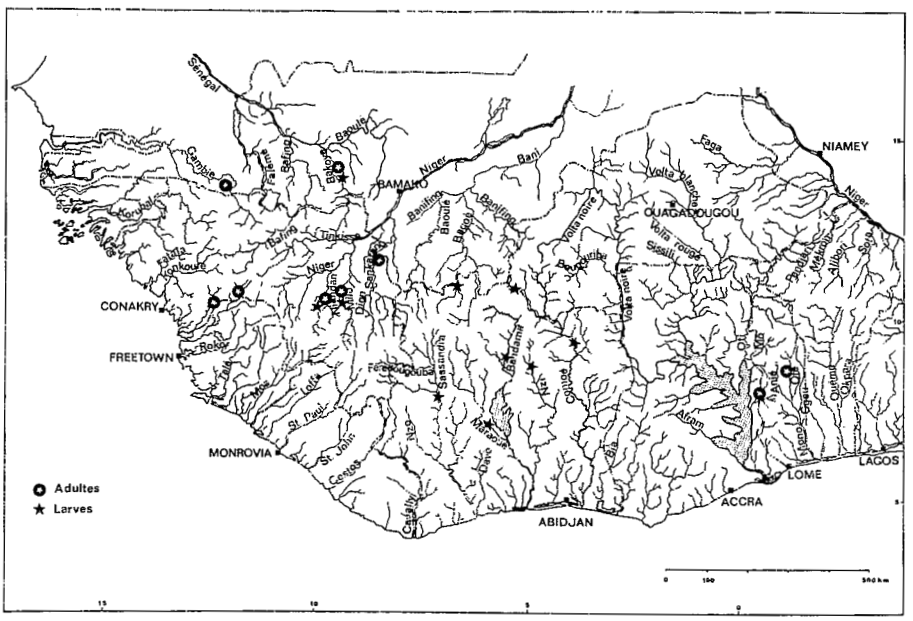

Fig. 9. Map showing sites of capture of adults and nymphs of *Machadorythus maculatus* in West Africa.

falling water levels and the season of low water. Adults were collected over a rather longer period running from September to April, which supports the idea of recruitment during the dry season.

GEOGRAPHICAL DISTRIBUTION

Apart from the material examined in the course of this study and listed above, the following collections have been cited in the literature.

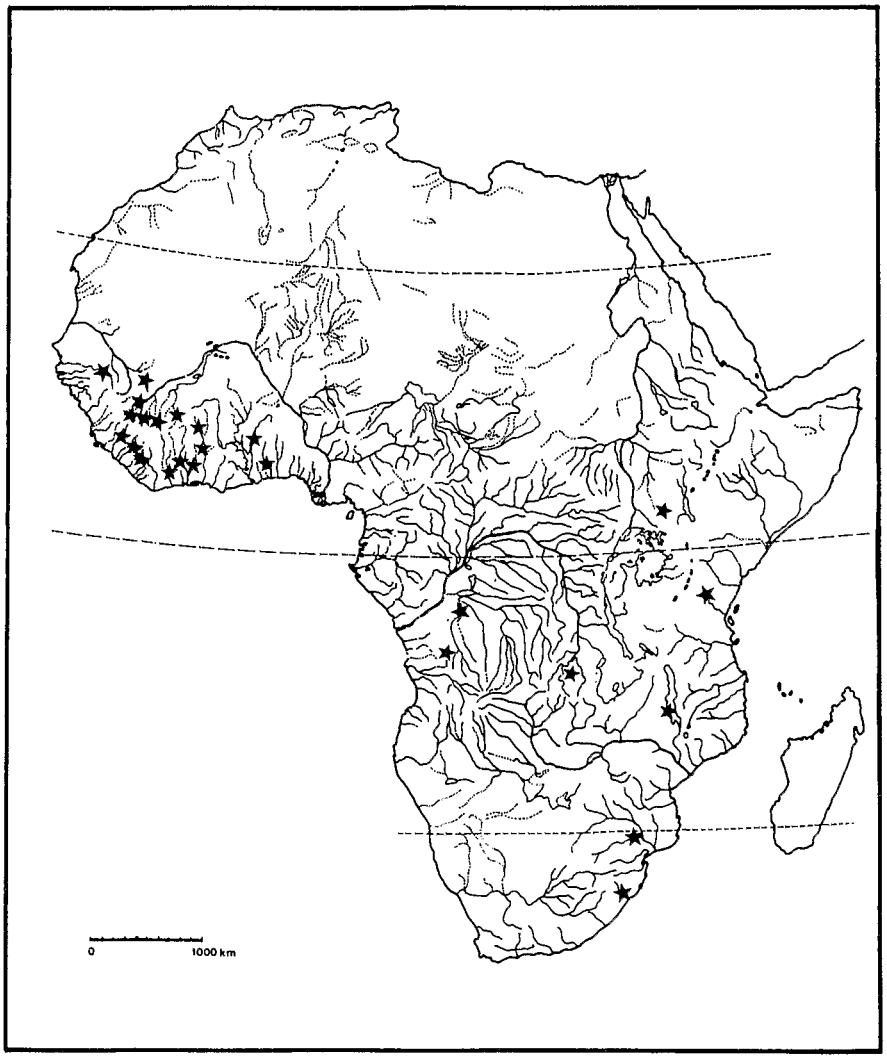

Fig. 10. Distribution map of *Machadorythus maculatus* in Africa.

Adults. MALAWI: L. Nyasa, Chipoka II, Fort Maguire (Miss R. H. Lowe), Ntundu (L. Berner), (Kimmins, 1949, 1955). ZAIRE: Ile de Mateba (Meuleman), (Demoulin, 1954). Parc National de l'Upemba, Lukawe, Kaswabilenga (Mission P. N. Upemba), (Demoulin, 1970).
Nymphs. ANGOLA: Dundo, la Luachima (A. de Barros Machado), (Demoulin, 1959). ZAIRE: Kenge (E. S. Ross and R. E. Leech), (Edmunds et al., 1963). SOUTH AFRICA: Komati river, E. Transvaal, (Matthew and Pyke, 1969). Umgeni river, Natal, (Schoonbee, 1973).

It appears that this species is widely distributed in all the large rivers of the savanna and preforest zone in West Africa (fig. 9). On the other hand, we have never found it in the forest zone. It should also be mentioned that *M. maculatus* has never been encountered in the Baoulé (an afferent of the R. Senegal in Mali) in the savanna, even though catches with light-traps and drift nets were regularly made over a period of 3 years. At the present time we cannot advance any theory to explain this absence, even though the species is present in another afferent of the Senegal, the Bakoye, which is geographically quite near.

This species is evidently present over much of tropical and southern Africa, since, apart from West Africa, it has been recorded from East Africa as well as central Uganda, Malawi, Zaire, Angola and South Africa (fig. 10).

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