

INSTITUT DES PARCS NATIONAUX  
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INSTITUUT DER NATIONALE PARKEN  
VAN BELGISCH CONGO

# Exploration du Parc National de l'Upemba

MISSION G. F. DE WITTE

en collaboration avec

W. ADAM, A. JANSSENS, L. VAN MEEL et R. VERHEYEN (1946-1949).

FASCICULE 56

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AFLEVERING 56

## AMPHIBIANS

BY

KARL P. SCHMIDT(†) and ROBERT F. INGER (Chicago)



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1959

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PARC NATIONAL DE L'UPEMBA  
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# AMPHIBIANS

## EXCLUSIVE OF

### THE GENERA *AFRIXALUS* AND *HYPEROLIUS*

BY

KARL P. SCHMIDT (†) and ROBERT F. INGER (Chicago) (\*)

## INTRODUCTION

The Mission G. F. DE WITTE to the « Parc National de l'Upemba » obtained approximately 80,000 amphibians in the intervals June-July, 1945, and February, 1947-July, 1949. Roughly 6,600 belonging to the genera *Afrixalus* and *Hyperolius* have already been reported on by LAURENT (1957). The remainder form the basis of this account. Data accompanying this remarkable collection are limited to locality, date, and altitude; no habitat notes have been available. Specimens were obtained at 106 localities, listed in Appendix A.

The « Parc National de l'Upemba » lies in the center of Katanga Province, the southeastern corner of the Belgian Congo (Fig. 1). The park boundaries run from 8°15'S to 9°50'S and from 26°E to 27°10'E; the maximum length (northeast-southwest) is approximately 215 kilometers and the greatest width 120 kilometers. The entire park lies within the drainage of the Lualaba River, the principal eastern arm of the Congo, and borders the eastern side of the chain of small lakes (of which Lake Upemba is the largest) flanking the Lualaba where it enters the uplands of the Mitumba Mountains. From the flat area surrounding Lake Upemba, which has an elevation of 585 meters, the land rises into the highlands and reaches a maximum elevation of 1,860 meters within the park. Part of the uplands comprise

(\*) The present study has been realized thanks to a financial aid of the « Fondation pour Favoriser l'Étude Scientifique des Parcs Nationaux du Congo Belge ».

an undulating plateau in which occur permanent marshes, as at Mukana (Plate IX, Fig. 2), whereas other parts, as at Mount Sombwe (Plate VIII, Fig. 1), are very steep.

The vegetation of the Upemba has been described in some detail by VERHEYEN (1953), and since the data accompanying the amphibians do not

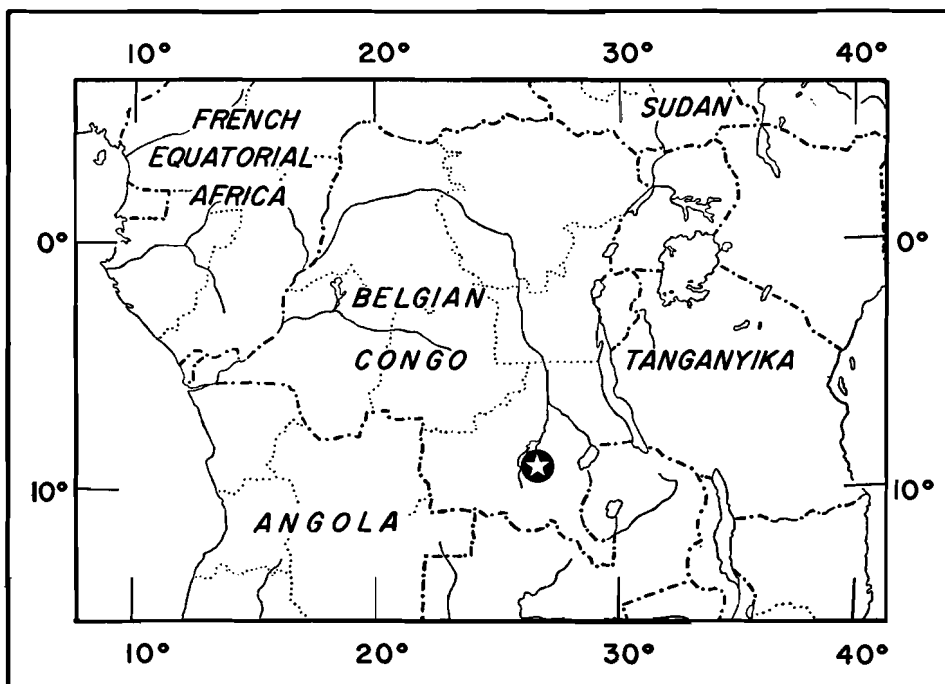


FIG. 1. — Belgian Congo showing the position of the Parc National de l'Upemba.

associate the animals with the vegetation, only a brief summary is warranted here. The high plateau is covered primarily by herbaceous savanna, which is marshy in places (Plate IX, Fig. 2) and crossed by gallery forests following the streams. Savanna dotted with shrubs borders the plateau and gradually merges into savanna forest (Plate VIII, 2) characteristic of the Katanga in middle and low elevations (up to about 1,250 meters). Sedges and rushes are abundant around the many small bodies of water in the flood plain of the Lualaba.

Rainfall in the Katanga is markedly seasonal with an extensive dry period. No weather stations lie within the park, but as the many surrounding it have identical rainfall patterns (Publ. Inst. Nat. Etude Agron. Congo Belge, Bur. Climat., Commun. No. 3), we may assume the park has a similar seasonal distribution of rainfall. Monthly precipitation data

for the decade 1940-1949 from twelve stations (Fig. 2) around the « Parc National de l'Upemba » show that each month from May to September inclusive has less than 25 mm of rain (Fig. 3). Each of the other seven months (October-April) has 90 mm or more. Of the twelve stations selected, four are at 570-750 m, five at 900-1,175 m, and three at 1,550-1,600 m so that the altitudinal range of the park is adequately covered.

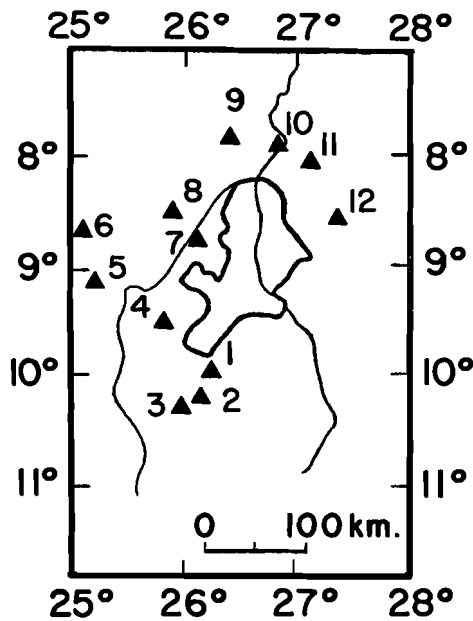


FIG. 2. — Rainfall stations surrounding the Parc National de l'Upemba.

Work on this enormous collection has been greatly facilitated by several grants from the « Institut des Parcs Nationaux du Congo Belge ». The first of these enabled the senior author to examine types in several European museums, and the second subsidized the text illustrations. We are very grateful to Dr. V. VAN STRAELLEN, President, Institut des Parcs Nationaux du Congo Belge, for this assistance. We are also indebted to our colleagues at other institutions for information concerning specimens in their care and for numerous favors while studying in their laboratories. In particular we should like to mention Dr. J. EISELT, Naturhistorisches Museum, Vienna; Miss A. G. C. GRANDISON and Mr. J. C. BATTERSBY, British Museum (Natural History); Dr. J. GUIBÉ, Museum National d'Histoire Naturelle; Mr. Arthur LOVERIDGE, formerly of the Museum of Comparative Zoology; and

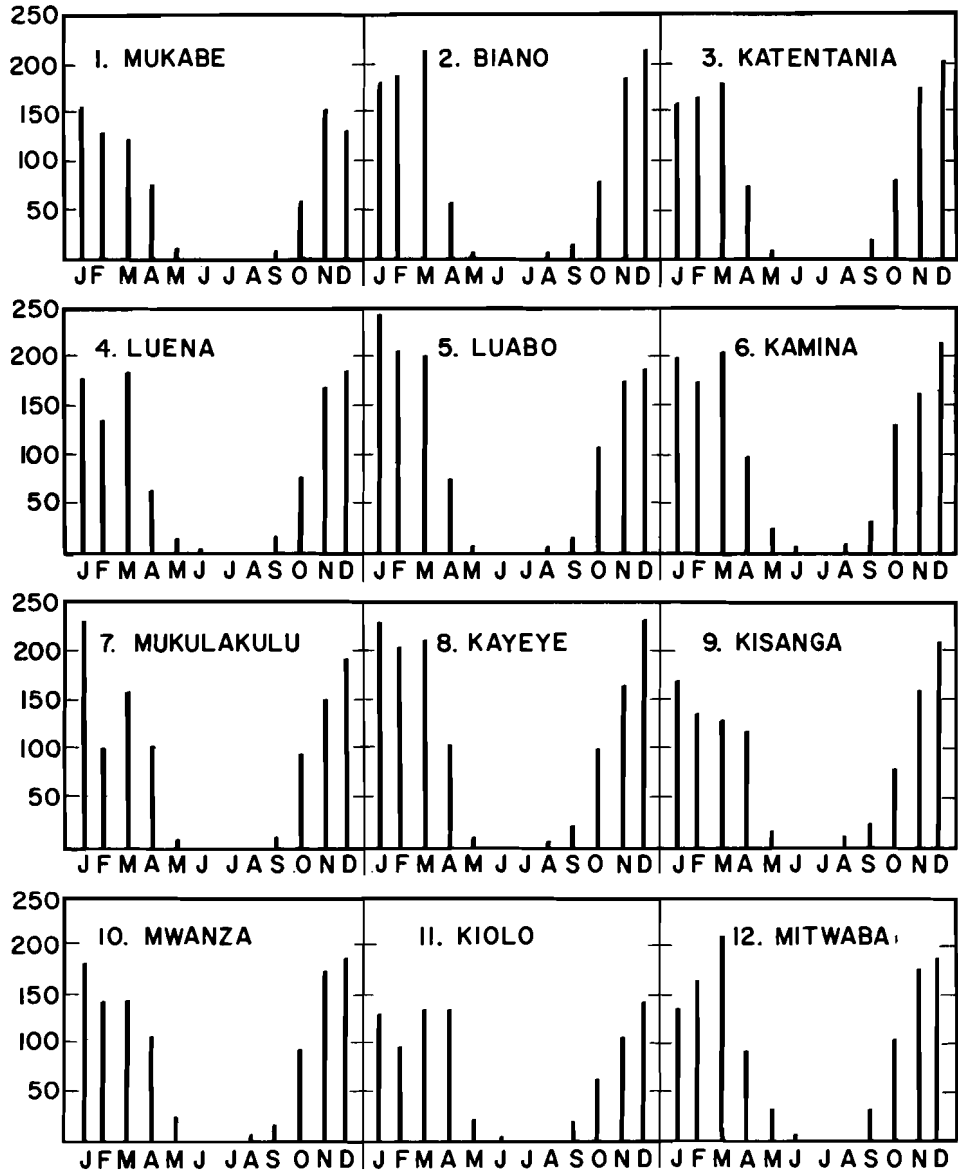


FIG. 3. — Average monthly rainfall (mm) of the stations shown in Figure 2 for the period 1940-1949.

Dr. H. WERMUTH, Zoologisches Museum, Berlin. Finally we owe our thanks to Mr. Hymen MARX, Miss Janet WRIGHT, and Mr. Michael DUEVER, all of the Division of Amphibians and Reptiles, Chicago Natural History Museum, for much assistance at all stages of this study. The maps and charts are the work of Miss WRIGHT; all other illustrations were made by Mr. E. John PFIFFNER, Chicago Natural History Museum.

The following abbreviations are used : AMNH-American Museum of Natural History, BM-British Museum (Natural History), CM-Carnegie Museum, CNHM-Chicago Natural History Museum, IPN-Institut des Parcs Nationaux du Congo Belge, and MCZ-Museum of Comparative Zoology.

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## Family PIPIDAE.

Genus **XENOPUS** WAGLER.1. — **Xenopus laevis poweri** HEWITT.

(Pl. IV, 1.)

*Xenopus poweri* HEWITT, 1927, Rec. Albany Mus., **3**, p. 413, pl. 24, fig. 3  
— Victoria Falls, Northern Rhodesia; LOVERIDGE, 1933, Bull. Mus. Comp.  
Zool., **74**, p. 352; MERTENS, 1937, Abh. Senck. Ges., **435**, p. 17.

Taxonomic notes. — The Upemba clawed frog represents a race sharply different from the typical subspecies of *laevis*, which ranges from Cape Province to Southern Rhodesia. PARKER (1936, p. 597) distinguished four geographic races of *laevis*, namely the southern *laevis laevis*, *laevis petersi* from Angola to Northern Rhodesia, *laevis victorianus* in Uganda and the adjacent region, and *laevis borealis* through Kenya Colony to Lake Rudolf.

We find two distinct forms in Angola, which were in fact distinguished by BOCAGE (1895) in the original description of *petersi*, namely a northern one, with large dark ventral spots sharply defined by a light reticulation (BOCAGE's Var. A), and a southern one, with a fine dark ventral vermiculation, which corresponds best with his Var. B. Color variety A (Fig. 4 C) characterizes all of 12 specimens from Gauca, Duque de Bragança, and Chitau (cf. SCHMIDT, 1936, p. 128). In five specimens from Huila (Fig. 4 B), a more southern station in Angola, we find an almost exact counterpart of the Upemba series (Fig. 4 A) in which the dark ventral color results from an extremely dense pattern of small isolated spots. From geographical considerations, as well as from the general correspondence of the type of *poweri*, it is this latter form in Angola that represents *poweri*. PARKER (1936), SCHMIDT (1936), and LOVERIDGE (1953, p. 334) are in error in suggesting the reference of *poweri* to the synonymy of *petersi*. Intercalating *poweri*, the series of subspecies of *laevis*, from south to north, is then : *Xenopus laevis laevis* DAUDIN, *X. laevis poweri* HEWITT, *X. laevis petersi* BOCAGE, *X. laevis victorianus* AHL, and *X. laevis borealis* PARKER (Fig. 5). *Xenopus laevis bunyoniensis* LOVERIDGE, with a much limited distribution, contrasts sharply in this respect with the several more wide-ranging subspecies; it seems not unlikely that other isolated populations of *Xenopus* may be found to be equally distinct within the ranges of the other forms.

Following the principle of least disturbance of the current nomenclature, *Xenopus petersi* BOCAGE is restricted to the « Var. A » of the original description and the type locality is designated as Dondo, in the Quanza drainage, from which region the specimens of true *petersi* at hand were obtained.



The East African species *Xenopus mulleri* PETERS, which LOVERIDGE reports from Lake Tanganyika, might well be expected in the Upemba region. It is not represented in the material of the Upemba Survey.

The illustration of the type of *Xenopus poweri* from Victoria Falls shows a spotted ventral coloration that can be very closely matched in the Upemba series, though it is the pattern of a minority (about 15 %) of the adult specimens. It is evident that a series of specimens from the type locality is essential to confirm our allocation of the Upemba *Xenopus*.

We have confirmed the distinctness of the Upemba *Xenopus* by examining certain characters, which, upon inspection, appeared to distinguish



FIG. 4. -- *Xenopus laevis*.

A (left), *Xenopus l. poweri* from Parc National de l'Upemba;  
 B (center), *Xenopus l. poweri* from Huila, Angola; C (right),  
*Xenopus l. petersi* from Duque de Bragança, Angola.

our specimens from the available material of *Xenopus laevis laevis*, 15 specimens, mainly from the Transvaal. The width of the nostril, with its bordering flap and papilla, is much less than the internarial distance in 17 Upemba specimens; dividing width of nostril by internarial distance, this proportion varies from 0.56 to 0.76. In Transvaal *laevis* the same measurements yield the proportion 0.83 to 1.25.

Another difference appears in the number of transverse bars of the lateral line organ counted in the row from eye to anus. This varies from 19 to 24 in 17 Upemba specimens, and from 23 to 34 in 16 Transvaal *laevis*.

In these two characters the series of five specimens in Chicago Natural History Museum from Huila, Angola agree with the Upemba figures.

Within what appears to be normal ontogenetic and individual variation, the large series of *poweri* examined is very uniform in coloration. In juvenile specimens, from the size at transformation (of 12 to 15 mm) to 18 or 20 mm in snout-vent length, the ventral surface is uniform yellowish

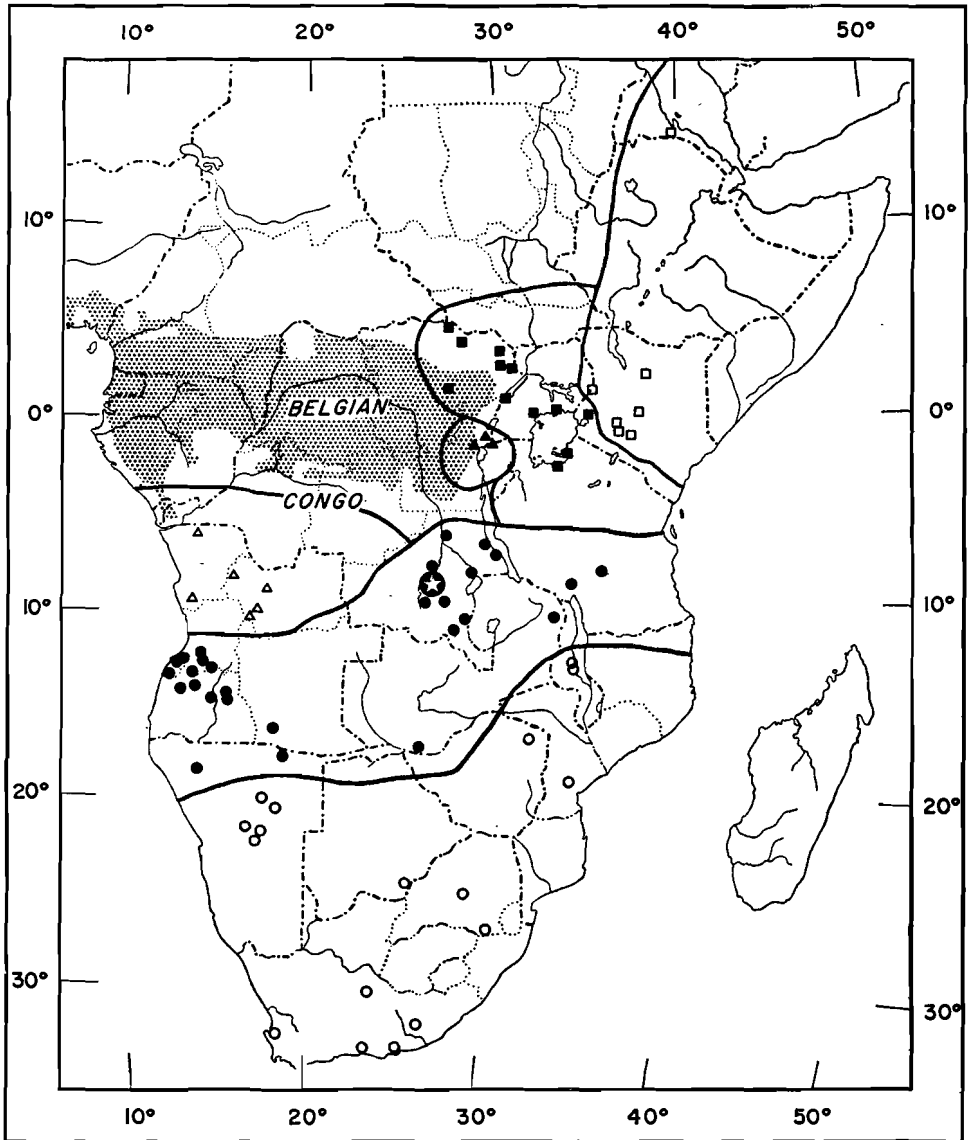


FIG. 5. — Distribution of subspecies of *Xenopus laevis* :

*X. laevis* indicated by hollow circles; *X. poweri* by solid circles; *X. petersi* by hollow triangles; *X. bunyoniensis* by solid triangles; *X. victorianus* by solid squares; *X. borealis* by hollow squares. Parc National de l'Upemba indicated by symbol with open star.

with a few dark spots on the under surfaces of the thighs, and with a fairly sharp boundary between the dark dorsal and the light ventral color. In larger specimens the spotting increases to cover the under surfaces quite uniformly, the spots being of the order of 1 mm diameter in specimens of 40 mm snout-vent length and of the same size (when they persist) in larger specimens. Even at the length of 40 mm, the spotting may be transformed into the uniform dark coloration that is most frequent in the adults.

We have tested the variation in coloration against a sample of 60 specimens (No. 927) from Lusunga, 1,700 m. In 20 specimens from 25 to 35 mm in snout-vent length, 3 (the smallest) have a relatively unspotted belly, with dark chins; 10 have the belly dark-spotted, the spots being relatively distinct; and 7 have the light space between the spots invaded by dark pigment, with nearly complete (90 %) obscuration of the spots. In 20 from 40 to 50 mm, 10 have the belly spotted, 10 have it uniformly dark. In the 20 specimens that exceed 50 mm, 3 are spotted, 3 have the spots obscured, and 14 have an almost uniform dark ventral coloration. In all, the spotting is evident on the under surfaces of the thighs, and in a few specimens there is an unspotted band along the mid-line of the thighs. A second sample, of 20 specimens (No. 900) from Mujinga-Kalenge, 1,050 m, has 3 with ventral surfaces spotted, 4 with fine vermiculate ventral spotting, and 13 uniform dark. Examination of the remaining series indicates that this is an adequate account of the variation in ventral spotting in the Upemba series.

**Diagnosis.** — Body elongate pear-shaped, head pointed, limbs short; snout projecting; no vomerine teeth; eye relatively large, its diameter equal to its distance from the labial border; subocular tentacle short; metatarsal tubercle little developed without horny claw; claws of three inner toes distinctly elongate.

Dorsal coloration uniform dark in preserved specimens unless examined under liquid, when obscure large darker spots can be distinguished. Ventral coloration from chin to waist normally dark (see below) the under surfaces of the thighs with lighter ground color and rather uniformly distributed darker spots (*ca* 1 mm in diameter).

**Secondary sex characters.** — The sexes of *Xenopus* are well distinguished by the relative development of the characteristic anal flaps, which are present in both sexes, but are much larger and more elaborately papillose in adult females. In them the dorsal lobe has a median ventral papilla, and both lateral lobes are conspicuously papillose. This structure is less elaborate in the immature female. The difference between male and female is very evident in specimens that have reached 40 mm snout-vent length. These structures are not subject to seasonal change.

The males are distinctly smaller than females. Males reach sexual maturity at 38 mm, females at 45 mm. The maximum length of males in a series of 113 mature specimens is 57.5 mm and the mean is  $46.46 \pm 0.40$  mm. In 69 females with pigmented ova the maximum is 73.7 mm, the mean  $60.53 \pm 0.66$  mm.

The arms of the males are provided with a thickened nuptial pad on the inner and upper side of the forearm, and this is covered with fine black asperities, mainly developed during the principal breeding season. The asperities extend in a narrow band on the upper arm and distad onto the fingers, extending to their tips. There are no vocal sacs.

**Ecological notes.** — That the development of the nuptial asperities is seasonal but not exclusively so is shown in Table 1. Of 20 males collected in June, 19 were without black asperities and one had the asperities fully developed, as at the height of the breeding season. In January, of 24 specimens, 23 have the asperities developed, but one is without them. For the females the contrast between the dry and wet seasons is much less sharp. Evidently, breeding takes place almost throughout the year, but most actively in the wet season.

Further light is thrown on the fact that the breeding season has a definite peak in the wet season by the examination of the large lots of juvenile specimens. The earliest dates for large lots of juveniles are March 12, 1947 (No. 973) and March 12, 1948 (No. 923). In the 1947 series of 39 individuals, all but 3 are transforming tadpoles still with long tails; one has a short tail; one has a tail vestige only and measures 15 mm; and one is fully transformed and measures 18 mm. In the 1948 series of 302 specimens, some are just transformed at 14 to 17 mm (with vestigial tails); 28 have snout-vent lengths from 25 to 35 mm; and the remaining 274, with no really tailed specimens represented, range in length from 14 to 23 mm. This date may be estimated as 10 to 12 weeks after egg-laying. The latest date on which a specimen with a tail vestige is found is March 31. Other juveniles (under 25 mm but without tail vestige) were collected on January 4, April 7, May 12, June 4, September 27.

The altitudinal distribution of the series at hand is as follows :

Altitude (m)	Number of Specimens
585-750	113
751-1,000	57
1,001-1,250	76
1,251-1,500	183
1,501-1,750	759
1,751-1,830	1,406

TABLE 1. — Monthly frequency of *Xenopus laevis poweri* from the Upemba in various stages of sexual competence.

Males (37.6 mm and larger)		
	Nuptial pads present	Nuptial pads absent.
January . . . . .	23 (42.7-53.1 mm)	1 (46.6 mm)
February . . . . .	1 (51.4 mm)	—
March . . . . .	32 (38.3-60.0 mm)	1 (45.5 mm)
April . . . . .	5 (38.3-48.7 mm)	8 (39.1-46.7 mm)
May . . . . .	1 (41.5 mm)	2 (38.8-45.8 mm)
June . . . . .	1 (42.1 mm)	19 (38.8-49.0 mm)
July . . . . .	6 (38.7-51.7 mm)	—
August .. . . .	4 (42.9-54.7 mm)	6 (44.9-55.2 mm)
September . . . . .	5 (44.0-50.7 mm)	4 (38.8-43.3 mm)
October .. . . .	14 (37.6-54.4 mm)	1 (40.2 mm)
November . . . . .	1 (49.0 mm)	—
December . . . . .	12 (39.3-54.1 mm)	—
Females (37.9 mm and larger)		
	Eggs well developed	Without well-developed eggs
January . . . . .	9 (57.6-64.8 mm)	8 (37.9-63.7 mm)
February . . . . .	—	1 (61.0 mm)
March . . . . .	26 (50.4-73.7 mm)	12 (39.1-56.1 mm)
April . . . . .	—	10 (43.9-56.3 mm)
May . . . . .	3 (56.2-59.0 mm)	5 (40.4-55.0 mm)
June . . . . .	2 (54.0-58.4 mm)	16 (45.7-69.0 mm)
July . . . . .	6 (38.7-51.7 mm)	—
August .. . . .	5 (59.5-68.2 mm)	3 (41.5-60.8 mm)
September . . . . .	5 (58.8-63.2 mm)	2 (41.2-45.9 mm)
October .. . . .	6 (59.1-69.3 mm)	6 (39.1-47.4 mm)
November . . . . .	1 (60.8 mm)	—
December . . . . .	12 (53.4-70.6 mm)	—

Range. — The species occurs with certainty from Kenya and northern Belgian Congo southwards to Cape Province, South Africa and westwards south of the rain forest to the Atlantic. BOULENGER (1882) records a specimen from Eritrea, but since this is far north of any other valid locality and since PARKER (1936) does not refer to the specimen, this locality is omitted from the range. The subspecies *poweri* ranges from southern Angola and adjacent Southwest Africa northeastwards through the Katanga, Northern Rhodesia, and southern Tanganyika.

Upemba localities and specimens :

Bowa (13); Bunda-Bunda (1); Buye-Bala (129); Bwalo (1); Dipidi (1); Ganza (10); Kabwe (2); Kabwekanono (5); Kafwe (50); Kalule-Nord (5); Kalumengongo (24); Kande (14); Kanonga (37); Kaswabilenga (2); Kateke (1); Katombwe (431); Katongo (6); Kilwezi (38); Kipondo (10); Kiwakishi (5); Luangalele (25); Lufwa (49); Lusinga (562); Lupiala (8); Mabwe (51); Masombwe (22); Mubale (99); Mujinga-Kalenge (31); Mukana (561); Mukelengia (25); Munoi (5); Munte-Mubale (181); Sanga (2).

Family BUFONIDAE.

Genus **BUFO** LAURENTI.

2. — **Bufo carens** SMITH.

*Bufo carens* SMITH, 1849, Illus. Zool. S. Afr., pl. 68, fig. 1 — Interior of South Africa.

Diagnosis. — Habitus stocky; snout broadly rounded, no cranial crests; no parotoids, their place taken by a narrow dorsolateral glandular ridge extending from behind the eye and above the tympanum to the groin; tympanum distinct, immediately behind the eye, diameter subequal to that of eye; skin with small, spinose warts or smooth dorsally, warts somewhat larger on sides. First finger equal to or slightly longer than second; all tubercles under fingers and toes single; inner metatarsal tubercle more prominent and a little larger than oval outer tubercle; tarsal fold present.

Size moderately large, females to 92 mm (LOVERIDGE, 1953).

Color (in alcohol) uniform grayish or dark brown above except for a pair of small oval dark spots above the sacrum; usually a dark band below dorsolateral ridge; limbs with obscured dark crossbars; underside dirty whitish, immaculate or with varying degrees of infuscation, usually darkest on throat (Pl. I, fig. 3).

Secondary sex characters. — Sex dimorphism in size is only vaguely indicated in the present sample. Six males with well developed

secondary sex characters range from 68.6 to 73.8 mm, snout to vent. The two females with pigmented ova measure 70.5 and 79.3 mm. LOVERIDGE (1953) extends the size range of females to 92 mm.

Mature males have median subgular vocal sacs and usually (8 out of 9) have a long slit-like opening into the sacs on each side of the tongue. Vocal sacs were observed in all males larger than 64 mm; they were absent in two other males (53.9 and 58.8 mm).

At the peak of development, nuptial pads occur on the first three fingers from their bases to the beginning of each of the terminal phalanges. The pad covers dorsal and median surfaces of the first finger, a broad dorso-median band on the second, and a narrow median strip on the third. The individual spinules that make up the pad are tipped with melanin when fully developed, giving the pad a dark brown appearance. Only four males (70.7-73.8 mm) have pads in this stage of development.

From the condition of the nuptial pads in other males, it is clear that the pads develop first on the first finger, then on the second, and finally on the third (Table 2). Only after the pad appears on the third finger do the spinules acquire melanin; the pads are yellowish prior to the acquisition of melanin. All males with nuptial pads have vocal sacs.

TABLE 2. — **Sizes (mm.) of male *Bufo carens* from the Upemba in various stages of nuptial pad development.**

	Fingers covered by pad		
	1	1-2	1-3
Pad spinules without melanin	64.6	—	68.6
	66.7	71.3	70.4
Pad spinules with melanin	—	—	70.7-72.5
	—	—	72.4-73.8

The low dorsal warts of both sexes are surmounted by small whitish, spinose tubercles. A small amount of melanin may be deposited at the tips of the tubercles without adding to their height (« light deposit »), or melanin may be present in sufficient quantity to increase tubercle height appreciably (« heavy deposit »). Nine of 15 females (all exceeding 55 mm) have no melanin and six a « light deposit ». Among the males the deposition of melanin is associated with the development of the nuptial pads. Of three males (53.9-68.6 mm) with no visible tubercle melanin, one has neither vocal

sac nor nuptial pads, one has nuptial pads on the first two fingers, and the third has nuptial pads on three fingers but the pads lack melanin. Five males (58.8-72.4 mm) have a light deposit; of these one has neither vocal sac nor nuptial pads, two have nuptial pads on the first and second fingers, and two have pads on the first three fingers. One of the last two has melanin on the nuptial pads. Only three males (70.7-73.8 mm) have a heavy deposit on the dorsal tubercles and all three have fully developed nuptial pads tipped with melanin.

A final difference between the sexes lies in the more extensive webbing of sexually competent males, a difference best measured by the number of phalanges free of broad web on the fourth toe. All Upemba females have from  $3 \frac{1}{3}$  to  $3 \frac{2}{3}$  phalanges extending beyond the web, with  $3 \frac{1}{2}$  free phalanges the prevailing number. Males also may have as many free phalanges, but, as shown in Table 3, those individuals with well-developed nuptial pads have only three phalanges free.

TABLE 3. — Frequency distribution of male *Bufo carens* from the Upemba with respect to webbing and nuptial pad development.

		Phalanges of fourth toe free		
		3	$3 \frac{1}{2}$	$3 \frac{2}{3}$
Number of fingers with nuptial pads	0	—	1	1
	1	—	2	—
	2	1	—	—
	3	6	—	—

Ecological notes. — *Bufo carens* is apparently restricted to the savanna and scrub forest of eastern Africa, where it breeds in small bodies of stagnant or sluggish water (POWER, 1925). It occurs from near sea level along the coast of Natal (ODHNER, 1908) to 1,600 m (MERTENS, 1940 A). The Upemba sample has an altitudinal range of from 585 to 1,100 m, with three-fourths of the toads caught below 750 m.

Our series is too small for the definition of a breeding period in the Upemba. However, nearly ripe ova were found in one female collected in March and in two collected in October.

Range. — From Natal (ODHNER, 1908) and southeastern Bechuanaland (HEWITT and POWER, 1913) to southeastern Belgian Congo and southern Kenya (PROCTER, 1920).



## Upemba localities and specimens :

Bowa (4); Kalule-Nord (6); Kande (1); Kanonga (3); Kaswabilenga (64); Kateke (9); Kiamokoto (1); Mabwe (5).

3. — **Bufo funereus upembae** n. subsp.

**Holotype.** — Institut des Parcs Nationaux du Congo Belge number 677. An adult male collected at Karibwe, Parc National de l'Upemba, Belgian Congo, at 1,700 m, March 4-6, 1947, by the Mission G. F. DE WITTE.

**Diagnosis.** — Size moderate, adults 44-65 mm. Like the typical subspecies, but differing in having a distinct tarsal fold, slightly larger warts on the dorsum, and a slightly smaller tympanum.

**Description of holotype.** — Head flat, without crests; snout obtusely pointed; tympanum distinct, horizontal diameter one-half that of eye; parotoid separated from eyelid by little less than tympanum diameter, ellipsoidal, length just under 3 times width, length equal to parotoid-nostril distance.

First finger longer than second; fourth and second subequal; a large subcircular outer palmar tubercle, inner one oval and about two-thirds width of outer; metacarpal tubercles prominent; subarticular tubercles single but larger ones cordiform. Toes about two-thirds webbed; third and fifth toes with one, and fourth toe with three phalanges free of web; subarticular tubercles single; sole with numerous conical tubercles; inner metatarsal tubercle oval, length slightly more than half its distance from tip of first toe; outer metatarsal tubercle much smaller and conical.

Color (in alcohol) blackish brown above, slightly paler below, a faint lighter area on interorbital; upper lip barred; all other markings obscured.

For description of skin see Secondary sex characters below.

Measurements of holotype (mm) : snout-vent 48.4, tibia 20.0, head width at tympanum 15.5, head length to jaw articulation 13.7.

**Paratypes.** — All of the following are from the Parc National de l'Upemba or immediately adjacent localities : IPN 504 A, 525 (6), 550, 553, 558 (6), 560 A, 561, 571, 576-78 (4), 582, 586, 587 A, 588, 589 A (2), 596, 599, 630 (4), 632 A, 633 (15), 642, 645 (2), 651 A, 652 (4), 655 A, 674-753 (642), 755-62 (14), 764-76 (37), 787, 790, 801, 2,689.

These resemble the holotype very closely. The principal non-seasonal variation is in coloration. Although they are all dark, a pattern is visible in some. The common, diagnostic marking consists of a yellowish interorbital area (described by БОЦАГЕ, 1882) delimited behind by two oblique dark bars. A short stem of the yellow area projects posteriorly between the two bars. Less distinct is a yellowish brown mark, beginning as a short narrow streak between the rear of the parotoids expanding to cover

a broad area in the middle of the back, and narrowing over the sacrum into a stripe that almost reaches the vent. Dark crossbars are sometimes visible on the limbs. About one-half of the specimens have the belly dotted with white as noted by BOCAGE (1866) in the typical form.

The horizontal diameter of the tympanum varies from two-fifths to two-thirds the diameter of the eye. The modal value is one-half the eye diameter. Variation in size is discussed below.

**Secondary sex characters.** — Females and juvenile males are covered dorsally and laterally by prominent heterogeneous conical warts tipped with black, horny spines. Similar spiny, conical warts are arranged in an irregular cluster on the area behind the rictus and below the parotoid and on the dorsal and lateral surfaces of the limbs. Males in the adult size range have the same rough skin, but as soon as nuptial pads begin to develop, all of the warts on the trunk and hind legs flatten out and lose their spines. The entire upper arm and the dorsal surface of the lower arm also become smooth. However, at the same time a series of large black spines develops on the elbow and along the lateral edge of the lower arm (Fig. 12).

The nuptial pad consists of clusters of black spinules and covers the dorsal surface of the first finger from the center of the metacarpal to the end of the basal phalanx, the entire median surface of the first finger from the proximal edge of the inner palmar tubercle to the middle of the terminal phalanx, the dorso-median surface of the second finger from its base to the middle of the terminal phalanx, and the median edge of the two basal phalanges of the third finger. At its maximum development the pad covers the entire ventral surface of the lower arm where, however, the spinules are concentrated on warts each of which bears a larger central black spine. The development of the nuptial pad and its relation to the other male secondary sex characters are discussed in greater detail by INGER and GREENBERG (1956).

Males of at least this subspecies of *funereus* do not have vocal sacs. WITTE (1930, p. 242) is the only author to state that *funereus* has these structures. Richard G. ZWEIFEL, American Museum of Natural History, informs us by letter that breeding males from some of the same northern Congo localities listed by WITTE do not have vocal sacs.

At maximum development of the secondary sex characters, a male has smooth dorsal skin, smooth upper arm, large spines at the elbow, and nuptial pad on the first three fingers and on the inner palmar tubercle and lower arm. Although it is evident from the data of INGER and GREENBERG that most males would not reach this stage of development until they had a snout vent length of 44 mm, the smallest male with mature secondary sex characters measures 39.0 mm.

Males are smaller than females. The 59 males with fully developed sex characters range between 39.0 and 58.1 mm (mean =  $47.15 \pm 0.48$ );

61 females with pigmented ova range between 44.0 and 65.2 mm (mean =  $53.26 \pm 0.64$ ).

Ecological notes. — Most of the literature records of *funereus* place it in rain forest although it has also been collected in gallery forest and in savanna. Known altitudinal distribution runs from near sea level to 1,300 m (LOVERIDGE, 1942). In the Upemba the range is 860 to 1,830 m with a frequency distribution as follows :

Meters.	No. of individuals.
751-1,000	40
1,001-1,250	95
1,251-1,500	132
1,501-1,750	242
1,751-1,830	250

The seasonal cycle in sex characters and in development of ova are treated in detail by INGER and GREENBERG (1956). Their results show that, whereas the females have a distinctly cyclic reproductive physiology, the males do not. A very high proportion of the females collected in the interval October-April have well-developed pigmented ova but only a small percentage of those from May through July do. Adult males may have completely developed secondary sex characters at all months of the year. The data are summarized in Table 4, which includes only individuals with snout-vent of 44 mm or over. No specimens were available from the months of August and September.

TABLE 4. — Seasonal frequency of *Bufo funereus upembae* with respect to development of sex characters.

	October-April	May-July
<b>Males :</b>		
secondaries complete ... ..	15	32
secondaries incomplete . ... ..	21	11
secondaries absent . ... ..	1	10
<b>Females :</b>		
ova pigmented ... ..	53	8
ova intermediate ... ..	5	3
ova immature . ... ..	14	91

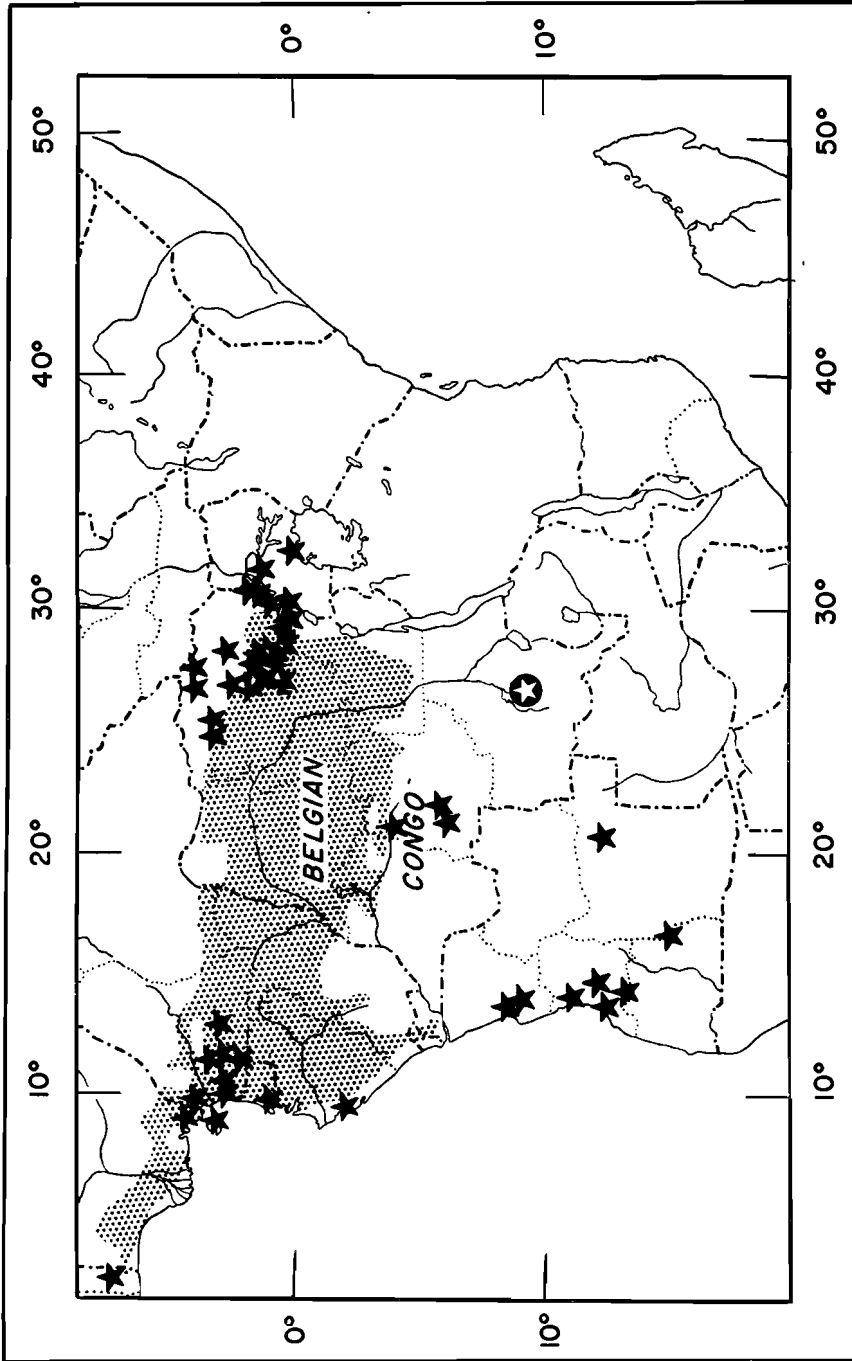


FIG. 6. — Distribution of *Bufo fumeus*.  
Parc National de l'Upemba indicated by symbol with open star.

Range. — The species occurs from Dahomey (CHABANAUD, 1919) to Uganda (LOVERIDGE, 1942) in the north, south and east through southeastern Belgian Congo and Angola (Fig. 6).

Upemba localities and specimens :

Babagi (6); Bowa (1); Buye-Bala (66); Bwalo (3); Dipidi (4); Ganza (25); Kabiteke (6); Kabwe (49); Kabwekanono (5); Kagomwe (40); Kalumengongo (5); Kamamulongo (1); Kamatshya (4); Kambi (7); Kamitungulu (19); Kamitunu (69); Kankunda (6); Kanpungu (2); Karibwe (37); Kasandendeko (2); Katongo (1); Kavizi (9); Kenia (8); Kiamakoto (3); Kilolomatambo (3); Kimapongo (14); Kimiala (8); Kimilombo (2); Kipangaribwe (28); Lufwa (4); Lukorami (1); Lusinga (144); Manda (1); Masombwe (3); Mitoto (8); Mubale (1); Mukana (1); Munte-Mubale (74); Pelenge (88); Tumbwe (1).

4. — **Bufo lemairi** BOULENGER.

*Bufo lemairii* BOULENGER, 1901, Ann. Congo Mus., (1), 2, p. 1, pl. 1, fig. 1 — Pweto, Belgian Congo.

Diagnosis. — Habitus raniform, size moderate, adults 50-70 mm; no cranial crests; parotoids narrowly separated from eyelid, elongate, three to four times as long as wide, length equal to distance from tip of snout to center of eye; tympanum distinct, horizontal diameter subequal to eye; an elongate, smooth gland from rictus to above arm insertion; dorsal surfaces covered with numerous small conical warts; metatarsal tubercles small, oval, raised but not blade-like; subarticular tubercles prominent, single; webbing leaving two phalanges of third and fifth toes and 3 ½ phalanges of fourth toe free.

Color (in alcohol) clay or olive brown above with pair of irregular dark spots of varying sizes usually present on back; ventral surface of head and body cream-colored, immaculate (Pl. I, fig. 1).

Secondary sex characters. — Despite the smallness of the sample, it is evident that females are larger than males. Only four females were available and they range from 61.6 to 70.5 mm, snout to vent, with an average of 66.2 mm. The 14 males with secondary sex characters in some stage of development range from 53.9 to 65.2 and only four exceed 60 mm.

Male *lemairi* have single, median, subgular vocal sacs opening through a slit on the left side of the mouth in eight and on the right side in six. Melanophores are distributed in the connective tissue between the fibers of the omohyoid muscle enveloping the vocal sac.

Nuptial pads consisting of dense clusters of horn-tipped spinules cover the dorsal and median surfaces of the first finger from its base to the beginning or center of the terminal phalanx, a broad dorso-median band on the second finger from its base to the last phalanx, and a narrow strip on the median edge of the third finger as far as the terminal phalanx.

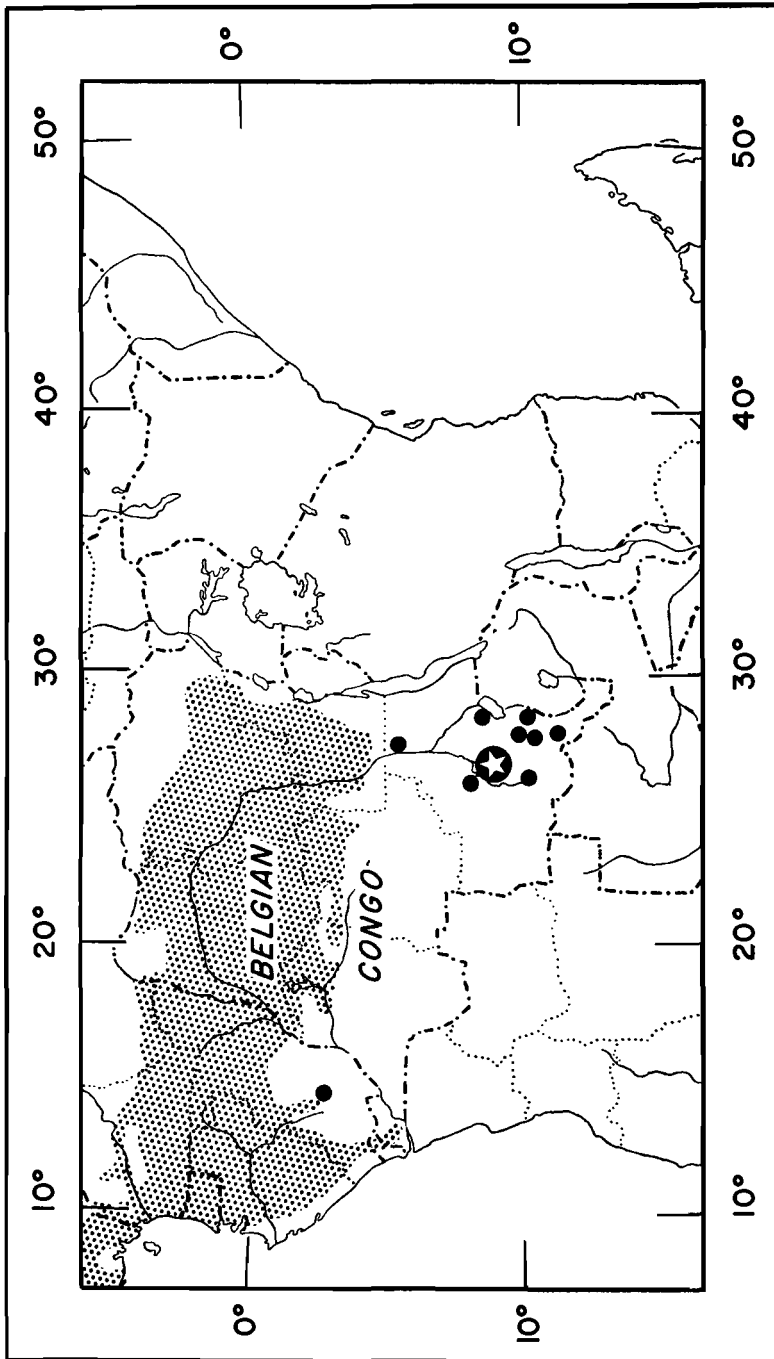


FIG. 7. — Distribution of *Bufo temairi*.  
Parc National de l'Upemba indicated by symbol with open star.

As in other anurans, the pad of *lemairei* develops first on the inner finger and spreads laterally to the others. Black pigment appears after the spinules develop on all three fingers.

The small, conical, dorsal warts are usually tipped with brownish or black horny material in both sexes. However, in males with fully developed nuptial pads, the horn is built up into sharp spines.

Ecological notes. — *Bufo lemairei* seems to be restricted to moderate or high elevations as it has been collected only in uplands. Two of the Upemba series were caught at 900 m, one at 1,480 m, and the remaining sixteen between 1,600 and 1,830 m above sea level.

The four adult females, all of which contain large, pigmented ova, were collected in April and June.

Range. — This distinctive *Bufo* has previously been reported only from southeastern Belgian Congo. However, one specimen in the collections of the Chicago Natural History Museum (CNHM 75084) was caught at Djambala, Moyen Congo, French Equatorial Africa (Fig. 7).

Upemba localities and specimens :

Kalumengongo (2); Kimiala (2); Lufwa (1); Lusinga (11); Munte-Mubale (1); N'Gozie (2).

##### 5. — *Bufo melanopleura* n. sp.

(Pl. IV, 2.)

Holotype. — Institut des Parcs Nationaux du Congo Belge, No. 807, from Kankunda, Parc National de l'Upemba, Belgian Congo. An adult male collected November 11-13, 1947, at an elevation of 1,300 m by the Mission G. F. DE WITTE.

Diagnosis. — A minute species of *Bufo* (males 17-21 mm snout-vent; females 20-25 mm) without a tympanum or cranial crests; with fourth finger barely projecting out of palm, an elongate but feebly distinct parotoid gland, and small, round, simple warts covering top and sides of head and back. Warts flattened in males (Fig. 8).

Description of holotype. — Habitus moderately slender, legs short; head pointed, shorter than width behind eye; no cranial crests; top of head flat; snout truncate, projecting beyond mandible; nostrils near tip of snout, above end of mandible; canthus rostralis well-marked but rounded; lores vertical, straight; interorbital equal to upper eyelid; horizontal diameter of eye equal to eye-nostril distance; pupil horizontal; tympanum absent; eustachian tube openings small; tongue oblong, length a little more than twice width, margin entire; parotoids feebly distinct but present, beginning immediately behind eyelid, four times as long as wide, as long as their distance from tip of snout.

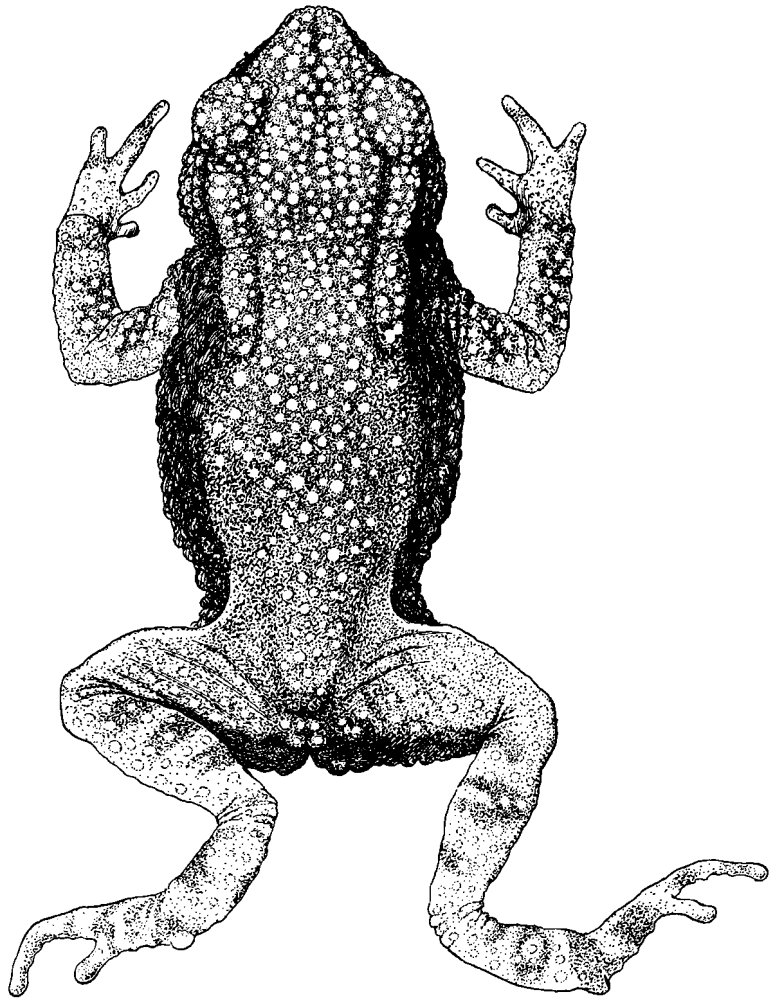


FIG. 8. — *Bufo melanopleura* ♂ paratype (×5).

Heels narrowly separated when legs are flexed and held perpendicular to body; tips of fingers and toes bluntly rounded, not dilated; fingers without web (Fig. 9); first finger shorter than second; fourth shorter than second and less than one-half third, barely projecting out of palm; one large palmar tubercle about twice size of finger tips; rest of palm covered with small conical tubercles that run out fingers as double rows of subarticular tubercles; fourth finger with two transverse groups of tubercles. Foot (measured



from base of inner metatarsal tubercle) shorter than tibia (Fig. 9); only two phalanges of fifth and three of third toes projecting out of fleshy sole; web at bases of outer toes; one and one-half phalanges of third toe, three of fourth, and one of fifth toe free of web; third toe longer than fifth; round metatarsal tubercles, inner slightly larger than tips of toes, outer slightly smaller, the two separated by little more than width of outer; sole and undersides of toes covered with small, conical tubercles, those on the toes in double rows.

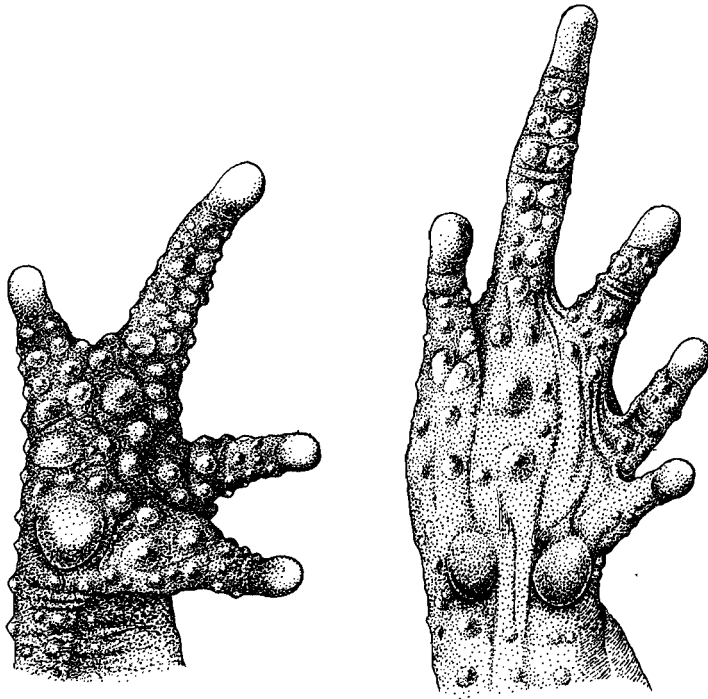


FIG. 9. — *Bufo melanopleura* ♂ paratype ( $\times 20$ ).  
Left, underside of right hand. Right, underside of right foot.

Skin of all dorsal surfaces and sides of head densely set with simple, flattened (see below for condition in females), round warts or tubercles; sides of body with larger warts; entire underside coarsely granular.

Color (in alcohol) brown above and on sides of head; tips of warts lighter; sides of body blackish brown; limbs above brown with obscure dark crossbars; entire underside whitish or cream-colored with an elongate dark mark beginning behind throat and running to center of belly.

Measurements (mm) : snout-vent 20.1, head length 6.4, head width 6.6, snout 3.0, tibia 6.0, foot 5.1.

Paratypes. — All of the following are from the Parc National de l'Upemba or immediately adjacent localities : IPN 147, 798-800 (5), 802-803 (10), 805-813 (208), 1076-1078 (3), 2699 (63), 2718 (12).

This series is relatively uniform except for sexual and size differences (see below), but shows minor variation in color. The dark pigment on the belly may cover only a narrow median strip or, at the maximum, it may occupy half of the ventral surface. In certain adult males, as in the holotype, the pattern of the dorsum is obscured. In other males and in most females the back is light brown marked with pairs of oblique or transverse dark brown bars.

Comparisons. — Its small size, complete absence of a tympanum, and lack of cranial crests distinguish *Bufo melanopleura* from all but a dozen African congeners. *Bufo osgoodi* LOVERIDGE (holotype examined) and *B. lonnbergi* (cotype examined) have much broader tongues, much longer fingers (fourth finger at least as long as second), and no warts or tubercles on the sides of the snout. *Bufo jordani* PARKER and *rosei* HEWITT differ from *melanopleura* in having smooth bellies, longer fourth fingers, and smooth heads. *Bufo taitanus* PETERS (lectotype seen) has much larger and more complex warts on the dorsum and much smaller metatarsal tubercles than *melanopleura*. *Bufo anotis* BOULENGER is larger (males 40 mm as compared to less than 25 mm) than *melanopleura* and lacks tubercles on the head. *Bufo chappuisi* ROUX is almost certainly a juvenile, which fact limits comparison, yet obviously differs from *melanopleura* in its longer fingers, smooth skin, and much broader interorbital region. *Bufo gardoensis* SCORTECCI lacks parotoid glands and may be further distinguished by the presence of a small tympanum. *Bufo katangus* LOVERIDGE has more extensive webbing (to tips of inner toes) than *melanopleura* and has flatter warts or tubercles.

*Bufo micranotis* LOVERIDGE (type series examined) and *ushoranus* LOVERIDGE (holotype examined) are similar to *melanopleura* in size and habitus. But *micranotis* has much shorter toes, an almost completely black underside and extremely large nuptial spines on the first finger in males. *Bufo micranotis rondoensis* LOVERIDGE (types seen) has much larger warts than *melanopleura* and a darker belly. *Bufo ushoranus* has compound warts — large, round structures bearing rosettes of spinules — and further differs from *melanopleura* in that the spinules of males become higher than those of females rather than the reverse.

Secondary sex characters. — As indicated by the diagnosis, females are slightly though consistently larger than males. Females with approximately mature ova range from 20.2 to 25.1 mm, snout to vent, with a mean of  $23.18 \pm 0.18$  mm (N=34). Males with nuptial pads vary from

17.6 to 21.4 mm and have a mean of  $19.70 \pm 0.19$  mm ( $N=26$ ). The difference between the two means is statistically significant.

The dorsal and lateral surfaces of the head and body are covered with simple tubercles or warts that are conical, obtusely pointed, and distinctly elevated in all females and in immature males. In adult males with nuptial pads the warts are greatly flattened and, although their bases are conspicuously enlarged, hardly raised above the level of the surrounding skin.

The nuptial pads, in fully developed males, cover the entire dorsal surfaces of the first two fingers except for the terminal phalanges and consist of brown-tipped clusters of fine spinules. The males lack vocal sacs.

**Ecological notes.** — The seasonal distribution of this series is not sufficient to determine the breeding cycle. However, the specimens collected in November and December are in breeding condition. Only four out of 38 females of mature size, that is, over 20.2 mm, do not contain mature ova. Similarly only three of the 29 adult males (over 17.5 mm) collected in those months lack nuptial pads and flattened warts. The two adult males available from the dry season (May) also lack secondary sex characters.

Despite the small size of the adult, the eggs of *melanopleura* are large, measuring 1.8 to 2.0 mm in diameter. This size corresponds to some of the largest *Bufo* eggs, which belong to much larger toads, *B. bufo* and *B. marinus* (INGER, 1954). The egg count of *melanopleura* is very small. One female (22.2 mm) held 17 large ova with pigmented animal hemispheres in the right ovary and 14 in the left. A second female (22.7 mm) contained 19 and 16 mature ova in the right and left ovaries respectively. Each ovary had as many small, immature ova as mature ones.

Although the present series of *melanopleura* has an altitudinal range of from 695 to 1,320 m above sea level, all but 22 specimens were collected at 1,300 and 1,320 m.

**Range.** — Known as yet only from the Parc National de l'Upemba.

**Upemba localities and specimens :**

Kabwe (10); Kankunda (270); Kanonga (1); Kaswabilenga (2); Kateke (16); Lupiala (3).

## 6. — *Bufo regularis* REUSS.

*Bufo regularis* REUSS, 1834, Mus. Senckenb., 1, p. 60 — Egypt.

**Taxonomic notes.** — As PARKER (1936 B) has correctly pointed out, the extremely local nature of the samples on which the many subspecies of *regularis* have been based discourages confidence in these subdivisions. The unfortunate result is that distinct species are probably buried in synonymies. For example, *Bufo regularis gutturalis* POWERS from South Africa was based on specimens collected from the same pond as some typical

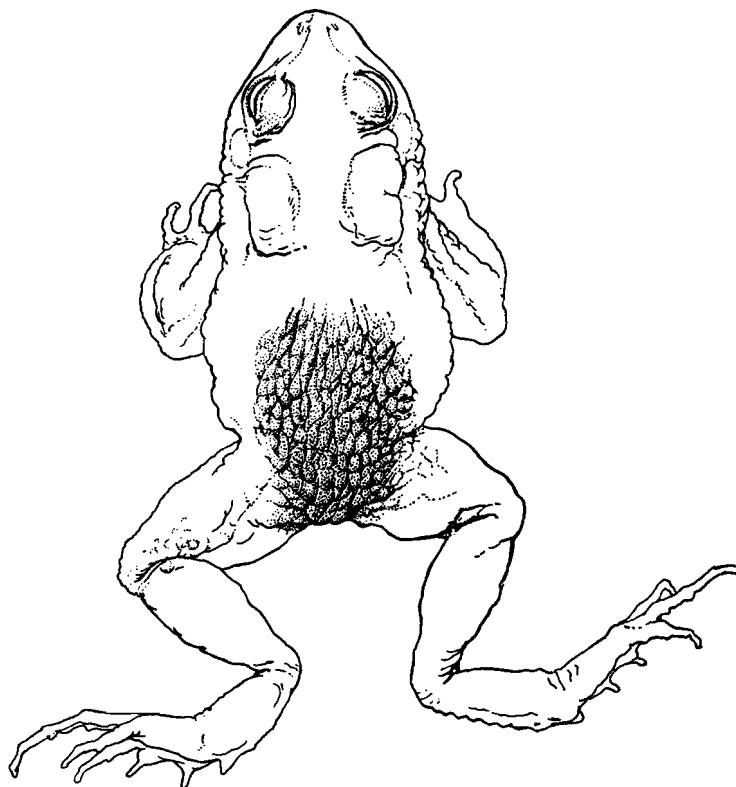


FIG. 10. — Dorsal skin of sacrum of adult male *Bufo kisoensis* during breeding season ( $\times 1$ ).

*regularis* and has the characteristics of a full species : it is sympatric with *regularis* but differs in its call and apparently in several morphological characters.

Similarly, *Bufo regularis kisoensis* LOVERIDGE (type locality Kisolo, Uganda) has recently been shown to be morphologically distinct from sympatric *regularis* and therefore to warrant specific recognition (LAURENT, 1952). Examination of the holotype and 30 paratypes of *kisoensis* (CNHM 9885, 12005, 18199) confirms LAURENT's opinion and adds another difference between the two species. Adult males of *regularis* develop horn-tipped spines on the dorsal warts (Fig. 11) and thus become much more spinous than the females during the breeding season, whereas adult males of *kisoensis* (Fig. 10) have no such spines and actually become smoother than the females. LAURENT calls attention to the absence in male *kisoensis* of the black gular pigmentation characteristic of *regularis*.

*Bufo regularis marakwetensis* ROUX (type locality Marakwet, western Kenya) is evidently a strict synonym of *kisoloensis*. The two males (65 mm) described by ROUX are adult and in breeding condition as determined by the presence of nuptial pads. According to ROUX their dorsal warts are low and lack spines and the throat is not infusate.

Several proposed subspecies of *regularis* are said by their describers to be smaller than typical *regularis*. For example, MERTENS (1937) differentiated *regularis pusillus* partly on the basis of its size; he had three reproductively mature males of the new form that had a snout-vent range of 45-48 mm. MERTENS himself was later (1940) able to show that *regularis* often has a remarkable size range within a small geographic area. He had mature males with a size range of 43-52 mm from the Bamenda district of the Cameroons and one large male (98 mm) from another locality within the same district. Reproductively mature males from the « Parc National de l'Upemba » have an equally extensive size range, varying from 47 to 94 mm, snout-vent.

A character that does exhibit marked geographic variation is the number of vocal sac openings. LU (1935) lists *regularis* as having bilateral openings but does not state from what part of the species range his sample was drawn.

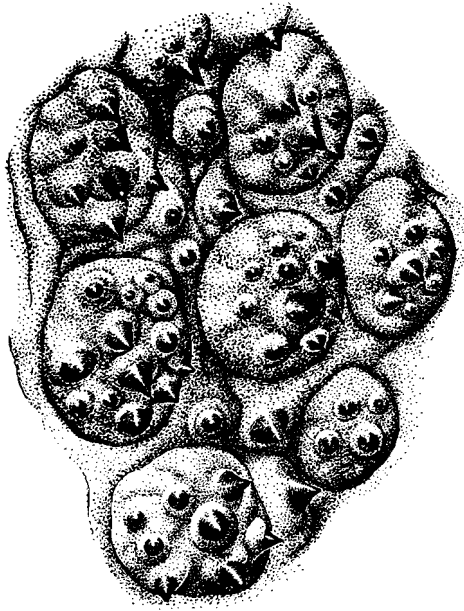


FIG. 11. — Enlargement of dorsal skin of sacrum of adult male *Bufo regularis* during breeding season ( $\times 12$ ).

Males from Upemba normally have a single opening, which may be on either side, and thus contrast sharply with those from Egypt (the type locality). Our examination of males from various parts of the range (Table 5) indicate a rough north-south dichotomy in the number of vocal sac openings. North of an arc from Nigeria to Uganda only the Ethiopian sample is characterized by a unilateral opening.

TABLE 5. — Frequency distribution of male *Bufo regularis* from various areas with respect to the number of vocal sac openings.

	Single opening	Paired openings
Egypt ... ..	0	13
Uganda .. ...	0	3
Senegal .. ...	0	11
Liberia .. ...	3	7
Nigeria .. ...	0	2
Cameroons ... ..	3	0
Ethiopia . ...	6	2
Angola ... ..	14	2
Bechuanaland ... ..	12	1
Belgian Congo (Upemba) .. ...	141	12

As we have found no other character with similar geographic variation, we cannot reasonably establish any subspecies. Our conclusions do not differ widely from PARKER'S (1936 B). In general, the proposed subspecies of *regularis* should not be recognized pending an intensive over-all survey, but at least one of them (*kisoloensis* LOVERIDGE) is certainly a distinct species. Very possibly others, especially *gutturalis* POWERS, will merit full specific status.

Diagnosis. — Size large, adults 47-115 mm; no cranial crests, parotoids separated from eyelid, elongate, roughly three times as long as wide, subequal to snout-riectus distance; tympanum distinct, horizontal diameter equals two-thirds eye; an elongate, smooth-edged gland or glands behind rictus; dorsal surfaces covered with round warts of various sizes; both metatarsal tubercles oval, raised but not compressed; subarticular tubercles prominent, single; web usually leaving two phalanges of third and fifth toes free.

Color (in alcohol) clay or olive-brown above, lighter below (except in males); two pairs of dark interorbital spots, the anterior usually extending forward on to snout; two pairs of oval or round dark spots on back.

Secondary sex characters. — Adult females are larger than males. Ninety-eight females containing pigmented ova vary from 56.8 to 114.8 mm snout to vent; mean= $70.22 \pm 1.28$  mm. The size range of 141 males with well-developed nuptial pads is 47.2-94.5 mm; mean= $58.49 \pm 0.69$  mm.

The other secondary sex characters of *regularis* are considered in detail elsewhere (INGER and GREENBERG, 1956). Briefly, the males have median, subgular vocal sacs communicating with the oral cavity by means of slit-like openings that usually are single in males from the region south of the equator but paired in males from north of the equator (Table 5). The gular skin of males in breeding condition becomes suffused with black pigment. Males in this stage have black nuptial pads on the median and dorsal surfaces of the first two fingers and in a narrow strip along the median edge of the third finger.

The warts of the black, upper arm, and dorsal surface of the leg have low, whitish spinules in females and non-breeding males. These spinules increase in height and acquire heavily pigmented horn as the males enter breeding condition (Figs. 11-12).

Ecological notes. — Though this most widely distributed of African toads is indifferent to floral provinces, it is restricted in the rain forest regions to large, artificial clearings such as cultivated fields and human habitations (NOBLE, 1924; SANDERSON, 1936). Its altitudinal distribution is also extensive and, while *regularis* is much more abundant at low elevations, it has been reported from as high as 2,100 m (LOVERIDGE, 1942). Upemba specimens were collected between 585 and 1,830 m with the following frequencies :

Meters.	No. of specimens.
500- 750	874
751-1,000	252
1,001-1,250	95
1,251-1,500	12
1,501-1,750	38
1,751-1,830	65

The annual cycle in male secondary sex characters and in ovarian activity is described in detail elsewhere (INGER and GREENBERG, 1956). It may be summarized by saying that the proportion of males with fully-developed secondary sex characters decreases sharply in February and evidently remains low until August when it rises sharply. The males remain in

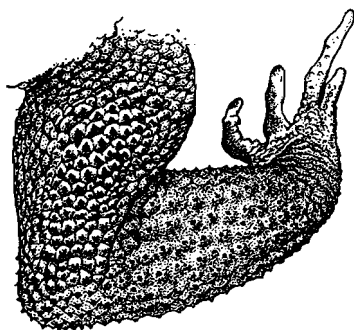
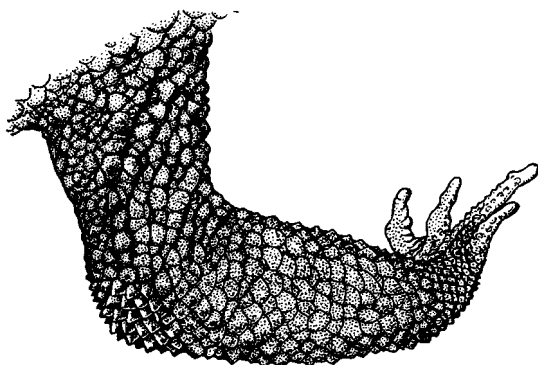


FIG. 12. — Lateral aspect of arms of male toads at height of breeding season.  
Above, *Bufo funereus upembae* ( $\times 3$ ). Below, *Bufo regularis* ( $\times 3$ ).

breeding condition until the next February. The proportion of females containing pigmented ova roughly follows the same trend. Dividing the year into two seasons on the basis of the male cycle, the frequencies of reproductively competent toads is shown in Table 6. A large series collected in October was obviously taken from a breeding aggregation; it included females with ovulated eggs and some with strands of ova hanging out of the anus.

Range. — All of Africa excepting the northwestern corner.



TABLE 6. — Seasonal frequency of *Bufo regularis* with respect to development of sex characters.

	August-January	February-July
Males :		
secondaries complete ... ..	134	8
secondaries incomplete . ... ..	4	7
secondaries absent . ... ..	3	33
Females :		
ova pigmented ... ..	95	17
ova not pigmented ... ..	17	23

## Upemba localities and specimens :

Bowa (1); Buye-Bala (21); Bwalo (7); Difirinji (1); Dipidi (1); Ganza (11); Kabenga (8); Kabwe (5); Kabwekanono (3); Kalule Nord (1); Kalumengongo (30); Kamakoko (19); Kande (152); Kankunda (3); Kanonga (9); Karibwe (2); Kaswabilenga (133); Kateke (18); Katombwe (1); Katongo (2); Kaziba (11); Kenia (1); Kiamakoto (39); Kilwezi (6); Kipangaribwe (1); Kipondo (184); Loie (2); Lufwi (1); Lukawe (3); Lupiala (3); Lusinga (27); Mabwe (503); Masombwe (31); Mubale (2); Mukelengia (3); Munoi (6); Munte-Mubale (4); Muye (1); Mware (2); N'Gongozi (1); Pelenge (4); Senze (2).

7. — *Bufo ushoranus* LOVERIDGE.

(Pl. IV, 3.)

*Bufo ushoranus* LOVERIDGE, 1932, Occ. Papers Boston Soc. Nat. Hist., 8, p. 45 — Ulugu, Ushora, Tanganyika Territory.

Taxonomic notes. — These toads have been compared with the type of *ushoranus*, with which they are certainly conspecific. The agreement in the distinctive rosette arrangement of horn-tipped spinules on the dorsal warts (Fig. 13) is especially striking. The Upemba sample differs from the type in the size of the metatarsal tubercles. These tubercles in the type are subequal to the tips of the toes and are separated by a distance equal to three times the width of the outer tubercle. In the Upemba series the metatarsal tubercles of both sexes are one and one-half times the toe tips and are separated by less than the width of the outer tubercle.

The original description (LOVERIDGE, 1932) referred to the rosette arrangement of spinules on the limbs only. The type, however, has this kind of wart on the back also.

**Diagnosis.** — Habitus stocky; snout narrow, obtusely pointed; no cranial crests; no distinct parotoids, though irregular groups of warts may take their place; no tympanum, tympanic annulus absent; dorsal and lateral surfaces of head and dorsal surfaces of limbs with spinose conical warts; warts on trunk larger, each with a large conical central spine surrounded by a ring of smaller spines. First finger shorter than second, fourth equal to second; subarticular tubercles of fingers and toes double; inner metatarsal tubercle larger than outer; no tarsal fold.

Size small, both sexes less than 26 mm, snout to vent.

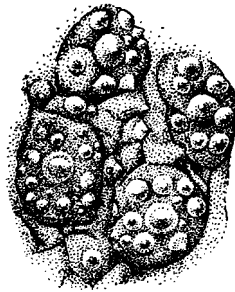


FIG. 13. — Rosette of spines  
on dorsal warts of *Bufo ushoranus* ( $\times 10$ ).

Color (in alcohol) clay brown above, some specimens with a pale area in the sacral region; below pale brownish, usually with a darker central area of varying size.

**Secondary sex characters.** — Though adult females are only slightly larger than adult males, the difference is statistically significant. Thirty-one females containing approximately mature ova vary from 21.3 to 25.3 mm, snout to vent, whereas 44 males having nuptial pads range from 20.1 to 23.7 mm. The means are  $23.39 \pm 0.18$  mm and  $21.38 \pm 0.15$  mm, respectively.

The spines surmounting the warts have a much heavier deposit of horn and are consequently higher and broader in mature males than in females and young males (Fig. 14). Mature males also differ from females in having dark brown or black throats; the corresponding areas in females are the same pale brownish or dirty cream color as the abdomen.

The nuptial pads of males cover the dorsal surfaces of the first two fingers except for the terminal phalanges. They consist of clusters of horn-tipped spinules.

Vocal sacs are not present.

Ecological notes. — All specimens of *ushoranus* in this collection were caught between November 11 and December 5, 1947. Since only four females and one male in the adult size range (see above) lacked mature sex characters, it is clear that the collection dates fall close to if not in the breeding period.



FIG. 14. — Heads of adult male (left) and female (right) of *Bufo ushoranus*.

The ova of *ushoranus*, though not especially small for a toad this size (see INGER, 1954), are only 1.0 mm in diameter and much smaller than those of *melanopleura*. However, the ova are unusual in that they lack pigment. The right ovary of one female contained 110 enlarged ova, that of a second female 234.

Forty-nine specimens were collected at 960 m, the remainder at 1,300 m.

Range. — Known previously from north central Tanganyika.

Upemba localities and specimens :

Kankunda (25); Kateke (49).