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Notes on *Trithemis bifida* and *T. donaldsoni* (Odonata: Libellulidae)

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Abstract

Trithemis bifida is reported for the first time from East Africa. Previously there were only two Afrotropical records of this species: one male from Zambia and one male from the Ivory Coast. The male of *T. bifida* is described and compared with the closely related *T. donaldsoni* which is also found in East Africa. Taxonomically relevant structures are figured, differential features between both species are described and notes on the ecology of *T. bifida* are given.

Introduction

Trithemis Brauer is a successful and widely distributed genus in Africa; the males are often colourful and dominant in all types of wetlands. Two blue pruinosed and very similar species were captured by me in coastal rain forest areas of Kenya: *T. bifida* Pinhey, a very little known species, which is reported for the first time in East Africa, and the widely distributed *T. donaldsoni* (Calvert). For both species a short history, differential features and biological notes are given and discussed. Comparisons with the similar *T. basitincta* Ris and *T. aconita* Lieftinck (syn. *T. caruncula* in Pinhey 1970) are also given.

Material and methods

Coastal forests of Kenya between Malindi and the Tanzanian border were visited between April and May 2000, in December 2000 and in March and April 2001. Studies in the Shimba Hills NP were conducted between 25 April and 13 May, 16 and 21 December 2000, 27 and 31 March 2001 and 12 and 15 April 2001. Collecting and observations on the odonate fauna were made in different habitats.

I visited collections of the Natural History Museum, London and of the National Museums of Kenya, Nairobi where I compared my material – seven ♂ and one ♀ of *Trithemis bifida*, five ♂ of *T. donaldsoni*, three ♂ of *T. aconita* – with the relevant

species. No labelled *T. bifida* and no females of *T. donaldsoni* were found in the collections of London and Nairobi. In the National Museums of Kenya I found 16 ♂ of *T. donaldsoni* and two *Trithemis* ♂ labelled "*T.* sp. nov. A", "Shimba Hills, Mombasa, Oct.-Nov. 1951, E. Pinhey" and "Turiani T.T. N. Morogoro, Apr. 1954, E. Pinhey". After comparing the specimen from Shimba Hills with my material and the literature, I have no doubt that it belongs to *T. bifida*. The second specimen (from Turiani) seems to be also *T. bifida*, but as the abdomen is missing, a final identification is not possible.

The collection sites

The Shimba Hills National Park, some 30 km south of Mombasa, covers 19,243 ha between 04°09' and 04°20'S and 39°16' and 39°30'E in eastern Kenya. The altitude ranges from 100 to 450 m a.s.l., most parts are very steep and only a few fast flowing rivers provide permanent water. The Shimba Hills comprise a dissected plateau that ascends steeply from the coastal plains. The whole area receives an average of 900 to 1,200 mm rain per year. The forested areas of the Shimba Hills were first gazetted as a National Forest in 1903, when the forest was already patchy there being large grasslands amongst forested sites.

The Shimba Hills belong to the coastal rain forest area and contain remnants of a once-closed forest that covered the coastal areas of most parts of Tanzania and Kenya. Many of the remaining forest patches in the coastal areas in Kwale and Kilifi districts are sacred forests, or so-called "Kayas", which means homestead in several Bantu languages. These "Kayas" once sheltered fortified villagers of coastal tribes, who where chased from their more northern ancestral homes by warlike Galla several centuries ago. The "Kayas" have also spiritual and ceremonial significance for the people of the Kenyan coast. Robertson & Luke (1993) give a detailed account of the vegetation and history of the remaining fragments of Kenya's natural coastal forest. The Shimba Hills hold one of the largest areas of coastal forest in Kenya. About 9,000 ha (44%) of the total area is forested, whereas 8,000 ha is forest/shrub and 3,400 ha is covered by grassland (cited in Bennun & Njoroge 1999).

The Rongo Mwagandi River in the Shimba Hills NP, the only place where *Trithemis bifida* was found, was visited on 10 April, 3, 12 May, and 18, 21 December 2000 as well as 24 March and 15 April 2001. In that area the river which crosses a mosaic of grassland with forest patches is between 2-4 m wide, fast running and mainly shallow with a sandy bed and some rocky parts. A strip of dense gallery forest shades the river, but there are always sunny spots and stretches along the margins. Other species observed patrolling, mating and egg-laying in the Rongo Magandi River (close to the Sheldrick Falls) during the visits are listed in Table 1.

At the coast males of *T. donaldsoni* were captured at the Kombeni River, Rabai (03°55'S, 39°34'E), 450 m a.s.l., 24 April 2000, there being one specimen in my collection. There the Kombeni River was running through very stony areas and had many stagnant areas, e.g. rock pools and swampy parts. The species reproducing in the Kombeni River differed considerably from that of the Rongo Mwagandi River.

Most species indicate the more or less permanent presence of stagnant water, species of fast flowing rivers being absent (Table 1).

Table 1. Species recorded at two rivers in eastern Kenya.

Species	Rongo Mwagandi River	Kombeni River
Phaon iridipennis (Burmeister)	+	-
Platycypha caligata (Selys)	+	-
Elattoneura glauca (Selys)	+	-
Ceriagrion glabrum (Burmeister)	-	+
Ceriagrion kordofanicum Ris	-	+
Pseudagrion commoniae nigerrimum Pinhey	+	+
Pseudagrion massaicum Sjöstedt	-	+
Enallagma nigridorsum Selys	-	+
Gomphidia sp.[1]	+	-
Microgomphus nyassicus (Grünberg)	+	-
Paragomphus genei (Selys)	+	+
Paragomphus magnus Fraser	+	
Anax ephippiger (Burmeister)	-	+
Anax speratus Hagen	+	-
Aethriamanta rezia Kirby	-	+
Brachythemis leucosticta (Burmeister)	-	+
Bradinopyga cornuta Ris	-	+
Crocothemis erythrea (Brullé)	-	+
Crocothemis sanguinolenta (Burmeister)	+	-
Nesciothemis farinosa (Förster)	+	+
Orthetrum julia falsum Longfield	-	+
Orthetrum machadoi Longfield	-	+
Palpopleura lucia (Drury)	-	+
Pantala flavescens (Fabricius)	-	+
Tramea basilaris (P.de Beauvois)	-	+
Trithemis aconita Lieftinck	+	-
Trithemis annulata (P.de Beauvois)	-	+
Trithemis bifida Pinhey	+	-
Trithemis donaldsoni (Calvert)	-	+
Trithemis kirbyi ardens (Gerstäcker)	+	+
Trithemis pluvialis Förster	+	-
Zygonyx natalensis (Martin)	+	-
Zygonyx torridus (Kirby)	+	-

[1]closest to *G. quarrei* Schouteden and *G. balii* Fraser

Short history of the relevant *Trithemis* species

Trithemis bifida

The holotype of *T. bifida* is a male from north Mwinilunga, NW Zambia which is deposited in the National Museum, Bulawayo (Pinhey 1970). The second and, as far as I am aware, last record of a male *T. bifida* was by Lindley from Korhogo, Ivory Coast (Pinhey 1978: 5). It is not clear where this male is deposited, though perhaps also in Bulawayo. Pinhey (1970: 136-138) tentatively discussed three females from different locations as potential females of *T. bifida*. Later Pinhey (1984: 48-49) included Zimbabwe and Nigeria in the distribution of *T. bifida*, but these localities seem to be based on the female records Pinhey cited as "possible females from North Nigeria, Uganda and Rhodesia" (Pinhey 1970: 137). No type of female *T. bifida* exists. Hardly anything is known about the ecology of *T. bifida*, e.g. Pinhey (1984: 48): "Ecology: not adequately known, but probably forest and bush".

When first describing *T. bifida* Pinhey (1970: 136) speculated that it "might be inferred that *bifida* is the westerly race of *donaldsoni*". At that time *T. donaldsoni* had not been recorded for Zambia. Currently *T. bifida* is definitely known from only three localities (Fig. 1).

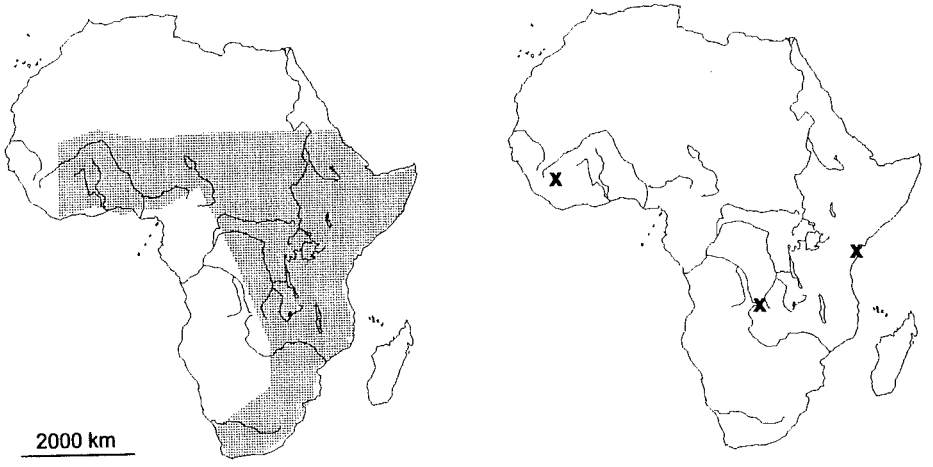

Figure 1. Distribution of *Trithemis donaldsoni* (left) and *T. bifida* (right; males only), records from literature and own material. The distribution of *T. donaldsoni* is shown on a large scale and does not give precise local distributions.

Trithemis donaldsoni *and* T. basitincta

T. basitincta, although easily separated from *T. bifida* and *T. donaldsoni* by its undivided lamina, is included here, because it was originally described as a subspecies of

T. donaldsoni (Ris 1912). The type of *T. donaldsoni* was formerly in the Philadelphia Academy of Sciences but seems to be mislaid (Pinhey 1970: 131), the lectotype of *T. erlangeri* – a synonym of *T. donaldsoni* – is in Ann Arbor, Michigan. The type of *T. basitincta* is in the Museum Nationale d'Histoire Naturelle, Paris. Both taxa were raised to species level by Pinhey (1951), based on colouring and distribution, e.g. wing colouring (Pinhey 1951: 266). Ten years later the differentiation between *T. donaldsoni* and the similar *T. basitincta* was still defined by its body colouring (Pinhey 1961: 169): "In contrast to *basitincta* this species [*T. donaldsoni*] is pale blue instead of dark". The separation between these two species in Pinhey's key was based on slight differences in size and basal amber in the hindwings. *T. basitincta* was placed by Pinhey in two groups which mainly differ in the lamina: in group 1 the lamina is described as "robust, more or less triangular", and in group 2 the lamina is described as having "a bilobed, bulbous apical portion, somewhat turned forwards and generally paler than the basal part of the anterior lamina" (Pinhey 1961: 167-169). Both forms of *T. basitincta* are reported by Pinhey (1961) from the Shimba Hills. Lieftinck (1969) clarified, what Pinhey (1961: 167) already suggested, that "this [*T. basitincta*] is a very variable species" and the *basitincta* group was split. Lieftinck (1969: 47) was the first to mention the deeply notched lamina of *T. donaldsoni* which is "easily distinguished from *T. basitincta* Ris and *T. aconita* Lieftinck". Pinhey (1970) raised several previous subspecies of *T. donaldsoni* to species rank, using mainly the notched lamina as the diagnostic feature. *T. basitincta* is never mentioned for Kenya again by Pinhey (e.g. Pinhey 1962, 1970, 1978). I do not know whether the early *T. basitincta* records from the Shimba Hills were misidentifications of *T. donaldsoni*, *T. bifida* or *T. aconita*.

T. donaldsoni is a well known species which is widely distributed (Fig. 1), but always "local at streams with moderate current" (Pinhey 1985: 33). Lindley and Gambles (as cited in Pinhey 1978: 7) "consider this taxon to be rather uncommon in areas where they have collected in West Africa". *T. donaldsoni* occurs from "Cape, Natal, Transvaal, north to East and West equatorial Africa; with ssp. *dejouxi* Pinhey from Ethiopia west to the rift of Ivory Coast" (Pinhey 1985: 49). Additional localities are Mali (Pinhey 1984) and Yemen from the Arabian Peninsula (Dumont & Al-Safadi 1991). Next to my record from the Kombeni River at the Kenyan coast, I collected this species also from the Ewaso Ngiro River, Rift Valley (01°78'S, 36°13'E), 25-29 December 2000, and Lake Chala (03°19'S, 37°42'E), 14 March 2001.

Differentiation of *Trithemis bifida* and *T. donaldsoni*

The differentiation in Pinhey (1970) is based mainly on colouring and on the shape of the genital lobe. Thus, for *T. bifida*: "Abdominal segment 4 with two yellow stripes (sometimes linked). Pruinosity of adult dark blue. Genital lobe short and broad at base." And for *T. donaldsoni*: "Segment 4 with only one (upper) thin stripe. Pruinosity of adult pale blue. Genital lobe long, slender throughout." Colouring is not a very precise differentiating feature for these species since they fade easily when dead and might appear more or less the same when living. Later Pinhey (1978: 5) wrote that the "pruinosity of the mature male (of *T. bifida*) is of the same rather palish blue tone

(as *T. donaldsoni*), not dark like in the other species (*T. basitincta*, *T. aconita*, *T. congolica*)." This is definitely not true for all *T. bifida* males I observed in the Shimba Hills in April and May 2000: they were very dark and did not show any pale pruinosity.

The genital lobe of the males of *T. bifida* (Fig. 2a) I examined is very similar to the ones of *T. donaldsoni* (Fig. 2a') and I would not regard this as a good diagnostic feature either. Striking is the difference in the prophallus and the long flagella of *T. bifida* (Fig. 2b) which are visible with the help of a good magnifying lens and a needle. The bifurcation of the lamina is also different, but this is a difficult feature to use if only one species is at hand. Better diagnostic features in the field seem to be the colouring of the wings and of the labium. All *T. bifida* I observed in the Shimba Hills had very smoky wings and traces of dark amber along basal veins, whereas all males of *T. donaldsoni* in the Natural History Museum, London had entirely hyaline wings (Fig. 3). Pinhey (1951: 266) wrote about *T. donaldsoni*: "The wings remain entirely hyaline, except for the merest trace, in females, of a yellow speck at base of cubital space on hindwing, and for a brown apical patch.".

The black markings on labrum and labium are much broader in *T. bifida* than in *T. donaldsoni* (Figs 2c, 2c'). The main differentiating features for *T. bifida* and *T. donaldsoni* are listed in Table 2.

Whether Pinhey's (1970) description of a *T. bifida* female can be trusted is doubtful. None of the females was collected together with a male, and the localities do not overlap with the localities where the two males of *T. bifida* had been collected. In 1970 Pinhey is doubtful himself whether the females are *T. bifida*. He gives as differentiating feature in the female key: "labrum all black" (leading to *T. bifida*) and "labrum pale with black T or median line" (leading to *T. donaldsoni*). Pinhey (1970) describes for females of both species short and broad bursal arms, which might be expected for *T. bifida*, because of the long cornuti, but is unexpected for *T. donaldsoni*.

I captured one female on 10 April 2000 from the same locality where males of *T. bifida* were observed and collected. Unfortunately I did not obtain a female in copula – thus establishing her identity beyond doubt – which is why I omit a detailed description. Potentially other species, of which the females are difficult to tell apart (see Pinhey 1970: 39-42) are *T. aconita* (recorded from Shimba Hills, including the same locality of *T. bifida*), *T. basitincta* (not recorded from Kenya, but from the Turiani Forest, East Tanzania) and *T. donaldsoni* (recorded from other habitats in this area). The wings of the female I got were deeply fumose as in *T. bifida* males. The labium was narrowly black in the centre, the labrum was black with two large yellow lateral spots, slightly in contact laterally, the fore femora had a yellow streak and thoracic markings were very dark, darker than given in Pinhey (1970) for potential *T. bifida* females.

Biological notes on *Trithemis bifida* and *T. donaldsoni*

The type of *T. bifida* was collected in thick gallery forest (Pinhey 1970), which corresponds to the habitat where I found this species in the Shimba Hills. I never found *T. bifida* at rivers in a dense forest with a closed canopy, nor at open areas.

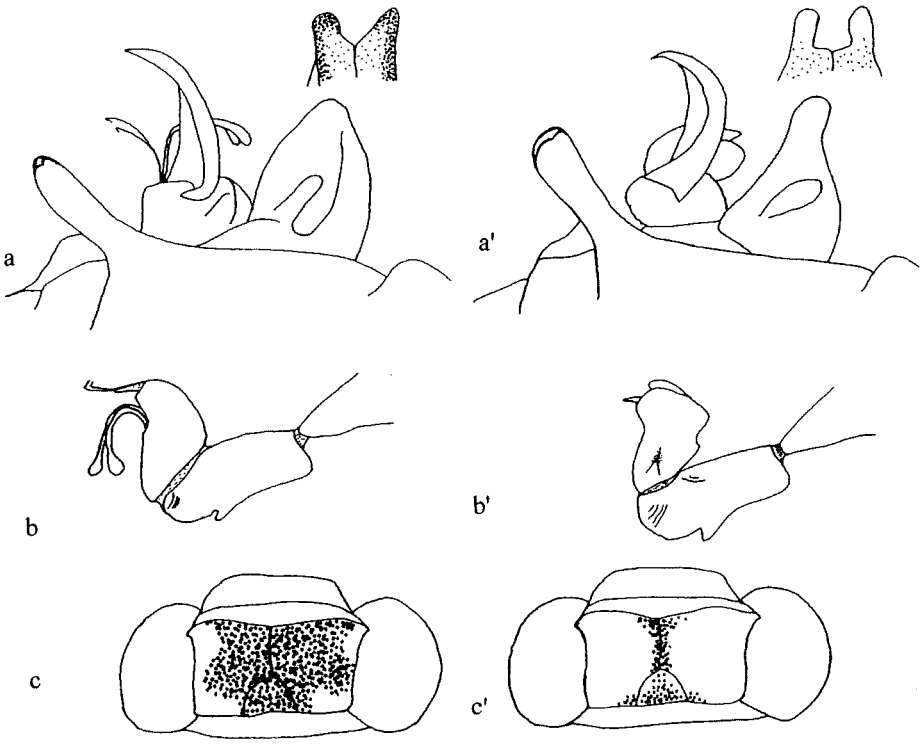

Figure 2. Male accessory genitalia and labium of *Trithemis bifida* (left: a, b, c) and *T. donaldsoni* (right: a', b', c') – (a, a') genitalia exposed in lateral view, lamina separately in ventral view; (b, b') penis in lateral view; (c, c') labium (head ventrally). Shadings are only given on the lamina in ventral view and on the labium.

Table 2. Diagnostic characters of males of *Trithemis bifida* and *T. donaldsoni*.

	bifida	*donaldsoni*
Wings	deeply fumose	hyaline
	dark amber rays along basal veins	no basal amber
Abdomen	long (ca 29-30 mm) and slender, specially S3-4 four times as long as mid-width	shorter (26-27 mm) and broad, 3-4 less than 2.5 times as long as mid-width
Lamina	V-shaped, dark-brown to black	U-shaped, brown with very pale tip (= bifurcation)
Prophallus:		
flagella	long, filiform, with apical backturned hook	very small, hardly visible
cornua	horns curved upwards	absent
glans	small	large
Labium	mainly black	only with median black line, widening ventrally

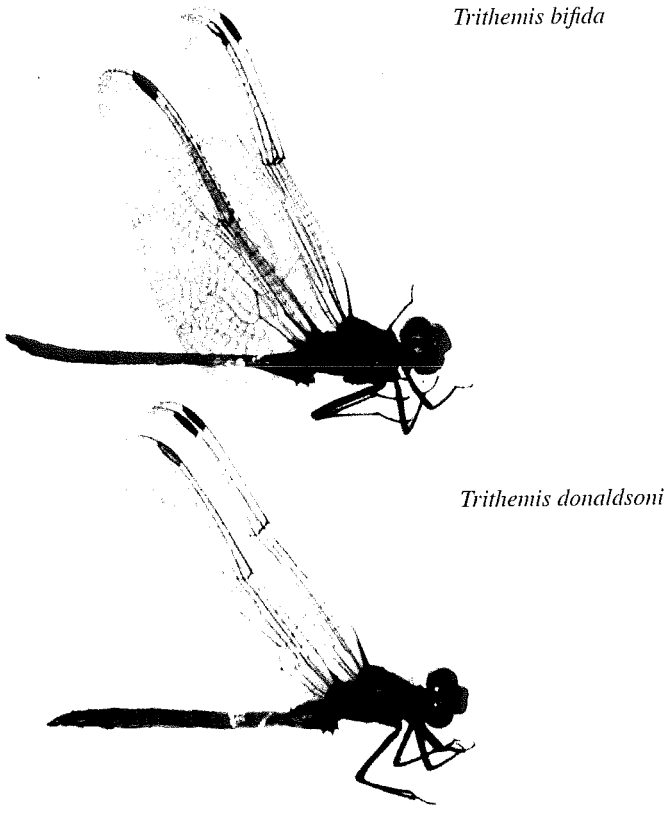

Figure 3. Males of *Trithemis bifida* (Rongo Mwagandi River, near Sheldrick falls, Shimba Hills NP, Kenya, 03 May 2000) and *T. donaldsoni* (Kombeni River, Rabai, Kenya, 24 April 2000). Note the smoky wings and the more slender abdomen in *T. bifida* compared with *T. donaldsoni*.

The males were patrolling short distances along shaded and partially shaded river stretches. The flight was fast and straight and the males spent most time on the wing in sunny wheather. Occasionally a male would hover in front of structures in or across the river, e.g. bushes or trees, apparently looking for ovipositing females. From time to time and when the sun disappeared the males of *T. bifida* would perch on sunny leaves or twigs overhanging the river for a short time. The co-occuring *T. pluvialis* was most of the time on the wing as well, patrolling very fast along the river and settling only rarely on stones in the river.

It is important to mention that I found *T. bifida* during the visits in April and May 2000 and in April 2001 only. In December 2000 and in March 2001 I captured *T. aconita* at the Rongo Mwagandi River, but no *T. bifida*. *T. aconita* was behaving in exactly the same way as *T. bifida*, even using the same perches. It was only possible to tell the species apart by examining the accessory genitalia closely. The lamina of *T. aconita* is turned anteriad, see Pinhey (1970: text fig. 53e). *T. aconita* has been

recorded from the Shimba Hills before and is widely distributed in Africa and is, like *T. donaldsoni,* a well known species.

It would be useful to conclude from my observations that there exists a temporary exclusion between *T. bifida* and *T. aconita.* But unfortunately there is the already mentioned unidentified male in the National Museums of Kenya, Nairobi labelled "Shimba Hills, Mombasa, Oct.-Nov. 1951, E. Pinhey" (see Material and methods). Pinhey (1970) does not refer to this specimen in his revision of the genus *Trithemis* and, although a lot of collections have been made in the Shimba Hills after 1951 by Pinhey and van Someren, no other record of *T. bifida* was obtained. From my observations I regard *T. bifida* as extremely seasonal, only flying in the rainy season in April and May.

T. donaldsoni is not found in rain forest areas, but in dry thorn bush country. The males found at Kombeni River, Rabai at the Kenyan coast, were caught in areas cleared from the natural rain forest. The behaviour of *T. donaldsoni* is very similar to that of *T. bifida.* Males were patrolling short distances above the water in a very fast and straight flight, occasionally hovering above currents or at turning points. Males would settle on twigs overhanging the water, on stones in the water or on sandy beaches in full sunlight.

Conclusion about the new locality record of *Trithemis bifida*

What surprised me most was the fact that my records of *T. bifida* and the two unidentified males deposited in the National Museums of Kenya, Nairobi are the first and only records for East Africa from a comparatively well collected and frequently visited place in Kenya. This species was relatively common in April and May during my visits; it was not shy and was permanently present at water. I doubt that *T. bifida* can be overlooked when observing dragonflies during that time of the year, unlike many gomphids.

While visiting the Shimba Hills at the onset of the rains in April 2000 I encountered a number of species which had never been recorded for East Africa before. This would not be surprising for a large number of areas, but the Shimba Hills have been visited quite frequently by van Someren and Pinhey for collecting (e.g. citations in Pinhey 1961, 1970). Where precise collecting dates are cited in the literature, such visits have been mainly made during the dry season, often around December, but never or very rarely during the rains in April and May. For example *Paragomphus magnus* Fraser was described from a single female collected by Pinhey from a river in the Shimba Hills in December 1950 (Fraser 1952). Until now this has remained the only record of this species from East Africa. During my visit in April 2000 this species was common and visible at all rivers I visited.

The "white spots" in tropical Africa are in many cases the result of spatial collecting gaps, e.g. in Tanzania. But even in "collected areas" seasonal collecting gaps exist, as exemplified by the Shimba Hills of the Kenyan coast.

Not much is known about the seasonal ecology of most Afrotropical Odonata. Species reproducing in seasonal pools in the tropics can be expected to be adapted to

dry seasons, e.g. to migrate or siccatate (= suspension of development during hot, dry season, Corbet 1999: 586). But for species reproducing in permanent water bodies in the tropics exogenous factors like photoperiod, temperature or presence of free water are of minor if any importance. Gambles (1960) stated that there is nothing to prevent odonates from breeding throughout the year. One reason for larvae, which are claspers or shallow burrowers, to emerge before the onset of the rainy season might be the hazardous nature of a watercourse (in spoke Corbet 1999). Species with unregulated life cycles and with life cycles alternating with wet and dry seasons are found in permanent tropical rivers (Umeozor 1993). This renders surveys which do not cover a full year unreliable and in the long run larvae might be more reliable indicators for faunistic surveys, once comprehensive identification material becomes available.

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References

Bennun, L. & P. Njoroge, 1999. Important bird areas in Kenya. East African Natural History Society, Nairobi.

Corbet, P.S., 1999. Dragonflies: behaviour and ecology of Odonata. Harley Books, London.

Dumont, H.J. & M.M. Al-Safadi, 1991. Additions to the dragonfly fauna of Yemen. Notulae Odonatologicae 3: 114-117.

Fraser, F.C., 1952. Notes on African Gomphidae with descriptions of four new species and a new genus (Order Odonata). Occasional Papers of the Coryndon Memorial Museum 3: 3-12.

Gambles, R.M., 1960. Seasonal distribution and longevity in Nigerian dragonflies. Journal of the West African Science Association 6: 18-26.

Lieftinck, M.A., 1969. Odonata Anisoptera. Scientific Results of the Hydrobiological Survey of the Lake Bangweulu & Luapula 14(4): 1-64.

Pinhey, E., 1951. The dragonflies of Southern Africa. Transvaal Museum Memoir 5: 1-335.

Pinhey, E., 1961. A survey of the dragonflies (Order Odonata) of Eastern Africa. British Museum (Natural History), London.

Pinhey, E., 1962. A descriptive catalogue of the Odonata of the African continent (up to December 1959) (Part I). Publicacoes Culturais de Companhia de Diamantes de Angola 59: 11-322.

Pinhey, E., 1970. Monographic study of the genus *Trithemis* Brauer (Odonata: Libellulidae). Memoirs of the Entomological Society of Southern Africa 11: 1-159.

Pinhey, E., 1978. Comparative notes on an African species of *Trithemis* Brauer (Odonata: Anisoptera) and its congeners. Arnoldia, Rhodesia 8(26): 1-8.

Pinhey, E., 1984. A check-list of the Odonata of Zimbabwe and Zambia. Smithersia 3: 1-64.

Pinhey, E., 1985. A survey of the dragonflies (Odonata) of South Africa, part 2: Anisoptera. Journal of the Entomological Society of Southern Africa 48: 1-48.

Ris, F., 1912. Libellulinen monographisch bearbeitet. Libellulinen 6. Collections Zoologiques du Baron Edm. de Selys Longchamps. Catalogue Systématique et Descriptif 14: 701-836, Plate VI.

Robertson, S.A. & W.R.Q. Luke, 1993. Kenya coastal forests. WWF, Nairobi.

Umeozor, O.C., 1993. Dragonfly distribution along New Calabar River, near Port Harcourt, Nigeria (Anisoptera). Notulae Odonatologicae 4: 12-15.