# The "arid corridor" distribution in Africa: a search for instances among amphibians

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ABSTRACT

Marked similarities exist between the flora and fauna of the arid southwestern and northeastern corners of Africa. Among amphibians, a tendency towards this distribution is shown by vicariating species of the *Bufo vertebralis* group, by the *B. garmani/pseudogarmani/poweri* complex, and by *Tomopterna cryptotis*. In all of these, greater taxonomic complexity is present in the south, and ranges include the moister southeast.

## INTRODUCTION

Marked similarities between the fauna and flora of the arid southwestern and northeastern corners of Africa have been commented on by several authors (e.g. Balinsky 1962; Werger 1978; Kingdon 1990). A strip of relatively arid country still connects the two areas through western Tanzania, and particularly during dry phases of the Quaternary there probably existed a substantial "drought corridor" or "arid corridor" (Balinsky 1962; Werger 1978) allowing xeric faunal and floral interchange between the southwest and northeast.

Several species of mammals, birds and plants currently show populations isolated in the arid southwestern and northeastern corners of the continent (Werger 1978; Kingdon 1990), but amphibians do not appear in such lists. They might indeed not be expected to show this pattern on account of a supposed vulnerability to drought. Nevertheless, during the course of a review of distribution patterns of African amphibians, centred in the Natural History Museum, London, a search has been made for distribution patterns that suggest connections, present or past, between the dry southwest and northeast areas of the continent. This paper reports on two groups of bufonids and a ranid species (possibly a species complex) which have been found to show at least a tendency towards an "arid corridor" distribution.

The genus *Bufo* could be expected to exhibit the clearest instances of a southwest to northeast connection, since many *Bufo* species are confined to arid parts of Africa. It has to be said that the determination and definition of African amphibian species is still in a rudimentary state, with the result that the groundwork has barely been set for phylogenetic analyses. In the case of *Bufo*, species grouping has been attempted in various ways other than phylogenetic analysis, without complete agreement being reached (Tandy & Keith 1972; Poynton & Broadley 1988). Nevertheless, it is noticeable that some generally accepted groups within the genus are composed entirely of species distributed in more arid parts of the continent and, in some cases, the adjoining Arabian Peninsula and beyond. Species in Africa that are assignable to these groups are reviewed first, after which consideration is given to other *Bufo* species that occur mainly in arid areas, but which are assignable to ecologically more heterogeneous groups.

## XERIC GROUPS OF *BUFO* IN AFRICA

The following groups, composed entirely of xeric species of *Bufo*, are based on the current survey of amphibians in the collection of the Natural History Museum, London. They do not correspond exactly with any published grouping. Only African species are listed here.

*B. blanfordii* group. Northern Somalia, Ethiopia, northern Kenya. *B. blanfordii*, *B. langanoensis*, *B. turkanae*.

*B. mauritanicus* group. Northwest Africa, relict patches in the western Sahara to the northern bend of the River Niger. *B. mauritanicus*.

*B. orientalis* group. Southeastern Egypt, Ethiopia, Somalia, Arabian Peninsula. *B. dodsoni*.

*B. pentoni* group. Mauritania to Red Sea, Arabian Peninsula. *B. pentoni*.

*B. vertebralis* group. Southern Africa (mostly southwestern) to Somalia. *B. damaranus*, *B. dombensis*, *B. fenoulheti*, *B. grandisonae*, *B. hoeschi*, *B. lughensis*, *B. parkeri*, *B. vertebralis*. It is uncertain whether *B. kavangensis* belongs more properly to this group of dwarf toads, or to the hardly separable *B. taitanus* group, occurring mainly in moister areas, and discussed below. Namibian taxa in particular still require definition and delimitation (Poynton & Broadley 1988; Poynton & Haacke 1993).

*B. viridis* group. North Africa, Middle East, Europe. *B. brongersmai*, *B. viridis*.

It may be seen that only one of these groups is not restricted to the northern part of the continent, namely the *vertebralis* group, which has representatives in southern Africa, as well as in Tanzania, Kenya, Ethiopia and Somalia (Fig. 1). The relationship between northeastern and southern taxa was first commented on by Tandy (1972) and Tandy and Keith (1972). Tandy (1972) considered that while relationships were not clear between the large-sized *B. dombensis* of Namibia and *B. lughensis*

of Kenya and Somalia, and between *B. fenoulheti* of southeastern Africa and *B. parkeri* of Tanzania and Kenya, nevertheless, "Further study may reveal that these pairs of 'species' represent allopatric populations of a single species."

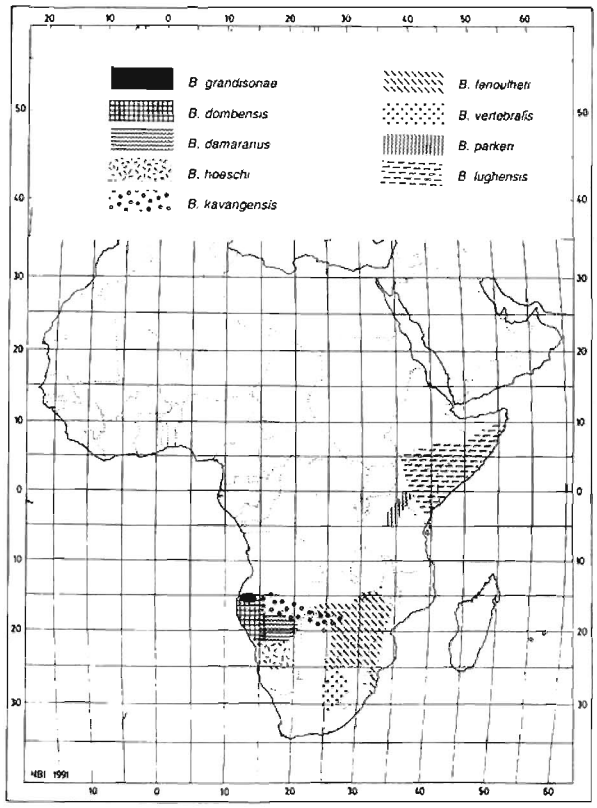


FIGURE 1: Areas occupied by species of the *Bufo vertebralis* group.

It has been confirmed in the present study that *B. lughensis* differs from *B. dombensis* in having a spotted ventral surface and a more extensive margin of web; while *B. parkeri* differs from *B. fenoulheti* also in having ventral speckling, and in having a narrower head (in the very limited material available), being 36% of the body length in contrast to over 40% in *B. fenoulheti*, and in having a clearly marked canthus. Consequently, while many similarities exist, there seems to be no reason for treating the four taxa presently recognized as being two species with disjunct populations.

The *vertebralis* assemblage therefore has the appearance of a highly vicariating species group, and while no single species shows the arid corridor pattern, the group as a whole forms a chain of species from Namibia-southern Angola to the Horn of Africa, with substantial breaks only in Zambia and Tanzania. The areas occupied by the various species are indicated in Fig. 1. The word "indicated" is used deliberately, since the taxonomy of this group has not yet been fully clarified, and species ranges are still inadequately known. Present evidence suggests that ranges of the different species show little or no overlap, although, particularly in the case of *B. dombensis* and *B. damaranus*, a complex situation might be found to exist: the taxonomic and distributional pictures regarding these two forms are still especially unclear (Poynton & Broadley 1988; Bauer *et al.* 1993; Poynton & Haacke 1993).

The tendency towards non-overlapping ranges is also evident in the closely related group of dwarf toads, the *taitanus* group, occurring mainly in moister areas of east and south-central Africa (*B. beiranus*, *B. lindneri*, *B. lonnbergi*, *B. taitanus*, *B. uzunguensis*, and perhaps *B. kavangensis*). This tendency has still to be explained. Also still to be explained is why the *vertebralis* group has undergone such prolific vicariation in the arid southwest.

## OTHER XERIC *BUFO* SPECIES

The above listing of *Bufo* species belonging to xeric groups leaves out of account three species and a species complex that are distributed mainly in arid areas, although the groups to which they are assignable also contain species with mesic to moist distributions.

*B. gariepensis* of the *angusticeps* group is distributed widely in the Karoo. Members of the *angusticeps* group (*B. amatolicus*, *B. angusticeps*, *B. gariepensis*, *B. inyangae*) are restricted to southern Africa, most species in relatively moist areas, and appear to show no particularly close affinities with any other division of *Bufo*. The distribution of *B. gariepensis* therefore does not seem very informative in the present context.

*B. steindachneri* of the *funereus* group is distributed from southern Somalia to northern Nigeria. Most species recognized in this paper as belonging to the group (*B. fuliginatus*, *B. funereus*, *B. kassasii*, *B. reesi*, *B. steindachneri*, *B. villiersi*, *B. vittatus*) occur in relatively moist areas. The distribution of *B. steindachneri* again does not seem very informative in the present context.

*B. xeros* of the *regularis* group is distributed from western Senegal across to Somalia and south to northern Tanzania. Most members of the *regularis* group, as here recognized (*B. garmani*, *B. gutturalis*, *B. kisoloensis*, *B. poweri*, *B. rangeri*, *B. regularis*, *B. xeros*), are geographically wide-ranging and ecologically catholic. As the name *B. xeros* implies, this species is restricted to more arid areas than other members of the *regularis* group, apart from the species complex to be considered next. Tandy *et al.* (1976) listed specimens from Chavuma in western Zambia as *B. xeros*, which could then suggest the existence of an interrupted arid corridor distribution. But Poynton and Broadley (1988) consider the identification to be questionable. Positive identification based on calling is needed to establish whether this distribution exists.

The taxonomically unresolved species complex *B. garmani/pseudogarmani/poweri*, also of the *regularis* group, has a range indicated in Fig. 2. *B. garmani* has been collected in northern Somalia through Ethiopia and western Kenya, but has not been reliably recorded from western Tanzania. Records continue in the Luangwa region of Zambia and to southern and western Zimbabwe where, in a belt from southern Mozambique-northern KwaZulu/Natal to Namibia, it undergoes complicated intergrading with *B. poweri*, and also with a possibly distinct *B. pseudogarmani*, centred in southern Angola, most of Namibia and central Northern Cape (Poynton &

Broadley 1988) . "Typical" *B. poweri* can be distinguished from "typical" *B. garmani* both morphologically (Poynton & Broadley 1988) and by call (Channing 1991), but in the wide belt of intergrading it is not yet clear whether or not a degree of independent assortment or merging occurs in these characters.

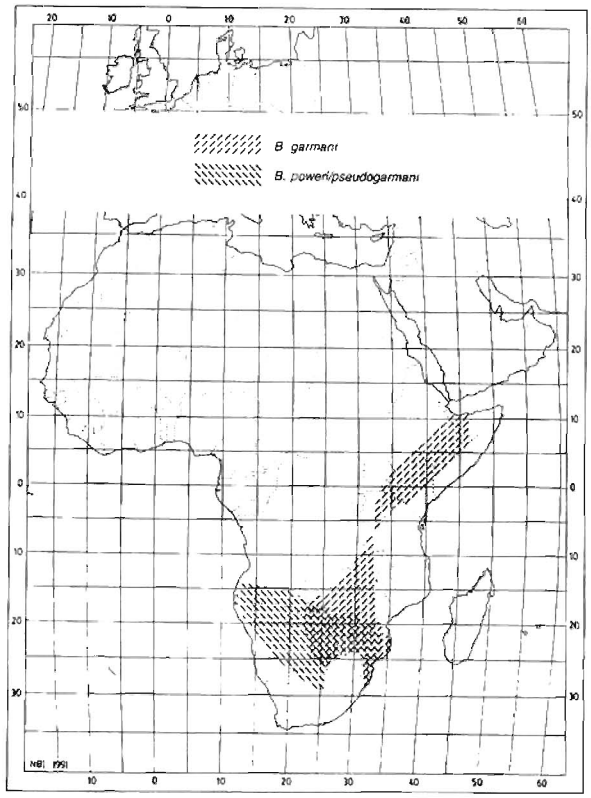


FIGURE 2: Areas occupied by members of the *Bufo garmani* complex.

The apparent gap in the distribution of *B. garmani* in Tanzania may reflect the extinction of populations of this species from the now relatively moister region of the arid corridor. This species complex therefore exhibits some features of the interrupted arid corridor distribution pattern, although the distribution and taxonomic complications in the south are not typical of the arid corridor pattern .

## NON-BUFONIDS

Among non-bufonids, *Tomopterna cryptotis* deserves some notice in the present context. It is the commonest frog in Namibian collections (Poynton 1964; Bauer *et al.* 1993), and is widespread in Somalia (Lanza 1981). This is reflected in the Natural History Museum collection by many specimens from the northeast and southwest, but only six specimens from Kenya and Uganda, and only one from Tanzania. Yet, as with the *Bufo* examples just considered, *T. cryptotis* is also distributed in less arid parts of southern Africa; it also is associated with taxonomic complexity in the south ( Poynton & Broadley 1985). Some complexity could be shown in other parts of its range: specimens collected in dry parts of West Africa have been assigned to this species, but the material is too limited to allow a clear taxonomic and distributional assessment.

It can be said that the species only partly shows any kind of arid corridor distribution pattern.

## DISCUSSION

While the interrupted arid corridor distribution pattern is shown to some extent by the *vertebralis* group, the *B. garmani/pseudogarmani/poweri* complex, and apparently less so by *T. cryptotis*, the unusual feature in all is the taxonomic complexity currently evident in populations in the south of the continent compared with the north, and their occurrence also in the moister southeast. It is not clear why *B. garmani* and members of the *vertebralis* group do not occur west of Ethiopia in the arid Sudan or Sahel zone. The restricted distribution in the northeast could be an indication of relatively recent occupation of the region, which would suggest southern origins, a possibility not inconsistent with the greater taxonomic complexity in the south. At present, there seem to be no means of evaluating the likelihood of this suggestion.

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