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Systematics of *Bradypodion tenue* (Matschie, 1892) (Sauria: Chamaeleonidae) with a description of a new species from the Uluguru and Uzungwe Mountains, Tanzania

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Abstract. The study of all available specimens of *Bradypodion tenue* (Matschie, 1892) and the corresponding literature demonstrated that two different species are involved: *B. tenue* (s. str.), restricted to the Usambara Mts. (Tanzania) and the Shimba Hills (first record for Kenya) and *B. oxyrhinum* n. sp. from the Uluguru and Uzungwe Mts. Their zoogeographical relationships are discussed.

Key words. Reptilia, Chamaeleonidae, *Bradypodion tenue*, *Bradypodion oxyrhinum* n. sp., Tanzania, Kenya, taxonomy, distribution, zoogeography.

Introduction

Matschie (1892) described *Bradypodion tenue* as *Chamaeleon* (sic) *tenuis*. He based his description on four specimens from Derema, East Usambara Mountains, Tanzania, that were collected by L. Conradt and subsequently deposited in the collection of the Zoologisches Museum in Berlin.

Tornier (1900) recorded *B. tenue*, one male and one female in possession of Franz Werner, from Mkoya in Ukami (Uluguru Mts.), Tanzania. In his "Prodromus" Werner (1902) mentioned the four Berlin types and his two specimens from Ukami. He also discussed the differences in external morphology between the two Ukami specimens and one juvenile male from Derema (probably one of the types). Especially the rostral appendage of one of the Ukami specimens is considerably longer and has a different structure than the rostral appendage of the Derema specimen. Although Werner contemplated the possibility the Ukami specimens to represent a new species he considered the specimens bearing a rostral appendage (all Berlin specimens, the juvenile male from Derema and one of his Ukami specimens) to be males and the one Ukami specimen lacking a rostral appendage to be the female of *B. tenue*. He, thus, believed to have described the female of *B. tenue* for the first time. The two Ukami specimens were depicted by Werner (1902, plate 15, reproduced here as fig. 1) and deposited in the Zoologisches Museum in Hamburg.

Nieden (1910) reported a new locality for *B. tenue*, viz. Amani, which is close to Derema, East Usambara Mts. and Werner (1911) repeated his view concerning the sexual dimorphism of *B. tenue*.

Sternfeld (1912) described *B. adolfifriederici*, basing his description on one female specimen from the Ituri region, Zaire. He considered this species to be related to *B. tenue* as he thought it to look very similar except for the absence of a rostral appendage. Sternfeld was the first to record explicitly and correctly that the Berlin type series of *B. tenue* contained one female specimen possessing a rostral appendage. He,

therefore, assumed the Ukami specimens discussed and depicted by Werner (1902) not to belong to *B. tenue*. As the female specimen resembles the type specimen of *B. adolfifriderici* Sternfeld tentatively assumed the Ukami specimens to be male and female of *B. adolfifriderici*.

Boettger (1913) corroborated Sternfeld's view as to the presence of a rostral appendage in female specimens of *B. tenue*, but noted it to be smaller than that of male specimens. Nieden (1913) recorded *B. tenue* from Derema and Amani, Usambara Mts. and adopted the view of Sternfeld to consider the Ukami specimens to belong to *B. adolfifriderici*.

Werner (1913) did not adopt this view of Sternfeld and Nieden, however, and still considered Derema, Amani and Ukami specimens to belong to *B. tenue*.

Fortunately Schmidt (1919) discovered the male of *B. adolfifriderici* that like the female of this species lacks any trace of a rostral appendage. Consequently the explanation of Sternfeld as to the different external morphology of the Ukami specimens as compared to Derema and Amani specimens was falsified.

Barbour & Loveridge (1928) discussed two specimens of *B. tenue* from Amani present in the collection of the Museum of Comparative Zoology. They considered the Ukami record of Werner (1911) the first record of *B. tenue* from the Uluguru Mts., which is incorrect as Tornier (1900) and Werner (1902) already mentioned this locality. Moreover, they thought the MCZ male specimen to be far larger than the type from Derema, viz. 101 versus 69 mm respectively. This, too, is incorrect as not one but four syntypes are known that are, except for one juvenile specimen, larger than the MCZ male specimen (cf. table 1 and the measurements of Matschie, 1892).

In his checklist Loveridge (1957) referred, surprisingly, only to the Usambara Mts. as the locality where *B. tenue* is found, thus neglecting the previous record from the Uluguru Mts. discussed by Barbour and himself in 1928.

Skelton-Bourgeois (1961) reported the capture of a female specimen of *B. tenue* from the forest above Ngorongoro Crater (2500 m alt.). She erroneously stated that this species was only known from the Usambara Mts. until then. Like Loveridge (1957) before him Mertens (1966) limited the distribution of *B. tenue* to the Usambara Mts., although he referred to Werner (1911) who also listed Ukami, Uluguru Mts.

Seven other references to *B. tenue* are known from literature, viz. Tornier (1896 & 1897), Monk (1903), Loveridge (1924 & 1939), Klaver (1981) and Klaver & Böhme (1986). Tornier (1896) repeated the original description, Tornier (1897) and Monk (1903) mentioned *B. tenue* to occur in East Africa, whereas Loveridge (1924 & 1939) reported *B. tenue* from the Tanganyika Territory and from a forest-edge habitat respectively. Klaver (1981) described the relatively plesiomorph lungs of *B. tenue*, whereas Klaver & Böhme (1986) described the hemipenes of *B. tenue* together with those of numerous other chameleon species. They changed the classification of chameleons in view of the accumulated comparative data. The classification of *B. tenue* together with other relatively plesiomorph chameleons from continental Africa in the genus *Bradypodion* is adopted in the present paper.

In view of what has been discussed above we assembled material of *B. tenue* from the various collections to study the variability of *B. tenue* and to establish the status of the specimens from the various localities presently known, viz. Usambara Mts., Uluguru Mts. and the Ngorongoro Crater.



Fig. 1: *Bradypodion tenue* sensu Werner (1902, table 15) = *B. oxyrhinum* n. sp. Male with a rostral appendage, female without a rostral appendage.

Material

The material of this study originates from the following institutions (followed by the institutional acronyms in parentheses):

British Museum (Natural History), London (BMNH),
Musée Royale de l'Afrique Centrale, Tervueren (MRAC),
Museum of Comparative Zoology, Cambridge, Mass. (MCZ),
Museum für Naturkunde der Humboldt-Universität, Berlin (ZMB),
Naturmuseum und Forschungsinstitut Senckenberg, Frankfurt a. M. (SMF),
Universitetets Zoologiske Museum, Copenhagen (ZMUC),
Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn (ZFMK),
Zoologisches Museum der Universität, Hamburg (ZMH),
Zoologische Staatssammlung, Munich (ZSM).

Results and Discussion

Types of *B. tenue*

The Zoologisches Museum in Berlin forwarded us five specimens of *B. tenue*, including the type series consisting of three specimens (ZMB 11348: 1–3, table 1 and



Fig. 2: Three of the four syntypes of *B. tenue*, ZMB 11348: 1—3, male, female, juvenile.

fig. 2). This is odd because in literature reference is made to four syntypes (cf. Matschie, 1892; Werner, 1902 a.o.). Another specimen (ZMB 22627) collected by Conradt from the type locality as well might be the fourth type specimen. However, it is incomprehensible as to why it should not have been included in the original type series under the same catalogue number. Moreover, at closer examination the putative specimen of *B. tenue* proved to be a *B. xenorhinum*! The locality attached, viz. Derema, does not correspond with the species involved as *B. xenorhinum* has thus far only been recorded from the Ruwenzori Mts. (cf. De Witte, 1965). The possibility of a new locality is highly unlikely, an accidental exchange with some other specimen seems more plausible.

The solution of this particular problem was provided by the material from the Munich museum. One specimen (ZSM 693/1920, see fig. 4 d) is indeed a *B. tenue*, but from the improbable locality Ruwenzori Mts. Fortunately, this specimen was still accompanied by the original label from the ZMB, from where it originated either by gift or by exchange, which reads among other things: "*Chamaeleon xenorhinus*". At one time it was established at the ZSM that not a *B. xenorhinum* specimen had been acquired but a *B. tenue* specimen instead. It was subsequently catalogued under the proper name, but one failed to notice the incongruence of the locality record. It, thus, appears that prior to the shipment of specimens from the ZMB-collection to the ZSM-collection two specimens were exchanged by accident. This may solve the problem of the improbable locality record of the two specimens involved, it does not solve our main problem, i.e. that of the missing type.

Matschie (1892) gave the measurements of one of the four syntypes, viz. head-body length: 54 mm, tail length: 66 mm, length rostral appendage: 3,5 mm. Similar data of the three types (ZMB 11348: 1–3) and the Munich specimen discussed (ZSM 693/1920) assembled in table 1 reveal the dimensions of the ZSM-specimen to approximate those given by Matschie most, i.e. they are virtually identical! This suggests that the same specimen is concerned and that the ZSM-specimen is the missing type. However, as this circumstantial evidence could not be bolstered up by independent proof as a result of searches into this matter at the Berlin museum, it leaves the separate catalogue number inexplicable and the status of this ZSM-specimen uncertain.

Locality records

Having ruled out the Ruwenzori Mts. as a locality of distribution of *B. tenue* three localities mentioned in literature remain, viz. the Usambara Mts. (Amani and Derema), the Uluguru Mts. (Ukami) and the Ngorongoro Crater (cf. map fig. 3). The specimen from this last locality (Skelton-Bourgeois, 1961), that was deposited in the collection of the MRAC in Tervueren under no. RGMC 21852, proved at closer examination not to belong to *B. tenue*. It is tentatively assumed to belong to *B. uthmoelleri* (Müller, 1938), a rare species thus far only known from the type specimen that originates from Mt. Hanang, a locality south of the Ngorongoro Crater (see map fig. 3). We shall comment on this species in a separate article shortly, it suffices to state here that the Tervueren specimen is definitely not a *B. tenue*. The geographical distribution as known from literature is thus restricted to the Usambara Mts. and the Uluguru Mts. However, when bringing together the material for the present study we discovered specimens from two new localities, viz. the Shimba Hills, Kenya (ZFMK 38677) and the Uzungwe Mts., Tanzania (ZMUC 51376; see map fig. 3).

Discussion

The specimen from the Shimba Hills, the first record of *B. tenue* from Kenya, proved to be a female with a well developed rostral appendage. All Usambara Mts. specimens regardless their sex do also have a rostral appendage, although in females it is shorter than in males (see table 1 and fig. 4). The female from Ukami, Uluguru Mts., however, has no rostral appendage, whereas the rostral appendage of the male from Ukami is much longer and more pointed than that of the males from the Usambara Mts. The same applies to the male specimen from the Uzungwe Mts. Moreover, the structure of the rostral appendage in both the Uzungwe and the Uluguru males differs from that in the Usambara males (see description below). We may conclude that there are distinct morphological differences between the specimens from the Usambara Mts. and the Shimba Hills on the one hand and those from the Uluguru Mts. and the Uzungwe Mts. on the other hand. The reason Werner (1902) considered the Uluguru specimens to belong to *B. tenue* was that, while basing himself on far less material, he erroneously considered all specimens possessing a rostral appendage to be males. We, on the other hand, consider the constant presence of a rostral appendage in females from the Usambara Mts. and the Shimba Hills, the absence of

Table 1: Head-body length (HBL), tail length (TL), length nasal appendage (NL) and head length (HL) in mm of *B. tenue* and *B. oxyrhina* n. sp.

coll. nr.	locality	sex	HBL	TL	NL	HL	remarks
ZMB	11348: 1	♂	70	75	3	20	lectotype, leg. Conradt
ZMB	11348: 2	♀	56	62	1	15	paralectotype, leg. Conradt
ZMB	11348: 3	juv.	27	33	0,2	9	paralectotype, leg. Conradt
ZMB	19645	♀	68	71	2	19	
ZMB	22627	♀	—	—	—	—	= <i>B. xenorhinum</i> , leg. Conradt
ZSM	693/1920	♂	54	65	3	15	probably exchanged with ZMB 22627
ZSM	22/1915	♂	59,5	72	4	16	
ZFMK	30419	♀	61	69	1	16	
ZFMK	38677	♀	61	57	3	15	
ZFMK	44881	♀	59	68	1	16	nasal appendage damaged
ZMH-R	01848	♂	68	80	3	18	
ZMUC	51331	♂	63	70	4	17	
ZMUC	51332	♀	62	69	1,5	17,5	
MCZ	24244	♀	65	67	1	18	
MCZ	24245	♂	51	49	3,5	16,5	
BMNH	1974.523	♀	58	55	2,2	—	
BMNH	1974.524	♂	55	66	4,5	18,5	
SMF	16428	♀	52	65	2	—	
ZFMK	46406	♂	72	92	7	25	holotype
ZFMK	46407	♀	70	68	—	18	paratype
ZMUC-R	51376	♂	67	77	7	23	paratype

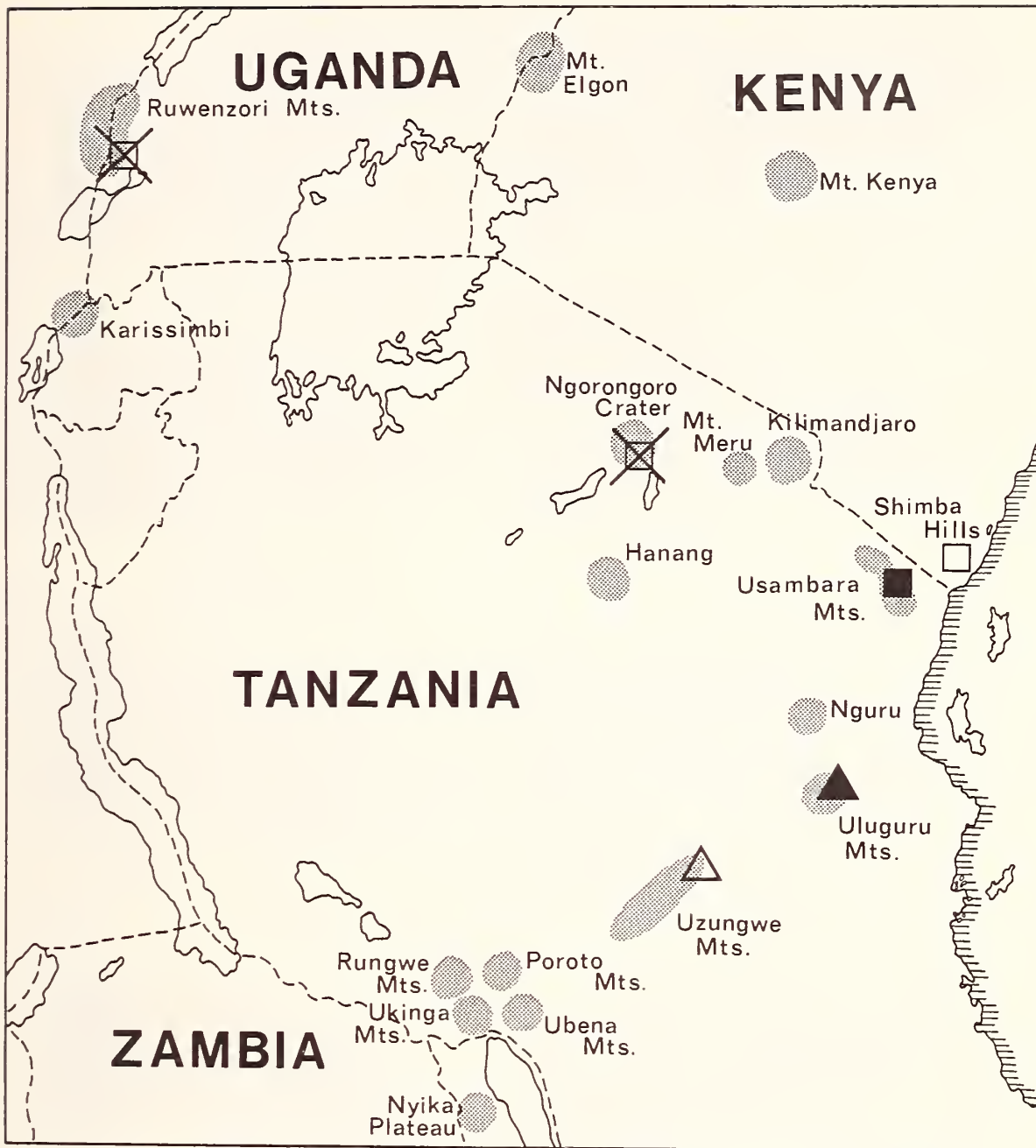


Fig. 3: Distribution of *B. tenue* (squares) and *B. oxyrinum* (triangles) in East Africa. Solid symbols: type localities, open symbols: other locality records, crossed symbols: erroneous locality records.

a rostral appendage in the female from the Uluguru Mts. and the different structure of the rostral appendage in the males from the Uluguru Mts. and the Uzungwe Mts. sufficient to distinguish two different species. Below we shall first give a short characterisation of *B. tenue* and subsequently describe the new species.

Bradypodion tenue (Matschie, 1892)

A small chameleon (see table 1) with a homogeneous body-scalation, canthi rostrales meet above the nostrils to form a simple, flexible and laterally flattened rostral appendage in both sexes, the margin of the appendage with bluntly pointed scales that give it a denticulate outline, rostral appendage in males larger than in females, the basal part of the rostral appendage may be ossified, casque only slightly elevated

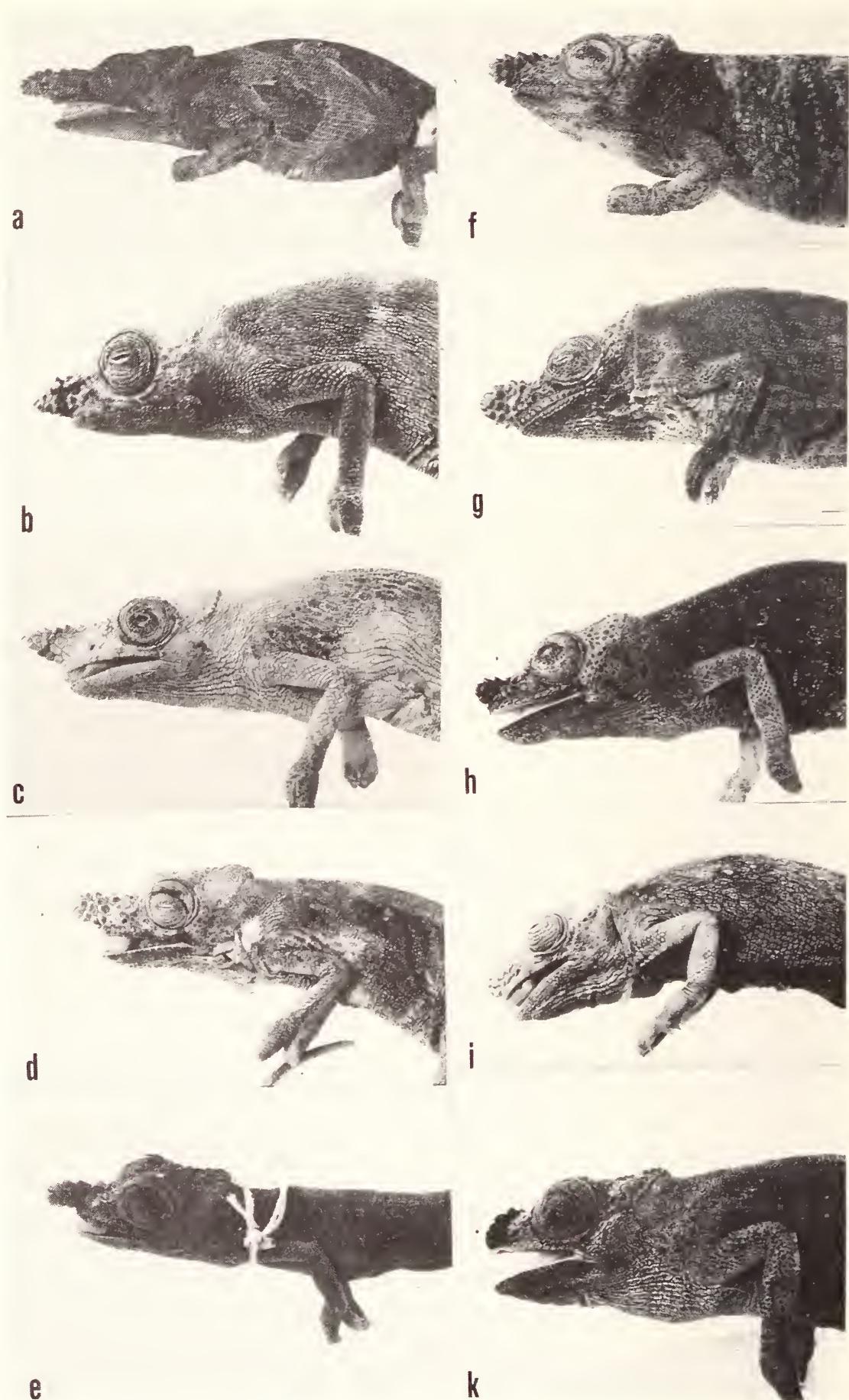


Fig. 4: Variability in rostral appendages in *B. tenue*: left column males (a = BMNH 1974.524, b = ZMNH 01848, c = ZSM 22/1915, d = ZSM 693/1920, e = MCZ 24245), right column females (f = BMNH 1974.523, g = ZFMK 38677, h = ZFMK 30419, i = ZMB 19645, k = MCZ 24244).

posteriorly and with prominent parietal and lateral (temporal?) crests, scales on the head flat, number of scales between the orbital crests: six.

Lectotype (by present designation): ZMB 11348: 1, male, Derema, Usambara Mts., leg. L. Conradt (fig. 2 above and fig. 6 left).

Paralectotypes: ZMB 11348: 2–3, female and juvenile, same data as lectotype (fig. 2 middle and below). Whether ZSM 693/1920 can be regarded as the third paralectotype or not remains uncertain.

Distribution: East Usambara Mts., Tanzania and Shimba Hills, Kenya (see map fig. 3).

Coloration: Werner (1902 & 1913) gave a colourful description of the coloration of a preserved male specimen from Derema. However, colour slides of a live specimen (ZFMK 38677) document the absence of vivid colours, the animal dresses a general brownish-grey colour with lighter spots.

Bradypodion oxyrhinum n. sp.

Diagnosis: *B. oxyrhinum* can be distinguished by the absence of a rostral appendage in the female, the elongate and pointed rostral appendage in males and the fusion of the canthi rostralis above the tip of the snout to form a rostral appendage. Derivatio nominis: The name *oxyrhinum* derives from the shape of the rostral appendage that is more elongate and pointed than the rostral appendage of *B. tenue*, the species with which *B. oxyrhinum* has been confounded until now.

Holotype: ZFMK 46406 (formerly ZMHR 01846), male, Mkoya in Ukami, Uluguru Mts., leg. G. Schlüter, 1899 (fig. 1 above, fig. 5 above and fig. 6 right).

Description: A small chameleon (see table 1) with a homogeneous body-scalation, canthi rostrales meet above the tip of the snout to form a long laterally flattened rostral appendage, three thirds of this appendage are supported by bone leaving only the tip flexible, the dorsal margin of the ossified part is formed by two parallel rows of scales that form the continuation of the canthi rostrales, lateral surface of the appendage with 4–5 rows of scales, outer margin of the rostral appendage bluntly denticulate, upper side of the snout concave with a few, large flat and polygonal scales, scales on the head flat and relatively large, number of scales between the orbital crests: eight, casque slightly elevated posteriorly, parietal crest present, on either side of its anterior end two prominent tubercles, lateral crest indicated.

Paratypes: ZFMK 46407 (formerly ZMHR 01847), female, same data as holotype (fig. 1 below). The female of *B. oxyrhinum* does not have a rostral appendage, the snout is convex and covered with small tubercular scales, tail shorter than head-body length and relatively shorter than the tail in the males. ZMUC-R 51376, male, Mwanihana forest, 1000 m alt., Uzungwe Mts., Kilombero district, Morogoro region, Tanzania, 6-VIII-1982, coll. N. Scharff (fig. 5 below). This male is similar to the holotype except for the scales on the head that are somewhat smaller. This results in 9–10 scales between the orbital crests and 6–7 rows of scales on the lateral surface of the rostral appendage.

Coloration: Werner (1902) gave a detailed description of the coloration of both holotype and female paratype. As his description was based on specimens that were preserved in alcohol for at least several years it has to be considered with caution as

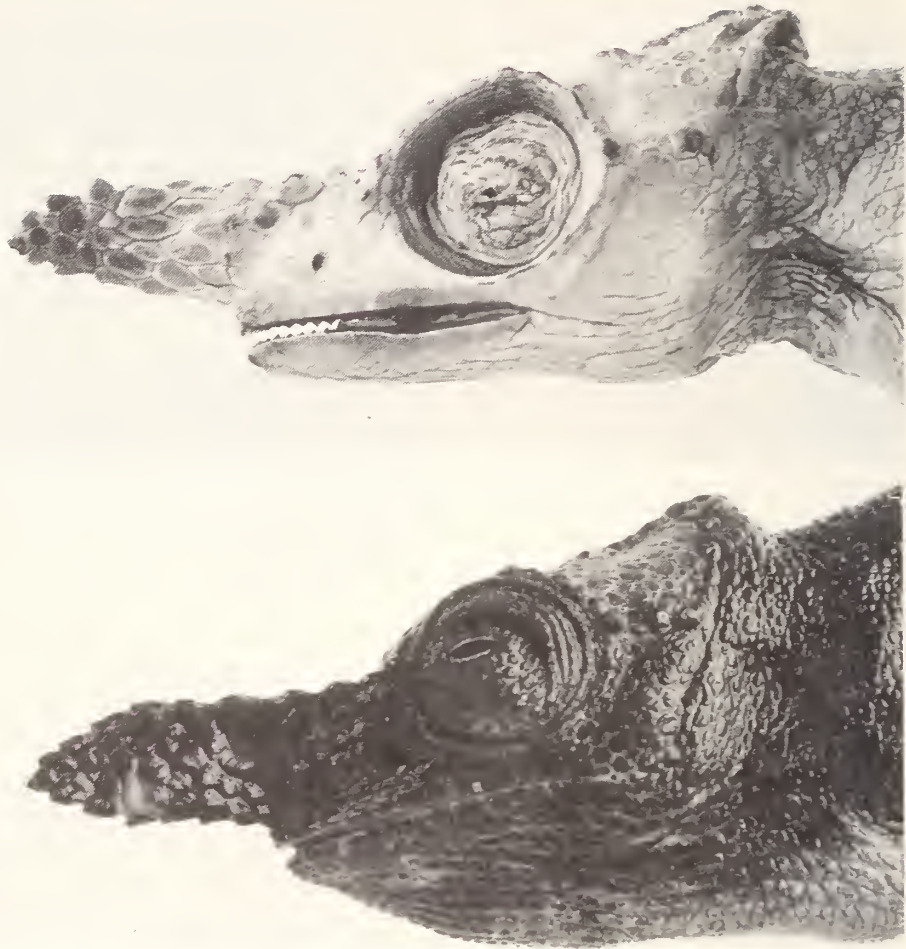


Fig. 5: Lateral view of the head of the males of *B. oxyrinum* (above ZFMK 46406, below ZMUC 51376).

discoloration of pigments is likely to have occurred. Field notes on the life coloration of the second paratype confirm this view as they read: head: blue, dorsum: green, tail: blue and throat: yellow. Today this preserved specimen shows a general brown colour with lighter shades on the flanks, limbs and tail.

Distribution: Uluguru Mts. and Uzungwe Mts., Tanzania.

Affinities: *B. oxyrinum* is closely related with *B. tenue*, with which it was confounded since Werner (1902) described two of the three specimens known as *B. tenue*. *B. spinosum* (Matschie, 1892) is the only other African species of the genus *Bradypodion* that possesses a flexible rostral appendage (in both sexes). Although it is probably related to *B. oxyrinum* and *B. tenue* it is to be distinguished from them by the shape of the rostral appendage and the heterogeneous body-scalation with numerous elongate soft tubercles on the body, limbs and tail. The present study furnishes no new information as to the relationship with other species of the genus *Bradypodion*. Species of the *Calumma nasuta*-group from Madagascar (cf. Klaver & Böhme, 1986) have a similar general appearance and a similar rostral appendage in either one or both sexes (Mertens, 1933 and Brygoo, 1971 & 1978). However, Klaver & Böhme (1986) and Böhme (1988) demonstrated the similar external morphology to be symplesiomorphous and the similar rostral appendages to be parallel



Fig. 6: Dorsal view of the head of the lectotype of *B. tenue* (ZMB 11348: 1, left) and the holotype of *B. oxyrhinum* (ZFMK 46406, right).

developments in distantly related groups that evolved from the same ancestral stock. Ecology and geography: The scant field notes and records in literature report *B. tenue* to be captured from lowland forest (ZFMK 38677), from bushes (BMNH 1974.523 & 524), from long grass (Barbour & Loveridge, 1928) and from a forest edge habitat (Loveridge, 1939). *B. oxyrhinum* was captured in the Mwanihana forest (ZMUC 51376). It seems that both species occur in bushes and forest patches from low to (sub-)montane elevations, viz. Shimba Hills, Usambara Mts., Uluguru Mts. and Uzungwe Mts. Barbour & Loveridge (1928) compared the herpetofaunae of the Usambara Mts. and the Uluguru Mts. and established close links between the herpetofaunae confined to these isolated mountainous regions. The present paper proves their analysis at least partly wrong as they still considered *B. oxyrhinum* and *B. tenue* conspecific. *B. tenue* occurs in the Usambara Mts. and the Shimba Hills in the north, whereas *B. oxyrhinum* links the Uluguru Mts. with the Uzungwe Mts. in the south. In this respect the situation in *B. oxyrhinum* and *B. tenue* resembles more the one found in some African members of the gekkonid genus *Cnemaspis* as discussed by Perret (1986). *C. barbouri* from the Uluguru Mts. seems to be more closely related to *C. uzungwae* from the Uzungwe Mts. than either of them is to *C. africanus*. *C. africanus* is distributed in Tanga, Usambara Mts., Mt. Kilimanjaro and

Mt. Meru in Tanzania and in the Taita Hills and Athiplain in Kenya. As to the Uluguru Mts. and the Uzungwe Mts. Perret (1986) distinguished two species (though of *C. uzungwae* only one specimen is known), whereas we consider the chameleons involved to be conspecific. When more material becomes available the morphological differences between *B. oxyrhinum* from the Uzungwe Mts. (noted elsewhere in this paper) and the specimens from the Uluguru Mts. may eventually prove to be constant and justify a subspecific status. This does not, however, alter the closer affinity between the Uluguru and Uzungwe Mts. populations of chameleons with a flexible rostral appendage as compared with those of the Usambara Mts. and the Shimba Hills.

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Zusammenfassung

Die Auswertung aller publizierten Informationen über *Bradypodion tenue* (Matschie, 1892) und die Untersuchung aller verfügbaren Sammlungsstücke ergaben, daß zwei Arten involviert sind: das eigentliche *B. tenue*, beschränkt auf die Usambara-Berge (Tansania) und die Shimba Hills (Erstnachweis für Kenia), und *B. oxyrhinum* n. sp. von den Uluguru- und Uzungwe-Bergen. Die zoogeographischen Beziehungen werden diskutiert.

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