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INTRODUCTION

Recent field studies including work on acoustic behavior have revealed a new species of *Bufo* belonging to the *Bufo regularis* group. This species is similar morphologically to several other species of the *B. regularis* complex, but its mating call is distinctive. On the basis of this behavior, the species was recognized by Duff-MacKay during 1951–71 and Keith during 1960–65 as different from sympatric species in eastern Africa. Mills Tandy also noticed that the voice of this species differed from those of other toads during field work in Kenya in 1965. In 1970, the Tandys acoustically recorded the species as far west as Chad. Later, Amiet found it in northern Cameroun (Amiet, 1973). Study of museum collections indicates that the species extends west to Senegal and at least as far south as Tanzania in dry savanna and desert regions. It may occur in southwestern Angola.

The nomenclature of the new species has been in doubt. Keith (1968) first thought that it was *Bufo gutturalis* Power. This opinion was based primarily on Power's (1927) description of the mating call of *B. gutturalis* as being similar to that of the Blue Crane (*Tetrapteryx paradisea*). Field work by the Tandys in 1970–71 revealed that *B. gutturalis* referred not to the new species described in this paper but rather to what Tandy and Keith (1972) and others termed "*B. regularis* East". A recording of the voice of the Blue Crane was obtained in 1971 with the aid of the McGregor Museum, Kimberley, South Africa; this recording resembles "*B. regularis* E." Furthermore, field work in South Africa indicates that the new species apparently does not occur there, although the voice of *B. poweri* Hewitt (1935) might be mistaken for it. Because of doubt about nomenclature, Tandy and Keith (1972) referred to the new species as "*Bufo* sp." Tandy (1972) and Tandy and Tandy (in press a) have used "*Bufo* sp. C" for this species.

We have studied one specimen in the Museo Bocage (MB324) from Dombe, Benguella Province, Angola, which morphologically closely resembles the new species. However, it could also be a specimen of *B. gutturalis* Power, *B. maculatus*, or a hybrid between various *B. regularis* group species that occur in that area. The museum record of MB324 is labeled "*B. regularis spinosus*" and it may be the specimen on which Bocage (1867) based his *Bufo spinosus* (preoccupied by *B. spinosus* Daudin, 1803). Bocage's description more closely resembles other specimens from Angola which appear to be *B. gutturalis* Power. Because of uncertainty of the identification of MB324 and the discrepancy between Bocage's description and the morphology of our new species, we do not list *B. spinosus* as a synonym of the new species and do not list MB324 under "other material." Because of the homonymy, Bocage's name *spinosus* is not available for any bufonid. It would not be surprising if the new species or a closely related one later were proved to occur in southwestern Angola. A similar geographic pattern is shown among *B. dombensis*, *B. fenoulheti*, *B. parkeri* and *B. lughensis of* the *B. vertebralis* complex, except that that complex is apparently not represented in sahelian western Africa. The purpose of this paper is to establish a valid name for the species, to clarify many literature references to it and to present additional data relating to its geographic distribution.

Terminology and methods of data collection and analysis are given in Tandy (1972), Tandy and Keith (1972) and Tandy and Tandy (in press a) and will be treated further in Tandy and Tandy (MS).

Specimens and tape recordings used are presented in this format:

Country

Locality name; Geographic coordinates; Sex and collection numbers of specimens; Collection numbers of tape recordings; Altitude; Date of collection; Collector.

The following abbreviations are used for collection numbers:

A	Collection of A. Duff-MacKay, National Museum, Nairobi
AMNH	American Museum of Natural History, New York
H	Natural History Museum, Addis Ababa
ISB	Institut royal des Sciences Naturelles de Belgique, Bruxelles
KTCK	Collection of tape recordings of R. Keith; tape cut from Kenya
MB	Museo Bocage, Lisboa
MCSG	Museo Civico di Storia Naturale in Genova
MCSM	Museo Civico di Storia Naturale in Milano
MHNG	Museum d'Histoire Naturelle, Genève
MT	Collection of M. Tandy
MT( )	Reference number of M. Tandy assigned to specimen of collection indicated within brackets
MT.TCC	Collection of tape recordings of M. Tandy; tape cut from Chad. Also Et—Ethiopia; K—Kenya; S—Somalia
MZUM	Museum of Zoology, University of Michigan, Ann Arbor

P Collection on loan from Maxime Lamotte, Paris
TNHC Texas Natural History Collection, Texas Memorial Museum, University of Texas, Austin

Bufo xeros n. sp.

Bufo regularis regularis; (not of Reuss, 1834); Gans, Laurent and Pandit, 1965:17.

Bufo gutturalis (not of Power, 1927); Guttman, 1967:48–49, 51, 64–66; Bogart 1968:44; Blair, 1969:323–324; Scheel, 1973:115; Blair, 1972a: Appendix H (crosses 66–110, 66–304, 66–308); Bogart, 1972:188, 365, 378 (chromosomes figured), 381, 386; Cei, Erspamer and Roseghini, 1972:241; Guttman, 1972:268 (Fig. 14–2); Martin, 1972:297, 300, 447; Tandy and Keith, 1972: 134.

Bufo regularis gutturalis; (not of Power, 1927); Keith, 1968:14.

Bufo sp. C; Tandy, 1972:v, x, 15, 31, 34–35 (sonagrams of mating call), 53–54, 58, 78–79, 90, 94–95, 97–98 (part), 104–105, 111–116, 128–131, 170–173, 176–177, 184; Tandy and Tandy (in press a).

Bufo garmani (not of Meek, 1897) ;Tandy, 1972:85 (Table 4, part), 87–89 (Table 7, Fig. 24B and E, part), 90 (part); Tandy and Keith, 1972:138–140 (Fig. 9–11B and E, Tables 9–4 and 9–7, part).

Bufo sp.; Blair, 1972a:216–217, Appendix H (cross 65–463), 355; Guttman, 1972:275; Low, 1972:257; Tandy and Keith, 1972:125 (Table 9–1, Somali region), 127–133 (sonagrams of mating call), 136–137, 140–141, 143 (part in Table 9–9), 144, 146–148, 151, 153, 159, 163; Amiet, 1973:67–68; Böhme, 1975:12.

Bufo regularis gp. sp.; Blair, 1972b: Appendix K–1.

Bufo maculatus; (not of Hallowell, 1854); Bogart, 1972:378 (Mtito Andei, Kenya).

Holotype: An adult male (TNHC39376 = MT1754 and MT.TC.Et 12) from Ghinda, Eritrea, Ethiopia, Station 32 (15°26′N, 39°05′E, altitude 940 m), collected August 30, 1970, by M. Tandy.

Paratypes: 8 adult males (TNHC39377 = MT1762 and MT.TC.Et 37; 39380 = 1783 and Et 27; –81 = 1784 and Et 16; –82 = 1785 and Et 40; –83 = 1788 and Et 19; –84 = 1791 and Et 31; –390 = 1782 and Et 14; –91 = 1786 and Et 17; –92 = 1787 and Et 35) and 1 adult female (TNHC 39393 = MT1790) same collection data as holotype.

Other material:

Cameroun

Garoua; (Amiet, 1973).

Chad

N'djamena (= Ft. Lamy); ♂ ♂ MT(P) 6220, –24, 6226, ♀ ♀ 6217, –22–23, –25; 2/VII/64; Gruvel. ♂ MT(P) 6221; 2/VIII/64; Gruvel. ♂ ♂ im. MT(P) 6188, –92, –96, –98–99, ♀ ♀ im. –89–91, –97; (Farcha); 10/VIII/64; Gruvel. ♂ ♂ MT(P) 6216, ♂ im. 6208, ♀ im. 6215, –18, –19, im. (not sexed) 6206–07, –09–13; (Farcha); 30/VIII/64; Gruvel. ♂ ♂ MT 1437, –39, –48, –61, –66, –80, –84, –86–87, –92, TNHC 38855, 38938–44, ♀ ♀ MT 1434,

1557–58, 1580–81, TNHC 41542, –44; 23–25/VII/70; J. & M. Tandy.

Ethiopia

Agordat, Eritrea; (Tandy & Tandy, MS).

Dolo; 04°11′N, 42°03′E; ♂ MCSG 29578; alt. ≈ 35 m; /11; Citerni.

Ghinda, Eritrea; ♂ TNHC 41519; alt. 960 m; 31/VIII/70; M. Tandy; (Tandy & Tandy, MS).

east of Metahara; 08°55′N, 39°57′E; ♂ ♂ H.39.A–B; alt. 950 m; 21/VII/68; M. Largen.

east base of Mt. Fantalle Crater, 30 km NE of Awash Falls, Shoa; 08°57′N, 39°54′E; ♀ ♀ im. H.190A–B; alt. ≈ 1200 m; 27/I/67; R. A. Dewey.

near Omo River; 05°22′N, 36°05′E; ♀ ♀ A/431/1–2; alt. 457 m; VI/67; A. Duff-MacKay.

south of Scheraro, Eritrea; ≈ 14°13′N, 37°56′E; ♀ ♀ im. H.343 A–C; alt. ≈ 1000 m; 20/II/71; M. Bolton.

Kenya

Aruba Dam; (Tandy & Tandy, MS).

Dakawachu Tank, Galana Ranch; 02°40′S, 39°42′E; ♂ A/808; alt. 152 m; XI/68; P. E. Leakey.

Galole irrigation scheme; 01°30′S, 40°02′E; ♂ A/1102; alt. 122 m; 7/VIII/70; P. L. Britton.

Garissa; 0°27′S, 39°39′E; ♀ AMNH 75631 (= KTC K.195); alt. 183 m; 7/XII/62; R. Keith.

Kiboko; 02°12′S, 37°43′E; ♂ AMNH 75629 (= KTC K.134), ♂ im. 75630. alt. 975m; 1/X/62; R. Keith.

Kibwezi; (Tandy, 1972; Tandy & Keith, 1972).

Kilaguni Lodge; Tsavo National Park; 02°40′S, 38°09′E; ♀ MHNG 1451.43; alt. ≈ 610 m; 5/XII/74; J. L. Perret & V. Mahnert.

Laisamis; 01°36′N, 37°48′E; ♂ ♂ A/1031/1–3, ♀ ♀ /4–5, juv./6; alt. ≈ 610 m; X/69; R. C. Drewes.

Lokichoggio, N.W. Turkana; 04°12′N, 34°21′E; ♂ A/187/1; alt. 762 m; VIII/66; A. D. Forbes-Watson.

Lokori, S. Turkana; 02°00′N, 36°08′E; ♂ ♂ A/1113/1–6; alt. ≈ 750 m; 23/V/70; M. D. Gwynne. ♀ A/1073/1; VII/70; M. J. Coe.

Loresho Ridge, Nairobi; ♂ AMNH 75619; alt. 1798 m; 17/III/63; R. Keith.

Makere, Tana River; (Tandy & Tandy, MS).

Mtito Andei; (Tandy & Tandy, MS). ♂ ♂ AMNH 75172, 75640 (= KTC K.785); 14/XII/65; R. Keith.

Mzima Springs; 02°59′S, 38°01′E; ♀ A/947/1; alt. 701 m; XII/69; A. Duff-MacKay & A. D. Forbes-Watson.

Ol Tukai, Amboseli; (Tandy & Tandy, MS). ♂ ♂ MT 188–89, ♀ TNHC 33028; 16/XI/65; M. Tandy.

Olorgesailie; 01°34′S, 36°27′E; ♀ A/331/1; alt. 975 m; IV/67; A. Duff-MacKay.

Tarash River, Kakuma, N.W. Turkana; 03°42′N, 34°52′E; ♂ ♂ A/171/1–3; alt. 762 m; 26/VIII/66; A. D. Forbes-Watson.

Teita Hills; (Tandy & Tandy, MS).

Voi; (Tandy, 1972; Tandy & Keith, 1972; Tandy & Tandy, MS). ♂ ♂ A/368/1–6; IV/69; A. Duff-MacKay.

near Voi; 03°20′S, 38°49′E; ♂ ♂ A/355/1–6, ♀ /7; alt. 549 m; IV/69; A. Duff-MacKay.

Niger

Delta de Timia, Air; ≈ 18°09′N, 08°46′E; ♂ ♂ ISB/AIR/1–4, ♀ /5; alt. ≈ 1250 m; 30/VI/74; Fairon.

Senegal

region de Dakar; ≈ 14°40′N, 17°26′W; ♀ im. MT(P) 6187; alt. 37 m; Roy.

Linguéré; 15°23′N, 15°09′W; ♂ P 116; alt. 21 m; 12/IX/67. ♂ P 157, ♂ im. 158, ♀ ♀ im. 155–56, 159; 15/IX/67. ♂ ♂ im. P 230, 234, ♀ ♀ im. 231–33, –35; 24/IX/67. ♂ p 251, ♀ 249, ♀ im. 252; 25/IX/67.

Ndella; ♂ im. P 194; 21/IX/67.

Richard Toll; 16°25′N, 15°42′W; ♂ ♂ MT(P) 6203–05; alt. ≈ 50 m; 5/VII/64. ♂ ♂ im. P 534, –37–38, –41, –43, –45, ♀ ♀ im. –46–47; 9/XI/67.

route de Rufisque; ≈ 14°40′N, 17°15′W; ♀ MT(P) 6200, ♀ ♀ im. 6201–02; alt. 4 m; 30/VIII/61; T. Leye.

Somalia

Afgoi; 02°10′N, 45°06′E; ♂ ♂ MT(MCSM) 486–491; alt. 86 m; 6/IX/37; Vatova & Parenzan. (Gans, Laurent & Pandit, 1965).

3 km SE of Afgoi; 02°07′N, 45°03′E; alt. ≈ 86 m. (Gans, Laurent & Pandit, 1965).

20 km SE of Afgoi; 02°04′N, 44°54′E; alt. ≈ 86 m; (Gans, Laurent & Pandit, 1965).

Audegle; 01°58′N, 44°49′E; alt. ≈ 100 m; (Gans, Laurent & Pandit, 1965).

2 km S of Audegle; 01°56′N, 44°49′E; alt. ≈ 100 m; (Gans, Laurent & Pandit, 1965).

Baidoa; 03°07′N, 43°41′E; ♂ MT(MCSM) 479; alt. 410 m; 2/X/37; Vatova & Parenzan.

Balad; 02°20′N, 45°22′E; alt. 107 m; (Gans, Laurent & Pandit, 1965).

Belet Uen; 04°42′N, 45°12′E; ♂ MCSG 29832B, ♂ im. 29832A; alt. 172 m; /13; Patrizi.

Bulessa; Loc. ?; ♀ im. MCSM 565.

Dujiuma; 01°15′N, 42°32′E; ♂ ♂ MT(MCSM) 493–94, –97, –99–501, ♀ ♀ 496, –98, ♀ ♀ im. 495, 502; alt. ≈ 50 m; 19/IX/37; Vatova & Parenzan.

Lugh; 03°49′N, 42°34′E; ♂ MCSG 28985 B, ♀ 28985A; alt. 164.8 m; Bottego.

Villabruzzi (Gioar); 02°45′N, 45°31′E; ♂ ♂ MCSM 610A–D; alt. 110 m; 25/XII/28; U. Fiechter. ♂ im. MCSM 668; II/30; U. Fiechter.

Villagio Sguss; ≈ 02°25′N, 45°24′E; alt. ≈ 90 m; (Gans, Laurent & Pandit, 1965).

Vittorio d'Africa; 01°39′N, 44°40′E; ♂ ♂ MCSM 669A–B; alt. 104 m; VII/31; Urbinati.

Tanzania

Mangasini; 05°13′S, 35°15′E; ♂ ♂ MZUM 70281A–B; alt. 1219 m; 14/XII/29; A. Loveridge.

Songea; 10°42′S, 35°38′E; ♂ A/274/1, ♀ 2; alt. 1219 m; 28/II/61; H. J. Disney.

Uganda

Moroto; (Tandy & Tandy, MS).

Diagnosis: The mating call is a complex pulse train containing simple pulse trains of passively produced pulses (Fig. 1). See also Tandy (1972) Figs. 9B, 32; Tandy & Keith (1972) Figs. 9–7B and 9–19. Table 1 gives quantitative values for variables of the mating call. Particularly diagnostic are the passive pulse repetition rate (Ghinda population (holotype & paratypes) $\bar{x}$ (N = 10) = 207.7 pulses/second), low emphasized frequency (Ghinda $\bar{x}$ = 697.7 Hz) and the comparative lack of acoustic energy at harmonics of the fundamental of the low emphasized frequency. See also Tandy (1972) Table 11; Tandy & Keith (1972) Table 9–11. To the human ear each pulse train sounds like a relatively pure unpulsed tone and somewhat resembles the "hoot" of a large owl. A medium sized African *Bufo* similar to *B. gutturalis* Power, *B. maculatus* and other species of the *B. regularis* complex; Body measurements and their ratios exhibit few diagnostic differences from most closely related species (Tables 2a & b). Tympanum distinct; a tarsal fold; usually bright scarlet vermiculations on posterior femoral integument in life (may fade in alcohol); first finger longer than second; toes moderately webbed; cornified spinules extensively developed. Ecological data for selected localities: mean annual rainfall $\bar{x}$ (N = 10) = 57.8 cm (range 29.9–100.0); mean annual temperature $\bar{x}$ (N = 10) = 23.4°C (range 16.0–29.2) (Table 3).

Cytology: The diploid (2N) chromosome number is 20 (Bogart, 1968 as "*B. gutturalis*").

Description of holotype:

Mating call structure (Fig. 1). Data based on 5 simple pulse trains of a complex pulse train recorded at the type locality on August 30, 1970, 19:45 hr; air temperature 29.4°C, water temperature 26.7°C, toad temperature 26.2°C, relative humidity 66%; toad sitting on rock beside pool in river, feet and lower abdomen in water: passive pulse repetition rate (PPR) $\bar{x}$ = 210.0 pulses/sec. (no measurable variation between simple pulse trains), number of passive pulses/simple pulse train (NPP/PT) $\bar{x}$ = 78.8 pulses (range 76–84), simple pulse train duration (PT DUR) $\bar{x}$ = 0.374 second (0.36–0.40), simple pulse train repetition rate (PTR) $\bar{x}$ = 1.0698 pulse trains/sec.

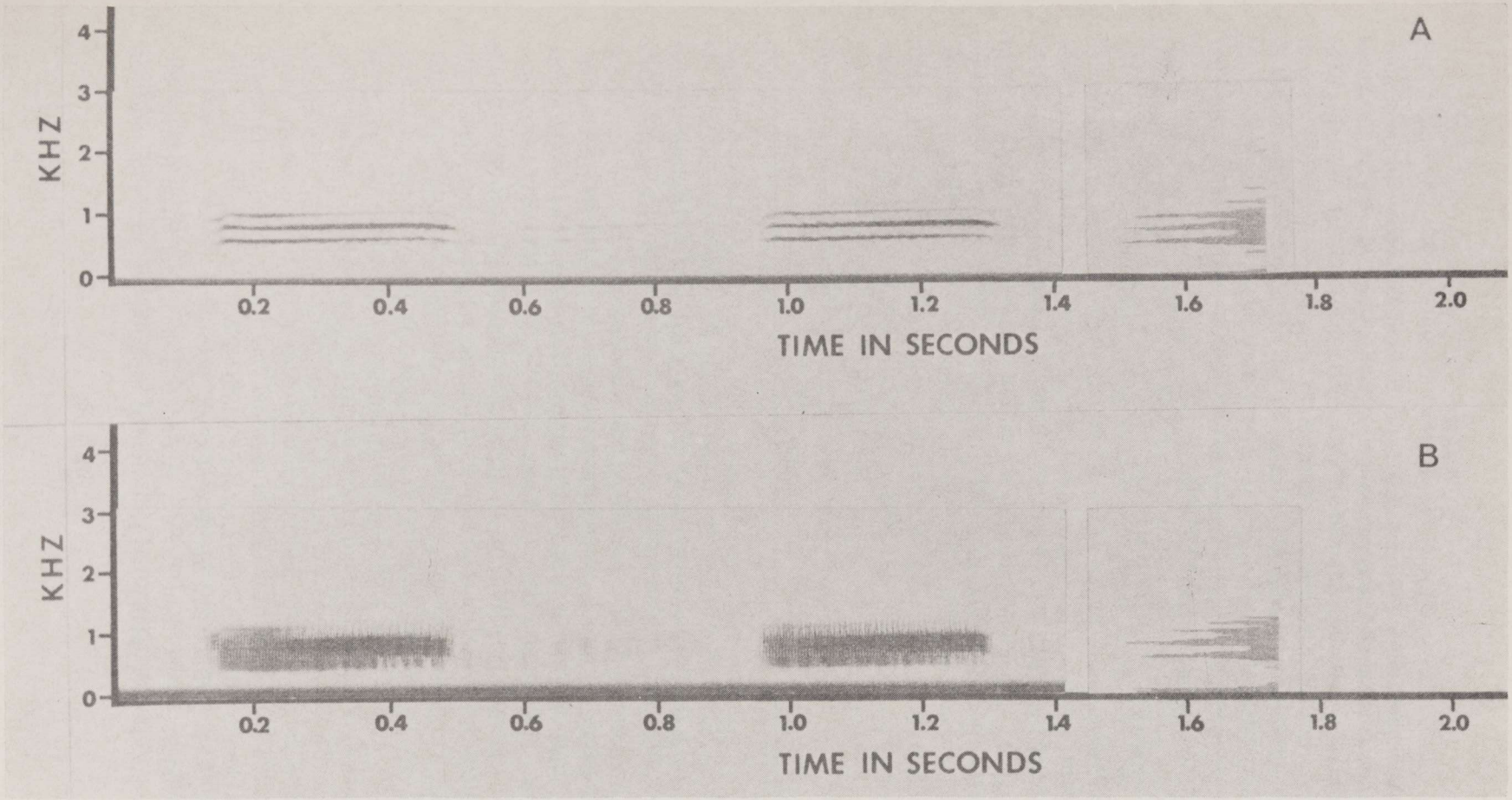

Fig. 1. Sound spectrogram of part of the mating call of *Bufo xeros* holotype male TNHC 37376. See description of holotype for data on recording conditions and analysis of physical structure. A) narrow band spectrogram (band width 50 Hz) of two simple pulse trains and narrow band spectral section made near the beginning of the first pulse train B) wide band spectrogram (band width 300 Hz) of same pulse trains and spectral section made near the midpoint of the second pulse train.

TABLE 1

Physical characteristics of the mating call of *Bufo xeros*. See description of holotype for explanation of mating call variables. Statistics are: number of individuals per sample (N), mean ($\bar{x}$), standard error of the mean (S.E.) and range. The number in brackets following $\bar{x}$ (except 23.0°C) is the average temperature of recorded animals for the call data to the right. Data opposite 23.0°C are standardized to that temperature.

Locality	N	Mating call variables PPR		PT DUR	PTR	(Hz)	DOM
Call statistics		(/sec.)	NPP/PT	(sec.)	(/sec.)	LOW EMP	(Hz)
Ghinda, Eritrea, Ethiopia	10						
$\bar{x}$ (26.2°C)		207.70	81.04	.390	1.1292	697.7	697.7
S.E.		2.978	2.949	.0138	.0419	38.94	38.94
Range		190.00–222.00	70.80–103.40	.340–.502	.8688–1.2876	564.4–880.4	564.4–880.4
$\bar{x}$ (23.0°C)		NC	NC	.182	1.6614	NC	NC
S.E.				.0078	.0306		
Range				.144–.214	1.5184–1.8496		

(0.714–1.370), low emphasized frequency (LOW EMP) $\bar{x}$ = 880.4 Hz (814–1023), dominant frequency (DOM) same as LOW EMP. Data for two variables that are correlated with temperature adjusted to 23°C: PT DUR $\bar{x}$ = 0.167 second, PTR $\bar{x}$ = 1.5987 pulse trains/second.

Morphology (Figure 2). snout urostyle length (SU) 61.3 mm; form moderately stout; head triangular, much broader than long, head width (HW) 23.4 mm, head length (HL) 12.0 mm, SU/HW 2.62, HW/HL 1.95; snout obtusely rounded; nostrils closer to tip of snout than to eye; canthus rostralis moderately sharp; horizontal diameter of the eye a little greater than length of snout; tympanum distinct, vertically oval, its horizontal diameter 60% that of eye, tympanum diameter (T) 3.7 mm, eye diameter (E) 6.2 mm, T/E 0.60, T/HW 0.16; a median darkly pigmented subgular vocal sac; vocal sac openings bilateral; parotoid glands moderately well-defined, slightly reniform, narrowly separated from the eye, the anterior edges poorly defined but lying between the anterior and posterior borders of the tympanum, parotoid length 22% of snout-urostyle length parotoid width 35% of parotoid length, parotoid length (PL) 13.7 mm, parotoid width (PW) 4.8 mm, PL/PW 2.85, HW/PL 1.71, T/PL 0.27, HW/PW 4.88, T/PW 0.77.

First finger longer than second, second a little longer than fourth; first three fingers densely melanized with nuptial asperities; fingers with indistinct

marginal folds; subarticular tubercles large, simple except for the middle tubercle of the first finger which is partially divided; palm with numerous conical tubercles but lacking spinules; inner metacarpal tubercle well developed but smaller than outer metacarpal tubercle and half covered with melanized nuptial asperities. A prominent elongate gland on the posterior surface of the forearm. Toes moderately webbed; toe IV with 3⅓ phalanges free on the inner margin; all toes with a margin of web extending almost to the tips; webbing without spinules; subarticular tubercles slightly smaller than those of the fingers, and some with a few small non-melanized spines; tubercles of sole similar to those of palms; inner and outer metacarpal tubercles prominent and apparently well-suited for burrowing, the inner larger than the outer. Tarsal fold moderately well developed, sharp edged, approximately three fourths the length of the tarsus. Urostyle-heel length (UH) 45.0 mm, SU/UH 1.36. Dorsum with numerous conical warts, each with a large melanin-tipped spinule; a few rounded warts on either side of the midline in the posterior region only, each with one or more large spinules and smaller spinules; spinules extending over entire dorsum including surfaces of parotoid glands; spinules less numerous anterior to eyes; laterally an oblique row of partially fused warts extending from beneath the parotoid to less than half the distance to the groin. Venter coarsely granular but lacking spinules. Warts at rictus forming almost unbroken gland with numerous small spinules.

Color (in alcohol) disruptively patterned olive-cream, gray, brown and yellowish. Dorsal background color cream to light brownish gray; six bilateral pairs of darker brown blotches with discontinuously darker margins: (1) on tip of snout extending over loreal ridges, (2) interorbital marks, (3) near anterior medial edges of parotoids, (4) near posterior medial edges of parotoids (largest and most distinct pair), (5) posterior to the fourth pair, more lateral and aligned with long axis of parotoid and (6) posterior to the fifth pair near the midline; a few nonpaired dark brown spots; remainder of dorsum more or less distinctly reticulated cream and brownish-gray. No *B. regularis*-like white spots on dorsum. No vertebral line. Parotoids, rictal glands and parts of dorsal surface of legs yellowish-olive. Dark melanized spinules prominent against lighter background. A pair of irregular cream stripes running from posterior of parotoids about half way to groin. Lower margin of orbit and part of area beneath the eye cream. An indistinct gray-brown canthal stripe extending from the eye to the upper jaw, but not posteriorly. Upper surface of limbs with ill-defined blotches forming cross-bars; posterior femoral integument with cream and gray reticulate pattern, red pigment (faded from that in life) visible against cream areas. Venter cream; gular skin gray-brown with cream granulation. Fig. 2.

Variation. Mating call structure varies quantitatively among individuals within the Ghinda population in all six characters examined: passive pulse repetition rate (PPR), number of passive pulses per simple pulse train (NPP/

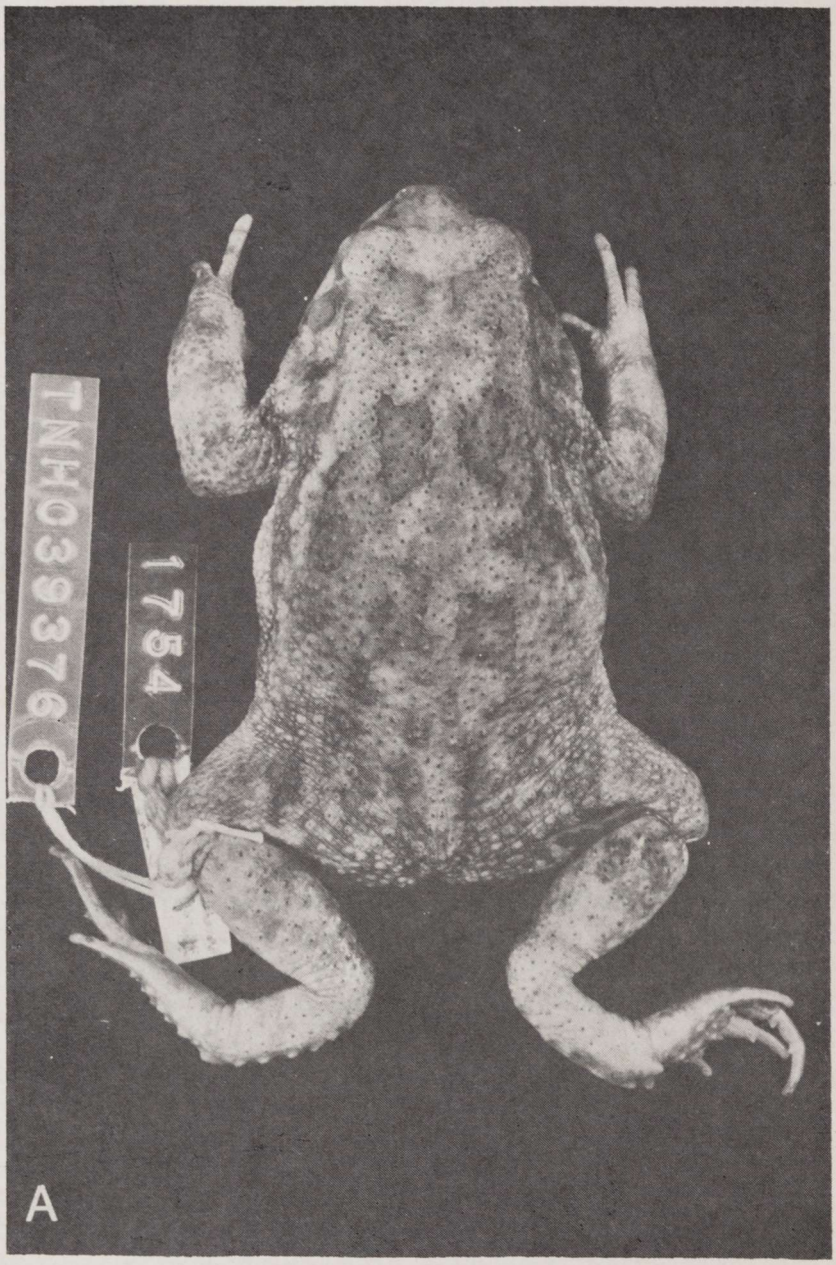

Fig. 2. *Bufo xeros* holotype ♂ TNHC 39376 (= MT1754), SU 61.3 mm. A. Dorsum.

B. Venter. Lateral dark areas on ventral abdomen are not pigmented but are accumulations of skin secretions produced during preservation. Photograph by M. Tandy as are Figures 3 and 4.

TABLES 2a & b

Linear measurements of external morphological characteristics and their ratios for two populations of *Bufo xeros*. See description of holotype for explanation of characters. See Table 1 for explanation of statistics. *=standard error values computed on sample sizes ranging between 5 and 9 individuals. Such standard errors are not as accurate as those for samples of 10 or more.

Table 2a

Locality Statistics (sex)	N	Character SU	HW	HL	T	E	PL	PW	SU	SU/HW
N'djamena, Chad										
$\bar{x}$ (♂ ♂)	10	71.00	25.37	15.14	4.32	7.50	16.58	6.23	50.41	2.801
S.E.		1.409	.570	.566	.118	.303	.681	.290	1.371	.0252
Range		60.5–75.9	21.9–27.2	12.0–17.1	3.5–4.8	5.6–8.8	13.5–20.1	5.2–7.8	42.5–56.8	2.69–2.99
$\bar{x}$ (♀ ♀)	6	69.03	24.13	14.20	4.43	7.37	15.25	5.85	47.67	2.861
S.E.*		.938	.165	.515	.049	.156	.167	.198	1.198	.0373
Range		67.6–73.6	23.4–24.6	12.9–15.8	4.3–4.6	6.9–8.0	14.8–15.8	5.1–6.4	43.0–52.0	2.80–3.03
Ghinda, Eritrea, Ethiopia										
$\bar{x}$ (♂ ♂)	10	55.53	20.61	11.18	3.47	6.08	12.98	4.23	40.33	2.698
S.E.		.825	.415	.222	.068	.141	.263	.103	.730	.0306
Range		52.3–61.3	19.4–23.4	9.9–12.0	3.1–3.9	5.0–6.6	11.8–14.6	3.9–4.8	37.6–45.0	2.57–2.91
$\bar{x}$ (♀ ♀)	5	60.78	21.88	11.70	4.10	6.32	14.02	4.26	43.74	2.778
S.E.*		1.870	.619	.432	.192	.204	.540	.150	.832	.0272
Range		54.5–64.2	19.6–23.2	10.5–12.9	3.5–4.7	5.7–6.8	11.9–14.8	3.8–4.5	41.8–45.8	2.68–2.85

Table 2b

Locality Statistics (sex)	N	Character HW/HL	T/HW	T/E	PL/PW	HW/PL	T/PL	HW/PW	T/PW	SU/UH
N'djamena, Chad										
$\bar{x}$ (♂ ♂)	10	1.692	.171	.583	2.675	1.545	.263	4.121	.702	1.413
S.E.		.0577	.0040	.0246	.0745	.0472	.0103	.1361	.0261	.0278
Range		1.39–2.10	.15–.19	.47–.71	2.21–3.08	1.31–1.87	.21–.31	3.39–4.87	.55–.81	1.27–1.53
$\bar{x}$ (♀ ♀)	6	1.710	.184	.603	2.625	1.583	.291	4.153	.762	1.452
S.E.*		.0581	.0028	.0114	.1096	.0150	.0051	.1634	.0283	.0355
Range		1.54–1.85	.18–.20	.56–.63	2.34–3.02	1.53–1.62	.27–.31	3.77–4.82	.67–.88	1.33–1.57
Ghinda, Eritrea, Ethiopia										
$\bar{x}$ (♂ ♂)	10	1.846	.169	.573	3.086	1.591	.268	4.888	.824	1.378
S.E.		.0317	.0022	.0172	.1017	.0316	.0070	.1122	.0239	.0123
Range		1.69–1.97	.16–.18	.52–.68	2.57–3.74	1.39–1.72	.23–.31	4.37–5.41	.71–.95	1.30–1.44
$\bar{x}$ (♀ ♀)	5	1.873	.187	.648	3.312	1.564	.293	5.172	.972	1.389
S.E.*		.0357	.0069	.0197	.1906	.0291	.0101	.2828	.0754	.0221
Range		1.80–2.01	.17–.21	.61–.70	2.64–3.74	1.47–1.65	.28–.33	4.36–5.82	.78–1.24	1.30–1.43

TABLE 3

Ecological characteristics for 10 populations of *Bufo xeros*. alt. = altitude in meters; $\bar{x}$ t. = mean annual temperature (°C); $\bar{x}$ r. = mean annual rainfall (cm). See Table 1 for explanation of statistics. Accuracies and sources of these data vary. Some figures are based on surveys or meteorological stations near the locality. Others were interpolated from map contours, isotherms or isohyets. One decimal point given does not necessarily imply such accuracy of measurement but rather that these were the figures used to compute the means. Individual values for some altitudes may be in error by 50 m or more. Most basic data are from Bartholomew (1956), Knoch & Schulze (1956) or Wernstedt (1959).

Country Locality	Geographic coordinates		alt. (m)	$\bar{x}$ t. (°C)	$\bar{x}$ r. (cm)
Chad					
N'djamena	12°07′N	15°02′E	300.0	27.9	64.3
Ethiopia					
Agordat, Eritrea	15°33′N	37°53′E	633.0	29.2	29.9
Ghinda, Eritrea	15°26′N	39°05′E	940.0	24.0	77.1
Kenya					
Aruba Dam, Tsavo	3°22′S	38°50′E	457.0	25.0	38.1
Makere, Tana River	1°50′S	40°07′E	55.0	26.0	58.4
Mtito Andei	2°41′S	38°10′E	738.0	22.0	38.1
Ol Tukai	2°06′S	37°02′E	1143.0	16.0	30.0
Teita Hills	3°19′S	38°18′E	1676.0	23.0	100.0
Voi	3°24′S	38°34′E	560.0	25.0	53.6
Uganda					
Moroto	2°33′N	34°36′E	1524.0	16.0	88.4
$\bar{x}$ (n = 10)			802.6	23.4	57.8
S.E.			164.72	1.41	7.80
Range			54.9–1676.4	16.0–29.2	29.9–100.0

PT), simple pulse train duration (PT DUR), simple pulse train repetition rate (PTR), low emphasized frequency (LOW EMP) and dominant frequency (DOM). In this species LOW EMP (anterior membrane resonant frequency) is the dominant frequency, so only 5 characters are involved. Part of this variation may be related to temperature differences. This will be treated further in Tandy & Tandy (MS). Effects of body size on the call have not yet been critically analyzed. However, comparison of data from Ghinda (Table 1) with those from 01 Tukai (Tandy, 1972; Tandy & Keith 1972) strongly suggests that the dominant frequency is inversely correlated with body size. Both temperature and body size effects will be covered further when analyses of additional recordings from Chad, Kenya and Somalia are completed.

Fig. 3. *Bufo xeros* ♀ MT2616, SU 65 mm. (live); Baidoa, Somalia; Sta. 58, small stream running through the town; October 22, 1970.

Fig. 4. *Bufo xeros* ♂ MT2609, SU 66 mm (live); same data as ♀ in Figure 3.

On the basis of the data discussed above, there appear to be significant differences in mating cell structure among different populations. This will be tested in another paper.

The paratype males are similar to the holotype. See population statistics on measurements, ratios and other morphological variation in Tables 2a & b. They range in size from SU = 52.3 to 61.3 m, $\bar{x}$ (N = 10) = 55.53. Some exhibit darker and others lighter dorsal background color than the holotype. They also vary in the distinctness of the dark dorsal spots. Four specimens lack red on the femoral integument in alcohol, although they exhibited the red pigment in life. Three individuals have the parotids colored like the dorsal background; the others are similar to the holotype. Three specimens have narrow indistinct discontinuous vertebral lines (Figure 4).

Females from Ghinda are slightly larger than males. For these females SU $\bar{x}$ (n = 6) = 60.78 mm, range 54.5–64.2. Such sexual dimorphism in size is not apparent for the N'djamena population. The female paratype is morphologically similar to the males except for primary and secondary sexual characteristics. It is gravid with darkly pigmented eggs. It lacks nuptial asperities, dark gular color, a vocal sac or vocal sac openings. Dorsal melanized spinules are less strongly developed. The dorsal color pattern exhibits more contrast than those of most males. Parotoid glands are cream colored. There is no red on the femoral integument and there was none in life. Three of five other females from this population did exhibit the red pigment in life. One of these females has a *B. regularis*-like white spot dorsolaterally (Figure 3).

Both sexes from Ghinda are smaller than specimens of the same sex from N'djamena. One of ten males from N'djamena exhibits slight ventral mottling. One of these males has a vocal sac opening only in the left compared to bilateral ones in the other specimens. Red femoral pigment is more strongly developed in the N'djamena samples of both sexes than in the Ghinda material. All specimens from the former locality exhibited the pigment in life and only two (1 ♂ & 1 ♀) do not show it in alcohol.

Table 3 gives data on ecological variables for ten populations. The usual habitat is xeric savanna—thus the derivation of the species name *xeros* which means dry in Greek.

Comparisons: Taxonomic treatment of species compared follows Tandy (1972) and Tandy & Tandy (in press b). Tandy & Tandy (MS) will present extensive comparative data on many of these species. *B. xeros* is known to be sympatric with *B. lughensis*, *B. parkeri*, *B. regularis*, *B. garmani*, *B. gutturalis*, *B. steindachneri* and *B. pentoni* at various localities. On the basis of ecological data, it is probably also sympatric with *B. blanfordi*, *B. maculatus*, *B.* sp. A and *B. dodsoni*.

The mating call of *B. xeros* differs diagnostically from those of all other African *Bufo* species known except *B. maculatus* in its passive pulse rate. Only *B. maculatus* has such a fast rate. It differs from that of *B. maculatus*

primarily in its harmonic structure. The *B. maculatus* call is much more "noisy" than that of *B. xeros* reflecting considerable energy over a broad frequency spectrum within pulses of the call of *B. maculatus*. *B. maculatus* often exhibits formants of almost equal amplitude at both the low emphasized frequency and its second harmonic. The second harmonic is often the dominant frequency in that species. Tandy & Tandy (MS) contains a key to the voices of Ethiopian *Bufo* including the Ghinda population of *B. xeros*.

Morphologically *B. xeros* is much less distinct from many other African *Bufo*. Its tarsal fold and much larger body size distinguish it from sympatric *B. lughensis*, *B. parkeri* and *B. steindachneri*. *B. pentoni* may be distinguished by its unique tarsal spur and its very short and broad head. *B. dodsoni* has less digital webbing. The parotoid glands of *B. blanfordi* are usually much less well defined, its dorsal pattern is less distinct and body size is smaller than in *B. xeros*. The tympanum of *B. xeros* is larger (T/E $>$ .45) than that of *B.* sp. A (T/E $<$ .45). No morphological characters are known which are always diagnostic between *B. xeros* and *B. regularis*, *B. garmani*, *B gutturalis* or *B. maculatus*. *B. regularis* usually does not exhibit red femoral pigment. In *B. garmani* the dark markings on the sides of the snout do not usually cross the loreal ridge to the dorsum, the snout usually lacks spinules, and dorsal spots are often rose-colored in alcohol. *B. maculatus* usually has much less distinct parotoid glands and usually lacks red femoral pigment. No diagnostic morphological character is known to separate *B. gutturalis* Power from *B. xeros*. *B. gutturalis* usually exhibits much more contrasting patterning—especially of the dark and light reticulated dorsal background. Males of *B. gutturalis* usually have relatively darker gular pigment than *B. xeros*. Tandy & Tandy (MS) contains a morphological and ecological key to Ethiopian *Bufo* including *B. xeros*.

B. xeros can produce viable F_1 hybrids with sympatric *B. garmani* and *B. gutturalis* (Blair 1972a, Tandy & Keith 1972). These hybrids appear to be sterile. They have mating calls and morphologies which are intermediate between those of the parental species.

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