

TANZANIAN BUFONID DIVERSITY: PRELIMINARY FINDINGS

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The toad family Bufonidae is being studied as part of a review of Tanzanian amphibians. The current list includes 6 genera (one undescribed), and 28 described and undescribed species. This represents 40% of the bufonid genera and 31% of the bufonid species known in sub-Saharan Africa. Two genera and fifteen species are considered to be endemic. Tanzania appears to have the richest bufonid fauna of any sub-Saharan country. Bufonid distribution conforms with the tendency in Tanzania towards marked differences between upland and lowland biotic communities. Separation of the Afromontane *Nectophrynoides* and the lowland *Mertensophryne* and *Stephopaedes* is particularly striking. Fifty-seven per cent of the bufonid species recorded in Tanzania appear to be associated with forest. Precise data concerning the rate and extent of forest disturbance and deforestation are lacking, and the potential for forest-associated bufonids to survive these perturbations is unknown. Effective conservation action requires more information and improved understanding of the many factors involved.

INTRODUCTION

The author is part of an informal network of scientists currently working on the amphibian fauna of Tanzania. This paper reports on the first phase of a study of the toad family Bufonidae, which brings out the extraordinary richness of the Tanzanian amphibian fauna. Work is based on material in the Natural History Museum, London (NHM), augmented by loans particularly from the American Museum of Natural History, New York (AMNH); Museum of Comparative Zoology, Cambridge (MCZ); and Muséum National d'Histoire Naturelle, Paris (MNHN).

Bufonid taxonomy throughout sub-Saharan Africa lacks proper analysis, and inadequate sampling gives a very incomplete picture of species' ranges. I estimate that some 89 bufonid species can presently be discerned in the subcontinent. Twenty-eight of these (31% of the total) occur in Tanzania, a number which surpasses even Cameroon's reported total of some 24 species to reveal Tanzania as having the richest bufonid fauna in Africa according to current taxonomic assessment.

Fifteen endemic bufonid species can so far be recognized in Tanzania (54% of the total), although some of these may yet be found in northern Mozambique or north-eastern Zambia, areas that are still poorly collected. The following species list indicates Tanzanian endemics by an asterisk, and outlines total range and habitat type. In Tanzania, diversity within the genus *Bufo* is considerable not only at species level. To indicate the degree of high-ranking diversity, species are grouped according to the 'divisions' of Poynton (1996). Classification of land cover follows Thompson (1996).

BUFO LAURENTI

(1) *FUNEREUS* DIVISION

Bufo fuliginatus Witte. Upland areas of south-western Tanzania, northern Zambia and southern Zaire. Woodland to forest.

**Bufo reesi* Poynton. Kihanzi-Kilombero floodplain, southern Tanzania. Floodplain grassland.

Bufo steindachneri Pfeffer. North-eastern Tanzania, Kenya, eastern Uganda, Somalia across to northern Nigeria. Wooded grassland and bushland.

(2) *KERINYAGAE* DIVISION

Bufo kerinyagae Keith. Highland areas of Tanzania, Uganda, Kenya, Ethiopia. Grassland and cleared forest.

(3) *MACULATUS* DIVISION

Bufo maculatus Hallowell. Sub-Saharan Africa excluding most of Botswana, Namibia and South Africa. Wooded grassland to forest edge.

(4) *REGULARIS* DIVISION

Bufo gutturalis Power. South-eastern Uganda and Kenya to the Eastern Cape, westwards to Angola-Namibia. Wooded grassland to forest edge.

Bufo kisoensis Loveridge. Highland areas of Kenya, Uganda, Rwanda, eastern Zaire, western Tanzania, northern Malawi. Forest.

Bufo xeros Tandy, Tandy, Keith & Duff-MacKay. Tanzania to Senegal. Sparsely wooded grassland and thicket.

(5) *SUPERCILIARIS* DIVISION

**Bufo brauni* Nieden. Eastern Arc Mountains of Tanzania, but not the southern highlands. Forest to forest edge.

(6) *TAITANUS* DIVISION

Bufo lindneri Mertens. Eastern Tanzania, northern Mozambique, south-eastern Malawi. Wooded grassland.

Bufo taitanus Peters. South-western Kenya, mainly western Tanzania, Malawi, northern Zambia. Wooded grassland.

**Bufo uzunguensis* Loveridge. South-western Tanzania. Swampy grassland.

**Bufo* sp. (*lonnbergi* complex). South-western Tanzania. Probably grassland.

(7) *URUNGUENSIS* DIVISION

Bufo urunguensis Loveridge. Mountains in Tanzania and Zambia bordering southern end of Lake Tanganyika. Woodland to forest.

(8) *VERTEBRALIS* DIVISION

Bufo parkeri Loveridge. Lake Natron Basin of Tanzania and Kenya. Sparsely wooded grassland.

SCHISMADERMA SMITH

Schismaderma carens (Smith). Tanzania, south-eastern Zaire, to Eastern Cape border. Wooded grassland.

NECTOPHRYNOIDES ROUX

**Nectophrynoides cryptus* Perret. Uluguru Mountains above 2000 m. Forest.

**Nectophrynoides minutus* Perret. Uluguru Mountains at about 1500 m. Forest.

**Nectophrynoides tornieri* (Roux). East Usambaras through to the Udzungwas between about 1500 m and 500 m; not lowland forests. Forest or forest margins, including plantations of exotics.

**Nectophrynoides viviparus* (Tornier). Southern Tanzanian highlands and (possibly a different form) the Uluguru Mountains. Forest.

**Nectophrynoides wendyae* Clarke. Udzungwa escarpment. Forest.

**Nectophrynoides* sp. West Usambaras. Forest.

**Nectophrynoides* sp. Uluguru North Forest Reserve. Forest.

**Nectophrynoides* sp. Kihansi Falls, Udzungwa Range. Forest.

UNDESCRIBED GENUS

**Nectophrynoides*-like species, undescribed. High Ukaguru mountains. Forest.

STEPHOPAEDES CHANNING

**Stephopaedes loveridgei* Poynton. South-eastern Tanzania. Forest, forest edge and woodland.

**Stephopaedes* sp. North-eastern Tanzania (including Mafia Island). Forest.

MERTENSOPHRYNE TIHEN

Mertensophryne micranotis (Loveridge). Eastern Tanzania (including Zanzibar and Songo Songo islands) and south-eastern Kenya. Forest or woodland.

BUFO AND *SCHISMADERMA*

Species of the genus *Bufo* occupy a wide spectrum of habitats in Africa ranging from semi-desert to forest, although the highest species diversity is in moist and relatively cool areas (Poynton, 1996). Tanzania provides a complete range of these habitats, apart from

semi-desert, as reflected by the absence of members of the *arabicus* and *blanfordii* divisions of the arid Horn of Africa. During drier phases of the Quaternary, Tanzania was evidently part of an 'arid corridor' which connected the flora and fauna of north-eastern and south-western Africa (Poynton, 1995). Among bufonids, residual fragments of this arid corridor appear to be represented by the very limited, disjunct distribution in Tanzania of *B. xeros*, an arid savanna member of the ecologically diverse *regularis* division. *B. garmani*, another member of the *regularis* division inhabiting dry savannas, shows a patchy distribution with no confirmed records in Tanzania; its distribution pattern may also represent fragments of the arid corridor (Poynton, 1995). Tanzania is also included in a break in the known distribution of the mainly dry-savanna *vertebralis* division of small-sized toads (Poynton, 1995). *B. parkeri* is the only member of this division known to occur in Tanzania, recorded in the Lake Natron Basin.

The *taitamus* division of small-sized toads, whose members show a preference for open but moister situations, is represented by *B. lindneri*, *B. taitamus*, *B. uzunguensis*, and a hitherto unrecognized species of the *lonnbergi* complex from Mbeya Mountain in the south (Poynton, in press). This complex is currently recorded from grassy highlands of Malawi and Kenya (Poynton, in press); a single NHM specimen which cannot be assigned to the Malawian or Kenyan taxa indicates that this complex is also represented in high open situations in Tanzania.

Grassy highland is an important element of the Afromontane region (Meadows & Linder, 1993); *B. kerinyagae*, apparently most closely related to *B. asmarae* of Ethiopia, is limited to it. The southern record of this species is the Ngorongoro Crater rim in Tanzania.

The widespread savanna member of the *regularis* division, *B. gutturalis*, is well represented in Tanzania, as is the similar *B. maculatus*. *B. reesi* of the ecologically diverse *funereus* division is known only from a small area of open floodplain. Its limited known range is probably a reflection of limited collecting in Tanzania. *B. steindachneri*, another member of the *funereus* division, reflects the same situation; this species is based on a single specimen collected near the eastern edge of the Nguru Mountains in 1888, deposited in the Hamburg Museum but destroyed in World War II. It is still the only Tanzanian record of the species. Specimens that appear to belong to this species have been collected from the Kenyan coastal lowlands and beyond, but their identification needs to be confirmed by fresh topotypic material. Another member of the *funereus* division, *B. fuliginatus*, appears to be a vicariant of *B. funereus* centred in Zaire; hitherto unrecorded in Tanzania, the NHM has a specimen collected in the last century apparently in highlands west of Lake Rukwa.

B. fuliginatus may be included among the four mainly forest-associated *Bufo* species in Tanzania, the remainder being *B. kisoensis*, *B. brauni* and *B. urunguensis*. *B. kisoensis* is a montane member of the *regularis* division, hitherto unrecorded in Tanzania but represented by two NHM juveniles from the Mahale Mountains bordering Lake Tanganyika; the species could well occur in several patches of montane forest in under-collected western Tanzania. *B. brauni*, common in forests above 500 m, is closely related to *B. superciliaris* of West African forests. The affinities of *B. urunguensis* have yet to be determined.

This rich mix of *Bufo* species has exploited all terrestrial and freshwater habitat types in Tanzania with the exception of lowland forest; no known species of *Bufo* is restricted to it and none enter deeply into it. The known distributions of all *Bufo* species are patchy and show the need for systematic sampling; nevertheless, the available data suggest a separation of much of the toad fauna into lowland and upland or Afromontane elements, whether in wooded or open habitats. This separation has been recognized for many years (Loveridge, 1937; Poynton, 1962), but locality data are still insufficient to allow the degree of analysis and quantification now possible in more southern areas (Poynton & Boycott, 1996).

Schismaderma carens, another large-sized toad, reaches its known northernmost limit in Tanzania. At present no ecological explanation is available for its limitation in the region, although its preference for deep pools or impoundments for breeding may limit its distribution in the drier north.

NECTOPHRYNOIDES, MERTENSOPHRYNE AND STEPHOPAEDES

Of special interest is the occurrence of the montane *Nectophrynoides* and an undescribed related Ukaguru Mountain form, and the more lowland *Mertensophryne* and *Stephopaedes*. All these small-sized bufonids are associated with forest and do not breed in open water. *Nectophrynoides* (*sensu* Dubois, 1987) is recorded only from Tanzania. Eggs are retained in the oviduct in species whose larval stage is known, and fully formed individuals emerge from the vent. The selective advantage of this retention still has to be investigated in detail. The ranges of most species are limited to particular forest blocks, no doubt the result of vicariation in ecologically isolated areas of montane forest. The number of known species is rapidly increasing as more forests become explored.

In contrast to the ovoviparous *Nectophrynoides*, *Mertensophryne* and *Stephopaedes* lay eggs in water-filled treeholes and other small containers that are normally available only in forests (references in Poynton, 1991). The tadpoles of both genera are very similar, although the adults differ sufficiently to suggest generic separation (Poynton, 1991). The

distribution of these toads is in lowland or transitional forest in south-eastern Kenya, Tanzania, and eastern Zimbabwe (Grandison & Ashe, 1983; Poynton & Broadley, 1988; Poynton, 1991). The ranges of the East African species are more extensive than those of most *Nectophrynoides* species, which is evidently linked to the more continuous distribution of lowland forest throughout the Quaternary (Livingstone, 1993). In the case of the two Tanzanian *Stephopaedes* species, vicariation may have resulted from range separation caused by the Great Ruaha-Rufiji Basin. The undescribed species that occurs north of this gap shows a very fragmented range which suggests it is verging on extinction.

The altitudinal separation between the *Nectophrynoides* group and *Mertensophryne/Stephopaedes* is part of a general pattern shown by eastern Tanzanian forest amphibians. *Nectophrynoides* appears to belong to a mainly Afromontane group whose members are distributed from Table Mountain in the Cape through East Africa and Ethiopia to West African mountains (Grandison, 1981; Gauld & Underwood, 1986). The taxonomic affinities of *Mertensophryne* and *Stephopaedes* have yet to be clarified; a knowledge of their history should contribute to understanding the broader issues of biogeography and evolution in East Africa.

SURVIVAL PROSPECTS

Some 57% of the Tanzanian bufonid species are associated with forest. While destruction of forest in Tanzania is widespread, there is little precise information about where it is occurring and how rapidly it is taking place (Anon. 1995). Also lacking is precise information about the extent to which forest-associated amphibians can survive deforestation. Howell (1993) recorded *B. brauni* remaining in deforested areas 'as long as adequate cover of some dense vegetation persists,' and the same appears true of many other 'forest' amphibians (Poynton, 1996). It is, however, not known how long such species may continue breeding in disturbed conditions. Informed and effective conservation action requires an improved knowledge of the rate, extent, and the short and long-term effects of forest disturbance and deforestation. It may be hoped that this will be achieved before the opportunity to study the wide range of natural communities is lost.

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