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TEINOBASIS ALLUAUDI MARTIN, 1896 FROM MAINLAND AFRICA: NOTES ON ECOLOGY AND BIOGEOGRAPHY (ZYGOPTERA: COENAGRIONIDAE)

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New records of *T. alluaudi* have been made from coastal forests of Kenya and Tanzania and from Pemba and Zanzibar Islands, Tanzania. Habitat and reproduction of this sp. are described. The systematic status of *T. alluaudi*, *T. a. berlandi* Schmidt, 1951 and *T. malawiensis* Pinhey, 1966 are discussed.

INTRODUCTION

Observations on African species of the genus *Teinobasis* are very rare. *T. alluaudi* was first reported as “parait assez commun” from Mahé by MARTIN (1896, p. 111), recorded from Mahé and Silhouette in 1908 and 1909 (CAMPION, 1913), then not found for a long time and thought to be extinct on the Seychelles (BLACKMAN & PINHEY, 1967; STUART et al., 1990) and only rediscovered there in 1997 (SAMWAYS, 1999). A recent study on Silhouette showed that the species is still present in several populations (D. Harding & J. Thompson, pers. comm.). *T. alluaudi* from Madagascar was given subspecies status by SCHMIDT (1951).

In 1966 Pinhey described *T. malawiensis* as a new *Teinobasis* from mainland Africa from “a few examples” (PINHEY, 1966, p. 5). This species has not been found again.

During my work on dragonflies of coastal forests of Kenya and Tanzania I found *T. alluaudi* in high numbers in coastal swamp forests in southern Kenya, on Pemba Island, and on Zanzibar, both Tanzania. The specimens from all localities belong to one species and match the descriptions given for *T. alluaudi* as well as the ones given for both *T. a. berlandi* (SCHMIDT, 1966) and for *T. malawiensis* (PINHEY, 1966).

LOCALITIES

BUDA FOREST, SOUTHERN KENYA. – The Buda Forest is the last remaining coastal forest with a patch of moist swamp forest in Kenya (Fig. 2). It is situated in southern Kenya (Tab. I) and is with 1300 to 1400 mm rainfall per year one of the wettest forests of the Kenyan coastal plain. The swamp forest areas are dominated by the palms *Raphia farinifera* and *Elaeis guineensis* and are adjacent to a small muddy stream. The Buda Forest has been heavily logged for several tree species, and thus the forest canopy has been opened in many places, and illegal uncontrolled logging still continues. Illegal logging also affects *Raphia* palms in the swamp forests; whether parts of the tree are locally used or just cut to open the forest up for future agriculture, I do not know.

NGEZI FOREST, PEMBA ISLAND, TANZANIA. – On Pemba Island the Ngezi Forest (Tab. I) is the only remaining large patch of the tropical moist forest that once widely covered the island. It attained the status of a Forest Reserve in 1959 with a presently gazetted area of about 1500 ha. The island is about 50 km off the coast of mainland Tanzania and about the same distance from Zanzibar. The climate is hot and moist, with a mean rainfall of 1860 mm per year, and rain almost every week of the year. Pemba Island experiences the highest rainfall of the entire coastal region, where the average mean rainfall is below 1000 mm per year. The monthly temperature variation on Pemba Island is, at 3.8°C, smaller than that of the coastal mainland.

JOZANI FOREST, ZANZIBAR ISLAND, TANZANIA. – The Jozani Forest on Zanzibar (Tab. I, Figs 1a-b) is a groundwater forest with seasonal swamp forest areas. There are no permanent surface waters. The forest stands on old corals and floods only during the rainy season, though the groundwater level is very high throughout the year. The Jozani Forest has been logged for timber extensively since the 1940s and was made a Forest Reserve in the early 1960s. Until the late 1980s, indigenous and exotic trees were planted to a large extent in the forest, and large areas of the Jozani Forest are plantations today (Fig. 1b), e.g. teak (*Tectona grandis*). In 1990 any human use of the forest was stopped. Worth mentioning are the monodominant stands of the screw-pine *Pandanus rabaiensis* in this forest (Fig. 1a).

NGUMBURUNI FOREST, RUFIJI DELTA, TANZANIA. – The Ngumburuni Forest is one of several remaining coastal forests in the Rufiji Delta. It is a groundwater forest with seasonal swamp forests along the Ruhoi river, similar to the swamp forest areas described above for the Buda Forest.

GENERAL. – All forests mentioned above are defined as coastal riverine/groundwater/swamp forest by WHITE (1983) and occur in areas where the water table is high and/or drainage is poor. CLARKE & ROBERTSON (2000) distinguish White's forest type on a finer scale, and all three forests are defined as

Table I
New records of *Teinobasis alluaudi*

Country	Locality	Lat./Long.	Altitude (m asl)	Date	Dominating trees in the swamp areas	Area (ha)
Kenya, south coast	Buda Forest	S04°26'/E39°24'	76	March 2001	*Raphia farinifera* *Elaeis guineensis* *Typhonodrum lindleyanum*	< 1
Tanzania, Zanzibar Island	Jozani Forest	S06°16'/E39°25'	27	October 2001	*Pandanus rabaiensis* *Elaeis guineensis*	ca. 3
Tanzania, Pemba Island	Ngezi Forest	S04°56'/E39°42'	38	October 2001	*Raphia farinifera* *Barringtonia racemosa* *Samadera indica*	33
Tanzania, Rufiji Delta	Ngumburuni Forest	S07°52'/E39°03'	64	February 2003	*Raphia farinifera* *Elaeis guineensis*	< 1

"swamp forest" by them. This forest type is rare in the coastal forest belt, and the vegetation is very distinct from other forest types. The dominant trees are monocotyledons (e.g. *Pandanus*, *Raphia*), (Fig. 1) and they are at least seasonally flooded. The geology of the swamp forest stands described above varies, but the top soil is usually clayish and rich in organic material. Streams may be found in or in the vicinity of the swamp forests, but not necessarily, as e.g. in the Jozani forest.

MATERIAL AND METHODS

The material examined (Tab. II) included my own material, specimens in the Natural History Museum, London and a *T. alluaudi* from the Seychelles that was kindly loaned to me by M. Samways. Of *T. malawiensis* only the paratype female could be examined, in the Natural History Museum, London. All other specimens of *T. malawiensis* collected (1 ♂, 2 ♀) are in the National Museum, Bulawayo, Zimbabwe, and cannot be loaned, as they are type material.

The colour patterns, appendages and penial structures of specimens from Madagascar, the Seychelles, Kenya, Pemba and Zanzibar (both Tanzania) were compared. From Malawi only the female could be compared with my material. For males of *T. malawiensis* I used the description and drawings given in PINHEY (1966).

HABITAT

The forests in which *Teinobasis alluaudi* was found by the author were all dark to medium dark and moist swamp forests with a dense vegetation dominated by

Figs 1-2. Habitats of *Teinobasis alluaudi*: (1a) monodominant stands of the screw pine (*Pandanus rabaiensis*) in the Jozani Forest, Zanzibar, Tanzania, 12-X-2001; – (1b) teak plantation in the Jozani Forest, 12-X-2001; a very high number of individuals were found in the dense fern understory in October 2001; – (2) *R. farinifera* dominated palm swamp in the Buda Forest, southern Kenya, 07-IV-2001.

monocotyledons (palms and/or screw pines) and a dense pinnatifolious understorey (*Raphia*, ferns). The canopy was 100% closed in the Ngezi Forest, and hardly any sunshine penetrated there to the forest floor. In Buda more light reached the forest floor through canopy gaps, and in the Jozani Forest the canopy light regime varied from dark in the *Pandanus* and *Raphia* stands to medium in the teak plantations. The teak plantations of Jozani Forest had a dense understorey of about 2 m high ferns (Fig. 1b). These ferns were used by many individuals of *T. alluaudi* as feeding and resting areas when I visited the forest in October 2001.

GENERAL BEHAVIOUR

Individuals liked to settle for long periods on the tips of palm or fern leaves from 1-2 m above the ground, lower branches of dense *Raphia farinifera* bushes being preferred perching places. The animals did not fly a lot, had a slowmotion flight, and only occasionally left their perch to glean prey from leaves and twigs nearby. If disturbed they did not fly long distances, but rather settled on the next twig.

Table II
Material of *Teinobasis alluaudi* and *T. malawiensis* examined

Labeled as	Date	Sex	Locality	Country	Collector
Natural History Museum, London					
alluaudi	1908	♂	Pointe Ehienne, Silhouette	Seychelles	Sladen Trust Exped.
no name at specimen	1908	♂	Pointe Ehienne, Silhouette	Seychelles	Sladen Trust Exped.
no name at specimen		♂	Mahé	Seychelles	Martin
no name at specimen		♀	East Madagascar	Madagascar	Martin
alluaudi berlandi	03/08/1949	♀	Tampolo, Lac	Madagascar	
alluaudi berlandi	03/08/1949	♀	Tampolo, Lac	Madagascar	
alluaudi berlandi	03/08/1949	♂	Tampolo, Lac	Madagascar	
alluaudi berlandi	03/08/1949	♂	Tampolo, Lac	Madagascar	
malawiensis (Paratype)	1966	♀	Mkuwadzi Forest, Nkata Bay	Malawi	Pinhey
Personal Collection					
alluaudi	22/03/2001	6 ♂	Buda Forest	Kenya	Clausnitzer
alluaudi	22/03/2001	♀	Buda Forest	Kenya	Clausnitzer
alluaudi	11/10/2001	10 ♂	Jozani Forest, Zanzibar	Tanzania	Clausnitzer
alluaudi	11/10/2001	2 ♀	Jozani Forest, Zanzibar	Tanzania	Clausnitzer
alluaudi	07/10/2001	14 ♂	Ngezi Forest, Pemba	Tanzania	Clausnitzer
alluaudi	07/10/2001	3 ♀	Ngezi Forest, Pemba	Tanzania	Clausnitzer
alluaudi	08/02/2003	2 ♂	Ngumburuni Forest, Rufiji	Tanzania	Clausnitzer
Loan from M. Samways					
alluaudi	24/05/2001	♂	Silhouette	Seychelles	Gerlach

MATING, OVIPOSITION AND AGGRESSION

In the Buda forest I observed mating and oviposition after the very first of the long rains in April 2001. Males perched on the occasional twigs or vegetation in the damp, but still waterless seasonal swamp and then approached females in a slow flight. Females were taken without courtship behaviour into the tandem position. After copulation in dense vegetation about 1-2 m above the ground, the couple returned as tandem to the dry swamp and females placed the eggs into the dry mud. Males continued contact guarding until the end of oviposition (n = 7), and I never observed a female ovipositing alone. Just 2 weeks later the swamp was filled with water, and no mating or ovipositing *Teinobasis* were found in or close to the swamp. Individuals were still found in the dense understorey of the swamp forest, often settling close to each other without showing any interaction.

All animals I observed in October 2001 on Pemba and Zanzibar Island showed no sign of mating or oviposition. Many individuals were found in dense fern understoreys and *Raphia* stands without taking any notice of each other. October is the peak of the dry season in Tanzania, and I assume that they siccatate during the dry season, similar to *Gynacantha* species, and reproductive behaviour begins at the onset of the rains.

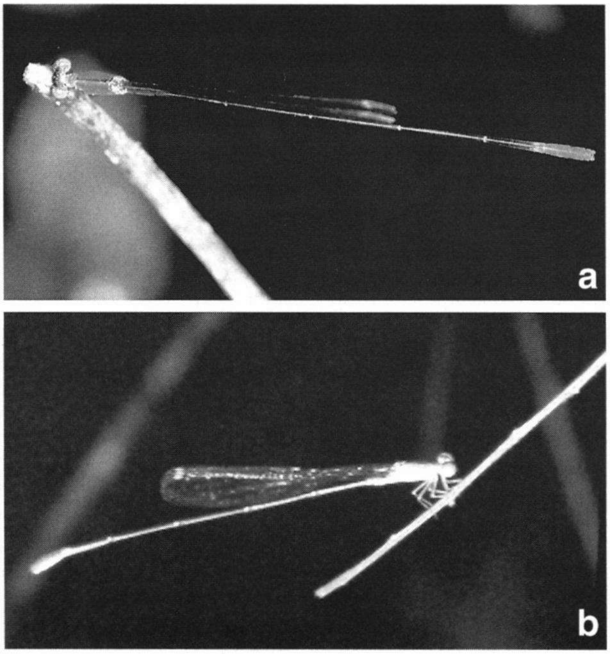

Fig. 3. *Teinobasis alluaudi*, Buda Forest, Kenya 22-III-2001.

FEEDING

The animals were observed to feed on small insects they gleaned from the tips of leaves or other vegetation. All individuals I observed, even males waiting for females close to the ground of swampy areas, flew for short distances along leaves and gleaned small insects. Though they would occasionally search closer to the ground, the preferred feeding height was 1-2 m above the ground.

COLOURING

All individuals I observed on Pemba and Zanzibar Islands in October 2001 had a greenish thorax, while those observed in the Buda Forest in April 2001 and on the Seychelles in March 2002 by D. Harding & J. Thompson (pers. comm.) were bright orange to even orange-red. The individuals observed in the Buda Forest and on the Seychelles were breeding, while the ones observed in October on Pemba and on Zanzibar neither showed mating nor ovipositing behaviour. The orange-reddish colour on the thorax might develop in the breeding season, or the more greenish colouring is a difference of the populations on Zanzibar and Pemba. More observations on colouration and colour changes in the different populations are necessary.

The females were very similar in colouration to the males, but a bit paler. The shape and extent of the black markings on the heads of both sexes varied slightly within the populations but had the tendency to resemble number c and/or f of the drawings given in SCHMIDT (1966, p. 153). All individuals had a black dorso-posterior line on the labrum. The postclypeus was in most individuals unmarked, in some animals with a black median line (running parallel to the body axis).

ASSOCIATED SPECIES OF DRAGONFLIES

Other species observed ovipositing in the breeding habitat of *T. alluaudi* were *Gynacantha usambarica* (Buda Forest only), *G. villosa* and *Thermochoria jeanneli.* Both *Gynacantha* species oviposited during the onset of the rains, when the swamps were not yet filled with water. Male *T. jeanneli* were observed being territorial in the still dry swamp during the onset of the rains, but breeding was not observed. It would be interesting to know if this species oviposits in dry mud like the *Gynacantha* species and *T. alluaudi.*

DISCUSSION

Teinobasis alluaudi might be found deeply in coastal forests far from any permanent water sources. It is a very elusive species that is easily overlooked. I expect more populations to be found in other swamp forests along the coastal forest belt in Tanzania and Mocambique (Fig. 4). Most of these forests have never been surveyed for dragonflies, and general collecting trips likely miss elusive odonates such as species of *Teinobasis.*

HABITAT

T. alluaudi needs an at least partly shady forest with seasonal swampy areas and pinnate leaves growing preferably between 1 and 2 m in height. The amount of light reaching the forest floor seems unimportant, as long as the forest is not opened up too much. There is hardly any light penetrating the Ngezi Forest, while there were gaps in Buda and a light-shade mosaic in some parts of Jozani. The amount of light of moist coastal closed canopy forests can be reduced to just 0.2% of full sunlight (MOREAU, 1935), which is definitely the case in Ngezi.

The main breeding habitats of *T. alluaudi* are swampy areas with stagnant or slowflowing water. The eggs are placed in damp soil or litter but not into the water. D. Harding & J. Thompson (pers. comm.) found a larva in a slowrunning and sluggish stream and observed oviposition in damp soil or detritus in areas flooded in the rainy season. Such breeding sites are often found in the vicinity of streams (e.g. Buda and Ngezi Forest) and may lead to the conclusion that the habitat of *T. alluaudi* is "clear streams in forest" (SAMWAYS 2002, p. 156). There are no streams in the Jozani Forest on Zanzibar, where I observed the highest *Teinobasis* densities (> 1000) in October 2001.

PINHEY (1966) collected *T. malawiensis* on "banks of a rocky stream" in Mkuwazi Forest, Malawi and assumed this to be the breeding habitat. In May 1977, M. Parr looked for *T. malawiensis* at the type locality but did not find it. He remembers the stream as rocky and sandy, flowing moderately fast in dense forest with very dim light, but could not say much about the surrounding forest (M. Parr, pers. comm.). According to the general preference of *Teinobasis* (see also below), I still assume that the specimens Pinhey caught were accidentally at the stream and reproduced perhaps in seasonal swampy areas close to the stream.

The preference for shady and damp forest with sluggish slowmoving streams or stagnant water seems to be shared by at least most, if not all representatives of this genus. Australasian *Teinobasis* species are reported as "forest dwellers which avoid cultivated areas" (LIEFTINCK, 1962, p. 19) and from "shady swampy situations" (FRASER, 1960, p. 19). Larvae of Australasian *Teinobasis* are described to "live either in small, slowly moving streams or in water accumulated in the axils of *Pandanus* and *Feycinetia*" (LIEFTINCK, 1962, p. 19) (but several species on Pohnpei, Micronesia, are common in swift mountain streams, PAULSON & BUDEN, 2003).

SYSTEMATICS

It has to be noted that KENNEDY (1920) separated the African species *malawienis* and *alluaudi* from *Teinobasis* and designated the new genus *Seychellibasis* (KENNEDY, 1920, p. 88): "Characters as in *Teinobasis*, except anal plate in male not elongate. Apical lobe of penis linear." Lieftinck wrote that the *Teinobasis* described from the Seychelles and Madagascar are "doubtfully congeneric" with the Asian species of this genus (LIEFTINCK, 1962, p. 18) but did not give any reasons except the geographic distance. Schmidt argues that the characters used by Kennedy are not generic characters but that Kennedy only created a "Genus monotypicum" (SCHMIDT, 1966, p. 160).

Schmidt redesignated *Teinobasis* as the valid genus for Africa (SCHMIDT, 1966, p. 160); which is generally accepted but has not been adopted by BRIDGES (1994).

SCHMIDT (1966) described the Madagascar *T. alluaudi* as a new subspecies *T. a. berlandi*, which is based on colour patterns of the head and shape of the pterostigma. Later LIEFTINCK (1965) referred to *T. a. berlandi* as *T. berlandi*, but this is based not on morphological grounds but on the datadeficient situation: "As long as the type of the latter [*T. alluaudi*] has not been adequately described and its genital structures figured, I prefer to keep both forms apart as distinct species." (LIEFTINCK, 1965, p. 251).

In his description of *T. malawiensis*, PINHEY (1966) states the similarity of *T. a. alluaudi* to *T. alluaudi berlandi* and lists as differential features only facial markings and the shape of the pterostigma. It remains unknown whether Pinhey compared his *T. malawiensis* with specimens of *T. a. alluaudi* from the Seychelles. In 1967 he wrote that "unfortunately no material of this species [*T. a. alluaudi*] has been seen from Seychelles by the present author" (BLACKMAN & PINHEY, 1967, p. 14). He continued that the "Malawi examples may be another race or a distinct species" (BLACKMAN & PINHEY, 1967, p. 15), although the description of *T. malawiensis* was already published and even cited there.

The amount and shape of black on the head, which was the main reason to split *Teinobasis alluaudi* (SCHMIDT, 1961), is not as straightforward as outlined by SCHMIDT (1961). Indeed the Seychelle animals are darker than all other populations and resemble SCHMIDT's (1961) fig. 81e, p. 153 (n = 4♂). The Madagascar animals range from very dark (SCHMIDT 1961, fig. 81e, p. 153) to very pale forms (fig. 81c, p. 153) (n = 2♂ & 4♀). All animals caught by the author on Pemba and Zanzibar Island and in the Buda Forest are pale and resemble SCHMIDT's (1961), fig. 81c, p. 153, but with the postclypeus entirely pale or only marked with a black line. The degree of melanism of facial markings of *T. alluaudi* is no basis for species differentiation. In Africa a number of species show a high variability in the amount and configuration of dark markings, usually along gradients. There is a tendency in Africa that populations become darker towards the Equator, e.g. *Gomphidia quarrei*, but also from East to Central Africa, e.g. *Orthetrum julia*. The tendency of melanism increases from south towards the equator and again from East Africa westwards along the equator.

The female protothorax (Tab. II) showed exactly the same colour and morphological pattern in all specimen examined (Tab. II). The drawings of the penial organs and of the appendages of *T. malawiensis* (PINHEY, 1966, p. 6) are identical to those of my animals and more or less to the drawing shown in SCHMIDT (1966, p. 161) for *T. a. berlandi*. The difference of all material I examined from SCHMIDT's (1966, p. 161) drawing is the small lobe at the beginning of the flagellum, which I suppose was hidden in the perspective shown. Penial organs I examined from specimens from Madagascar, the Seychelles, Pemba Island, Zanzibar and Kenya were identical to each other, not only in this respect. This feature seems to be also present in *T. malawienis* (PINHEY 1966, p. 6, fig. 1g), but this needs further examination.

From my observations and all available material, I regard the *Teinobasis* populations from the Seychelles, Madagascar and Eastern Africa as one species (= *T. alluaudi*). From the description and the females I assume that *T. malawiensis* is a synonym of *T. alluaudi*, but as long as the type of *T. malawiensis* has not been checked and compared to *T. alluaudi*, it has to remain a good species.

BIOGEOGRAPHY

The genus *Teinobasis* has its centre of diversity in Eastern Australasia (especially New Guinea, as well as Indonesia and the Philippines). Some insular endemics occur across the Pacific, but the genus is absent from the Indian Subcontinent. LIEFTINCK (1962) assumed the Philippine Islands and New Guinea to be the principal centres of dispersal. Currently about 65 species are recognized (BRIDGES, 1994), of which only 2 occur in Africa.

The origin of the African *Teinobasis* can be explained by trans-oceanic dispersal from Australasia. The Seychelles are about half way between the African (ca. 2300 km) and Indian continent (ca. 2750 km). Despite these long distances a number of dragonfly species have reached the islands by longdistance dispersal from both regions. Biogeographic affinities to Africa are shown by, e.g. *Rhyothemis semihyalina* (Sél.) and *Ceriagrion glabrum* (Burm.), while links to the Indian region are indicated by *Agriocnemis pygmaea* (Ramb.), *Anax guttatus* (Burm.) and *Diplacodes trivialis* (Ramb.). Some species found on the Seychelles are widespread in both the Asian and African regions and are well known to migrate actively long distances overland and overwater, e.g. *Pantala flavescens* (Fabr.), *Tholymis tillarga* (Fabr.) and *Hemianax ephippiger* (Burm.) (DUMONT, 1977; SAMWAYS, 1989; AVERILL, 1995; SCHNEIDER, 2000). Other species from the Asian and/or African region are weak fliers and must have been dispersed with strong wind currents, e.g. *Agriocnemis pygmaea, Ischnura senegalensis* (Ramb.), *Diplacodes lefebvrii* (Ramb.) and *D. trivialis.*

The active dispersal potential of *Teinobasis* is very low to nil. Species of this genus have a slow flight and stay in the dense undergrowth of swamp forests, e.g. *T. rufithorax* (Sél.) has a "slow flight and retiring habits" (FRASER, 1960, p. 19). Dispersal in this genus must therefore be passive with wind. Currently the Seychelles are influenced by two major wind systems, the southeast monsoon from May to early October and the northwest monsoon from October to April, allowing the drift of insects from both Asian and African regions to the Seychelles.

The Seychelles, unlike any other part of the Afrotropic Region, have been reached by effectively dispersing odonates from the Indian region, but only the Oriental dragonfly *Zyxomma petiolatum* has reached the more south-eastern island Mauritius as well. Thus the invasion of *Teinobasis* from Asia via the Seychelles into the afrotropical region and to Madagascar would be quite unexpected. The question remains open whether colonisation from the Seychelles into Africa started from Madagascar or from Eastern Africa and whether before or after the separation of the islands from the main

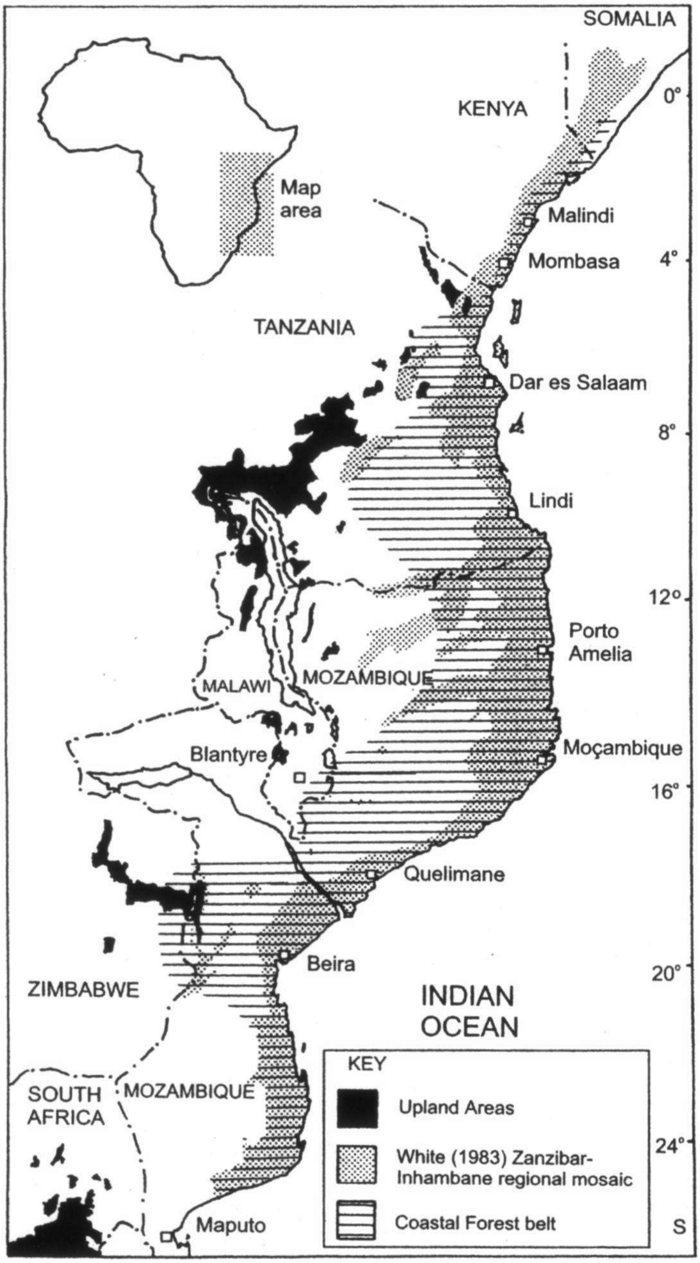

Fig. 4. Zanzibar-Inhambane region (after WHITE, 1983) and Coastal Forest belt in eastern and southeastern Africa (after CLARKE, 2000).

continent. The Africa-Madagascar separation ended about 121 million years ago, the Madagascar-Indian Subcontinent separated about 65 million years ago, the Seychelles Bank remained at its present position while India drifted northwards and Pemba Island is believed to have become separated about 10 million years ago (GRIFFITHS, 1993; RICHMOND, 1997).

The question arises of why this genus radiated into over 50 species in the Australasian region and into only a single or very few species with a very scattered distribution in Africa. Either *Teinobasis* had reached Africa recently, or conditions in Africa did not allow a similar radiation observed in Australasia. The very scattered distribution of *T. alluaudi* in Africa fits the scenario that it was either dispersed from the Seychelles independently to different Afrotropic regions or it had a once much wider distribution range. In the latter case the present distribution would be relictual, which can be explained by climatic changes in Africa. Dry climatic periods and glacial advances during the Pleistocene led to the well known depauperated flora and fauna of Africa (GENTRY, 1988). Such periods have mainly hit the moist and hot lowland forests of Africa, e.g. with cooling to below the tolerances of tropical stenothermic species or destruction of habitats, and led to random extinctions in the African rain forests, e.g. COLINVAUX (1993). The coastal forests of Eastern Africa are believed to have been climatically more stable during Ice Age periods than most other forests in Africa (FJELDSA et al., 1997; FJELDSA & LOVETT, 1997), which is why more ancient taxa have survived the drier periods in those forests. There are for example a number of plant taxa shared between the lowland moist and wet forests of Madagascar and the lowland Amazonian forest of South America, which are presently absent from mainland Africa but were discovered there as fossils (GENTRY, 1988, 1993). Generally all coastal forests of eastern Africa are much drier today than they used to be (CLARKE, 2000a). Once the Eastern African Coastal Forests covered most of the East African coast from southern Mozambique to southern Somalia (WHITE, 1983; CLARKE 2000a; Fig. 4). The western limits of this "coastal forest belt" are the Eastern Arc Mountains in Tanzania, and it reaches into eastern Malawi, including Mount Mlanje, and into eastern Zimbabwe, including Haroni and Rusitu (CLARKE, 2000a, p. 22-23). Only relatively recently this coastal forest belt has been reduced by human encroachment and climatic changes to small separated forest patches, often of less than 500 ha in size (BURGESS et al., 2000).

CONSERVATION STATUS

By conserving Coastal Forests a great part of Africa's biodiversity will be protected" (BURGESS & CLARKE, 2000, p. 7). The coastal forests of eastern Africa are recognized in general as core areas for biodiversity and endemism in Africa (KINGDON, 1989; FJELDSA & LOVETT, 1997; BURGESS & CLARKE, 2000), which also holds true for dragonflies (e.g. CLAUSNITZER, 2002, 2003a, 2003b). One reason for the very high level of endemism, including neoendemics and biogeographical relicts in coastal forests as well as in forests of the Eastern Arc Mountains (which often merge), is their relative climatic and habitat stability (FJELDSA et al., 1997).

Although coastal forests are listed as important areas in terms of conservation for East Africa (STUART et al., 1990), they have been shrinking very rapidly over the last decades and still experience heavy pressure from outside. These remaining forests have in common that they are small and highly fragmented and are extremely vulnerable. The Coastal and Eastern Arc Forests of Tanzania and Kenya cover an area of 2,000 km² today, which is only 6.7 % of their original extent (MYERS et al., 2000).

From the three forests mentioned in the text, the Jozani Forest on Zanzibar is the most disturbed, but currently best protected one. The Jozani Forest Conservation Project has done a lot of publicity work during the last years, and no recent illegal activities in the forest (e.g. logging) were visible during my visit. The Ngezi Forest on Pemba Island is still very large and in very good shape, but the growing population is beginning to penetrate into the forest (see also BEENTJE, 1990). The Ngezi Forest has a high potential as an eco-tourism site, which would generate some money and involve more local people with the forest protection. The Buda Forest in southern Kenya is comparatively large for coastal Kenyan standards, but already heavily logged, and logging continues in an alarming rate. It contains the last remaining patch of *Raphia* Swamp Forest in Kenya, where forests in general are underrepresented in the protected area system. Several species of this forest (flora and fauna) are found nowhere else in Kenya (e.g. ROBERTSON & LUKE, 1993; Copeland, pers. comm.), which might help to raise a national interest to put more effort into its protection.

Though the populations on Pemba and Zanzibar Island were fairly large, *T. alluaudi* should definitely remain on the IUCN Red-List as "vulnerable". It is restricted to coastal swamp forests, which exist only in tiny patches nowadays and are not adequately protected in most cases. I am sure it occurs in more appropriate habitats along the coastal belt of Tanzania and Mozambique,but the question is whether populations will be found before the habitat is destroyed.

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