PARC NATIONAL DE L'UPEMBA
I. MISSION G. F. DE WITTE
en collaboration avec
W. ADAM, A. JANSSENS, L. VAN MEEL
et R. VERHEYEN (1946-1949).
Fascicule 56

NATIONAAL UPEMBA PARK
I. ZENDING G. F. DE WITTE
met medewerking van
W. ADAM, A. JANSSENS, L. VAN MEEL
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Aflevering 56

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

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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

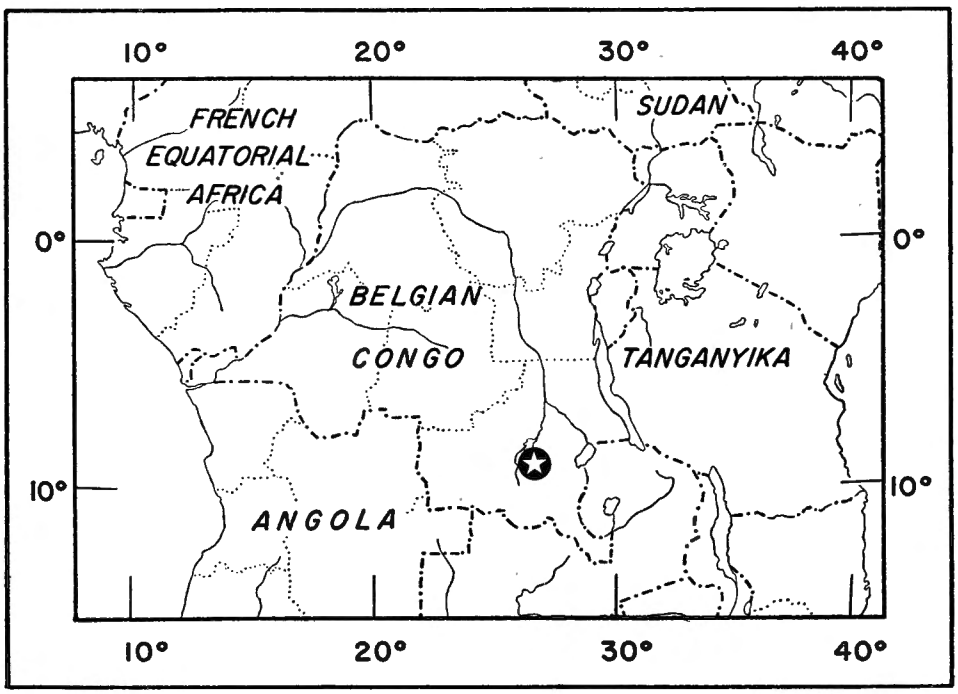


FIG. 1. — Belgian Congo showing the position of the Parc National de l'Upemba.

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.

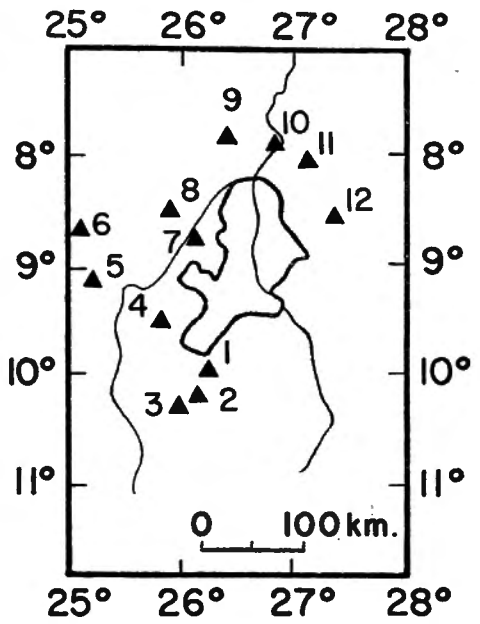


FIG. 2. — Rainfall stations surrounding the Parc National de l'Upemba.

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 STRAELEN, 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

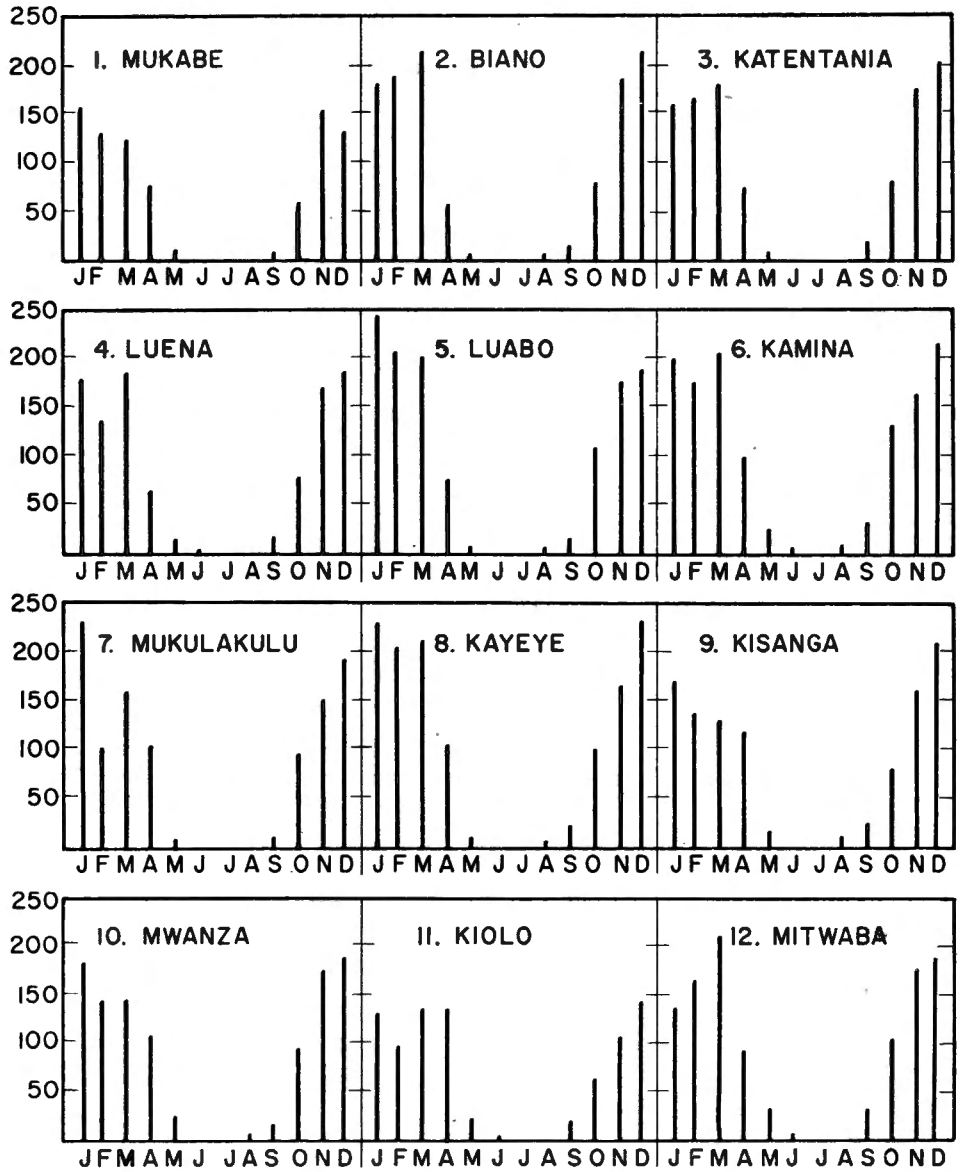


FIG. 3. — Average monthly rainfall (mm) of the stations shown in Figure 2 for the period 1940-1949.

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.

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 Transvall *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

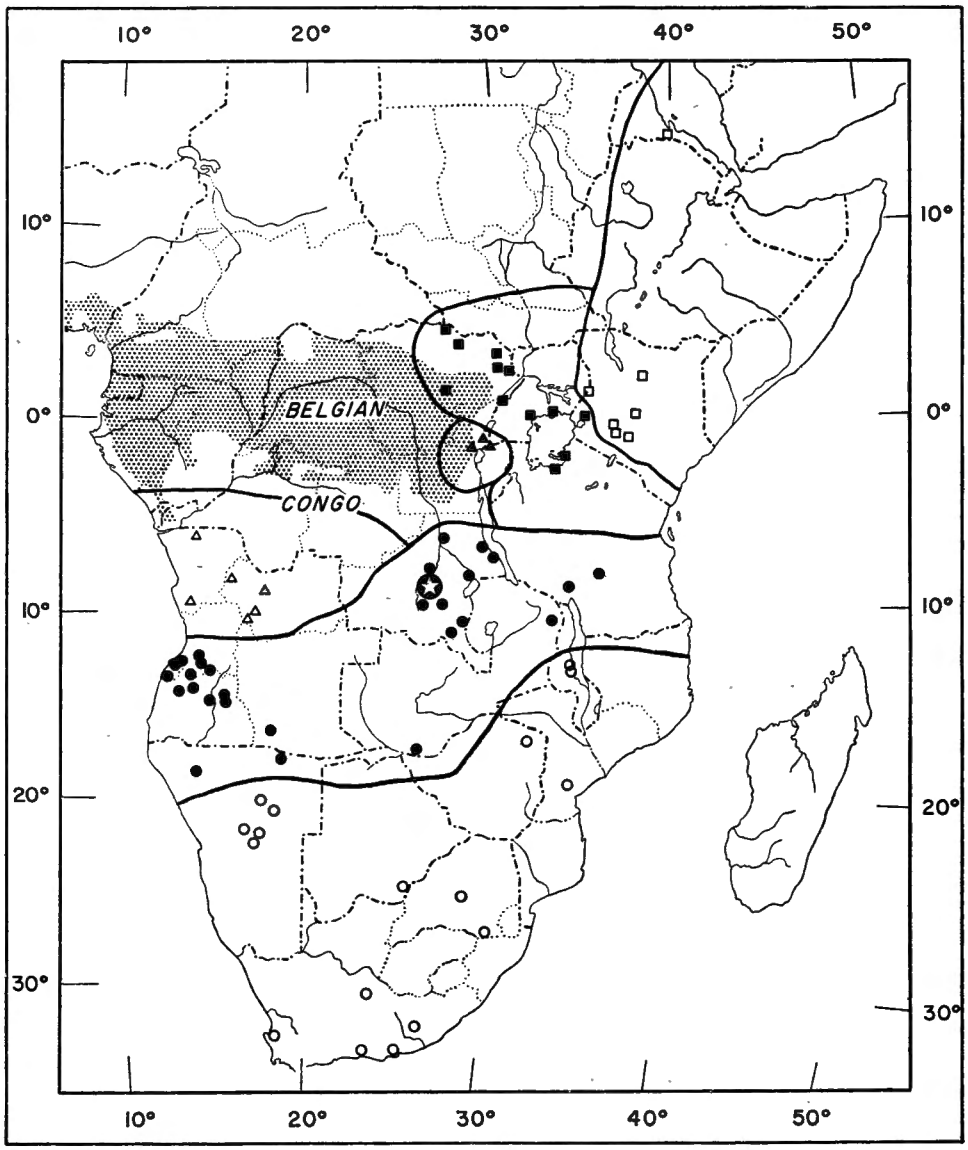


FIG. 5. — Distribution of subspecies of *Xenopus laevis* :
l. laevis indicated by hollow circles; *l. poweri* by solid circles; *l. petersi* by hollow triangles; *l. bunyoniensis* by solid triangles; *l. victorianus* by solid squares; *l. borealis* by hollow squares. Parc National de l'Upemba indicated 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 Lusinga, 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 distinquished. 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 ± 0.40 mm. In 69 females with pigmented ova the maximum is 73.7 mm, the mean 60.53 ± 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 ⅓ to 3 ⅔ phalanges extending beyond the web, with 3 ½ 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 devlopment.**

		Phalanges of fourth toe free		
		3	3 1/2	3 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 defnition 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 BOCAGE, 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 ± 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 ere 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
Males :		
secondaries complete	15	32
secondaries incomplete	21	11
secondaries absent	1	10
Females :		
ova pigmented	53	8
ova intermediate	5	3
ova immature	14	91

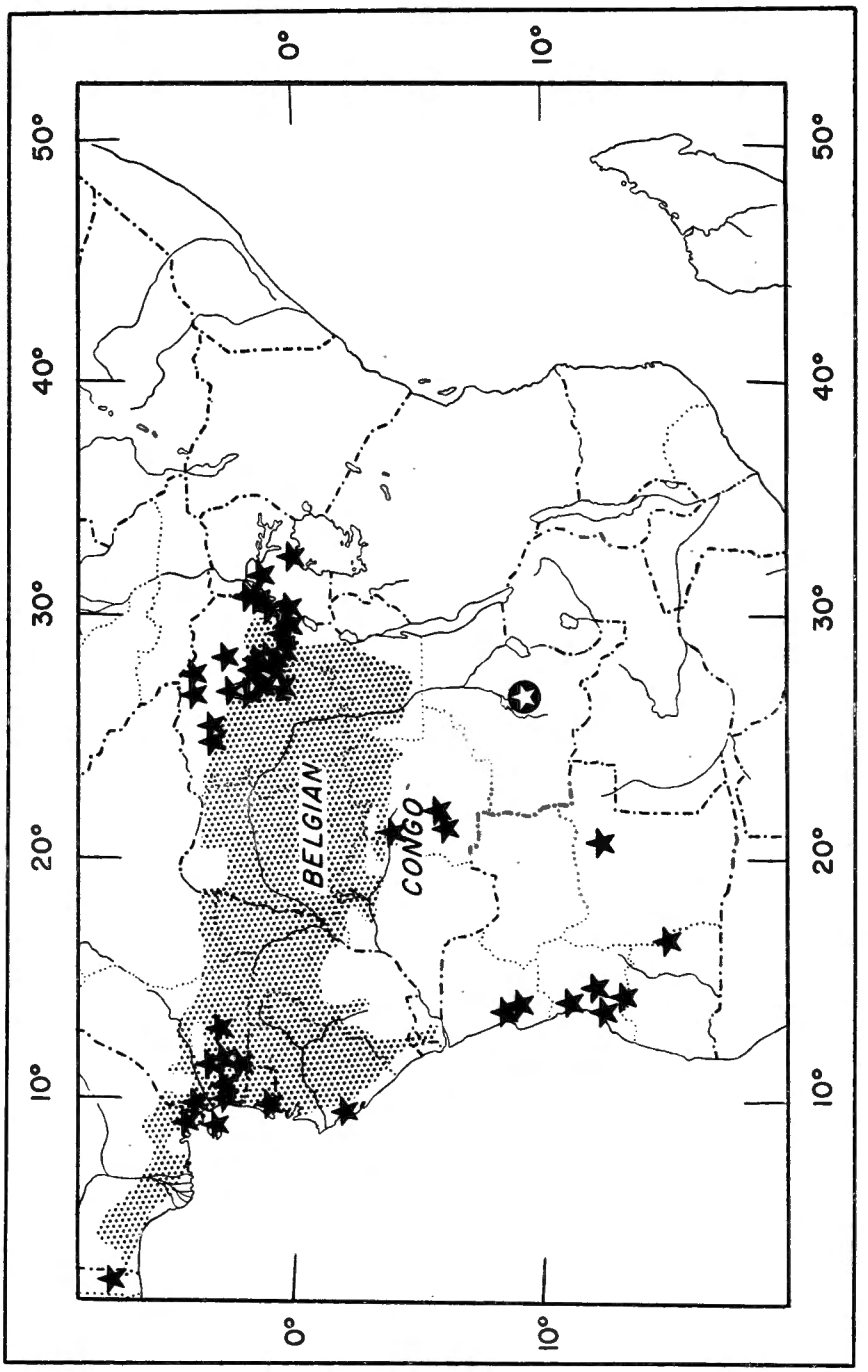


FIG. 6. — Distribution of *Bufo funereus*.
Parc National de l'Upemba indicated by symbol with open star.

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); Kilolomatembo (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 lemairei** 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 *lemairei* 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.

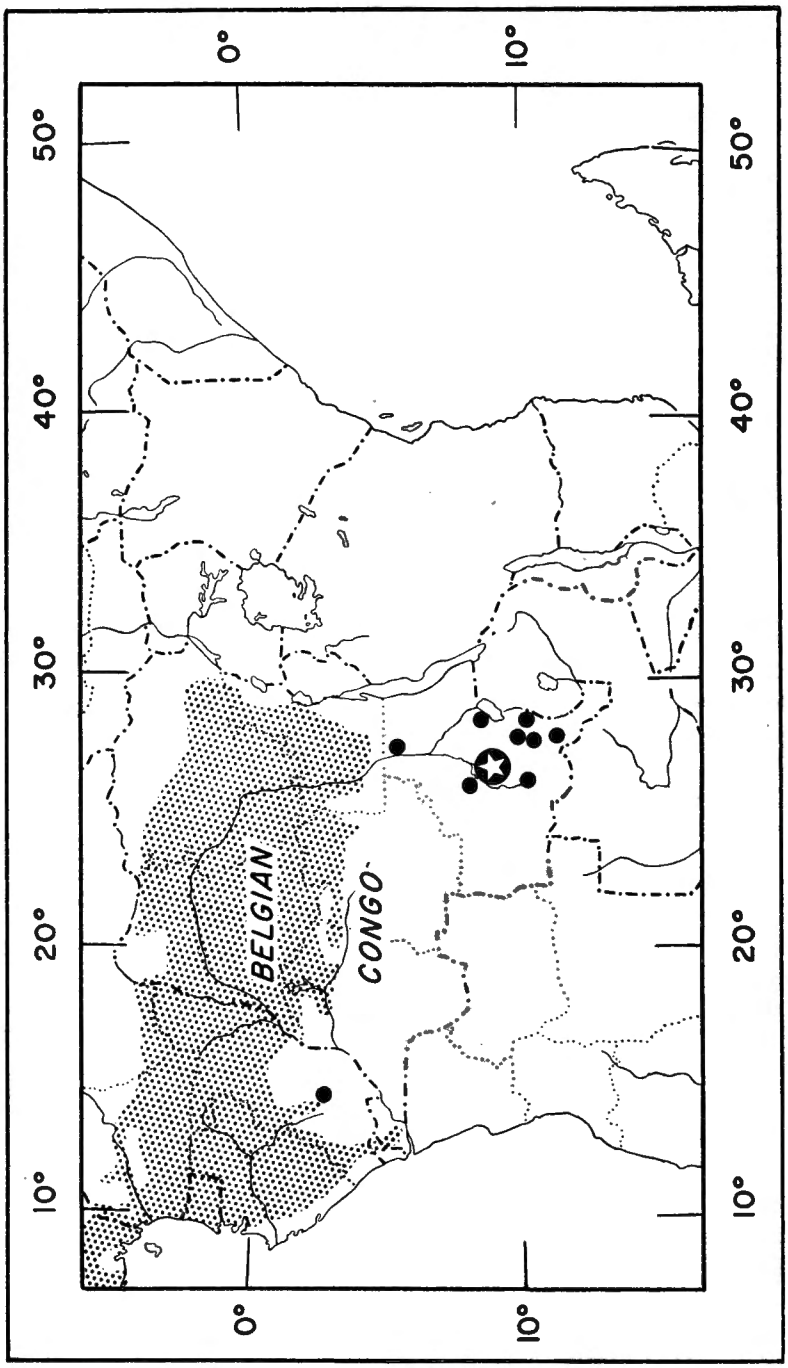


FIG. 7. — Distribution of *Bufo lemairei*.
Parc National de l'Upemba indicated by symbol with open star.

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.

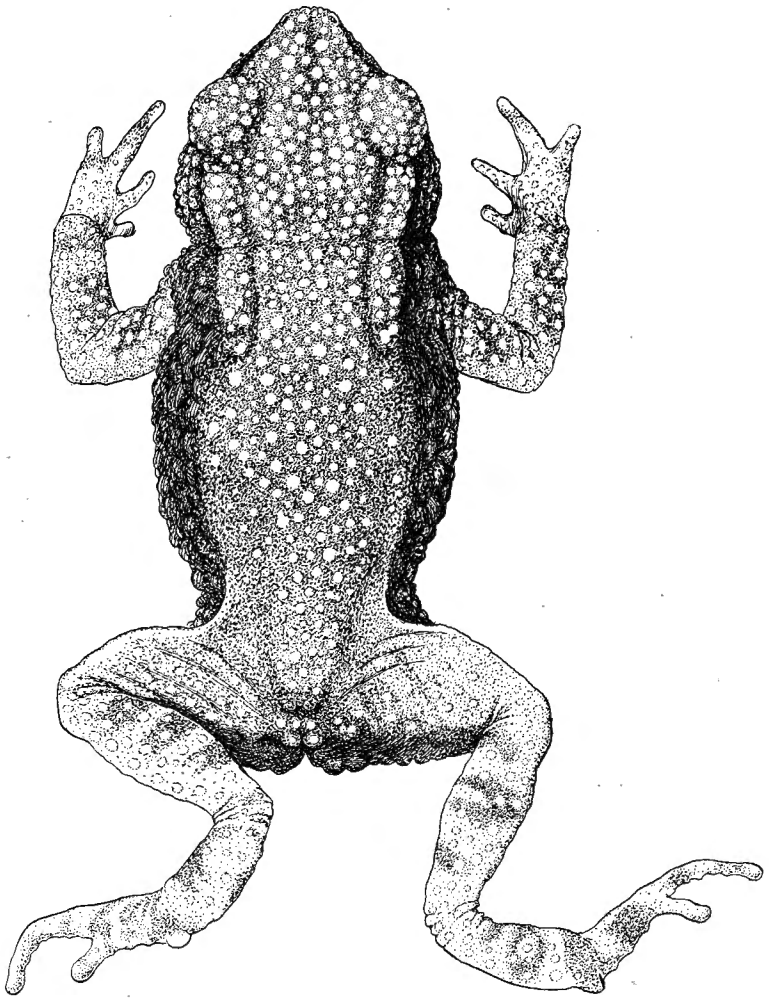


FIG. 8. — *Bufo melanopleura* ♂ paratype (×5).

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.

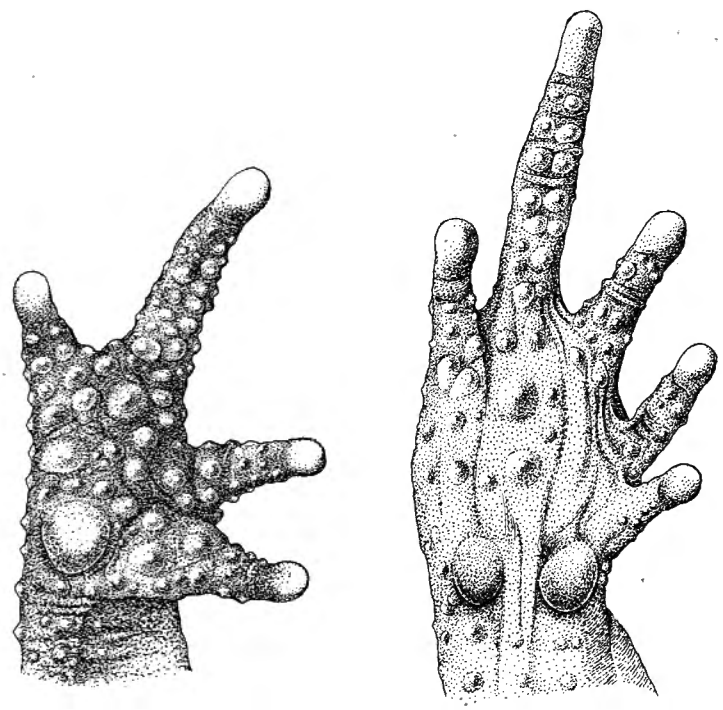


FIG. 9. — *Bufo melanopleura* ♂ paratype (×20).
Left, underside of right hand. Right, underside of right foot.

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 witdth 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 ± 0.18 mm ($N=34$). Males with nuptial pads vary from

17.6 to 21.4 mm and have a mean of 19.70±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

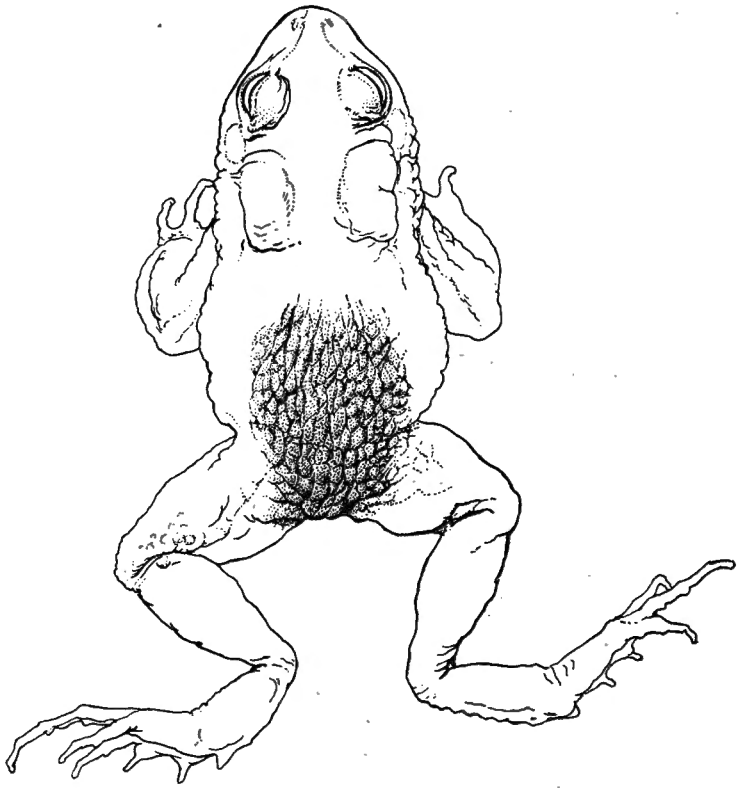


FIG. 10. — Dorsal skin of sacrum of adult male *Bufo kisoloensis* during breeding season (×1).

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 kisoloensis* 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 *kisoloensis* (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 *kisoloensis* (Fig. 10) have no such spines and actually become smoother than the females. LAURENT calls attention to the absence in male *kisoloensis* 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 infuscate.

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. LIU (1935) lists *regularis* as having bilateral openings but does not state from what part of the species range his sample was drawn.

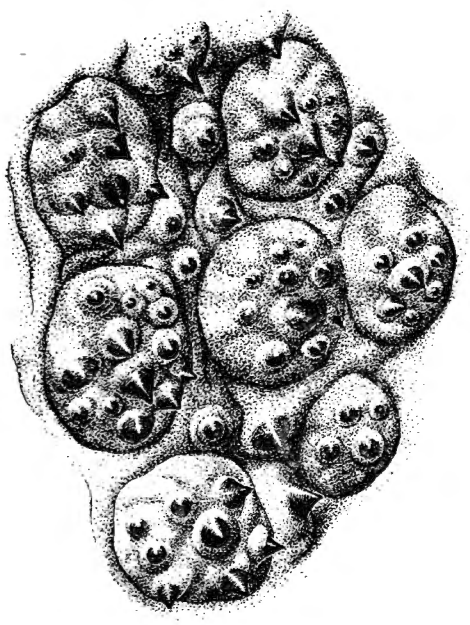


FIG. 11. — Enlargement of dorsal skin of sacrum of adult male *Bufo regularis* during breeding season (×12).

Males from Upemba normally have a single opening, which may be on either side, and thus contrast sharply with those form 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-rictus 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±1.28 mm. The size range of 141 males with well-developed nuptial pads is 47.2-94.5 mm; mean=58.49± 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

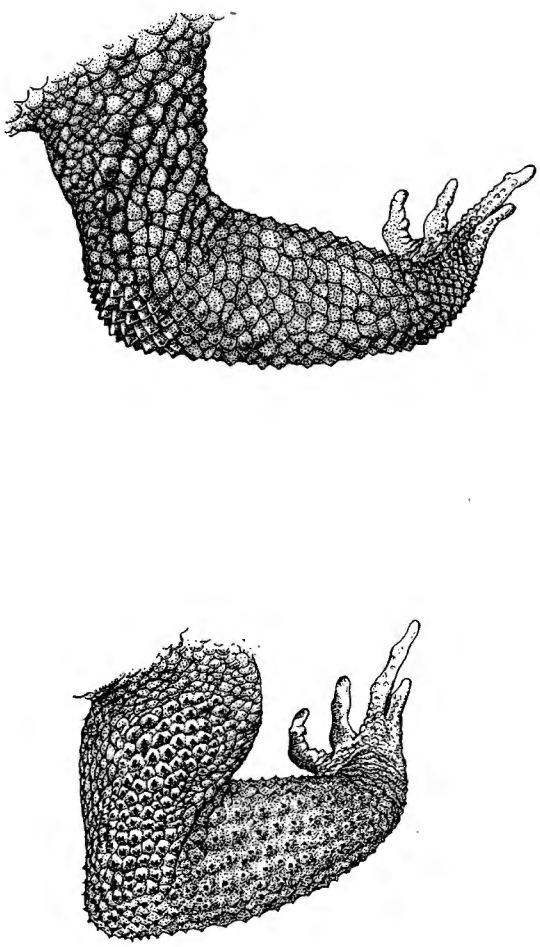


FIG. 12. — Lateral aspect of arms of male toads at height of breeding season. Above, *Bufo funereus upembae* (×3). Below, *Bufo regularis* (×3).

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. — **Bufa 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.

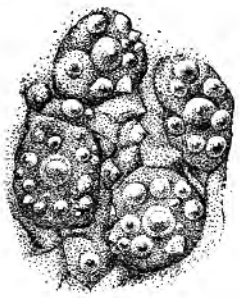


FIG. 13. — Rosette of spines on dorsal warts of *Bufo ushoranus* (×10).

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±0.18 mm and 21.38±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.

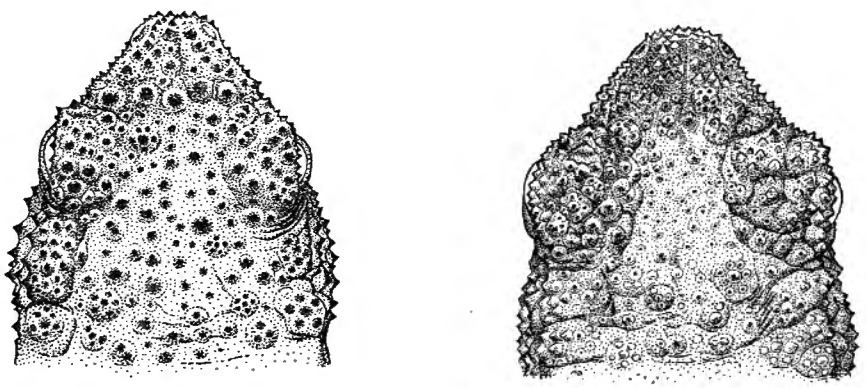


FIG. 14. — Heads of adult male (left) and female (right) of *Bufo ushoranus*.

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).

Family RANIDAE.

Genus **RANA** LINNAEUS.

8. — **Rana tuberculosa** BOULENGER.

(Pl. IV, 4.)

Pyxicephalus rugosus GÜNTHER, 1864, Proc. Zool. Soc. London, **1864**, p. 479, pl. 33, fig. 1 — Pungo Adongo, Angola.

Rana tuberculosa BOULENGER, 1882, Cat. Batr. Sal. Brit. Mus., p. 30 (new name).

Rana pulchra BOULENGER, 1896, Ann. Mag. Nat. Hist., (6), **18**, p. 468 — Lake Tanganyika.

Taxonomic notes. — The small Upemba series and two British Museum specimens (1940.1.20 5-6) from Ulengule, Tanganyika, bridge the gap between *tuberculosa* and *pulchra* and extend the range of variation. By a manuscript note in the British Museum catalogue, BOULENGER indicated that he, too, thought *pulchra* was conspecific with *tuberculosa*. The original description of *pulchra* notes a light V on the rear of the head (actually between the shoulders) and a similar mark is shown in the plate accompanying the original description of *rugosus*. The principal difference between the two descriptions lies in the absence of a vertebral light line in the type of *rugosus* (=*tuberculosa*).

In one Upemba frog the interscapular light mark is reduced to a squarish area and is followed by a series of square dark spots each of which encloses a large square wart. A complete transition to the V illustrated by GÜNTHER is formed by other specimens in our sample.

The Upemba series also demonstrates that the tuberculation of the back is subject to variation that differences in preservation will not account for. The large warts may be uniformly square or square and elongate (apparently as a result of fusion of adjacent warts). The interscapular light mark usually encloses a pair of oblique, elongate ridges but these may be broken into several small ones and a large square wart. In most of these frogs the pattern of tuberculation is symmetrical about the vertebral line, but there are exceptions to this rule also. One feature of tuberculation, however, seems invariable, i.e., the ring of small, low tubercles surrounding the large dorsal warts.

Diagnosis. — Habitus stocky; head obtusely pointed, deep; snout projecting slightly; vomerine teeth in small, oblique groups widely separated from each other and the choanae; tympanum below and behind eye, usually without prominent rim, half diameter of eye, less than distance between eye and nostril; mid-dorsum with two rows of warts beginning on snout

and continuing to anal region; warts small and roundish on head, becoming subequal to tympanum and squarish or elongate on trunk; sides with large squarish and elongate warts; all of larger warts surrounded by small, low tubercles.

Tips of fingers and toes bluntly rounded; first finger equal to or slightly longer than second; each metacarpal with a least one round supernumerary

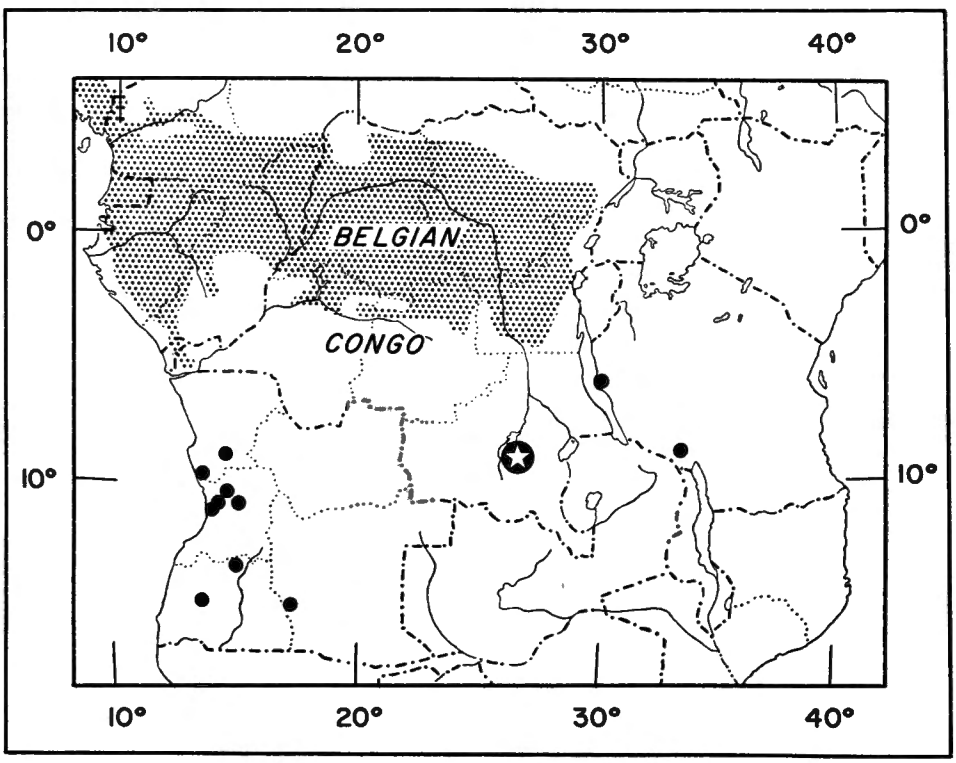


FIG. 15. — Distribution of *Rana tuberculosa*.
Parc National de l'Upemba indicated by symbol with open star.

tubercle. Toes webbed at bases; fourth toe with three and one-half to four phalanges free of web; fifth toe with two and one-half free; inner metatarsal tubercle compressed, blade-like, a little shorter than first toe; a small, round outer metatarsal tubercle usually visible.

Color (in alcohol) light brown above with a double row of dark brown squarish or oval spots; an interscapular light mark; dorsal surface of limbs boldly crossbarred; underside (at least in females) cream-colored, immaculate except at rear of lower jaw.

Secondary sex characters. — No males were available for intensive examination but one in the British Museum (1940.1.20.5) l.c. Has black pigment on the chin and anterior gular region. If this pigment is a secondary sex character, the specimen, which measures 32.5 mm, is probably mature. Two Upemba females with pigmented ova are 39.7 and 41.3 mm, snout to vent.

Ecological notes. — The known localities of *tuberculosa* all lie in the savanna provinces south of the rain forest belt (Fig. 15) and, with the exception of one specimen from Novo Redondo on the coast of Angola (FERREIRA, 1904), at elevations above 500 m. The six Upemba frogs were caught between 1,630 and 1,810 m above sea level.

The two females with pigmented ova were collected between November and February.

Range. — From the central highlands of Angola (BOCAGE, 1895) to Tanganyika (BOULENGER, 1896). The present specimens are the first recorded from the Belgian Congo (Fig. 15).

Upemba localities and specimens :

Lufwa (1); Lusinga (2); Mubale (2); Muye (1).

9. — **Rana ornata moeruensis** BOULENGER.

(Pl. IV, 5.)

Rana moeruensis BOULENGER, 1901, Ann. Congo Mus., Zool., (1), **2**, p. 2, pl. 1, fig. 2 — Pweto, Belgian Congo.

Taxonomic notes. — The frogs of the subgenus *Hildebrandtia* NIEDEN, as outlined in BOULENGER's synopsis (1919), constitute a chain of closely related forms whose interrelationships are best expressed in trinomials. Restricted to the savanna provinces (Fig. 18), they include *budgetti* BOULENGER (Senegal), *togoensis* BOULENGER (Togo), *ornata* PETERS (Somaliland to Portuguese East Africa), *moeruensis* BOULENGER (south-eastern Belgian Congo), and *ornatissima* BOCAGE (Angola and South West Africa). On the basis of the individual variation seen in the Upemba series, we tentatively suggest that *ruddi* BOULENGER (type locality Portuguese East Africa) is a strict synonym of *ornata ornata* and that *miotympanum* BOULENGER (Angola) is a synonym of *ornata ornatissima*. *Rana macrotympanum* BOULENGER (Gallaland) may not be conspecific with the *ornata* series.

The pair of longitudinal light gular stripes or V-shaped marks that charcterize the entire complex are invaded by dark pigment and even completely obscured in the Upemba sample of *moeruensis*.

Larvae from the Upemba differ from those of Somaliland (*ornata ornata*) in the number of labial tooth rows. Somaliland larvae have one upper

and two lower rows (BOULENGER, 1896), whereas Upemba specimens have two lower rows but no upper ones.

Diagnosis. — Habitus stocky, limbs relatively short; head bluntly pointed, snout projecting; vomerine teeth in two widely separated transverse groups in contact with antero-median corners of choanae; tympanum distinct, two-thirds to five-sixths horizontal diameter of eye, diameter equal to or greater than distance between eye and nostril; a dorsolateral glandular ridge continuous from above tympanum to sacral region; mid-dorsum usually with irregular elongate or round warts arranged in two rows; sides with round or elongate warts.

Tips of fingers and toes bluntly pointed; first and second fingers subequal, fourth shorter; no supernumerary metacarpal tubercles. Toes moderately webbed; fourth toe with three or three and one-half phalanges free of web; fifth toe with one to one and two-thirds phalanges free; an outer metatarsal tubercle feebly indicated.

Color (in alcohol) brownish above, a narrow light brown vertebral stripe flanked by two broad dark areas that may be broken into spots; a dark temporal mask; an oblique lateral light band; underside whitish; gular and pectoral regions with varying amounts of dark pigment.

Secondary sex characters. — Females are apparently slightly larger than males though the sample is too small for statistical treatment. The three females with pigmented ova vary from 65.4 to 69.4 mm, snout to vent, and the three males with developed secondary sex characters 62.2 to 63.9 mm.

The vocal sac apparatus consists of paired subgular vocal sacs, communicating with the mouth through round openings near the jaw commissures, and gular pouches that are everted during vocalization. The pouches are oblique to the mandible, begin below the front edge of the tympanum, and end near the ventral border of the insertion of the arm.

When fully developed the nuptial pads (Fig. 16) consist of a light brown velvety cluster of spinules on the forearm just above the bases of the three inner fingers and on the same three fingers. The pad is continuous from the forearm on to the first finger, which is completely covered dorsally and medially except for the terminal phalanx. The entire dorsal surface of the second finger and the dorso-median surface of the third finger are also covered by the pad except for the last phalanx of each, but these areas are not continuous with that of the forearm. Though based on the specimens of *moeruensis* at hand, the above description also applies to the nuptial pad of *ornatissima* (BOULENGER, 1905) but not to *budgetti*. Three adult males (CNHM 20836) of the last, while having the same distribution of pad material on the first three fingers, have no nuptial callosities on the forearm.

Larvae. — Forty-six larvae and transforming young were collected between the months of November and January. Most of the larvae have the hind limbs almost fully developed and others form a graded series from this stage to transformed juveniles. The latter have diagnostic characters of the adults, e.g., the rows of tubercles and color pattern, so that identification of the larvae is certain.

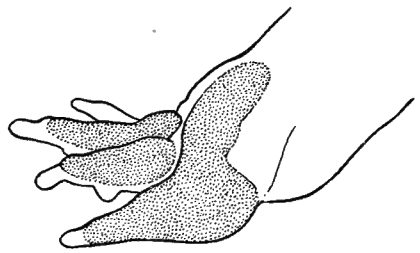


FIG. 16. — Nuptial pads of *Rana ornata moeruensis* (×3).

The larvae (Fig. 17) have sub-spherical bodies, terminal mouths, spiracle low on the left side and midway between eye and vent, fins subequal to tail muscle and the upper beginning high on body, vent median and opening at the edge of the fin. A tadpole (snout-vent 11.6 mm) with hind limbs in the paddle stage has two rows of labial teeth on the lower or

FIG. 17. — Oral disk of larva
of *Rana ornata moeruensis* (×18).

posterior lip but no teeth on the upper lip. Since labial teeth usually reach their maximum development at this stage (INGER, 1956, p. 411), the tooth count of this larva can be considered typical for this population. Eleven of the twelve older larvae, those with fully or nearly fully developed hind limbs (snout-vent 16.5-21.2), have the same labial tooth formula; the twelfth has only a single row on the lower lip.

The beaks are very large, black, and finely serrated. Papillae form a continuous single row along the lower lip, reaching the extreme lateral corners of the upper lip. Those at the corners of the oral disk are conspicuously larger than the others.

None of the larvae having erupted fore limbs (16.3-23.9 mm) retain the horny beaks or labial teeth although the lateral papillae may still be present. One larva (18.2 mm) without erupted fore limbs has lost the labial teeth and the lower beak.

BOULENGER's brief description (1896) of larvae from Somaliland differs from the above only in noting that his material had one anterior tooth row.

Ecological notes. — As indicated above (p. 38), *ornata* and its related forms are confined to the savanna provinces (Fig. 18). The occurrence of *ornatissima* in the dry forest of upland central Angola (BOCAGE, 1895; BOULENGER, 1905) does not alter this generalization since this forest is of limited extent. The altitudinal distribution of *ornata* (*sensu latus*) derived from literature records runs from sea level at the coasts of Tanganyika (LOVERIDGE, 1951), Angola (MONARD, 1937), and Mozambique (BOULENGER, 1907) to 1,700 m in central Angola (BOCAGE, 1895), and is more extensive than shown by the Upemba records, which lie between 585 m (the lowest elevation in the park) and 960 m.

Range. — From Senegal and Gambia in the west to Somaliland in the northeast and to South West Africa and Mozambique (Fig. 18) in the south (BOULENGER, 1919).

Upemba localities and specimens :

Kanonga (4); Kaswabilenga (1); Kateke (1); Mabwe (87).

10. — **Rana albolabris lemairei** WITTE.

Rana lemairei WITTE, 1921, Rev. Zool. Bot. Afr., **9**, p. 1, pl. 1, figs. 1-4 — Lofoi, Katanga, Belgian Congo.

Taxonomic notes. — Specimens of the present series agree with the type, which we have examined, and differ from West African *albolabris* in having smaller finger disks. In addition to this difference between the two forms, WITTE (1921) states that *lemairei* has a smaller eye, a wider dorsolateral fold, and a darker ventral coloration. Our examination of 26 frogs from the Cameroons (CNHM 19967-74, 19986-93, 59084-93) and 21 from Liberia (CNHM 57797-805, 57907, 57932), which is presumed to be the type locality of *albolabris*, indicates WITTE to be correct only in the matter of size of disks and in coloration. In the last character, however, the difference is not sharp. The larger frogs (55 mm and over) from the Cameroons are usually brown on the throat and chest as are Upemba adults.

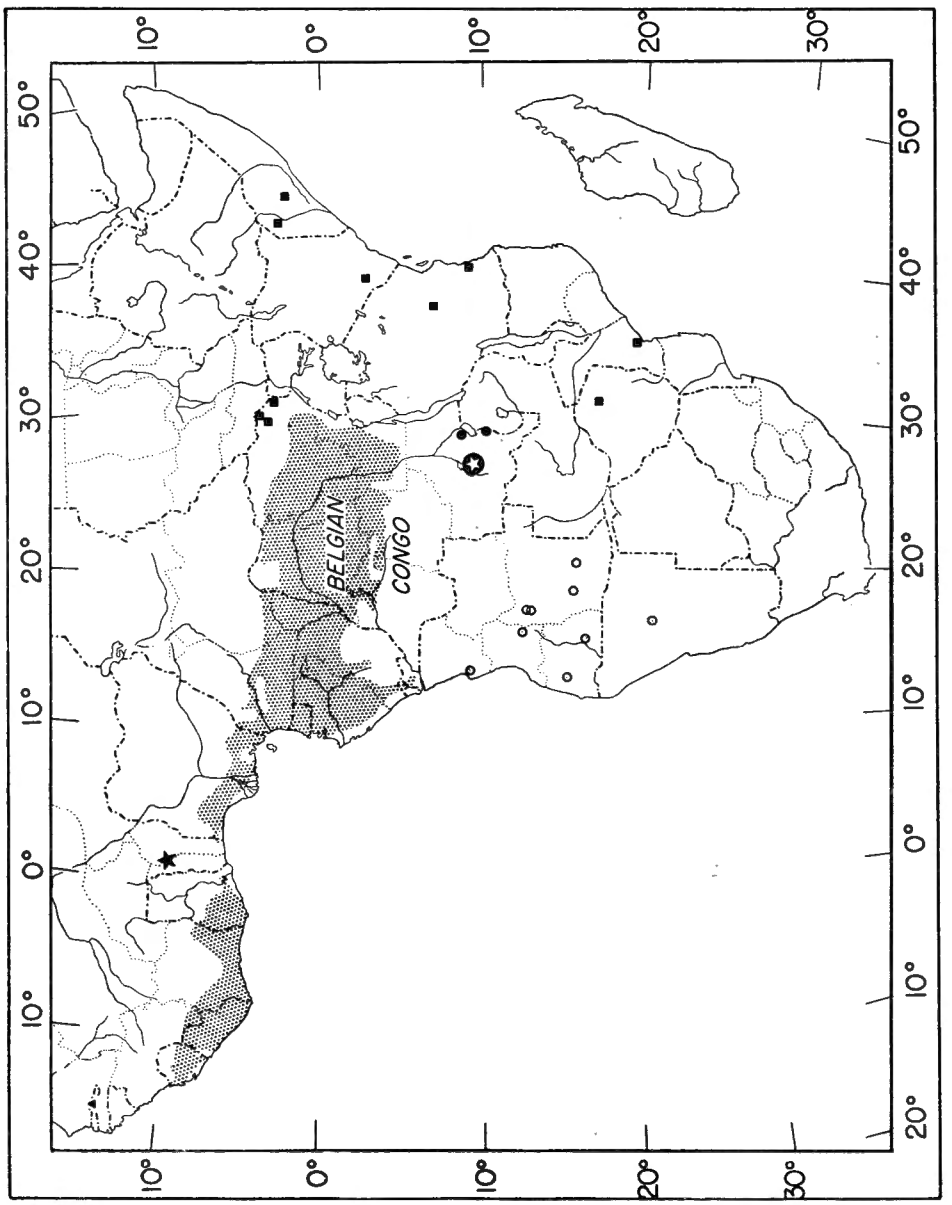


FIG. 18. — Distribution of *Rana ornata*.
R. o. ornata, solid squares; *R. o. moeruensis*, solid circles; *R. o. ornatissima*, hollow circles; *R. o. togoensis*, solid star; *R. o. budgetti*, solid triangle.
Parc National de l'Upemba indicated by symbol with open star.

The greatest disparity in the two samples involves smaller frogs (below 50 mm), those from the Upemba being darker as a rule.

The Upemba frogs have slightly more extensive webbing (Fig. 19). The difference is most evident along the median edge of the second toe, which is webbed to the distal edge of the subarticular tubercle in *lemairei* but usually only to the base of the tubercle in our West African specimens.

In view of the slight differences between *lemairei* and West African *albolabris*, we prefer to regard the former as a subspecies.

Five Angolan frogs previously referred to *albolabris* (SCHMIDT, 1936) differ from the preceding forms and from *albolabris acutirostris* PARKER (=*a. parkeriana* MERTENS), also from Angola, in the absence of digital disks, in the absence of circummarginal grooves on the tips of the toes, in the reduced webbing, and in the relatively longer foot. *Rana a. parkeriana*, collected in the forested country of western Angola, resembles *a. albolabris* and *a. lemairei* in the extent of the web between the outer toes. In all three the web usually reaches the bases of the disks of the third and fifth toes, which means that only half of the respective terminal phalanges extend beyond the web (1). In our Angolan frogs, which are from Chitau in the open country of central Angola, two phalanges of the third toe and 1 ½ to two phalanges of the fifth toe are free of web (Fig. 19, left).

The possession of distinctly dilated disks at the tips of fingers and toes characterizes *a. parkeriana* as well as the typical form and *a. lemairei*. The circummarginal horizontal grooves usually accompanying the development of disks are present at least on the toes and outer fingers of these three subspecies. On the other hand both grooves and dilated disks are absent in the Chitau series.

Differences in the relative lengths of the foot, though based on relatively few specimens, seem great enough to expect that additional material would substantiate the trend. In the four measurable Chitau frogs, the foot, measured from the base of the inner metatarsal tubercle to the tip of the fourth toe, varies from 0.52 to 0.59 of the snout-vent length. This proportion in four chosen at random from the Cameroons series (*a. albolabris*) ranges from 0.39 to 0.51 and in four Upemba frogs (*a. lemairei*) from 0.47 to 0.49.

The Chitau series is sufficiently distinct to warrant recognition as a subspecies and is described below as *Rana albolabris adiscifera*.

Diagnosis. — Habitus moderately stocky; head pointed; vomerine teeth in two oblique groups equidistant from each other and the choanae; tympanum distinct, two-thirds to four-fifths eye diameter, usually equal to distance between eye and nostril; dorsal skin granular; a continuous, narrow glandular dorsolateral ridge; tips of fingers and toes very slightly

(1) We are indebted to Miss GRANDISON of the British Museum for precise information on this and other characters of the types of *R. a. acutirostris* PARKER.

dilated, those of outer fingers and of all toes with circummarginal horizontal grooves; first finger longer than second; a supernumerary tubercle usually visible on each metacarpal; all toes except fourth usually webbed to base of disks; two terminal phalanges of fourth toe with a narrow fringe of web only; a round outer metatarsal tubercle usually visible.

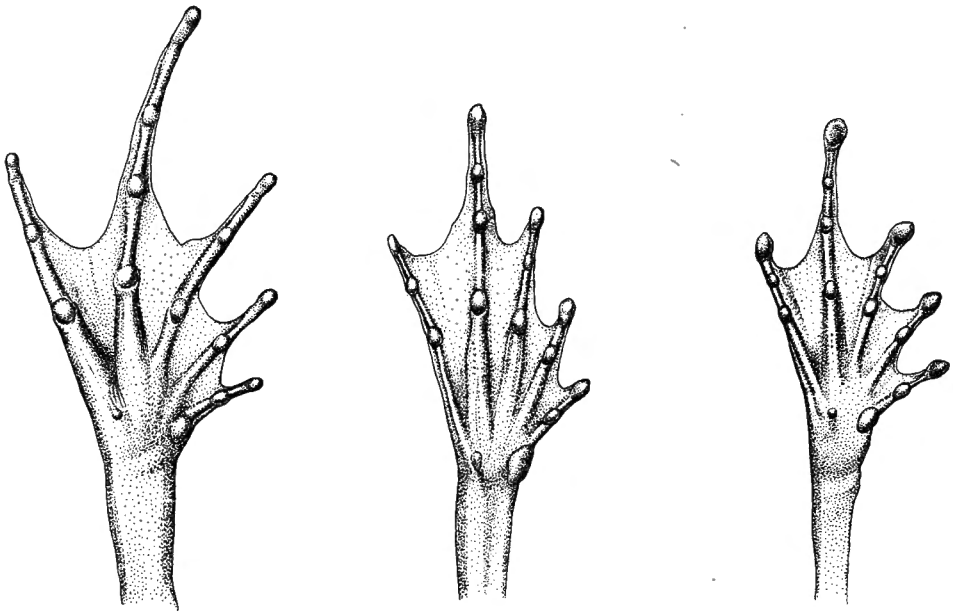


FIG. 19. — Extent of webbing in *Rana albolabris*.
Left, *R. albolabris adiscifera*. Center, *R. a. lemairei*. Right, *R. a. albolabris*.

Color (in alcohol) above slate gray with or without small, irregular dark spots; sides almost black; underside whitish, uniform in small frogs (ca. 30 mm) usually becoming increasingly darker with increase in size, especially on throat and chest; upper lip with a white streak extending to groin in small specimens but ending near axilla in adults; some adults with stripe completely obscured.

Secondary sex characters. — Females average about 10 mm larger than adult males. The smallest female containing well-developed pigmented ova measures 50.8 mm snout to vent, the largest 75.5 mm; the mean of 87 specimens equals 63.69±0.71 mm. The size range of 119 males having vocal sacs is 38.2-66.3 with a mean of 53.22±0.56 mm.

The vocal sacs of male *albolabris* are subgular, paired, and open through the floor of the mouth farther back in the throat than is usual for *Rana*. Male *albolabris* also have a large, flat, oval gland on the upper arm and a grayish, velvety nuptial pad on the first finger. On the dorsal surface of the finger the pad extends only to the end of the metacarpal but on the median edge it reaches the end of the basal phalanx or slightly beyond.

As in other species of *Rana* (p. 99), the nuptial pad of *albolabris* develops after the vocal sac. Apparently the pad undergoes seasonal regression since nine large males (55-63 mm) with vocal sacs and humeral glands have no pads. The humeral gland also develops later than the vocal sacs. In the smallest male with vocal sacs (38.2 mm), the gland is not evident; in eight other males (41.4-57.6 mm) vocal sacs and glands are present but the glands have only about half the depth achieved at maximum development.

Both males and females may have numerous white spinules scattered over dorsal and lateral surfaces of head and body. Though there is much individual variation within sexes, males generally have more numerous and stronger spinules.

Larvae. — Six nearly transformed young and one tadpole without erupted fore limbs are available. The hands and feet are identical to those of the adults whose disks, full webbing, and supernumerary metacarpal tubercles are not matched by any other Upemba species.

The tadpole (snout-vent 22.0 mm; tail 37.0 mm) has a subspherical body, sinistral spiracle a little closer to the eye than to the vent, and upper tail fin somewhat deeper than the muscle. The hind limbs are almost fully developed and have two metatarsal tubercles, fully webbed toes, and small disks. The body and tail are pale brown in preservative and spotted with dark brown. Spotting on the tail is almost confined to the muscle. The oral disk is subterminal and has a labial tooth formula of I:4+4/1+1:II. Papillae are arranged in a staggered, uninterrupted double row across the posterior lip and extend over the lateral quarters of the upper lip. At the corners of the oral disk the papillae are in two rows. The beaks are weak and feebly serrated. They are creamy white basally and brownish near the edges. Only the anterior beak has a black edge.

The partially resorbed tails of the transforming young have the bold brown spotting of the tadpole, and one (22.6 mm) has enough vestiges of the oral disk (teeth, papillae) to confirm the identification of the tadpole.

Ecological notes. — Most of the known localities for *albolabris* are in the rain forest belt though it has also been collected in the surrounding savanna country. NOBLE (1924) reports frogs on the ground in a coffee plantation, in grassy swamp, and in water holes. MERTENS' specimens (1938) from the Cameroons were seen on low vegetation.

Rana albolabris has been collected primarily at elevations below 1,000 m although LOVERIDGE (1942) reports a locality at approximately 2,000 m. The altitudinal distribution for the Upemba sample is as follows (maximum 1,480 m) :

Meters.	Specimens.
585- 750	179
751-1,000	191
1,001-1,250	34
1,251-1,500	156

A distinct breeding season does not emerge from examination of the Upemba sample. As Table 7 shows, only at the end of the wet season and beginning of the dry season does a large proportion of adult females have

TABLE 7. — **Monthly frequency of adult** *Rana albolabris lemairei* **in various stages of sexual competence.**

	Females (*) Ova			Males (**) Nuptial pad	
	pigmented	intermediate	immature	present	absent
February	0	1	1	1	0
April	12	1	0	12	2
May	12	3	8	11	7
June	13	6	0	22	0
July	1	2	4	5	2
August	4	1	4	12	10
September	0	0	4	8	2
October	0	0	3	3	0
November	0	0	6	10	4
December	0	0	1	8	0
Summary :					
Dry season	30	12	20	58	21
Wet season	12	2	11	34	6

(*) All females over 50.8 mm, the smallest with developed ova.

(**) All males with vocal sacs.

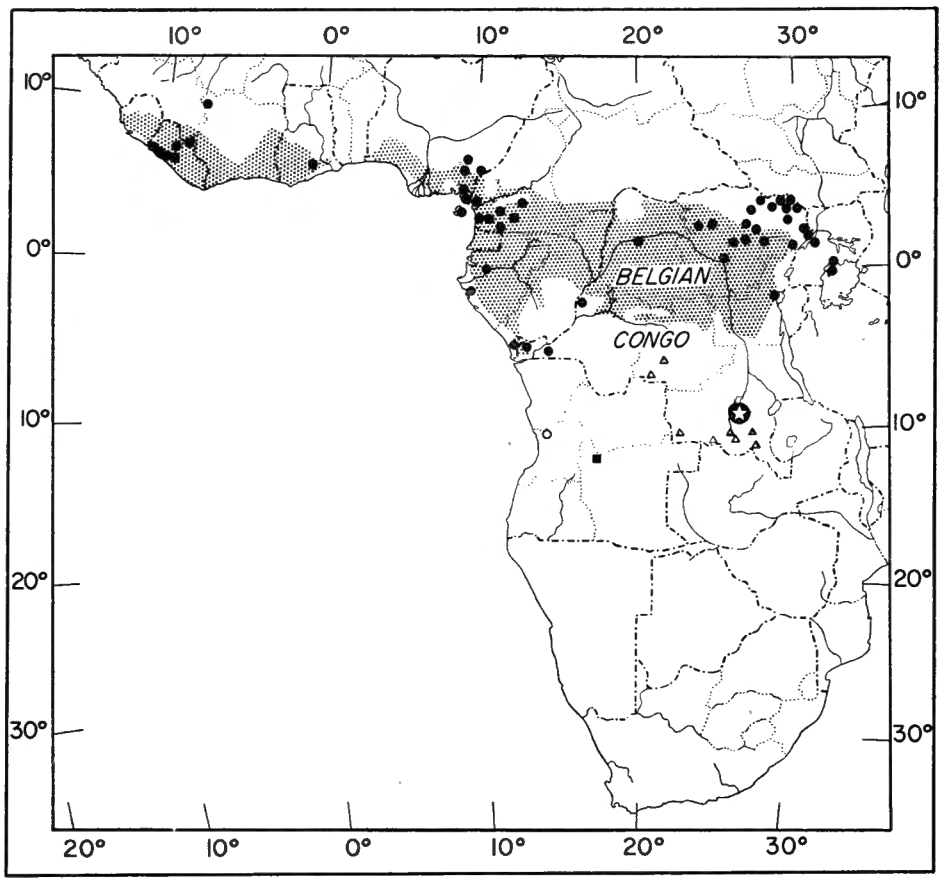


FIG. 20. — Distribution of *Rana albolabris*.
R. a. albolabris, solid circles; *R. a. lemairei*, hollow triangles; *R. a. parkeriana*, hollow circle; *R. a. adiscifera*, solid square. Parc National de l'Upemba indicated by symbol with open star.

well-developed ova. Males with nuptial pads have approximately the same proportional frequency in wet and dry seasons. The collection of one tadpole and five transforming young in mid-September at the end of the dry season and one transforming juvenile in May during the dry season is consistent with the lack of a sharply defined breeding period.

Range. — *Rana albolabris* ranges across the central forest belt of Africa from Liberia (LOVERIDGE, 1938) and Angola (BOCAGE, 1895) on the west to Uganda (NIEDEN, 1915) and southeastern Belgian Congo on the east. The subspecies *lemairei* is confined to southeastern Belgian Congo (Fig. 20).

Upemba localities and specimens :

Kabwe (96); Kalala (2); Kalungwe (12); Kande (18); Kankunda (7); Kanonga (50); Kaswabilenga (47); Kateke (24); Kilwezi (72); Kipondo (16); Lukawe (28); Lupiala (36); Mokey (1); Munoi (64); Munte-Mubale (53); Pelenge (34).

11. — **Rana albolabris adiscifera** n. subsp.

Holotype. — Chicago Natural History Museum number 21171, an adult male from Chitau, Angola. Collected January 12-16, 1931.

Description of holotype. — Like the type form except in the following characters. Tips of digits not dilated, without horizontal circummarginal grooves; toes half webbed; first toe with 1 ½ phalanges free, second toe with one, third toe with two, fourth toe with three, and fifth toe with 1 ½ phalanges free of web. Ventral surfaces without dark pigment.

Snout to vent 61.5 mm, length of foot 35.0 mm.

Paratypes. — CNHM 21170, CM 6754, 6756, 6788. All are from the type locality. CM 6754 is an adult female, 72.1 mm. The others are subadults varying from 42.8 to 45.7 mm. Variation among these is negligible and all agree with the holotype in the diagnostic characters.

Comparisons. — Differences between *adiscifera* and the other forms are discussed above (p. 43).

Remarks. — The holotype has well-developed secondary sex characters agreeing with the description given on p. 45.

Range. — Known only from the type locality in central Angola.

12. — **Rana fuscigula** Duméril and Bibron.

(Pl. IV, 6.)

Rana fuscigula Duméril and Bibron, 1841, Erp. Gén., **8**, p. 386 — Cape of Good Hope, South Africa.

Rana angolensis Bocage, 1866, Jour. Sci. Lisboa, **1**, p. 73 — Duque de Bragança, Angola.

Rana chapini Noble, 1924, Bull. Amer. Mus. Nat. Hist., **49**, p. 214, fig. 6 — Batama, Belgian Congo.

Taxonomic notes. — The relationship of the forms assigned to this species are poorly understood. The primary question still requiring an answer is : What is the nature of the variation observed in *fuscigula* ? Is the variation geographic, ecological, or merely individual ?

Division into subspecies was first suggested by Hewitt (1927), presumably based on his earlier work (1911). In the latter publication Hewitt distinguished between *fuscigula* Duméril and Bibron and *angolensis*

BOCAGE on the basis of extent of web, rugosity of dorsal skin, length of leg, and color. But HEWITT noted that certain series of « *fuscigula* » resembled « *angolensis* » and certain series of the latter resembled the former. Furthermore, his two forms did not occupy separate regions of South Africa. It now appears that HEWITT's forms were typological in conception rather than « biological ».

This impression is strengthened by examination of the characters HEWITT used. The toes of *angolensis* were said by HEWITT to be « ... two thirds webbed or a little more », while those of *fuscigula* were « ... nearly entirely webbed ». If a difference in webbing does exist, it requires sharper definition especially when, as HEWITT indicates, the difference is not great. Again the dorsal skin in *angolensis* had « ... narrow interruped lines » whereas in *fuscigula* the skin was « ... smooth or with elongate warts ». The distinction between an elongate wart and narrow interrupted lines is a fine one. HEWITT determined the difference in leg length by the customary but unreliable method of adpressing the limb against the body. Analysis of HEWITT's color distinction shows a gradation from one extreme to the other.

The Upemba series exhibits all the color variations of both forms as defined by HEWITT. Also included in this large sample are frogs with the area between the dorsolateral folds smooth and others with short glandular ridges in that region. The amount of webbing, however, varies less in the Upemba frogs than in HEWITT's material.

A similar typological approach seems to have prevailed in subsequent literature. LOVERIDGE (1933) presents a key to the forms of *fuscigula*, including *chapini* NOBLE. However, plotting the East African localities given by LOVERIDGE (1933, 1942, 1953) for the three forms shows them all to occur within a distance of 200 kilometers. If we add HEWITT's localities (1911), which LOVERIDGE seems to accept, the area of overlap for *angolensis* and *fuscigula* extends from Uganda to the Cape of Good Hope and half the east-west width of Africa.

LOVERIDGE (1933) expresses the opinion that *chapini* is a forest form and, by implication, that the others are open country forms. PARKER (1936 A), MERTENS (1940 A, 1955), and other authors have followed LOVERIDGE. The fact that « *chapini* » and « *angolensis* » have been collected at the same localities in Kenya (LOVERIDGE, 1936) and Tanganyika (MERTENS, 1940 a) has been explained away by assuming that specimens of the former were from local forests and the latter from surrounding savanna. Yet LOVERIDGE (1942) relates catching *angolensis* in forest and (1936 A) identified a large series (CNHM 12195-202, 12210-23) from the forests of Ruwenzori as *angolensis*.

The distribution records in the literature are sufficient evidence that the variation subsumed by the trinomials is not geograpihc. The facts

that several authors have found so-called forest and savanna forms in one locality and that the « savanna » frog has been collected in forest country demonstrate that the variation is not ecological. We are left then with the conclusion that what is involved is individual variation, that these subspecies are no more than morphological types.

Comparison of the Upemba sample with 22 from Ruwenzori, 28 from the Transvaal, and 31 from Angola exposes some geographic variation in extent of web. If the number of phalanges of the first toe distal to the maximum excision of the membrane between the first two toes is counted, the Upemba frogs have somewhat more extensive webbing (see Table 8). Similarly, the Upemba series has more web along the fifth toe. The Ruwenzori frogs have the least extensive web.

TABLE 8. — **Extent of web in** *Rana fuscigula.*

Locality	Number of phalanges of first toe beyond the excision of web						Number of phalanges of fifth toe free of web	
	1	1 1/4	1 1/3	1 1/2	1 2/3	2	1/2	1
	Number of individuals							
Upemba	3	3	2	5	1	0	14	0
Ruwenzori	0	0	0	0	6	4	0	10
Transvaal	0	0	1	7	3	0	6	5
Angola	0	0	2	4	3	0	3	1

Males of *fuscigula* during the breeding season have spinules (described in detail below) on the chin and, usually, across the rear of the abdomen. Males from Ruwenzori lack the abdominal spines though the abundance of these structures elsewhere on the body and the nuptial pads indicate that secondary sex characters were at the height of their development. As will be shown below in the section on secondary sex characters, very large males (over 60 mm) of all samples lack abdominal spines, but the Ruwenzori males are all in the size range (under 55 mm) in which these spines are developed in other populations.

Because no other geographic variation is evident in samples available to us and because the forms in the literature are not true geographic races, we do not recognize any subspecies of *fuscigula.*

Diagnosis. — Habitus moderately stocky; head obtusely pointed; vomerine teeth in oblique groups usually in contact with antero-median corners of choanae; tympanum distinct, about two-thirds eye diameter, slightly less than distance between eye and nostril; back and sides set with highly variable glandular ridges, usually a dorsolateral ridge; tips of fingers and toes bluntly rounded; first finger equal to or shorter than second; no supernumerary metacarpal tubercles; toes almost fully webbed; fourth toe (in Upemba sample) with one phalanx free of web on lateral border; fifth toe (Upemba sample) usually with half of terminal phalanx free of web; lateral border of fifth toe with a distinct flap or ridge of skin; no external metatarsal tubercle.

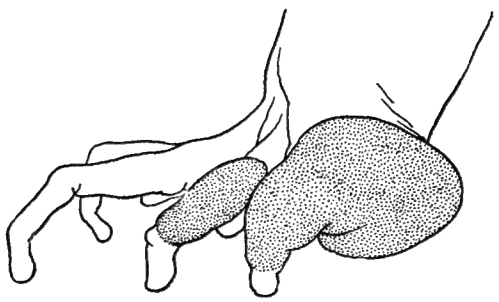


FIG. 21. — Nuptial pad of *Rana fuscigula* from the Parc National de l'Upemba (×3).

An obscure dark interorbital bar; back and dorsal surfaces of legs with irregular black spots that may be obscure in preserved material; underside of head with faint brown suffusion, a dark network, or solid brownish black; a distinct bar across front of arm insertion; chest, abdomen, and undersides of legs cream-colored.

Secondary sex characters. — Although the size ranges of the two sexes overlap very broadly, the females are distinctly larger, the means of snout-vent being 63.65±0.96 mm (162 specimens) for Upemba females and 50.52±0.65 mm (236 specimens) for Upemba males. The smallest female containing pigmented ova measures 48.8 mm, snout to vent, and the largest female 103.8 mm. This compares with the males' range of 41.4 mm (the smallest with developed nuptial pads) to 88.6 mm.

The nuptial pads at the height of their development (Fig. 21) cover the dorsal and median surfaces of the first finger, from its base to the beginning of the terminal phalanx, and the dorso-median surface of the second finger over the basal phalanx. At this stage the pads consist of brownish or yellowish clusters of spinules. The male prepollex is enlarged

and, though it does not pierce the skin, gives the inner finger a swollen appearance. As is usual in frogs, the pad develops first on the inner finger, and then on the second.

The dorsal surfaces of males are covered with whitish spinules. Some females have similar structures on the hind limbs but their visibility in preserved material depends on the quality of preservation. In males these spinules are uniformly dense except on the dorsal surface of the upper arm where they are less numerous. The development of the dorsal spinules is independent of seasonal changes, but similar asperities on the lower jaw and abdomen are not so constant. A male that, judging by the nuptial pad, is in breeding condition has a band of spinules under the lower jaw and, depending on the size of the frog, has the posterior half or third of the abdomen covered with them. At the height of development, the abdominal and lower lateral spinules are larger than those elsewhere on the body.

Male *fuscigula* also have subgular vocal sacs. The round openings are located on both sides of the floor of the mouth. The development of the vocal sacs relative to the other sex characters is the same as observed in Upemba *Rana* (*Ptychadena*), i.e., the vocal sacs appear before the other structures and never regress. Of 158 adult-sized males, fourteen with vocal sacs lack the other secondary sex characters. Three have neither vocal sacs nor any other secondaries. All males having nuptial pads or ventral asperities in any stage of development also have vocal sacs.

Certain variations in the ventral spinules seem to be associated with age. The size frequency distribution of Upemba males, presented in Table 11, shows a distinct bimodality. It is a reasonable assumption that the larger group centering around 75 mm consists of older individuals. Not all males having well-developed nuptial pads have abdominal spinules. However, as the data of Table 9 show, abdominal spinules are characteristic of the younger group only. The use in Table 9 of the double criterion of nuptial pads and spinules on the lower jaw confines the query to sexually

TABLE 9. — **Distribution of Upemba male *Rana fuscigula* having abdominal spinules with respect to snout-vent lengths. All males have nuptial pads and asperities on the lower jaw and were collected March-June.**

Snout-vent (mm)	Abdominal spinules	
	present	absent
40–60	56	2
61–90	0	18

competent males and the restriction of the samples to the period March through June (the interval in which all the larger males were collected) eliminates seasonal variation as a factor. We have already (p. 50) noted the absence of abdominal spinules in even small males from Ruwenzori.

Ecological notes. — LOVERIDGE (1933, 1936, 1942, 1953) reports *fuscigula* from swift streams in forest or open country in East Africa. CURRY-LINDAHL (1956) found *fuscigula* to be abundant at the edges of both ponds and streams in forested country around Lake Kivu and in Ruanda. South African (HEWITT, 1911) and Angolan localities (PARKER, 1936 A) place this species in scrub savanna and grassland, while NOBLE's record (1924) is in the lowland rain forest.

Rana fuscigula has been recorded from near sea level in South Africa (HEWITT, 1911) to 2,200 m in East Africa (LOVERIDGE, 1933). The large Upemba series has the following altitudinal distribution.

Meters.	Specimens.
585- 750	51
751-1,000	45
1,001-1,250	491
1,251-1,500	59
1,501-1,750	233
1,751-1,860	474

Sexual activity of Upemba *fuscigula* does not have the same seasonal cycle as that observed in the *Rana* (*Ptychadena*) of this collection (see p. 101). As shown in Table 10, during the dry season (May through September), all of the adult-sized males have fully developed secondary sex characters whereas only three-fourths of the wet season males are in that stage. This pattern is radically different from that of Upemba *Rana porosissima* (p. 101) in which fully developed secondary sex characters appear only in males collected during the wet season.

Similarly, from the monthly distribution of female *fuscigula* having pigmented ova (Table 10), a picture emerges of acyclic sexual competence. The reproductive physiology of both sexes of *fuscigula* are different from those of, for examples, *Rana oxyrhyncha* (p. 95), a species more abundant below 1,000 m in the Upemba, and *Rana porosissima* (p. 100), which is more common above 1,500 m.

Rana fuscigula is known to have an extensive size range (LOVERIDGE, 1933) and this is borne out by the present series. But, as shown in Table 11, large individuals are only rarely encountered above 1,500 m though other authors e.g. (LOVERIDGE, 1936, 1953), have reported a few large (over 80 mm) specimens from such heights. An explanation of this differential distribution is not immediately evident. It is unreasonable to say that elevations above 1,500 m do not provide a suitable habitat because most of our material comes from those heights.

TABLE 10. — **Monthly frequency of adult *Rana fuscigula* from the Upemba in various stages of sexual competence.**

	Males (*) Development of secondary sex characters			Females (**) Stage of ova		
	Complete	In-complete	Absent	Pig-mented	Inter-mediate	Im-mature
January	3	0	0	0	0	0
February	0	0	4	0	1	4
March	17	3	8	24	2	2
April	23	7	0	19	1	7
May	17	0	0	21	0	0
June	17	0	0	26	5	1
July	14	0	0	19	1	3
September	0	0	0	0	0	3
October	19	6	4	11	1	2
November	15	0	1	9	0	1
Summary :						
Dry season (May-September) ..	48	0	0	66	6	7
Wet season (October-April) ...	77	16	17	63	5	16

(*) All males exceeding 41.4 mm, the smallest with fully developed sex characters.
(**) All females exceeding 48.8 mm, the smallest containing fully developed ova.

The other phenomenon illustrated in Table 11 is a distinct bimodality in the frequency distributions of both sexes. We have already referred (p. 52) to the groups as representing different ages though we do not assume that the large frogs compose a single age class. However, the small frogs may; presumably they are young adults in their first breeding year. Bimodal size frequency distributions are characteristic of populations having a restricted breeding period and sampled over a narrow time range. But, as Table 10 shows, our series of *fuscigula* satisfies neither requirement. Differential susceptibility of the various size classes to predation does not provide a reasonable explanation of bimodality because the infrequent class of males is the same size (56-65 mm) as the most abundant females. A solution to this problem is clearly not available in the laboratory.

TABLE 11. — **Size frequency distribution by altitude of adult *Rana fuscigula* from the Upemba.**

Males					Females				
Snout-vent (mm)	Below 1,000 m	1,000-1,500 m	Above 1,500 m	Total	Snout-vent (mm)	Below 1,000 m	1,000-1,500 m	Above 1,500 m	Total
41–45	7	14	43	64	55	7	9	23	39
46–50	1	75	42	118	56– 60	3	10	30	43
51–55	2	21	1	24	61– 65	2	24	16	42
56–60	0	1	0	1	66– 70	2	7	3	12
61–65	0	3	0	3	71– 75	2	3	0	5
66–70	2	3	0	5	76– 80	3	1	0	4
71–75	3	3	1	7	81– 85	1	1	0	2
76–80	1	6	0	7	86– 90	0	1	0	1
81–85	0	5	0	5	91– 95	3	2	0	5
86–90	1	1	0	2	96–100	1	6	0	7
					101–105	0	2	0	2
Totals	17	132	87	236		24	66	72	162
Means	57.41±3.67	52.85±0.94	45.79±0.40	50.52±0.65		68.63±3.02	68.08±1.76	57.50±1.59	63.65±0.96
Minimum = 41.4 Maximum = 88.6					Minimum = 48.8 Maximum = 103.8				

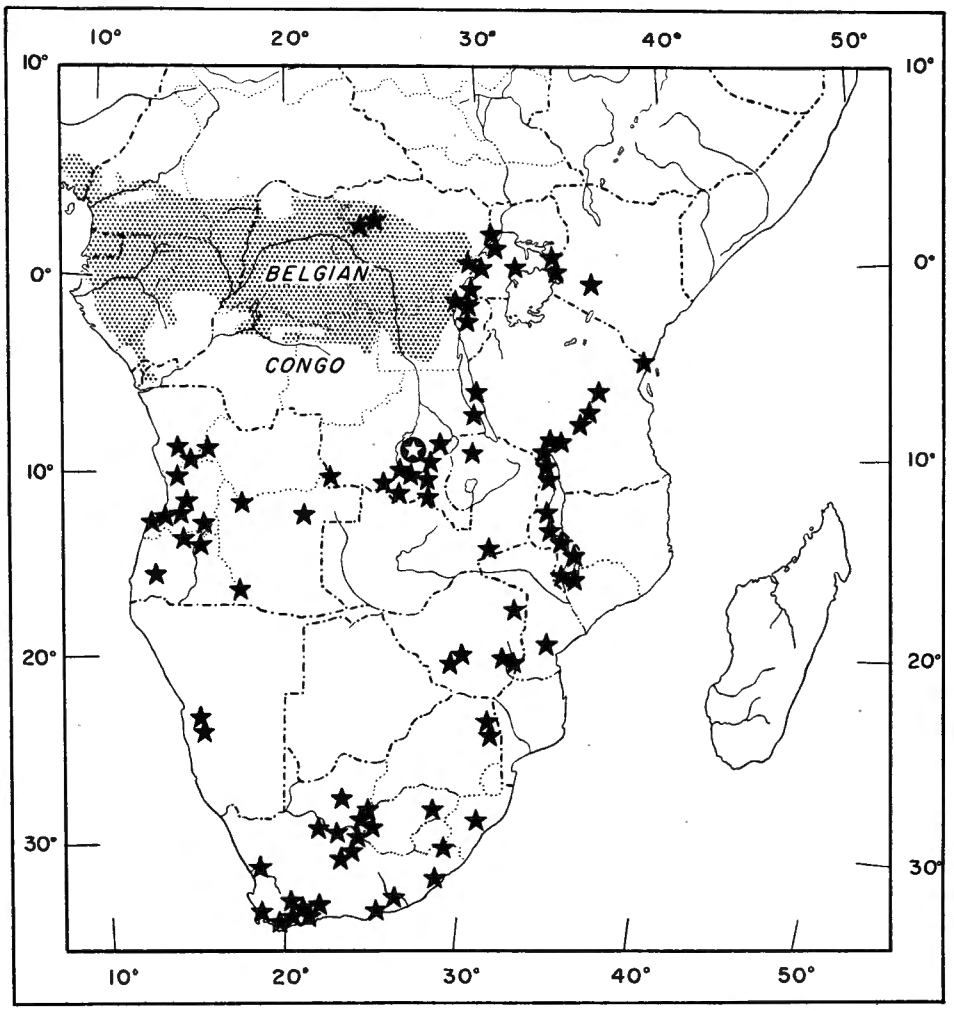


FIG. 22. — Distribution of *Rana fuscigula*.
Parc National de l'Upemba indicated by symbol with open star.

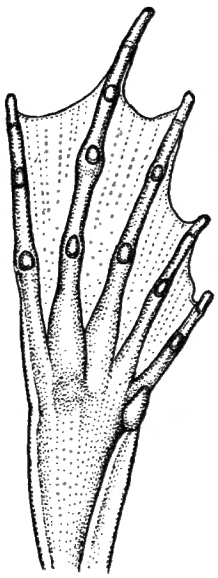
Range. — *Rana fuscigula* is distributed throughout Africa south of a line connecting Kenya with northern Angola (Fig. 22).

Upemba localities and specimens :

Babagi (6); Bowa (15); Bwalo (15); Difirinji (11); Dipidi (10); Ganza (8); Kabenga (134); Kabwe (21); Kafwe (7); Kagomwe (4); Kakolwe (1); Katamshya (2); Kamitungulu (12); Kamitunu (10); Kande (10); Kankunda (38); Kanonga (2); Karibwe (94); Kasandendeke (1); Kaswabilenga (2); Kateke (8); Kavizi (2); Kayumbwe (2); Kaziba (4); Kiamakoto (46); Kimapongo (1); Kimiala (19); Kipangaribwe (63); Loie (1); Lukawe (15); Lukorami (2); Lupiala (5); Lusinga (476); Mabwe (1); Masombwe (42); Mukelengia (1); Mukukwe (3); Munte (3); Mware (6); Pelenge (249); Tumbwe (1).

Subgenus **PTYCHADENA.**

The work of LAURENT (1954) demonstrates that many forms of this remarkable group remain to be discovered. In addition to four of the new species found by LAURENT, the Upemba collection includes two others described for the first time below. Unfortunately the literature prior to 1950 cannot be relied upon. As the papers of GUIBÉ and LAMOTTE (1953, 1954, 1955, 1955 A) have shown, many good species have been erroneously



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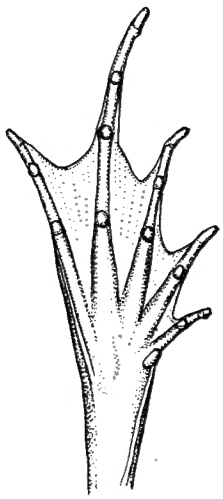

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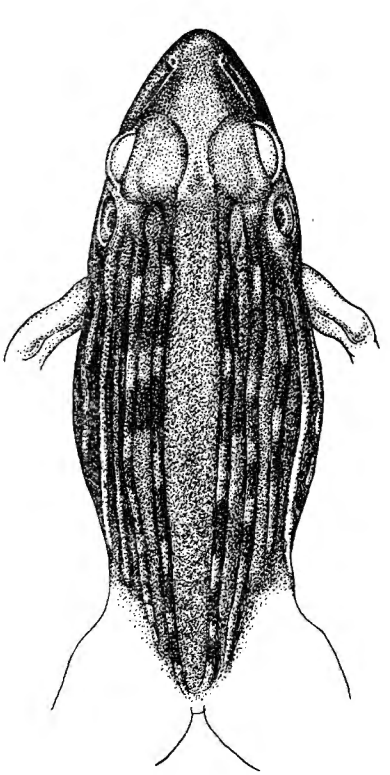
FIG. 23. — Webbing of *Rana subpunctata* (×1½).
FIG. 24. — Webbing of *Rana taenioscelis* (×3).

buried in the synonymies of other forms, while still others, e.g., *longirostris*, have been described under several names (GUIBÉ and LAMOTTE, 1954). In the course of this study, we examined the series identified by NOBLE (1924) as *mascareniensis* and found not only that species, but also *maccarthyensis*, *taenioscelis*, *uzungwensis*, and *mossambica.*

Some measure of the remarkable ecological success of *Ptychadena* is given by the fact that thirteen full species occur in the Parc National de l'Upemba. Because of the unreliability of the literature, a key to the Upemba species follows.



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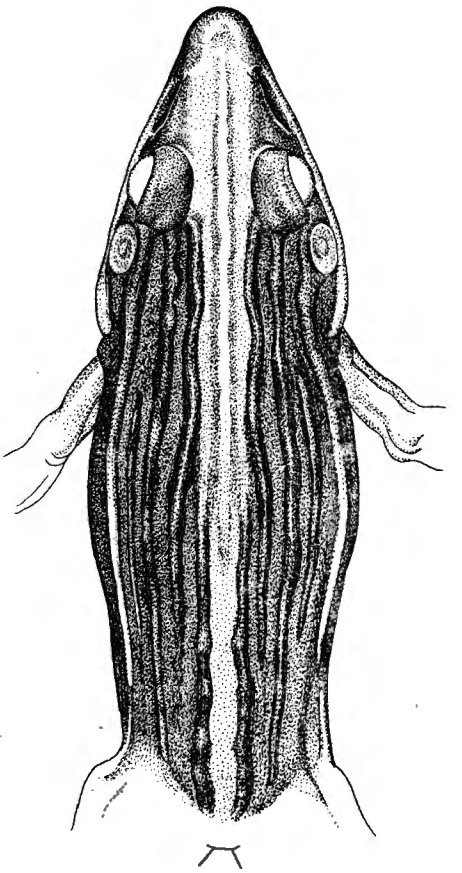

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FIG. 25. — Dorsal skin folds of *Rana mascareniensis* (×2).
FIG. 26. — Dorsal skin folds of *Rana chrysogaster guibei* (×3).

KEY TO UPEMBA SPECIES OF *RANA* (*PTYCHADENA*).

1A. Less than one phalanx of fifth toe free of web (Fig. 23) 2
B. One or more phalanges of fifth toe free of web (Fig. 24) 7

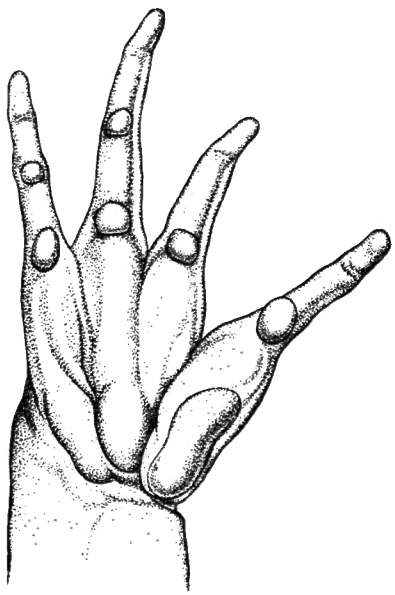
2A. Mid-dorsal pair of skin folds continuous from occiput to supra-anal region (Fig. 25) 3
B. Mid-dorsal pair of skin folds interrupted or present on posterior half of body only (Fig. 26) 6

3A. At most one transverse row of spots on back ..... *obscura.*
B. At least two transverse rows of dorsal spots 4

4A. Posterior face of thigh with light vermiculation or network ..... *oxyrhyncha.*

B. Posterior face of thigh with distinct longitudinal light stripes 5

5A. Median edges of second and third fingers with a distinct, narrow fringe of skin (Fig. 27); gular pouch openings oblique to mandible ..... *subpunctata.*



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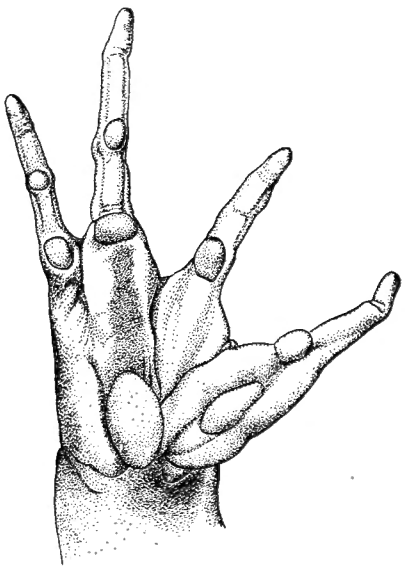

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FIG. 27. — Ventral view of hand of *Rana subpunctata* (×4).
FIG. 28. — Ventral view of hand of *Rana mascareniensis* (×4).

B. Median edges of second and third fingers without a fringe of skin (Fig. 28); gular pouch openings parallel to mandible ..... *mascareniensis.*

6A. An outer metatarsal tubercle and, usually, a row of small tubercles on fourth metatarsal ..... *frontalis.*

B. No outer metatarsal tubercle and no row of tubercles on fourth metatarsal ..... *superciliaris.*

7A. Mid-dorsal pair of skin folds interrupted or present only posteriorly (Fig. 26) ..... *chrysogaster guibei.*

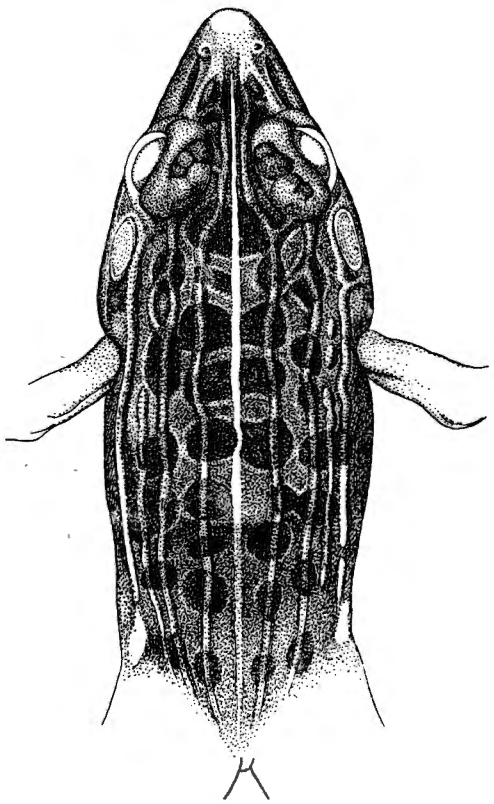

FIG. 29. — Dorsal skin folds of *Rana uzungwensis* (×3).

B. Mid-dorsal pair of skin folds continuous from occiput to anal region 8

8A. Mid-dorsal pair of skin folds extending forward on to snout (Fig. 29) 9

B. Mid-dorsal pair of skin folds ending between or behind eyes 10

9A. Posterior face of thigh with longitudinal light stripes ... *taenioscelis.*

B. Posterior face of thigh with light network or spots ..... *uzungwensis.*

10A. At least two phalanges of fifth toe free of web 11

B. Less than two phalanges of fifth toe free of web 12

11A. Posterior face of thigh with longitudinal light stripes ..... *upembae.*

B. Posterior face of thigh with rows of light spots ..... *ansorgei.*

12A. No outer metatarsal tubercle 13
B. Outer metatarsal tubercle present 14

13A. Posterior face of thigh with round light spots ..... *porosissima.*
B. Posterior face of thigh with longitudinal light stripes ..... *mascareniensis.*

14A. Dorsal face of tibia with longitudinal light line ..... *porosissima.*
B. Tibia without longitudinal light line 15

15A. Back without dark spots or with one or two transverse rows of spots ..... *obscura.*
B. Back with more than four transverse rows of dark spots ..... *grandisonae.*

13. — **Rana ansorgei** BOULENGER.

Rana ansorgii BOULENGER, 1905, Ann. Mag. Nat. Hist., (7), **16**, p. 107, pl. 4, fig. 1 — between Benguella and Bihé, Angola.

Taxonomic notes. — In appearance this well defined species resembles both *uzungwensis* LOVERIDGE and *porosissima* STEINDACHNER, but has less extensive webbing than either and differs in certain aspects of coloration. The three species occur at the same localities in the Upemba.

The Upemba series differs slightly from the type in the color pattern on the rear face of the thigh. In the type, which we have examined, this surface is marbled whereas in the Upemba frogs it bears small light spots.

In the greatly reduced webbing, elongate snout, and size *ansorgei* resembles *stenocephala* BOULENGER, of which we have examined two cotypes. But the coloration of *stenocephala* is very different. The lower jaw of *ansorgei* bears a broad continuous dark band that reaches the lower lip.

FIG. 30. — Pattern on mandibles
of (left) *Rana stenocephala* and (right) *Rana ansorgei* (×2).

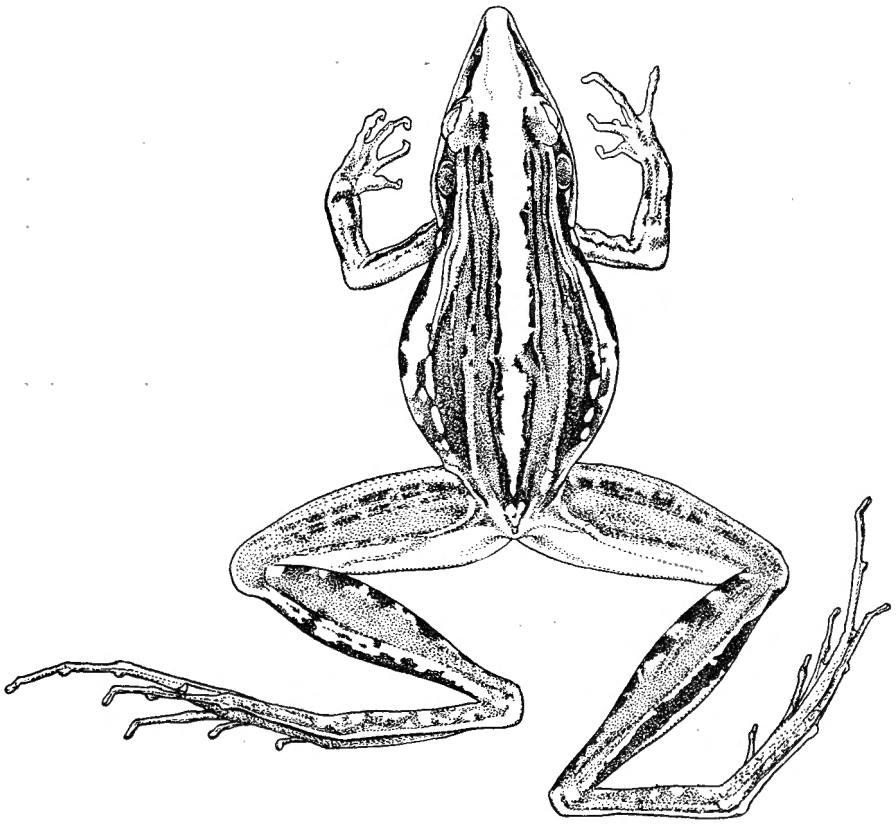

FIG. 31. — Dorsal view of *Rana stenocephala* (×1½).

Although *stenocephala* (Fig. 30) too has a black stripe on the mandible, it is much narrower than that of *ansorgei* (Fig. 30) and widely separated from the mouth by a broad light area. The dark markings on the hind limbs of *stenocephala* (Fig. 31) are arranged longitudinally with a long dark streak along the anterior face of the thigh, a similar one along the outer edge of the calf, and a row of spots on the inner edge of the calf. The mid-dorsal surface of the calf has no dark markings. On the other hand, *ansorgei* (Fig. 32) has transverse bars on the legs, those of the calf usually continuous across the dorsal surface, and no longitudinal dark streak on the thigh.

Similar differences are shown by the pattern of the body (Figs. 31, 32). *Rana stenocephala* has a broad oblique dark band on the sides and, though *ansorgei* also has dark lateral markings, these are in the form of square spots. On the back, too, *stenocephala* has longitudinal dark streaks whereas *ansorgei* has square spots.

Diagnosis. — Body moderately slender; legs slender; head pointed; snout strongly projecting; nostril mid-way between eye and tip of snout or closer to eye; vomerine teeth in short transverse groups, in contact with antero-median corners of choanae; tympanum distinct, one-half to two-thirds eye diameter, shorter than eye-nostril distance; back with 8 longitudinal folds, the mid-dorsal pair usually beginning between the anterior borders of the orbit and continuous to anal region (Fig. 32); tips of fingers and toes bluntly rounded; first finger equal to or slightly shorter than second, which is equal to fourth; supernumerary metacarpal tubercles present, distinct; toes about half webbed; fourth toe with 3 ⅓ to 3 ½ phalanges free of web on lateral border; fifth toe with 2 phalanges free; a small proportion of individuals with a small, round, external metatarsal tubercle; a round light spot present in the corresponding position in other individuals; a row of feeble, distinct, small tubercles present or absent on fourth metatarsal.

Back with alternating rows of squarish black spots, each of which is larger than tympanum; almost all specimens with a thin, light vertebral line or (more rarely) a vertebral band; thigh and tibia without light lines on dorsal surfaces; posterior face of thigh chocolate brown with longitudinal rows of small, round, light spots; 4 to 6 usually uninterrupted black bars on tibia (Fig. 32); usually 3 black tarsal bars; underside of foot uniformly brown except for row of light tubercles; lower jaw (Fig. 30) with a continuous black band, narrow near chin and broadening posteriorly; a pair of prefrontal spots occasionally present.

Secondary sex characters. — The vocal sac apparatus is typical of *Rana* (*Ptychadena*). The openings of the gular pouches begin below the center of the eye and run obliquely to near the ventral border of the insertion of the arm. In four males the openings are 0.18 to 0.21 of the snout-vent length. The skin in the gular pouches is intense black.

No males were collected during the breeding season and, consequently, our specimens do not have nuptial pads or other nuptial asperities.

Females are evidently larger than males but the extent of the difference cannot be determined from the present sample because no female contains ripe ova, preventing determination of maturity. The four males with gular pouches measure 30.6-33.3 mm, and 10 females 32.4-37.3 mm snout to vent. LOVERIDGE (1953) records a male 36 mm and females 35-43 mm.

Ecological notes. — All records of *ansorgei* are from south of the rain forest areas. However, one locality (PARKER, 1931) is in dense gallery forest and three others (LOVERIDGE, 1933, 1953; PARKER, 1936 A) in montane forest. The region between Benguella and Bihé, Angola (the type locality) includes montane and deciduous broadleaved forests and tree savanna. Several of LOVERIDGE's localities (1953) are in tree savanna.

The species has a moderately high altitudinal distribution. Literature records range from 610 to 1,830 m. The Upemba series was collected

FIG. 32. — Dorsal view of *Rana ansorgei* from Parc National de l'Upemba (×2).

between the elevations of 1,250 and 1,750 m, with three-fourths of the material from the lowest elevation and only one-twentieth from the highest.

LOVERIDGE (1953) collected *ansorgei* along small streams and in grassy swamps.

Range. — From western Angola (BOULENGER, 1905) to Zululand (PARKER, 1931) and Uganda (LOVERIDGE, 1936).

Upemba localities and specimens :

Buye-Bale (2); Kabwe (11); Pelenge (28).

14. — **Rana chrysogaster guibei** LAURENT.

Ptychadena chrysogaster guibei LAURENT, 1954, Ann. Mus. Roy. Congo Belge, **34**, p. 23 — Muita, Luemba, Angola.

Taxonomic notes. — This series of frogs resembles *chrysogaster guibei* LAURENT very closely. They differ from the Congo paratypes (Musée Royal du Congo Belge 175, 627, 36222, 36289-90), which we have examined, in two details of coloration. Whereas all the paratypes have a distinct longitudinal light line on the dorsal surface of the tibia, only 2 (4 %) of the present series have this line. Also, the black crossbars of the tibia are narrowly interruped in the Upemba frogs but broadly so in the Congo paratypes.

The great similarity in other characters enumerated in the diagnosis (see below) argues against considering the Upemba frogs distinct from the subspecies *guibei*.

The range of the latter is the open country of northeastern Angola and southern Belgian Congo, and one locality given by LAURENT (1954), Lofoi, is approximately 100 kilometers from the Parc National de l'Upemba.

This form bears a slight resemblance to *porosissima* STEINDACHNER but differs in the coloration of the thighs (posteriorly with round spots in *porosissima*) and tibia (bars not interrupted in *porosissima*), and in the short median pair of sacral folds (absent in *porosissima*).

Diagnosis. — Body and limbs moderately slender; head pointed, snout strongly projecting; nostril mid-way between eye and tip of snout or nearer to eye; vomerine teeth in transverse or slightly oblique groups, in contact with antero-median borders of choanae; tympanum distinct, ¾ to ⅘ diameter of eye, much shorter than eye-nostril distance; back anteriorly with 6 longitudinal skin folds, posteriorly with 8-10; median pair of skin folds interrupted or with a short mid-dorsal pair of folds in sacral region (Fig. 26); anteriorly median pair of folds ending behind interorbital; tips of fingers and toes bluntly rounded; first, second, and fourth fingers subequal, or first slightly shorter; supernumerary metacarpal tubercles

usually present; toes about two-thirds webbed; fourth toe with 3 or, less often, 3 ⅓ phalanges free of web on lateral border; fifth toe with 1 ½ to 2 phalanges free; external metatarsal tubercle present; a row of small tubercles under fourth metatarsal in ⅘ of specimens.

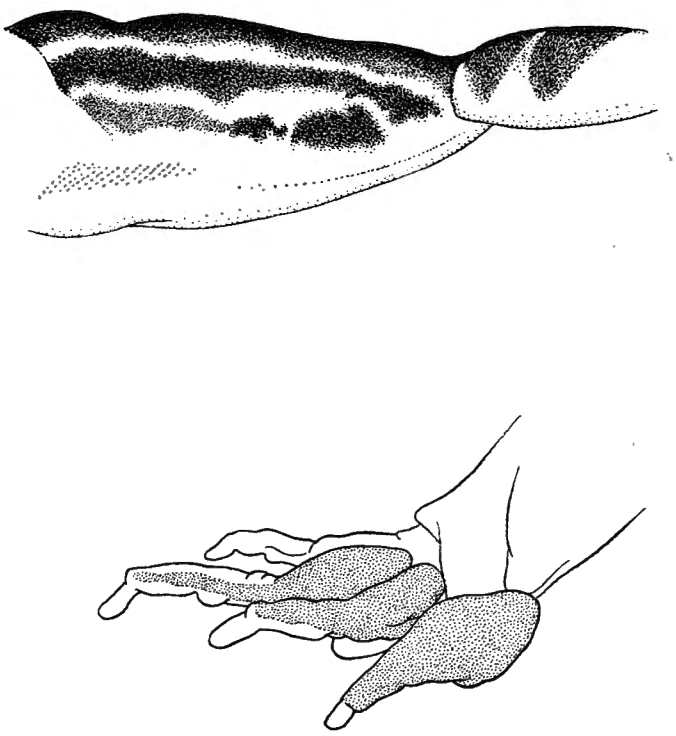

FIG. 33. — *Rana chrysogaster guibei* from Parc National de l'Upemba. Above, posterior face of thigh (×4). Below, nuptial pads (×8).

Back with alternating rows of black oblong spots, each usually longer than diameter of tympanum; a broad mid-dorsal light band with a more or less distinct light vertebral line (Fig. 26); dorsal surfaces of tibia and thigh with or without (in Upemba series) longitudinal light lines; posterior face of thigh dark brown with two regular light longitudinal stripes (Fig. 33); tibia with 4 to 6 interrupted crossbars; 2 or, occasionally, 3 tarsal bars; underside of foot uniformly dark brown except for light metatarsal and subarticular tubercles; lower jaw usually with a continuous dark streak; throat and anterior portion of abdomen suffused with dark brown to varying degrees.

Secondary sex characters. — The nuptial pads (Fig. 33) are cream-colored or dusky velvety clusters of spinules. At their maximum development the pads cover the dorsal and median surfaces of the first finger from its base to the beginning of the last phalanx, the dorsal surface of the second finger from its base to the beginning of the last phalanx, and a tapering area of the dorso-median surface of the third finger over the metacarpal and proximal phalanx. Males with nuptial pads developed to this degree have small, translucent, colorless spinules distributed over the throat and chest and whitish spinules on sides and back. Males in which the pad does not extend beyond the third metacarpal usually lack the ventral spinules. Neither type of spinule is present in males without pads. Characteristic of the subgenus, only males with fully developed gular pouches have nuptial pads.

The vocal sac apparatus consists of paired vocal sacs and corresponding gular pouches lined with black or black and gray wrinkled skin. The slit-like openings of the pouches are oblique to the lower jaw, beginning below the center of the eye and ending near the ventral border of the insertion of the arm. In six males with nuptial pads, the length of the opening varies from 0.13 to 0.18 of the snout-vent length (mean 0.159 ± 0.007).

Mature females are larger than mature males. LAURENT (1954) gives 49 mm as the maximum snout-vent length of females and 35.5 mm as the maximum in males. Only the three largest females of the Upemba series contain pigmented ova and they measure 45.1-47.7 mm. The six adult Upemba males range from 35.5 to 37.5 mm (mean $= 36.55 \pm 0.33$ mm).

Ecological notes. — The twenty-four Upemba specimens were collected between 585 and 700 m above sea level. The nominate form of this species is apparently restricted to higher elevations, the localities given for *c. chrysogaster* by LAURENT (1954) ranging in altitude from 1,650 to 2,600 m. The recorded localities of *guibei* all lie south of the rain forest belt in savanna country (Fig. 34).

The three females with pigmented ova were collected in December and the six males with nuptial pads in the months of November, December, and February. The males in the adult size range (35.1, 36.8 mm) collected in October had fully developed gular pouches but no nuptial pads. Evidently the breeding season does not begin until November.

Range. — Known only from northeastern Angola and southern Belgian Congo (LAURENT, 1954).

Upemba localities and specimens :

Kande (1); Kanonga (1); Lupiala (2); Mabwe (20).

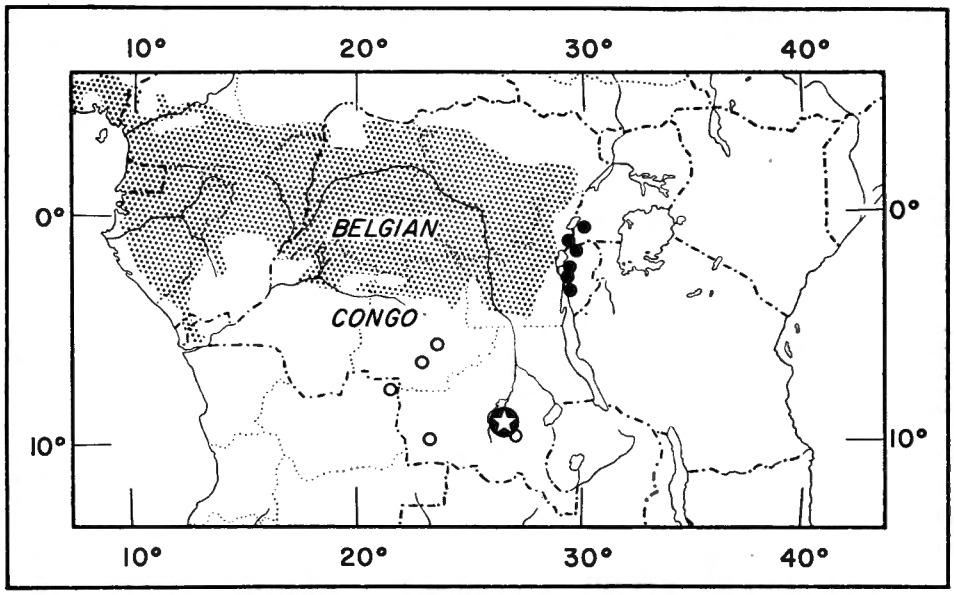

FIG. 34. — Distribution of *Rana chrysogaster*.
R. chrysogaster chrysogaster shown by solid circles; *R. c. guibei* by hollow circles. Parc National de l'Upemba indicated by symbol with open star.

15. — **Rana frontalis** LAURENT.

Ptychadena frontalis LAURENT, 1954, Ann. Mus. Roy. Congo Belge, **34**, p. 26, pl. 4, fig. 8, pl. 5, fig. 2 — Kiambi, Tanganika, Belgian Congo.

Taxonomic notes. — The large series of Upemba *frontalis* agree with LAURENT's description (1954) and with the type series, which we have seen, in all significant details. We have confirmed the difference in the pectoral girdles of *floweri* BOULENGER and *frontalis* mentioned by LAURENT. Both *floweri* and *frontalis* are characterized by short legs and feet and are similar in habitus, coloration, and arrangement of skin folds. But, in addition to the difference in ossification of the clavicle, the two forms differ in the position of the opening of the gular pouch. That of *frontalis* is oblique to the mandible and ends near the ventral border of the insertion of the arm, whereas that of *floweri* is parallel to the mandible, ending near the upper border of the axilla.

Diagnosis. — Body moderately stocky; legs short, stocky; head obtusely pointed; snout projecting; nostril nearer to tip of snout than to eye; vomerine teeth in transverse or slightly oblique series, in contact with antero-median borders of choanae; tympanum distinct, about two-

thirds diameter of eye, shorter than eye-nostril; back with 8 longitudinal folds, the median pair beginning behind interorbital and interrupted in sacral region (Fig. 35); tips of fingers and toes bluntly rounded; first finger slightly longer than second, second equal to or longer than fourth; supernumerary metacarpal tubercles usually present and distinct; toes almost completely webbed; fourth toe with 2 ½ to 2 ⅔ phalanges free of web on lateral border; fifth toe with one-third to one-half phalanx free; a small, round external metatarsal tubercle; usually a row of small tubercles on fourth metatarsal.

Back with rows of alternating, squarish black spots each usually larger than tympanum; only very rarely (less than one percent of individuals) with a light mid-dorsal stripe or line; no light line on dorsal surface of tibia or thigh; posterior face of thigh dark brown with two or three irregular, light, longitudinal stripes (Fig. 35); 4 or 5 dark crossbars on tibia, usually uninterrupted; underside of foot dark brown, often with small light areas at base of web; lower jaw barred with black.

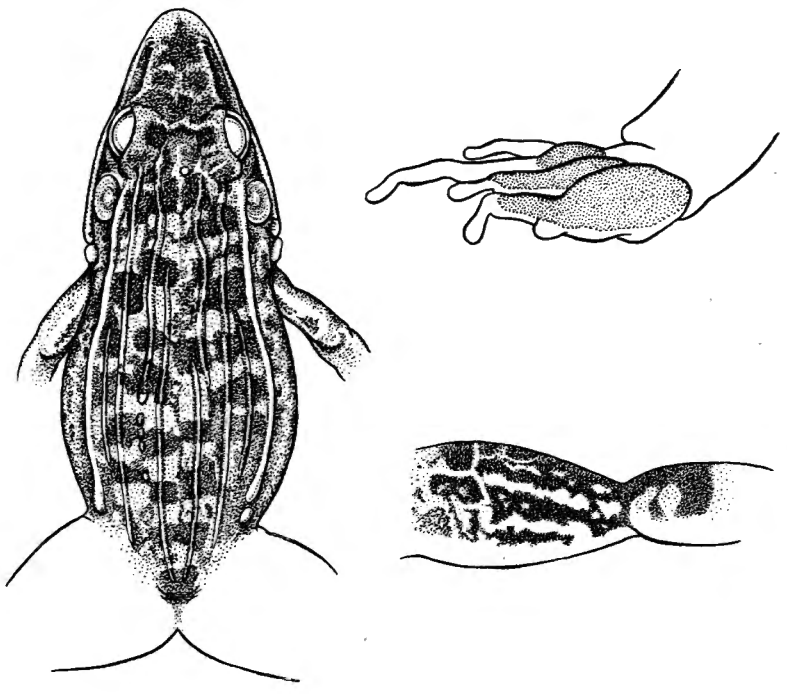

FIG. 35. — *Rana frontalis* from Parc National de l'Upemba.
Left, dorsal view (×2). Right upper, hand of male showing nuptial pads (×6). Right lower, rear face of thigh (×2).

Secondary sex characters. — Fully developed males have dusky or cream-colored nuptial pads on the entire dorsal and median surfaces of the first finger from its base to the beginning of the last phalanx, on the dorsal surface of the second finger from its base to the beginning of the terminal phalanx, and on an oval area on the dorso-median surface of the third finger not extending beyond the level of the basal subarticular tubercle (Fig. 35). Males in this stage have small, translucent, colorless spinules uniformly scattered over the throat and chest.

The vocal sac apparatus consists of paired vocal sacs and corresponding gular pouches. The openings of the latter are oblique to the mandible and run from below the posterior half of the eye to near the ventral border of the insertion of the arm. The length of the openings varies from 0.15 to 0.21 of the snout-vent in 10 males (mean=0.186±0.005). The wrinkled skin inside the gular pouches is black or, more often, black anteriorly and gray or white posteriorly.

Females are distinctly larger than males. Fifty-five mature females vary from 39.5 to 46.7 mm, snout to vent (mean=42.98±0.20 mm). Forty-two adult males vary from 35.0 to 40.3 mm (mean=36.96±0.18 mm).

Ecological notes. — Reported localities are in the savanna provinces of the southern Congo. One of the Upemba specimens was collected at 620 m and the remaining 432 at 585 m.

Two females, collected in July-August, lack pigmented ova though the frogs are mature in size (see above). The rest of this large sample was taken during the months of November to January. All males had fully developed secondary sex characters and approximately ninety percent of females examined (51/55) had ripe ova.

Range. — The type locality, in southeastern Belgian Congo, is the only other recorded locality.

Upemba localities and specimens :

Mabwe (432); Mwema-Mabole (1).

16. — **Rana grandisonae** LAURENT.

Ptychadena grandisonae LAURENT, 1954, Ann. Mus. Roy. Congo Belge, **34**, p. 11, pl. 1, figs. 2, 5, pl. 3, figs. 1-2, pl. 4, figs. 1, 9 — Muita, Luemba, Angola.

Taxonomic notes. — In the original description, LAURENT (1954) compared *grandisonae* to *maccarthyensis* and called attention to the difference in the extent of webbing, relative length of the tibia, and pattern of the posterior face of the thigh. Although we can confirm the first distinction, the other two differences are not borne out by our examination of several hundred *grandisonae* and seven *maccarthyensis*.

However, we observe the following additional differences between the two species. The two median dorsal skin folds are continuous from the interorbital to the anal region in *grandisonae* but are interrupted in the sacral region of *maccarthyensis* (Fig. 36). Our six *maccarthyensis* males have a large nuptial pad on the distal portion of the lower arm near the

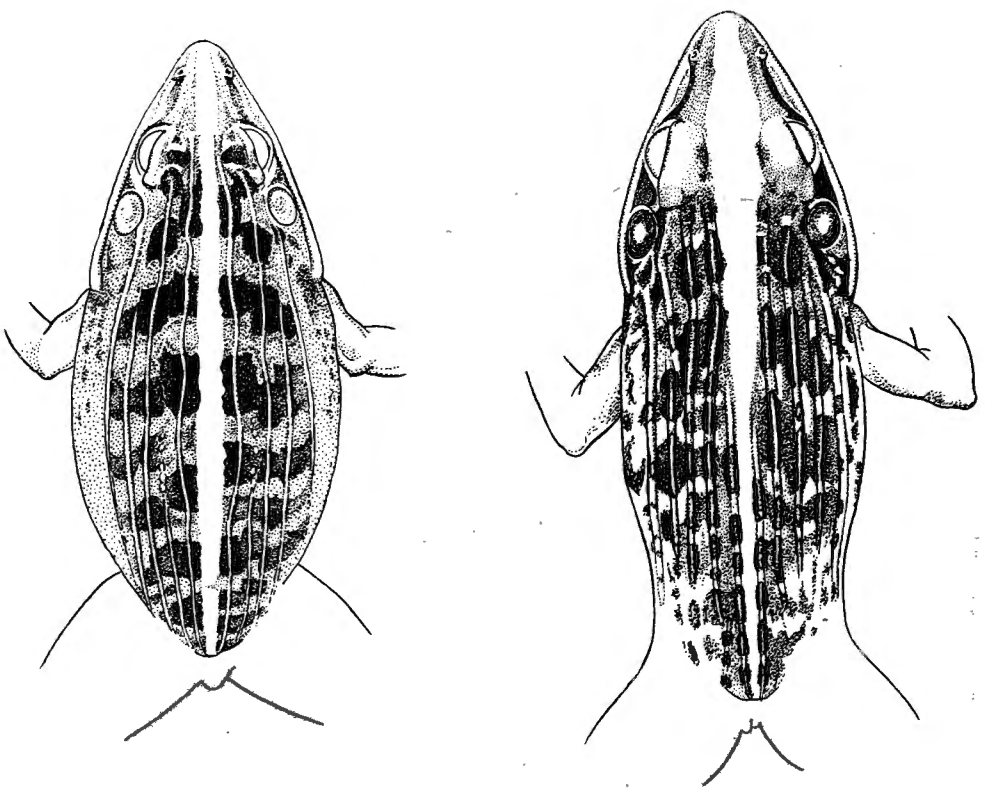

FIG. 36. — Dorsal views of *Rana grandisonae* (left) and *Rana maccarthyensis* (right) (both 2×).

base of the first finger; fully developed *grandisonae* males have nuptial pads on the fingers only (Fig. 37). The gular pouch of mature *grandisonae* males is distinctly bicolored, the anterior half of the wrinkled skin being black and the posterior half white. The gular pouch of *maccarthyensis* is either uniformly black or black and dark gray.

The present species also resembles *vernayi* Fitz SIMONS, which has similar webbing and an outer metatarsal tubercle. But *vernayi*, of which we have seen seven half-grown paratypes, has the mid-dorsal skin folds interrupted over the sacrum (as in Fig. 36, right) and lacks the row of small tubercles under the fourth metatarsus.

Rana mossambica PETERS (Fig. 38), though similar to *grandisonae* in habitus, webbing, and position of the gular pouch opening, differs from the latter in the position of the nostril (which is nearer the tip of the snout in *mossambica*), in the shape of the black spots on the back (longitudinally elongate in *mossambica*, squarish or transversely elongate in *grandisonae*), in the color of the gular pouch (not bicolor in *mossambica*), and in the absence of an outer metatarsal tubercle and the row of small tubercles on the fourth metatarsus. Comments on *mossambica* are based on examination of the type and three paratypes from the type locality.

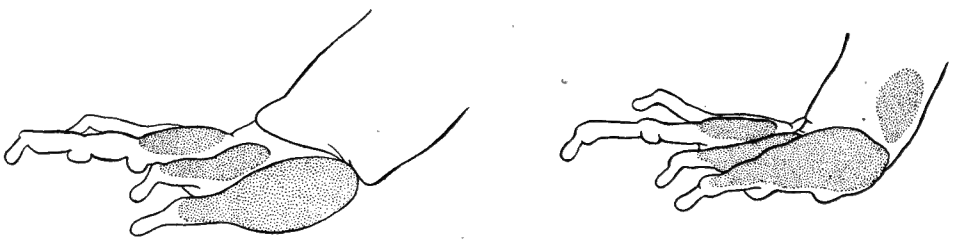

FIG. 37. — Male *Rana grandisonae* (left) and *Rana maccarthyensis* (right) showing nuptial pads on fingers and lower arm (×5).

Diagnosis. — Body and limbs moderate; head pointed; snout moderately projecting; nostril slightly closer to tip of snout than to eye; vomerine teeth just off a transverse line, in contact with antero-median corners of choanae; tympanum distinct, three-fourths to four-fifths eye diameter, shorter than distance between eye and nostril; back with 8 folds, the mid-dorsal pair ending between the orbits and continuous from interorbital to anal region (Fig. 36, left); tips of fingers and toes bluntly rounded; first finger slightly shorter than second; supernumerary metacarpal tubercles present, distinct; toes about two-thirds webbed; fourth toe usually with 3 phalanges free of web on lateral border; fifth with 1 phalanx free, rarely 1 ¼ free, a small but distinct, round external metatarsal tubercle present; a row of small, light-colored tubercles on fourth metatarsus.

Back with alternating rows of squarish black spots, each of which having the transverse axis subequal to the tympanum; a broad mid-dorsal light band, usually without a lighter vertebral line; thigh and tibia without light line on dorsal surfaces; posterior face of thigh dark brown with longitudinal series of light spots; 4 to 6 black bars on dorsal surface of tibia, bars always interrupted in mid-line; 2 or 3 black tarsal bars; underside of foot uniformly brownish except for light tubercles; lower jaw barred with black.

Secondary sex characters. — The vocal sacs, as in all *Ptychadena*, are paired. The wrinkled skin of the gular pouches is bicolored, black anteriorly and white posteriorly. The extent of the black pigment varies although most commonly the entire posterior half of the pouch is

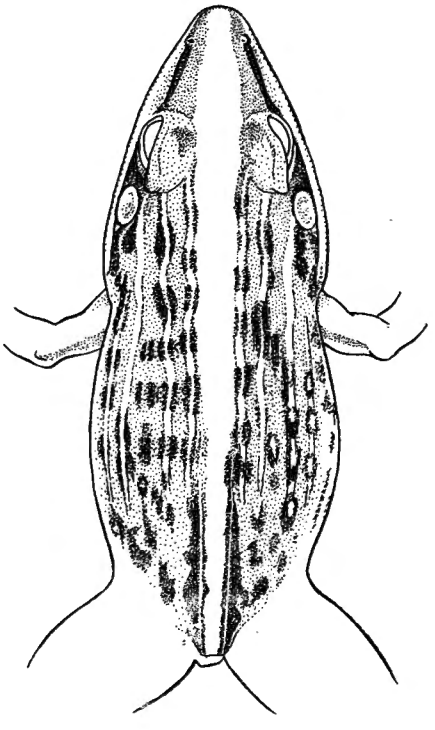

FIG. 38. — *Rana mossambica* PETERS, paratype (×2).

white. The openings of the gular pouches are oblique to the mouth gape and run from below the center of the eye to the medio-ventral border of the insertion of the arm. In 20 males with fully developed nuptial pads, the slits of the gular pouches vary between 0.16 and 0.21 of the snout-vent length (mean=0.190±0.001).

The nuptial pads resemble those of other *Rana* (*Ptychadena*) in appearance, consisting of light colored, velvety clusters of minute spines. At their maximum development the pads cover the dorsal and median surfaces of the first finger from its base to the end of the basal phalanx, the dorsal and median surfaces of the second finger from its base to the end of the basal phalanx, and a small oval area near the end of the third metacarpus

on its dorso-median edge (Fig. 37, left). Males with nuptial pads in this condition usually have translucent, colorless, widely spaced spinules on the entire underside of the head and on the chest. These spinules are inconspicuous and very feeble compared to those of male *Rana porosissima.*

The developmental sequence of the male secondary sex characters is as outlined in detail for *porosissima* (p. 99). The vocal sac apparatus (sacs plus gular pouches) appears in ontogeny before the nuptial pads. As shown in Table 12, males may have partially or fully developed gular pouches and completely lack nuptial pads; on the other hand, all males having nuptial pads in any stage of development always have fully developed gular pouches.

TABLE 12. — **Monthly frequency of adult male (*)** *Rana (Ptychadena) grandisonae* **from the Upemba in various developmental stages.**

Gular pouch . ... Nuptial pads	Mature Complete	Mature Incomplete	Mature Absent	Immature Absent
January	51	0	0	0
February	2	0	0	0
March	34	1	0	0
April	22	2	0	1
May	8	3	2	2
June	0	4	3	0
July , ...	2	0	1	0
November-December	3	0	0	0

(*) All males larger than 33.6 mm, the smallest with fully developed nuptial pads.

Mature females are larger than adult males. Fifty-eight females with pigmented ova measure from 37.5 to 49.4 mm, snout to vent (mean = 42.10±0.32 mm); 122 males with fully developed nuptial pads vary from 33.6 to 43.5 mm (mean=38.63±0.18 mm). The difference between the means is statistically significant.

Ecological notes. — This little known species has been reported (LAURENT, 1954) only from localities along the southern and eastern borders

of the rain forest. In the Upemba it is primarily an inhabitant of the higher elevations, only 48 of the 603 specimens coming from below 1,500 m. The lowest Upemba record is 900 m. One of LAURENT's localities has an elevation of 1,650 m; the others are on plateaus presumably at altitudes in excess of 1,000 m.

Although our material gives no definite information as to the inception of the breeding period of Upemba *grandisonae*, Table 13 suggests that breeding ends in April. The proportions of females with pigmented ova and of sexually active males drop sharply in May.

TABLE 13. — **Monthly frequency of adult** *Rana grandisonae* **from the Parc National de l'Upemba in various stages of reproductive competency.**

	Mature males (*)		Mature females (**)	
	Nuptial pads fully developed	Nuptial pads incomplete or absent	Pigmented ova present	Pigmented ova absent
January	51	0	16	1
February	2	0	3	0
March	34	1	18	3
April	22	2	18	4
May	8	5	3	10
June	0	7	0	5
July	2	1	0	3

(*) Includes all males with fully developed gular pouches.

(**) Includes all females as large as or larger than the smallest having pigmented ova (37.5 mm). Five females (January through May) with only a few pigmented ova are listed in the left hand column.

Range. — *Rana grandisonae* is known so far only from northeastern Angola, Ruanda, and southeastern Belgian Congo (LAURENT, 1954).

Upemba localities and specimens :

Buye-Bala (186); Bwalo (12); N'Gongozi (2); Kabwekanono (49); Kalumengongo (3); Katongo (3); Kimiala (2); Luangalele (5); Lufwa (131); Lusinga (139); Mubale (91); Mukana (146); Munte-Mubale (46).

17. — **Rana mascareniensis mascareniensis** DUMÉRIL and BIBRON.

Rana mascareniensis DUMÉRIL and BIBRON, 1841, Erp. Gén., **8**, p. 350 — Mascarene Islands.

Rana mascareniensis mascareniensis LOVERIDGE, 1933, Bull. Mus. Comp. Zool., **74**, p. 369.

Taxonomic notes. — LOVERIDGE (1933) recognized three subspecies of *mascareniensis* : the nominate form from the non-forested regions of eastern Africa, a large western subspecies whose range he found to be roughly coincident with the rain forest, and *mascareniensis uzungwensis*. After separation of *uzungwensis* as a distinct species (see p. 118), we find support for the first two subspecies in the frogs available to us.

LOVERIDGE (1933, 1936 A) distinguished the western, « forest » subspecies on the basis of size and applied the name *venusta* WERNER to it. Though LOVERIDGE suggested that the western form had less webbing than *m. mascareniensis*, he subsequently (1942) changed his opinion. There is also an oblique reference (LOVERIDGE, 1941, p. 136) to a difference in leg length.

Our material is divisible into western and eastern (2) groups. In the former we place 126 from northeastern Belgian Congo (AMNH ex series 11122-259, CNHM 12232, 12759-60, 12793), 7 from the Cameroons (CNHM 59156-60, 59163, 59166), and 9 from Liberia (CNHM 57816, 57939, 57943, 57948, 57951, 57955, 57958, 57960, 57965). In the eastern group are 20 from eastern Tanganyika (CNHM 12263-68, 27792-93), 3 from Uganda (CNHM 12001-03), 26 from Egypt (CNHM 68861-86), and over 500 from the Upemba. Four were at hand from Madagascar (CNHM 18229).

The differences between the two groups in snout-vent length shown in Table 14 are statistically significant if the combined « western » sample is compared with the Upemba series (males diff./SE=6.46, $P<.001$; females diff./SE=8.88, $P<.001$). LOVERIDGE also found the western form to be larger. For example, he gave the following size ranges (1942) : Uganda-Ruanda males 40-53 mm, females 52-65 mm; Kenya-Tanganyika males 41-42 mm, females 34-48 mm. The difference between the Upemba and western sample in relative length of tibia is also statistically significant (diff./SE=13.70, $P<.001$).

The plantar surface of the foot in this species may be either uniformly brownish or distinctly bicolored. In the latter instance the toes are dark brown or black and the web, particularly those portions between the first and second and second and third toes, is cream-colored. The light areas usually cross the bases of the first three metatarsi so that the median half

(2) Actually « eastern » should be « eastern and southern ». We use « eastern » for the sake of simplicity.

TABLE 14. — **Comparison of forest (or western) and non-forest (or eastern) samples of adult** *Rana mascareniensis*.

Sample	Snout-vent length (mm)						Tibia/snout-vent		
	Males			Females			Sexes combined		
	No.	Range	Mean ± SE	No.	Range	Mean ± SE	No.	Range	Mean ± SE
Eastern :									
Upemba	85	36.9–46.3	41.73 ± 0.22	59	41.4–57.9	47.80 ± 0.52	20	0.49–0.57	0.532 ± 0.004
Tanganyika	2	35.7–40.1	37.9	5	44.1–49.0	46.2	6	0.51–0.54	0.519
Madagascar	1	38.5	38.5	3	41.6–49.7	45.5	4	0.51-0 .62	0.569
Western :									
Northern Congo	21	40.1–50.6	46.1	26	47.7–62.9	56.0	46	0.56–0.66	0.607
Cameroons	3	42.1–44.6	43.7	1	53.3	53.3	3	0.55–0.66	0.605
Liberia	3	45.5–50.3	47.6	1	55.7	55.7	5	0.58–0.62	0.604
Combined western	27	40.1–50.6	45.64 ± 0.56	28	47.7–62.9	55.86 ± 0.74	54	0.55–0.66	0.606 ± 0.003

of the foot bears two or three dark, longitudinal streaks that are isolated by lighter areas from the lateral half. The striped, bicolored pattern is characteristic of the Upemba, Tanganyika, Uganda, and Egyptian frogs. The uniform pigmentation characterizes the western frogs although a few individuals have striped feet. The Madagascan specimens are too faded for analysis.

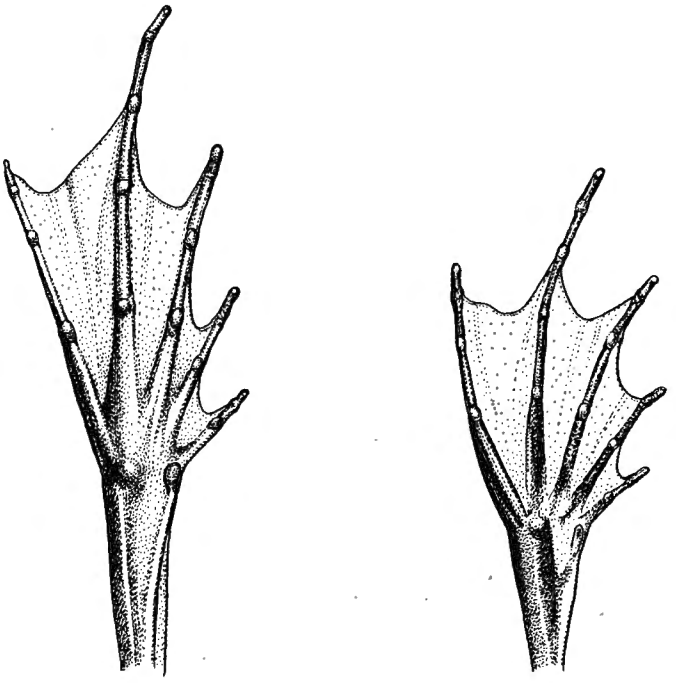

FIG. 39. — Ventral view of feet of *Rana mascareniensis hylaea* (left) and *R. m. mascareniensis* (right) (×2).

Adult males of *mascareniensis* have a number of distinctive secondary sex characters (see below, p. 81), of which one does not occur in all populations. Only males having fully developed nuptial pads have been used in the following comparison. Males of the western samples have colorless, translucent spinules scattered uniformly over the venter. These structures are absent in males of the eastern samples, but present in the single male from Madagascar.

As noted above (p. 76) LOVERIDGE originally thought the western and eastern populations differed in the extent of webbing. This character varies geographically in our material, but the pattern of variation does not fit a west versus east dichotomy and, consequently, does not coincide with

the variation in the preceding characters. The Upemba population (Fig. 39, right) seems to have the most extensive webbing; usually less than one phalanx of the fifth toe and only 2 phalanges on the lateral border of the fourth toe are free of web. The frogs from Liberia (Fig. 39, left) Cameroons, and the four from Madagascar have one phalanx of the fifth toe and 2 to 2 ½ phalanges of the fourth toe free. Those from northeastern Belgian Congo and Tanganyika have one to 1 ½ phalanges of the fifth toe and 2 ½ to 3 phalanges of the fourth toe free.

Two subspecies of *mascareniensis* are clearly recognizable on the basis of size, relative leg length, pigmentation of the foot, and development of ventral spinules in the males. So far we have called these two groups « western » and « eastern ». But as noted earlier (p. 76) LOVERIDGE referred to them as « forest » and « non-forest » as well as « western » and « eastern ». Their relationships to these phytogeographic divisions appear complex even on the basis of the little information now available.

Besides drawing attention to the rough correspondence of the range of the « western » form to the main rain forest region of central and western Africa, LOVERIDGE (1942) reported this subspecies from one of the isolated montane forests (Magrotto Mountains) in extreme eastern Tanganyika. LOVERIDGE (1937) previously had related the insular distribution of forest forms in East Africa to the contraction of the once much more extensive rain forest belt.

LOVERIDGE also pointed out that some of the forest animals persisted for a few decades after deforestation especially if scattered clumps of trees were left. One of the places LOVERIDGE specifically mentioned as a locality at which this phenomenon was evident is Entebbe, Uganda, now outside the forest belt and one of the non-forest localities for the western subspecies of *mascareniensis*. The same phenomenon probably explains the presence of the western subspecies at Faradje, Niangara, and Garamba in the Belgian Congo, about 120 kilometers from the northern boundary of the rain forest.

On the whole, the western subspecies may with justice be referred to as a forest form that is now contracting its range. But if we are dealing with true subspecies and, therefore, with interfertile populations, the contraction of the range should be viewed not as a movement of populations but as a change in local frequencies of genotypes resulting from changing selective values.

It is not possible to find existing names for both subspecies. The eastern, non-forest race is obviously *m. mascareniensis*. But the western, forest form presents a problem. LOVERIDGE (1933) referred to the latter as *m. venusta* WERNER. But the type locality of *venusta* is is Mongalla, Sudan, and not Entebbe, Uganda, as LOVERIDGE (1933) stated. Mongalla is in savanna country about 420 kilometers northeast of therain forest boundary. Although the forest form has persisted in eastern Tanganyika at much greater distances from the main forest region, it has done so only where

forest now or very recently existed. We have no evidence that Mongalla has had the same recent history. But the principal reason for rejecting the name *venusta* for the forest subspecies is the fact that WERNER's description (1908, pp. 1,899, 1,892) does not permit *venusta* to be related to any *Ptychadena* with confidence, and certainly allows no choice between a relationship with *mascareniensis* and one with *chrysogaster* LAURENT, for example.

Only five named forms of the subgenus *Ptychadena* are known to have the openings of the gular pouches parallel to the mandible and ending near the upper border of the insertion of the arm : *mascareniensis*, *newtoni* BOCAGE, *floweri* BOULENGER, *cooperi* PARKER, and *taenioscelis* LAURENT. Only *floweri* and *taenioscelis* resemble *mascareniensis* in the striped pattern behind the thigh. Additional characters distinguish *cooperi* (no vomerine teeth, reduced web) and *newtoni* (interruption of skin folds) from *mascareniensis*. Both *floweri* and *taenioscelis* are sympatric with the eastern, non-forest race of *mascareniensis* and specifically distinct from it.

Accordingly, in the absence of an available name, the western, forest subspecies is described below (p. 83) as ***Rana mascareniensis hylaea.***

Diagnosis of *m. mascareniensis*. — (Based on Upemba specimens only.) Body moderately slender (males) to somewhat stocky (gravid females); limbs moderately slender; head obtusely pointed; snout projecting; nostril nearer to tip of snout than to eye; vomerine teeth in transverse or slightly oblique series, in contact with antero-median borders of choanae; tympanum distinct, two-thirds to three-fourths diameter of eye, about equal to distance bteween eye and nostril; back with 8 continuous, longitudinal folds, folds ending behind orbits (Fig. 25); tips of fingers and toes bluntly rounded; first finger sometimes equal to but usually shorter than second, fourth longer than second; no supernumerary metacarpal tubercles (Fig. 28); toes extensively webbed (Fig. 39, right); fourth toe with 2 or (rarely) 2 ½ phalanges free of web on lateral margin; fifth toe with ½ to (rarely) 1 phalanx free; no external metatarsal tubercle; no row of small tubercles on fourth metatarsal.

Back with alternating rows of black squarish or oblong spots that may fuse across rows; usually with a mid-dorsal light line or band or both; a dorsal light line present on tibia, though sometimes very faint; occasionally a short dorsal light line on distal portion of thigh; posterior surface of thigh dark brown or black with two or three longitudinal light stripes; 4 to 6 continuous or broadly interrupted dark crossbars on tibia; underside of foot bicolored, dark pigment usually confined to the toes, the web usually cream-colored except distally between the outer toes; lower jaw barred or vermiculated with black.

Secondary sex characters. — The nuptial pads (Fig. 40) consist of velvety, cream-colored or dusky clusters of fine spinules. At the peak of their development, the pads cover the entire dorsal and median surfaces of the first finger from its base to the beginning or middle of the last phalanx, the same portions of the second finger, and the dorso-median edge of the third finger from its base to the end of the penultimate phalanx. The width of the pad on the third finger is greater over the metacarpal than distally.

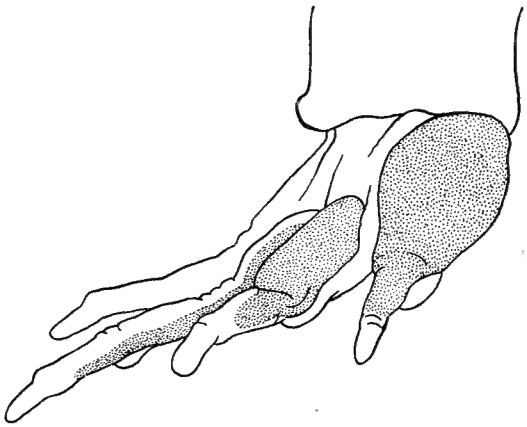

FIG. 40. — Hand of male *Rana m. mascareniensis* showing nuptial pads (×8).

The vocal sac apparatus consists of paired vocal sacs and corresponding gular pouches. The slit-like openings of the last are parallel to the lower lip, beginning below the posterior half of the eye or opposite the hind corner of the eye and ending near the upper border of the insertion of the arm. The lengths of the slits vary from 0.12 to 0.19 of the snout-vent (mean=0.145±0.005) in 14 mature males from the Upemba. In 4 males from Madagascar, Tanganyika, and Kenya the proportion ranges from 0.12 to 0.16. The wrinkled skin within the gular pouches is black.

Males with fully developed nuptial pads also have pale, translucent spinules scattered on the undersides of the toes. (These are much smaller than the tubercles confined to the ventral surface of the fourth metatarsal of *grandisonae*; the tubercles of the latter occur in both sexes.) Similar spinules are found on the dorsal and lateral surfaces of the body. Females usually have a few spinules on the sides.

As noted above (p. 78) Upemba males lack the spinules present on the ventral surfaces of head and body in males of the western, forest subspecies.

TABLE 15. — **Monthly frequency of adult** *Rana mascareniensis mascareniensis* **from the Parc National de l'Upemba in various stages of sexual competency.**

Males (*)			
Gular pouch	Fully developed	Fully developed	Early stages
Nuptial pad	Fully developed	Absent	Absent
August	0	9	8
September	2	3	5
November	26	0	0
December	25	0	0
January	29	0	0
February	4	0	0
Females (**)			
Ova	Pigmented	Intermediate	Immature
August	1	0	23
September	0	1	6
November	19	0	1
December	16	2	1
January	20	0	1
February	3	0	0

(*) All as large as or larger than 36.9 mm, the smallest with fully developed nuptial pads.
(**) All as large as or larger than 41.4 mm, the smallest with mature ova.

The temporal relationships among the male secondary sex characters follow the pattern of other species of *Rana* (*Ptychadena*) (see p. 99). The vocal sacs and gular pouches develop first and only later do nuptial pads appear. Twelve males had mature vocal sac apparatus but no trace of nuptial pads; all males with nuptial pads have fully developed gular pouches and vocal sacs (Table 15). The spinules under the foot and on the back develop synchronously with the nuptial pads.

The males are distinctly smaller than the females. The former average 41.73±0.22 mm and the latter 47.80±0.52 mm (Table 14). The difference between these means is statistically significant.

Ecological notes. — As stated above, this form of *mascareniensis* is distributed through the non-forested portions of eastern Africa. LOVERIDGE (1933) found them in abundance in swampy, grassy areas. All Upemba material was collected in the vicinity of Lakes Upemba and Kabwe.

LOVERIDGE's localities (1933, 1936, 1942) range in altitude from sea level to 2,000 m. Within the Parc de l'Upemba, however, *mascareniensis* seems to be sharply limited to the lowest elevations. Nine specimens were collected at 695 m and 514 at 585 m.

The breeding season apparently begins in October or November in the Upemba. Practically no adults are sexually competent (i.e., females with pigmented ova; males with fully developed nuptial pads) in August or September. No data are available for October, but from November through February a high proportion of adults are sexually active (Table 15). The evidence from August and September suggests that there is no breeding during the dry period (April or May through September).

Range. — This subspecies is distributed through the drier portions of East Africa, from Egypt to the Cape of Good Hope Province (HEWITT, 1912) and Madagascar. We have seen no frogs from the dry areas of West Africa and are unable to allocate those populations to a subspecies.

Upemba localities and specimens :

Kanonga (9); Mabwe (514).

Reasons have been given in the preceding pages for recognizing two forms of *Rana mascareniensis*. The western subspecies is described here as.

Rana mascareniensis hylaea n. subsp.

Holotype. — Chicago Natural History Museum number 57965 from Mount Nimba, Liberia. Adult male collected by Harry A. BEATTY, March, 1948, between 450 and 600 m.

Description of holotype. — Body slender, limbs slender; head obtusely pointed; snout projecting (slightly damaged); nostril distinctly closer to tip of snout than to eye; internarial distance equal to eye-nostril; vomerine teeth in slightly oblique series, in contact with anteromedian corners of choanae; tympanum four-fifths diameter of eye, equal to eye-nostril distance; back with 8 continuous folds (counting dorso-lateral ones), median pair beginning behind interorbital and ending above vent; first finger shorter than second, which is shorter than fourth; no supernumerary metacarpal tubercles; first toe with 1 ½ phalanges free of web, second with one, third with 1 ½, and fourth with 2 ½ free on lateral margin, fifth toe with one free (Fig. 39, left); no external metatarsal tubercle.

Back with alternating rows of oblong black spots; anteriorly spots fuse across rows; a broad, light, mid-dorsal band and thin vertebral line present; dorsal surfaces of thigh and tibia without dark crossbars; tibia with a faint light line dorsally; posterior face of thigh blackish brown with two wavy, longitudinal light stripes; ventral surface of foot uniformly brownish.

The nuptial pad covers the entire dorsal and median surfaces of the first finger from the wrist to the base of the distal phalanx, the dorsal surface of the second finger to the base of the distal phalanx, and the dorso-median surface of the third finger as far as the base of the penultimate phalanx. Translucent spinules cover the ventral surfaces of the head, body, and foot, the sides of the body, and the posterior third of the back.

Paratypes. — Liberia : Mount Nimba CNHM 57816, 57951, 57955, 57958, 57960; a stream near Mount Nimba CNHM 57939. 57943, 57948.

French Cameroons : Sangmelina CNHM 19984; Ebolowa CNHM 59156-57; Mete CNHM 59158-60, 59163, 59166.

Belgian Congo : Beni CNHM 12759-60; 40 miles west of Beni CNHM 12793; 1,200 m on Mount Ruwenzori CNHM 12232 (13); Stanleyville AMNH 11122-54, 11156-64, 11167-68, 11170-73; Faradje AMNH 11174-85, 11187-99, 11201-09, 11211, 11214-16, 11219-20, 11223, 11225, 11234-35, 11238, 11240-42; Garamba AMNH 11243; Ngayu AMNH 11245; Avakubi AMNH 11246-47; Bafwasende AMNH 11248-49; Niangara AMNH 11250; Medje AMNH 11251, 11253-57, 11259.

Variation in size and relative tibia length among these is given in Table 14. All have uniformly brownish plantar surfaces. Variation in the size and disposition of dorsal spots in minor. Only one lacks both vertebral band and line. The fifth toe has from 1 to 1 ⅔ phalanges free and the fourth toe 2 to 3 free.

Comparisons. — Differences between *hylaea* and the typical form are discussed above (p. 79).

Remarks. — A male (CNHM 74214) from Huila in the highlands of southern Angola agrees with *hylaea* in size, coloration, and secondary sex characters. On the other hand, a female (CNHM 21163) from Chitau

in central Angola resembles *m. mascareniensis*. Allocation of these Angolan populations to these subspecies cannot be made on the basis of single specimens.

We have seen no frogs from the savanna area of West Africa and, therefore, cannot comment on their relations.

Range. — Apparently limited to the rain forest province of Africa and the isolated forest islands of East Africa.

18. — **Rana obscura** n. sp.

Holotype. — Institut des Parcs Nationaux du Congo Belge number 1425. An adult male collected at Kaziba, Parc National de l'Upemba, Province Katanga, Belgian Congo, February 15-21, 1948, by the Mission G. F. DE WITTE.

Diagnosis. — A *Rana* (*Ptychadena*) with an external metatarsal tubercle and a cluster of small tubercles along the underside of the fourth and, usually, the third metatarsals (Fig. 42); a row of small tubercles on external face of tarsus; the fifth toe with one-half to one phalanx free of web; the mid-dorsal pair of skin folds continuous from occiput to anal region; and the dorsal pattern reduced to a few indistinct, small dark spots or no spots present (Fig. 41).

Description of holotype. — Body and limbs moderately stocky; head obtusely pointed; snout moderate, projecting less than a tympanic diameter beyond mandible; nostril closer to tip of snout than to eye; internarial distance less than eye-nostril, but much greater than interorbital width; width of upper eyelid equal to interorbital; canthus rostralis rounded, sloping; lores feebly concave; long diameter of eye equal to eye-nostril distance; tympanum distinct, equal to ⅔ eye diameter, separated from orbit by slightly less than half of its diameter; vomerine teeth in transverse groups, in contact with antero-median corners of choanae.

Fingers and toes bluntly rounded; first finger slightly longer than second; second and fourth subequal; subarticular tubercles distinct; metacarpals with distinct supernumerary tubercles (Fig. 42). Toes about ¾ webbed; first toe with 2, second with 1 ½, third with 1 ⅔, and fourth with 2 ⅔ phalanges free of web on lateral borders; fifth toe with one phalanx free; subarticular tubercles distinct; inner metatarsal tubercle oval, about equal to its distance from subarticular tubercle of first toe; a small, but distinct, round external metatarsal tubercle; a row of small tubercles under third and fourth metatarsals.

Back with prominent folds; median pair beginning on occiput and continuing without break to anal region; a second continuous fold beginning at posterior corner of upper eyelid and ending at groin; a dorso-lateral fold beginning above tympanum and reaching groin with a break

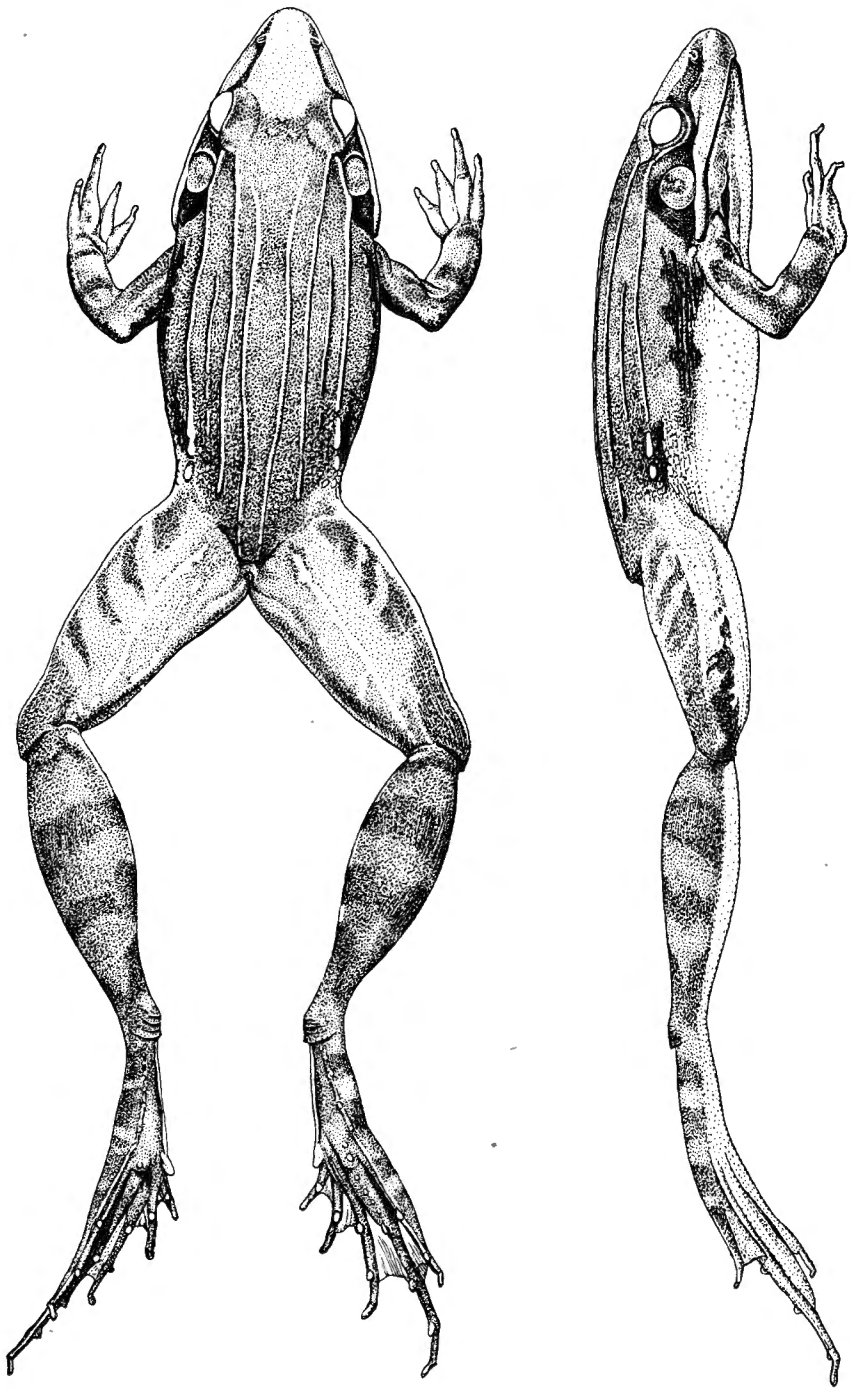

FIG. 41. — *Rana obscura* new species (×2).

near its end; a short fold in center of body between the last two folds; sides of body coarsely granular with several large rounded warts anteriorly; a glandular ridge from beneath tympanum to upper border of axilla; back and sides with fine spinules (see Secondary sex characters below); below smooth except for nuptial spinules.

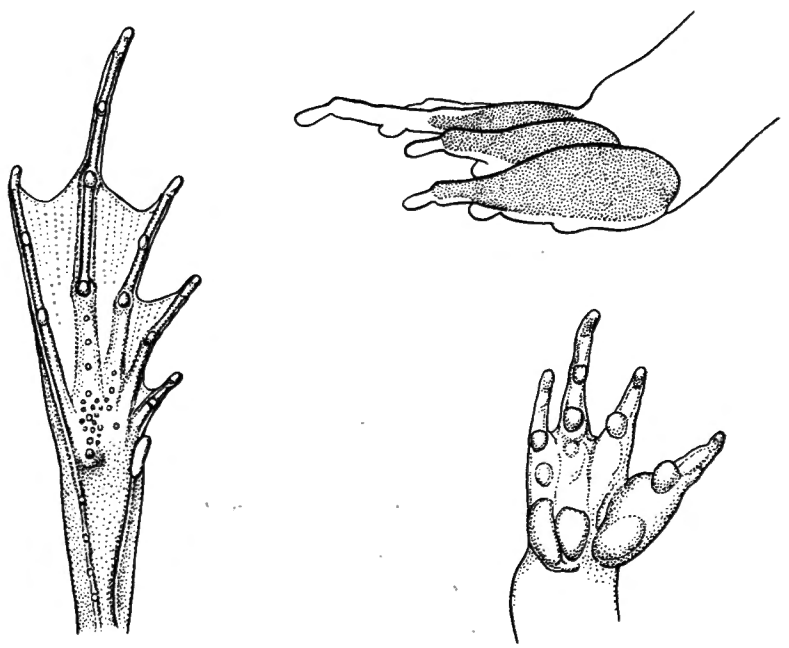

FIG. 42. — *Rana obscura.*
Left, underside of foot (×3). Right upper, hand of male showing nuptial pads (×6). Right lower, underside of hand (×4).

Color (in alcohol) of dorsal and lateral surfaces dark brown, indistinctly mottled and with a pair of narrow black spots, one on each of the middle longitudinal folds above shoulders; dorso-lateral fold cream-colored; sides of body with several black spots anteriorly; a dark streak beginning at tip of snout, running in upper half of lores, narrowing below the eye, and expanding to cover entire temporal region except for slightly lighter tympanum; upper lip sooty grayish brown; infratympanic glandular swelling cream-colored, the streak continued forward as a narrow line between darkened lip and loreal stripe; lower jaw from symphysis to axilla black, enclosing a few light, round spots; all other ventral surfaces immaculate cream-colored; dorsal surface of lower arm barred with dark brown; no light longitudinal lines on dorsal surface of leg; dorsal surface of thigh with 6-7 short black bars; anterior face of thigh with a short dark stripe

distally, not in contact with dorsal bars; posterior face of thigh cinnamon brown with indistinct lighter spots; dorsal surface of tibia with 5 dark cross bars, 2 of which reach only to center of leg; two dark tarsal bars; underside of foot dark brown except for lighter tubercles.

Dimensions (mm) of holotype : Snout-vent 36.2; head length (to angle of jaw) 14.0; head width (at center of tympanum) 12.0; length of gular pouch opening 5.7.

Secondary sex characters of holotype. — Cream-colored, velvety nuptial pads (Fig. 42) cover the entire dorsal and median surfaces of the first finger from its base to the end of the penultimate phalanx, the dorsal surface of the second finger to the end of the penultimate phalanx, and the dorso-median edge of the third finger usually to the base of the penultimate phalanx (or opposite distal subarticular tubercle). Small, translucent, colorless spinules are uniformly distributed over practically every part of the animal except the inner surfaces of the arms, the ventral surface of the thigh and tibia, and the dorsal surface of the foot.

The round openings of the vocal sacs are situated in the floor of the mouth near the angle of the jaws. The gular pouch openings begin opposite the posterior half of the eye and run oblique to lower jaw, ending near the ventral insertion of the lower arm. The wrinkled skin within the pouches is dark gray.

Paratypes. — All of the following specimens were collected in the Parc National de l'Upemba or at immediately adjacent localities. IPN 793-797 (9), 1272, 1299 B (5), 1317 B (5), 1333, 1342, 1349, 1354 B, 1355 B, 1386 (12), 1408, 1424-25 (7), 1429 (11), 1436, 1439 (2), 1452 A (2), 1453, 1470, 1472 (6), 1474, 1495 A, 1496 A, 1497 C, 1536 (14), 1542 A, 1543 B, 1550 (46), 1563 (4), 1565 (2), 1568, 1571 (5), 1574, 1576-77 (3), 1587, 1590-91, 1596, 1598, 1600-02 (14), 1605 (2), 1622-23, 1625-29 (25), 1631 (4), 1709 A (2), 1712 A, 1716 A (32), 1731 A, 2693 (6).

The entire sample is relatively uniform. The dorsum is without any black spots in about ⅕ of the series; one or two specimens each have two or three transverse pairs of spots. The great majority, however, are like the holotype and have a single pair of spots. Some ontogenetic variation shows up in the coloration of the lower jaw. Young specimens tend to have the black streak interrupted by two or three light crossbars.

The median pair of dorsal skin folds are uninterrupted in about ⅘ of the paratypes. In a few these folds begin behind the usual origin, the occiput. One-fourth of the series lacks the small tubercles under the third metatarsal. Most specimens have one phalanx of the fifth free of web although only one-half phalanx is free in one-sixth. The number of free phalanges on the fourth toe varies from 2 ½ to 3.

Variation in size and several body proportions are given in Table 16.

TABLE 16. — **Variation in paratypes of** *Rana obscura*.

Character	No.	Range	Mean ± SE
Snout-vent (mm) :			
Males with nuptial pads	14	33.8–37.6	35.76 ± 0.29
Females with mature ova	7	38.7–45.2	43.67 ± 0.88
Gular pouch opening (males) (*)	10	0.15–.019	0.169 ± 0.004
Tibia (males and females) (*)	22	0.59–0.67	0.628 ± 0.005

(*) These dimensions given as proportions of snout-vent.

Comparison with other species. — The combination of the row of small tubercles under the fourth metatarsal with the reduction of the dorsal pattern to no more than 6 very small dark spots distinguishes *obscura* from all members of the *Rana* (*Ptychadena*) group. The fourth metatarsal has a row of tubercles in *grandisonae*, *frontalis*, *upembae*, *maccarthyensis*, *porosissima*, and *chrysogaster guibei* (as defined above, p. 65). But each of these has a conspicuous longitudinal dorsal pattern of quadrangular spots, and each differs from *obscura* in at least one other character. For example, in *grandisonae* the mid-dorsal folds end between the eyes (behind eyes in *obscura*), the lower jaw is distinctly barred (continuous black streak in *obscura*), and sexually active males do not have light spinules on the back. *Rana frontalis* has the lower jaw barred with black, the mid-dorsal folds interrupted (continuous in *obscura*), and no dorsal spinules in males. The same distinctions hold true for *maccarthyensis*, which also has more extensive webbing (at most 2 ⅓ phalanges of fourth toe free; at least 2 ½ phalanges free in *obscura*). Males of *porosissima* never have dorsal spinules, and both sexes have a light vertebral marking and a light longitudinal line on the tibia (both lacking in *obscura*). *Rana chrysogaster guibei* has less webbing (1 ½-2 phalanges of fifth toe free; at most 1 in *obscura*), discontinuous mid-dorsal folds or a short posterior median pair, and a vertebral light stripe. *Rana upembae* has less web, a vertebral stripe, but no dorsal spinules in males.

Other species with a greatly reduced or absent dorsal pattern are *christyi*, *longirostris*, and eastern populations of *superciliaris*. Besides lacking the row of tubercles under the fourth metatarsal, all three of these differ from *obscura* in having at most two phalanges of the fourth toe free of web (between 2 ½ and 3 free in *obscura*) and in having the rear face of the thigh more conspicuously marked.

Secondary sex characters. — The holotype represents the maximum development of these characters. The sequence of development of the several male secondary sex characters is the roughly the same in *obscura* as in other species of the subgenus (see p. 89). The vocal sacs and gular pouches complete their development before the appearance of the other structures. The ventral and dorsal spinules develop concomittantly with the nuptial pads.

As indicated in Table 16, the females reach a larger size than the males.

Ecological notes. — In the Upemba, *obscura* is confined to elevations above 750 m and occurs only rarely below 1,000 m. The altitudinal distribution of the present sample is as follows :

Meters.	Specimens.
751-1,000	16
1,001-1,250	107
1,251-1,500	14
1,501-1,750	92
1,751-1,830	13

All males (14) with secondary sex characters fully developed and all females (7) containing pigmented ova were collected during the interval November-April. On the other hand, 6 adult-sized males (33-37 mm, c.f. Table 16) with mature gular pouches but totally lacking other secondary sex characters were obtained in the interval May-September. Thirteen females of mature size (38 mm or larger) were collected between March and July. No males were caught in July, August, or October and no females in August, September, or October. Apparently the breeding period coincides roughly with the rainy season and lasts from November to April.

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

Upemba localities and specimens :

Babagi (4); Buye-Bala (3); Ganza (1); Kabenga (2); Kabwe (10); Kabwekanono (8); Kafwe (1); Kagumwe (13); Kalumengongo (2); Kambi (11); Kamitunu (1); Kankunda (3); Karibwe (1); Kaziba (10); Kipangaribwe (1); Lufwa (2); Lusinga (62); Mokey (3); Munoi (8); Muye (1); Pelenge (95).

19. — **Rana oxyrhyncha** SMITH.

Rana oxyrhynchus SMITH, 1849, Ill. Zool. South Africa, pl. 77, fig. 2 — Natal.

Rana (*Ptychadena*) *gribinguiensis* ANGEL, 1922, Bull. Mus. Hist. Nat. Paris, **28**, p. 399, fig. — Fort Crampel, French Equatorial Africa.

Rana oxyrhynchus gribinguiensis LOVERIDGE, 1936, Bull. Mus. Comp. Zool., **79**, p. 416.

Taxonomic notes. — In view of SMITH's excellent description (1849), it is surprising that this widespread species should still have been confused in the literature of the last 20 years. ANGEL's description and figure of *gribinguiensis* (1922) fit SMITH's description remarkably well. Angel states that *gribinguiensis* is distinguished by the length and proportions of the hind limb. According to his measurements the leg of *gribinguiensis* is 2.12 times the snout-vent length; SMITH's measurements give a ratio of 2.04, hardly a significant difference. SMITH states that *oxyrhyncha* has « long rather robust » hind limbs, which is the phrase (« long, robustes ») used by ANGEL to describe *gribinguiensis*. The distinct interorbital bar, the light triangle of the forehead, and the vermiculation of the posterior face of the thighs, all diagnostic of *gribinguiensis*, are either figured or mentioned by SMITH. There is no reason to consider *gribinguiensis* ANGEL other than a strict synonym of *oxyrhyncha* SMITH, an opinion supported by comparison of a Natal specimen collected by SMITH and now in the British Museum (1858.11.25.96), with the type of *gribinguiensis*.

LOVERIDGE (1936) recognizes two forms in British East Africa, *oxyrhyncha oxyrhyncha* and *o. gribinguiensis*, distinguished by size (females rarely over 50 mm with a maximum near 55 in *o. oxyrhyncha*; females 59 to 67 mm in *o. gribinguiensis*) and extent of webbing (fourth toe with 1 ½ to 2 phalanges free in *o. oxyrhyncha*; 1 to 1 ½ free in *o. gribinguiensis*). In subsequent papers LOVERIDGE reports the two subspecies from Liberia (1938, 1941), Belgian Ruanda (1942), and Nyasaland (1953). These papers call attention to another character distinguishing the two forms : the posterior surface of the thigh is striped in *o. oxyrhyncha* and vermiculated in *o. gribinguiensis*. The important point here is that the characteristics LOVERIDGE attributes to *o. gribinguiensis* are those of *oxyrhyncha* SMITH. SMITH's type is 57 mm long; its thighs are, to use SMITH's phrase, « reticulated or freckled » posteriorly; and its web leaves little more than one phalanx of the fourth toe free.

But the characters noted by LOVERIDGE certainly define two forms and, considering that they are sympatric from Liberia to Kenya and Mozambique, we treat them as full species. LOVERIDGE's *o. gribinguiensis* is clearly *oxyrhyncha* SMITH and his *o. oxyrhyncha* is almost certainly *superciliaris*

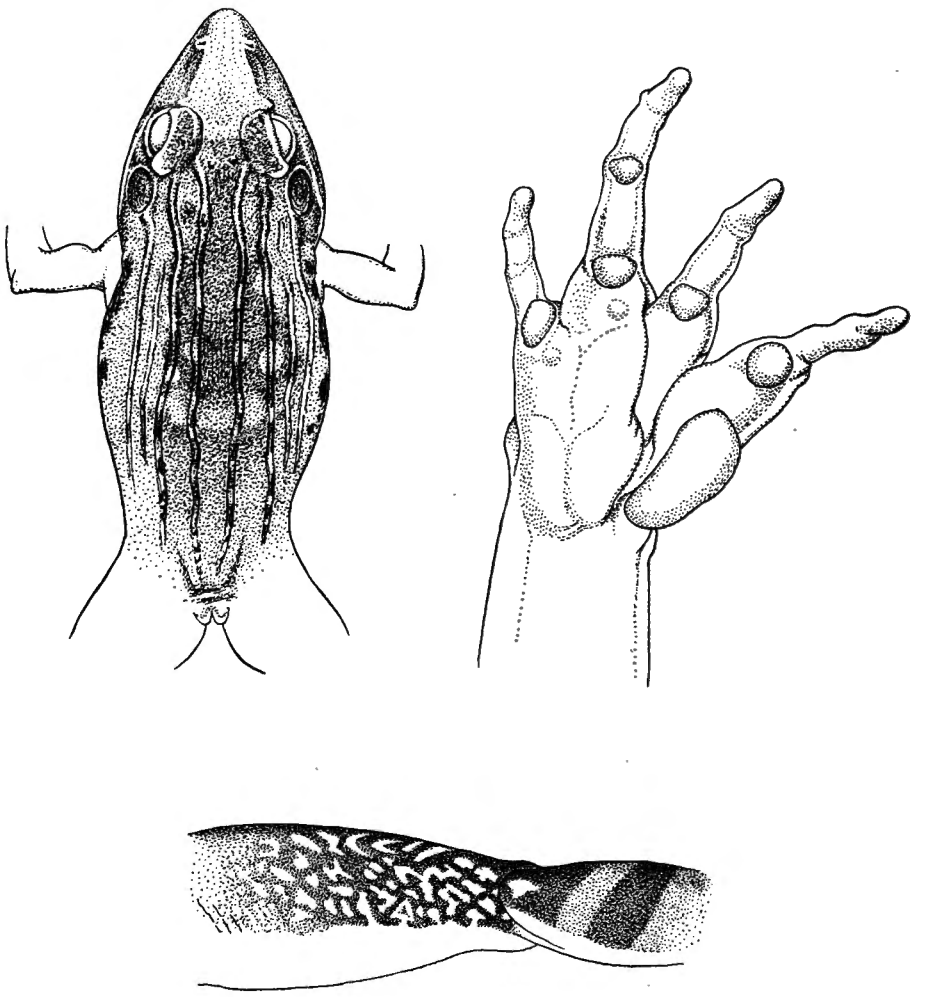

FIG. 43. — *Rana oxyrhyncha* from Parc National de l'Upemba.
Upper left, dorsal view (×1½). Upper right, ventral surface of hand (×5).
Lower right, posterior surface of thigh (×2).

GÜNTHER. We have examined the type of the last and it agrees in every detail with the diagnoses of *o. oxyrhyncha* LOVERIDGE of the previously listed papers and with Congo and East African specimens LOVERIDGE had identified as *oxyrhyncha* elsewhere (1936 A).

Diagnosis. — Body moderately stocky, limbs heavy; head obtusely pointed; snout projecting; nostril nearer to eye than to tip of snout; vomerine teeth in transverse series, in contact with antero-median borders of choanae; tympanum distinct, about ¾ diameter of eye, slightly less than distance

between eye and nostril; back with 6 or 8 longitudinal folds, folds ending behind orbits, mid-dorsal pair continuous (Fig. 43); tips of fingers (Fig. 43) and toes bluntly rounded; first finger slightly shorter than second; usually no supernumerary metacarpal tubercles; toes almost completely webbed; fourth toe with one to one and one-half phalanges free of web on lateral border; fifth toe usually webbed to tip; no external metatarsal tubercle; no row of small tubercles on fourth metatarsal.

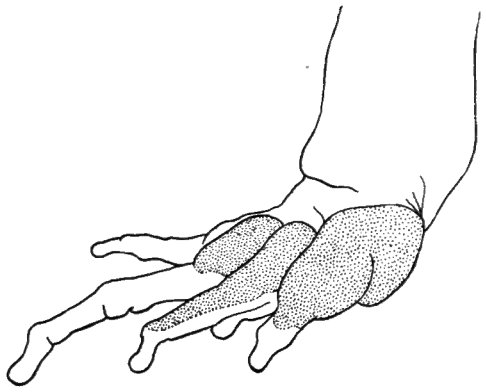

FIG. 44. — *Rana oxyrhyncha.*
Hand of male showing nuptial pads (×5).

Back with alternating rows of small squarish black spots, each of which is smaller than the tympanum; no mid-dorsal band or line; no light line on thigh or tibia; posterior surface of thigh dark brown or black with a vermiculation of white (Fig. 43); 4 to 6 interrupted black bars across tibia; 3 tarsal bars; underside of foot dark brown, occasionally small light areas at base of web; lower jaw barred with black.

Secondary sex characters. — The nuptial pads (Fig. 44) have have the same gross appearance as in all members of the subgenus *Ptychadena*; that is, they consist of velvety cream-colored clusters of spinules. At the height of development the nuptial pad covers the entire dorsal and lateral surfaces of the first finger from its base to the end of the basal phalanx, the dorsal surface of the second finger from its base to the first phalanx, and a circular area on the dorsal surface of the third finger not extending beyond the level of the proximal subarticular tubercle.

The slits of the gular pouches begin slightly anterior to the tympanum and end at the ventral border of the insertion of the arm. The length of the slits varies from 0.15 to 0.19 of snout-vent (mean=0.164) in seven mature males. The gular pouches are usually black or black anteriorly and gray

or white posteriorly in mature males; in one male the pouches are light gray. Fine ventral asperities are feebly developed in only four males.

The slit of the gular pouch develops before the nuptial pad. The latter appears only in males having fully developed vocal sacs and gular pouches; on the other hand, fifteen males with fully developed gular pouches (snout-vent 43.6-53.5 mm) have no trace of nuptial pads (Table 17). Initially the slits for the pouches appear as a short and shallow fold on each side of the throat. Thirty-one males (32.3-52.1 mm) are in this stage; only one male (28.4 mm) has no indication of these folds. None of these last 32 males has a trace of nuptial pad.

The females are significantly larger than the males. Thirty-one adult females (all individuals with pigmented ova) measure 49.2-62.0 mm (mean=58.22±0.48 mm) and 27 mature males (all individuals with vocal sacs and nuptial pads) measure 43.6-53.2 mm (mean=49.71±0.47 mm).

Ecological notes. — Because significant portions of the literature have misidentified this species, one gains a false impression of the relative abundance of *oxyrhyncha*. It is far less common than the literature indicates. For example, LOVERIDGE lists 101 *o. oxyrhyncha* from Kenya and Uganda (1936), 18 from Uganda and Tanganyika (1942), and 148 from Nyasaland (1953). But, as we have shown above, all of these specimens were misidentified. The true *oxyrhyncha* (*o. gribinguiensis* of LOVERIDGE) listed in those three papers number 4, 1, and 11 respectively. The Upemba collection contains 142 *oxyrhyncha*, a modest number in terms of this enormous collection; by contrast the Upemba material includes over 1,000 *Rana porosissima*, a high altitude form, and over 500 *R. mascareniensis* from low altitudes.

As its wide geographic range suggests, *oxyrhyncha* is able to live in several vegetation formations. PARKER (1936 A) and SANDERSON (1936) report it from rain forest and more open forest in Angola and the Cameroons, and LOVERIDGE (1942, 1953) from forested areas of East Africa. All of the localities given by ANGEL (1922), CHABANAUD (1921), and MERTENS (1938) lie outside the rain forest belt, but their specimens may have come from gallery forest. Reports from southern and southeastern Africa (SMITH, 1849; POWER, 1927) locate *oxyrhyncha* in savannah country.

Rana oxyrhyncha has been found from sea level (SMITH, 1849; LOVERIDGE, 1941) to 2,150 m (LOVERIDGE, 1936). Specimens in the Upemba collection show the following altitudinal distribution :

Meters.	Specimens.
500- 750	30
751-1,000	77
1,001-1,250	16
1,251-1,500	13
Above 1,500	9

The development of the secondary sex characters and the monthly distribution of females with pigmented ova indicate that in the Upemba the breeding season of *oxyrhyncha* begins with the rains in October and continues at least into November. Only 2 of the 35 adult females collected from May through August, in the dry season, has pigmented ova; however, by September most of them have pigmented ova and by October (the start of the rainy season) and November all of them are reproductively competent (see Table 17). Similarly, the males of the dry season do not usually have the secondary sex characters fully developed. In September most of them show maximum development of these structures, and in October and November all do.

TABLE 17. — **Frequency by months of** *Rana oxyrhyncha* **from the Parc National de l'Upemba in various developmental stages of reproductive competence.**

	Males (*)			Females (**)	
	Vocal sacs and nuptial pads	Vocal sacs only	No vocal sacs or pads	Pigmented ova present	No pigmented ova
February	1	0	0	—	—
April	0	1	1	—	—
June	0	5	6	0	17
July	1	2	5	0	4
August	1	6	9	2	12
September	12	1	1	12	2
October	2	0	0	12	0
November	10	0	0	6	0

(*) All larger than 43 mm; smallest with nuptial pads 43.6 mm.

(**) All larger tahn 49 mm; smallest with pigmented ova 49.2 mm.

Range. — *Rana oxyrhyncha* is known with reasonable certainty from Cape Province (POWER, 1935) in the south to Ethiopia (PARKER, 1930) in the north and from Kenya (LOVERIDGE, 1936) and Mozambique (PARKER, 1930) in the east to Angola and Liberia in the west.

Upemba localities and specimens :

Ganza (22); Kabenga (3); Kalala (1); Kalungwe (1); Kaluwamba (2); Kande (6); Kankunda (13); Kanonga (7); Karibwe (2); Kaswabilenga (6); Kiamakoto (5); Kilwezi (36); Kipondo (5); Loie (1); Lufira (4); Lukawe (4); Lupiala (2); Lusinga (5); Mabwe (6); Masombwe (8); Mukukwe (2); Munoi (4); Muye (1); Mware (3); Senze (2).

20. — **Rana porosissima** STEINDACHNER.

Rana porosissima STEINDACHNER, 1867, Reise Novara, Amph., p. 19, pl. 1, figs. 9-13 — Angola.

Rana loveridgei LAURENT, 1954, Ann. Mus. Congo Belge, **34**, p. 14, pl. 1, fig. 4, pl. 2, fig. 1, pl. 3, figs. 3-4, pl. 4, figs. 2, 7 — Tare, Busanza, Ruanda.

Taxonomic notes. — LAURENT (1954) notes that males of *loveridgei* have the strong spinosity of *porosissima* but distinguishes the two forms on the basis of differences in the positions of the external slits of the gular pouches. Actually, a close comparison of STEINDACHNER's description and figures with those of *loveridgei* presented by LAURENT reveals agreement in even minute details. Dr. J. EISELT has very kindly compared two males from the Upemba with the holotype of *porosissima* and informs us that in coloration, webbing, body proportions, and in the position of the gular pouches our specimens agree with *porosissima*. Dr. EISELT specifically notes (in litt.) that, contrary to LAURENT's opinion, the openings of the gular pouches of *porosissima* end near the ventral border of the insertion of the arm and, hence, are arranged exactly like those of *loveridgei*.

We have compared the frogs sent to Dr. EISELT with a male paratype of *loveridgei* (CNHM 74922) and can find no significant differences. However, the longitudinal light line on the dorsal surface of the thigh, said by LAURENT to be characteristic of *loveridgei*, is sporadic in appearance within the entire Upemba series. Approximately one-sixth of our frogs have a complete line on the thigh, an additional one-sixth have an incomplete line, and the rest have no line at all. The absence of this line from the thigh of the holotype of *porosissima* is one of the trivial differences between it and the description of *loveridgei*.

LOVERIDGE (1953) states that *porosissima* is a synonym of *subpunctata* BOCAGE. The two forms differ in so many respects that we must disagree with that opinion. The webbing is much more extensive in *subpunctata*, leaving at most one-half of the last phalanx of the fifth toe free whereas in *porosissima* one to two complete phalanges are free. Males of *porosissima* rarely reach a length of 45 mm and females rarely exceed 55 mm. On the other hand males of *subpunctata* often exceed 50 mm and females commonly exceed 60 mm. BOCAGE (1866) states clearly (and is supported by our *subpunctata*) that the posterior face of the thigh is striped; in *porosissima* this area has round light spots that occasionally coalesce into a light network. The two forms also differ in the pattern on the lower jaw.

Diagnosis. — Body moderate to slender, limbs moderate; head pointed; snout greatly projecting; nostril nearer to eye than to tip of snout; vomerine teeth in transverse series, in contact with antero-median borders of choanae; tympanum distinct, ¾ to ⅘ diameter of eye, about equal to

distance between eye and nostril; back with 8 folds ending behind orbits, mid-dorsal folds continuous (Fig. 45); tips of fingers and toes bluntly rounded; first finger equal to second; supernumerary metacarpal tubercles usually present, distinct; toes about two-thirds webbed; fourth toe with 3 to 3 ¼ phalanges free of web on lateral border; fifth toe with 1 ⅓ to 1 ½ phalanges free; external metatarsal tubercle usually absent; a row of small tubercles on fourth metatarsus present in about half of individuals.

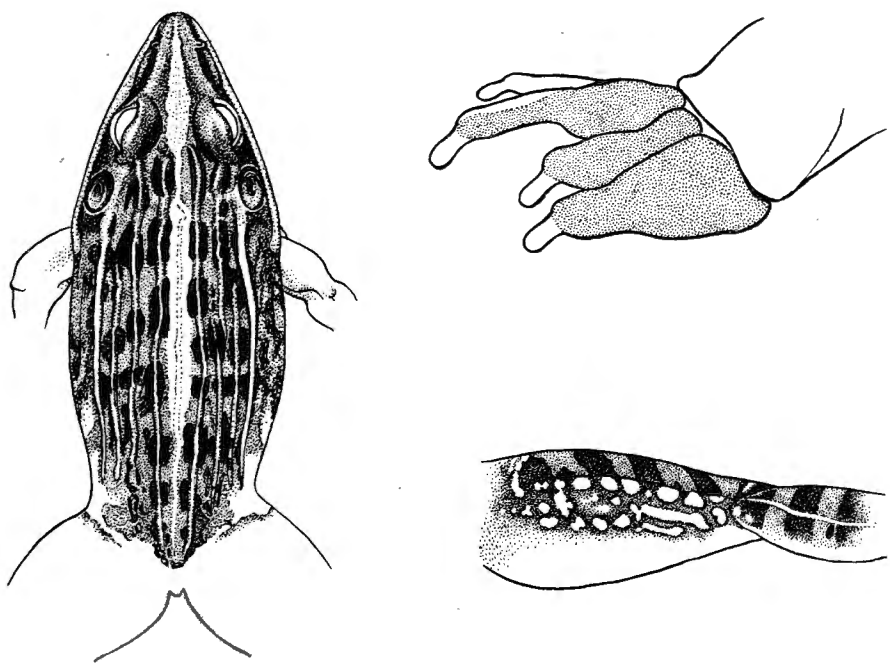

FIG. 45. — *Rana porosissima* from Parc National de l'Upemba.
Left, dorsal view (×2). Right upper, hand of male showing nuptial pads (×6). Right lower, posterior surface of thigh (×2).

Back with alternating rows of squarish black spots, each of which is subequal to tympanum; a broad mid-dorsal band of light color through which a still lighter vertebral line is visible; a light line always present on dorsal surface of tibia; thigh with or without light line (see Taxonomic notes); posterior face of thigh dark brown with roundish or oval light spots (Fig. 45); 4 to 6 black bars across tibia, usually complete; 2 or 3 black tarsal bars; underside of foot uniform brownish; lower jaw with continuous blackish streak that widens abruptly just before axilla.

Secondary sex characters. — The nuptial pads (Fig. 45) are cream-colored velvety clusters of spinules. At the height of development the pads cover the entire dorsal surfaces of the first and second fingers from the wrist to the base of the terminal phalanx and the medio-dorsal surface of the third finger from its base to the proximal end of the terminal phalanx. Most males with nuptial pads also have well-developed spines uniformly distributed over the venter from the chin to the groin. At the climax of development the ventral spines are tipped with black pigment.

As in other *Ptychadena* the vocal sac apparatus consists of paired vocal sacs and gular pouches. The openings for the pouches run from a point opposite the middle of the eye to the antero-ventral corner of the arm insertion. In 15 males with fully developed pouches and nuptial pads, the slits of the gular pouches vary from 0.15 to 0.21 of the snout-vent length (mean=0.177±0.004).

The development of the masculine secondary sex characters follows a clear sequence. First, in males about 29 mm snout-vent, a fold appears in the skin on each side of the gular region; these folds develop into shallow invaginations that gradually deepen into the gular pouches that protrude during vocalization. The blind apex of each gular pouch then partially evaginates, becomes wrinkled, and acquires the dark pigment typical of

TABLE 18. — **Frequency by size classes of male** *Rana porosissima* **in different stages of development of the gular pouch.**

Snout-vent (mm)	Gular skin		
	No modification	Fold to complete invagination	Mature gular pouch
22.4–24.9	6	1	0
25.0–26.9	3	0	0
27.0–28.9	10	1	0
29.0–30.9	2	15	0
31.0–32.9	0	16	1
33.0–34.9	0	29	1
35.0–36.9	0	29	12
37.0–38.9	0	20	31
39.0–40.9	0	4	28
41.0–42.9	0	0	6
Totals	21	115	79

adults. Only in males having the gular pouches in the last stage are there opening to the vocal sacs in the floor of the mouth. The relation between snout-vent length and the development of the gular pouches is shown in Table 18.

A sharp distinction must be made between the gular pouches, which are invaginations of gular skin, and the vocal sacs, which presumably are evaginations from oral epithelium (LIU, 1935). One hundred thirty-six males (snout-vent 22.4-42.9 mm) in various stages of gular pouch development prior to the appearance of wrinkled, pigmented skin were examined; none has vocal sac openings in the floor of the mouth and none has recognizable vocal sacs under the floor of the mouth. On the other hand all 79 males with fully developed gular pouches have vocal sacs and openings to them in the floor of the mouth. Since no intermediate stages of vocal sac development were found, the development of the sacs is probably rapid. A more detailed account of the anatomy and development of the vocal sac apparatus is given elsewhere (INGER, 1956 A).

The nuptial pads develop after the vocal sacs. All 59 males (snout-vent 34.0-42.1 mm) with nuptial pads in some stage of development have mature vocal sacs (that is, the openings are present in the mouth) whereas 20 males (32.7-42.3 mm) have the vocal sac apparatus fully formed but no trace of nuptial pads. The ventral spinules are the last of the secondary sex characters to appear and are found only on males having fully developed nuptial pads. The sequence of development of the secondary sex characters is shown in Table 19.

As the first two columns of Table 19 show, nuptial pads and ventral spines have a cyclic development and are absent in males collected during most of the dry season (late April through August), during wich *porosissima* does not breed (see *Ecological notes*). The cyclic appearance of these two structures corresponds with the periodicity in the nuptial pads of *Rana graeca* (CEI, 1944), *R. esculenta* (ARON, 1926), and *R. pipiens* (GLASS and RUGH, 1944), which have been shown to be controlled by periodic changes in hormone production. The nuptial pads of the Holarctic species are well-developed only immediately before, during, and immediately after the breeding period. Well-developed gular pouches and vocal sacs are found in male *porosissima* even during the dry season (third column of Table 19). Conceivably, the development of these gular structures might be initiated by androgens and their appearance in the dry season could be explained merely by a failure to regress. But this hypothesis would leave unexplained the initiation of development of the gular pouches in males from the dry season (see fourth column) when production of androgens is at an ebb. The data of Table 19 suggest that the development of vocal sacs and gular pouches in under direct genetic control.

The mature females are larger than adult males. Nineteen with pigmented ova measure 39.3-48.9 mm snout-vent (mean=44.3±0.64 mm) and 59 males with nuptial pads 34.0-42.1 mm (mean=39.2±0.22 mm).

TABLE 19. — **Monthly frequency and size range (mm.) of male** *Rana porosissima* **in various stages of development of secondary sex characters.**

Gular pouches	Fully developed	Fully developed	Fully developed	Early stages	Absent
Vocal sacs	Present	Present	Present	Absent	Absent
Nuptial pads	Present	Present	Absent	Absent	Absent
Ventral spines	Present	Absent	Absent	Absent	Absent
	Number and size (mm) of males				
January	21 (35.6-40.7)	0	0	0	0
February	0	0	1 (38.3)	11 (30.1-37.3)	3 (27.0-28.0)
March	8 (38.1-42.1)	4 (37.5-40.1)	3 (38.8-42.3)	25 (24.5-40.5)	12 (22.8-29.5)
April	0	0	7 (37.5-41.9)	16 (34.0-38.9)	3 (23.4-30.1)
May	0	0	2 (35.7-37.3)	30 (30.8-39.8)	1 (24.0)
June	0	0	0	18 (29.0-37.4)	0
July	0	0	6 (36.6-39.6)	15 (32.3-38.2)	0
September	19 (35.9-41.7)	0	0	0	2 (22.4-23.3)
October	6 (34.0-38.2)	0	0	0	0
November-December ...	0	1 (39.2)	1 (32.7)	0	0
Totals	54 (34.0-42.1)	5 (37.5-40.1)	30 (32.7-42.3)	115 (24.5-40.5)	21 (22.4-30.1)

Ecological notes. — *Rana porosissima* lives at moderate to high elevations. The lowest elevation reported by LAURENT (1954) is 1,285 m and the highest 2,200 m. In the Upemba collection the lowest elevation for *porosissima* is 1,250 m and the highest 1,830 m. BOCAGE (1895) reported *porosissima*, which he considered to be a variety of *mascareniensis*, from the high plateaus of Angola. The altitudinal distribution of the Upemba specimens and those listed by LAURENT as *loveridgei* is as follows :

Meters.	LAURENT (1954).	Upemba collection.
—	—	—
— 1,250	—	2
1,251-1,500	6	61
1,501-1,750	27	313
1,751-2,000	64	746
Above 2,001	3	—

The breeding season of *porosissima* probably begins in the Upemba in October, coinciding with the beginning of the rains, and continues through March. The monthly frequency of adult females in two stages of the reproductive cycle is given in Table 20. Only females larger than 39 mm are considered mature; the smallest female with ripe ova is 39.3 mm. The distribution of females with pigmented ova thus agrees with that of males having nuptial pads (first two columns of Table 19) and supports the view that *porosissima* is ready to breed in September immediately before the onset of the rains. The collection of 21 transforming young in March gives added confirmation. Only one other transforming juvenile was caught, and that in January. No larvae were obtained.

TABLE 20. — **Monthly frequency of adult female** *Rana porosissima* **from the Parc National de l'Upemba in two phases of the reproductive cycle.**

	With pigmented ova	Without pigmented ova
January	4	0
February	3	4
March	4	18
April	0	28
May	0	12
June	0	12
July	0	8
September	7	0
October	1	0
November-December	0	2

Range. — *Rana porosissima* occurs with certainty from northeastern Angola to Tanganyika and Uganda.

Upemba localities and specimens :

Between Buye-Bala and Katonga (43); Buye-Bala (86); Bwalo (18); Dipidi (20); N'Gozie (7); Kabwe (10); Kabwekanono (302); Kafwe (20); Kagomwe (1); Kalumengongo (34); Kamitunu (1); Kampadika (1); Kanpungu (1); Karibwe (23); Kasandendeko (1); Katombwe (14); Katonga (15); Kayango (1); Kenia (6); Kipangaribwe (2); Luangalele (7); Lufira (11); Lufwa (11); Lusinga (340); Mitoto (2); Mubale (1); Mukana (142); Mukelengia (1); Munte-Mubale (40); Pelenge (2).

21. — **Rana subpunctata** BOCAGE.

(Pl. V, 1.)

Rana subpunctata BOCAGE, 1866, Jour. Acad. Sci. Lisbonne, **1**, p. 73 — Duque de Bragança, Angola.

Rana katangae WITTE, 1921, Rev. Zool. Afric., **9**, p. 3, pl. 2, figs. 1-4 — Lofoi, Katanga, Belgian Congo.

Rana chobiensis FITZSIMONS, 1932, Ann. Transvaal Mus., **15**, p. 39 — Kasane, Chobe River, Bechuanaland.

Taxonomic notes. — LOVERIDGE has suggested that *katangae* (1936) and *chobiensis* (1953) are synonyms of *subpunctata*. We concur in these opinions. The Upemba specimens agree with the original description of *subpunctata* in all details. Nothing in WITTE's description (1921) of *katangae* will distinguish it from *subpunctata*. The same applies to FITZSIMONS' description (1932) of *chobiensis* and the 7 paratypes of the latter available (CNHM 18028-29). WITTE's description and figure (of *katangae*) and the paratypes of *chobiensis* show the characteristic pigmentation of venter, thighs, and plantar surfaces, the relatively large size, the extensive webbing, the absence of supernumerary metacarpal tubercles (see *Diagnosis*, p. 104), and the fringe of web along the second and third fingers (see below, p. 104).

WITTE (1921) does not describe clearly the position of the opening of the gular pouch. Although at one point (p. 4) he notes that it ends near the upper border of the arm (« ... près du bord supérieur du bras ») and at another (p. 6) that it ends above the lower border of the arm (« ... au-dessus du bord inférieur du bras »), the figure of the type (pl. 2, fig. 3) distinctly shows the opening running at an angle to the lower lip or gape of the mouth, which is the critical fact. A young male paratype of *chobiensis* (CNHM 18029; 42 mm) has the gular pouch in an early stage of development, yet clearly oblique to the lower lip. The opening in fully mature males from the Upemba (IPN-1262 B; 54.6 mm) is also oblique to the lower lip. BOCAGE (1866, 1895) did not describe the position of the gular pouch in *subpunctata*, but overall agreement of the present specimens with his descriptions oblige us to identify them as *subpunctata*.

In many ways this species is very similar to *Rana m. mascareniensis*. BOTH have bicolored plantar surfaces and striped thighs; neither has supernumerary metacarpal tubercles normally; both have the tibia bars broadly interrupted; both have continuous mid-dorsal skin folds that end behind the eyes; neither has an outer metatarsal tubercle; etc. However, minor but consistent differences do separate the two. *Rana subpunctata* has slightly more extensive webbing than the most fully webbed *mascareniensis* (i.e., those from the Upemba). The difference is more readily seen and more easily described on the hands than on the feet. The hand of *subpunctata* (Fig. 27) has a distinct rudiment of web between the first and

second fingers and a distinct though narrow fringe along the median edges of the second and third fingers, giving these fingers a somewhat flattened appearance. A few *mascareniensis* have a rudiment of web between the first two fingers but none of the many examined had a fringe on the sides of the second and third fingers (Fig. 28). The ventral spotting, confined to the throat in *mascareniensis*, usually occupies the chest and often the abdomen of *subpunctata*.

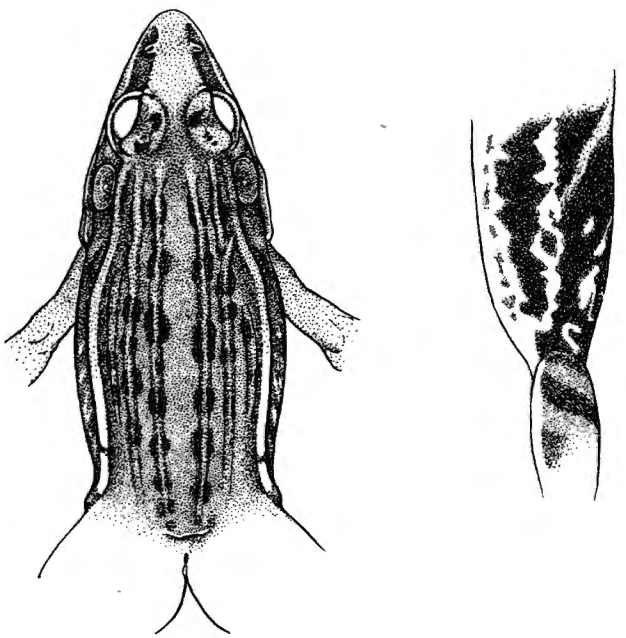

FIG. 46. — *Rana subpunctata* from Parc National de l'Upemba (×1).
Left, dorsal view. Right, posterior face of thigh.

Males of the two species are readily differentiated. In *mascareniensis* the openings of the gular pouches are parallel to the lower lip and end at the upper border of the insertion of the arm; in *subpunctata* the opening makes a distinct angle with the lower lip and ends more ventrally. The males of *subpunctata* lack the light spinules that in *mascareniensis* cover the plantar surfaces, sides, and often the throat.

Diagnosis. — Body and limbs moderately stocky; head obtusely pointed; snout projecting; nostril nearer to tip of snout than to eye; vomerine teeth in transverse series, in contact with anterior borders of choanae;

tympanum distinct, three-fourths to four-fifths diameter of eye, slightly shorter than eye-nostril distance; back (Fig. 46) with 8 continuous skin folds, the mid-dorsal pair beginning behind eyes; fingers and toes bluntly rounded; first finger slightly shorter than second which is slightly shorter than fourth; a rudiment of web between first and second fingers; second and third fingers with a narrow fringe of skin along median edges; no supernumerary metacarpal tubercles; toes almost completely webbed; fourth toe with two phalanges free of web on lateral border; fifth toe webbed to tip or with one-half phalanx free; no external metatarsal tubercle; no row of small tubercles on fourth metatarsal.

Back with alternating rows of squarish black spots; half of specimens with a light vertebral line or band; dorsal surface of tibia usually with a light, longitudinal line; thigh with light line dorsally in half of individuals; posterior face of thigh (Fig. 46) dark brown with two light longitudinal stripes; 4 to 6 broadly interrupted dark crossbars on tibia; usually 2 dark tarsal bars; underside of foot bicolored, the toes dark and the web mostly cream-colored; lower jaw with a black network.

Secondary sex characters. — Only two fully mature males are included in this sample. The nuptial pads are cream-colored and cover the entire dorsal and median surfaces of the first finger from its base to the beginning of the terminal phalanx, the dorsal surface of the second finger from its base to the base of the terminal phalanx, and a dorso-median area of the third finger from its base to a point mid-way between the two subarticular tubercles. Light spinules are not present on any part of the body.

The opening of the gular pouch runs from below the center of the eye to a point near the ventral border of the insertion of the arm. The opening is 0.16 of the snout-vent length in both males. The wrinkled skin of the pouch is black.

These males measure 50.8-54.6 mm and the two females with ripe ova 64.1-67.6 mm.

Ecological notes. — All recorded localities of *subpunctata* and its synonyms are in the open country south of the rain forest belt. All Upemba specimens were collected at 585 m.

Range. — Known only from northern Angola (Bocage, 1866), south-eastern Belgian Congo, and Bechuanaland (FitzSimons, 1932).

Upemba locality and specimens :

Mabwe (14).

22. — **Rana superciliaris** GÜNTHER.

Rana superciliaris GÜNTHER, 1848, Cat. Batr. Brit. Mus., pp. 17 and 132, pl. 1, fig. B — Sierra Leone.

Rana (Ptychadena) superciliaris GUIBÉ and LAMOTTE, 1955, Bull. Mus. Nat. Hist. Nat., (2), **27**, p. 363.

Rana mascareniensis (part), BOULENGER, 1882, Cat. Batr. Brit. Mus., p. 52.

Rana oxyrhynchus oxyrhynchus (non SMITH) LOVERIDGE, 1936, Bull. Mus. Comp. Zool., **79**, p. 415.

Taxonomic notes. — Until the recent publication of GUIBÉ and LAMOTTE (1955 A), the status of *superciliaris* has been obscure. GÜNTHER himself (1858, p. 132) contributed to the difficulty by stating that it was probably a synonym of *bibroni* HALLOWELL. The name was subsequently buried in the catch-all synonymy of *mascareniensis* by BOULENGER (1882). More recently the species has been misidentified by LOVERIDGE as *oxyrhynchus* (see p. 91). But GUIBÉ and LAMOTTE have firmly and clearly reestablished *superciliaris* as a distinct species.

Without knowing that GUIBÉ and LAMOTTE had been working on this problem, we examined the type of *superciliaris*, thanks to the courtesy of Miss GRANDISON of the British Museum, and arrived at precisely the same conclusions. As noted by GUIBÉ and LAMOTTE, *superciliaris* has much more extensive webbing than *bibroni* and differs from *mascareniensis* in the position of the opening of the gular pouch. The striped rear face of the thigh, the absence of an outer metatarsal tubercle, the interruption of the mid-dorsal skin folds, the transverse arrangement of the vomerine teeth, and the fully webbed fifth toe, taken in combination, distinguish *superciliaris* from all members of the subgenus *Ptychadena.*

Liberian specimens (CNHM 57940-63) agree with the type of *superciliaris* remarkably well and leave no doubt as to their identity. About one-half of this series has a broad vertebral stripe. As in the type, the web of the Liberian frogs reaches the tip of the fifth toe but leaves two phalanges of the fourth, one and one-third phalanges of the third, and one phalanx on each of the second and first toes free (on lateral borders of first to fourth toes).

East African specimens apparently lack any light vertebral marking; we have examined 9 from Tanganyika, 3 from Kenya, 2 from Ethiopia, and 13 from French Somaliland, as well as 72 from the Upemba. The eastern populations also differ in having slightly more extensive webbing. The fourth toe has 1 ½ to 2 phalanges free and the third, second, and first toes are either webbed to the tips or have one phalanx free. Considering only males with the secondary sex characters fully developed (see Secondary sex characters below), the openings of the gular pouches are relatively longer in the West African population. In five males from Liberia and

Sierra Leone (the type), these slits are 0.17 to 0.19 of the snout-vent length (mean=0.180±0.004), whereas in 11 from East Africa the corresponding figures are 0.14-0.17 (mean=0.150±0.003). This small difference is statistically significant. Otherwise the eastern frogs are like the type and Liberian specimens; the two groups are certainly conspecific.

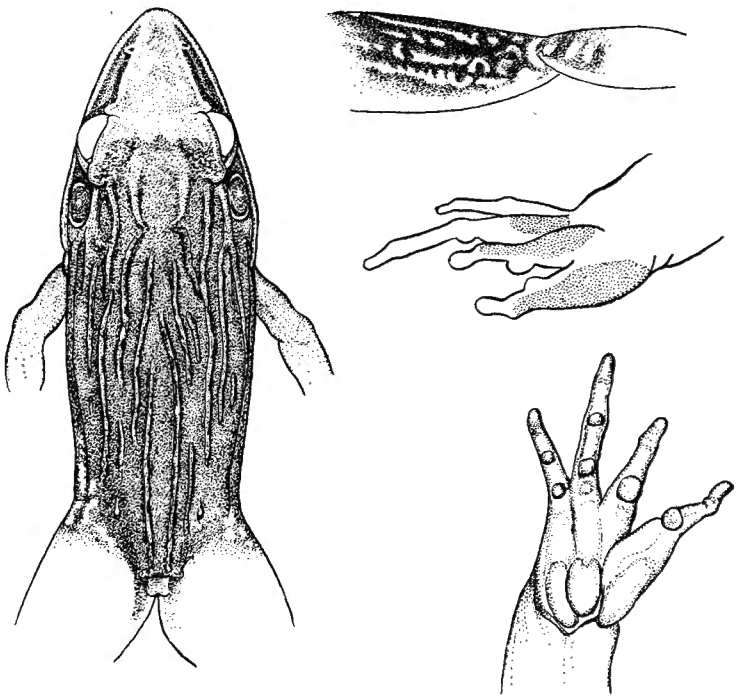

FIG. 47. — *Rana superciliaris* from Parc National de l'Upemba. Left, dorsal view (×2). Right upper, posterior face of thigh (×2). Right center, nuptial pads of male (×4). Right lower, ventral surface of hand (×4).

Diagnosis. — Body raniform; limbs moderately long; head obtusely pointed; snout projecting slightly; nostril nearer to tip of snout than to eye; vomerine teeth in transverse series, in contact with anterio-median borders of choanae; tympanum distinct, about ⅘ diameter of eye, slightly less than eye-nostril distance; back (Fig. 47) with 6 or 8 longitudinal folds, folds ending behind orbits, mid-dorsal pair interrupted or present only in posterior half of body; tips of fingers and toes bluntly rounded; first finger equal to or shorter than second; usually no supernumerary metacarpal tubercles; toes almost completely webbed; fourth toe with one and one-half

to two phalanges free of web on lateral border; fifth toe usually webbed to tip; no external metatarsal tubercle; no row of small tubercles under fourth metatarsal.

Back with alternating rows of oblong black spots equal to tympanum diameter (West African frogs) or smaller than tympanum (East African individuals), or with spots absent (East African frogs); mid-dorsal band common in West African population only; no light line on thigh or tibia; posterior surface of thigh (Fig. 47) dark brown or black with yellowish or whitish, irregular stripes or with light spots arranged in longitudinal series; 3 to 6 usually interrupted black bars on tibia; 2 or 3 tarsal bars; underside of foot dark brown, small light areas at base of web; lower jaw barred with black.

Secondary sex characters. — At maximum development the nuptial pad of *superciliaris* is cream-colored and covers the dorsal and median surfaces of the first finger from its base to the end of the proximal phalanx, the dorsal surface of the second finger from its base to the end of the proximal phalanx, and an oval area on the dorsal surface of the third finger not extending beyond the level of the basal subarticular tubercle (Fig. 47). The smallest male with fully developed pads measures 33.6 mm snout to vent.

The slit-like openings of the gular pouches begin below the posterior half of the eye and end near the ventral border of the insertion of the arm. In six adult males from the Upemba collection these slits are 0.14 to 0.17 of the snout-vent length. The range for 16 males from scattered localities (see Taxonomic notes above) is 0.14-0.19. The skin of the gular pouches varies from black to black and white. Ventral asperities were not seen in any male.

The sequence of development of the male secondary sex characters is as in other species of this group. The gular pouches develop before the nuptial pads. Six males (35.1-39.3 mm) from the Upemba have fully developed gular pouches and vocal sacs but not a trace of nuptial pads. On the other hand, no male lacking the gular pouches has nuptial pads.

Males are distinctly smaller than females. Six Upemba males with nuptial pads measure 33.6-37.8 mm snout to vent (mean=35.13±0.61); 13 additional mature males from other localities extend the range to 31.4-42.8 mm (mean=36.70 mm). Only one Upemba female contains ripe ova, and it measures 49.0 mm; 9 other Upemba females vary from 40.2 to 48.4 mm. Two Liberian females with pigmented ova measure 51.9 and 52.5 mm.

Ecological notes. — Published habitat information associate *superciliaris* with streams and their immediate vicinity (LOVERIDGE, 1936, 1942, 1953 as *o. oxyrhyncha*).

In the Upemba 13 *superciliaris* were obtained at altitudes between 680 and 750 m and 60 at altitudes between 800 and 860 m.

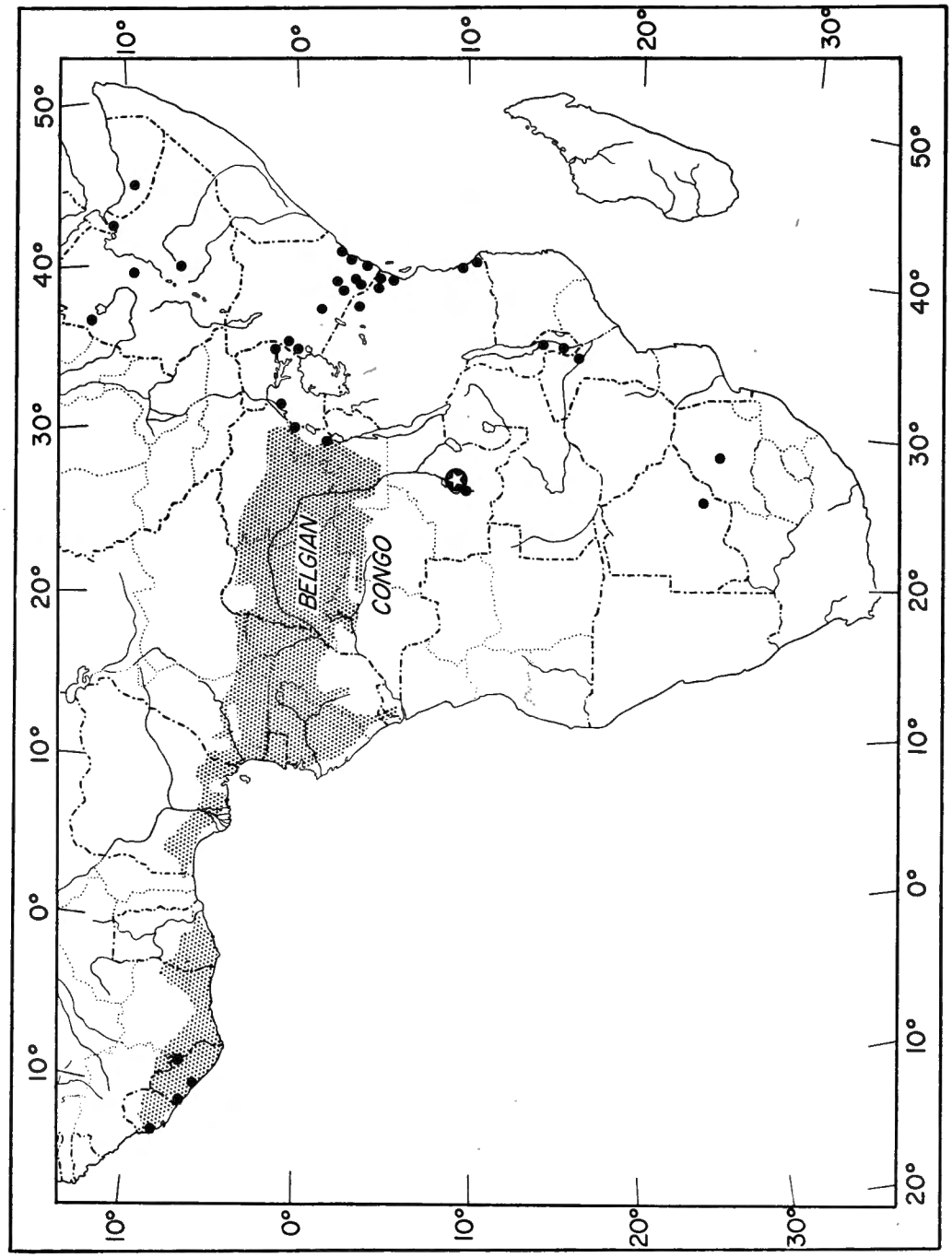

Fig. 48. — Known distribution of *Rana superciliaris*, based on collections of Chicago Natural History Museum and papers of Loveridge (as *R. o. oxyrhynchus*).

Too few specimens were available to determine the breeding period adequately, but the data fit the cycle worked out for other species of the genus (e.g., *oxyrhyncha*, *porosissima*). Nuptial pads, which are indicators of sexual activity, are absent in all 13 adult males of June and all 7 of July, but are present in 1 of 4 adult August males, in all 4 September males, and in the single October male. The only female with ripe ova was collected in September; the collection includes only 10 females.

Range. — In the west *Rana superciliaris* is known with certainty only from Sierra Leone and Liberia. In East Africa it occurs from Bechuanaland (CNHM 18026) in the south to Ethiopia in the north (Fig. 48).

Upemba localities and specimens :

Ganza (47); Kande (1); Kaswabilenga (1); Kilwezi (3); Kipondo (4); Loie (2); Lufira (2); Lukoka (3); Mware (8); Senze (2).

23. — **Rana taenioscelis** LAURENT.

Ptychadena taenioscelis LAURENT, 1954, Ann. Mus. Roy. Congo Belge, **34**, p. 25, pl. 4, fig. 6, pl. 5, fig. 1 — Lukula, Tanganika, Belgian Congo.

Taxonomic notes. — The specimens at hand agree remarkably well with the type series, which we have examined. Though resembling the sympatric *uzungwensis*, as LAURENT points out, the two species differ in coloration of the feet and thighs, in the position of the openings for the gular pouches, and in the supernumerary metacarpal tubercles (present only in *uzungwensis*). In those characters, *taenioscelis* recalls *m. mascareniensis*. However, *taenioscelis* is readily distinguished by its smaller size (maximum of males near 35 mm, of females 40 mm), the extension of the mid-dorsal skin folds on to the snout (Fig. 49), the presence of prefrontal spots, and the restriction of the nuptial pad of the third finger to the metacarpus (Fig. 49). In fact, the forward extension of the skin folds in combination with the light longitudinal stripes behind the thighs distinguishes *taenioscelis* from all other forms of *Rana* (*Ptychadena*).

Diagnosis. — Body and limbs moderately slender; head pointed; snout projecting; nostril equidistant between eye and tip of snout or closer to latter; vomerine tooth groups transverse or slightly oblique, in contact with antero-median corners of choanae; tympanum distinct, three-fourths to four-fifths diameter or eye, equal to or shorter than eye-nostril distance; back (Fig. 49) with 8 continuous skin folds, the mid-dorsal pair beginning on snout and ending in anal region; tips of fingers and toes bluntly rounded; first finger shorter than second, second shorter than fourth; no supernumerary metacarpal tubercles; toes about two-thirds webbed; fourth toe with 3 phalanges free of web on lateral border; fifth toe with one to

1 ⅓ phalanges free; no external metatarsal tubercle present; no row of small tubercles on fourth metatarsal.

Back with alternating rows of obscure, squarish or oblong, black spots whose longest axes are subequal to tympanum; a vertebral light line or band usually present, never with both band and line; a pair of dark, prefrontal spots usually present; dorsal surface of tibia with obscure, light,

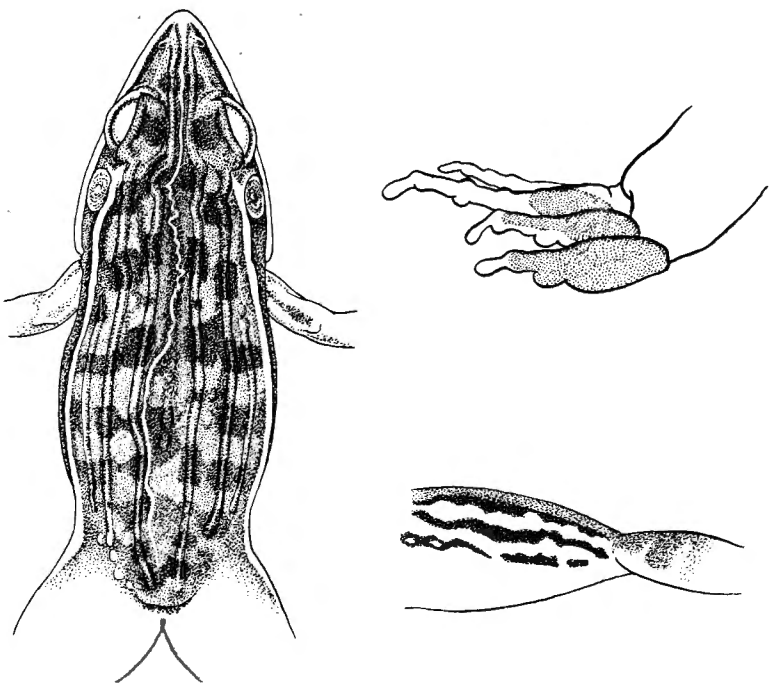

FIG. 49. — *Rana taenioscelis* from Parc National de l'Upemba. Left, dorsal view (×2½). Right upper, hand of male showing nuptial pad (×6). Right lower, posterior face of thigh (×2½).

longitudinal line; dorsal surface of thigh occasionally with light line in distal half; posterior face of thigh (Fig. 49) dark brown with two longitudinal light stripes; 4 to 7 usually uninterrupted black bars on dorsal surface of tibia; 3 or, less often, 2 black tarsal bars; underside of foot distinctly bicolored, the toes dark brown or black, the web cream-colored except distally between the outer toes; lower jaw barred with back; throat sometimes with small dark spots; chest and abdomen immaculate cream-colored.

Secondary sex characters. — Males have cream-colored or dusky nuptial pads. At the peak of their development, the pads (Fig. 49) cover the entire dorsal and median surfaces of the first finger from its base to the beginning of the terminal phalanx, the dorsal surface of the second finger from its base to the beginning of the terminal phalanx, and an oval, dorso-median area on the third metacarpal but not extending beyond the level of the basal subarticular tubercle. Males at this stage usually have feeble, translucent spinules scattered over the throat. They never develop such spinules on the back, sides, or on the feet (see *mascareniensis*, p. 81).

The vocal sac apparatus consist of paired vocal sacs and gular pouches. The openings of the latter are parallel to the lower lip and run from below the center or posterior half of the eye to the upper border of the insertion of the arm. The skin of the gular pouches is black or black and gray. In 5 males with mature nuptial pads, the openings of the pouches vary from 0.13 to 0.18 of the snout-vent length (mean=0.155).

The females are slightly but consistently larger than the males, as suggested by LAURENT (1954), who cites 40 mm as the maximum snout-vent length of females and 35 mm as the maximum for males. Nine females at hand have a range of 30.7-36.7 mm (mean=34.71±0.75 mm), the smallest with pigmented ova measuring 31.1 mm. The seven males at hand have a range of 30.2-32.6 mm (mean=31.49±0.30 mm) and even the smallest has fully developed gular pouches but no nuptial pads. The difference between the two means is statistically significant ($t=3.594$, $n=14$, $P<.01$).

Ecological notes. — The 22 frogs available were collected between 1,700 and 1,810 m above sea level. The localities LAURENT cites are in moderately high country south of the rain forest province.

Range. — Known only from southern and eastern Belgian Congo (LAURENT, 1954).

Upemba localities and specimens :

Kafwe (1); Kalumengongo (1); Kampadika (1); Lufwa (11); Lusinga (7); Mubale (1).

24. — **Rana upembae** n. sp.

Holotype. — Institut des Parcs Nationaux du Congo Belge number 1304. An adult male collected at Kaswabilenga, Parc National de l'Upemba, Province Katanga, Belgian Congo on January 5-9, 1949, by the Mission G. F. DE WITTE.

Diagnosis. — A *Rana* (*Ptychadena*) (Fig. 50) with one to two phalanges of fifth toe free of web, mid-dorsal pair of skin folds continuous from occiput to the anal region, strongly projecting snout, uniformly dark lower lip, posterior face of thigh striped, and no longitudinal light line on dorsal face of tibia.

FIG. 50. — *Rana upembae* new species.
Left, dorsal view (×2). Right upper, ventral surface of hand (×5). Right center, hand of male showing nuptial pad (×6). Right lower, ventral surface of foot (×3).

Description of holotype. — Body and limbs slender; head long and narrow, roundly pointed in profile; snout long, projecting beyond tip of mandible more than diameter of tympanum; nostril slightly closer to eye than to tip of snout; internarial distance subequal to eye-nostril distance but much greater than interorbital; width of upper eyelid equal to interorbital; canthus rostralis rounded; lores oblique, distinctly concave; long diameter of eye equal to eye-nostril distance; tympanum distinct, equal to 4/5 eye diameter, separated from orbit by half its diameter; vomerine teeth in transverse groups, in contact with antero-median borders of choanae.

Fingers and toes bluntly rounded; first and second fingers equal, fourth slightly shorter than second, third much longer than fourth; subarticular tubercles distinct; metacarpals with supernumerary tubercles. Toes about two-thirds webbed; first toe with 2, second with 1 ½, third with 1 ⅔, and fourth with 3 phalanges free of web on lateral borders; fifth toe with 1 ½ phalanges free; subarticular tubercles distinct; innelr metatarsal tubercle oval, less than half the length of first toe; a small but distinct, round external metatarsal tubercle; fourth metatarsal with a row of small tubercles, third with a shorter row of feebler ones.

Back with prominent folds; median pair beginning at postero-lateral corner of interorbital and continuing without interruption to anal region; a second fold beginning at posterior edge of upper eyelid and running without break almost to inguinal region; a somewhat heavier dorso-lateral fold beginning in a glandular swelling above tympanum and running to inguinal region with several interruptions; a short fold between dorso-lateral fold and next long fold above; round and oval swellings between all folds; sides coarsely granular with relatively large round warts anteriorly; a thick glandular swelling from beneath tympanum to upper border of axilla; skin below smooth except for secondary sexual spinules (see below); postero-ventral surface of thigh coarsely granular.

Color (in alcohol) of dorsal surfaces of head, body, and limbs light brown; a broad, light mid-dorsal band from tip of snout to vent; a thin lighter vertebral line from internasal to vent; back with two staggered rows of dark oblong spots; dorso-lateral fold becoming whitish posteriorly; sides of body dark brown anteriorly, becoming pale brownish posteriorly; a narrow dark brown streak from tip of snout, through upper half of lores, covering entire temporal region except for slightly lighter tympanum; upper lip grayish brown; lower jaw black almost from symphysis to insertion of arm, the black streak gradually widening posteriorly; all other ventral surfaces immaculately cream-colored; dorsal surfaces of lower arm and outer fingers barred with dark brown; no light longitudinal line on dorsal surfaces of hind limbs; dorsal surface of thigh with narrow dark crossbars; posterior face of thigh (Fig. 50) dark brown with two irregular, light, longitudinal stripes; dorsal surface of tibia with 4 uninterrupted dark bars; two dark tarsal bars; underside of foot dark brown except for lighter subarticular and metatarsal tubercles.

Dimensions (mm) of holotype : snout-vent 40.8; head length (to angle of jaw) 16.8; head width (at center of tympanum) 12.0; length of gular pouch opening 7.6; tibia 25.2; foot (less tarsus) 22.0.

Secondary sex characters of holotype. — The nuptial pads (Fig. 50) are cream-colored, velvety clusters of spinules occupying the entire dorsal and median surfaces of the first finger from its base to the end of the penultimate phalanx, the dorsal surface of the second finger from its base to the end of the penultimate phalanx, and an oval area on the medio-dorsal surface of the third finger from its base to a point just beyond the level of the basal subarticular tubercle. Very feeble, colorless, translucent spinules are scattered over the gular and pectoral regions and on the plantar surface of the foot. Dorsal or lateral nuptial spinules are absent.

The gular pouch openings begin below the posterior third of the eye and run somewhat oblique to the lower jaw ending near the ventral border of the axilla. The wrinkled skin within the gular pouch is black. Oval vocal sac openings are situated in the floor of the mouth near the corners.

Paratypes. — All of the following specimens are from the Parc National de l'Upemba or immediately adjacent localities. IPN 1244 B (3), 1273 (6), 1296, 1297 (2), 1299 (4), 1302, 1304 (3), 1313 (11), 1315, 1320-21 (3), 1322 A, 1323-30 (17), 1334 (2), 1385, 1391, 1398, 1402-03 (3), 1419-23 (8), 1424 A, 1425 A, 1428 (11), 1430-35 (22), 1437, 1557 A.

This series is remarkly uniform despite the fact that two-thirds are juveniles. The vomerine teeth may be in transverse or slightly oblique groups. The dorso-lateral fold is usually interrupted, but the positions of the breaks vary from the anterior third of the fold to its posterior third. Approximately one-sixth of the sample lacks the external metatarsal tubercle and the row of smaller tubercles on the fourth metatarsal.

The outer edge of the thigh usually has a dark streak connecting the ends of the dark dorsal crossbars. The whitish stripes on the rear of the thigh are sometimes broken up. A few specimens have a pair of dark prefrontal spots. Nevertheless, the basic pattern varies but little. Characteristically, these frogs have a light mid-dorsal band and line, a dark loreal stripe, a dark lower jaw, uninterrupted bars on the tibia, light stripes behind the thigh, but no light line on the dorsal surface of the leg.

Adult males with fully developed nuptial pads are 38.0-43.9 mm long (mean of $10=40.58\pm0.61$ mm). Another male with pads incompletely developed measures 36.3 mm. Two females containing pigmented ova are 42.8 and 45.9 mm. Four additional females without ripe ova have snout-vent lengths of 46.0-50.8. Body proportions (given as decimals of snout-vent) vary as shown in Table 21.

TABLE 21. — **Variation in body proportions (as decimals of snout-vent) among paratypes of** *Rana* (*Ptychadena*) *upembae*.

	No	Range	Mean ± SE
Tibia	9	0.58–0.63	0.608 ± 0.006
Foot	9	0.52–0.58	0 549 ± 0.006
Head width	10	0.30–0.35	0.315 ± 0.005
Snout	10	0.19–0.21	0.202 ± 0.002
Gular pouch opening	10	0.15–0.20	0.178 ± 0.006

For the above calculations the foot was measured from the proximal edge of the inner metatarsal tubercle to the tip of the fourth toe, the head width taken at the center of the tympanum, and the snout measured from the eye forwards.

Comparisons. — This discussion is limited to those forms of the subgenus *Ptychadena* having between 1 and 2 phalanges of the fifth toe free of web and the median pair of skin folds continuous from occiput to anal region. The species thus eliminated from consideration (e.g., *oxyrhyncha*, *superciliaris*, *bibroni*, *chrysogaster*, *mossambica*, etc.) differ in one or more additional characters from *upembae*. There still remain 8 species to be disposed of. Two, *mascareniensis* and *taenioscelis*, differ from *upembae* in the position of the gular pouch openings and in the coloration of the lower jaw (barred in the first two) and plantar surface of the foot (bicolored in the first two). *Rana grandisonae*, *venusta*, and *vernayi* differ from *upembae* in coloration of the lower jaw (barred in the first three) and tibia (crossbars interrupted in the first three) and in the shape of the snout. *Rana uzungwensis* is distinguished from *upembae* by the extension of the median skin folds on to the snout, by the presence of prefrontal spots, and by the barred lower jaw. *Rana submascareniensis* is a much smaller frog, with adult males averaging 26.4 mm, according to GUIBÉ and LAMOTTE (1953), as compared to a range of 36-43 mm in *upembae*, and lacks vomerine teeth. A shorter snout, smaller dorsal spots, and the dorsal spinules of sexually competent males separate *obscura* from *upembae*.

Probably *upembae* is more likely to be confused with *porosissima* than with any other species. They are approximately the same size and similar in coloration, especially in such details as the dark brown or black lower jaw, the conspicuous dark loreal stripe, and the uninterrupted crossbars

on the tibia. But *upembae* lacks the light longitudinal streak so characteristic of the dorsal surface of the tibia in *porosissima*; the light markings on the posterior face of the thigh are usually in the form of isolated round spots in *porosissima* (Fig. 45) and in the shape of irregular longitudinal stripes in *upembae* (Fig. 50). The tibia and snout are relatively longer in *upembae* as shown in Table 22; though not large, the differences are statistically significant at the one percent level. The two species also differ in the male secondary sex characters. The ventral spinules in sexually active *upembae* are much weaker and are not black as in male *porosissima*. The nuptial pad on the third finger covers one more phalanx in *porosissima*, reaching the terminal phalanx, whereas in *upembae* it ends at the base of the penultimate one.

TABLE 22. — **Body proportion differences between** *Rana porosissima* STEINDACHNER **and** *R. upembae* n. sp. **All specimens from Parc National de l'Upemba.**

	Tibia/snout-vent			Snout/snout-vent		
	No.	Range	Mean	No.	Range	Mean
upembae	9	0.58–0.63	0.608±0.006	10	0.19–0.21	0.202±0.002
porosissima	20	0.52–0.63	0.581±0.005	9	0.15–0.20	0.172±0.005

A comparison with *bibroni*, fortunately facilitated by the recent redescription by GUIBÉ and LAMOTTE (1955), is necessary in view of the confusion centering around that species. The fifth toe of *bibroni* has 2 phalanges free of web whereas only 1 to 1 ¾ are free in *upembae*. According to GUIBÉ and LAMOTTE *bibroni* has a short mid-dorsal pair of skin folds that do not extend anterior to the sacral region. The mid-dorsal folds of *upembae* are continuous from the occiput to the anal region. The dorsum of *upembae* bears alternating rows of distinctly quadrangular dark spots while the back of *bibroni* has a distinctly striped appearance given it by small elongated dark streaks.

Secondary sex characters. — The holotype represents the most advanced condition of these characters. Counting the holotype, only ten males (38.0-43.9 mm) have fully developed nuptial pads and all were collected during the months January-March. All but three of these have gular and plantar spinules. Another male (39.4 mm) collected in February has a nuptial pad on the first finger only and has no sign of gular or plantar spinules. Five presumably adult males (38.2-40.8 mm), collected

in August and September, have fully developed vocal sac apparatus but no other secondary sex characters. A slightly smaller male (36.3 mm) caught in April has nuptial pads on the first two fingers, but no gular spinules. Males without nuptial pads and in the size range 35-37 mm were taken in April, September, and October.

Ecological notes. — Though the small sample size limits confidence in the speculation, the seasonal distribution of males with well developed secondary sex characters suggests that breeding in the Upermba starts after October and continues through March. The sole female with a full complement of ripe ova was collected in January. Another female, apparently caught very shortly after oviposition, has a few ovulated ova; this frog was collected on April 7.

Rana upembae is most abundant at middle and low elevations as the following tabulation shows.

Meters.	Individuals.
500- 750	30
751-1,000	56
1,001-1,250	12
1,251-1,500	0
1,501-1,750	11

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

Upemba localities and specimens :

Ganza (9); Kabenga (7); Kalungwe (2); Kambi (11); Kande (17); Kanonga (5); Kaswabilenga (6); Kaziba (4); Kilwezi (19); Lupiala (2); Munoi (26); Tumbwe (1).

25. — **Rana uzungwensis** LOVERIDGE.

Rana mascareniensis uzungwensis LOVERIDGE, 1932, Bull. Mus. Comp. Zool., **72**, p. 384 — Dabaga, Uzungwe Mountains, Tanganyika; 1933, idem, **74**, p. 370; 1936, idem, **79**, p. 418; 1953, idem, **110**, p. 372.

Ptychadena uzungwensis LAURENT, 1954, Ann. Mus. Roy. Congo Belge, **34**, p. 9, pl. 1, fig. 1, pl. 4, fig. 4.

Rana mascareniensis subpunctata (non BOCAGE) SCHMIDT, 1936, Ann. Carnegie Mus., **25**, p. 129.

Taxonomic notes. — The availability of a large series convinces us that LOVERIDGE (1936) is right in disagreeing with the senior author's placing of *uzungwensis* in the synonymy of *subpunctata* BOCAGE. The latter differs from *uzungwensis* not only in the extent of webbing (LOVERIDGE, 1953), but also in size, coloration, and relative length of dorsal skin folds (c.f., Figs. 29 and 46).

However, we also agree with LAURENT (1954) that *uzungwensis* is a distinct species and not, as LOVERIDGE has it, a form of *mascareniensis*. LAURENT correctly points out that *mascareniensis* and *uzungwensis* differ sharply in the position of the opening of the gular pouch. Furthermore they differ in coloration, the anterior extent of the mid-dorsal folds, the development of supernumerary metacarpal tubercles (usually absent in *mascareniensis*), and the extent of webbing. On the basis of morphology alone, *uzungwensis* is no more closely related to *mascareniensis* than many others of their congeners and less so than some.

Although LAURENT (1954) states that *uzungwensis* and *mascareniensis* are sympatric, we are able to glean only one instance of their occurring together from the literature. SCHMIDT (1936, p. 129) reported a *mascareniensis* (CNHM 21163; reëxamined by us) and LAURENT (1954, p. 9) an *uzungwensis* from Chitau, Angola. The large series NOBLE (1924, p. 221) lists under *mascareniensis* actually includes *uzungwensis* (AMNH 11213, 11217-18) and *mascareniensis* from Faradje, Belgian Congo. Despite the fact that both species occur in the Upemba, we do not have both from a single locality. At least in the Upemba differences in altitudinal distributions isolate the two frogs (see pp. 83 and 121).

The extension of the mid-dorsal folds onto the snout distinguishes *uzungwensis* (Fig. 29) from all forms of *Rana* (*Ptychadena*) except *taenioscelis* (Fig. 49) and *ansorgei* (Fig. 32). The last differs from *uzungwensis* in having less extensive webbing and the black pigment of the lower jaw continuous. *Rana taenioscelis* differs in the position of the gular pouch opening, in coloration, and in the absence of supernumerary metacarpal tubercles.

Contrary to LAURENT's statement (1954, p. 31) that *uzungwensis* has neither an external metatarsal tubercle nor a row of small tubercles under the fourth metatarsus, about half of the specimens at hand have both structures, though not as well developed as in *grandisonae*.

Our material agress well with a male paratype (CNHM 18345) from the type locality. The specimen (CNHM 12515) from Kitete, Tanganyika listed by LOVERIDGE (1936 A) is a *Rana porosissima*.

Diagnosis. — Body and limbs moderately slender; head pointed; snout rather strongly projecting; nostril usually mid-way between eye and tip of snout; vomerine teeth slightly oblique, in contact with anteromedian corners of choanae; tympanum distinct, one-half to two-thirds eye diameter, much shorter than distance between eye and nostril; back (Fig. 29) with 8 folds, the mid-dorsal pair beginning between nostrils and continuous to anal region; tips of fingers and toes bluntly rounded; first, second, and fourth fingers subequal; supernumerary metacarpal tubercles present, distinct; toes about two-thirds webbed; fourth toe with 3 phalanges free of web on lateral border; fifth toe with 1 to 1 ½ phalanges free; about half

of the individuals with a small, round, external metatarsal tubercle; a row of feebly distinct, small, light-colored tubercles on the fourth metatarsus.

Back with alternating rows of squarish black spots, each of which having the transverse axis subequal to tympanum; occasionally spots of adjacent rows fuse forming irregular transverse bands; a narrow, vertebral line in almost all individuals; thigh and tibia without light lines on dorsal surfaces; posterior face of thigh (Fig. 51) dark brown with round light spots that occasionally coalesce into a network; 4 to 6 uninterrupted black bars on dorsal surface of tibia; 2 or 3 black tarsal bars; underside of foot uniformly brownish except for lighter tubercles; lower jaw barred with black; a pair of black prefrontal spots usually present.

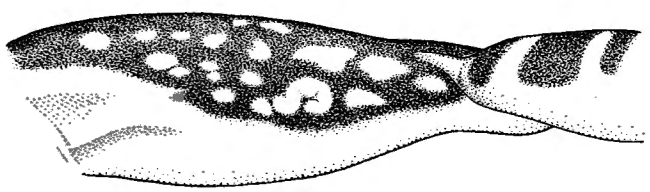

FIG. 51. — *Rana uzungwensis* from Parc National de l'Upemba. Posterior face of thigh (×4).

Secondary sex characters. — The vocal sacs of *uzungwensis* are paired as in other *Rana* (*Ptychadena*). The wrinkled skin of the gular pouches is customarily uniformly black, although in some males the posterior half of the pouch may be distinctly lighter than the anterior. The openings of the gular pouches begin below the posterior half of the eye and end near the antero-ventral border of the insertion of the arm. In 15 males with fully developed nuptial pads, the slits of the gular pouches vary from 0.15 to 0.19 of the snout-vent length (mean=0.165±0.003).

The nuptial pads (Fig. 52) consist of cream-colored or dusky velvety clusters of spinules. The pads at the peak of development cover the dorsal and median surfaces of the first finger from its base to the end of the first phalanx, the dorsal surface of the second finger from its base to the end of the first phalanx, and an oval area on the dorso-median edge of the distal half of the third metacarpus. Males with pads in this condition usually have translucent, colorless, widely spaced spinules under the head and body and small, whitish spinules uniformly distributed over the dorsal surfaces of the head, trunk, and hind legs.

These secondary sex characters have the usual sequence of development. Only after the gular pouches and vocal sacs develop do the nuptial pads and the dorsal and ventral spinules appear. Eighteen males have com-

TABLE 23. — **Correlation of the development of two secondary sex characters of male** *Rana uzungwensis* (*).

	Nuptial pad			
	Absent	On first finger only	On first two fingers	On three fingers
Dorsal and ventral spinules :	Number of individuals			
Absent	18	2	0	2
Present	0	0	2	24

(*) All males with mature gular pouches and vocal sacs.

pletely formed gular pouches but have no trace of nuptial pads or spinules. On the other hand, all males having pads or spinules in any stage of development have mature gular pouches. The ventral and dorsal spinules develop simultaneously. The correlation between their development and the nuptial pad is shown in Table 23. Apparently the spinules and the nuptial pads begin development at approximately the same level of hormone production.

The females are distinctly larger than the males. Only 4 females with pigmented ova were available and these range in size from 41.9 to 45.7 mm. Nineteen additional females had snout-vent lengths in excess of 40 mm,

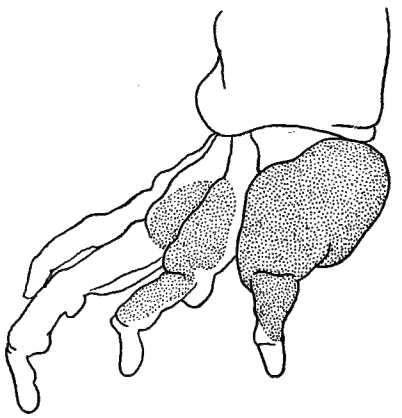

FIG. 52. — Hand of male *Rana uzungwensis* showing nuptial pad (×8).

the largest measuring 47.6 mm. By contrast, 26 males with fully developed secondary sex characters have a snout-vent range of 31.6 to 35.7 mm (mean=33.54±0.22 mm). LAURENT (1954) gives similar size ranges : 39-49 mm for females, and 31.5-36.5 mm for males.

Ecological notes. — *Rana uzungwensis* is apparently most abundant at elevations between 1,000 and 2,000 m. Records from the literature place the lowest known elevation at 1,600 m and the highest at 2,000 m (both from LAURENT, 1954). The Upemba series shows the following distribution :

Meters.	Individuals.
890-1,000	6
1,001-1,250	22
1,251-1,500	75
1,501-1,750	13
1,751-1,815	31

All known localities lie outside the rain forest province.

Too few specimens are available for working out the reproductive cycle in the Upemba but the indications are that, like other species of *Rana*, the breeding season ends in March or April. As shown by Table 24, the proportion of adult males with nuptial pads drops sharply after March, suggesting a decrease in sexual activity.

Range. — This species is known with certainty from central Angola (SCHMIDT, 1936) to Tanganyika (LOVERIDGE, 1932) and from Southern Rhodesia to Ruanda (LAURENT, 1954) (Fig. 53).

TABLE 24. — **Monthly frequency of adult male** *Rana uzungwensis* **with respect to nuptial pad development.**

	Nuptial pads		
	complete	incomplete	absent
January	12	1	0
March	7	1	0
April	4	2	4
May	2	0	13
June	0	0	1

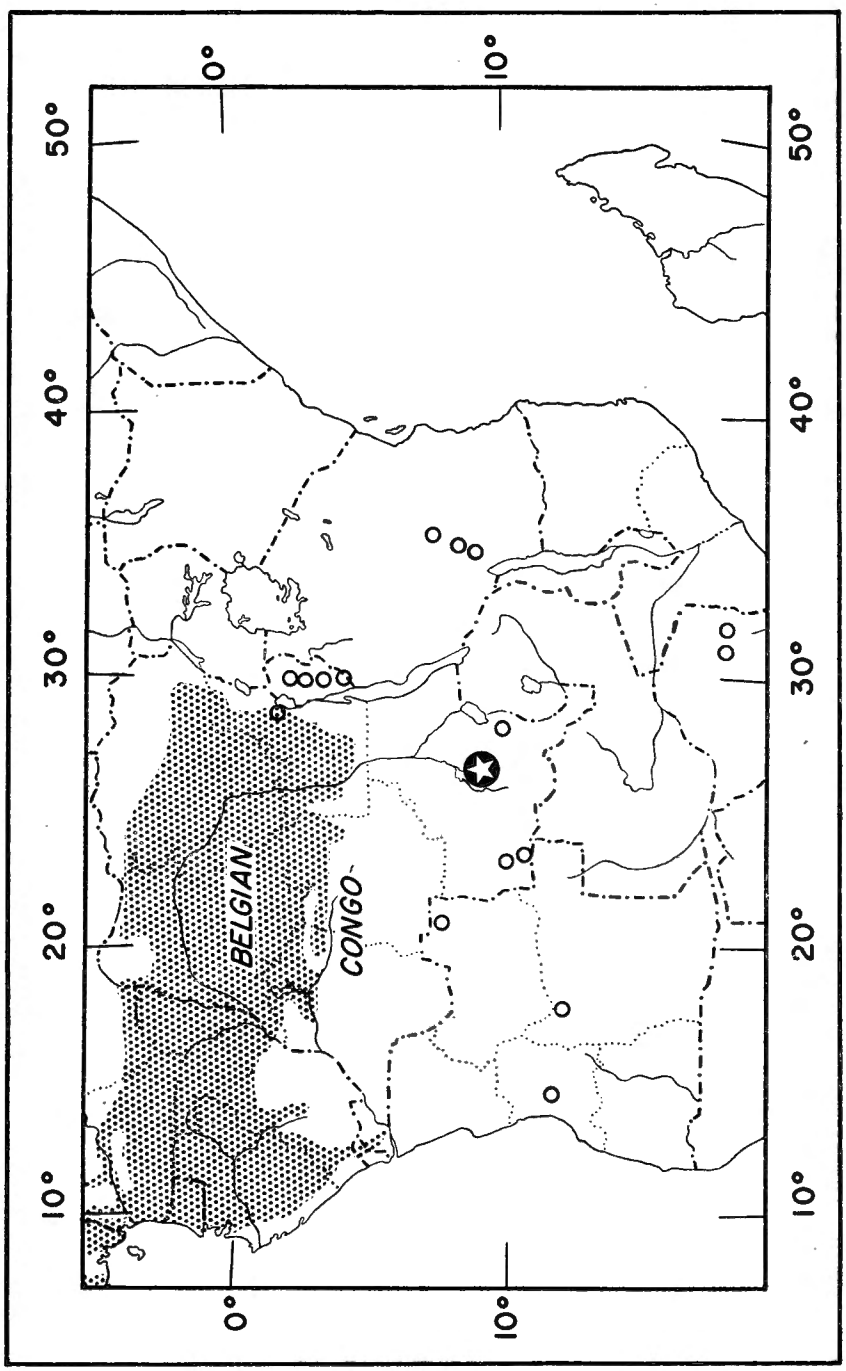

Fig. 53. — Distribution of *Rana uzungwensis*.
Parc National de l'Upemba indicated by symbol with open star.

Upemba localities and specimens :

Buye-Bala (4); Bwalo (1); Kabenga (7); Kabwe (56); Kabwekanono (6); Kafwe (4); Kagomwe (1); Kamitungulu (1); Kampadika (15); Kankunda (1); Katongo (1); Kaziba (1); Kimiala (2); Lufwa (6); Lusinga (4); Mubale (1); Munoi (4); Munte-Mubale (18); Pelenge (14).

Genus **ARTHROLEPTIS** SMITH.

The species most authors have grouped in the genus *Arthroleptis* (after removing those belonging to *Phrynobatrachus*) were divided into the genera *Cardioglossa* BOULENGER, *Schoutedenella* WITTE, and *Arthroleptis* SMITH by LAURENT (1940, 1954 A). The last he considered to include the subgenera *Abroscaphus*, *Coracodichus*, and *Arthroleptulus* (LAURENT, 1940), the last being absorbed later by *Schoutedenella* (LAURENT, 1954 A). In his most recent paper on this group, LAURENT (1957 A) merges *Schoutedenella* with *Arthroleptis* and elevates *Abroscaphus* and *Coracodichus* to full generic status.

These taxonomic opinions have been based wholly on osteological data, the principal characters being the degree of ossification of the ethmoid, the degree of bifurcation of the coracoid, and the relative size and compression of the inner metatarsal tubercle. But the species of this group can be arranged to form a gradual transition from one extreme condition to another in each character. With the exception of the last one, the characters used are of doubtful or at least uncertain phylogenetic, morphological, and ecological significance.

An enlarged, compressed inner metatarsal tubercle is characteristic of fossorial frogs and, within the present group, is best developed in the forms LAURENT places in *Coracodichus*. These forms, such as *stenodactylus* PFEFFER (see below), are fossorial, but according to LAURENT (1957 A, p. 275) so are species assigned to *Arthroleptis* (*sensu* LAURENT) and *Abroscaphus*. In fact, one of the last, *variabilis* MATSCHIE, has a tubercle essentially the same relative size and form as that of *stenodactylus*.

In summary, the differences noted by LAURENT do not suggest the more or less fundamental evolutionary divergence that should be required for generic recognition. Until an analysis indicating the evolutionary significance of the differences is presented, we refer LAURENT's new genera to the synonymy of *Arthroleptis* SMITH.

26. — **Arthroleptis stenodactylus** PFEFFER.

(Pl. V, 2.)

Arthroleptis stenodactylus PFEFFER, 1893, Jahrb. Hamburg Wiss. Anst., **10**, p. 93, pl. 1. fig. 11 — Kihengo, Tanganyika.

Taxonomic notes. — Existing definitions of subspecies appear rather weak. The principal difference between *s. whytii* and *s. stenodactylus*, according to LOVERIDGE (1953), involve size, shape of finger tips and metatarsal tubercle, and coloration of the breast in females. Snout-vent of adult *whytii* are given by LOVERIDGE as : males 23-35 mm, females 29-44 mm; and for *stenodactylus* as 23 mm and 30-34 mm. The Upemba sample is almost exactly intermediate, mature males ranging from 21 to 35 mm and females from 29 to 38 mm. LOVERIDGE himself refers to much variation in the digit tips and metatarsal tubercle without presenting data illustrating a statistical difference. The dusky marbling of the breast of *whytii* females is the only character given by LOVERIDGE that seems to hold good. Females from the Upemba are usually immaculate white or cream-colored below, thus resembling the typical form.

Diagnosis. — Habitus stocky; head as broad as long; obtusely pointed; tympanum visible, about two-fifths eye diameter; maxillary teeth present.

Tips of fingers obtuse, first two fingers subequal; third finger elongated in adult males; tips of toes obtuse; a very slight web at bases of toes; subarticular tubercles prominent; blade-like inner metatarsal tubercle equal to or longer than first toe; no outer metatarsal tubercle.

Skin usually smooth above; a few tubercles scattered on sides; belly coarsely granular.

Color (in alcohol) above brown with a dark irregular mid-dorsal pattern; a few individuals with a light vertebral stripe; below immaculate white or cream-colored except for throat of male (see below).

Secondary sex characters. — Females with mature ova have a snout-vent range of 29.5-38.1 mm (mean=33.63±0.98; N=41). Mature males, i.e., those with gular modifications, range from 20.8 to 35.4 mm, though only one is smaller than 25.6; the mean of 85 is 29.71±0.21 mm.

Males have a median subgular vocal sac with a round opening on each side of the mouth. The gular skin becomes densely pigmented with melanin in a broad band just mesad of the mandible, and a cluster of small, colorless tubercles appears just behind the symphysis.

Male *stenodactylus* also develop elongated third fingers and, as in *Arthroleptis globosus*, the elongation is an indicator of maturity. Twelve males in the size range 25.0-29.0 mm and lacking vocal sacs and pigmented gular skin have third fingers equivalent to 0.178 to 0.199 (mean 0.187±0.002) of the snout-vent length. In fourteen from the same size range but having vocal sacs and pigmented throats the proportion of finger

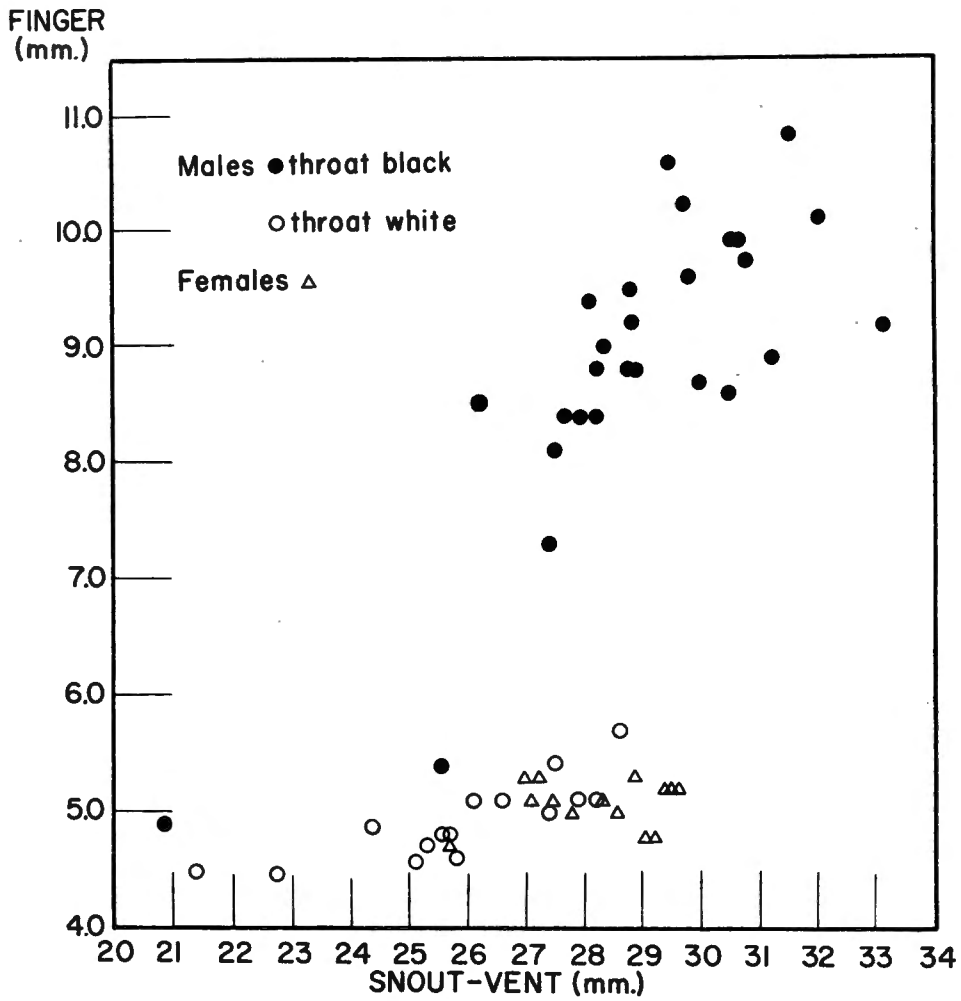

FIG. 54. — Relation between the length of the third finger and snout-vent length in *Arthroleptis stenodactylus* from Parc National de l'Upemba.

to snout-vent length varies from 0.211 to 0.335 (mean 0.302 ± 0.008). As Fig. 54 shows, there seems to be a sudden spurt in the growth of the third finger shortly after the development of vocal sacs. In females, on the contrary, growth of the third finger apparently ceases after the animal reaches a length of 27 mm (Fig. 54).

The masculine secondary sex characters of *stenodactylus* show no evidence of seasonal regression. All males with pigmented gular skin have well-developed vocal sacs and vice versa. All males in that stage

of development and only those males have elongated third fingers. And, as shown in Table 25, about half of the males collected in the dry period have fully developed sex characters.

Only the fifteen adult-sized males listed in the second column of Table 25 can constitute evidence for seasonal regression. None of them has a vocal sac or an elongate third finger. Since we know of no documented case of seasonal disappearance of vocal sacs and since it is unlikely that the phalanges undergo seasonal shrinkage, the best interpretation of these males is that they are immature. This interpretation is supported by the fact that 59 of the 84 males listed in the first (i.e., mature) column are larger than the largest (28.6 mm) individual of the second (i.e., theoretically immature) column.

Ecological notes. — *Arthroleptis stenodactylus* has been collected in open country (LOVERIDGE, 1933, 1942, 1953) and in rather dry forest (LOVERIDGE, 1933, 1953), but never in rain forest. The altitudinal range as reported by LOVERIDGE is extensive, running from sea level to 1,800 m. In the Parc de l'Upemba *stenodactylus* is found at all elevations from 585 m to 1,830 m, with the following frequency :

Meters.	Individuals.
585- 750	2,634
751-1,000	197
1,001-1,250	314
1,251-1,500	80
1,501-1,830	3

The eggs of *stenodactylus* are deposited in small protected burrows away from bodies of water (LOVERIDGE, 1953). In the Upemba breeding appears to begin in November, when the proportion of adult females containing enlarged ova rises sharply (Table 25), and ends in January, when the proportion falls.

Range. — Probably confined to East Africa (Fig. 55) from north-eastern Belgian Congo (WITTE, 1934) southeastwards to Northern Rhodesia (FITZSIMONS, 1939) and central Portuguese East Africa (PARKER, 1930). ANGEL (1940) lists specimens from Sierra Leone and the Cameroons, but these localities are so far off from the main body of the range that the identification requires confirmation.

Upemba localities and specimens :

Bowa (23); Bunda Bunda (3); Ganza (3); Kabenga (4); Kabwe (17); Kalule Nord (3); Kalumengongo (2); Kande (14); Kankunda (59); Kanonga (216); Kaswabilenga (914); Kateke (89); Kaziba (281); Kiamakoto (1); Kilwezi (19); Kimiala (2); Kipondo (34); Loie (1); Lukawe (11); Lupiala (11); Lusinga (1); Mabwe (1,467); Masombwe (5); Mokey (1); Munoi (46); Tumbwe (2).

TABLE 25. — **Monthly frequency of adult *Arthroleptis stenodactylus* from the Upemba in different stages of sexual competence.**

	Males (*)		Females (**)	
	Gular skin pigmented	Gular skin non-pigmented	Ova mature	Ova immature
January	7 (26.2-31.5 mm)	1 (25.6 mm)	3	2
February	6 (28.2-30.8 mm)	5 (25.4-28.2 mm)	0	8
March	1 (29.5 mm)	4 (26.0-27.8 mm)	0	4
April	0	1 (25.9 mm)	—	—
May	2 (27.2-29.4 mm)	0	—	—
June	1 (31.6 mm)	3 (25.7-27.6) mm	0	1
August	—	—	0	2
October	6 (25.6-29.5) mm	1 (28.6 mm)	6	7
November	23 (27.0-33.1 mm)	0	22	4
November-December ...	36 (27.6-33.2 mm)	0	7	1
December	2 (30.7-35.4 mm)	0	3	0

(*) All individuals larger than 25.4 mm.

(**) All individuals larger than 29.4 mm.

27. — **Arthroleptis globosa** WITTE.

(Pl. V, 3.)

Schoutedenella globosa WITTE, 1921, Rev. Zool. Afr., **9**, p. 18, pl. 5, fig. 1 — Lofoï, Katanga, Belgian Congo.

Arthroleptis lameerei WITTE, 1921, Rev. Zool. Afr., **9**, p. 12, pl. 4, fig. 1 — Lofoï, Katanga, Belgian Congo.

Schoutedenella muta WITTE, 1933, Rev. Zool. Bot. Afr., **24**, p. 101 — Kando, Katanga, Belgian Congo.

Taxonomic notes. — In the original description of *muta*, WITTE (1933) states that it differs from *globosa* in having longer hind limbs and in lacking both vocal sacs and sex dimorphism in the length of the third finger. Snout-vent length of the holotypes are 17 and 21.5 mm, respectively (WITTE, 1921, 1933). The Upemba collection contains upwards of 15,000 frogs of a single arthroleptine species, this immense sample demonstrating conclusively that *muta* is merely a juvenile of *globosa*.

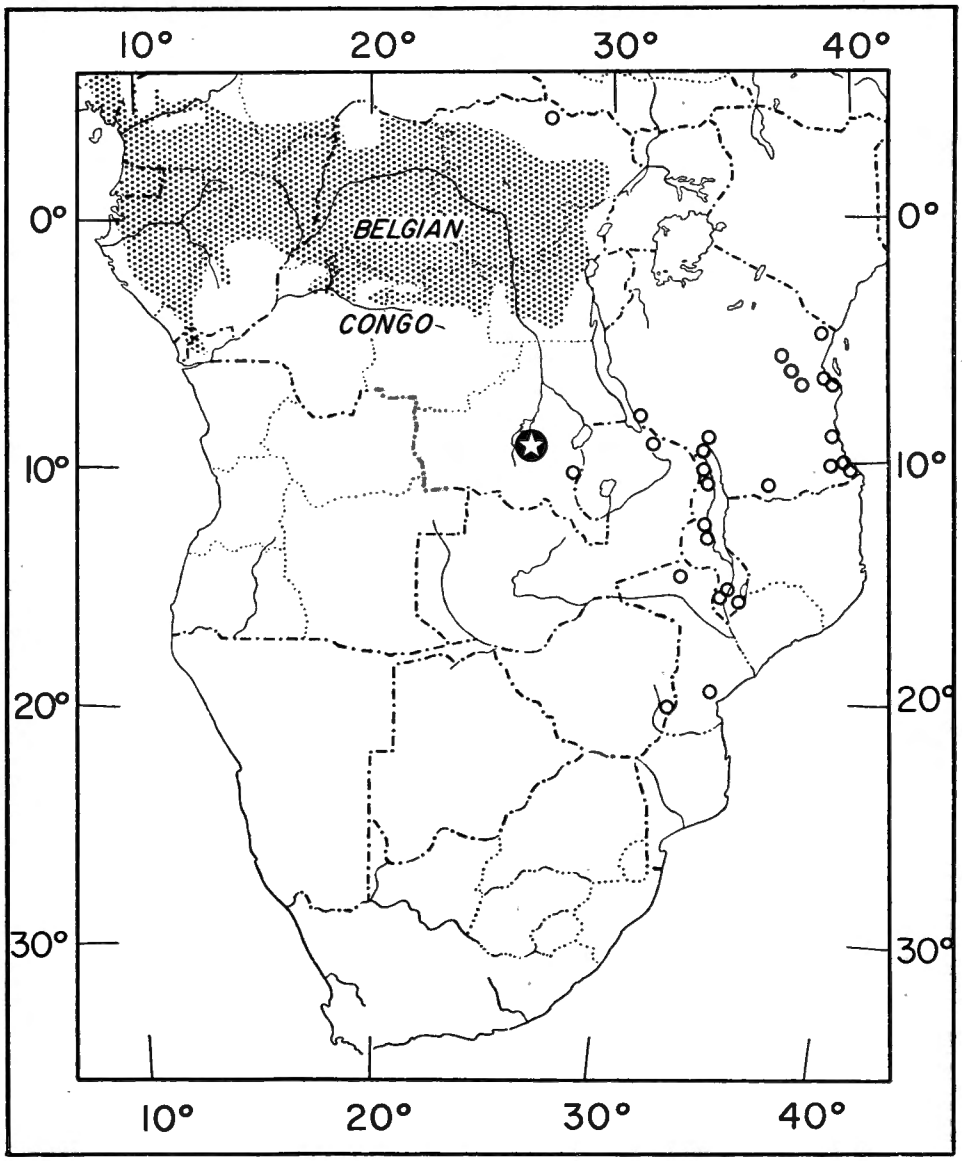

FIG. 55. — Distribution of *Arthroleptis stenodactylus*.
Parc National de l'Upemba indicated by symbol with open star.

As Fig. 56 shows, a continuous size gradation spanning the lengths of the holotypes is present in our series. Elongation of the third finger in males is clearly a function of size and, hence, of age; the finger grows continuously and at a steadily increasing rate. The third finger of 13 males in the snout-vent interval 16.5-17.5 mm represents 0.201-0.320 (mean=0.262) of snout-vent length, whereas in 9 from the interval 20.5-21.5 the proportion is 0.361-0.447 (mean=0.399). Thus the difference between *muta* and *globosa* in this character is easily accounted for by the difference in size.

In Fig. 57 the lengths of tibia and foot are plotted against snout-vent length. Neither the tibia nor the foot grows appreciably after the frog has reached a certain size (ca. 17 mm). Therefore, the segments of the hind limb are relatively shorter in the larger specimens than in the smaller ones, i.e., precisely the difference between *muta* and *globosa*.

In much of the literature of the 1930's and earlier the term « vocal sac » was used loosely and customarily referred to some externally visible modification of the gular skin. The gular skin of adult, male *globosa* is heavily pigmented and distinctly wrinkled. This is true of all Upemba males over 17.1 mm and all of these have openings into true vocal sacs in the floor of the mouth. Twelve in the size range 14.0-17.1 mm have gular skin identical to that of the females; i.e., smooth and nonpigmented except, possibly, at the symphysis. Only one (14.9 mm) of the twelve actually lacks a vocal sac. If, as is highly probable, WITTE's examination was confined to the exterior of the animal, the absence of vocal sacs refers to modification of the gular skin and, as just skown, is characteristic of young males.

Paratypes of *muta* (MCZ 19420-23; 21801-09) have been compared directly with Upemba frogs and agree with the small individuals so closely as to leave no doubt of the indentification. But as these small frogs are merely juveniles of adults that, in turn, agree with description of *globosa*, *muta* must be considered a synonym of *globosa*.

According to WITTE, both *muta* and *globosa* have a large papilla in the center of the tongue. All the specimens we have seen-paratypes of *muta*, examples of *globosa* identified by WITTE, and the Upemba frogs-lack this structure.

One final point in the *globosa-muta* question should be mentioned. The two type localities are 100 miles apart but four of the five additional *globosa* localities listed by WITTE (1934, p. 181) are also places from which he records *muta* (1934, p. 182).

Arthroleptis lameerei WITTE, described in the same paper and from the same locality as *globosa*, is also based on juveniles (14 mm). The original description agrees with that of *muta* point for point and LAURENT (1954 A) recognized the similarity, if not identity, of these nominate forms. Following the arguments presented above, *lameerei* and *globosa* are juvenile and adult of the same species. We retain the name *globosa* because the type series includes adults.

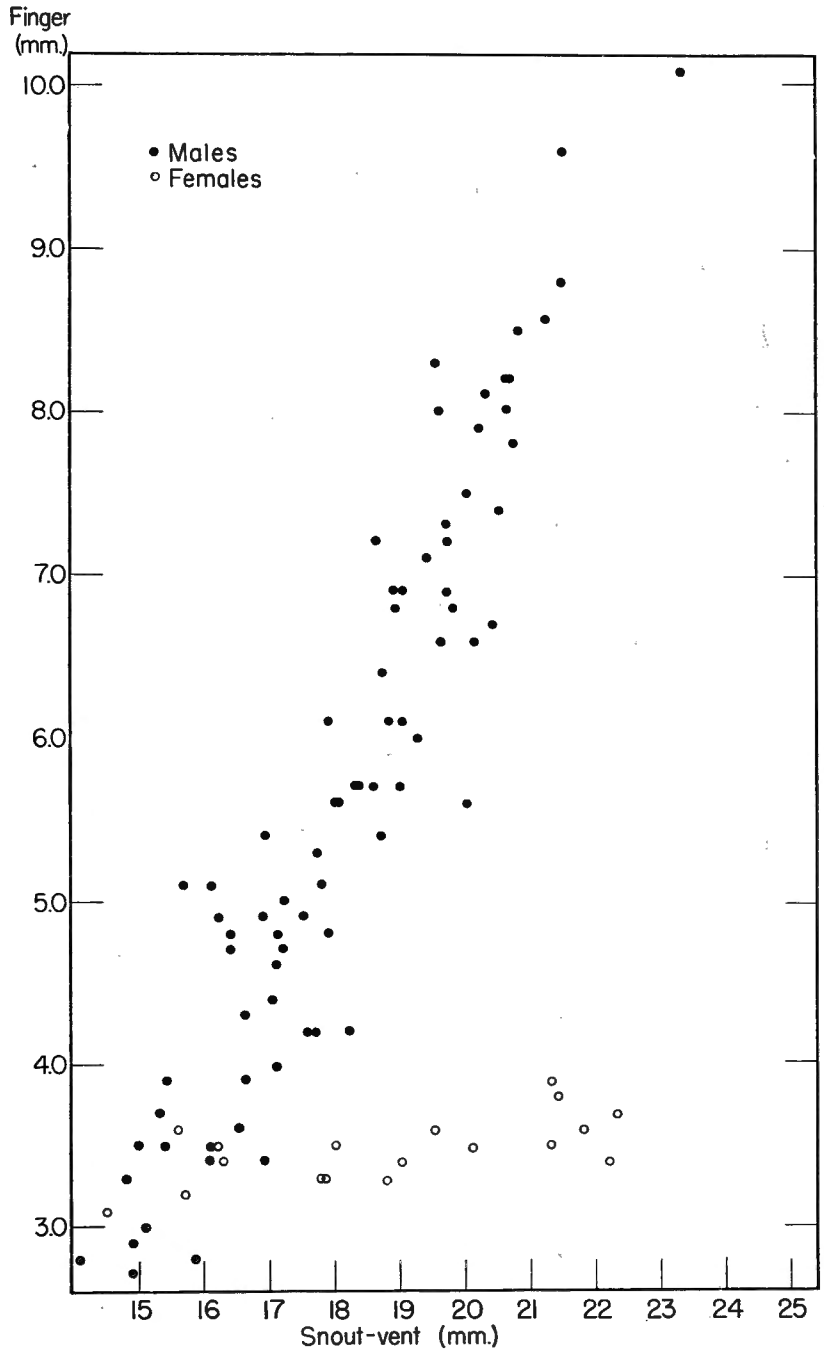

FIG. 56. — Relation between the length of the third finger and snout-vent length in *Arthroleptis globosa* from Parc National de l'Upemba.

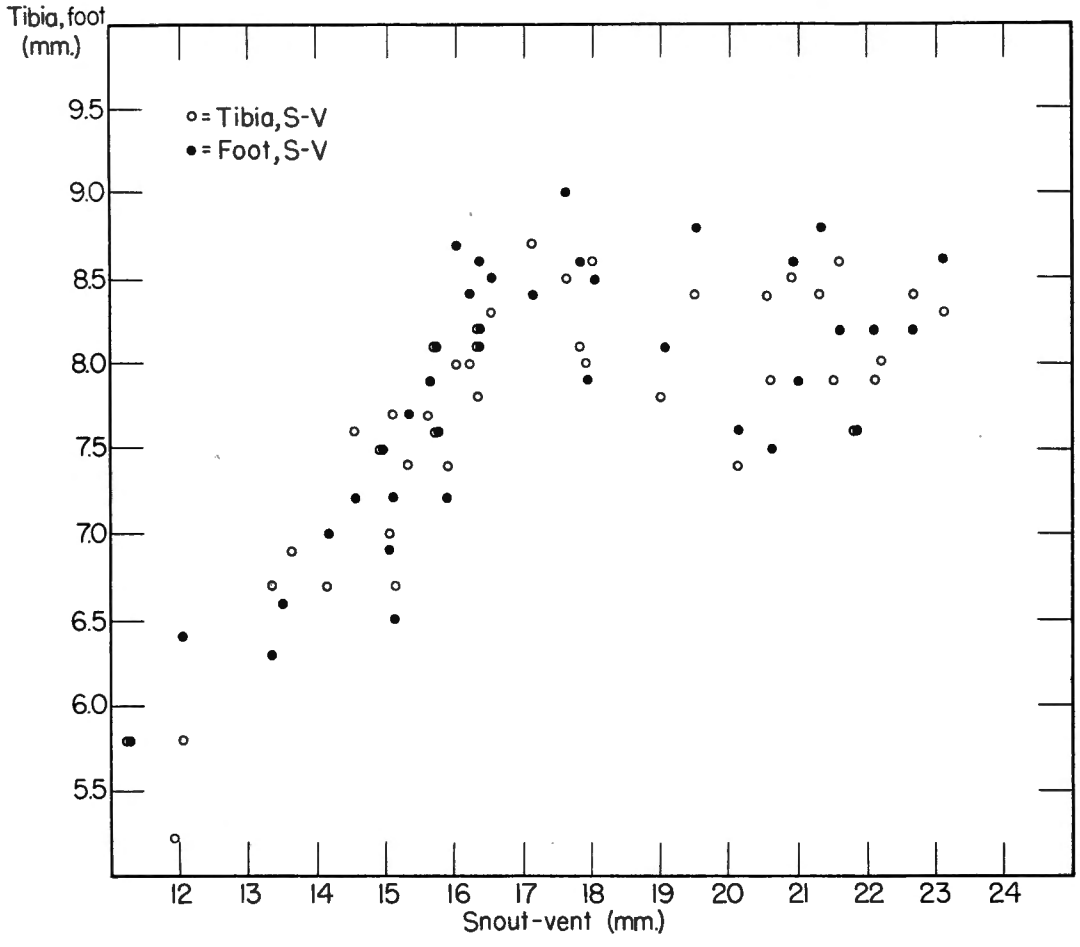

FIG. 57. — Relations of the lengths of foot and tibia to snout-vent length in *Arthroleptis globosa* from Parc National de l'Upemba.

Diagnosis. — Habitus moderate (juveniles) to stocky (large females); head as broad as long; snout obtusely pointed; tympanum visible, one-half to two-thirds diameter of eye; teeth absent.

Tips of fingers obtuse or slightly swollen; first finger shorter than second; third finger elongated in adult males (see below); tips of toes obtusely pointed or swollen; no web; subarticular tubercles prominent; oval inner metatarsal tubercle as long as first toe or somewhat shorter; no outer metatarsal tubercle.

Skin usually smooth above with a few irregularly distributed tubercles; sides coarsely granular; underside smooth except granular near groin.

Coor (in alcohol) brown above, uniform or with a double hourglass figure; below cream-colored, immaculate or with a few melanophores on throat (for adult males see below).

Secondary sex characters. — Females with mature ova vary in size from 18.4 to 24.3 mm; the mean of 32 is 21.15±0.85 mm. Considering as mature only individuals with modified gular skin (see below), males have a snout-vent range of 15.4-23.3 mm but have a smaller mean (18.66±0.21; N=64) than the females. The difference between the means is tatistically significant (t=2.835; P=0.006).

Seventy-six males, 14 mm and up, were examined for the condition of the secondary sex characters; 11 were less than 16.0 mm long. All but one (14.9 mm) has a median subgular vocal sac with round or oval openings on each side of the floor of the mouth just behind the commissure of the jaws. The gular skin of most males is densely pigmented and wrinkled. As stated above (p. 129), gular skin modified in this fashion is absent in only 12 and these fall in the range 14.1-17.1 mm. Fourteen others in the size class 15.4-17.1 mm have the typical adult modification.

Elongation of the third finger in males is a feature of many *Arthroleptis* species. Males and females of *globosa* below 16.5 mm do not differ in the length of the third finger (Fig. 56). But above this size the finger of males becomes progressively larger whereas it scarcely grows at all in females. The relation of finger length to snout-vent for males is given by the formula : $Y = +12.478 + 0.994\ X$, where Y equals the length of the third finger and X the snout-vent. By contrast the corresponding formula in females is : $Y = +2.521 + 0.051\ X$.

Now, the coefficient of X (snout-vent length) is the rate of change in Y (finger length) with respect to change in X, expressed in absolute terms. Naturally, an increase of one millimeter in finger length is relatively a much greater change than the same increase is snout-vent length. Comparing the coefficients of X in the two formulae, we find that in the males' formula the coefficient is about 20 times that of the females'. This means that in the size range covered the third finger in males grows at roughly 20 times the rate in females.

Although the morphology of this sexual dimorphism has been described often, its ontogenesis has not been understood. Various authors write of the presence or absence of this character without regard to the developmental stages of the specimens at their disposal. As shown above (see *taxonomic notes*), this failure in part led to the erroneous description of *muta* as a distinct species. Even LAURENT (1954 A) in his brief review of *Schoutedenella* remarks that dimorphism in finger length varies from species to species and uses *muta* as an example of one totally lacking this modification. Clearly, reasonably large series (ca. 30 or more) of males of each species must be treated in a statistical manner before comparisons are made between species.

The distribution of points in Fig. 56 indicates that the third finger does not regress seasonally. However, the elongated finger in males bears small spines on its inner margin and these spines evidently are not permanent. Of the 45 males lacking these spinules 20 are less than 17.1 mm snout to vent, 16 are 17.1 to 19.0 mm, and 9 are larger than 19.0 mm. Similarly, somewhat less than one-half of the males lacking spinules have third fingers under 4.0 mm long and about one-eighth have fingers longer than 6.0 mm. Thus, while the spinules tend to be more common in larger and, therefore, older males, they may be absent in otherwise mature individuals. A sharp pattern of seasonal distribution of the spinules does not emerge from Table 26 although the relative abundance of males without spinules is greater during the dry season (May-September).

A pink linea masculina is present along the ventral margin of the obliquus muscle in mature males. The six lacking this secondary sex character (see Table 26) fall in the size range 14.1-17.1 mm. The single male (14.9 mm) lacking vocal sacs also lacks lineae masculinae.

TABLE 26. — **Monthly frequency of males of Upemba *Arthroleptis globosa* in various stages of development. All have vocal sacs.**

Character	Stage of development			
Lineae masculinae	Present	Present	Present	Absent
Gular skin	Modified	Modified	Unmodified	Unmodified
Spinules, third finger	Present	Absent	Absent	Absent
Months	**Number of individuals**			
January	2	0	0	0
February	10	5	0	0
March	17	1	0	0
April	1	4	0	0
May	0	2	0	0
June	0	2	0	0
October	9	13	5	6
November	16	3	0	0
November-December	4	3	0	0
December	0	1	0	0

Table 26 suggests the order in which the secondary sex characters develop. Since all males with any of the sex characters has vocal sacs, these structures appear first in ontogeny. This is the same pattern observed in other Upemba frogs. The lineae masculinae develop next and are followed by modification of the gular skin and then by the appearance of spinules on the third finger. The elongation of the third finger does not readily fit into this sequence because the finger continues to grow after the other sex characters have appeared.

Ecological notes. — All the localities from which *globosa* has been reported by WITTE are in the upland savanna region of southeastern Belgian Congo. In the Upemba, *globosa* occurs at all elevations from 585 to 1,830 m, with the following frequency :

Meters.	Individuals.
585- 750	2,597
751-1,000	6,680
1,001-1,250	2,815
1,251-1,500	1,978
1,501-1,750	1,066
Above 1,751	441

The proportion of sexually competent individuals in this collection rises sharply in November and continues high until February or March (Tables 26, 27), suggesting that breeding begins in November.

TABLE 27. — **Monthly frequency of adult female *Arthroleptis globosa* from the Upemba with respect to development of ova. All exceed 18.0 mm., snout-vent.**

Months	Ova		
	mature	intermediate	immature
February	6	0	2
March	0	0	1
April	3	0	3
May	0	0	1
October	4	2	8
November	13	4	0
November-December	3	0	0
December	3	0	1

Range. — Known only from southeastern Belgian Congo.

Upemba localities and specimens :

Bowa (3); Buye-Bala (467); Bwalo (1); Difiringi (2); Dipidi (7); Ganza (1,400); Kabenga (57); Kabwe (1,425); Kabwekanono (117); Kagomwe (1); Kankunda (2); Kalubamba (1); Kalumengongo (6); Kalungwe (65); Kambi (35); Kamitungulu (14); Kamitunu (1); Kamusanga (87); Kande (611); Kankunda (172); Kanonga (805); Kanpungu (44); Kaswabilenga (491); Kateke (51); Katongo (60); Kavizi (40); Kayumbwe (16); Kaziba (373); Kenia (58); Kiamakoto (29); Kilolomatembo (11); Kilwezi (1,671); Kimapongo (5); Kipondo (261); Loie (146); Lufira (17); Lukawe (103); Lukoka (13); Lukorami (138); Lupiala (476); Lusinga (138); Mabwe (2); Manda (13); Masombwe (120); Mitoto (1); Mubale (140); Mukana (21); Mukelengia (285); Mukukwe (3); Munoi (2,729); Munte (3); Munte-Mubale (377); Muye (30); Mware (114); Pelenge (2,188); Senze (67); Tumbwe (1).

Genus **CACOSTERNUM** BOULENGER.

28. — **Cacosternum leleupi** LAURENT.

Cacosternum leleupi LAURENT, 1950, Rev. Zool. Bot. Afr., **44**, p. 138 — Kundelungu, Katanga, Belgian Congo.

Taxonomic notes. — The present series of juveniles agrees well with the original description. A lateral black band is present in the eleven at hand and each has a transverse pectoral fold. Since neither character is mentioned by LAURENT (1950), the Upemba series may differ somewhat from the type, which is the only other specimen known.

Diagnosis. — Tongue narrow, not notched; no teeth; a distinct pectoral fold; two metatarsal tubercles; subarticular tubercles conspicuous; third, fourth, and fifth toes webbed to basal tubercles. A white line from shoulder forward below eye; a dark lateral band from eye to groin. Snout-vent 12.1-15.3 mm.

Ecological notes. — These young frogs were collected at altitudes between 1,750 and 1,830 m. The type locality is at 1,750 m.

Range. — As yet known only from the Katanga.

Upemba localities and specimens :

Bwalo (1); Kabwekanono (4); Kalumengongo (1); Katongo (1); Lusinga (1); Mukana (2); Mukelengia (1).

Genus **CARDIOGLOSSA** BOULENGER.

29. — **Cardioglossa** sp.

A juvenile (9.6 mm) too small for reliable identification. Mubale (1).

Genus **PHRYNOBATRACHUS** GÜNTHER.

Probably no genus of African Salientia, with the exception of *Hyperolius*, gives taxonomists as much difficulty as *Phrynobatrachus*. Some species, such as *perpalmatus* and *natalensis* are easily distinguished, but they are exceptional. The principal sources of the trouble are relatively obvious : the species are numerous, the animals small in size, and the older descriptions inadequate. Although we have been able to examine the types of many nominate forms while on a brief tour of European museums, we are certain that before most of the species are satisfactorily defined the majority will have to be examined in one laboratory at one time. Another prerequisite is large series of both sexes.

But in addition to these requirements, more rigorous definition of frequently used characters, elimination of certain characters from consideration, and use of still others will be necessary. WITTE's synopsis (1919) of *Phrynobatrachus*, which is the most recent attempt to cover the whole genus though it included less than half the species, employed the old but ambiguous method of describing the extent of webbing in terms of proportion of the toes webbed, e.g., two-thirds or one-fourth webbed. LOVERIDGE recognizes the inadequacies of this method and in his most recent paper (1953), as well as in earlier ones, uses the number of digits free of web as a more accurate means of describing this character. Because the web may extend distally as a narrow fringe for varying distances, we prefer to note the extent of broad web, which varies less, relative to the subarticular tubercles.

Similarly, greater care should make the tympanum more helpful. Commonly keys and descriptions note that the tympanum is hidden. Such statements assume the presence of the structure but usually it is not explicitly indicated that a tympanum was found. In some species, as in three small ones reported on here, the tympanum is indeed hidden; it is present but covered by rather thick skin obliterating all external signs of its presence. On the other hand, in our fourth dwarf form, and this is probably true of some species from other areas, the tympanic annulus is not present, as determined by actual dissection.

The spacing of the tarsal and metatarsal tubercles, another character used by WITTE, has not facilitated our work though it may be of help in distinguishing species of other regions. Four small species have been

especially troublesome to us and we have tried to use every conceivable character including the spacing of the tubercles. The ratio of the distance between the metatarsal tubercles to the distance between the outer metatarsal tubercle and the tarsal tubercle varies within species from 0.46 to 0.78, for example, whereas the means only vary from 0.59 to 0.62. Considering that the measurements involved are less than 2.0 mm, the differences between means are hardly significant taxonomically. Similar results were obtained for all ratios among these distances. For the small species, therefore, this character is not promising.

Male secondary sex characters, as a rule, have not been exploited by students of Salientia. Though use of them has the practical disadvantage of requiring both sexes, in view of the muddle that now exists in this genus that requirement is probably a blessing in disguise. PARKER (1936 A) has pointed out that a femoral gland is present in males of some species; among the six covered by this report, four have femoral glands.

The lineae masculinae have been especially helpful in corroborating distinctions made on the basis of other characters. *Phrynobatrachus natalensis*, *gutturosus*, and *perpalmatus* males have lineae masculinae at both dorsal and ventral borders of the obliquus muscle. Those of *parvulus* have a single linea and that at the ventral border of the obliquus. One of the new forms described below has a dorsal linea only and the second new form none at all. As with all secondary sex characters, the lineae masculinae must be explicitly defined. We have applied the term only to a transparent narrow band of tissue, sometimes pinkish otherwise colorless, paralleling the longitudinal edges of the obliquus. In some instances the ventral line may be overlain by the pars abdominis of the pectoralis and this muscle must be carefully lifted when a ventral line is not immediately visible. The final condition to the use of these structures is that only mature males should be examined, a structure applying equally to other secondary sex characters. If the male being examined has nuptial pads, then its lineae masculinae should be in definitive condition since, as will be shown below, the last always develop before the nuptial pads.

In describing *Phrynobatrachus* species, authors often refer to black or dark throats in males. The black pigment may be on one or both of two layers, though the distinction has not been recognized previously. Males of *Phrynobatrachus parvulus* and *gutturosus* both have dark throats, usually darker in the former. In *parvulus* the melanophores are concentrated on the gular skin, in *gutturosus* on the vocal sac and its investing muscle. Admittedly the difference in appearance is trivial; nonetheless a genetic distinction exists and has been helpful in our study.

The common ambiguity of taxonomic literature with regard to the vocal sac should be mentioned. The vocal sac is never external in the sense of superficial. Invariably it is covered by the gular skin and with few exceptions by the subhyoideus muscle as well. In examining the

throat of male *Phrynobatrachus*, the gular skin should not be confused with the vocal sac. The former has its own specializations, such as folds and asperities (Fig. 58), and, though these have a definite developmental time relationship to the vocal sac, they are not physically part of the latter.

Despite the small number of species included in this collection, a diagnostic key is given because of the difficulties commonly encountered in identifying members of this genus.

FIG. 58. — Gular regions of male *Phrynobatrachus* from Parc National de l'Upemba. Upper left, *P. cryptotis* (×4). Upper center, *P. gutturosus* (×4). Upper right, *P. perpalmatus* (×4). Lower left, *P. anotis* (×5). Lower center, *P. parvulus* (×5). Lower right, *P. natalensis* (×2½).

KEY TO UPEMBA *PHRYNOBATRACHUS*.

1A. Toes broadly webbed to base of disks ..... *perpalmatus*.
B. Toes not webbed beyond subarticular tubercles 2

2A. Toes broadly webbed to distal subarticular tubercles of third and fifth toes ..... *natalensis*.
B. Web at most reaching distal subarticular tubercles of third and fifth toes as a narrow fringe 3

3A. Tips of toes expanded into disks having circummarginal grooves; broad web extending beyond basal subarticular tubercles of third and fifth toes; never with silvery streak below tympanum 4

B. Tips of toes not expanded, lacking circummarginal grooves; web usually not extending beyond basal subarticular tubercles of third and fifth toes, at most extending distally as a narrow fringe; silvery streak below tympanum present or absent 5

4A. Tympanum absent; posterior third of abdomen usually mottled or spotted with brown pigment; adult males with white throats, no transverse fold behind modified gular skin (Fig. 58) ..... *anotis.*

B. Tympanum present though usually not visible through skin; posterior third of abdomen usually without dark pigment; adult males with black pigment at least under chin and often over entire throat, a transverse fold behind modified gular skin (Fig. 58) ..... *gutturosus.*

5A. A silvery streak below tympanum from eye to arm insertion (Fig. 62); posterior fourth of abdomen with dark spots; tympanum present though hidden under skin; throat of adult male blackish (Fig. 58) ..... *parvulus.*

B. No silvery infratympanic streak; posterior fourth of abdomen without dark spots; tympanum present though hidden under skin; throat of adult male blackish at least at chin (Fig. 58) ..... *eryptotis.*

30. — **Phrynobatrachus anotis** n. sp.

(Pl. V, 4.)

Holotype. — Institut des Parcs Nationaux du Congo Belge, No. 1958, adult male from Lusinga, 1,810 m, Parc National de l'Upemba, Katanga, Belgian Congo, collected May 22, 1945, by the Mission G. F. DE WITTE. Allotype, 1958, female, same data.

Diagnosis. — A small *Phrynobatrachus*, adults 15-23 mm; tympanic annulus absent; tips of toes with small disks having circummarginal grooves; broad web extending beyond basal subarticular tubercles of third and fifth toes but not reaching distal tubercles; no silvery infratympanic stripe (Fig. 59); throats of males whitish (Fig. 58), with at most a faint dusting of small spots.

Description of holotype. — Habitus of *Phrynobatrachus*, with a moderately pointed snout, projecting slightly beyond mouth; body stocky, limbs relatively long; lingual papilla present; vomerine teeth absent, maxillary teeth present; tympanum absent; tips of fingers and toes slightly expanded, with subterminal horizontal grooves; second finger a little longer than first, third finger once and a half as long as second; subarticular tubercles well-defined; webs between toes well developed, web between

third and fourth toes at level of a point midway between the basal and the second tubercle of the fourth toe; web extended along fourth toe as a flap of skin on both sides of penultimate phalanx of fourth toe; dorsal skin with low tubercles; ventral skin entirely smooth.

Dark brown above, with an obscure line across head at the middle of the eyelids, anterior to which the snout is lighter; a broad yellowish line along the posterior foce of the thigh; upper surface of thighs and tibia with obscure dark bars; sides of head with obscure dark bars radiating from eye; a dark line, with an obscure light line below it, from eye to shoulder; ventral surfaces pale yellow, with brown spots on breast and abdomen.

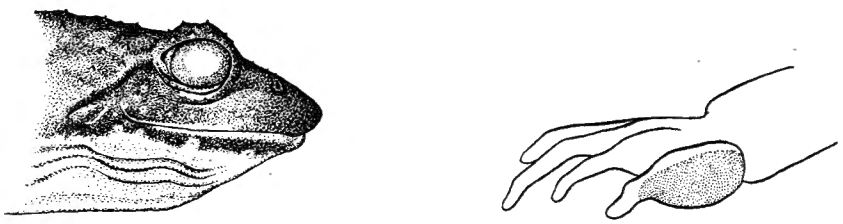

FIG. 59. — Male *Phrynobatrachus anotis* new species.
Left, side view of head (×6). Right, nuptial pad (×8).

Throat (Fig. 58) with two strong lateral folds, one parallel to the labial border, the other curved toward the mid-line posteriorly; no transverse posterior gular fold; gular skin very lightly pigmented; vocal sac and muscle not pigmented; tip of chin with a few white asperities; back (Fig. 59) with numerous white asperities from snout to above anus; nuptial pad (Fig. 59) on first finger; femoral gland present; no linea masculina.

Measurements of holotype and allotype.

	Holotype. (mm)	Allotype. (mm)
	—	—
Length from snout to vent	17.0	24.0
Length of arm	8.0	13.0
Length of leg	26.0	33.0
Length of tibia	9.0	11.0
Width of head at angles of mouth ...	6.2	8.5

Paratypes. — Approximately 1,970 specimens from various localities in the Parc National de l'Upemba form a remarkably uniform series. Significant variation is described in the section on secondary sex characters (below).

Comparisons. — The character of presence or absence of the tympanum proper (to be observed when a flap of skin over the tympanic region is reflected) has not been ascertained for most of the species of *Phrynobatrachus*. The tympanum is definitely absent in *ogowensis* BOULENGER and in *keniensis* BARBOUR and LOVERIDGE. In *ogowensis*, from the Gaboon, the toes are more extensively webbed, and the gular sac is bounded posteriorly by a transverse fold. *Phrynobatrachus keniensis*, from Mount Kenya, was described without a male; males subsequently associated with this species by LOVERIDGE lack longitudinal folds on the gular pouch. *Phrynobatrachus anotis* is not *scheffleri*, in which the tympanum is present beneath the skin (partly further concealed by a slip of muscle). This new form is thoroughly distinct from all other *Phrynobatrachus* is the Katanga region; it nearest relatives may be found among some of the still inadequately described species of the East African region and of the Congo Forest.

Secondary sex characters. — Adult females (with large pigmented ova) are distinctly longer than mature males (with complete secondary sex characters). The former have a snout-vent range of 17.6-22.8 mm (mean 20.83±0.12; N=84), and the latter one of 15.0-20.2 mm (mean 17.62±0.11; N=95). Maxumum size for all females is 23.4 mm.

Surrounding the vent of adult females is a cluster of whitish spinules similar to those occurring in female *gutturosus* (see below). A small proportion of males have similar structures though they are smaller and fewer in number than those of females.

The male secondary sex characters are typical of the genus. Median subgular vocal sacs, opening through longitudinal slits, and horizontally oval femoral glands are present in males larger than 15.0 mm. The gular skin (Fig. 58), which in females bears rather large brown spots, loses its pigmentation in adult males and becomes almost immaculate cream-colored. Pigment never appears on the vocal sac or on the subhyoideus muscle. One or two longitudinal folds develop laterally in the gular skin, but not a single male of the hundreds examined has a transverse fold such as characterizes *gutturosus*, *parvulus*, and *cryptotis*.

The nuptial pad (Fig. 59) is a velvety structure covering the dorsal and median surfaces of the first finger from its base to the end of the proximal phalanx. At its maximum development, that is, when its detailed structure is most easily seen under the microscope, the pad is yellowish. At other times it is dark gray. Small whitish spinules or asperities, like those of *parvulus* and *gutturosus*, are present in a cluster on the chin, and similar ones are more widely scattered over the dorsal surfaces of head, trunk, and hind limbs. No lineae masculinae were seen.

The vocal sac and femoral gland appear in all males having any other secondary sex characters. On the other hand, ten of 123 males examined in detail have vocal sacs and femoral glands only, so that these two

structures must develop first just as they do in *gutturosus* and other species. The folds in the gular skin probably develop next and probably do not regress. Of the twelve males lacking these folds, nine are smaller than 15.7 and three others measure 16.2, 16.9, and 17.7 mm. All except the last may be judged young adults. Only two (15.7, 16.9) of the twelve have nuptial pads.

By contrast six of the sixteen lacking nuptial pads have gular folds. The sixteen include five in the size range 17.1-18.1 mm, certainly fully adult in size, which suggests that the pads may regress. Aside from ten males having vocal sacs and femoral glands only, thirteen lack mental asperities (nine in the size range 17.1-18.5) and fifteen lack dorsal asperities (twelve in the size range 17.1-18.5). These two classes do not coincide exactly as one without the spinules on the chin has them on the back and four without spinules on the back have them on the chin. Since the two classes include many individuals that are fully mature with respect to size, it is reasonable to assume that asperities on both regions of the body develop later than the other sex characters and that they undergo regression. The distribution of male secondary sex characters with respect to one another is shown in Table 28.

TABLE 28. — **Monthly frequency of adult male *Phrynobatrachus anotis* with respect to development of secondary sex characters. All have vocal sacs and femoral glands.**

Gular folds	Present	Present	Present	Present	Present	Absent	Absent
Nuptial pad	Present	Present	Present	Absent	Absent	Present	Absent
Mental asperities	Present	Present	Absent	Present	Absent	Absent	Absent
Dorsal asperities	Present	Absent	Absent	Absent	Absent	Present	Absent
January	18	0	0	0	0	0	0
February	2	0	0	0	0	0	0
March	8	0	0	0	0	0	5
April	18	0	2	0	0	1	0
May	15	2	3	0	0	0	0
June	17	1	0	1	0	0	1
July	11	0	1	0	5	0	2
October	7	0	0	0	0	1	2
	96	3	6	1	5	2	10

Ecological notes. — Though five specimens in this collection were caught at 860 m, *Phrynobatrachus anotis* is much more abundant at the higher elevations within the Parc National de l'Upemba as shown by the following tabulation of this sample.

Meters.	Individuals.
751-1,000	10
1,001-1,250	58
1,251-1,500	109
1,501-1,750	803
1,751-1,830	994

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

Upemba localities and specimens :

Babagi (1); Buye-Bala (29); Dipidi (8); Ganza (5); Kabenga (4); Kabwe (37), Kabwekanono (20); Kagomwe (35); Kakolwe (1); Kamamulongo (15); Kamatshya (24); Kambi (31); Kamitungulu (15); Kamitunu (47); Kanpungu (24); Karibwe (9); Kasandendeko (157); Kavizi (232); Kayumbwe (24); Kaziba (2); Kenia (56); Kilolomatembo (63); Kimapongo (51); Kimiala (2); Kipangaribwe (74); Luanana (1); Lufwa (1); Lusinga (784); Manda (1); Masombwe (2); Mitoto (8); Mukana (88); Munoi (2); Munte-Mubale (71); Pelenge (50).

31. — **Phrynobatrachus cryptotis** n. sp.

(Pl. V, 5.)

Arthroleptis schoutedeni Witte, 1934, Ann. Mus. Congo Belge, Zool., (1), **3**, p. 178 (part).

Arthropleptis scheffleri, idem, p. 178 (part).

Holotype. — Institut des Parcs Nationaux du Congo Belge, No. 1926, adult male from the upper Bwalo River (an affluent from the left of the Muye, which is an affluent from the right of the Lufira), 1,750 m, Parc National de l'Upemba, Upper Katanga, Belgian Congo; collected April 9, 1948, by the Mission G. F. de Witte. Allotype, 1926, with the same data.

Diagnosis. — A small *Phrynobatrachus*, adults 13-22 mm; tympanum present, but normally not visible through skin; tips of digits without expansions and lacking circummarginal grooves; broad web not usually extending beyond basal subarticular tubercle of third and fifth toes; no silvery infratympanic stripe (Fig. 60); gular skin of males (Fig. 58) pigmented near chin, usually free of pigment posteriorly; vocal sac densely powdered with melanophores.

Description of holotype. — Habitus of *Phrynobatrachus*; with moderately pointed and projecting snout, stocky body, and relatively short

limbs; lingual papilla present; tongue emarginate behind; vomerine teeth absent, maxillary teeth present; tympanum not distinguishable externally, present beneath the skin; tips of fingers and toes entirely without expansion; second finger about as long as first, third finger half again the length of the first and second; subarticular tubercles well developed; a basal web between toes, its margin between the third and fourth and fourth and fifth toes at the level of the basal tubercle of the fourth toe, extending along toes as a narrow membrane to the second tubercle of the third and fifth toes, a little beyond the basal tubercle of the fourth; dorsal skin with low tubercles, ventral skin entirely smooth.

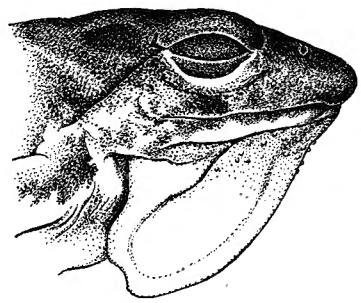

FIG. 60. — Side view of head of male *Phrynobatrachus cryptotis* (×6).

Lighter and darker gray above, with a narrow light line from snout to vent, and from vent along upper faces of the thighs, reappearing on the lower half of the tibiae and over the heel to the foot; a broader less sharply defined line parallel to the upper narrow one on the otherwise dark posterior faces of the thighs; an obscure light line from below the eye to the insertion of the arm; ventral surfaces light (very pale yellow), the chin with dark fine spotting, and lateral brown spotting on breast and abdomen; under surfaces of arms, thighs, and tibiae immaculate, yellowish; border of lower lip strongly barred with subequal dark and light vertical maculation.

Vocal sac conspicuous, black, showing through the thin skin of the posterior part of the throat, which is pigmented only anteriorly; a curved transverse fold bounds the throat posteriorly, behind which is a parallel curved band, a millimeter wide on which (as on the edge of the fold) there is fine black punctulation; chin (Fig. 58) with fine white asperities; a dark gray nuptial pad of extremely fine and close-set asperities on the inner basal portion of the first finger; an oval femoral gland.

Measurements of holotype and allotype.

	Holotype. (mm)	Allotype. (mm)
	—	—
Length from snout to vent	17.9	19.5
Length of arm	9.0	10.0
Length of leg	24.0	26.5
Length of tibia	8.4	9.0
Width of head at angles of mouth ...	5.6	6.0

Paratypes. — An enormous sample of 11,659 specimens from the Parc National de l'Upemba comprise the type series. Variation is limited to minor differences in pigmentation of the throat and abdomen and to the characters discussed under *secondary sex characters*.

Comparisons. — Examination of the lectotype and twenty additional specimens of *Phrynobatrachus scheffleri* NIEDEN, from Kibwezi, Kenya Colony, shows *cryptotis* to be very similar to this species, at least as concerns female specimens. Though faded, the ventral pattern of *scheffleri* is distinctive and very unlike that of *cryptotis*. It is pale brown with numerous small white spots over the whole underside. Definitive description of *scheffleri* must await collection of adult males from the type locality, for the original collection contains only females and juveniles.

Specimens of *cryptotis* from the Katanga region, in the collections of the Musée du Congo Belge, have been identified as *minutus*. We find this Abyssinian species to be distinguished from the new form by its more extensive webbing, its distinct tympanum, and by the unmodified gular skin of the male. The ventral surface of *minutus* is immaculate. The type, in the British Museum (Natural History), has been examined. In addition to the characters named, it has a distinctive dorsal pattern of paired dark markings.

Secondary sex characters. — Adult females (with enlarged pigmented ova) have a snout-vent range of 15.2-22.2 mm and a mean of 19.26±0.15 mm (N=99). This mean is significantly larger, statistically, than that of adult males (those with completely developed sex characters). The snout-vent range in adult males is 13.4-20.3 mm and the mean 17.05±0.11 mm (N=107).

Females of *cryptotis* have pre-anal spinules similar to those described for *gutturosus* (see below).

Male secondary sex characters closely resemble those of *gutturosus*. A median subgular vocal sac opens into the mouth through longitudinal slits. The outer layer of the vocal sac and the investing subhyoideus muscle are heavily dusted with melanophores as is the gular skin, though the pigment of the last may be restricted to the chin. In this stage of development the gular skin (Fig. 58) has a conspicuous transverse fold marking its

TABLE 29. — **Monthly distribution of male** *Phrynobatrachus cryptotis*
In each cell, in vertical order, are given : the number of specimens, the

Vocal sacs	Present	Present	Present
Femoral glands	Present	Present	Present
Linea masculina	Present	Present	Present
Gular skin	Modified	Modified	Modified
Nuptial pads	Present	Present	Present
Mental asperities	Present	Present	Absent
Dorsal asperities	Present	Absent	Absent
January	26 16.2–19.7 17.68	3 17.6–18.6 17.9	0
February	6 17.3–18.7 17.80	4 18.0–18.7 18.2	1 18.2
March	16 15.7–18.6 17.08	0	0
April	15 15.7–18.8 17.61	1 16.4	0
May	1 18.3	0	1 18.2
July	0	0	1 17.7
August	1 20.3	0	1 19.4
September	14 14.5–17.2 16.05	2 14.5–15.2 14.85	0
October	20 13.4–17.2 15.86	0	0
November	3 17.3–18.8 18.23	3 17.2–17.6 17.47	1 17.6
December	5 16.4–17.8 17.14	10 16.3–17.7 17.33	0
Totals	107 13.4–20.3 17.05±0.11	23 14.5–18.7 17.33±0.20	5 17.6–19.4 18.22±0.32

with respect to development of secondary sex characters.
range of snout-vent (mm.), and the average snout-vent length.

	Present	Present	Present	Present	Present
	Present	Present	Present	Present	Absent
	Present	Absent	Present	Absent	Absent
	Modified	Modified	Unmodified	Unmodified	Unmodified
	Absent	Absent	Absent	Absent	Absent
	Absent	Absent	Absent	Absent	Absent
	Absent	Absent	Absent	Absent	Absent
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	1 16.7	0	0	0	0
	16 15.3–18.9 17.34	0	0	1 13.8	1 14.5
	12 15.9–18.7 17.02	0	0	2 15.4–15.7 15.55	0
	17 14.4–17.3 16.16	1 16.6	1 16.3	1 13.8	0
	1 13.8	0	2 12.0–13.0 12.5	2 10.6–11.5 11.05	0
	0	0	0	0	0
	0	0	0	1 16.0	0
	0	0	0	0	0
	47 13.8–18.9 16.74±0.15	1 16.6	3 12.0–16.3 13.77	7 10.6–16.0 13.83±0.80	1 14.5

TABLE 30. — **Seasonal distribution of certain sex characters in male *Phrynobatrachus cryptotis* having vocal sacs and femoral glands. Numbers in table refer to number of specimens.**

	Nuptial pads		Mental asperities		Dorsal asperities		Gular folds		Linea masculina	
	Present	Absent	Present	Absent	Present	Absent	Present	Absent	Present	Absent
January	29	0	29	0	26	3	29	0	29	0
February	11	0	10	1	6	5	11	0	11	0
March	16	0	16	0	16	0	16	0	16	0
April	16	1	16	1	15	2	17	0	17	0
May	2	18	1	19	1	19	18	2	18	2
July	1	14	0	15	0	15	13	2	13	2
August	2	20	1	21	1	21	20	2	20	2
September	16	5	16	5	14	7	17	4	19	2
October	20	0	20	0	20	0	20	0	20	0
November	7	1	6	2	3	5	7	1	7	1
December	15	0	15	0	5	10	15	0	15	0

posterior border and, usually, a short lateral fold. Immediately behind the transverse fold of some males is a narrow band of transparent skin.

Horizontally oval femoral glands and a linea masculina at the dorsal border of the obliquus muscle are present. There is no ventral linea maculina.

A grayish, velvety nuptial pad covers the dorsal and median surfaces of the first finger from its base to the end of the basal phalanx. A dense cluster of small whitish spinules or asperities occurs on the chin (Fig. 58) and similar, though much more widely spread, ones are distributed over the entire dorsal surface.

As in other species, the vocal sacs of *cryptotis* develop early, probably before the femoral glands become discernible and certainly before all other secondary sex characters. All males with any secondary sex characters have vocal sacs and, almost invariably, femoral glands (Table 29). One male (14.5 mm) has vocal sacs only, seven others (10.6-16.0, mean 13.8 mm) vocal sacs and femoral glands. The linea masculina probably is the next sex character to develop. Two small males (12.0, 13.0 mm) have this structure in addition to vocal sacs and femoral glands. Another individual (16.3 mm) having the same secondary sex characters also has feeble lateral folds on the throat representing initiation of modification of the gular skin; the vocal sac lacks chromatophores completely.

Many specimens have lineae masculinae, gular skin folds, and pigmented vocal sacs but lack nuptial pads and mental and dorsal asperities. A male in this condition could be either a young adult in which the last three structures had not yet developed, or a fully mature individual in which these structures had regressed between breeding periods. Both interpretations probably apply to the present sample, for some males in this condition are quite small (nine in the range 13.8-15.9 mm) and others larger (six in the range 18.0-18.9 mm) than the average adult male. Furthermore the seasonal incidence of males having fully developed sex characters (Table 30) strongly suggests regression of the nuptial pads.

Most of the males in the most abundant stage collected in May (Table 29) are fully mature, judging by size, as ten of sixteen are larger than 17.5 mm (mean of all fully developed males 17.05 mm). Presumably in these ten the nuptial pads and mental and dorsal asperities have regressed. July males of the same category include only three larger than 17.5 mm, two in the range 17.0-17.5 mm, six between 16.0 and 16.9 mm, and one 15.9 mm. In August this category is divided as follows : three in the range 17.0-17.5, ten 16.0-16.9, four 15.0-15.9, and one 14.4 mm. Thus the proportion of young adults increases from May through August as juveniles of the preceding year class become mature.

The movement of the new adults into the class of all adults is also reflected in the monthly changes in average size of males having completely developed sex characters (Table 29, column 1).

Ecological notes. — The range in altitude of specimens collected is from 585 m to 1,850 m, distributed as follows :

Meters.	Individuals.
585- 750	2,584
751-1,000	683
1,001-1,250	291
1,251-1,500	863
1,501-1,750	2,460
1,751-1,850	4,778

Probably the low numbers collected between 751 and 1,500 m reflect lack of a suitable habitat rather than an effect of altitude.

The largest single lots are from Mabwe, on Lake Upemba at 585 m (1,545), and from Mukana, at 1,810 m (2,803). Both the Mabwe and Mukana series are from marshes.

Apparently *cryptotis* has a more sharply delimited breeding season than *gutturosus* or *parvulus*. The proportion of adults in breeding condition (females containing mature ova; males with fully developed sex characters) drops sharply after April and rises in September (see Table 31).

TABLE 31. — **Monthly frequency of adult *Phrynobatrachus cryptotis* from Parc National de l'Upemba with respect to breeding condition.**

	Males (*) Secondary sex characters		Females (**) Ova	
	complete	incomplete	mature	immature
January	26	3	23	0
February	6	5	12	0
March	16	0	8	8
April	15	2	6	8
May	1	18	4	10
July	0	15	3	12
August	1	21	0	8
September	14	5	15	3
October	20	0	7	1
November	3	5	6	8
December	5	10	15	0

(*) All with vocal sacs and femoral glands.

(**) All over 15.0 mm; smallest with pigmented ova = 15.2 mm.

Range. — The vast numbers of *Phrynobatrachus cryptotis* from the Upemba region, and its past confusion with *schoutedeni* (=*parvulus*) and *scheffleri*, as well as with *minutus*, indicate that this species ranges far beyond the Upemba region. Specimens in the Musée du Congo Belge, identified as *Arthroleptis moorei* BOULENGER by LOVERIDGE, though juveniles, can be positively identified as *cryptotis*. They came from Nyamruado, Northern Rhodesia. Specimens in the Musée du Congo Belge from Dilolo (Lulua District, Belgian Congo), in the Kasai drainage, far to the west of the Katanga include positively identifiable males of *cryptotis*, associated with *parvulus*.

Upemba localities and specimens :

Bunda-Bunda (1); Buye-Bala (897); Bwalo (184); Dipidi (48); Ganza (200); Kabenga (10); Kabwe (22); Kabwekanono (1,345); Kafwe (17); Kalubamba (2); Kalumengongo (136); Kalungwe (7); Kamitungulu (2); Kamitunu (2); Kampadika (117); Kamusanga (11); Kande (146); Kanonga (473); Karibwe (1); Kaswabilenga (147); Kateke (2); Katongo (8); Kaziba (14); Kenia (6); Kiamakoto (188); Kilwezi (123); Kipondo (42); Loie (6); Luangalele (6); Lufira (44); Lufwa (37); Lukawe (77); Lupiala (86); Lusinga (602); Mabwe (1,545); Manda (10); Masombwe (60); Mokey (7); Mubale (132); Mukana (2,803); Mukelengia (612); Mukukwe (1); Munoi (78); Munte (277); Munte-Mubale (837); Mwema-Mabole (1); Pelenge (19); Sanga (96); Senze (173).

32. — **Phrynobatrachus gutturosus** CHABANAUD.

(Pl. V, 6.)

Arthroleptis gutturosus CHABANAUD, 1921, Bull. Com. Études Hist. Sci. Afr. Occ. Française, **1921**, p. 452, pl. 2, fig. 2-4 — Sanikolé, Liberia; NOBLE, 1924, Bull. Amer. Mus. Nat. Hist., **49**, p. 315; WITTE, 1934, Ann. Mus. Congo Belge, (1), **3**, p. 180.

Phrynobatrachus gutturosus LAURENT, 1941, Rev. Zool. Bot. Afr., **34**, p. 207, fig. 3g.

Taxonomic notes. — The redescription of this species by WITTE, with his careful comparison of Katanga specimens with the West African types, convinces us that this is the proper allocation of the Upemba series. It is to be presumed that the range is not actually so discontinuous, and that the species will yet be found in the region between Liberia and the Katanga. There are differences between the Liberian types and our large Upemba series, but these cannot be evaluated without additional specimens from the intermediate region.

Diagnosis. — A small *Phrynobatrachus*, adults 16-25 mm; tympanum present, but not visible through skin; tips of fingers slightly dilated; tips of toes with small, yet distinct disks having circummarginal grooves; broad web extending well beyond basal subarticular tubercles of third and fifth toes but not reaching distal tubercles except as a narrow fringe; no silvery infratympanic stripe; gular skin of male black near chin; vocal sac with dark chromatophores.

Descriptive notes. — Snout triangular in outline from above, rounded in profile, longer than eye; nostril a little closer to tip of snout than to eye; interorbital space equal to upper eyelid; tongue with a strong median papilla; dorsal skin strongly glandular, with raised rounded tubercles; a pair of elongate tubercles on shoulders; first finger shorter than second; three strong metacarpal tubercles.

General color dark above and light beneath; a pale streak often present from eye to shoulder, but never silvery as in *Phrynobatrachus parvulus*; upper lip distinctly barred, the dark bars about equal to the light interspaces; dark bars of lower lip usually wider than interspaces; venter spotted anteriorly, posterior part of abdomen usually without dark spots.

Secondary sex characters. — Adult females (with pigmented ova) are distinctly larger than males having nuptial pads. Adult males (93) range in snout-vent length from 16.2 to 22.7 mm (mean 19.78±0.12 mm); adult females (72) range from 19.5 to 25.3 mm (mean 22.60±0.17 mm).

Adult females have a cluster of conical, whitish spinules on a dark triangle surrounding the anus. A few spinules may occur outside the triangle laterally on the rear of the thighs. The dark triangle is present in males but is devoid of spinules, though a few low glandules sometimes occur.

Median subgular vocal sacs and oval femoral glands are invariably present in males larger than 16.0 mm. The gular skin (Fig. 58) forms a loose pouch that is sharply defined posteriorly by a transverse fold in front of the chest. Frequently the pouch is bordered laterally by a longitudinal fold on each side. Anteriorly the gular pouch is heavily pigmented, the chromatophores becoming less dense posteriorly so that the rear portion of the throat is only faintly dusted or immaculate whitish. The vocal sac and its investing muscle usually bear numerous melanophores and, when especially dark, give the gular skin a dark gray appearance.

A pinkish linea masculina forms the ventral border of the obliquus muscle and is ordinarily visible superficially although in some males the pars abdominis of the pectoralis overlaps it as in *parvulus* (see below). Usually a linea masculina appears at the dorsal boder of the obliquus.

A grayish or yellowish velvety nuptial pad appears on the dorsal and medial surfaces of the first finger from its base to the middle or end of the proximal phalanx. Small whitish spinules or asperities occur in a dense group near the chin (Fig. 58) on the gular skin and much more diffusely on the back.

As in other *Phrynobatrachus* the vocal sac and femoral gland are developed in all males having any other secondary sex characters and apparently develop before the other structures. Only three of the males examined lacked lineae masculinae; nuptial pads were present in these three. In three others lineae masculinae were present but nuptial pads absent. Seven males possessing both lineae masculinae and nuptial pads

lacked mental spinules, whereas only one having mental asperities lacked a linea masculina and none was without nuptial pads. Therefore, mental spinules probably develop after the nuptial pads and lineae masculinae. Dorsal asperities evidently appear last for, with one exception, all males having them also have all the other secondary sex characters while the converse is not true. The exceptional individual has dorsal asperities but not mental spinules. The distribution of secondary sex characters with respect to one another is given in Table 32.

TABLE 32. — **Monthly frequency of adult male** *Phrynobatrachus gutturosus* **from the Upemba with respect to development of secondary sex characters. All have vocal sacs and femoral glands.**

Nuptial pad	Present	Present	Present	Present	Present	Present	Absent
Linea masculina	Present	Present	Present	Present	Absent	Absent	Present
Mental asperities	Present	Present	Absent	Absent	Absent	Present	Absent
Dorsal asperities	Present	Absent	Absent	Present	Absent	Absent	Absent
February	22	2	0	0	0	1	0
March	13	0	0	0	0	0	0
April	16	1	0	1	0	0	0
May	4	0	1	0	0	0	0
June	1	1	0	0	1	0	0
July	1	1	4	0	0	0	0
October	0	1	1	0	0	0	3
November-December ..	12	1	0	0	1	0	0
Total	69	7	6	1	2	1	3

Ecological notes. — The range in altitude of specimens collected is from 585 m to 1,780, distributed as follows :

Meters.	Individuals.
585- 750	470
751-1,000	359
1,001-1,250	685
1,251-1,500	19
1,501-1,750	19
1,751-1,780	2

The proportion of females with enlarged, pigmented ova remains high throughout the year (see Table 33), suggesting that breeding may take place during any month. The proportion of males with fully developed secondary sex characters is relatively high except in June, July, and October.

TABLE 33. — **Monthly frequency or adult *Phrynobatrachus gutturosus* from the Upemba with respect to breeding condition.**

	Males (*) Secondary sex characters		Females (**) Ova	
	complete (***)	incomplete	mature	immature
February	22	3	19	0
March	13	0	12	0
April	16	2	14	0
May	4	1	7	0
June	1	2	1	0
July	1	5	5	0
September	—	—	1	1
October	0	5	2	1
November-December	12	2	16	0

(*) All having vocal sacs and femoral glands.

(**) All larger than 19.5 mm, the minimum for females with pigmented ova.

(***) The first column of Table 32.

Range. — The discontinuity in the known range of *gutturosus* — from Liberia to the Katanga — is almost certainly apparent rather than real. Part of the difficulty may be a result of the taxonomic muddle involving some of the smaller species of *Phrynobatrachus*.

Upemba localities and specimens :

Difirinji (2); Ganza (19); Kabenga (288); Kabwe (13); Kafwe (1); Kambi (16); Kamusanga (1); Kande (4); Kankunda (2); Kanonga (307); Kaswabilenga (137); Kateke (158); Kaziba (358); Kiamakoto (10); Kilwezi (19); Kipondo (78); Lukoka (1); Lupiala (19); Lusinga (3); Mabwe (2); Masombwe (29); Mokey (5); Mukukwe (1); Munoi (80); Mware (1).

33. — **Phrynobatrachus natalensis** SMITH.

(Pl. VI, 1.)

Stenorhynchus natalensis SMITH, 1849, Ill. S. Afr. Rept., App., p. 23 — Natal.

Phrynobatrachus natalensis GÜNTHER, 1862, Proc. Zool. Soc. London, **1862**, p. 190; LOVERIDGE, 1953, Bull. Mus. Comp. Zool., **110**, p. 378.

Phrynobatrachus ranoides BOULENGER, 1894, Proc. Zool. Soc. London, **1894**, p. 644, pl. 39, fig. 2 — Pietermaritzburg, Natal.

Phrynobatrachus natalensis forma *gracilis* ANDERSSON, 1904, *in* Jägerskiöld, A.L.K.E., Res. Swedisch Zool. Exped. Egypt White Nile, Part 1, No. 9, p. 10, figure — Ghrab el Aish, south of Kaka, White Nile.

Phrynobatrachus boulengeri WITTE, 1919, Rev. Zool. Africaine, **6**, p. 6 — Beira and Coguno, Portuguese East Africa.

Phrynobatrachus maculatus FITZSIMONS, 1932, Ann. Trans. Mus., **15**, p. 40 — Rain Forest, Victoria Falls; idem, **16**, p. 391, fig. 27.

Taxonomic notes. — The species *Phrynobatrachus natalensis* has an enormous range from Senegal to the Egyptian Sudan, southward to Natal and Cape Colony, and westward south of the Congo forest to Angola (Fig. 61). The supposed species *ranoides*, regarded by LAURENT so lately as 1941 as distinguishable from *natalensis*, has been referred to *natalensis* by various authors, and most lately by LOVERIDGE (1953). DE WITTE's *P. boulengeri* has been referred to *natalensis* by NOBLE (1924) and LOVERIDGE (1925). We find no distinctions, except those of juveniles, between *Phrynobatrachus maculatus* and *natalensis*; we have examined a paratype of *maculatus* in Chicago Natural History Museum. The original description of this form compares it only with *ranoides*, which is clearly a synonym of *natalensis*.

Diagnosis. — A medium-sized *Phrynobatrachus*, adults 25 to 40 mm; tympanum present, usually hidden under skin; tips of digits not dilated, without circummarginal grooves; toes broadly webbed to distal subarticular tubercle of third and fifth toes; no silvery infratympanic stripe; lower lip barred with brown or brown with light spots; throat spotted with brown in females, black in adult males.

Secondary sex characters. — Females are slightly but distinctly larger than males. One hundred ninety-nine females with pigmented ova vary from 26.6 to 38.6 mm (mean 33.00±0.16 mm) snout to vent, although only one measures less than 28.2 and one female lacking mature ova measures 39.3 mm. The size range of males having fully developed secondary sex characters (see below) is 26.2-36.3 mm (mean 30.86±0.13 mm; N=211).

Adult males have median subgular vocal sacs (LIU, 1935) joining the oral cavity by means of bilateral round or slit-like openings. The smallest

male with vocal sacs measures 26.2 mm and the largest lacking them 32.8 mm. The mean of the snout-vent length of males larger than 26.0 lacking vocal sacs is 28.45±0.18 mm (N=59); the difference between this mean and that of males having vocal sacs (see above) is statistically significant.

The nuptial pad consists of a velvety cluster of minute white or cream-colored spinules. When fully developed the pad covers the entire dorsal and median surfaces of the first finger from its base to the end of the basal phalanx.

The gular skin (Fig. 58) in breeding males is thrown into longitudinal folds, the deepest of which are lateral. Numerous round white asperities, each tipped by a minute spicule, cover the throat in such males. Finally, these males have a layer of black pigment on the dorsal (i.e., inner) surface of the gular skin. This black pigment is quite distinct from the brown pigment of the gular region of females and juveniles males, for the latter is concentrated on the ventral (i.e., outer) surface of the gular skin. Femoral glands are not found in this species.

In *Phrynobatrachus natalensis* the vocal sac develops prior to the other secondary sex characters. Fifty-four males have vocal sacs but lack nuptial pads, black gular pigment, gular asperities, or some combination of one or more of the three. On the other hand, all males having one or more of the last three characters also have vocal sacs. The temporal distribution (Table 34) of the five combinations in which the secondary sex characters (excluding the vocal sac) appear is best explained in the following manner.

The nuptial pads seem to go through a seasonal cycle of development and regression, the crest of the cycle occurring from September through January and the trough from May through July. The black gular pigment and the gular asperities, once they develop, apparently do not normally regress, for the proportion of adult males (i.e., those with vocal sacs) having these structures remains high except in August and September (Table 34).

Nineteen males collected in August and September have vocal sacs but lack one or more of the other secondary sex characters. They range in size from 26.6 to 30.5 mm (mean 28.06±0.27), all therefore falling below the mean (30.86 mm) of the fully developed males. Consequently it is reasonable to view the 19 as newly adult. The sharp drop in August in the proportion of adult males having black gular pigment and gular asperities probably results from a lag between the time males acquire vocal sacs (and thus move into the « adult » category) and the time they develop the other sex characters.

Three males collected in April lack secondary sex characters other than vocal sacs, and their small size (30.0, 30.4, 30.8 mm) suggests that they,

TABLE 34. — **Monthly frequency of adult-sized (over 26.0 mm.) male *Phrynobatrachus natalensis* from the Upemba in various stages of development of the secondary sex characters.**

Vocal sac	Present	Present	Present	Present	Present	Present	Absent	Total
Nuptial pad	Present	Absent	Absent	Present	Present	Absent	Absent	
Black gular pigment	Present	Present	Absent	Absent	Absent	Absent	Absent	
Gular asperities	Present	Present	Present	Present	Absent	Absent	Absent	
January	26	0	0	0	0	0	0	26
February	19	4	0	0	0	0	0	23
March	15	4	0	0	0	0	2	21
April	10	8	0	0	0	3	6	27
May	3	6	0	0	0	0	4	13
June	3	5	0	0	0	1	22	31
July	1	3	0	0	0	0	20	24
August	7	1	1	5	2	3	4	23
September	44	0	1	4	0	2	1	52
October	29	0	0	1	0	0	0	30
November	28	0	0	0	0	0	0	28
November-December	19	0	0	0	0	0	0	19
December	7	0	0	0	0	0	0	7
Total	211	31	2	10	2	9	59	324

too, are in this intermediate stage of development. The only other male preserved in this stage is too large (33.6 mm, June) to be considered a new adult.

Of the 12 new adults from August, 5 lack gular asperities, 5 lack nuptial pads, and 11 black gular pigment (Table 34). Only 2 of the 7 new adults collected in September lack gular asperities, 3 lack nuptial pads, and all lack black gular pigment. Evidently gular asperities and nuptial pads develop at approximately the same time, to be followed by the appearance of black pigment.

Ecological notes. — *Phrynobatrachus natalensis* is an inhabitant of savannah swamps, ponds, and flood plain lakes outside of the rain

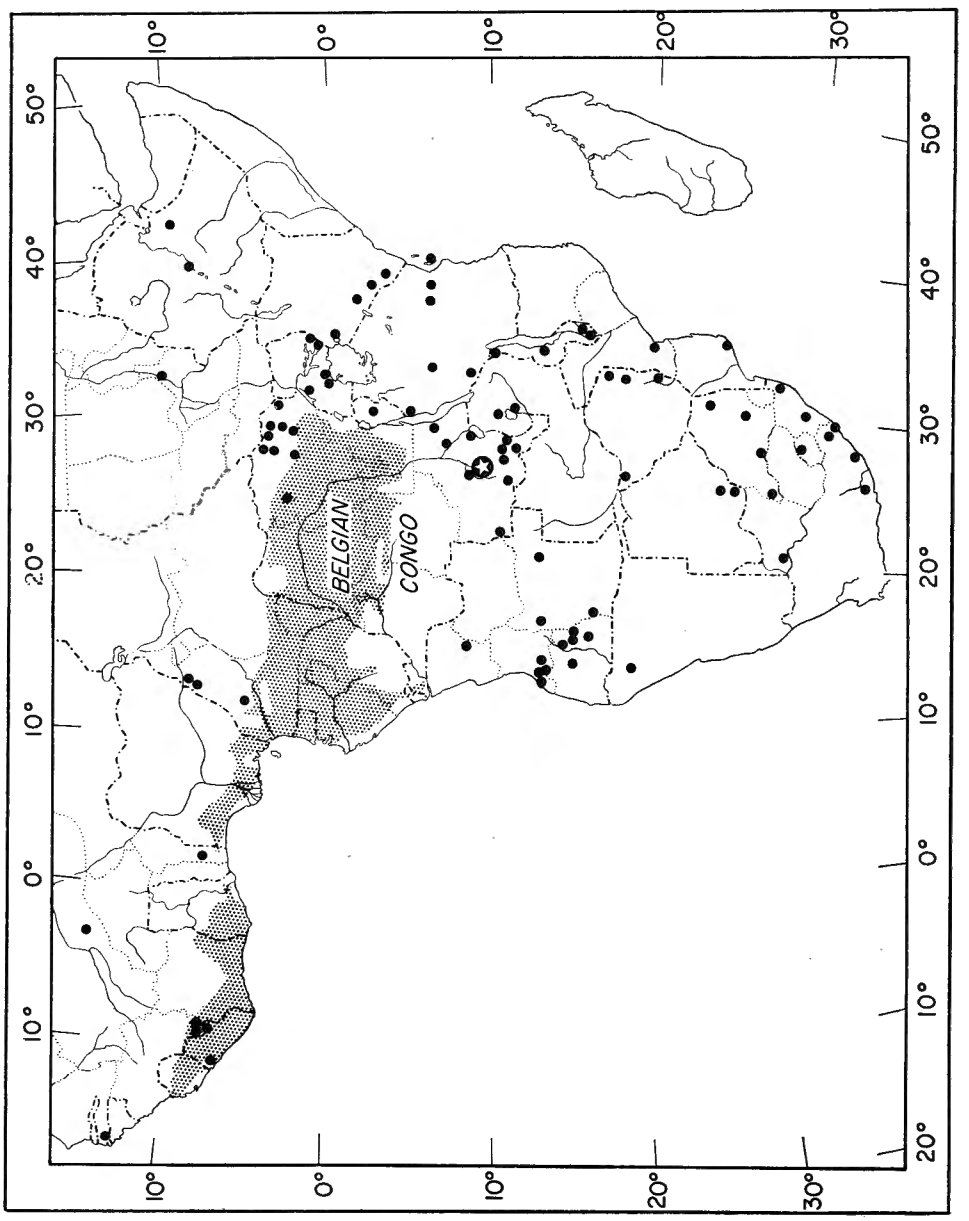

FIG. 61. — Distribution of *Phrynobatrachus natalensis*.
Parc National de l'Upemba indicated by symbol with open star.

forest region (LOVERIDGE, 1942; NOBLE, 1924). CHABANAUD (1921 A) and LOVERIDGE (1941) have recorded it from the West African forest and NOBLE (1924) and WITTE (1934) note localities at the edge of the Ituri forest. It has been reported from sea level (MONARD, 1937; POWER, 1935) to 2,100 m (LOVERIDGE, 1936). In the Parc de l'Upemba it occurs at all elevations; specimens in the present collection show the following distribution :

Meters.	Individuals.
585- 750	2,989
751-1,000	2,065
1,001-1,250	1,275
1,251-1,500	767
1,501-1,750	661
1,751-1,830	356

Table 35 presents the monthly frequencies of *natalensis* adults according the stage of development of the ova, in the case of females, and of the secondary sex characters (which are indicators of breeding condition), in the case of males. The pattern is the same for both sexes although the proportion of males in breeding condition never falls as low as that of females (see also Fig. 74). The high proportion of females in breeding condition in October and November, followed by a gradual decrease in that proportion in the period December-March, suggests that breeding takes place from November to March. From March to July, the low proportion of sexually competent adults indicates the ebb period of the cycle. In August, September, and probably October both sexes move into breeding condition as shown by the rise in the curves of Fig. 74.

The reproductive cycle is synchronized with the rainfall cycle (Fig. 74) although the upsurge in the former precedes the beginning of the rains by several months.

Range. — South of the Sahara, which forms the northern boundary of the range, *natalensis* is found throughout Africa save only the rain forest regions (with the exceptions noted above) and, probably, the Kalahari area (Fig. 61).

Upemba localities and specimens :

Bowa (49); Bunda-Bunda (3); Buye-Bala (216); Bwalo (6); Difirinji (6); Dipidi (20); Ganza (358); Kabenga (99); Kabulumba (2); Kabwe (54); Kabwekanono (42); Kafwe (57); Kalubamba (5); Kalumengongo (38); Kalungwe (330); Kamatshya (2); Kambi (22); Kamitunu (19); Kampadika (17); Kamusanga (36); Kande (583); Kankunda (27); Kanonga (1,022); Karibwe (5); Kasandendeko (2); Kaswabilenga (275); Kateke (157); Katongo (6); Kaziba (351); Kenia (9); Kiamakoto (455); Kilwezi (591); Kimiala (9); Kipondo (186); Loie (46); Lufira (75); Lufwa (28); Lukawe (70); Lukoka (13); Lukorami (6); Lupiala (231); Lusinga (260); Mabwe (662); Manda (1); Masombwe (303); Mokey (45); Mubale (36); Mukana (46); Mukelengia (154); Mukukwe (21); Munoi (101); Munte (9); Munte-Mubale (677); Muye (12); Mware (20); Mwemba-Mabole (1); Pelenge (18); Sanga (64); Senze (156).

TABLE 35. — **Monthly frequencies of adults of Upemba *Phrynobatrachus natalensis* in various stages of sexual competence.**

	Males Secondary sex characters		Females Ova	
	complete	incomplete	pigmented	not pigmented
January	26	0	24	3
February	19	4	16	5
March	15	4	14	10
April	10	11	6	20
May	3	6	0	24
June	3	6	1	28
July	1	3	0	39
August	7	12	8	13
September	44	7	49	16
October	29	1	36	0
November	28	0	31	0
November-December ...	19	0	6	0
December	7	0	8	1

34. — **Phrynobatrachus parvulus** BOULENGER.

(Pl. VI, 2.)

Arthroleptis parvulus BOULENGER, 1905, Ann. Mag. Nat. Hist., (7), **16**, p. 109, pl. 4, fig. 3 — Bange Ngola, northeastern Loanda, Angola; NOBLE, 1924, Bull. Amer. Mus. Nat. Hist., **49**, p. 202, 316; LOVERIDGE, 1933, Bull. Mus. Comp. Zool., **74**, p. 386; WITTE, 1934, Ann. Mus. Congo Belge, Zool., (1), **3**, fasc. 4, p. 180 (part); PARKER, 1936, Nov. Zool., **40**, p. 142; MERTENS, 1937, Abh. Senck. Naturf. Ges., **435**, p. 20; 1940, Zool. Anz., **131**, p. 247; 1955, Abh. Senck. Naturf. Ges., **490**, p. 27.

Phrynobatrachus parvulus LAURENT, 1941, Rev. Zool. Bot. Africaine, **34**, p. 206.

Arthroleptis schoutedeni WITTE, 1921, Rev. Zool. Bot. Africaine, **9**, p. 13, pl. 4, fig. 3 — Lofoi, Katanga, Belgian Congo; NOBLE, 1924, Bull. Amer. Mus. Nat. Hist., **49**, p. 317; WITTE, 1934, Ann. Mus. Congo Belge, Zool., (1), **3**, fasc. 4, p. 178; MERTENS, 1937, Abh. Senck. Naturf. Ges., **435**, p. 20.

Phrynobatrachus schoutedeni LAURENT, 1941, Rev. Zool. Bot. Africaine, **34**, p. 205 (?).

Arthroleptis minutus WITTE, 1934, loc. cit., p. 178 (part).

Arthroleptis scheffleri WITTE, 1934, loc. cit., p. 178 (part).

Taxonomic notes. — The distinction of the smaller species of *Phrynobatrachus* of the Katanga requires attention especially to the characters of the male, to the size of the digital discs, to the amount of webbing between the toes, and to the coloration, particularly of the ventral surfaces and the side of the head. The very large series of these smaller species in the collections reported upon by DE WITTE in 1934 have been critically examined after making our discrimination of four species (in addition to *natalensis* and *perpalmatus*) as set forth in our key. The collections, preserved in the Musée du Congo Belge under the names *schoutedeni*, *minutus*, and *scheffleri*, all prove to be mixtures in varying proportions, of *Phrynobatrachus parvulus* and our new species *cryptotis*. The confusion of the two species under different designations is the result of the very large proportion of juvenile specimens and females and the inadequate representation of males. When the males are sorted out and carefully defined, it becomes possible to distinguish most, though not quite all, of the juveniles and females as well.

The recognition of *Phrynobatrachus parvulus* as a species ranging from Angola to Lake Tanganyika (LOVERIDGE, 1933) calls attention to the probability, indeed the certainty, that this species is present in the Katanga. Examination of the types of *parvulus* in the British Museum and the fortunately uniform series of five co-types of *Phrynobatrachus schoutedeni* in the Musée du Congo convinces us that these forms are conspecific. Both bear, in every specimen, the silvery facial stripe characteristic of the species; and the distinctive femoral gland of the adult male, described by PARKER (1936 A) is present in our Katanga males. The dorsal coloration of *parvulus*, figured by BOULENGER in the original description, can be matched as a frequent variant in our series; it is found in only two of the four co-types.

Diagnosis. — A small *Phrynobatrachus*, adults 12-25 mm; tympanum present, but usually not visible through skin; tips of digits not dilated, no circummarginal grooves; web not extending beyond basal subarticular tubercles of third and fifth toes, sometimes extending farther distally as a narrow fringe; a distinct silvery infratympanic stripe (Fig. 62); throat of female mottled with dark brown, of mature male finely and densely punctate with black (Fig. 58); vocal sac usually without pigment.

Descriptive notes. — Limbs relatively short; snout somewhat flattened and pointed; dorsal skin often with symmetrically arranged, low, oval glands.

General color dark brown above; pale beneath with dark brown spots, most dense anteriorly, often with a light median area and with more scattered spotting extending to the posterior part of the abdomen; a light vertebral stripe often present; some specimens with the back uniform gray, sharply set off from the darker sides; upper and lower lips dark with

light, often silvery, spots, rarely with dark and light bars of equal width; the silvery infratympanic stripe sometimes reduced to a row of spots.

Secondary sex characters. — Females with pigmented ova range in size from 12.6 to 24.8 mm snout to vent (mean 18.37±0.13; N=255). Although these figures are similar to the corresponding ones of the males (range 12.3-20.4 mm; mean 16.18±0.12; N=219), the difference between the means is statistically significant.

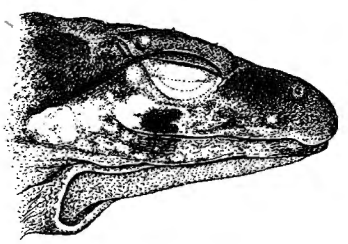

FIG. 62. — Side view of head of male *Phrynobatrachus parvulus* from Parc National de l'Upemba (×6).

PARKER (1936 A) has described an oval femoral gland in males; all adult males in the present collection have these glands. Males also have median subgular vocal sacs with bilateral slit-like openings into the mouth. Usually the vocal sac and the investing subhyoideus muscle are devoid of pigment, but in a small proportion of individuals a few melanophores may be present.

Though the gular skin is usually spotted in females, it is much darker and the pigment more or less uniformly distributed in males (Fig. 58). Some males, preserved with an inflated throat, have lighter appearing skin because the stretching separates the chromatophores. The gular skin in mature males normally has several shallow, longitudinal folds laterally and a transverse fold posteriorly. Towards the chin several whitish conical tubercles develop. Similar asperities appear on the rear of the dorsum in many, though not all, mature males.

The nuptial pad consists of a grayish velvety pile on the dorsal and median surfaces of the first finger from the wrist to the base of the first finger. Finally, a pinkish linea masculina appears sporadically along the ventral border of the obliquus muscle but, because it is covered by the pars abdominis of the pectoralis, it is not visible superficially.

With the exception of the last one, the male secondary sex characters have a relatively simple developmental relationship. The vocal sac and

TABLE 36. — **Monthly frequency of adult male *Phrynobatrachus parvulus* from the Upemba with respect to development of secondary sex characters.**

Femoral glands	Present	Present	Present	Present	Present	Present	Present	
Vocal sacs	Present	Present	Present	Present	Present	Present	Present	
Nuptial pads	Present	Present	Present	Absent	Absent	Absent	Absent	Total
Mental asperities	Present	Present	Absent	Present	Present	Absent	Absent	
Dorsal asperities	Present	Absent	Absent	Present	Absent	Present	Absent	
January	12	9	2	0	0	0	0	23
February	13	0	0	0	0	0	0	13
March	9	2	1	0	0	0	2	14
April	0	5	4	0	0	0	0	9
May	7	4	0	1	0	0	5	17
June	14	0	1	0	0	0	0	15
July	1	2	1	0	1	1	15	21
August	4	0	0	0	1	0	3	8
September	13	0	0	0	0	0	0	13
October	2	4	3	0	0	0	7	16
Total	75	26	12	1	2	1	32	149

femoral gland develop earliest. On the basis of the present material, a decision as to which of these two appears first is impossible; all males having one of these structures has the other. However, thirty-two males with vocal sacs and femoral glands lack other secondary sex characters (Table 36). The femoral gland in these particular males is rather thin though its area is not reduced.

As shown by Table 36, only four males lacking nuptial pads have mental or dorsal asperities or both, whereas thirty-eight with nuptial pads lack one or both of those characters. Three explanations of these observations are possible : (1) normally the nuptial pads develop prior to both types of asperities; (2) the asperities undergo regression whereas the pads do not; (3) a combination of (1) and (2). As Tables 36 and 37 contain little evidence of regression, we reject the last two explanations. By analogous reasoning the mental asperities appear to develop before those of the dorsum.

Ecological notes. — *Phrynobatrachus parvulus* inhabits open country south of the rain forest, for the most part in regions more than 500 m above sea level. LOVERIDGE (1933) reports it at an elevation of 2,100 m. Within the Parc National de l'Upemba, *parvulus* is present at all but the lowest elevations, the observed range being 695-1,830 m and the frequency within zones as follows :

Meters.	Individuals.
585- 750	1,270
751-1,000	1,692
1,001-1,250	11,300
1,251-1,500	245
1,501-1,750	1,945
1,751-1,830	1,788

TABLE 37. — **Monthly frequency of adult *Phrynobatrachus parvulus* from the Upemba in various stages of reproductive condition.**

	Males Secondary sex characters (*)			Females (**) Ova	
	complete	incomplete	absent	mature	immature
January	12	11	0	40	1
February	13	0	0	33	0
March	9	3	2	47	1
April	0	9	0	32	5
May	7	5	5	41	8
June	14	1	0	24	4
July	1	5	15	13	10
August	4	1	3	10	3
September	13	0	0	11	3
October	2	7	7	15	4
November	0	0	0	0	10
	75	42	32	256	49

(*) Excluding vocal sacs and femoral glands, which are present in all males listed in this table.

(**) All females 12.0 mm or larger; smallest female with mature ova 12.6 mm.

The monthly frequency of adults in various stages of reproductive condition is given in Table 37. A large proportion of males are apparently in an inactive reproductive state in July and October, but the incidence of these proportions in these particular months is probably a matter of chance since, besides the separation in time, the two months are in totally different seasons with respect to rainfall. The picture is made even more irrational by the lack of correspondence between the two sexes. September and October are months of equal sexual development for the females, whereas for the males these two months are at opposite extremes. The irregular pattern that emerges from Table 37 leads to the conclusion that *parvulus* does not have a sharply defined breeding period in the Upemba.

Range. — From the mouth of the Congo (NOBLE, 1924) eastward through Angola and southeastern Belgian Congo to central Tanganyika (LOVERIDGE, 1933) and southward to the Zambezi (WITTE, 1934, as *schoutedeni*) and northeastern South West Africa (MERTENS, 1955). WITTE (1934) also gives Buta, Lower Uelle, as a locality (see Fig. 63), but that is so far north of all other records, besides lying within the rain forest, that the identification needs confirmation.

Upemba localities and specimens :

Bunda-Bunda (2); Buye-Bala (379); Dipidi (140); Ganza (957); Kabenga (913); Kabwe (209); Kabwekanono (22); Kafwe (13); Kagomwe (84); Kakolwe (1); Kalala (9); Kalungwe (64); Kamamulongo (22); Kamatshya (90); Kambi (146); Kamitungulu (217); Kamitunu (184); Kampadika (94); Kande (30); Kankunda (1); Kanonga (949); Kanpungu (184); Karibwe (12); Kasandendeko (71); Kaswabilenga (219); Katongo (2); Kavizi (80); Kayango (2); Kaziba (5,048); Kenia (368); Kiamakoto (18); Kilolomatemba (232); Kilwezi (165); Kimapongo (64); Kimiala (28): Kipangaribwe (15); Kipondo (40); Lufira (1); Lufwa (1); Lupiala (36); Lusinga (1,106); Masombwe (1,389); Mitoto (135); Mokey (45); Mubale (21); Mukana (24); Mukelengia (18); Mukukwe (1); Munoi (167); Munte (2); Munte-Mubale (33); Pelenge (3,925); Sanga (36); Senze (214); Tumbwe (8).

35. — **Phrynobatrachus perpalmatus** BOULENGER.

Phrynobatrachus perpalmatus BOULENGER, 1898, Proc. Zool. Soc. London, **1898**, p. 479, pl. 38, fig. 1 — Lake Mweru.

Phrynobatrachus perpalmatus werneri AHL, 1924, Zool. Anz., **60**, p. 273 — El Grassi and the White Nile (Tonga, Renk, and Kaskawal).

Taxonomic notes. — No species of the genus *Phrynobatrachus* has suffered less from taxonomic confusion than *perpalmatus*. The subspecies *werneri* proposed by AHL in 1924 for the northermost populations has been referred to the synonymy by LOVERIDGE (1933). The name *werneri* was preoccupied in *Phrynobatrachus* by *P. werneri* NIEDEN (described as an *Arthroleptis*).

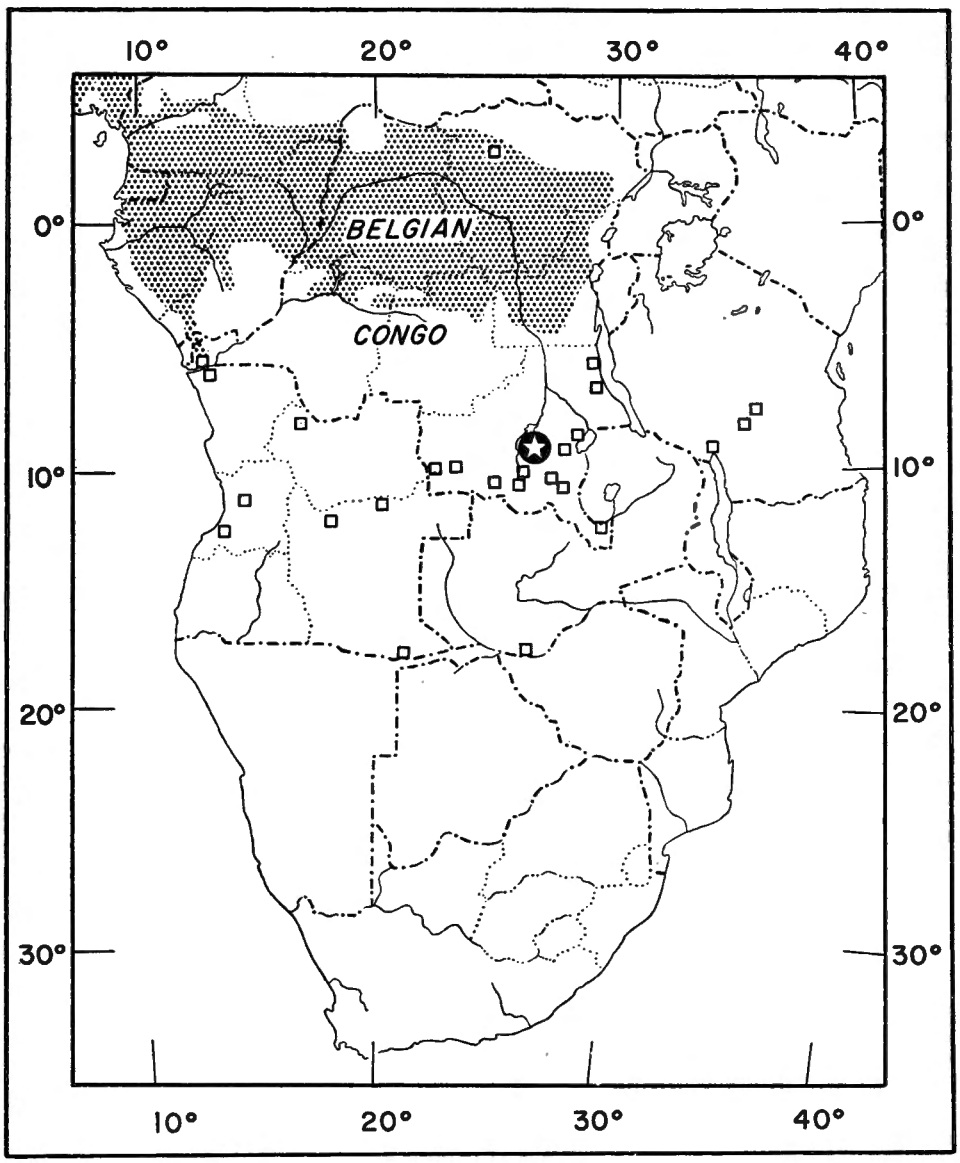

FIG. 63. — Distribution of *Phrynobatrachus parvulus*.
Parc National de l'Upemba indicated by symbol with open star.

Diagnosis. — A medium-size *Phrynobatrachus*, adults 20-30 mm; tympanum present, usually visible through skin; tips of fingers not dilated; toes with small disks having weakly indicated circummarginal grooves; toes, except fourth, broadly webbed to disks, fourth commonly with one phalanx free; no infratympanic silvery stripe; throats of females densely mottled with grayish color, of males sparsely dotted with dark pigment or immaculate whitish (Fig. 58).

Secondary sex characters. — Adult females average larger in size than males though there is much overlap. Fifty-two females containing mature ova have a snout-vent range of 20.8 to 29.2 mm and a mean of 24.29±0.24 mm. Forty-nine males having nuptial pads measure from 18.8 to 25.0 mm and have a mean of 22.44±0.19 mm.

The median subgular vocal sac of males is connected with the oral cavity through a pair of round openings at the corners of the mouth. The gular skin has no distinct folds, but usually lacks pigmentation in contrast to the dark-spotted throat of females. Feebly developed mental asperities appear in a few males; in the others they are totally lacking. A mature male has a pair of pinkish lineae masculinae, one each at the dorsal and ventral edges of the obliquus muscle. The ventral band is overlain by the pars abdominalis of the pectoralis muscle. A velvety, yellowish nuptial pad covers the dorsal and median surfaces of the first finger from its base to the beginning of the basal phalanx. No femoral gland is present.

As in other species of *Phrynobatrachus*, the vocal sac and lineae masculinae may be present when nuptial pads are absent; this occurs in 12 out of 62 males. However, the converse is never true.

Ecological notes. — *Phrynobatrachus perpalmatus* usually inhabits swampy grasslands (LOVERIDGE, 1933, 1942) and river flood plain pools (LOVERIDGE, 1953) of the savanna country though it has also been found along streams deep in rain forest territory (NOBLE, 1924). LOVERIDGE's observations indicate that swampy shores of lakes seem to be especially favorable to this frog, whose fully webbed toes are functionally related to its thoroughly aquatic habits. About three-fourths of the Upemba series was collected at Mabwe, which is on the shore of Lake Upemba.

This species evidently is confined to low and moderate elevations, the highest literature record for it being 860 m (LOVERIDGE, 1942; 2,800 feet). Altitudinal range in the Parc National de l'Upemba is limited; 2,020 specimens were taken at 585 m and 597 at 695 m. The absence of *perpalmatus* from the marshes at Mukana (1,810 m) is evidence that the meteorological conditions of high altitudes are decidedly unfavorable.

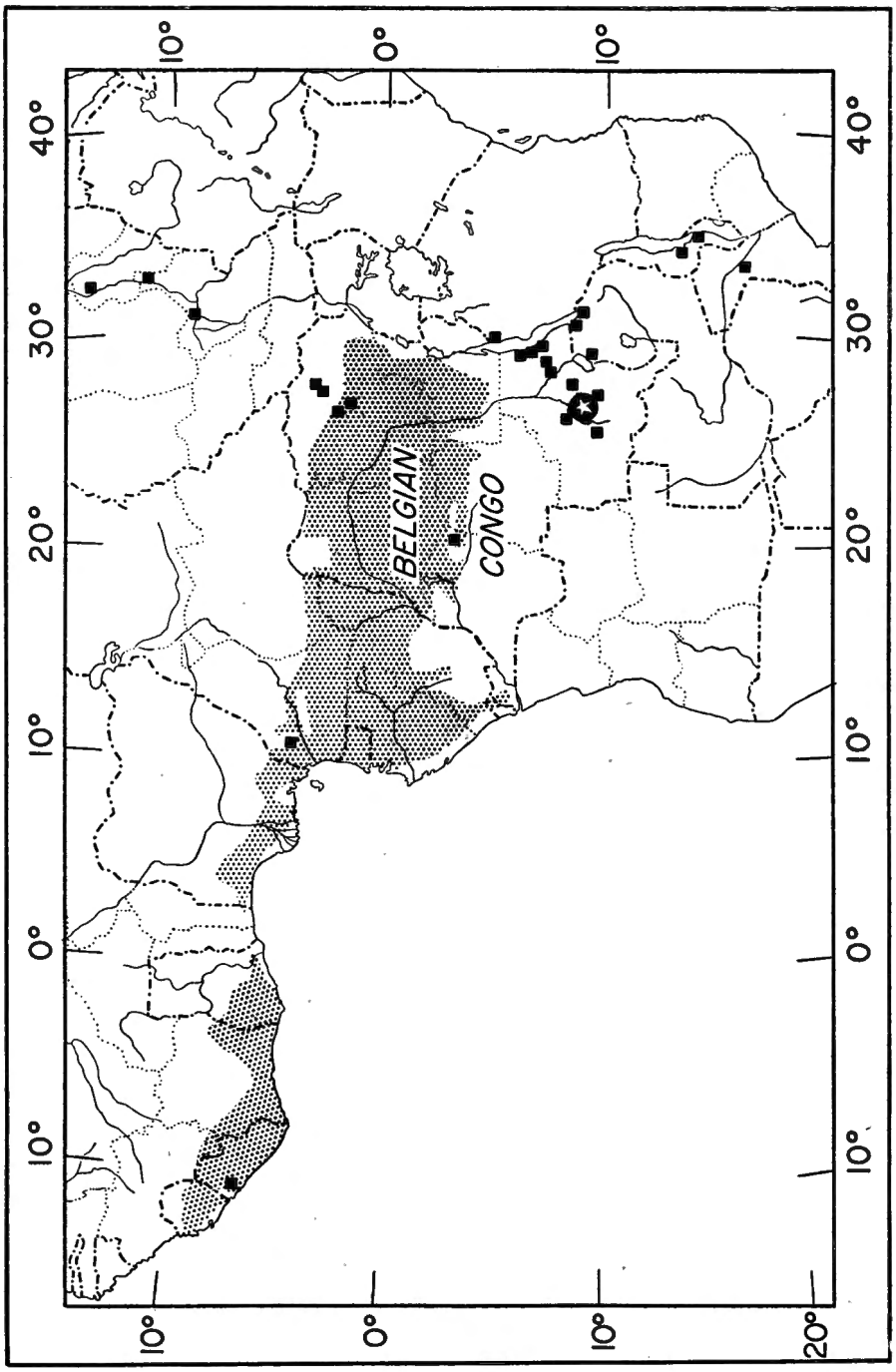

FIG. 64. — Distribution of *Phrynobatrachus perpalmatus*.
Parc National de l'Upemba indicated by symbol with open star.

Specimens were available from only a limited portion of the calendar year. However, the frequency of females with mature ova and that of males having nuptial pads (Table 38) indicate that breeding begins after September.

TABLE 38. — **Monthly frequency of adult *Phrynobatrachus perpalmatus* from the Upemba in various stages of sexual competency.**

	Males (*) Nuptial pads		Females (**) Ova	
	present	absent	mature	immature
January	17	0	15	2
February	15	0	11	0
March	—	—	1	0
July	4	2	—	—
August	—	—	1	0
September	0	7	0	16
November	11	1	11	1
December	3	2	13	6
	50	12	52	25

(*) All males having vocal sacs.

(**) All females larger than 20.8 mm (the smallest containing mature ova).

Range. — From Sudan (Fig. 64) just south of Khartoum (ANDERSSON, 1904) to central Mozambique (LOVERIDGE, 1953), and from the Rift Valley to central Belgian Congo (BARBOUR and LOVERIDGE, 1930 A). The last two authors (1930) also record *perpalmatus* from Liberia.

Upemba localities and specimens :

Kanonga (597); Mabwe (2,020).

Genus **HEMISUS** GÜNTHER.

36. — **Hemisus marmoratus** PETERS.

(Pl. VI, 3, 4, 5.)

Engystoma marmoratum PETERS, 1854, Monatsber. Akad. Wiss. Berlin, **1854**, p. 628 — Cabaçeira, Mozambique.

Hemisus marmoratus PETERS, 1882, Reise nach Mozambique, Amph., p. 173.

Taxonomic notes. — LOVERIDGE (1933) recognizes two forms, *m. marmoratus* and *m. guineensis* COPE, distinguishing them on the basis of size and relative length of foot. Males of the typical form, according to LOVERIDGE, have a snout-vent range of 24-27 mm and the females 27-33 mm. Snout-vent ranges given for *m. guineensis* are 31-36 mm and 32-52 mm for males and females, respectively. However, as LOVERIDGE lists Tanganyika localities for *guineensis* that are completely surrounded by localities he gives for the typical form, the validity of these subspecies is questionable. As indicated by Figure 63, the size-frequency distributions in the Upemba completely span LOVERIDGE's ranges and that of the males is unimodal, prohibiting a division into two groups on the basis of size. Distinct bimodality is shown by the Upemba females.

The ratio of snout-vent to foot length is given by LOVERIDGE as 1.4-1.7 in *m. marmoratus* and 1.7-1.9 in *m. guineensis*. Within the Upemba series this ratio in nine specimens has a range of 2.1-3.1 and varies roughly with size as shown by the following tabulation.

Snout-vent (mm) ..	22.0	23.4	23.5	32.0	32.0	35.6	44.3	48.8	53.7
Snout-vent/foot ...	2.1	2.5	2.1	2.6	2.7	2.8	2.4	2.6	3.1

The differences between LOVERIDGE's figures for the ratio and ours obviously stem from differences in definition of the term « foot ». Our measurement extends from the proximal edge of the metatarsal tubercle to the end of the fourth toe.

The largest frogs in the Upemba series have a distinctly mottled coloration and a conspicuous narrow light vertebral line. By contrast the smallest specimens are usually uniformly dark brownish above and lack the light line. But a smooth transition from uniform to mottled patterns can be formed by specimens of intermediate size range (27-35 mm). Frogs of this intermediate size class also usually have a faintly indicated vertebral line.

Thus all of the differences between large and small *marmoratus* seem to be associated with growth. When it is also considered that the ranges of the two forms would overlap over half the width of Africa, the subspecies of *marmoratus* appear poorly founded.

Diagnosis. — Size small to moderate (20-55 mm); habitus stocky; snout pointed, hard; hand without web or disks; toes without disks; web of foot rudimentary, not extending beyond basal subarticular tubercles; inner metatarsal tubercle enlarged, prominent, and compressed.

Color (in alcohol) dark brownish purple above, uniform (in small individuals) or mottled (in larger frogs); ventral surfaces, except throat (see below), cream-colored.

Secondary sex characters. — Females attain greater lengths then males (Fig. 65). Considering only the 33 containing enlarged ova, the females of the Upemba series range from 29.0 to 55.2 mm and have a mean of 37.30±1.32 mm. The 51 males with developed secondary sex characters have a range of 21.7-39.3 mm and a mean of 27.78±0.52 mm.

The gular region in both sexes has a dusky area at the tip of the chin and a faint dusky streak paralleling each jaw. During the breeding season, the entire gular region in males becomes intensely black and the skin is thrown into folds by the activity of the underlying vocal sac.

The vocal sac is a median subgular structure with a slit-like opening on each side of the tongue. Though when inactive the vocal sac is completely covered by the subhyoideus muscle, it becomes greatly enlarged during the breeding season. At that time it bulges through a transverse split in the subhyoideus and is then largely free of the muscle.

NOBLE (1924) refers to « ... a broad glandular surface covering the upper surfaces of the wrist and three inner fingers » in « breeding males ». No such modified skin nor any type of nuptial asperities are present in any Upemba male.

Larvae. — Twenty-one larvae ranging in stages from those with half-developed hind limbs to those with only a stump of tail have snout-vent lengths of 17.0-20.2 mm. The mouth parts and tail are as described by WAGER (1929). Labial tooth rows show the following variation : I : 4+4/1+1 : III (7 specimens), I : 4+4/4+4 (1). The distinctly U-shaped lower beak, the six extremely long papillae, and the peculiar thickened fins at the root of the tail confirm the identification.

These tadpoles have a broad ventral flap of skin in the anal region not shown by WAGER's drawings or photographs. This flap (Fig. 66) extends between the lateral sides of the insertions of the hind limbs and overlies the proximal half of the thighs until it is resorbed at a very late stage of development. The vent, which is dextral, opens at the end of a long tube at the juncture of the anal flap and ventral fin.

Eighteen were collected December-January and two February 28 — March 1.

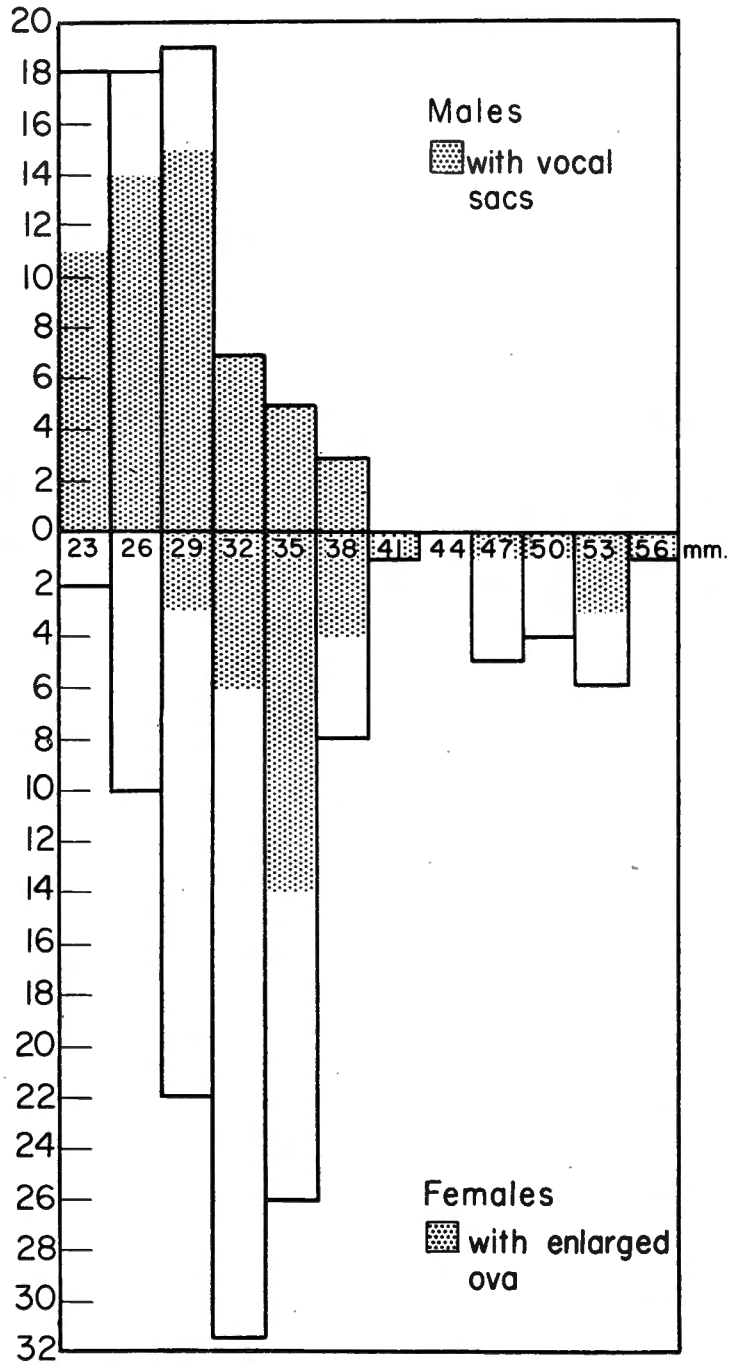

FIG. 65. — Size frequency distribution of *Hemisus marmoratus* from Parc National de l'Upemba.

Ecological notes. — With the exception of certain localities in Liberia given by CHABANAUD (1921) and a few Congo localities given by WITTE (1934), records of *Hemisus marmoratus* lie outside the belt of tropical rain forest. Indeed *Hemisus* has a typical circum-forest distribution

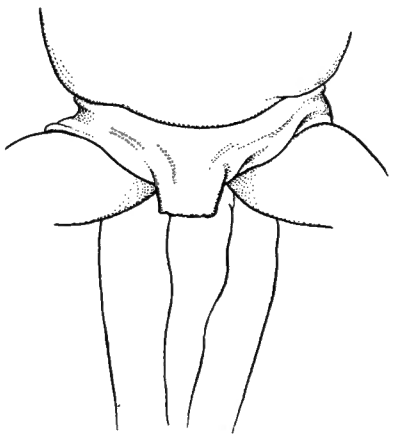

FIG. 66. — Ventral view of anal region of larval *Hemisus marmoratus* from Parc National de l'Upemba.

(Fig. 67). Altitudinal distribution in the literature runs from sea level to 1,400 m (LOVERIDGE, 1933). The Upemba series was obtained between elevations of 585 and 1,815 m with the following frequency.

Meters.	Individuals.
585- 750	175
751-1,000	12
1,001-1,250	79
1,251-1,500	15
1,501-1,750	15
1,751-1,815	3

The frequency of adults in breeding condition is very closely associated with the rainy season in the Upemba. As shown in Table 39, during the dry period males lack modified gular skin and females usually lack mature ova. With the beginning of the rains, the proportion of sexually competent individuals rises sharply.

If WAGER's estimate (1929) that metamorphosis occurs about six weeks after the eggs are laid is correct, the collection of larvae with fore-limbs

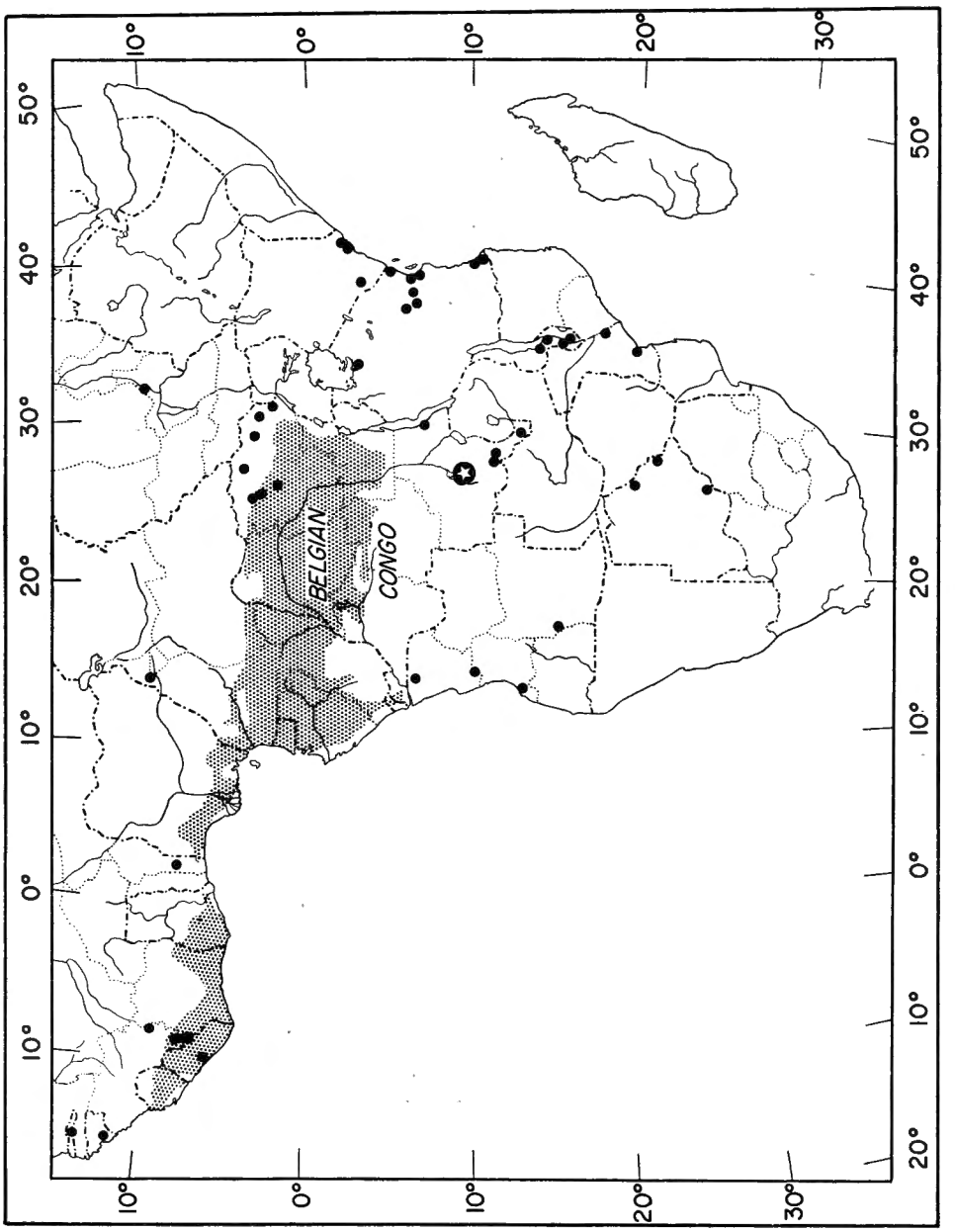

Fig. 67. — Distribution of *Hemisus marmoratus*.
Parc National de l'Upemba indicated by symbol with open star.

TABLE 39. — **Monthly frequency of adult *Hemisus marmoratus* from the Upemba in various stages of sexual competence.**

	Males Gular skin		Females (*) Ova	
	modified (**)	not modified	mature	immature
January	12	0	9	7
February	1	0	1	7
March	2	1	0	7
April	0	4	0	3
May	0	4	1	7
June	0	1	0	0
July	0	2	0	10
September	0	4	0	3
October	18	4	2	7
November	6	0	7	4
December	12	0	13	12
Summary :				
Dry season (May-September) ...	0	11	1	20
Wet season (October-April) ...	51	9	32	47

(*) All larger than 29.0 mm, the smallest with mature ova.

(**) As described in text (secondary sex characters).

erupted and tail partially resorbed in late December and late February indicates that *Hemisus* begins breeding in the Upemba in early November, if not before, and continues at least until mid-January.

Range. — In a broad belt around the rain forest region (Fig. 67) from Gambia (ANDERSSON, 1937) to Sudan, thence south to Mozambique and west through Bechuanaland (FITZSIMONS, 1935) and Angola.

Upemba localities and specimens :

Bowa (2); Kabenga (9); Kabwe (5); Kabwekanono (2); Kaswabilenga (59); Katango (1); Kateke (4); Kilwezi (4); Kipondo (1); Lufwi (1); Lukawe (2); Lupiala (1); Lusinga (14); Mabwe (113); Masombwe (68); Munoi (3); Munte-Mubale (10).

Family RHACOPHORIDAE.

Genus **LEPTOPELIS** GÜNTHER.

37. — **Leptopelis bocagei lebeaui** WITTE.

Hylambates lebeaui WITTE, 1933, Rev. Zool. Bot. Afr., **24**, p. 102 — Nyonga, Katanga, Belgian Congo.

Leptopelis bocagei haasi MERTENS, 1937, Abh. Senck. Naturf. Ges., No. 435, p. 21, fig. 2 — Nsombo, Northern Rhodesia.

Taxonomic notes. — Direct comparison of a paratype of *lebeaui* (MCZ 21674) with numerous Upemba specimens indicates that WITTE was describing juvenile frogs. The holotype has a snout-vent length of 36 mm and at this size range (37-40 mm) Upemba frogs are definitely juvenile : males lack vocal sacs and females have distinctly immature oviducts. Other specimens roughly the same size as the paratype (29 mm) have traces of recently resorbed tails.

The white lines on the upper lip and on the outer edges of the lower arm and leg gradually fade with age. But the white stripe over the vent is more persistent and is evident in four-fifths of the specimens over 35 mm long. The disks of the fingers are somewhat larger in the juveniles but PARKER (1936 C) has already called attention to the fact that the disks are proportionately larger in young *Leptopelis*.

The adults of *lebeaui* are very similar to *bocagei* of Angola (CNHM 21220-21 and various specimens in the British Museum). The close relationship of these two forms is evident in the absence of webbing between the fingers, the lack of expanded disks, size, and habitus. However, the Angolan frogs differ from the Upemba series and from individuals from Nyasaland and Northern Rhodesia (BM 1934.2.1.9; 1933.3.6.27-29; 1953.1.9.42-43) in lacking the supra-anal white line and in the form of the dorsal marking, which is a solid mass in Angolan frogs but is broken into longitudinal bands by peninsulae of ground color in the others. One form assumed by the dorsal marking in eastern *bocagei* is illustrated by MERTENS (1947) for *bocagei haasi*, which we consider a synonym of *lebeaui*.

Diagnosis. — A large species (adult males 40-50 mm; females 50-65 mm); head broader than long; tips of fingers not wider than penultimate phalanges; fingers without web; web of foot between subarticular tubercles of third and fifth toes or to bases of distal tubercles; inner metatarsal tubercle elevated, compressed, its length slightly shorter than its distance from end of first toe; usually a white line above anus; dorsal pattern usually of longitudinal bands.

Secondary sex characters. — Females attain a larger size than males. The snout-vent range for fifteen females having mature ova is 47.2-63.7 mm; the mean is 55.70±1.15 mm. For 22 males having vocal sacs the range is 37.1-48.4 mm, and the mean 44.45±0.55 mm.

Mature males have paired subgular vocal sacs with round openings in the floor of the mouth near the commissure of the jaws. Generally males larger than 40 mm have vocal sacs and those smaller do not; the only exceptions in the Upemba series are one frog with vocal sacs measuring 37.1 mm and three without vocal sacs measuring 44.4, 45.0, and 47.2 mm.

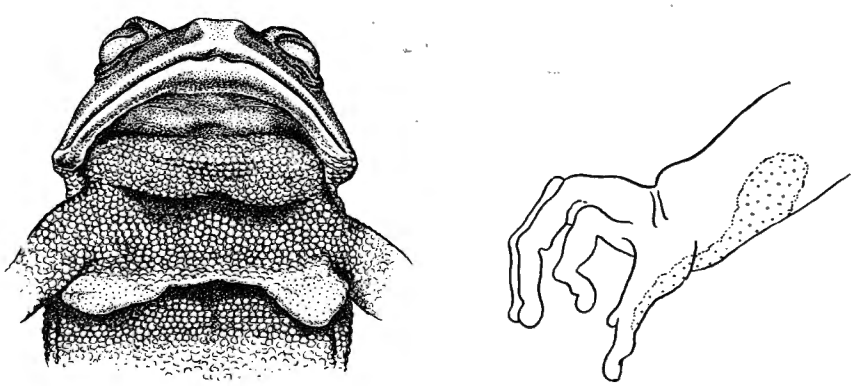

FIG. 68. — Male *Leptopelis bocagei lebeaui* from Parc National de l'Upemba.
Left, ventral view showing pectoral glands (×2).
Right, hand and lower arm showing nuptial pad (×3).

The nuptial pads (Fig. 68) consist of clusters of cream-colored glands occupying the dorsomedian surface of the first finger from its base to the level of the subarticular tubercle and extending up the inner surface of the lower arm. The pad is without spines.

Just mesad from the insertion of the arm in males is a transversely elongate pectoral gland (Fig. 68) consisting of a group of individual « glandules » identical in appearance to those forming the nuptial pads.

The vocal sacs develop before the nuptial pads or pectoral glands. No male having either or both of the last two structures is without vocal sacs. On the other hand six males having vocal sacs lack both nuptial pads and pectoral glands. Two other males with vocal sacs have feebly developed pectoral glands but no nuptial pads. Pectoral glands are absent and nuptial pads present in another male that has vocal sacs.

Larvae. — Only two tadpoles (snout-vent 15.7-20.7 mm) without erupted forelimbs were obtained. Their hind limbs are identical to

those of adults and transforming young in form and in color pattern. The body is oval in outline and somewhat depressed; the spiracle sinistral, lateral, and much closer to eye than to vent; vent tubular and dextral, opening at edge of ventral fin; fins equal to depth of muscle. The body and tail are dark blackish brown above and lighter below. The anterior two-thirds of the ventral fin is colorless. A double row of papillae extends without interruption from the lateral corner of the anterior lip around the posterior one. The labial tooth formula is I : 3+3/III in both tadpoles.

The beaks are rather weak, subequal in depth, serrated, and black in their marginal halves only. They resemble the beaks of *Leptopelis natalensis* (WAGER, 1930) and of *L. aubryi* (MERTENS, 1938), but differ radically from those of *L. maculatus* as figured by NOBLE (1926). The last are almost certainly *Kassina*, as WAGER suggests, for the exceedingly strong and acute lower beak and the small accessory horny plates described by NOBLE are characteristic of *Kassina*. Since PARKER (1930) refers tadpoles to *Leptopelis bocagei* on the basis of their having beaks agreeing with NOBLE's description, his specimens, too, are probably *Kassina*.

Ecological notes. — The distribution of *bocagei* as summarized by PARKER (1936 C) lies outside of the rain forest belt. The Parc National de l'Upemba also falls in the broad belt of savanna and gallery forest. The highest altitude recorded for *bocagei* is 1,540 m (LOVERIDGE, 1953). The Upemba series has an altitudinal range of 585-1,810 m with the following frequency distribution :

Meters.	Individuals.
585- 750	100
751-1,000	5
1,001-1,250	130
1,251-1,500	4
1,501-1,750	47
1,751-1,810	5

The number and monthly distribution of adults are inadequate for determination of the breeding season. However, the relative abundance of females with mature ova (Tabe 40) suggests that the breeding period ends in the middle of the rainy season (October-April). No such pattern emerges from the distribution of sexually competent males.

Range. — PARKER (1936 C) gives the range of *bocagei* as running from Ethiopia to Northern Rhodesia and Tanganyika in the south and to Angola in the east. But since his Ethiopian record seems to be based on a misidentification (see above), *bocagei* probably does not occur north of Kenya and the Belgian Congo. The range of the subspecies *lebeaui* includes with certainty only Northern Rhodesia, Nyasaland, and eastern Belgian Congo.

TABLE 40. — **Monthly frequency or adult *Leptopelis bocagei lebeaui* from the Upemba in various stages of sexual competence.**

	Males Secondary sex characters (*)			Females (**) Ova	
	complete	incomplete	absent	mature	immature
January	5	0	0	2	6
February	1	0	3	0	7
March	—	—	—	0	3
May	0	0	1	—	—
September	—	—	—	2	2
October	5	0	0	2	0
November	2	1	1	4	1
December	2	2	1	5	5

(*) Pectoral glands and nuptial pads. All have vocal sacs.

(**) All over 47.0 mm. Smallest with nature ova 47.2 mm.

Upemba localities and specimens :

Kabwe (2); Kafwe (1); Kande (3); Kanonga (12); Kaswabilenga (46); Kateke (4); Kaziba (129); Lufwa (46); Lupiala (2); Lusinga (4); Mabwe (37); Masombwe (1); Mubale (1); Munoi (1); Munte-Mubale (2).

38. — **Leptopelis parvus** n. sp.

Holotype. — Institut des Parcs Nationaux du Congo Belge number 828. An adult male collected at Kande, Parc National de l'Upemba, Belgian Congo, October 4-7, 1947, by the Mission G. F. DE WITTE.

Diagnosis. — A small species (adult males 27-32 mm, adult females 45-48 mm) with head broader than long, tips of outer fingers (Fig. 69) distinctly dilated, fingers without web, inner metatarsal tubercle large and compressed, no white line above anus, and dorsal pattern obscure.

Description of holotype. — Habitus stocky (Fig. 69); head broader than long; snout longer than eye, obtuse, profile almost vertical; nostril closer to tip of snout than to eye; canthus rostralis obtuse; lores weakly concave, oblique, deeper than long; interorbital wider than upper

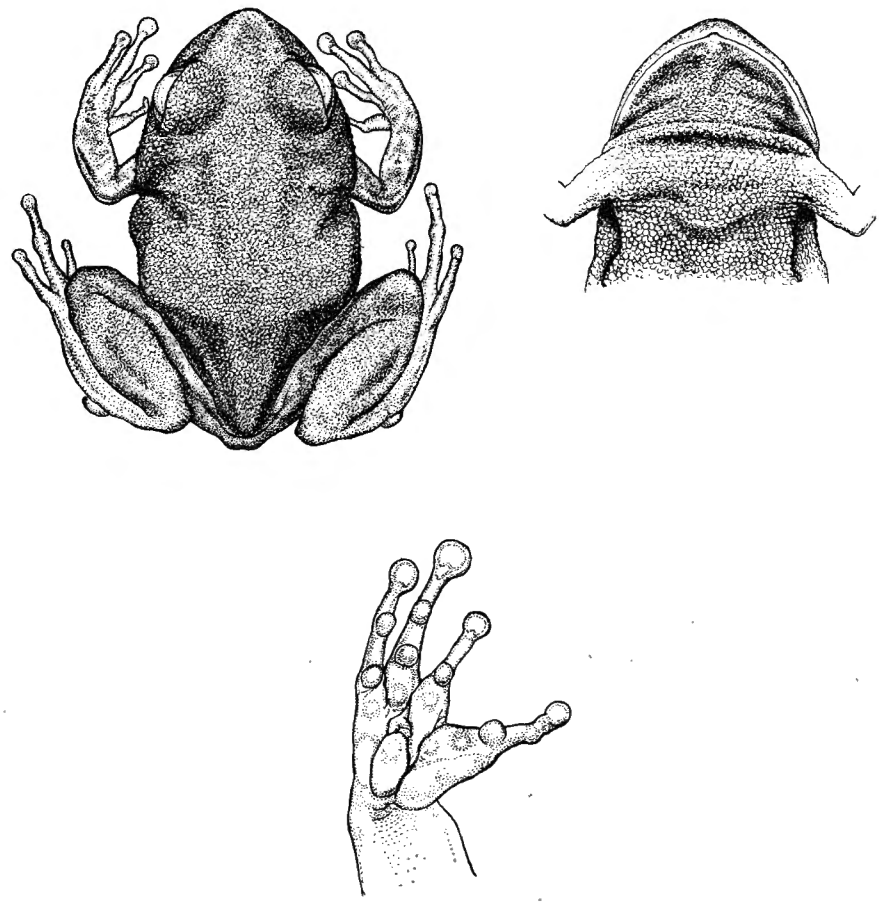

FIG. 69. — Male paratype of *Leptopelis parvus* new species.
Left, dorsal view (×2). Right, ventral view (×2). Below, underside of band (×4).

eyelid; tympanum distinct, two-fifths eye diameter, separated from eye by one-third of its diameter; vomerine teeth in two widely separated, oblique groups.

Tips of third and fourth fingers distinctly dilated into disks having circummarginal grooves; fourth finger extending beyond second which extends beyond first; fingers without web; subarticular tubercles prominent. Tips of four outer toes with circummarginal grooves; tips scarcely wider than penultimate phalanges; fifth toe slightly longer than third; web reaching base of subarticular tubercles of first and second toes, base of distal subarticular tubercles of third and fifth toes, and base of middle

tubercle of fourth toe (on outer edge); inner metatarsal tubercle very prominent, compressed, its length slightly shorter than its distance from end of first toe; no outer metatarsal tubercle.

Skin above rather coarsely shagreened, becoming coarsely granular on sides, and very roughly granular below; a group of large tubercles below tympanum.

Color (in alcohol) chocolate brown above, cream-colored below; an obscure dark interorbital marking; faint dark markings on dorsal surfaces of limbs; immaculate below; no light lines above anus or along outer edges of limbs.

Openings of vocal sacs in floor of mouth; glandular nuptial pad on lower arm and at base of first finger; no pectoral gland (Fig. 69).

Measurements of holotype (mm) : Snout-vent 31.8; head width 12.7; head length 11.9; tibia 12.4.

Paratypes. — All of the following specimens were collected in or immediately adjacent to the Parc National de l'Upemba : IPN 824, 832 A (2), 833, 834 (2), 835 A (2), 838-845 (9), 847.

Aside from secondary sex characters, which are discussed below, the paratypes are very similar to the holotype. All have distinct disks on the outer fingers and no light lines on appendages or above the vent. In three specimens the web does not quite reach the distal subarticular tubercle of the third toe. A more clearly defined interorbital triangle is evident in several paratypes.

Secondary sex characters. — Only three females with enlarged ova are included in the present series and they range from 45.2 to 47.4 mm, snout to vent, with a mean of 46.10 mm. The males are distinctly smaller, the 12 with vocal sac openings varying from 27.2 to 31.8 mm (mean 29.25 ± 0.49 mm).

Males have paired subgular vocal sacs with round openings situated close to the mandible near the commissure of the jaws. The nuptial pads are cream-colored clusters of glands, each of which is distinguishable. The pads cover the dorso-median surface of the first finger but do not extend beyond the level of the subarticular tubercle. Instead the nuptial pad extends up the median border of the lower arm for varying distances. Pectoral glands common in other *Leptopelis* (Fig. 68) do not occur in *parvus* (Fig. 69) males.

Comparisons. — *Leptopelis parvus* is most similar to *viridis* (*sensu* PARKER, 1936 C), which is also small, has distinct digital disks, and lacks webbing between the fingers. However, the type of *viridis*, which we have examined, has a white mark at the heel and over the anus. Other West African *viridis* examined in the British Museum have white lines

TABLE 41. — **Distribution of secondary sex characters in males of** *Leptopelis viridis* **and** *L. parvus*.

Species	Locality	Snout-vent (mm)	Vocal sac (*)	Nuptial pad (*)	Pectoral gland (*)
parvus	Upemba	31.8	X	X	O
parvus	Upemba	31.3	X	X	O
parvus	Upemba	28.2	X	X	O
parvus	Upemba	31.6	X	X	O
parvus	Upemba	29.7	X	O	O
parvus	Upemba	28.2	X	X	O
parvus	Upemba	27.5	X	X	O
parvus	Upemba	27.2	X	X	O
parvus	Upemba	30.8	X	X	O
parvus	Upemba	28.4	X	X	O
parvus	Upemba	27.5	X	X	O
parvus	Upemba	28.8	X	X	O
viridis	Portuguese Guinea	33	—	—	X
viridis	Portuguese Guinea	38	—	—	X
viridis	Sierra Leone	33	—	—	X
viridis	Sierra Leone	—	X	—	X
viridis	Sierra Leone	—	X	—	X
viridis	Sierra Leone	34.9	X	O	X
viridis	Liberia	33.4	X	O	X
viridis	Liberia	37.4	X	O	X
viridis	Ivory Coast	33.4	X	O	X
viridis	Gold Coast	39.8	X	O	O

(*) X = present. O = absent.

along the outer edges of the lower arm and tibia and above the anus. Males of *viridis* also differ from male *parvus* in having distinct pectoral glands and in being slightly larger (see Table 41). The differences between males of the two forms is not a function of maturity, for the *parvus* males have nuptial pads and are clearly mature.

Of the remaining *Leptopelis* without web between the fingers, *anchietae*, *bocagei*, and *jordani* are much larger (females about 60 mm) and the last two have white lines on the appendages and above the anus. Neither *anchietae* nor *bocagei* has expanded finger tips. *Leptopelis concolor* AHL has a smaller metatarsal tubercle and its males have pectoral glands.

Ecological notes. — All *parvus* available were caught in the interval October-December, which falls in the rainy season. The presence of enlarged ova in the three largest females and the development of nuptial pads suggest that breeding may take place at that time.

Three specimens were collected at elevations between 700 and 800 m, 7 at 960 m, and 9 at 1,300 m.

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

Upemba localities and specimens :

Kaluwamba (1); Kande (1); Kankunda (9); Kaswabilenga (1); Kateke (7).

Genus **KASSINA** GIRARD.

39. — **Kassina senegalensis** DUMÉRIL and BIBRON.

(Pl. VI, 6.)

Cystignathus senegalensis DUMÉRIL and BIBRON, 1841, Erp. Gén., **8**, p. 418 — Galam, Senegal.

Kassina senegalensis GIRARD, 1853, Proc. Acad. Nat. Sci. Phila., **6**, p. 421.

Taxonomic notes. — LAURENT (1957 A) divides this wide ranging frog into northern and southern species, the former retaining the name *senegalensis* and the latter being assigned the name *argyreivittis* PETERS. The separation is based upon color pattern and body proportions. As has been shown by ANDERSSON (1911), the length of limbs, one of LAURENT's characters, is subject to considerable change during growth. In the absence of Sudanese material, we are unable to confirm or reject LAURENT's proposal. We retain the older name provisionally solely for conservative reasons.

Diagnosis. — Size small, snout-vent length 20 to 41 mm. Body form elongate, head rounded, without distinct canthus rostralis, hind limbs short; vomerine teeth in small groups between the choanae; tongue large, oval, emarginate behind; tympanum usually distinct, often obscured by thickened glandular skin; fingers and toes slender, without disks; fingers without webs, very distinct subarticular tubercles; very short webs between the third and fourth and fourth and fifth toes; a well-defined somewhat

pointed inner metatarsal tubercle and a very small outer one. Skin smooth above anteriorly, somewhat obscurely granulate posteriorly, smooth on throat and breast in females, coarsely granulate on the ventral surfaces farther behind (see secondary sex characters).

Coloration (in alcohol) pale brown with a conspicuous pattern of dark brown longitudinal lines or rows of spots; pale ground color reaching the border of the mouth at the tip of the snout between large brown labial markings; dark lines or spots ordinarily in a mid-dorsal, a pair of dorso-lateral, and a pair of lateral lines; the limbs boldly cross-barred; the spots or lines more or less distinctly outlined by a silvery line; white or creamy-white beneath, except for the dark throat in males.

Secondary sex characters. — Females and males are approximately the same size. Observed range for adult females (all those larger than the smallest containing mature ova) is 32.4-39.3 mm, for males with black gular pouches (see below) 30.0-41.0 mm. The means are 35.10 ± 0.82 ($N=10$) and 35.41 ± 0.31 ($N=58$), respectively.

The males are without evident modification of the fingers, but have a distinct gland on the inner surface of the forearm, set off by absence of pigmentation. The ventral skin of males is much more rugose than that of females, the rugosity extending from the throat to the proximal half of the lower surface of the thighs, whereas in females the anterior half of the ventral surfaces is smooth, and the rugosity on the posterior surfaces is less developed.

The females have two pairs of distinct fleshy lobes at the anus, as described and figured by Witte (1934, p. 184, pl. 8, fig. 3 c). The figure cited does not adequately depict the nature of these lobes, which are fringed with well-developed papillae, with a second parallel row of smaller papillae. The individual deposition of the eggs described by Power (1926) suggests the papillate lobes may function to hold the egg until it is attached. It is interesting to find this structure equally well developed in a specimen of *Mocquardia obscura* in the collections of Chicago Natural History Museum.

The remarkable gular pouch (Fig. 70) of males of *Kassina senegalensis* has been described as consisting of a central « adhesive disc » with lateral pouches. The somewhat thickened middle part, which extends as a broad strap-like band from close to the anterior margin of the lips to a point on the throat opposite the tympanum, is quite certainly without adhesive function. On either side of the strap-like portion the very black skin is withdrawn in wrinkled folds of much thinner membrane, which then fits into depressions in the muscle at the rear. Inflation of the sac is by expansion of the internal vocal sac, which is accomplished in two stages, producing first a globular central pouch after which the lateral skin

evaginates to form a pair of lateral smaller pouches (as described by POWER, 1926). POWER describes the central pouch as white, which is not the case in our specimens, and it is not, in fact, shown as white in his figure.

Larvae. — One tadpole (snout-vent 8.1 mm) without hind limb buds agrees with NOBLE's figure (1926) of the oral disk and POWER's figure (1926) of the whole tadpole. The high dorsal fin originating far forward on the body, the extremely large oblique lower beak, and the small horny plates parallel to the latter are diagnostic.

Forty-two larvae having erupted fore limbs and at least a stump of a tail vary in snout-vent length from 15.7 to 20.7 mm.

Ecological notes. — *Kassina senegalensis* is obviously, from the great number of records of its collection, a frog of the savanna region, but many details of its mode of life remain to be recorded. The altitudinal distribution in Parc National de l'Upemba is :

Meters.	Individuals.
500- 750	5
751-1,000	2
1,001-1,250	7
1,251-1,500	56
1,501-1,750	224
1,751-1,830	89

Only seven females contained mature ova. Five were obtained in January, one in November, and one in December. The limbless larva noted previously was caught in January and those with erupted forelimbs in January through June. Assuming that development in the Upemba takes place at the same rate detrmined by POWER (1926) for Bechuanaland larvae, the metamorphosing larvae represent eggs laid in October or November through March.

Range. — *Kassina senegalensis* is recorded from almost the whole of the savannas and deserts of Africa south of the Sahara. The species is occasionally recorded from the rain forest, but it is certainly no more than a casual entrant within the borders of the forest region proper.

Upemba localities and specimens :

Buye-Bala (44); Bwalo (64); Kabwe (13); Kabwekanono (18); Kalumengongo (4); Kanonga (1); Katango (6); Kateke (1); Kankunda (1); Kazibwa (3); Kenia (1); Lufira (1); Lufwa (1); Lusinga (144); Mabwe (4); Manda (1); Masombwe (3); Mubale (6); Mukana (8); Munoi (1); Munte-Mubale (42); N'Gongazi (2); N'Gozie (1); Pelenge (1).

40. — **Kassina wittei** LAURENT.

Kassinula wittei LAURENT, 1940, Rev. Zool. Bot. Afr., **33**, p. 314, fig. 1-2 — Kansenia, Katanga.
[*Kassina wittei*] LAURENT, 1950, *idem*, **43**, p. 269.

Taxonomic notes. — We follow LAURENT in dropping the generic distinction from *senegalensis* of the well-defined small species *wittei*. It is evident that a review of the species now recognized as members of the genus *Kassina* and distinct from *senegalensis* is much to be desired, but with only *wittei* available for examination we are unable to pursue this problem. *Mocquardia*, for the Abyssinian species *obscura* BOULENGER, *kounhiensis* MOCQUARD, and *abyssinica* PARKER, may be recognized, though evidently closely related to *Kassina*.

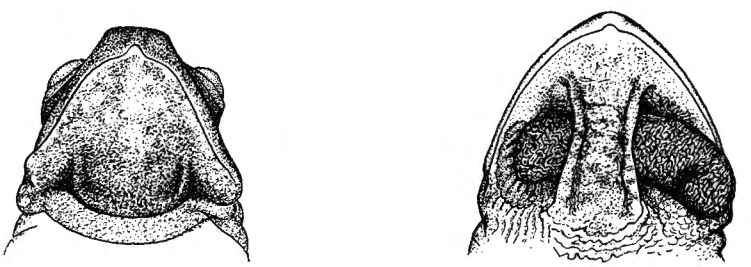

FIG. 70. — Ventral views of male *Kassina wittei*, left (×5), and *K. senegalensis*, right (×3).

The original description of *Kassinula wittei* was based on a specimen only 14 mm in length, with two paratypes of 12.5 and 13.0 mm. The figure, which excellently depicts the distinctive color pattern, exaggerates the length of the hind leg, which in the text is said to have the tibia contained 2-1/5 to 2-1/3 times in the snout vent length. The new material available from the Upemba region consists of two males with recognizable vocal sacs and five presumably subadult females. The two males measure 17.3 and 19.5 mm in snout-vent length, the five females from 18.4 to 21.4 mm. The tibia amounts to 0.41 of the snout-vent length in the smaller male, and only 0.35 in the larger one. In females the ratio of tibia to snout-vent length is 0.38 in the smallest specimen and 0.32 in the largest. Thus the ratios of 0.43 and 0.45 in the type series fall into line with the decrease of the relative length of hind limbs with growth to be expected in species of *Kassina*, from the change in this respect known in *senegalensis*. Our adult specimens entirely lack vomerine teeth.

Diagnosis. — Size small, transforming at about 12 mm snout-vent length, adult at 20-22 mm; habitus of *Kassina senegalensis* when adult, legs relatively longer in juveniles; no vomerine teeth; digits slender, without discs; subarticular tubercles obscure; union of the outer metatarsals prolonged as union of the basal phalanges, with a very short web between the fourth and fifth and third and fourth toes; no tarsal fold; two metatarsal tubercles; skin smooth except for the posterior part of the belly, where it is feebly granular.

Color pattern of the dorsum a complex system of light and dark brown longitudinal bands; each of the light bands bisected by a narrow dark line; limbs dark, with a darker brown longitudinal band on the tibia; belly light.

Secondary sex characters. — Females are apparently slightly larger than males, the snout-vent ranges in this small series being 18.4-21.4 and 17.3-19.5 mm, respectively. Males have a dark throat and strongly developed vocal sac, like that of *Kassina senegalensis*, but shorter and with a straight transverse fold directly behind it (Fig. 70). Males lack indication of a gland on the forearm. Females have the anal lobes of *senegalensis*, but these structures are without fingerlike papillae in the specimens at hand.

Ecological notes. — The Upemba series of seven comes from altitudes of 1,700 to 1,750 m, thus with the strong indication that *wittei* is confined to the higher altitudes. The smaller of the adult males was collected January 15, 1948, the remaining specimens in April.

Range. — Known only from the Upper Katanga (Kansenia, Kando, and Kanzenze) and from higher altitudes in the Upemba area.

Upemba localities and specimens :

Bwalo (1); Lufwa (1); Mukelengia (5).

Family PHRYNOMERIDAE.

Genus **PHRYNOMERUS** NOBLE.

41. — **Phrynomerus bifasciatus** SMITH.

Brachymerus bifasciatus SMITH, 1849, Ill. Zool. South Africa, Rept., pl. 63 — east and north east of Cape Colony.

Phrynomerus bifasciatus NOBLE, 1926, Amer. Mus. Novit., No. 212, p. 20.

Taxonomic notes. — WITTE and LAURENT (1942) consider *microps* PETERS to be a sub-species of *bifasciatus* because the only difference between the two forms was coloration. Although *bifasciatus* exhibits much

individual variation in color, the basic pattern remains a dark back with two conspicuous reddish or yellowish dorsolateral stripes (Fig. 71). *Phrynomerus microps*, however, has a reddish dorsum with one or two small black spots or lines (Fig. 71). The two forms also differ in the relative size of the raised coccygeal glandular mass. In twenty *bifasciatus* the width of the glandular area varies from 0.14 to 0.20 (mean 0.168±0.003) of the snout-vent length. In the six *microps* examined (all topotypes), the proportion varies from 0.20 to 0.29 (mean 0.243).

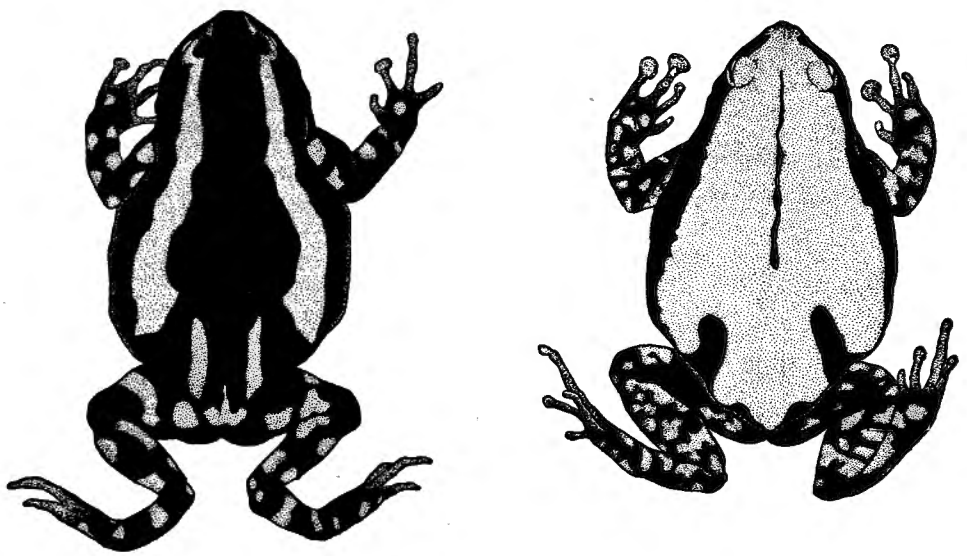

FIG. 71. — Dorsal views of *Phrynomerus bifasciatus* (left, ×1) and *P. microps* (right, ×1).

With one exception the distribution of *microps* lies to the north and northeast of the rain forest whereas that of *bifasciatus* (Fig. 72) lies south and east of the forest. The exceptional locality is Mkero, Massai Steppe, Tanganyika, given for *microps* by TORNIER. However, the specimens listed by TORNIER were juveniles and, since the coloration of the young does not resemble that of adults (LOVERIDGE, 1925), the identification is open to question.

Since the differences between *bifasciatus* and *microps* are of the order of magnitude distinguishing other species, e.g., *affinis* BOULENGER, from *bifasciatus*, *microps* should be treated as a full species.

Diagnosis. — Habitus stocky, hind limbs short; snout blunt; tympanum faintly visible through skin. Fingers long, tips dilated into

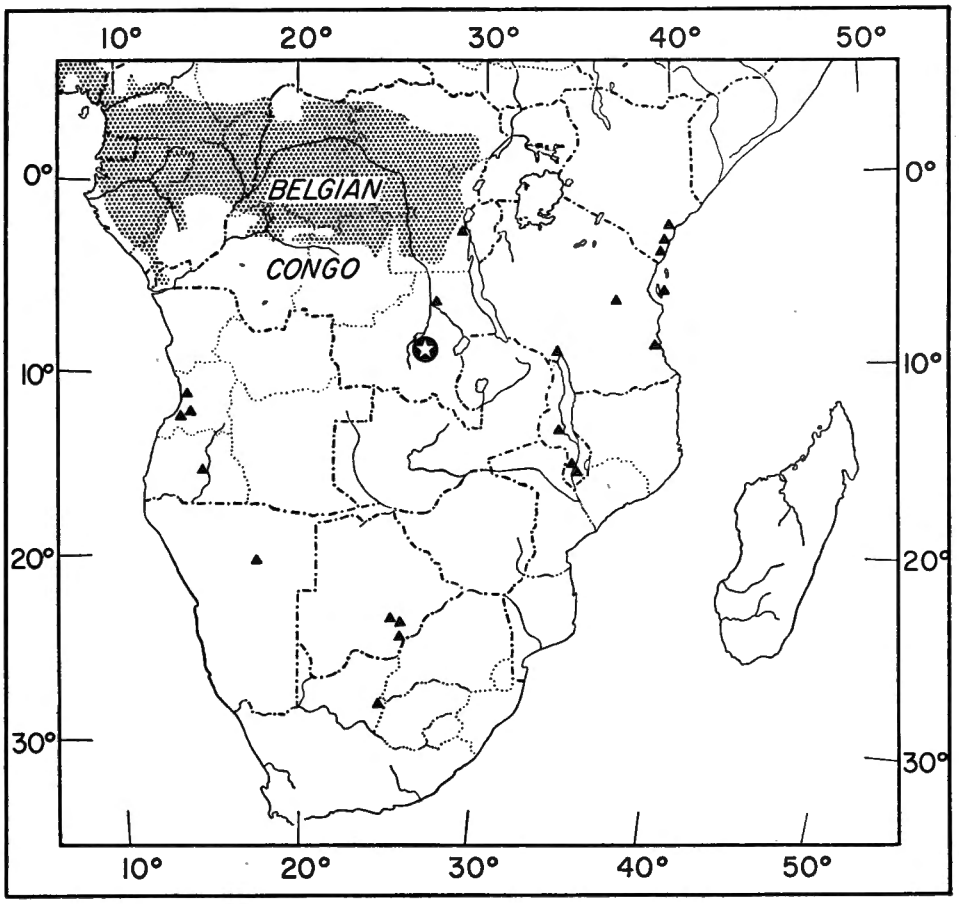

FIG. 72. — Distribution of *Phrynomerus bifasciatus*.
Parc National de l'Upemba indicated by symbol with open star.

broad, truncate disks; palmar tubercles feeble; toes without web; a distinctly raised coccygeal glandular mass.

Color (in alcohol) purplish black above and on sides with broad pinkish or yellowish (red in life) dorsolateral stripes; a similarly light-colored U or blotch on coccygeal gland; light spots on back present or absent.

Secondary sex characters. — Females are distinctly larger, having a snout-vent range of 49.8-59.2 mm and a mean of 54.92±0.84 mm (N=16) as compared to the males' 42.0-50.1 and 45.93±0.34 (N=35). Only females containing ripe ova and males with fully developed sex characters are included in the preceding.

Our examination confirms LIU's statement (1933) tat male *bifasciatus* have median subgular vocal sacs with slit-like openings on each side of the mouth. In mature males the gular skin is black and rugose, contrasting with the brown and white spotted throats of females and immature males. In addition, adult males have reddish lineae masculinae at each border of the obliquus muscle.

One evidently immature male (38.1 mm) has no vocal sac or lineae masculinae. The gular skin resembles that of a female. Three larger males (40.0-47.0 mm) have fully developed vocal sacs and lineae masculinae, but their throats are like the females.

Ecological notes. — *Phrynomerus bifasciatus* inhabits the open country east and south of the equatorial rain forest. It breeds in shallow water, forming large aggregations (LOVERIDGE, 1925). Of the 21 adult females in the Upemba collection, 16 contained ripe ova; all were collected during the period November-January, in the rainy season. The condition of the males (see above) indicates active breeding.

All Upemba specimens were caught at the lowest elevation in the park — 585 m.

Range. — From Angola to Kenya, south to Natal (Fig. 72).

Upemba locality and specimens :

Mabwe (117).

CONCLUSION

ZOOGEOGRAPHIC RELATIONS.

The geographic distribution of the species contained in the Upemba collection (3) is given in Table 42. The division of Africa into faunal regions has been attempted many times, including once by the senior author (1923). The scheme presented now (Fig. 73) differs from that earlier one in containing more divisions corresponding to a finer division of the vegetation (modified from GOODE's School Atlas, New York, Rand McNALLY and Co., 1930, and BOUGHEY, 1957). For example, we now distinguish between the large area (V) dominated by savanna forest stretching from central Angola through Northern Rhodesia and central Tanganyika and the less wooded areas to the north (IV) and east (VII).

We also distinguish the semi-arid and arid region of southwestern Africa (XIII) and the temperate savanna and woodland at the extreme south (XIV, XV) from the tropical savannas. Contrary to the earlier paper, the grasslands of eastern Tanganyika are not separated from the similar formation in Mozambique, a decision justified by the similarities in vegetation and climate. For purposes of exposition, we have made arbitrary divisions between the western and eastern portions of the Sudan savanna and between the latter and the East African grasslands.

NOBLE's (1924) zoogeographic division of Africa is not suitable for present purposes because his separation of Angola and the Katanga runs counter to the distribution of many Upemba forms. On the other hand, the lack in NOBLE's system of a distinction between savanna and savanna forest regions obscures one aspect of the ecological distribution of the species with which we are concerned.

CHAPIN (1932) also divided Africa into faunal zones. Since his scheme was based upon roughly the same vegetational zones as ours, the two sets of faunal divisions correspond closely.

Zones XI and XII in the north, and XIII and the western half of XIV in the south are semi-arid, scrubby grasslands having less than twenty inches of rainfall annually. Zone X is primarily an area of temperate deciduous brush and woodland with some grassland. Zone VI is a region

(3) Unless otherwise stated the genera *Afrixalus* and *Hyperolius* are ommitted from the discussion. These two difficult genera have been reported on by LAURENT (1957).

TABLE 42. — **Distribution of Upemba species**
For definition of zones

Species	I	II	III	IV	V
Xenopus laevis	..	..	+	+	+
Bufo carens	..	..	..	+	+
B. funereus	..	+	+	+	+
B. lemairei	..	..	..	+	+
B. regularis	+	+	+	+	+
B. ushoranus	..	..	..	..	..
Rana tuberculosa	..	..	..	+	+
R. ornata moeruensis	..	..	..	+	+
R. fuscigula	..	..	+	+	+
R. albolabris	+	+	+	+	+
R. frontalis	..	..	..	..	+
R. grandisonae	..	..	..	+	+
R. ansorgei	..	..	..	..	+
R. chrysogaster	..	..	..	+	+
R. mascareniensis	+	+	+	+	+
R. oxyrhyncha	+	+	+	+	+
R. subpunctata	..	..	..	+	+
R. porosissima	..	..	..	+	+
R. taenioscelis	..	..	..	..	+
R. superciliaris	+	..	+	..	+
R. uzungwensis	..	..	..	+	+
Arthroleptis stenodactylus	..	..	..	..	+
A. globosa	..	..	..	..	+
Cacosternum leleupi	..	..	..	..	+
Phrynobatrachus gutturosus	+	..	..	..	+
P. natalensis	+	..	+	+	+
P. parvulus	..	..	+	+	+
P. perpalmatus	+	..	+	+	+
Hemisus marmoratus	+	+	+	+	+
Leptopelis bocagei	..	..	..	+	+
Kassina senegalensis	+	+	+	+	+
K. wittei	..	..	..	..	+
Phrynomerus bifasciatus	..	..	..	+	+

of amphibians outside the limits of the park.
see Figure 73.

Zones									
VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV
+	+	+	..	..	..	..	+	+	+
+	+	..	..	..	..	..	+	+	..
+	..	+	+	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..
+	+	+	+	+	+	+	+	+	+
..	+	..	..	..	..	..	..	..	..
+	..	..	..	..	..	..	..	..	..
..	+	+	+	..	+	..	+	..	..
+	+	+	..	..	..	..	+	+	+
+	..	+	+	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..
+	..	..	..	..	..	..	..	..	..
+	+	..	..	..	..	..	+	+	..
+	..	..	..	..	..	..	..	..	..
..	+	+	..	+	..	..	+	+	..
..	+	+	..	+	..	..	..	+	..
..	..	..	..	..	..	..	..	..	..
+	+	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..
+	+	..	..	+	+	..	+	+	..
+	+	..	..	..	..	..	..	..	..
..	+	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..
+	+	+	+	+	..	..	+	+	+
..	+	..	..	..	..	..	..	..	..
+	+	+	..	..	..	+	..	..	..
..	+	+	+	..	..	..	+	..	..
..	+	+	..	..	..	..	..	..	..
+	+	+	+	..	..	+	+	+	+
..	..	..	..	..	..	..	..	..	..
+	+	..	..	..	..	..	+	+	..

of high altitude grassland and scattered montane forests; the boundary between it and zone VII is somewhat arbitrary. Zones I, II, and III are lowland rain forest. Though the second two are separated by the Congo-Ubangi River, a number of the Cameroons-Gabon genera are not recorded east of the Ubangi. The other zones are defined above.

Finally, we make no claim of universality for the faunal zones of Figure 73. However, the distribution of the Upemba species in this scheme forms a rational and expected pattern.

The great preponderance of records on which Table 42 is based have been taken from many sources. Literature identifications unaccompanied by descriptive notes should always be regarded with scepticism. But in the cases of common wide-spread species untainted by taxonomic confusion (for example, *Bufo regularis*), little danger is risked in accepting literature records. We have avoided using literature reports of other names, such as *Rana mascareniensis*, that are known to have been collecting grounds for many valid species. Where valid reasons for doubt existed, we rejected a literature record.

Because of this limitation, some of the distributions in Table 42 are incomplete. A good example is the range of *Rana superciliaris*, only lately resurrected from the synonymy of *mascareniensis* by GUIBÉ and LAMOTTE (1955 A). The range in the table (and in Fig. 48) is based entirely on specimens we have examined. Since the type locality is in Sierra Leone (zone I) and since we have many specimens from zones V-VII, the species is certain to occur in the Sudanese savannas (zones VIII and IX). For similar reasons we expect the known range of *Rana porosissima* to be extended considerable.

As the Parc National de l'Upemba lies on the boundary between zones IV and V, one expects species occurring in the Upemba to be found in both zones. Excluding the six species described above as new and to date known only from the park, all but one Upemba species have been recorded from zone V previously. The exception is *Bufo ushoranus* known from zone VII in Tanganyika (LOVERIDGE, 1932). On the other hand, only 23 Upemba species have been reported from zone IV.

In general the number of Upemba species known from other zones diminishes with increasing distance so that, for example, 20 occur in zone VII (East African grasslands), 13 in zone VIII (eastern Sudan grasslands) and 7 in zone IX (western Sudan grasslands). The climatic and vegetational characteristics of the zones are factors modifying the influence of distance in the distributions shown in Figure 73. The semi-arid Somaliland grassland (zone XI) is only slightly more distant from the Parc National de l'Upemba than the eastern Sudan savanna (zone VIII) and is considerably closer than the western Sudan (zone IX). Yet zone XI has only one-fourth as many Upemba species as zone VIII and about one-half as many as zone IX. The reduction in numbers of Upemba species

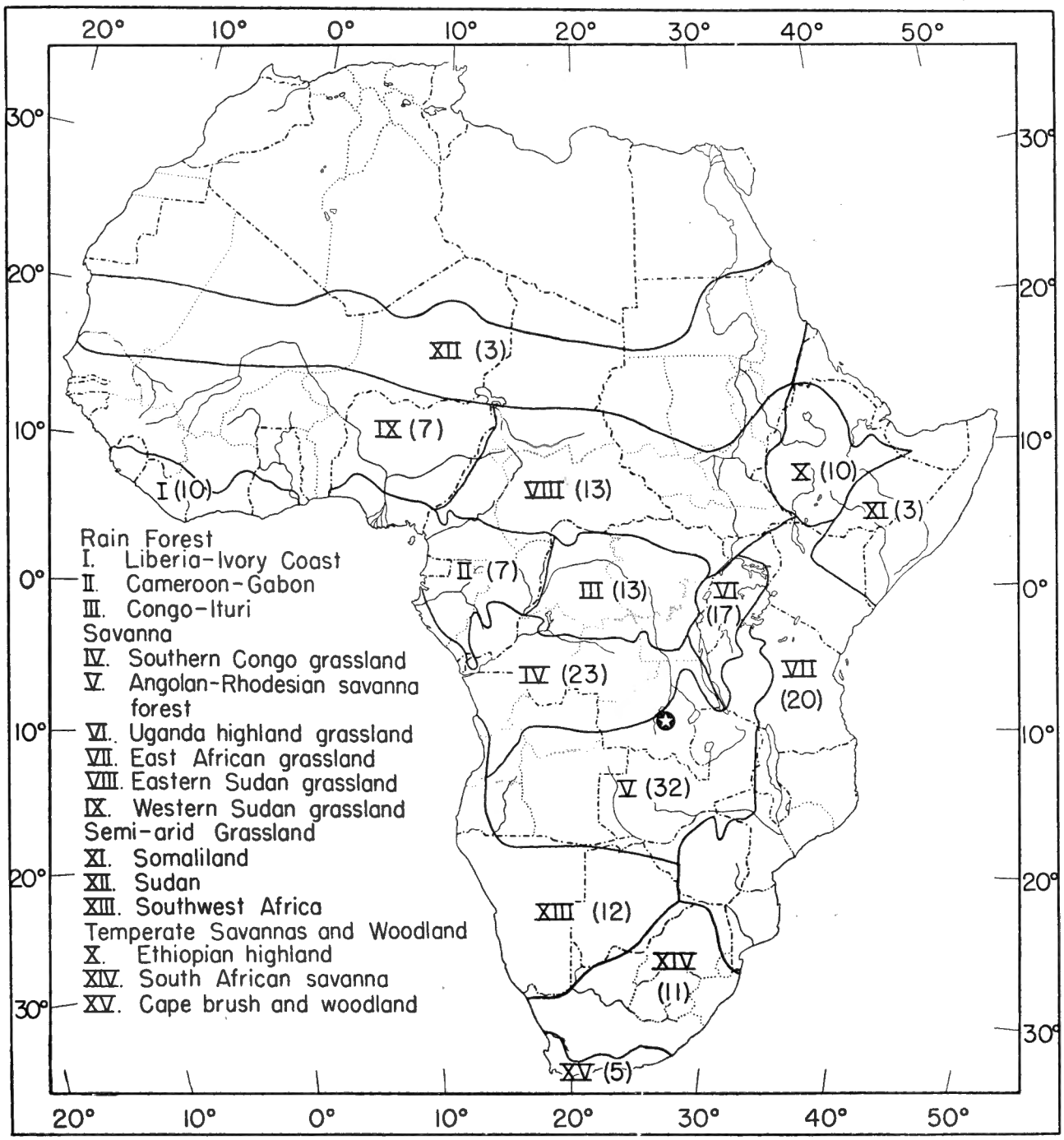

FIG. 73. — Suggested faunal division of Africa.

Roman numerals correspond to those of key. Arabic numerals in parentheses indicate number of Upemba amphibians occurring in each faunal zone.

Parc National de l'Upemba indicated by symbol with open star.

in the Ituri lowland rain forest (zone III), which is relatively close to the Parc National de l'Upemba on this continental scale, is another example of the ecological effect. Although 14 of the Upemba species have been reported from lowland rain forest areas, only two, *Bufo funereus* (Fig. 6) and *Rana albolabris* (Fig. 20), are as generally distributed in the forest as out of it.

ALTITUDINAL DISTRIBUTION.

The altitudinal distributions of the species samples in this collection are summarized in Table 43. Data on the genera *Afrixalus* and *Hyperolius* are from LAURENT (1957).

Many factors, such as relative proportions of land area and the duration of collecting time at various elevations, may so affect observed frequencies that the latter tell us little about the biology of the amphibians. This may be true, for example, of the observed distribution of *Rana obscura* (Table 43). It is probable that the small number collected in the 1,251-1,500 m interval indicates a small amount of collecting time and/or the small proportion of the park's area at that elevation. This suggestion is reinforced by the small total number (last column of Table 43) collected at that altitude.

A few of the observed gaps must be ignored. For instance, the absence of *Bufo ushoranus* from 1,001-1,250 m does not indicate an effect of altitude as it is found above and below that level. The same is to be said of the absence of *Bufo melanopleura* and *Rana grandisonae* from the same zone. In the following discussion it is assumed that the altitudinal range of every species is continuous.

For the most part, the broad outlines of the observed frequencies seem to reflect true altitudinal distributions, though some of course may be truncated at either the low or high end by the limitations of the park. Despite the fact that little ecological information on various localities in the park is now available, it may be determined in some instances whether the absence of a particular species at one elevation is to be explaned by lack of a suitable biotope or by climatic differentiation. As an example, consider the distribution of *Phrynobatrachus perpalmatus*, which was obtained at only two Upemba localities, Kanonga (597 frogs) and Mabwe (2,020), both below 750 m. At these localities 473 and 1,545 specimens, respectively, of *Phrynobatrachus cryptotis* were also caught. Three hundred eight-four of the latter were collected at Lusinga in a marsh at 1,640 m. Since *cryptotis* is abundant at both altitudinal extremes and since *perpalmatus* apparently occupies the same biotope as *cryptotis*, it is reasonable to conclude that the absence of *perpalmatus* at high altitudes is explained by its inability to tolerate climatic conditions of high altitude and not by the absence of the habitat.

On the other hand, the relatively few numbers of *Phrynobatrachus cryptotis* collected at 1,001-1,250 m probably is explained by scarcity of the proper biotope. Obviously, since it is abundant above and below that level, climatic conditions do not restrict its abundance. The enormous numbers of *Phrynobatrachus parvulus* caught at 1,001-1,250 m demonstrate that considerable collecting effort was expended in that altitude.

Twenty-three of the 51 forms are distributed in five or more of the altitudinal zones and fifteen in only one or two zones. Ignoring discontinuities in observed distributions (see above), eight of the ten species spanning five zones are absent in the lowest one (585-750 m). On the other hand, most of the 22 species that range through three or fewer zones, that is, the specialized or stenokous forms, are concentrated in the lower altitudes. Fourteen occur only in the three lowest zones, six in the three highest zones, and only two in the middle zones.

Bufo, *Rana*, *Phrynobatrachus*, and *Hyperolius*, the only genera represented by more than two species, differ in the extent to which their species are restricted altitudinally (Table 44). The altitudinal ranges in Table 44 are given in terms of zones spanned. For example, *Hyperolius granulatus*, *Rana ansorgei*, and *Bufo carens* all occur in three altitudinal zones and are listed in the same column although they do not occur in the same zones. *Rana* clearly shows more altitudinal differentiation than the other genera. Conceivably, this extreme interspecific differentiation may explain the ability of such a small area to support so many species of *Rana*. Conversely, the lack of altitudinal specialization in *Phrynobatrachus* suggests that interspecific isolation in this genus has a different basis.

TABLE 44. — **Number of species with indicated extent of altitudinal range in Parc National de l'Upemba.**

Genus	Total number of species	Number of altitudinal zones spanned					
		1	2	3	4	5	6
		Number of species					
Bufo	6	—	—	2	1	2	1
Rana	17	4	4	1	2	4	2
Phrynobatrachus	6	1	—	—	—	1	4
Hyperiolus	10	1	1	4	—	3	1

REPRODUCTIVE CYCLES.

The reproductive cycle in amphibians generally is assumed to be geared to the seasonal incidence of rainfall in those areas, such as the Parc National de l'Upemba, having sharply defined wet and dry seasons. Most of the Upemba species fit this pattern, as has been indicated above (e.g., pp. 101, 159). The data presented separately for each species are best analyzed for each sex independently.

Nuptial pads and similar dermal secondary sex characters of males are known to fluctuate in development according to the production of

TABLE 45. — **The nature of reproductive activity of male amphibians from the Parc National de l'Upemba as determined by the development of nuptial pads.**

	Cyclic	Acyclic
Xenopus laevis poweri	+ (Oct.-Mar.)	—
Bufo regularis	+ (Aug.-Feb.)	—
Bufo funereus upembae	—	+
Rana fuscigula	—	+
Rana albolabris lemairei	—	+
Rana grandisonae.	+ (Nov.-May)	—
Rana m. mascareniensis	+ (Oct.-Feb.)	—
Rana oxyrhyncha..	+ (Sept.-Feb.)	—
Rana obscura	+ (Nov.-Apr.)	—
Rana porosissima.	+ (Sept.-Mar.)	—
Rana upembae	+ (?-Mar.)	—
Rana uzungwensis	+ (?-Apr.)	—
Arthroleptis globosus	+ (Oct.-Mar.)	—
Phrynobatrachus anotis	—	+
Phrynobatrachus parvulus	—	+
Phrynobatrachus gutturosus	—	+
Phrynobatrachus cryptotis	+ (Sept.-Apr.)	—
Phrynobatrachus natalensis.	+ (Aug.-Mar.)	—

testicular hormones (ARON, 1926; GLASS and RUGH, 1944; GREENBERG, 1942; PONSE, 1924). These studies have shown that immediately before and during the breeding season, when secretion of testicular hormone is at a maximum, the nuptial pads and similar asperities reach their maximum development. With the end of the breeding season, production of testicular hormone wanes and the epidermal portions of the nuptial pads are sloughed off, to be redeveloped when hormone production rises before the next breeding season. If the species has acyclic reproductive activity, the nuptial pads do not regress (CEI, 1949). Thus nuptial pads are good indicators of reproductive competence in males.

Table 45 indicates the nature of the reproductive activity, as nearly as it can be detrmined from the development of nuptial pads and, in the case of *Arthroleptis globosus*, spines. Some of the Upemba species are

TABLE 46. — **The nature of reproductive activity of female amphibians from the Parc National de l'Upemba as determined by the presence of elarged ova.**

	Cyclic	Acyclic
Xenopus laevis poweri	+ (June-Mar.)	—
Bufo regularis	+ (Aug.-May)	—
Bufo funereus upembae	+ (Oct.-Apr.)	—
Rana fuscigula	—	+
Rana albolabris lemairei	+ (Apr.-June)	—
Rana grandisonae.	+ (?-Apr.)	—
Rana m. mascareniensis	+ (Nov.-Feb.)	—
Rana oxyrhyncha.	+ (Sept.-?)	—
Rana obscura	+ (Nov.-Apr.)	—
Rana porosissima.	+ (Sept.-Jan.)	—
Arthroleptis globosus	+ (Nov.-Apr.)	—
Arthroleptis stenodactylus	+ (Nov.-Jan.)	—
Phrynobatrachus anotis	—	+
Phrynobatrachus parvulus	—	+
Phrynobatrachus gutturosus	—	+
Phrynobatrachus cryptotis	+ (Sept.-Mar)	—
Phrynobatrachus natalensis.	+ (Sept.-Mar.)	—
Hemisus marmoratus	+ (Nov.-Jan.)	—

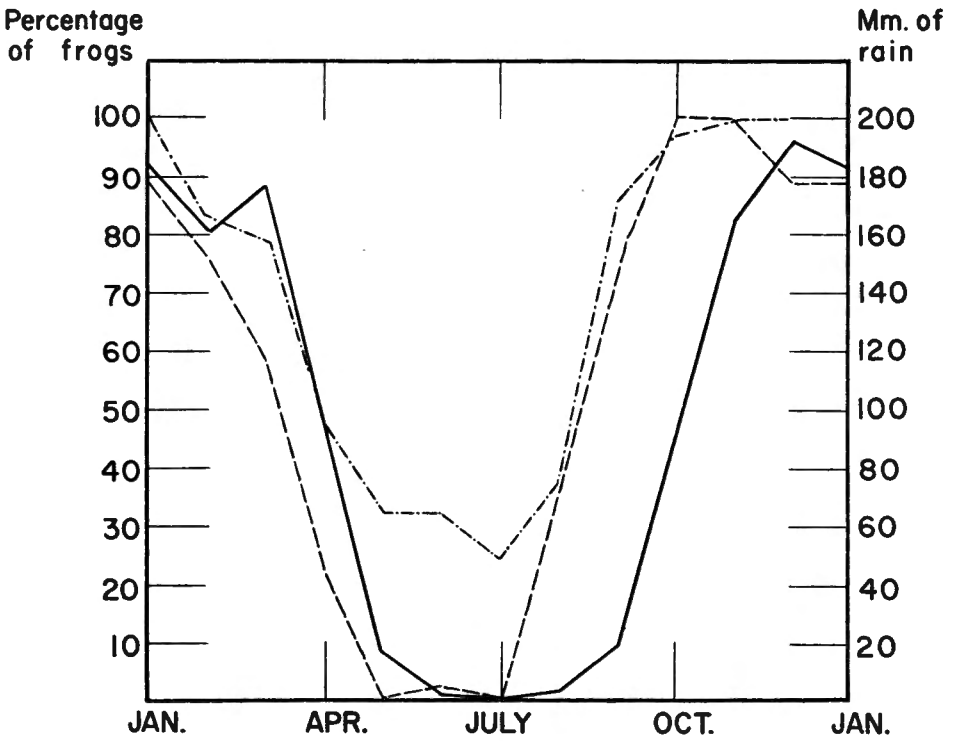

FIG. 74. — Relation between rainfall (——) in the Parc National de l'Upemba and percentage of *Phrynobatrachus natalensis* in breeding condition. Males with nuptial pads (—.—.—); females with enlarged ova (———).

excluded from the table because adults were not collected in a sufficient number of months; others, e.g., *Hemisus marmoratus*, are omitted because males never develop nuptial pads. If fifty per cent or more of the adult males obtained in a particular month had nuptial pads well-developed, that month was considered part of the breeding period.

Females were considered to be in reproductive condition if the eggs were fully pigmented and large. The ova of some species, for example, *Arthroleptis stenodactylus*, are pigmentless and in such cases size of ova was the criterion. The gonads of females are less reliable as indicators of the species reproductive behavior than the males' nuptial pads because enlarged and pigmented ova may not be fully mature. Furthermore, a week or two after a given female has spawned her gonads are at a low point in the cycle although other females may still be ready to breed. Nevertheless the females are tabulated (Table 46) in the same fashion as the males, using the fifty per cent criterion.

As stated above, most of the Upemba species have sharply defined, though extended, breeding periods. In general the patterns derived from both sexes agree. Only in *Bufo funereus* and *Rana albolabris* do the females show one pattern (cyclic in both cases) and the males another.

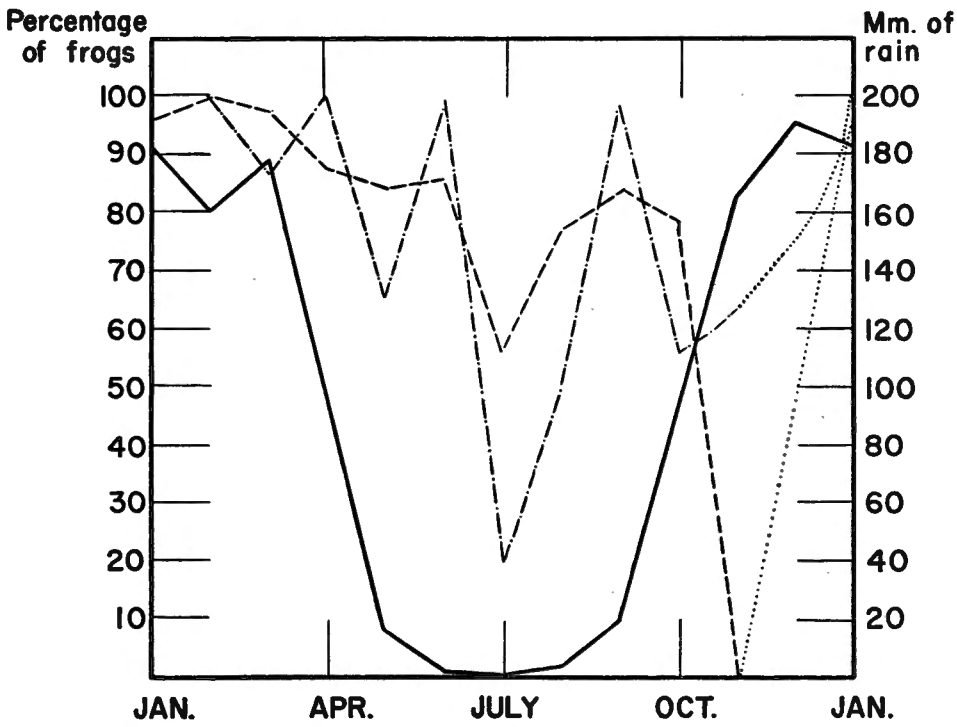

FIG. 75. — Relation between rainfall (——) in the Parc National de l'Upemba and percentage of *Phrynobatrachus parvulus* in breeding condition. Males with nuptial pads (—.—.—); females with enlarged ova (———). Dotted lines indicate periods for which data are not available.

With a few exceptions, the breeding seasons occupy most of the rainy season (October through April, Fig. 74). The presence of many suitable larval habitats during this interval is probably the ultimate factor controlling these reproductive cycles (INGER and GREENBERG, 1956). So little rain falls during the five dry months that many aquatic habitats must disappear with destruction of any amphibian larvae lacking the ability to aestivate. But rainfall is probably not the proximate factor stimulating secretion of reproductive hormones, for from one-third to one-half of the

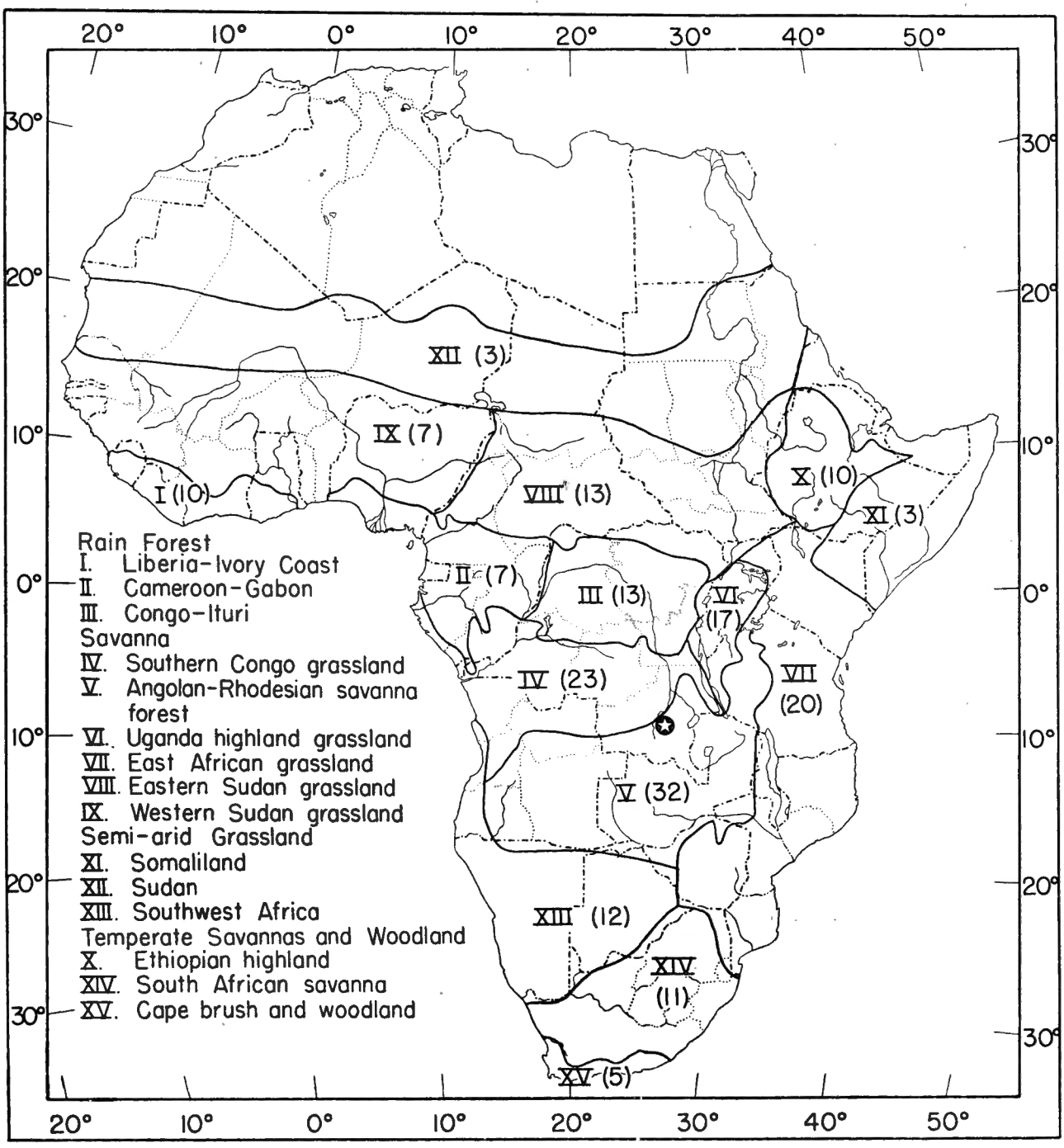

FIG. 73. — Suggested faunal division of Africa.
Roman numerals correspond to those of key. Arabic numerals in parentheses indicate number of Upemba amphibians occurring in each faunal zone.
Parc National de l'Upemba indicated by symbol with open star.

TABLE 43. — **Frequency distribution by altitude of amphibians collected in the Parc National de l'Upemba by the Mission G. F. de Witte. Data on** *Afrixalus* **and** *Hyperolius* **taken from Laurent (1957).**

	Xenopus laevis poweri	*Bufo carens*	*Bufo funereus upembae*	*Bufo lemairei*	*Bufo melanopleura*	*Bufo regularis*	*Bufo ushoranus*	*Rana tuberculosa*	*Rana ornata moeruensis*	*Rana fuscigula*	*Rana albolabris lemairei*	*Rana frontalis*	*Rana grandisonae*	*Rana ansorgei*	*Rana chrysogaster guibei*	*Rana m. mascareniensis*	*Rana oxyrhyncha*	*Rana obscura*	*Rana subpunctata*
585- 750 m	113	73	—	—	6	874	—	—	92	51	179	433	—	—	24	523	31	—	14
751-1,000 m	57	9	40	2	16	252	49	—	1	45	91	—	2	—	—	—	82	16	—
1,001-1,250 m	76	11	95	—	—	95	—	—	—	491	34	—	—	28	—	—	16	107	—
1,251-1,500 m	183	—	132	1	280	13	25	—	—	59	156	—	46	11	—	—	13	14	—
1,501-1,750 m	759	—	242	3	—	38	—	4	—	233	—	—	362	2	—	—	4	92	—
1,751-1,860 m	1,406	—	250	13	—	65	—	2	—	481	—	—	405	—	—	—	5	13	—
Total	2,594	93	759	19	302	1,337	74	6	93	1,360	560	433	815	41	24	523	151	242	14

	Rana porosissima	*Rana taenioscelis*	*Rana superciliaris*	*Rana upembae*	*Rana uzungwensis*	*Arthroleptis stenodactylus*	*Arthroleptis globosus*	*Cacosternum leleupi*	*Phrynobatrachus anotis*	*Phrynobatrachus parvulus*	*Phrynobatrachus gutturosus*	*Phrynobatrachus cryptotis*	*Phrynobatrachus natalensis*	*Phrynobatrachus perpalmatus*	*Leptopelis parvus*	*Leptopelis bocagei lebeaui*	*Kassina senegalensis*	*Kassina wittei*
585- 750 m	—	—	13	30	—	2,634	2,597	—	—	1,270	470	2,584	2,989	2,617	3	100	5	—
751-1,000 m	—	—	60	56	6	187	6,680	—	10	1,692	359	683	2,065	—	7	5	2	—
1,001-1,250 m	2	—	—	12	22	314	2,815	—	58	11,301	685	291	1,275	—	—	130	7	—
1,251-1,500 m	61	—	—	—	75	80	1,978	—	109	245	19	863	767	—	9	4	56	—
1,501-1,750 m	313	11	—	11	13	—	1,006	3	803	1,945	19	2,460	661	—	—	47	224	—
1,751-1,860 m	746	11	—	—	31	3	441	8	994	1,788	2	4,778	356	—	—	5	89	7
Total	1,122	22	73	109	147	3,228	15,517	11	1,974	18,241	1,554	11,659	8,113	2,617	19	291	383	7

	Hemisus marmoratus	*Phrynomerus bifasciatus*	*Afrixalus fulvovittatus upembae*	*Afrixalus wittei*	*Hyperolius bocagei*	*Hyperolius cinnamomeoventris wittei*	*Hyperolius granulatus*	*Hyperolius kibarae*	*Hyperolius marmoratus argentovittis*	*Hyperolius marmoratus ephiboides*	*Hyperolius nasutus nasutus*	*Hyperolius platyceps major*	*Hyperolius quinquevittatus*	*Hyperolius sansabaricus kivuensis*	Total
585- 750 m	175	117	4	61	25	3	—	—	90	—	248	2	—	81	18,531
751-1,000 m	12	—	—	3	47	—	—	30	10	—	48	24	11	79	12,848
1,001-1,250 m	79	—	—	20	6	—	—	135	—	—	211	97	1,582	186	20,181
1,251-1,500 m	15	—	—	—	—	—	6	199	—	93	120	3	1	—	5,636
1,501-1,750 m	15	—	—	—	—	—	94	278	—	138	218	5	92	—	10,095
1,751-1,860 m	3	—	—	—	—	—	123	531	—	621	1,035	—	31	—	14,243
Total	299	117	4	84	78	3	223	1,173	100	852	1,880	131	1,717	346	81,534

species appear to be in breeding condition in August or September, well in advance of the rains (Fig. 74). It is doubtful that these forms (e.g., *Bufo regularis*, *Rana porosissima*, *Phrynobatrachus natalensis*) actually begin to breed then. Conceivably, by being ready to spawn as soon as the rains begin, a given female could produce several clutches of ova in the interval from October to March.

With the possible exception of female *Rana albolabris*, the breeding periods of the cyclic species show no significant differentiation (Tables 45 and 46). Species isolation in this area is not promoted by this factor as it may be in other parts of the world (see MOORE, 1949, for an example).

The absence of a cycle in the development of sex characters in *Rana fuscigula*, *Phrynobatrachus anotis*, *P. parvulus* (Fig. 75), and *P. gutturosus* (Table 45) is well established by the data given on pages 54, 142, 164 and 154 All four range from the lowest to the highest altitudinal zones (Table 43). In the absence of field observation of the habits and habitats of these species, speculation on these data are not warranted.

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APPENDIX A.

LIST OF LOCALITIES

from which amphibians were obtained by the Mission G. F. de Witte to the Parc National de l'Upemba.

		Altitude (m)
Bagagi	rivière, affl. Katembula et s.-affl. de Muye ...	585
Bowa	affl. dr. Kalule Nord et s.-affl. dr. Lualaba, près Kiamalwa	1,050
Bunda-Bunda	près riv. Lufwa, affl. dr. Lufira, au Nord de Sampwe (ex. P.N.U.)	900
Buye-Bala	affl. g. Muye et s.-affl. dr. Lufira	1,750
Bwalo	affl. g. Muye et s.-affl. dr. Lufira	1,750
Difirinji	affl. g. Lufira	750
Dipidi	affl. dr. Lufwa et s.-affl. dr. Lufira (ex P.N.U).	1,700
Ganza	salines près riv. Kamandula, affl. dr. Lukoka et s.-affl. g. Lufira	860
N'Gongozi	près Mukana	1,810
N'Gozie	mare à gauche de la route Lusinga-Mitwaba (ex. P.N.U.)	1,600
Kabenga	près de Kaziba (ex. P.N.U.)	1,240-1,300
Kabulumba	chaîne de montagnes entre Mabwe et la Lufira, 22 km à l'Est de Mabwe	987
Kabwe	sur la rive dr. Muye, affl. dr. Lufira	1,320
Kabwekanono	mare près tête de source Lufwa, affl. dr. Lufira, sur rive g. Lusinga	1,815
Kafwe (Petite)	rivière près Mukana-Kiamakoto, affl. dr. Grande-Kafwe et s.-affl. dr. Lufwa	1,780
Kafwe (Grande) ...	affl. dr. Lufwa et s.-affl. dr. Lufira	1,780-1,830
Kagomwe	affl. Lusinga et s.-affl. dr. Lufwa	1,700
Kakolwe	affl. Kenia et s.-affl. dr. Lusinga (ex P.N.U.).	1,660-1,720
Kalala	affl. g. Mokey et s.-affl. g. Muye	800
Kalubamba	affl. g. Lufira	700- 800
Kalule-Nord	rive g. face Mujinga-Kalenge, affl. dr. Lualaba.	1,050
Kalumengongo	affl. dr. Lualaba	1,780-1,830
Kalungwe	affl. dr. Senze et s.-affl. dr. Lufira	800-1,700
Kaluwamba	affl. g. Lufira	700- 800
Kamakoko	salines près Ganza (près riv. Kamandula, affl. Lukoka et s.-affl. g. Lufira)	860
Kamamulongo	affl. Lusinga et s.-affl. dr. Lufwa	1,700
Kamatshya	affl. Lusinga et s.-affl. dr. Lufwa	1,750
Kambi	affl. Grande-Kafwe et s.-affl. dr. Lufwa (vers Masombwe)	1,750
Kamitungulu	affl. g. Lusinga et s.-affl. dr. Lufwa	1,760
Kamitunu	affl. g. Lusinga et s.-affl. dr. Lufwa	1,760-1,800

		Altitude (m)
Kampadika	affl. Grande-Kafwe et s.-affl. dr. Lufwa	1,810
Kamusanga	affl. g. Lufira (en face du Mt Sombwe)	700
Kande	affl. g. Lupiala et s.-affl. dr. Lufira	700-730
Kankunda	affl. g. Lupiala et s.-affl. dr. Lufira	1,300
Kanonga	affl. dr. Fungwe	675-695-860
Kanpungu	affl. Lusinga et s.-affl. dr. Lufwa	1,750
Karibwe	affl. Lusinga et s.-affl. dr. Lufwa	1,700
Kasandendeko	affl. Kamitungulu et s.-affl. g. Lusinga	1,700
Kaswabilenga	rive dr. Lufira (piste Lusinga-Mabwe)	680
Kaswabilenga	cours inf. Lupiala, affl. dr. Lufira	700
Kaswabilenga	rive g. Lufira	750
Kateke	affl. Muovwe et s.-affl. dr. Lufira	960
Katombwe	(Mukana), près Lusinga (lieu-dit)	1,812
Katongo	affl. g. Mubale et s.-affl. g. Munte	1,750
Kavizi	affl. de la Lusinga et s.-affl. rive dr. de la Lufwa	±1,700-1,750
Kayango	affl. Lusinga et s.-affl. dr. Lufwa	1,700
Kayumbwe	affl. g. Muye et s.-affl. dr. Lufira	1,350-1,730
Kaziba	affl. g. Senze et s.-affl. dr. Lufira	1,140
Kenia	affl. dr. Lusinga et s.-affl. dr. Lufwa (ex. P.N.U.)	1,585
Kiamakoto	(entre Masombwe et Mukana) sur rive dr. Lukima, affl. dr. Grande-Kafwe	1,100
Kilolomatembo	affl. Lusinga et s.-affl. dr. Lufwa	1,750
Kilwezi	affl. dr. Lufira	700-1,000-1,400
Kimapongo	affl. Lusinga	±1,760
Kimiala	affl. Luizi et s.-affl. g. Lufwa, près Sampwe (Kundelungu) (ex. P.N.U.)	900
Kimilombo	affl. Grande-Kafwe et s.-affl. dr. Lufwa	1,400
Kipangaribwe	affl. dr. Lusinga et s.-affl. dr. Lufwa	1,600
Kipondo	affl. dr. Lufira (près Kilwezi)	800
Kiwakishi	(grottes) près Kiamakoto (ex. P.N.U.)	1,100
Loie	affl. g. Lufira	700-1,000
Luanana	affl. g. Kamesia et s.-affl. dr. Muye	1,500
Luangalele	près Mukana (Lusinga)	1,850
Lufira	affl. dr. Lualaba (près Mt Sombwe)	700-750
Lufira	ligne de faîte Munte-Pelenge	1,400
Lufwa	affl. dr. Lufira, tête de source près Lusinga	1,700
	(ex. P.N.U.)	1,760
Lufwi	tête de source, affl. dr. Grande-Kafwe	700
Lukawe	affl. dr. Lufira	750
Lukoka	affl. g. Lufira	750-900
Lukorami	affl. g. Lufira	700-850-1,200
Lupiala	affl. dr. Lufira	1,650
Lusinga	riv. Dipidi (voir Dipidi)	1,640
Lusinga	Kapero	1,810
Lusinga	(colline de)	±1,700
Lusinga	riv. Karungwe	1,810
Lusinga	riv. Lusinga, affl. dr. Lufwa	±1,700
Lusinga	riv. Kagomwe (voir Kagomwe)	±1,700
Lusinga	riv. Kamalonge	1,760
Lusinga	riv. Kamitungulu (voir Kamitungulu)	1,760

		Altitude (m)
Lusinga	riv. Lufwa, tête de source (voir Lufwa)	1,810
Mabwe	rive Est du lac Upemba	585
Manda	affl. Kalumengongo et s.-affl. dr. Lualaba (ex. P.N.U.)	1,750
Masombwe	sur Grande-Kafwe (ex. P.N.U.)	1,120
Masombwe	riv. Kanakakasi	1,120
Masombwe	riv. Lukobwe	1,120
Masombwe	riv. Kipepe	1,120
Mitoto	affl. Lusinga et s.-affl. dr. Lufwa	±1,760
Mokey	affl. g. Muye et s.-affl. dr. Lufira	800
Mubale	affl. g. Munte et s.-affl. dr. Lufira	1,480-1,780
Mubale	région confluent Mubale-Munte	1,480
Mujinga-Kalenge ...	(village), rive dr. Kalule-Nord, affl. dr. Lualaba	1,050
Mukana	marais près Lusinga	1,810
Mukana	près Petite-Kafwe, affl. Grande-Kafwe (près Mukana, marais) (ex. P.N.U.)	1,100
Mukelengia	affl. g. Kalumengongo et s.-affl. dr. Lualaba.	1,750
Mukukwe	affl. Muye et s.-affl. dr. Lufira	1,760
Munoi	bifurcation riv. Lupiala, affl. dr. Lufira	890
Munte	affl. dr. Lufira	1,450
Munte	tête de source	1,750
Muye	tête de source	1,630
Muye	confl. Kabangasi	800
Muye	rive dr. près ancien village de Kabenga	1,480
Mware	affl. g. Lufira	700-950
Mwema-Mabole	riv. à 10 km à l'Est de Mabwe	620
Pelenge	affl. dr. Lufira	1,250-1,600
Sanga	affl. lac Upemba (rive Est)	700
Sange	affl. Lusinga	±1,760
Senze	affl. dr. Lufira	700-1,800
Tumbwe	riv.	1,120

APPENDIX B.

SPECIES AND NUMBER OF SPECIMENS COLLECTED AT EACH LOCALITY.

Babagi ±900 meters

Bufo funeus upembae	6
Rana fuscigula	6
Rana obscura	4
Hyperolius kibarae	4

Bowa 1,050 meters

Xenopus laevis powri	13
Bufo carens	4
Bufo regularis	1
Bufo funereus upembae	1
Rana fuscigula	15
Arthroleptis stenodactylus	23
Arthroleptis globosa	3
Phrynobatrachus natalensis	49
Hemisus marmoratus	2

Bunda-Bunda 900 meters

Xenopus laevis poweri	1
Arthroleptis stenodactylus	3
Phrynobatrachus parvulus	2
Phrynobatrachus cryptotis	1
Phrynobatrachus natalensis	3

Buye-Bala 1,750 meters

Xenopus laevis poweri	129
Bufo regularis	21
Bufo funereus upembae	66
Rana ansorgei	2
Rana grandisonae	53
Rana porosissima	86
Rana obscura	3
Rana uzungwensis	4
Arthroleptis globosa	467
Phrynobatrachus parvulus	379
Phrynobatrachus cryptotis	897
Phrynobatrachus natalensis	216
Kassina senegalensis	44
Hyperolius granulatus	25
Hyperolius epheboides	80
Hyperolius nasutus nasutus	100
Hyperolius quinquevittatus	49

Between Buye-Bala and Katonga 1,750 metres

Rana grandisonae	133
Rana porosissima	43
Hyperolius marmoratus epheboides.	8
Hyperolius nasutus nasutus	43

Bwalo 1,750 meters

Xenopus laevis poweri	1
Bufo regularis	7
Bufo funereus upembae	3
Rana fuscigula	15
Rana grandisonae	12
Rana porosissima	18
Rana uzungwensis	1
Arthroleptis globosa	1
Cacosternum leleupi	1
Phrynobatrachus cryptotis	184
Phrynobatrachus natalensis	6
Kassina wittei	1
Kassina senegalensis	64
Hyperolius granulatus	17
Hyperolius marmoratus epheboides.	22
Hyperolius nasutus nasutus	9

Difirinji 750 meters

Bufo regularis	1
Rana fuscigula	11
Arthroleptis globosa	2
Phrynobatrachus gutturosus	2
Phrynobatrachus natalensis	6

Dipidi 1,700 meters

Xenopus laevis poweri	1
Bufo regularis	1
Bufo funereus upembae	4
Rana fuscigula	10
Rana porosissima	2
Arthroleptis globosa	7
Phrynobatrachus parvulus	140

Prynobatrachus cryptotis 48
Phrynobatrachus natalensis 20
Hyperolius kibarae 11
Hyperolius marmoratus epheboides. 2
Hyperolius placyceps major 1
Hyperolius quinquevittatus 5

Ganza 860 meters
Xenopus laevis poweri 8
Bufo regularis 11
Bufo funereus upembae 25
Rana fuscigula 8
Rana oxyrhyncha 22
Rana obscura 1
Rana superciliaris 47
Rana upembae 9
Arthroleptis stenodactylus 3
Arthroleptis globosa 1,400
Phrynobatrachus parvulus 957
Phrynobatrachus gutturosus 19
Phrynobatrachus cryptotis 200
Phrynobatrachus natalensis 358
Afrixalus wittei 2
Hyperolius bocagei 1
Hyperolius marmoratus argenovittis. 8
Hyperolius nasutus nasutus 47
Hyperolius sansabaricus kivuensis. 42

N'Gongozi 1,810 meters
Bufo regularis 1
Rana grandisonae 2
Kassina senegalensis 2
Hyperolius nasutus nasutus 7

N'Gozie 1,600 meters
Bufo lemairei 2
Rana porosissima 7
Kassina senegalensis 1
Hyperolius marmoratus epheboides. 2

Kabenga 1,250 meters
Bufo regularis 8
Rana fuscigula 134
Rana oxyrhyncha 3
Rana odscura 2
Rana upembae 7
Rana uzungwensis 7
Arthroleptis stenodactylus 4
Arthroleptis globosa 57
Phrynobatrachus parvulus 913
Phrynobatrachus gutturosus 288
Phrynobatrachus cryptotis 10
Phrynobatrachus natalensis 99
Hemisus marmoratus 9
Afrixalus wittei 8
Hyperolius kibarae 1
Hyperolius nasutus nasutus 6
Hyperolius platyceps major 1
Hyperolius quinquevittatus 116
Hyperolius sansabaricus kivuensis. 6

Kabulumba 987 meters
Phrynobatrachus natalensis 2

Kabwe 1,320 meters
Xenopus laevis poweri 2
Bufo regularis 5
Bufo funereus upembae 49
Bufo melanopleura 10
Rana fuscigula 21
Rana albolabris lemairei 96
Rana ansorgei 11
Rana porosissima 10
Rana obscura 10
Rana uzungwensis 56
Arthroleptis stenodactylus 17
Arthroleptis globosa 1,425
Phrynobatrachus parvulus 209
Phrynobatrachus gutturosus 13
Phrynobatrachus cryptotis 22
Phrynobatrachus natalensis 54
Leptopelis bocagei lebeaui 2
Kassina senegalensis 13
Hemisus marmoratus 5
Hyperolius granulatus 3
Hyperolius kibarae 22
Hyperolius marmoratus epheboides. 16
Hyperolius nasutus nasutus 20
Hyperolius platyceps major 3
Hyperolius quinquevittatus 1

Kabwekanono 1,815 meters
Xenopus laevis poweri 5
Bufo regularis 3
Bufo funereus upembae 11
Rana grandisonae 49
Rana porosissima 302
Rana obscura 8
Rana uzungwensis 6
Arthroleptis globosa 117

Cacosternum leleupi	4
Phrynobatrachus parvulus	22
Phrynobatrachus cryptotis	1,345
Phrynobatrachus natalensis	42
Kassina senegalensis	18
Hemisus marmoratus	2
Hyperolius granulatus	16
Hyperolius Hibarae	8
Hyperolius marmoratus epheboides.	10
Hyperolius nasutus nasutus	149

Kafwe (Grande) 1,790 meters

Xenopus laevis poweri	50
Rana fuscigula	7
Rana porosissima	20
Rana taenioscelis	1
Rana uzungwensis	4
Phrypobatrachus parvulus	10
Phrynobatrachus cryptotis	17
Phrynobatrachus natalensis	49
Leptopelis bocagei lebeaui	1

Kafwe (Petite) 1,780 meters

Rana obscura	1
Phrynobatrachus parvulus	3
Phrynobatrachus gutturosus	1
Phrynobatrachus natalensis	8
Hyperolius quinquevittatus	1

Kagomwe 1,700 meters

Bufo funereus upembae	40
Rana fuscigula	4
Rana porosissima	1
Rana obscura	13
Rana uzungwensis	1
Arthroleptis globosa	1
Phrynobatrachus parvulus	84
Hyperolius platyceps major	1

Kakolwe 1,660 meters

Rana fuscigula	1
Phrynobatrachus parvulus	1
Hyperolius kibarae	2

Kalala 800 meters

Rana albolaris lemairei	2
Rana oxyrhyncha	1
Phrynobatrachus parvulus	9

Kalubamba 700-800 meters

Arthroleptis globosa	1
Phrynobatrachus cryptotis	2
Phrynobatrachus natalensis	5

Kalule Nord 1,050 meters

Xenopus laevis poweri	5
Bufo carens	6
Bufo regularis	1
Arthroleptis stenodactylus	3

Kalumengongo 1,780 meters

Xenopus laevis poweri	18
Bufo funereus upembae	4
Rana porosissima	1
Arthroleptis globosa	5
Phrynobatrachus cryptotis	3
Phrynobatrachus natalensis	26
Hyperolius granulatus	1
Hyperolius marmoratus epheboides.	21
Hyperolius nasutus nasutus	1

Kalumengongo 1,830 meters

Xenopus laevis poweri	3
Bufo regularis	30
Bufo lemairei	2
Bufo funereus upembae	1
Rana grandisonae	3
Rana porosissima	33
Rana obscura	2
Rana taenioscelis	1
Arthroleptis stenodactylus	2
Arthroleptis globosa	1
Cacosternum leleupi	1
Phrynobatrachus cryptotis	133
Phrynobatrachus natalensis	12
Kassina senegalensis	4
Hyperolius granulatus	2
Hyperolius kibarae	59
Hyperolius marmoratus epheboides.	4
Hyperolius nasutus nasutus	31

Kalungwe 800 meters

Rana albolabris lemairei	12
Rana oxyrhyncha	1
Rana upembae	2
Arthroleptis globosa	65
Phrynobatrachus parvulus	64
Phrynobatrachus cryptotis	7
Phrynobatrachus natalensis	330
Hyperolius bocagei	9
Hyperolius platyceps major	1
Hyperolius sansabaricus kivuensis.	9

Kaluwamba 800 meters
Rana oxyrhyncha 2
Leptopelis parvus 1

Kamakoko 860 meters
Bufo regularis 19

Kamamulongo 1,700 meters
Bufo funereus upembae 1
Phrynobatrachus parvulus 22

Kamatshya 1,750 meters
Bufo funereus upembae 4
Rana fuscigula 2
Phrynobatrachus parvulus 90
Bufo funereus upembae 69
Rana fuscigula 10
Rana porosissima 1
Rana obscura 1
Arthroleptis globosa 1
Phrynobatrachus parvulus 184
Phrynobatrachus cryptotis 2
Phrynobatrachus natalensis 19
Hyperolius granulatus 1
Hyperolius kibarae 45
Hyperoliuss marmoratus epheboides. 52

Kampadika 1,810 meters
Rana porosissima 1
Rana taenioscelis 1
Rana uzungwensis 15
Phrynobatrachus parvulus 94
Phrynobatrachus cryptotis 117
Phrynobatrachus natalensis 17
Hyperolius nasutus nasutus 21
Hyperolius quinquevittatus 23
Phrynobatrachus natalensis 2

Kambi 1,750 meters
Bufo funereus upembae 7
Rana obscura 11
Rana upembae 11
Arthroleptis globosa 35
Phrynobatrachus parvulus 146
Phrynobatrachus gutturosus 16
Phrynobatrachus natalensis 22
Hyperolius kibarae 1
Hyperolius platyceps major 2

Kamitungulu 1,760 meters
Bufo funereus upembae 19
Rana fuscigula 12
Rana uzungwensis 1
Aarhroleptis globosa 14
Phrynobatrachus parvulus 217
Phrynobatrachus cryptotis 2
Hyperolius quinquevittatus 1

Kamitunu 1,760 meters

Kamusanga 700 meters
Arthroleptis globosa 87
Phrynobatrachus gutturosus 1
Phrynobatrachus cryptotis 11
Phrynobatrachus natalensis 36

Kande 730 meters
Xenopus laevis poweri 14
Bufo regularis 152
Bufo carens 1
Rana albolabris lemairei 18
Rana fuscigula 10
Rana upembae 17
Rana superciliaris 1
Rana oxyrhyncha 6
Rana chrysogaster guibei 1
Arthroleptis globosa 611
Arthroleptis stenodactylus 14
Phrynobatrachus natalensis 583
Phrynobatrachus parvulus 30
Phrynobatrachus gutturosus 4
Phrynobatrachus cryptotis 146
Leptopelis bocagei lebeaui 3
Leptopelis parvus 1
Hyperolius sansabaricus kivuensis. 2

Kankunda 1,300 meters
Bufo regularis 3
Bufo funereus upembae 6
Bufo melanopleura 270
Bufo ushoranus 25
Rana fuscigula 38
Rana albolabris lemairei 7
Rana oxyrhyncha 13
Rana obscura 3
Rana uzungwensis 1
Arthroleptis stenodactylus 59
Arthroleptis globosa 174
Phrynobatrachus parvulus 1
Phrynobatrachus gutturosus 2
Phrynobatrachus natalensis 27
Leptopelis parvus 9
Kassina senegalensis 1
Hyperolius kibarae 27

Kanonga 695 meters

Xenopus laevis poweri	35
Bufo carens	3
Bufo regularis	9
Bufo melanopleura	1
Rana fuscigula	2
Rana albolabris lemairei	44
Rana ornata	4
Rana mascareniensis	9
Rana chrysogaster guibei	1
Rana oxyrhyncha	7
Rana upembae	5
Arthroleptis stenodactylus	216
Arthroleptis globosa	804
Phrynobatrachus parvulus	949
Phrynobatrachus gutturosus	307
Phrynobatrachus natalensis	1,022
Phrynobatrachus cryptotis	473
Phrynobatrachus perpalmatus	597
Leptopelis bocagei lebeaui	12
Kassina senegalensis	1
Afrixalus wittei	2
Hyperolius bocagei	17
Hyperolius marmoratus argentovittis.	27
Hyperolius nasutus nasutus	2
Hyperolius sansabaricus kivuensis.	33

Kanpungu 1,750 meters

Bufo funereus upembae	2
Rana porosissima	1
Arthroleptis globosa	44
Phrynobatrachus parvulus	184

Karibwe 1,700 meters

Bufo regularis	2
Bufo funereus upembae	37
Rana fuscigula	94
Rana porosissima	23
Rana oxyrhyncha	2
Rana obscura	1
Prhynobatrachus parvulus	13
Prhynobatrachus cryptotis	1
Phrynobatrachusnatalensis	5
Kassina senegalensis	2
Hyperolius kibarae	135

Kasadendeko 1,700 meters

Bufo funereus upembae	2
Rana fuscigula	1
Rana porosissima	1
Phrynobatrachus parvulus	71
Phrynobatrachus natalensis	2
Hyperolius kibarae	5

Kaswabilenga 680 meters

Bufo carens	64
Bufo regularis	21
Rana fuscigula	1
Rana albolabris lemairei	47
Rana ornata	1
Rana oxyrhyncha	6
Rana superciliaris	1
Rana upembae	2
Arthroleptis stenodactylus	2
Arthroleptis globosa	198
Phrynobatrachus parvulus	148
Phrynobatrachus gutturosus	137
Phrynobatrachus cryptotis	138
Phrynobatrachus natalensis	193
Lepopelis bocagei lebeaui	11
Hemisus marmoratus	54

Kaswabilenga 700 meters

Xenopus laevis poweri	2
Bufo regularis	111
Bufo melanopleura	2
Rana upembae	4
Arthroleptis stenodactylus	913
Arthroleptis globosa	291
Phrynobatrachus parvulus	71
Phrynobatrachus crypotis	6
Phrynobatrachus natalensis	41
Leptopelis parvus	1
Leptopelis bocagei lebeaui	25
Hemisus marmoratus	2
Hyperolius bocagei	4
Hyperolius marmoratus argentovittis.	1
Hyperolius sansabaricus kivuensis.	2

Kaswabilenga 750 meters

Bufo regularis	1
Rana fuscigula	1
Arthroleptis globosa	2
Phrynobatrachus cryptotis	3
Phrynobatrachus natalensis	41
Leptopelis bocagei lebeaui	10
Hemisus marmoratus	3

Kateke 960 meters

Xenopus laevis poweri	1
Bufo carens	9
Bufo regularis	18

Bufo ushoranus 49
Bufo melanopleura 16
Rana fuscigula 8
Rana albolabris lemairei 24
Rana ornata 1
Arthroleptis senodactylus 89
Arthroleptis globosa 51
Phrynobatrachus gutturosus 158
Phrynobatrachus cryptotis 2
Phrynobatrachus natalensis 157
Leptopelis parvus 7
Leptopelis bocagei lebeaui 4
Kassina senegalensis 1
Hemisus marmoratus 4
Hyperolius marmoratus argentovittis. 1
Hyperolius platyceps major 1

Katombwe 1,812 meters
Xenopus laevis poweri 431
Bufo regularis 1
Rana porosissima 14
Hyperolius nasutus nasutus 1

Katongo 1,750 meters
Xenopus laevis poweri 6
Bufo regularis 2
Bufo funereus upembae 1
Rana grandisonae 3
Rana porosissima 15
Rana uzungwensis 1
Arthroleptis globosa 60
Cacosternum leleupi 1
Phrynobatrachus parvulus 2
Phrynobatrachus cryptotis 8
Phrynobatrachus natalensis 6
Kassina senegalensis 6
Hemisus marmoratus 1
Hyperolius granulatus 2
Hyperolius marmoratus epheboides. 10
Hyperolius nasutus nasutus 16
Hyperolius quinquevittatus 3

Kavizi 1,700 meters
Bufo funereus upembae 9
Rana fuscigula 2
Arthroleptis globosa 4
Phrynobatrachus parvulus 80

Kayango 1,700 meters
Rana porosissima 1
Phrynobatrachus parvulus 2
Hyperolius kibarae 1

Kayumbwe 1,670 meters
Rana fuscigula 2
Arthroleptis globosa 16
Hyperolius kibarae 1

Kaziba 1,140 meters
Bufo regularis 11
Rana fuscigula 4
Rana obscura 10
Rana upembae 4
Rana uzungwensis 1
Arthroleptis stenodactylus 281
Arthroleptis globosa 409
Phrynobatrachus parvulus 5,048
Phrynobatrachus gutturosus 358
Phrynobatrachus cryptotis 14
Phrynobatrachus natalensis 351
Leptopelis bocagei lebeaui 129
Kassina senegalensis 3
Afrixalus wittei 10
Hyperolius bocagei 6
Hyperolius nasutus nasutus 7
Hyperolius platyceps major 83
Hyperolius quinquevittatus 883
Hyperolius sansabaricus kivuensis. 169

Kenia 1,585 meters
Bufo regularis 1
Bufo funereus upembae 8
Rana porosissima 6
Arthroleptis globosa 58
Phrynobatrachus parvulus 368
Phrynobatrachus cryptotis 6
Phrynobatrachus natalensis 9
Kassina senegalensis 1
Hyperolius kibarae 7
Hyperolius platyceps major 1
Hyperolius quinquevittatus 5

Kiamakoto 1,100 meters
Bufo carens 1
Bufo regularis 39
Bufo funereus upembae 3
Rana fuscigula 46
Rana oxyrhyncha 5
Arthroleptis stenodactylus 1
Arthroleptis globosa 29
Phrynobatrachus cryptotis 188
Phrynobatrachus gutturosus 10
Phrynobatrachus parvulus 18
Phrynobatrachus natalensis 455
Hyperolius platyceps major 1
Hyperolius quinquevittatus 1

Kilolomatembo 1,750 meters

Bufo funereus upembae	3
Arthroleptis globosa	11
Phrynobatrachus parvulus	232
Hyperolius quinquevittatus	1

Kilwezi 800 meters

Xenopus laevis poweri	338
Bufo regularis	6
Rnaa albolabris lemairei	72
Rana oxyrhyncha	36
Rana superciliaris	3
Rana upembae	19
Arthroleptis stenodactylus	19
Arthroleptis globosa	1,671
Phrynobatrachus parvulus	165
Phrynobatrachus gutturosus	19
Phrynobatrachus cryptotis	123
Phrynobatrachus natalensis	591
Hemisus marmoratus	4
Hyperolius bocagei	16
Hyperolius kibarae	26
Hyperolius sansabaricus kivuensis.	15
Hyperolius platyceps major	19

Kimapongo 1,760 meters

Bufo funereus upembae	14
Rana fuscigula	1
Arthroleptis globosa	5
Phrynobatrachus parvulus	64

Kimiala 900 meters

Bufo lemairei	2
Bufo funereus upembae	8
Rana fuscigula	19
Rana grandisonae	2
Rana uzungwensis	2
Arthroleptis stenodactylus	2
Phrynobatrachus parvulus	28
Phrynobatrachus natalensis	9
Hyperolius nasutus nasutus	1

Kimilombo 1,400 meters

Bufo funereus upembae	2

Kipangaribwe 1,600 meters

Bufo regularis	1
Bufo funereus upembae	28
Rana fuscigula	63
Rana porosissima	2
Rana obscura	1
Phrynobatrachus parvulus	15
Hyperolius kibarae	41
Hyperolius marmoratus epheboides.	E

Kipondo 800 meters

Xenopus laevis poweri	1
Bufo regularis	183
Rana albolabris lemairei	16
Rana oxyrhyncha	5
Rana superciliaris	4
Arthroleptis stenodactylus	34
Arthroleptis globosa	261
Phrynobatrachus parvulus	40
Phrynobatrachus gutturosus	78
Phrynobatrachus cryptotis	42
Phrynobatrachus natalensis	186
Hemisus marmoratus	1
Hyperolius bocagei	3
Hyperolius platyceps major	2
Hyperolius sansabaricus kivuensis.	10

Kiwakishi 1,100 meters

Xenopus laevis poweri	5

Loie 700 meters

Rana fuscigula	1
Arthroleptis stenodactylus	1
Arthroleptis globosa	19
Phrynobatrachus natalensis	25

Loie 800 meters

Rana oxyrhyncha	1
Rana superciliaris	2
Phrynobatrachus cryptotis	6

Loie 1,000 meters

Bufo regularis	2
Arthroleptis globosa	127
Phrynobatrachus natalensis	21

Luanana 1,500 meters

Hyperolius kibarae	149

Luangalele 1,850 meters

Xenopus laevis poweri	25
Rana grandisonae	5
Rana porosissima	7
Phrynobatrachus cryptotis	6
Hyperolius nasutus nasutus	1

Lufira 800 meters

Rana oxyrhyncha	4
Rana superciliaris	2

Arthroleptis globosa 17
Phrynobatrachus parvulus 1
Phrynobatrachus cryptotis 44
Phrynobatrachus natalensis 75
Hyperolius sansabaricus kivuensis. 2

Lufira 1,320 meters
Rana porosissima 11

Lufwa 1,700 meters
Xenopus laevis poweri 49
Bufo lemairei 1
Bufo funereus upembae 4
Rana tuberculosa 1
Rana grandisonae 131
Rana porosissima 11
Rana obscura 2
Rana taenioscelis 11
Rana uzungwensis 6
Phrynobatrachus parvulus 1
Phrynobatrachus cryptotis 37
Phrynobatrachus natalensis 28
Leptopelis bocagei lebeaui 46
Kassina senegalensis 1
Kassina wittei 1
Hyperolius granulatus 44
Hyperolius kibarae 1
Hyperolius marmoratus epheboides. 8
Hyperolius nasutus nasutus 37
Hyperolius quinquevittatus 1

Lufwi 1,760 meters
Bufo regularis 1
Hemisus marmoratus 1

Lukawe 700 meters
Bufo regularis 3
Rana fuscigula 15
Rana albolabris lemairei 28
Rana oxyrhyncha 4
Arthroleptis stenodactylus 11
Arthroleptis globosa 103
Phrynobatrachus cryptotis 77
Phrynobatrachus natalensis 70
Hemisus marmoratus 2

Lukoka 750 meters
Rana superciliaris 3
Arthroleptis globosa 13
Phrynobatrachus gutturosus 1
Phrynobatrachus natalensis 13

Lukorami 900 meters
Bufo funereus upembae 1
Rana fuscigula 2
Arthroleptis globosa 138
Phrynobatrachus natalensis 6

Lupiala 700 meters
Xenopus laevis poweri 8
Bufo regularis 2
Bufo melanopleura 3
Rana fuscigula 5
Rana albolabris lemairci 36
Rana chrysogaster guibei 2
Rana oxyrhyncha 2
Rana upembae 2
Arthroleptis stenodactylus 11
Arthroleptis globosa 464
Phrynobatrachus parvulus 36
Phrynobatrachus gutturosus 19
Phrynobatrachus cryptotis 86
Phrynobatrachus natalensis 231
Leptopelis bocagei lebeaui 2
Hemisus marmoratus 1
Hyperolius bocagei 1
Hyperolius sansabaricus kivuensis. 1

Lupiala 850 meters
Arthroleptis globosa 12

Lupiala 900 meters
Bufo regularis 1

Lusinga, marais près tête de source Kapero 1,640 meters
Xenopus laevis poweri 43
Rana porosissima 70
Phrynobatrachus gutturosus 3
Phrynobatrachus cryptotis 384
Phrynobatrachus natalensis 142
Kassina senegalensis 100
Hemisus marmoratus 14
Hyperolius granulatus 3
Hyperolius marmoratus epheboides. 1
Hyperolius nasutus nasutus 1
Hyperolius quinquevittatus 2

Lusinga, rivière Dipidi 1,650 meters
Bufo funereus upembae 2
Arthroleptis globosa 5
Phrynobatrachus parvulus 67

Lusinga, riv. Kagomwe 1,700 meters
Rana fuscigula 3
Rana porosissima 3
Rana obscura 11
Rana oxyrhyncha 1
Hyperolius kibarae 16

Lusinga, rivière Kamalonge 1,700 meters
Bufo funereus upembae 4
Rana fuscigula 26
Rana obscura 4
Phrynobatrachus parvulus 1

Lusinga, rivère Karungwe 1,700 meters
Bufo funereus upembae 45
Rana fuscigula 3
Rana porosissima 5
Rana oxyrhyncha 1
Rana obscura 46
Phrynobatrachus parvulus 27
Hyperolius kibarae 12

Lusinga, riv. Lufwa 1,700 meters
Xenopus laevis poweri 425

Lusinga, rivère Kamalonge 1,760 meters
Rana porosissima 6
Arthroleptis globosa 15
Hyperolius kibarae 2

Lusinga, rivière Kamitungulu 1,760 meters
Rana fuscigula 1
Arthroleptis stenodactylus 1
Arthroleptis globosa 112
Hyperolius kibarae 52
Hyperolius marmoratus epheboides. 1

Lusinga, sur rivière Sange 1,760 meters
Xenopus laevis poweri 2
Phrynobatrachus parvulus 6

Lusinga, rivière Kafwe Petite (près Mukana) 1,780 meters
Xenopus laevis poweri 16
Rana porosissima 2

Lusinga, collines de 1,810 meters
Xenopus laevis poweri 26
Bufo regularis 7
Bufo funereus upembae 18
Phrynobatrachus natalensis 1
Leptopelis bocagei lebeaui 2
Hyperolius granulatus 7
Hyperolius kibarae 374
Hyperolius marmoratus epheboides. 2
Hyperolius nasutus nasutus 222

Lusinga, rivière 1,810 meters
Xenopus laevis poweri 11
Bufo regularis 20
Bufo lemairei 5
Bufo funereus upembae 75
Rana fuscigula 450
Rana tuberculosa 2
Rana grandisonae 123
Rana oxyrhyncha 3
Rana porosissima 193
Rana obscura 1
Rana taenioscelis 7
Rana uzungwensis 4
Arthroleptis globosa 6
Cacosternum leleupi 1
Phrynobatrachus parvulus 1,007
Phrynobatrachus cryptotis 217
Phrynobatrachus natalensis 117
Leptopelis bocagei lebeaui 2
Kassina senegalensis 46
Hyperolius granulatus 35
Hyperolius kibarae 28
Hyperolius marmoratus epheboides. 244
Hyperolius quinquevittatus 5

Lusinga, près marais Mukana 1,810 meters
Xenopus laevis poweri 236
Bufo lemairei 6
Rana grandisonae 16
Rana porosissima 14
Kassina senegalensis 9
Hyperolius granulatus 5

Lusinga, près Kabwekanono 1,815 meters
Xenopus laevis poweri 2
Rana porosissima 38

Mabwe 585 meters
Xenopus laevis poweri 51
Bufo carens 5
Bufo regularis 575

Rana fuscigula 1
Rana ornata 87
Rana frontalis 431
Rana chrysogaster guibei 20
Rana m. mascareniensis 515
Rana oxyrhyncha 6
Rana subpunctata 14
Arthroleptis stenodactylus 1,469
Arthroleptis globosa 1
Phrynobatrachus gutturosus 2
Phrynobatrachus cryptotis 1,545
Phrynobatrachus natalensis 662
Phrynobatrachus perpalmatus 2,020
Leptopalis bocagei lebeaui 37
Kassina senegalensis 4
Hemisus marmoratus 113
Phrynomerus bifasciatus 117
Afrixalus fulvovottatus upembae. 4
Afrixalus wittei 59
Hyperolius bocagei 3
Hyperolius cinnamomeoventris wittei. 3
Hyperolius marmoratus argentovittis. 62
Hyperolius nasutus nasutus 246
Hyperolius sansabaricus kivuensis. 41

Manda 1,750 meters
Bufo funereus upembae 1
Arthroleptis globosa 13
Phrynobatrachus cryptotis 10
Phrynobatrachus natalensis 1
Kassina senegalensis 1

Masombwe, sur Grande Kafwe 1,120 meters
Xenopus laevis poweri 10
Bufo regularis 27
Bufo funereus upembae 2
Rana fuscigula 21
Rana oxyrhyncha 4
Arthroleptis stenodactylus 2
Arthroleptis globosa 112
Phrynobatrachus parvulus 1,389
Phrynobatrachus gutturosus 23
Phrynobatrachus cryptotis 60
Phrynobatrachus natalensis 291
Kassina senegalensis 3
Hemisus marmoratus 68
Afrixalus wittei 1
Hyperolius nasutus nasutus 198
Hyperolius platyceps major 3
Hyperolius quinquevittatus 23
Hyperolius sansabaricus kivuensis. 11

Masombwe, près rivière Kanakakasi 1,120 meters
Arthroleptis stenodactylus 3
Arthroleptis globosa 5

Masombwe, rivière Kipepe 1,120 meters
Xenopus laevis poweri 8
Bufo regularis 4
Bufo funereus upembae 1
Rana fuscigula 21
Rana oxyrhyncha 4
Arthroleptis globosa 3
Phrynobatrachus gutturosus 6
Phrynobatrachus natalensis 12

Masombwe, rivière Lukobwe 1,120 meters
Leptopelis bocagei lebeaui 1

Mitoto 1,760 meters
Bufo funereus upembae 8
Rana porosissima 2
Arthroleptis globosa 1
Phrynobatrachus parvulus 135

Mokey 800 meters
Rana albolabris lemairei 1
Rana obscura 3
Arthroleptis stenodactylus 1
Phrynobatrachus parvulus 45
Phrynobatrachus gutturosus 5
Phrynobatrachus cryptotis 7
Phrynobatrachus natalensis 45
Hyperolius bocagei 2

Mubale 1,750-1,780 meters
Xenopus laevis poweri 99
Bufo regularis 2
Bufo funereus upembae 1
Bufo melanopleura 3
Rana tuberculosa 2
Rana grandisonae 91
Rana taenioscelis 1
Rana uzungwensis 1
Rana porosissima 1
Arthroleptis globosa 140
Cardioglossa sp. 1
Phrynobatrachus parvulus 21
Phrynobatrachus cryptotis 132

Phrynobatrachus natalensis	36
Leptopelis bocagei lebeaui	1
Kassina senegalensis	6
Hyperolius granulatus	2
Hyperolius marmoratus epheboides.	2
Hyperolius nasutus nasutus	7
Hyperolius quinquevittatus	2

Mujinga-Kalenge 1,050 meters

Xenopus laevis poweri	31

Mukana 1,100 meters

Afrixalus wittei	1

Mukana 1,810 meters

Xenopus laevis poweri	561
Bufo funereus upembae	1
Rana grandisonae	146
Rana porosissima	119
Arthroleptis globosa	21
Cacosternum leleupi	2
Phrynobatrachus parvulus	24
Phrynobatrachus cryptotis	2,803
Phrynobatrachus natalensis	46
Kassina senegalensis	8
Hyperolius granulatus	56
Hyperolius kibarae	8
Hyperolius marmoratus epheboides.	287
Hyperolius nasutus nasutus	605
Hyperolius quinquevittatus	1

Mukelengia 1,750 meters

Xenopus laevis poweri	25
Bufo regularis	3
Rana fuscigula	1
Rana porosissima	1
Arthroleptis globosa	285
Cacosternum leleupi	1
Phrynobatrachus parvulus	18
Phrynobatrachus cryptotis	612
Phrynobatrachus natalensis	154
Kassina wittei	5
Hyperolius marmoratus epheboides.	1
Hyperolius quinquevittatus	24

Mukukwe 1,760 meters

Rana fuscigula	3
Rana oxyrhyncha	2
Arthroleptis globosa	3
Phrynobatrachus parvulus	1
Phrynobatrachus gutturosus	1
Phrynobatrachus cryptotis	1
Phrynobatrachus natalensis	21

Munoi 890 meters

Xenopus laevis poweri	5
Bufo regularis	6
Rana albolabris lemairei	64
Rana oxyrhyncha	4
Rana obscura	8
Rana upembae	26
Rana uzungwensis	4
Arthroleptis stenodactylus	46
Arthroleptis globosa	2,729
Phrynobatrachus parvulus	167
Phrynobatrachus gutturosus	80
Phrynobatrachus cryptotis	78
Phrynobatrachus natalensis	101
Leptopelis bocagei lebeaui	1
Kassina senegalensis	1
Hemisus marmoratus	3
Hyperolius bocagei	16
Hyperolius platyceps major	3
Hyperolius quinquevittatus	11

Munte 1,450 meters

Arthroleptis globosa	2
Phrynobatrachus cryptotis	4
Phrynobatrachus natalensis	9
Hyperolius kibarae	1

Munte 1,750 meters

Rana fuscigula	3
Arthroleptis globosa	1
Phrynobatrachus parvulus	2
Phrynobatrachus cryptotis	273
Hyperolius granulatus	1
Hyperolius marmoratus epheboides.	1
Hyperolius nasutus nasutus	5

Munte-Mubale 1,480 meters

Xenopus laevis poweri	811
Bufo lemairei	1
Bufo regularis	4
Bufo funereus upembae	74
Rana albolabris lemairei	52
Rana grandisonae	46
Rana porosissima	40
Rana uzungwensis	18
Arthroleptis globosa	377
Phrynobatrachus parvulus	35
Phrynobatrachus cryptotis	837

Phrynobatrachus natalensis 677
Leptopelis bocagei lebeaui 2
Kassina senegalensis 42
Hemisus marmoratus 10
Hyperolius granulatus 3
Hyperolius marmoratus epheboides. 77
Hyperolius nasutus nasutus 100

Muye 800 meters
Rana oxyrhyncha 1
Arthroleptis globosa 28

Muye 1,480 meters
Rana obscura 1

Muye 1,630 meters
Bufo regularis 1
Rana tuberculosa 1
Arthroleptis globosa 2
Phrynobatrachus natalensis 12

Mware 750 meters
Bufo regularis 2
Rana fuscigula 4
Rana oxyrhyncha 1
Rana superciliaris 8
Arthroleptis globosa 19
Phrynobatrachus gutturosus 1
Phrynobatrachus natalensis 13

Mware 950 meters
Rana fuscigula 2
Rana oxyrhyncha 2
Arthroleptis globosa 95
Phrynobatrachus natalensis 7

Mwema-Mabole 620 meters
Rana frontalis 1
Phrynobatrachus cryptotis 1
Phrynobatrachus natalensis 1

Pelenge 1,250 meters
Bufo regularis 4
Bufo funereus upembae 88
Rana fuscigula 249
Rana albolabris lemairei 34
Rana ansorgei 28
Rana porosissima 2
Rana obscura 95
Rana uzungwensis 14
Arthroleptis globosa 2,188
Phrynobatrachus parvulus 3,925
Phrynobatrachus cryptotis 19
Phrynobatrachus natalensis 18
Kassina senegalensis 1
Hyperolius kibarae 134
Hyperolius platyceps major 9
Hyperolius quinquevittatus 559

Sanga 700 meters
Xenopus laevis poweri 1
Phrynobatrachus parvulus 36
Phrynobatrachus cryptotis 96
Phrynobatrachus natalensis 64
Hyperolius marmoratus argentovittis. 1

Sange 1,760 meters
Hyperolius nasutus nasutus 17

Senze 800 meters
Xenopus laevis poweri 1
Bufo regularis 2
Rana oxyrhyncha 2
Rana superciliaris 2
Arthroleptis globosa 67
Phrynobatrachus parvulus 214
Phrynobatrachus cryptotis 173
Phrynobatrachus natalensis 156
Afrixalus wittei 1
Hyperolius sansabaricus kivuensis. 3

Tumbwe 1,120 meters
Bufo funereus upembae 1
Rana fuscigula 1
Rana upembae 1
Arthroleptis stenodactylus 2
Arthroleptis globosa 1
Phrynobatrachus parvulus 8

APPENDIX C.

COMPLETE LIST OF THE DIFFERENT LOCALITIES.

Xenopus laevis poweri. 2.603 exemplaires.

Lusinga (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.810 m] : 22-25.V.1945 (5 ex.), 14-18.VI.1945 (8 ex.).

Lusinga, près marais Mukana [alt. 1.810 m] : 28-29.V.1945 (116 ex.), 4.VI.1945 (91 ex.), 28-30.VI.1945 (29 ex.).

Lusinga (colline de) [alt. 1.810 m] : 30.V.1945 (5 ex.), 23.III-9.IV.1947 (2 ex.), 9-17.IV.1947 (2 ex.), 28.VI-21.VII.1947 (2 ex.), XI-XII.1947 (13 ex.), 9.I.1948 (1 ex.), 23.IV.1949 (1 ex.).

Lusinga, mare Kabwekanono, près de la tête de source de la Lufwa, affluent droit de la Lufira [alt. 1.815 m] : 31.V.1945 (2 ex.).

Kabwekanono, mare près tête de source de la Lufwa, affluent droit de la Lufira, sur rive gauche de la Lusinga [alt. 1.815 m] : 31.V.1945 (5 ex.).

Lusinga, rivière Lufwa, affluent droit de la Lufira (tête de source) près Lusinga [alt. 1.700 m] (Ex. P.N.U.) : 1.VI.1945 (425 ex.).

Lusinga, rivière Petite Kafwe, affluent droit de la Grande Kafwe et sous-affluent droit de la Lufwa [alt. 1.780 m] : 5.VI.1945 (16 ex.).

Lusinga, sur rivière Sange, affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. ± 1.760 m] : 7.VI. 1945 (2 ex.).

Mukana, marais près de Lusinga [alt. 1.810 m] : 12.VI.1945 (1 ex.), 12.III.1947 (45 ex.), 14.IV.1947 (6 ex.), 5.VII.1947 (6 ex.), 4.III.1948 (117 ex.), 12.III.1948 (302 ex.), 24.III.1948 (25 ex.), 29.III.1948 (37 ex.), 3-4.I.1949 (22 ex.).

Lufwa (rivière), affluent droit de la Lufira (tête de source près de Lusinga) [alt. 1.700 m] (Ex. P.N.U.) : 17.III.1947 (30 ex.), 15.I.1948 (19 ex.).

Luangalele, près de Mukana (Lusinga) [alt. 1.850 m] : 19.III.1947 (25 ex.).

Katomowe (Mukana), près Lusinga (lieu-dit) [alt. 1.812 m] : 22.III.1947 (431 ex.).

Kalumengongo (rivière), affluent droit du Lualaba [alt. 1.780 m] : 18.IV.1947 (1 ex.), IV.1947 (20 ex.), 16.IV.1949 (3 ex.).

Munte-Mubale (région du confluent des rivières), affluents droits de la Lufira [alt. 1.480 m] : 1-8.V.1947 (22 ex.), 1-9.V.1947 (1 ex.), 10-14.V.1947 (152 ex.), 15-19.V.1947 (6 ex.).

Ganza, salines près de la rivière Kamandula, affluent droit de la Lukoka et sous-affluent gauche de la Lufira [alt. 860 m] : 27.VI-2.VII.1947 (10 ex.).

Mabwe. rive Est du lac Upemba [alt. 585 m] : 28.VII-12.VIII.1947 (3 ex.), 26-30.XI.1948 (1 ex.), 27.XI.1948 (1 ex.), 3-6.XII.1948 (1 ex.), 5-10.XII.1948 (1 ex.), 17-18.XII.1948 (1 ex.), 20-30.XII.1948 (19 ex.), 28.XII.1948 (1 ex.), 4-8.I.1949 (4 ex.), 5.I.1949 (1 ex.), 6.I.1949 (7 ex.), 8.I.1949 (7 ex.), 13-14.I.1949 (4 ex.), 25.I.1949 (4 ex.), 8-12.II.1949 (1 ex.).

Kande (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 730 m] : 13-27.IX.1947 (2 ex.), 10-18.X.1947 (12 ex.).

Kanonga (rivière), affluent droit de la Fungwe [alt. 695 m] : 13-27.IX.1947 (30 ex.), 30.IX.1947 (1 ex.), 16-18.II.1949 (3 ex.), 18-19.II.1949 (2 ex.), 19-21.II.1949 (1 ex.)

Lupiala (rivière), affluent droit de la Lufira [alt. 700 m] : 14-22.X.1947 (5 ex.), 20.X.1947 (2 x.), 28.X.1947 (1 ex.).

Kaswabilenga, région du cours inférieur de la Lupiala, affluent droit de la Lufira [alt. 700 m] : 31.X-5.XI1.947 (1 ex.), 24.I1949 (1 ex.).

Kateke (rivière), affluent de la Muovwe et sous-affluent droit de la Lufira [alt. 960 m] : 23.XII-5.XII.1947 (1 ex.).

Lusinga, marais du Kapero, près de la tête de source, affluent droit de la Lufwa [alt. 1.640 m] : 9.I.1948 (43 ex.).

Mubale (tête de source de la rivière), affluent gauche de la Munte et sous-affluent droit de la Lufira [alt. 1.750 m] : 16.I.1948 (24 ex.), 7.IV.1948 (75 ex.).

Dipidi (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.700 m] (Ex. P.N.U.) : 19.I.1948 (1 ex.).

Kafwe (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.790 m] : 18.III.1948 (50 ex.).

Buye-Bala (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.750 m] : 1-7.IV.1948 (105 ex.), 8-12.IV.1948 (1 ex.), 13.IV.1948 (5 ex.), 27.IX.1948 (18 ex.).

Bwalo (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.750 m] : 9.IV.1948 (1 ex.).

Katongo (rivière), affluent gauche de la Mubale et sous-affluent gauche de la Munte [alt. 1.750 m] : 10.IV.1948 (6 ex.).

Mukelengia (rivière), affluent gauche de la Kalumengongo et sous-affluent droit du Lualaba [alt. 1.750 m] : 12.IV.1948 (22 ex.), 13.IV.1948 (3 ex.).

Kabwe, sur la rive droite de la rivière Muye, affluent droit de la Lufira [alt. 1.320 m] : 6-7.V.1948 (1 ex.), 21-25.V.1948 (1 ex.).

Munoi, bifurcation de la rivière Lupiala, affluent droit de la Lufira [alt. 890 m] : 12-16.VI.1948 (5 ex.).

Sanga (rivière), affluent du lac Upemba [alt. 700 m] : 21.VI.1948 (1 ex.).

Kiwakishi (grottes de), près de Kiamakoto [alt. 1.100 m] (Ex. P.N.U.) : 7-9.VII.1948 (5 ex.).

Masombwe, sur la rivière Grande Kafwe, affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.120 m] (Ex. P.N.U.) : 7-9.VII.1948 (4 ex.), 4-16.X.1948 (5 ex.), 7.X.1948. (1 ex.).

Kilwezi (rivière), affluent droit de la Lufira [alt. 800 m] : 1-7.VIII.1948 (37 ex.), 16-17.VIII.1948 (1 ex.).

Kipondo (rivière), affluent droit de la Lufira (près de Kilwezi) [alt. 800 m] : 7.VIII.1948 (1 ex.).

Senze (rivière), affluent droit de la Lufira [alt. 800 m] : 20.VIII.1948 (1 ex.).

Masombwe, rivière Kipepe, affluent de la Tumbwe et sous-affluent de la Grande Kafwe [alt. 1.120 m] : 4-16.X.1948 (12 ex.).

Bunda-Bunda, près de la rivière Lufwa, affluent droit de la Lufira, au Nord de Sampwe [alt. 900 m] (Ex. P.N.U.) : 9.X.1948 (1 ex.).

Bowa (rivière), affluent droit de la Kalule-Nord et sous-affluent droit du Lualaba, près de Kiamalwa [alt. 1.050 m] : 28.II-1.III.1949 (5 ex.), 2-3.III.1949 (7 ex.), 4.III.1949 (1 ex.).

Kalule-Nord (rivière), rive gauche en face de Mujinga-Kalenge, affluent droit du Lualaba [alt. 1.050 m] : 4.III.1949 (5 ex.).

Mujinga-Kalenge (village), rive droite de la rivière Kalule-Nord, affluent droit du Lualaba [alt. 1.050 m] : 4-5.III.1949 (91 ex.).

Bufo carens. 93 exemplaires.

Kande (rivière). affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 730 m] : 10-18.X.1947 (1 ex.).

Kaswabilenga, rive droite de la rivière Lufira (piste Lusinga-Mabwe) [alt. 680 m] : 1-8.XI.1947 (1 ex.), 8-20.XII.1948 (3 ex.), 8.XII.1948-3.I.1949 (8 ex.), 5-9.I.1949 (8 ex.), 24.I.1949 (5 ex.), 31.I.1949 (6 ex.), 7.II.1949 (3 ex.). 21.II.1949 (11 ex.), 28.II.1949 (4 ex.), 7.III.1949 (5 ex.), 16.III.1949 (10 ex.).

Lufira (rivière) [alt. 960 m] : 23.XI-5.XII.1947 (9 ex.).

Kiamakoto (entre Masombwe et Mukana), sur la rive droite de la rivière Lukima, affluent droit de la Grande Kafwe [alt. 1.100 m] (Ex. P.N.U.) : 4-16.X.1948 (1 ex.).

Mabwe, rive Est du lac Upemba [alt. 585 m] : 20.XI. 1948 (1 ex.), 20-30.XII.1948 (2 ex.), 26.XII.1948 (1 ex.), 12-17.II.1949 (1 ex.).

Kanonga (rivière), affluent droit de la Fungwe [alt. 695 m] : 15-23.II.1949 (3 ex.).

Bowa (rivière), affluent droit de la Kalule-Nord et sous-affluent droit du Lualaba, près Kiamalwa [alt. 1.050 m] : 28.II-1.III.1949 (3 ex.), 2-3.III.1949 (1 ex.).

Kalule-Nord (rivière), affluent droit du Lualaba (rive gauche en face de Mujinga-Kalenge [alt. 1.050 m] : 4.III.1949 (6 ex.).

Bufo funereus upembae. 757 exemplaires.

Lusinga (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.810 m] : 1941-1943 (1 ex.), 20-25.V.1945 (19 ex.), 14-18.VI.1945 (9 ex.), 18-30.VI.1945 (3 ex.), 23.III-9.IV.1947 (36 ex.), 28.VI-21.VII.1947 (6 ex.), XI-XII.1947 (1 ex.).

Lusinga, rivière Karungwe, affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. ± 1.700 m] : 6.IV.1945 (2 ex.), 6.VI.1945 (14 ex.).

Kagomwe (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.700 m] : 8.VI.1945 (13 ex.), 12.VII.1945 (27 ex.).

Lusinga, rivière Kamalonge, affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. ± 1.760 m] : 11.VI.1945 (4 ex.), 22.VI.1945 (29 ex.).

Lusinga, rivière Dipidi, affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.700 m] (Ex. P.N.U.) : 12.VI.1945 (2 ex.).

Kamitungulu (rivière), affluent gauche de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.760 m] : 13.VI.1945 (9 ex.), 7.III.1947 (5 ex.), 18.IV.1947 (5 ex.).

Kambi (rivière), affluent de la Grande Kafwe et sous-affluent droit de la Lufwa (vers Masombwe) [alt. 1.750 m] : 25-27.VI.1945 (7 ex.).

Kipangaribwe (rivière), affluent droit de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.600 m] : 2-4.VII.1945 (25 ex.), 6.VII.1945 (2 ex.), 24.VII.1945 (1 ex.).

Kamatshya (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.750 m] : 6.VII.1945 (4 ex.).

Mitoto (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. ± 1.760 m] : 9.VII.1945 (8 ex.).

Kamitunu (rivière), affluent gauche de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.760 m] : 10-11.VII.1945 (53 ex.), 13.III.1947 (2 ex.), 14.I.1948 (6 ex)., 21.I.1948 (8 ex.).

Lusinga (colline de) [alt. 1.810 m] : 13-20.VII.1945 (1 ex.), 23.II.-9.IV.1947 (9 ex.), XI.1947 (1 ex.), XI-XII.1947 (4 ex.), 25.X.1948 (2 ex.), 23.IV.1949 (1 ex.).

Babagi (rivière), affluent de la Katembula et sous-affluent de la Muye [alt. ± 900 m] : 14.VII.1945 (6 ex.).

Kavizi (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. ± 1.700 m] : 14.VII.1945 (9 ex.).

Kanpungu (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.750 m] : 16.VII.1945 (2 ex.).

Kilolomatembo (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.750 m] : 17.VII.1945 (3 ex.).

Kimapongo (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. ± 1.760 m] : 18.VII.1945 (14 ex.).

Karibwe (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.700 m] : 4-6.III.1947 (36 ex.), 2.IV.1947 (2 ex.).

Kasandendeko (rivière), affluent de la Kamitungulu et sous-affluent gauche de la Lusinga [alt. 1.700 m] : 10.III.1947 (2 ex.).

Kenia (rivière), affluent droit de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.585 m] (Ex. P.N.U.) : 11.III.1947 (3 ex.), 28.III.1947 (3 ex.), 10.VII.1947 (2 ex.).

Kamamulongo (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.700 m] : 11.III.1947 (1 ex.).

Lufwa (rivière), affluent droit de la Lufira, tête de source près de Lusinga [alt. 1.700 m] (Ex. P.N.U.) : 17.III.1947 (1 ex.).

Kabiteke-Kabwekanono, mare près tête de source de la Lufwa, affluent droit de la Lufira, sur rive gauche de la Lusinga [alt. 1.815 m] : 18 III.1947 (6 ex.).

Pelenge (gorges de la rivière), affluent droit de la Lufira [alt. 1.250 m] : 8-11.IV.1947 (1 ex.), 20.V-7.VI.1947 (7 ex.), 21-30.V.1947 (13 ex.), 8-11.VI.1947 (22 ex.), 12-15.VI.1947 (17 ex.), 18-19.VI.1947 (24 ex.), 24.VI.1947 (3 ex.), 10-19.III.1949 (1 ex.).

Kalumengongo (rivière), affluent droit du Lualaba [alt. 1.830 m] : IV.1947 (4 ex.), 17.I.1949 (1 ex.).

Munte-Mubale (région du confluent), affluent et sous-affluent droit de la Lufira [alt. 1.480 m] : 1-9.V.1947 (36 ex.), 10-14.V.1947 (1 ex.), 15-19.V.1947 (37 ex.).

Mukana, marais près de Lusinga [alt. 1.810 m] : 14.IV.1947 (1 ex.).

Kabwekanono, mare près tête de source de la Lufwa, affluent droit de la Lufira, sur rive gauche de la Lusinga [alt. 1.815 m] : 4.VII.1947 (3 ex.), 14.I.1948 (2 ex.).

Kankunda (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 1.300 m] : 11-19.XI.1947 (1 ex.), 14-17.XI.1947 (1 ex.), 21-22.XI.1947 (4 ex.).

Tumbwe (rivière), affluent gauche de Grande Kafwe et sous-affluent droit de la Lufwa [alt. 1.460 m] : 10.I.1948 (1 ex.).

Kimilombo (rivière), affluent de la Grande Kafwe et sous-affluent droit de la Lufwa [alt. 1.400 m] : 10-I.1948 (2 ex.).

Dipidi (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.700 m] (Ex. P.N.U.) : 19.I.1948 (4 ex.).

Buye-Bala (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.750 m] : 28-31.III.1948 (7 ex.), 1-7.IV.1948 (43 ex.), 8-12.IV.1948 (15 ex.), 13.IV.1948 (1 ex.).

Mubale (rivière), affluent gauche de la Munte et sous-affluent droit de la Lufira (tête de source) [alt. 1.780 m] : 7.IV.1948 (1 ex.).

Bwalo (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.750 m] : 9.IV.1948 (3 ex.).

Katongo (rivière), affluent gauche de la Mubale et sous-affluent gauche de la Munte [alt. 1.750 m] : 14-15.IV.1948 (1 ex.).

Manda (rivière), affluent de la Kalumengongo et sous-affluent droit du Lualaba [alt. 1.750 m] (Ex. P.N.U.) : 20.IV.1948 (1 ex.).

Kabwe, sur la rive droite de la rivière Muye, affluent droit de la Lufira [alt. 1.320 m] : 28.IV-2.V.1948 (16 ex.), 6-7.V.1948 (12 ex.), 8-11.V.1948 (9 ex.), 12-15.V.1948 (3 ex.), 16-17.V.1948 (1 ex.). 21-25.V.1948 (8 ex.).

Kiamakoto (entre Masombwe et Mukana), sur la rive droite de la rivière Lukima, affluent droit de la Grande Kafwe [alt. 1.100 m] (Ex. P.N.UU.) : 4-16.X.1948 (3 ex.).

Masombwe, dans la rivière Grande Kafwe, affluent droit de la Lufwa [alt. 1.120 m] (Ex. P.N.U.) : 4-16.X.1948 (2 ex.).

Masombwe, dans la rivière Kipepe, affluent de la Tumbwe et sous-affluent gauche de la Grande Kafwe [alt. 1.120 m] : 4-16.X.1948 (1 ex.).

Bowa (rivière), affluent droit de la Kalule-Nord et sous-affluent droit du Lualaba, près de Kiamalwa [alt. 1.050 m] : 28.II-1.III.1949 (1 ex.).

Kimiala (rivière), affluent de la Luizi et sous-affluent gauche de la Lufwa, près de Sampwe (Kundelungu) [alt. 900 m] (Ex. P.N.U.) : 31.III.1949 (7 ex.), 1.IV.1949 (1 ex.).

Ganza, salines près de la rivière Kamandula, affluent droit de la Lukoka et sous-affluent gauche de la Lufira [alt. 860 m] : 30.V-4.VI.1949 (6 ex.), 30.V-10.VI.1949 (1 ex.), 6-10.VI.1949 (2 ex.), 12-18.VI.1949 (9 ex.), 20-25.VI.1949 (1 ex.), 27.VI-2.VII.1949 (6 ex.).

Lukorami (rivière), affluent gauche de la Lufira [alt. ± 900 m] : 13.VI.1949 (1 ex.).

Bufo lemairei. 19 exemplaires.

Lusinga, près du marais Mukana [alt. 1.810 m] : 28-29.V.1945 (6 ex.).

Lusinga, rivière Lufwa (tête de source), affluent droit de la Lufira [alt. 1.810 m] (Ex. P.N.U.) : 1.VI.1945 (5 ex.).

Munte-Mubale (région du confluent), affluent droit de la Lufira [alt. 1.480 m] : 11.V.1947 (1 ex.).

Lufwa (rivière), affluent droit de la Lufira, tête de source près de Lusinga [alt. 1.700 m] (Ex. P.N.U.) : 17.III.1948 (1 ex.).

Kalumengongo (rivière), affluent droit du Lualaba [alt. 1.830 m] : 17.I.1949 (1 ex.), 16.IV.1949 (1 ex.).

N'Gozie, mare à gauche de la route Lusinga-Mitwaba [alt. 1.600 m] (Ex. P.N.U.) : II.1949 (1 ex.), 6.IV.1949 (1 ex.).

Kimiala (rivière), affluent Luizi et sous-affluent gauche de la Lufwa, près Sampwe (Kundelungu) [alt. 900 m] (Ex. P.N.U.) : 4.IV.1949 (2 ex.).

Bufo melanopleura. 307 exemplaires.

Lupiala (rivière), affluent droit de la Lufira [alt. 700 m] : 23.X.1947 (3 ex.).

Kankunda (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 1.300 m] : 11-13.XI.1947 (58 ex.), 14-17.XI.1947 (95 ex.), 17.XI.1947 (3 ex.), 18-19.XI.1947 (11 ex.), 20.XI.1947 (1 ex.), 21-22.XI.1947 (32 ex.), 24-26.XI.1947 (75 ex.).

Kateke (rivière), affluent de la Muovwe et sous-affluent droit de la Lufira [alt. 960 m] : 23.XI-5.XII.1947 (16 ex.).

Kabwe, sur la rive droite de la rivière Muye, affluent droit de la Lufira [alt. 1.320 m] : 8-11.V.1948 (8 ex.), 12-15.V.1948 (2 ex.).

Kaswabilenga, région du cours inférieur de la rivière Lupiala, affuent droit de la Lufira [alt. 700 m] : 31.I.1949 (1 ex.), 16.III.1949 (1 ex.).

Kanonga (rivière), affluent droit de la Fungwe [alt. 695 m] : 15-23.II.1949 (1 ex.).

Bufo regularis. 1.310 exemplaires.

Mabwe, rive Est du lac Upemba [alt. 585 m] : 16-17.IV.1945 (1 ex.), 28.III-12.VIII.1947 (24 ex.), 30.VIII-4.IX.1947 (497 ex.), 7-9.IX.1947 (1 ex.), 6-7.XI.1948 (2 ex.), 15.XI.1948 (2 ex.), 26-30.XI.1948 (3 ex.), 3-6.XII.1948 (4 ex.), 5-8.XII.1948 (1 ex.), 17-18.XII.1948 (1 ex.), 21.XII.1948 (5 ex.), 1-13.I.1949 (8 ex.), 4-8.I.1949 (1 ex.), 5.I.1949 (1 ex.), 14.I.1949 (3 ex.), 19.I.1949 (8 ex.), 24.I.1949 (1 ex.), 25.I.1949 (5 ex.), 2.II.1949 (2 ex.), 8-12.II.1949 (3 ex.), 17-22.II.1949 (1 ex.), 6.III.1949 (1 ex.).

Lusinga (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.810 m] : 22-25.V.1945 (1 ex.), 28-29.V.1945 (1 ex.), 30.V.1945 (1 ex.), 1.VI.1945 (1 ex.), 18-30.VI.1945 (1 ex.), 20.II-21.III.1947 (4 ex.), 23.III-9.IV.1947 (2 ex.), 3.IV.1947 (1 ex.), 9-17.IV.1947 (1 ex.), 31.X-5.XI.1947 (1ex.), XI-XII.1947 (1 ex.), I.1948 (1 ex.).

Kipangaribwe (rivière), affluent droit de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.600 m] : 2-4.VII.1945 (1 ex.).

Karibwe (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.700 m] : 4-6.III.1947 (1 ex.), 10.IV.1948 (1 ex.).

N'Gongozi, près marais Mukana [alt. 1.810 m] : 15.III.1947 (1 ex.).

Katombwe (Mukana), près de Lusinga (lieu-dit) [alt. 1.812 m] : 22.III.1947 (1 ex.).

Pelenge (gorges de la rivière), affluent droit de la Lufira [alt. 1.250 m] : 8-11.IV.1947 (1 ex.), 21-30.V.1947 (1 ex.), 12-15.VI.1947 (1 ex.), 18-19.VI.1947 (1 ex.).

Lusinga (colline de) [alt. 1.810 m] : 9-27.IV.1947 (1 ex.), 28.VI-2.VII.1947 (2 ex.), XI-XII.1947 (3 ex.), 20.III.1949 (1 ex.).

Munte-Mubale, région du confluent, affluent et sous-affluent droit de la Lufira [alt. 1.480 m] : 2.V.1947 (1 ex.), 10-14.V.1947 (1 ex.), 15-19.V.1947 (2 ex.).

Kabwekanono, mare près tête de source de la rivière Lufwa, affluent droit de la Lufira, sur rive gauche de la Lusinga [alt. 1.815 m] : 4.VII.1947 (3 ex.).

Kanonga(rivière), affluent droit de la Fungwe [alt. 695 m] : 13-27.IX.1947 (3 ex.), 14-16.II.1949 (1 ex.), 18-19.II.1949 (3 ex.), 19-21.II.1949 (1 ex.), 26-28.II.1949 (1 ex.),

Kaswabilenga. cours inférieur de la rivière Lupiala, affluent droit de la Lufira [alt. 700 m] : 13-27.IX.1947 (9 ex.), 8-20.XII.1948 (13 ex.), 8.XII.1948-3.I.1949 (22 ex.), 5-9.I.1949 (7 ex.), 24.I.1949 (5 ex.). 31.I.1949 (4 ex.), 7.II.1949 (11 ex.), 21.II.1949 (7 ex.), 28.II.1949 (6 ex.), 7.III.1949 (10 ex.), 16.III.1949 (17 ex.).

Kaswabilenga, rive droite de la Lufira (piste Lusinga-Mabwe) [alt. 680 m] : 13-27.IX.1947 (20 ex.), 29.X.1947 (1 ex.).

Lukawe (rivière). affluent droit de la Lufira [alt. 700 m] : 27.IX.1947 (1 ex.). 28.X.1947 (2 ex.).

Kande (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 730 m] : 10-18.X.1947 (8 ex.), 25.X.1947 (2 ex.), 27.X.1947 (142 ex.).

Lupiala (rivière), affluent droit de la Lufira [alt. 700 m] : 24.X.1947 (1 ex.), 28.X.1947 (2 ex.).

Kaswabilenga, rive gauche de la Lufira [alt. 750 m] : 5.XI.1947 (1 ex.).

Kankunda (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 1.300 m] : 11-19.XI.1947 (2 ex.), 21-22.XI.1947 (1 ex.).

Kateke (rivière), affluent de la Muovwe et sous-affluent droit de la Lufira [alt. 960 m] : 23.XI-5.XII.1947 (18 ex.).

Kaziba (rivière), affluent gauche Senze et sous-affluent droit de la Lufira [alt. 1.140 m] : 1-11.II.1948 (7 ex.), 15.II.1948 (1 ex.), 15-21.II.1948 (3 ex.).

Kenia (rivière), affluent droit de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.585 m] (Ex. P.N.U.) : 12.III.1948 (1 ex.).

Dipidi (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.700 m] (Ex. P.N.U.) : 16.III.1948 (1 ex.).

Buye-Bala (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.750 m] : 1-7.IV.1948 (16 ex.), 13.IV.1948 (1 ex.), 18.IV.1948 (4 ex.).

Muye (rivière), tête de source, affluent droit de la Lufira [alt. 1.630 m] : 6.IV.1948 (1 ex.).

Mubale (rivière), affluent gauche de la Munte et sous-affluent droit de la Lufira (tête de source) [alt. 1.780 m] : 7.IV.1948 (2 ex.).

Bwalo (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.750 m] : 9.IV.1948 (7 ex.).

Katongo (rivière), affluent gauche de la Mubale et sous-affluent gauche de la Munte [alt. 1.750 m] : 10.IV.1948 (2 ex.), 18.IV.1948 (1 ex.).

Mukelengia (rivière), affluent gauche de la Kalumengongo et sous-affluent droit du Lualaba [alt. 1.750 m] : 15.IV.1948 (3 ex.).

Lufwi (rivière), tête de source, affluent droit de la Grande Kafwe [alt. 1.760 m] : 18.IV.1948 (1 ex.).

Kabwe, sur la rive droite de la Muye, affluent droit de la Lufira [alt. 1.320 m] : 28.IV-2.V.1948 (1 ex.), 6-7.V.1948 (2 ex.) 8-10.V.1948 (1 ex.), 21-25.V.1948 (1 ex.).

Munoi, bifurcation de la rivière Lupiala, affluent droit de la Lufira [alt. 890 m] : 1-11.VI.1948 (2 ex.), 12-16.VI.1948 (2 ex.), 24.VI.1948 (2 ex.).

Masombwe, dans rivière Kipepe, affluent de la Tumbwe et sous-affluent gauche de la Grande Kafwe [alt. 1.120 m] : 7-9.VII.1948 (1 ex.), 4-16.IX.1948 (3 ex.).

Kiamakoto (entre Masombwe et Mukana), sur rive droite de la Lukima, affluent droit de la Grande Kafwe [alt. 1.100 m] (Ex. P.N.U.) : 7-9.VII.1948 (1 ex.), 4-16.X.1948 (38 ex.).

Kilwezi (rivière), affluent droit de la Lufira [alt. 800 m] : 16-17.VIII.1948 (1 ex.), 30.VIII.1948 (1 ex.), 3.IX.1948 (3 ex.), 6.IX.1948 (1 ex.).

Loie (rivière), affluent gauche de la Lufira [alt. ± 1.000 m] : 17.VIII.1948 (1 ex.), 6.VI.1949 (1 ex.).

Kipondo (rivière), affluent droit de la Lufira (près Kilwezi) [alt. 800 m] : 10.IX.1948 13.IX.1948 (183 ex.).

Senze (rivière), affluent droit de la Lufira [alt. 800 m] : 16.IX.1948 (2 ex.).

Masombwe sur la rivière Grande Kafwe, affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.120 m] (Ex. P.N.U.) : 4-16.X.1948 (3 ex.).

Kalumengongo (rivière), affluent droit du Lualaba [alt. 1.830 m] : 24.XI.1948 (1 ex.), 17.I.1949 (27 ex.), II.1949 (2 ex.).

Bowa (rivière), affluent droit de la Kalule-Nord et sous-affluent droit du Lualaba, près de Kiamalwa [alt. 1.050 m] : 2-3.III.1949 (1 ex.).

Kalule-Nord (rivière), rive gauche en face de Mujinga-Kalenge, affluent droit du Lualaba [alt. 1.050 m] : 4.III.1949 (1 ex.).

Kabenga, près de Kaziba [alt. 1.250 m] (Ex. P.N.U.) : 27.III.1949 (2 ex.), 30.III-8.IV.1949 (1 ex.), 2.IV.1949 (1 ex.). 6.IV.1949 (2 ex.), 7.IV.1949 (2 ex.).

Ganza, salines près de la rivière Kamandula, affluent droit de la Lukoka et sous-affluent gauche de la Lufira [alt. 860 m] : 30.V.1949 (7 ex.), 6-10.VI.1949 (1 ex.), (20-25.VI.1949 (1 ex.), 27.VI-2.VII.1949 (2 ex.).

Kamakoko, salines près Ganza (près rivière Kamandula, affluent de la Lukoka et sous-affluent gauche de la Lufira [alt. 860 m] : 30.V-10.VI.1949 (91 ex.).

Difirinji (rivière), affluent gauche de la Lufira [alt. 750 m] : 27.VI.1949 (1 ex.).

Mware (rivière), affluent gauche de la Lufira [alt. 750 m] : 11.VII.1949 (2 ex.).

Bufo ushoranus. 74 exemplaires.

Kankunda (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 1.300 m] : 11-13.XI.1947 (4 ex.), 14-17.XI.1947 (6 ex.), 17.XI.1947 (4 ex.), 20.XI.1947 (3 ex.), 21-22.XI.1947 (5 ex.), 24-26.XI.1947 (4 ex.).

Kateke (rivière), affluent de la Muovwe et sous-affluent droit de la Lufira [alt. 960 m] : 23.XI-5.XII.1947 (49 ex.).

Bufo sp. 5 exemplaires.

Lupiala (rivière), affluent droit de la Lufira [alt. 900 m] : 9-12.X.1947 (1 ex.).

Kande (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 730 m] : 16-23.X.1947 (1 ex.).

Mubale (tête de source de la rivière), affluent gauche de la Munte et sous-affluent droit de la Lufira [alt. 1.750 m] : 7.IV.1948 (3 ex.).

Rana tuberculosa. 6 exemplaires.

Muye (tête de source de la rivière), affluent droit de la Lufira [alt. 1.630 m] : 28.XI.1947 (1 ex.).

Lusinga (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.810 m] : XI-XII.1947 (1 ex.), I-II.1949 (1 ex.).

Lufwa (rivière), affluent droit de la Lufira (tête de source près de Lusinga) [alt. 1.700 m] (Ex. P.N.U.) : 15.I.1948 (1 ex.).

Mubale (rivière), affluent gauche de la Munte et sous-affluent droit de la Lufira [alt. 1.750 m] : 7.IV.1948 (2 ex.).

Rana ornata moeruensis. 94 exemplaires.

Kateke (rivière), affluent de la Muovwe et sous-affluent droit de la Lufira [alt. 960 m] : 23.XI-5.XII.1947 (1 ex.).

Parc National de l'Upemba : 1947-1949 (2 ex.).

Mabwe, rive Est du lac Upemba [alt. 585 m] : 26.XI.1948 (1 ex.), XI.1948-I.1949 (21 ex.), 5-10.XII.1948 (1 ex.), 13-16.XII.1948 (11 ex.), 17.XII.1948 (2 ex.), 17-18.XII.1948 (30 ex.), 24.XII.1948 (6 ex.), 28.XII.1948 (3 ex.), 3.I.1949 (1 ex.), 5.I.1949 (3 ex.), 13-14.I.1949 (5 ex.), 22.I.1949 (1 ex.), 24.I.1949 (1 ex.).

Kaswabilenga, rive droite de la Lufira (piste Lusinga-Mabwe) [alt. 680 m] : 7.II.1949 (1 ex.).

Kanonga (rivière), affluent droit de la Fungwe [alt. 695 m] : 11-14.II.1949 (1 ex.), 14.II.1949 (1 ex.), 19-21.II.1949 (2 ex.).

Rana albolabris lemairei. 558 exemplaires.

Munte-Mubale (région du confluent), affluent droit de la Lufira [alt. 1.480 m] : 1-8.V.1947 (10 ex.), 1-9.V.1947 (18 ex.), 2.V.1947 (1 ex.), 10-14.V.1947 (3 ex.), 15-19.V.1947 (21 ex.).

Pelenge (gorges de la rivière), affluent droit de la Lufira [alt. 1.250 m]: 20.V-7.VI.1947 (4 ex.), 21-30.V.1947 (8 ex.), 8-11.VI.1947 (13 ex.), 10-19.VI.1947 (1 ex.), 18-19.VI.1947 (8 ex.).

Kaswabilenga, rive droite de la Lufira (piste Lusinga-Mabwe) [alt. 680 m] : 13-27.IX.1947 (1 ex.), 31.X-5.XI.1947 (45 ex.), 1-8.XI.1947 (1 ex.).

Kanonga (rivière), affluent droit de la Fungwe [alt. 695 m] : 13-27.IX.1947 (39 ex. + 6 têtards), 19-21.II.1949 (3 ex.).

Lukawe (rivière), affluent droit de la Lufira [alt. 700 m] : 27.IX.1947 (1 ex.), 17.X.1947 (12 ex.), 28.X.1947 (15 ex.).

Kande (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 730 m] : 4-7.X.1974 (11 ex.), 10-18.X.1947 (1 ex.), 13-14.X.1947 (3 ex.).

Lupiala (rivière), affluent droit de la Lufira [alt. 700 m] : 9-12.X.1947 (8 ex.), 14-22.X.1947 (8 ex.), 20.X.1947 (3 ex.), 24.X.1947 (5 ex.), 31.X.1947 (1 ex.), 5.XI.1947 (11 ex.).

Kankunda (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 1.300 m] : 11-13.XI.1947 (4 ex.), 11-19.XI.1947 (1 ex.), 21-22.XI.1947 (2 ex.).

Kateke (rivière), affluent de la Muovwe et sous-affluent droit de la Lufira [alt. 960 m] : 23.XI-5.XII.1947 (24 ex.).

Kabwe, sur la rive droite de la rivière Muye, affluent droit de la Lufira [alt. 1.320 m] : 28.IV-2.V.1948 (42 ex.), 1-5.V.1948 (1 ex.), 6-7.V.1948 (19 ex.), 8-10.V.198 (29 ex.), 21-25.V.1948 (5 ex.).

Munoi, bifurcation de la rivière Lupiala, affluent droit de la Lufira [alt. 890 m] : 1-11.VI.1948 (55 ex.), 6.VI.1948 (1 ex.), 12-16.VI.1948 (7 ex.), 24.VI.1948 (1 ex.).

Kilwezi (rivière), affluent droit de la Lufira [alt. 800 m] : 23-31.VII.1948 (1 ex.), 26-28.VII.1948 (16 ex.), 1-7.VIII.1948 (38 ex.), 9-14.VIII.1948 (2 ex.), 16-17.VIII.1948 (12 ex.), 24.VIII.1948 (1 ex.), 30.VIII.1948 (2 ex.).

Kipondo (rivière), affluent droit de la Lufira (près Kilwezi) [alt. 800 m] : 7.VIII.1948 (10 ex.), 27.VIII.1948 (6 ex.).

Kalungwe (rivière), affluent droit de la Senze et sous-affluent droit de la Lufira [alt. 800 m] : 13.VIII.1948 (9 ex.), 19.VIII.1948 (3 ex.).

Katala (rivière), affluent gauche de la Mokey et sous-affluent gauche de la Muye [alt. 800 m] : 1.IX.1948 (2 ex.).

Mokey (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 800 m] : 1.IX.1948 (1 ex.).

Rana fuscigula. 1.360 exemplaires.

Lusinga (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.810 m] : 1941-1943 (6 ex.), 23.III-5.IV.1945 (9 ex.), 22.V.1945 (1 ex.), 22-25.V.1945 (88 ex.), 14-18.VI.1945 (33 ex.), 18-30.VI.1945 (9 ex.), 10.VII.1945 (5 ex.), 13-20.VII.1945 (3 ex.), 20.II-21.III.1947 (12 ex.), 23.III-9.IV.1947 (155 ex.), 8.IV.1947 (2 ex.), 9-17.IV.1947 (1 ex.), 28.VI-21.VII.1947 (68 ex.), 25.X.1948 (52 ex.), I-II.1949 (5 ex.), 23.IV.1949 (1 ex.).

Lusinga, rivière Karungwe, affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. ± 1.700 m] : 6.VI.1945 (3 ex.).

Lusinga, rivière Kagomwe, affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. ± 1.700 m] : 8.VI.1945 (3 ex.).

Lusinga, rivière Kamalonge, affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. ± 1.700 m] : 11.VI.1945 (11 ex.), 22.VI.1945 (15 ex.).

Lusinga. rivière Kamitungulu, affluent gauche de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.760 m] : 13.VI.1945 (1 ex.).

Kipangaribwe (rivière), affluent droit de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.600 m] : 2-4.VII.1945 (56 ex.), 6.VII.1945 (7 ex.).

Kamatshya (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.750 m] : 6.VII.1945 (2 ex.).

Kamitunu (rivière), affluent gauche de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.760 m] : 10-11.VII.1945 (3 ex.). 13.III.1947 1947 (2 ex.), 21.I.1948 (5 ex.).

Kagomwe (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.700 m] : 12.VII.1945 (4 ex.).

Kavizi (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. ± 1.700 m] : 14.VII.1945 (2 ex.).

Babagi (rivière), affluent de la Katembula et sous-affluent de la Muye [alt. ± 900 m] : 14.VII.1945 (6 ex.).

Mukukwe (rivière), affluent de la Muye et sous-affluent droit de la Lufira [alt. 1.760 m] : 17.VII.1945 (3 ex.).

Kimapongo (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. ± 1.760 m] : 18.VII.1945 (1 ex.).

Karibwe (rivière), affluent de la Lusinga et sous-affluent droit de la Lufira [alt 1.700 m] : 4-6.III.1947 (83 ex.), 2.IV.1947 (10 ex.), 14-17.XI.1947 (1 ex.).

Kamitungulu (rivière), affluent gauche de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.760 m] : 7.III.1947 (7 ex.), 18.IV.1947 (5 ex.).

Kasandendeko (rivière), affluent de la Kamitungulu et sous-affluent gauche de la Lusinga [alt. 1.700 m] : 10.III.1947 (1 ex.).

Pelenge (gorges de la rivière), affluent droit de la Lufira [alt. 1.250 m] : 20.V-7.VI.1947 (32 ex.), 21-30.V.1947 (24 ex.), 24.V.1947 (1 ex.), 1.VI.1947 (1 ex.), 8-11.VI.1947 (80 ex.), 12-15.VI.1947 (33 ex.), 18-19.VI.1947 (73 ex.), 23.VI.1947 (4 ex.), 24.VI.1947 (1 ex.).

Kanonga (rivière). affluent droit de la Fungwe [alt. 695 m] : 13-27.IX.1947 (2 ex.).

Kande (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 700 m] : 13-27.IX.1947 (2 ex.), 10-18.X.1947 (3 ex.), 13-14.X.1947 (4 ex.), 16-23.X.1947 (1 ex.).

Lukawe (rivière), affluent droit de la Lufira [alt. 700 m] : 27.IX.1947 (2 ex.), 28.X.1947 (14 ex.).

Lupiala (rivière), affluent droit de la Lufira [alt. 700 m] : 13-15.X.1947 (2 ex.), 28.X.1947 (3 ex.).

Kaswabilenga, rive droite de la Lufira [alt. 680 m] : 29..X.1947 (1 ex.).

Kaswabilenga, rive gauche de la Lufira [alt. 750 m] : 5.XI.1947 (1 ex.).

Kankunda (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 1.300 m] : 11-13.XI.1947 (7 ex.), 11-19.XI.1947 (6 ex.), 18-19.XI.1947 (3 ex.), 21-22.XI.1947 (21 ex.), 24-26.XI.1947 (1 ex.).

Kateke (rivière), affluent de la Muovwe et sous-affluent droit de la Lufira [alt. 960 m] : 23.XI-5.XII.1947 (8 ex.).

Tumbwe (rivière), affluent gauche de la Grande Kafwe et sous-affluent droit de la Lufwa [alt. 1.120 m] : 10.I.1948 (1 ex.).

Dipidi (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.700 m] (Ex. P.N.U.) : 19.I.1948 (9 ex.), 20.X.1948 (1 ex.).

Kaziba (rivière), affluent gauche de la Senze et sous-affluent droit de la Lufira [alt. 1.140 m] : 1-11.II.1948 (3 ex.).

Kabenga. près de Kaziba [alt. 1.250 m] (Ex. P.N.U.) : 9-10.II.1948 (1 ex.), 27.III.1949 (2 ex.), 28.III.1949 (38 ex.), 30.III-8.IV.1949 (20 ex.), 2.IV.1949 (15 ex.), 4.IV.1949 (7 ex.), 5.IV.1949 (5 ex.), 7.IV.1949 (47 ex.).

Kafwe (rivière Grande), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.790 m] : 18.III.1948 (7 ex.).

Bwalo (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.750 m] : 9.IV.1948 (14 ex.).

Mukelengia (rivière), affluent gauche de la Kalumengongo et sous-affluent droit du Lualaba [alt. 1.750 m] : 12.IV.1948 (1 ex.).

Kabwe, sur la rive droite de la Muye, affluent droit de la Lufira [alt. 1.320 m] : 28.IV.1948 (1 ex.), 28.IV-2.V.1948 (12 ex.), 6-7.V.1948 (3 ex.), 8-10.V.1948 (3 ex.), 21-25.V.1948 (2 ex.).

Kayumbwe (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.670 m] : 7.VII.1948 (2 ex.).

Kiamakoto (entre Masombwe et Mukana), sur la rive droite de la rivière Lukima, affluent de la Grande Kafwe [alt. 1.100 m] (Ex. P.N.U.) : 7-9.VII.1948 (2 ex.), 4-16.X.1948 (44 ex.).

Loie (rivière), affluent gauche de la Lufira [alt. 700 m] : 3.IX.1948 (1 ex.).

Masombwe, (dans la rivière Kipepe), affluent de la Tumbwe et sous-affluent gauche de la Grande Kafwe [alt. 1.120 m] : 4-16.X.1948 (23 ex.).

Masombwe, sur la Grande Kafwe [alt. 1.120 m] (Ex. P.N.U.) : 4-16.X.1948 (17 ex.), 7.X.1948 (2 ex.).

Kakolwe (rivière), affluent de la Kenia et sous-affluent droit de la Lusinga [alt. 1.660 m] (Ex. P.N.U.) : 21.X.1948 (1 ex.).

Mabwe, rive Est du lac Upemba [alt. 585 m] : 24.I.1949 (1 ex.).

Bowa (rivière), affluent droit de la Kalule-Nord et sous-affluent droit du Lualaba. près de Kiamalwa [alt. 1.050 m] : 28.II-1.III.1949 (9 ex.), 2-3.III.1949 (5 ex.), 4.III.1949 (1 ex.).

Kimiala (rivière), affluent de la Luizi et sous-affluent gauche de la Lufwa, près de Sampwe (Kundelungu) [alt. 900 m] (Ex. P.N.U.) : 30.III.1949 (1 ex.), 31.III.1949 (14 ex.), 1.IV.1949 (3 ex.), 4.IV.1949 (1 ex.).

Munte (rivière), affluent droit de la Lufira [alt. 1.450 m] : 21.IV.1949 (3 ex.).

Ganza, salines près de la rivière Kamandula, affluent droit de la Lukoka et sous-affluent gauche de la Lufira [alt. 860 m] : 30.V-4.VI.1949 (4 ex.), 6-10.VI.1949 (3 ex.), 20-25.VI.1949 (1 ex.).

Lukorami (rivière), affluent gauche de la Lufira [alt. 900 m] : 13.VI.1949 (2 ex.).

Mware (rivière), affluent gauche de la Lufira [alt. 950 m] : 20-24.VI.1949 (2 ex.), 11.VII.1949 (5 ex.).

Difirinji (rivière), affluent gauche de la Lufira [alt. 750 m] : 27.VI.1949 (11 ex.).

Rana ansorgei. 41 exemplaires.

Pelenge (gorges de la rivière), affluent droit de la Lufira [alt. 1.250 m] : 20.V-7.VI.1947 (14 ex.), 20.V-22.VI.1947 (5 ex.), 8-9.VI.1947 (1 ex.), 12-15.V.I1947 (1 ex.), 15.VI.1947 (3 ex.), 16.VI.1947 (3 ex.), 18-19.VI.1947 (2 ex.).

Buye-Bala (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.750 m] : 1-7.IV.1948 (1 ex.), 18.IV.1948 (1 ex.).

Kabwe, sur la rive droite de la Muye, affluent droit de la Lufira [alt. 1.320 m] : 28.IV-2.V.1948 (1 ex.), 8-10.V.1948 (8 ex.), 21-25.V.1948 (1 ex.).

Rana chrysogasta guibei. 24 exemplaires.

Mabwe,rive Est du lac Upemba [alt. 585 m] : 28.VII-12.VIII.1947 (12 ex.), 28.XI.1948 (1 ex.), 20.XII.1948 (1 ex.), 22.XII.1948 (5 ex.), 29.XII.1948 (1 ex.)

Kande (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 700 m] : 10-18.X.1947 (1 ex.).

Lupiala (rivière), affluent droit de la Lufira [alt. 700 m] : 13-15.X.1947 (1 ex.), 24.X.1947 (1 ex.).

Kanonga (rivière), affluent droit de la Fungwe [alt. 695 m] : 14-16.II.1949 (1 ex.).

Rana frontalis. 437 exemplaires.

Mabwe, rive Est du lac Upemba [alt. 585 m] : 28.VII-12.VIII.1947 (2 ex.), 30.VIII-4.IX.1947 (1 ex.), 26.XI.1948 (40 ex.), 26-30.XI.1948 (8 ex.), 27.XI.1948 (17 ex.), 28.XI.1948 (24 ex.), 1-2.XII.1948 (3 ex.), 5-6.XII.1948 (16 ex.), 5-10.XII.1948 (11 ex.), 13-16.XII.1948 (12 ex.), 17-18.XII.1948 (33 ex.), 20.XII.1948 (21 ex.), 22.XII.1948 (7 ex.), 24.XII.1948 (8 ex.), 28.XII.1948 (19 ex.), 29.XII.1948 (1 ex.), XII.1948 (3 ex.), 3.I.1949 (6 ex.), 4-8.I.1949 (30 ex.), 5.I.1949 (12 ex.), 6.I.1949 (5 ex.), 13-14.I.1949 (1 ex.), 17.I.1949 (1 ex.), 21.I.1949 (122 ex.), 24.I.1949 (8 ex.), 25.I.1949 (23 ex.), 28.I.1949 (1 ex.).

Mwema-Mabole, rivière à 10 kilomètres à l'Est de Mabwe [alt. 620 m] : 27.I.1949 (1 ex.).

Kanonga (rivière), affluent droit de la Fungwe [alt. 695 m] : 16-18.II.1949 (1 ex.).

Rana grandisonae. 849 exemplaires.

Lusinga (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.810 m] : 22-25.V.1945 (1 ex.), 14-18.VI.1945 (3 ex.), 28.IV-21.VII.1947 (3 ex.), XI-XII.1947 (3 ex.), II-III.1948 (3 ex.).

Lusinga, près du marais Mukana [alt. 1.810 m] : 23-30.V.1945 (73 ex.), 28-29.V.1945 (6 ex.), 4.VI.1945 (18 ex.).

Kabwekanono, mare près tête de source de la Lufwa, affluent droit de la Lufira, sur rive gauche de la Lusinga [alt. 1.815 m] : 31.V.1945 (12 ex.), 18.III.1947 (13 ex.), 4.VII.1947 (6 ex.), 30.IX.1948 (18 ex.).

Lusinga, près de Kabwekanono, mare près de la tête de source de la Lufwa, affluent droit de la Lufira, sur la rive gauche de la Lusinga [alt. 1.815 m] : 31.V.1945 (6 ex.).

Lusinga, rivière Lufwa, affluent droit de la Lufira [alt. 1.810 m] : 1.VI.1945 (1 ex.), 1-2.VI.1945 (22 ex.).

Mukana, marais près de Lusinga [alt. 1.810 m] : 21.V.1945 (21 ex.), 12.III.1947 (43 ex.), 24.III.1947 (3 ex.), 29.III.1947 (13 ex.), 14.IV.1947 (40 ex.), 5.VII.1947 (13 ex.), 4.III.1948 (9 ex.), 1.IX.1948 (3 ex.), 3-4.I.1949 (1 ex.).

Mubale (rivière) (rive gauche de la tête de source), affluent gauche de la Munte et sous-affluent droit de la Lufira [alt. 1.780 m] : 28.VI.1945 (61 ex.).

N'Gongozi, près marais Mukana [alt. 1.810 m] : 15.III.1947 (2 ex.).

Luangalele, près marais Mukana (Lusinga) [alt. 1.850 m] : 19.III.1947 (5 ex.).

Munte-Mubale (région du confluent), affluent droit de la Lufira [alt. 1.480 m] : 1-9.V.1947 (18 ex.), 10-14.V.1947 (28 ex.), 15-19.V.1947 (10 ex.).

Lufwa (rivière), affluent droit de la Lufira, tête de source près de Lusinga [alt. 1.700 m] (Ex. P.N.U.) : 15.I.1948 (125 ex.), 17.III.1948 (6 ex.).

Mubale (rivière), affluent gauche de la Munte et sous-affluent droit de la Lufira [alt. 1.750 m] : 16.I.1948 (30 ex.).

Buye-Bala (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.750 m] : 28-31.III.1948 (21 ex.), 1-7.IV.1948 (11 ex.), 8-12.IV.1948 (25 ex.), 13.IV.1948 (18 ex.), 27.IX.1949 (1 ex.).

Bwalo (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.750 m] : 9.IV.1948 (12 ex.).

Katongo (rivière), affluent gauche de la Mubale et sous-affluent gauche de la Munte [alt. 1.750 m] : 10.IV.1948 (3 ex.).

Kabwe, sur la rive droite de la Muye, affluent droit de la Lufira [alt. 1.320 m] : 21-25.V.1948 (1 ex.).

Entre Buye-Bala et Katongo-étang à sec, [alt. 1.750 m] : 27.IX.1948 (133 ex.).

Kalumengongo (rivière), affluent droit du Lualaba [alt. 1.830 m] : II.1949 (2 ex.), 16.IV.1949 (1 ex.).

Kimiala (rivière), affluent de la Luizi et sous-affluent gauche de la Lufwa, près de Sampwe (Kundelungu) [alt. 900 m] (Ex. P.N.U.) : 4.IV.1949 (2 ex.).

Rana mascareniensis. 532 exemplaires.

Mabwe, rive Est du lac Upemba [alt. 585 m] : 28.VII-12.VIII.1947 (46 ex.), 30.VIII-4.IX.1947 (10 ex.), 7-9.IX.1947 (1 ex.). 26.XI.1948 (21 ex.), 26-30.XI.1948 (18 ex.), 27.XI.1948 (38 ex.), 28.XI.1948 (3 ex.), 1-2.XII.1948 (16 ex.), 3-6.XII.1948 (10 ex.), 5-6.XII.1948 (3 ex.), 5-10.XII.1948 (13 ex.), 13-16.XII.1948 (5 ex.), 17-18.XII.1948 (11 ex.), 20.XII.1948 (7 ex.), 20-30.XII.1948 (41 ex.), 21.XII.1948 (12 ex.), 22.XII.1948 (73 ex.), 24.XII.1948 (8 ex.), 28.XII.1948 (8 ex.), 29.XII.1948 (4 ex.), XII.1948 (29 ex.), 1-16.I.1949 (1 ex.), 3.I.1949 (15 ex.), 4-8.I.1949 (3 ex.), 5.I.1949 (1 ex.), 6.I.1949 (23 ex.), 8.I.1949 (3 ex.), 13-14.I.1949 (24 ex.), 17.I.1949 (7 ex.), 24.I.1949 (7 ex.), 25.I.1949 (13 ex.), 28.I.1949 (31 ex.), 4-7.II.1949 (1 ex.), 8-12.II.1949 (2 ex.), 12-17.II.1949 (3 ex.), 17-22.II.1949 (1 ex.).

Kanonga (rivière), affluent droit de la Fungwe [alt. 695 m] : 13-27.IX.1947 (9 ex.).

Kande (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 730 m] : 13-14.X.1947 (11 ex.).

Rana obscura. 242 exemplaires.

Lusinga, rivière Kagomwe, affluent de la Lusinga et sous-affluent droit de la Lufwa

Lusinga, rivière Kagomwe, affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. ± 1.700 m] : 8.VI.1945 (11 ex.).

Lusinga, rivière Kamalonge, affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. ± 1.700 m] : 11.VI.1945 (1 ex.), 22.VI.1945 (3 ex.).

Kambi (rivière), affluent de la Grande Kafwe et sous-affluent droit de la Lufwa (vers Masombwe) [alt. 1.750 m] : 25-27.VI.1945 (11 ex.).

Lusinga, rivière Karungwe, affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. ± 1.700 m] : 6.VII.1945 (46 ex.).

Kipangaribwe (rivière), affluent droit de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.600 m] : 6.VII.1945 (1 ex.).

Kagomwe (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.700 m] : 12.VII.1945 (12 ex.).

Babagi (rivière). affluent de la Katembula et sous-affluent de la Muye [alt. ± 900 m] : 14.VII.1945 (4 ex.).

Muye (rivière), rive droite près ancien village de Kabenga [alt. 1.480 m] : 16.VII.1945 (1 ex.).

Karibwe (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.700 m] : 4-6.III.1947 (1 ex.).

Lufwa (rivière), affluent droit de la Lufira, tête de source près de Lusinga [alt. 1.700 m] (Ex. P.N.U.) : 17.III.1947 (2 ex.).

Pelenge (gorges de la rivière), affluent droit de la Lufira [alt. 1.250 m] : 20.V-7.VI.1947 (13 ex.), 20.V-22.VI.1947 (6 ex.), 21-30.V.1947 (9 ex.), 8-11.VI.1947 (1 ex.), 10-14.VI.1947 (4 ex.), 12-15.VI.1947 (32 ex.), 15.VI.1947 (1 ex.), 17-18.VI.1947 (5 ex.), 18-19.VI.1947 (19 ex.).

Munoi, bifurcation de la rivière Lupiala, affluent droit de la Lufira [alt. 890 m] : 21-30.V.1947 (1 ex.), 12-16.VI.1947 (1 ex.), 28-31.V.1948 (1 ex.), 6.VI.1948 (5 ex.). 8-11.VI.1948 (1 ex.).

Kabwekanono, mare près tête de source de la Lufwa, affluent droit de la Lufira, sur la rive gauche de la Lusinga [alt. 1.815 m] : 4.VII.1947 (2 ex.), 14.I.1948 (1 ex.), 14.III.1948 (5 ex.).

Kankunda (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 1.300 m] : 11-19.XI.1947 (1 ex.), 21-22.XI.1947 (1 ex.), 24-26.XI.1947 (1 ex.).

Kamitunu (rivière), affluent gauche de la Lusinga et sous-affluent droit de la Lufwa

Kaziba (rivière), affluent gauche de la Senze et sous-affluent droit de la Lufira [alt. 1.140 m] : 1-6.II.1948 (2 ex.), 15-21.II.1948 (4 ex.), 19.II.1948 (4 ex.).

Kafwe (tête de source de la rivière Petite), affluent droit de la Grande Kafwe et sous-affluent droit de la Lufwa [alt. 1.780 m] : 29.III.1948 (1 ex.).

Buye-Bala (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.750 m] : 1-7.IV.1948 (3 ex.).

Kabwe, sur la rive droite de la Muye, affluent droit de la Lufira [alt. 1.320 m] : 28.IV-2.V.1948 (2 ex.), 6-7.V.1948 (1 ex.), 8-10.V.1948 (6 ex.), 16-17.V.1948 (1 ex.).

Ganza, salines près de la rivière Kamandula, affluent droit de la Lukoka et sous-affluent gauche de la Lufira [alt. 860 m] : 21-25.V.1948 (1 ex.).

Kayumbwe (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.670 m] : 7.VII.1948 (1 ex.).

Mokey (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 800 m] : 1.IX.1948 (3 ex.).

Kilwezi (rivière), affluent droit de la Lufira [alt. 800 m] : 11.IX.1948 (4 ex.).

Kalumengongo (rivière), affluent droit du Lualaba [alt. 1.830 m] : 17.I.1949 (2 ex.).

Kabenga, près de Kaziba [alt. 1.205 m] (Ex. P.N.U.) : 4.IV.1949 (1 ex.), 7.IV.1949 (1 ex.). [alt. 1.800 m] : 21.I.1948 (1 ex.).

Rana oxyrhyncha. 146 exemplaires.

Lusinga, rivière Karungwe, affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. ± 1.700 m] : 6.VI.1945 (1 ex.).

Lusinga, rivière Kagomwe, affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. ± 1.700 m] : 8.VI.1945 (1 ex.).

Lusinga (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.810 m] : 18-30.VI.1945 (1 ex.), 10.VII.1945 (2 ex.).

Lupiala (rivière), affluent droit de la Lufira [alt. 700 m] : 30.VI.1945 (1 ex.), 28.X.1947 (1 ex.).

Mukukwe, affluent de la Muye et sous-affluent droit de la Lufira [alt. 1.760 m] : 17VII.1945 (2 ex.).

Karibwe (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.700 m] : 4-6.III.1947 (2 ex.).

Mabwe, rive Est du lac Upenba [alt. 585 m] : 28.VII-12.VIII.1947 (5 ex.), 30.VIII-4.IX.1947 (1 ex.).

Kanonga (rivière). affluent droit de la Fungwe [alt. 695 m] : 13-27.IX.1947 (7 ex.).

Kande (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 700 m] : 13-27.IX.1947 (3 ex.), 10-18.X.1947 (3 ex.).

Kaswabilenga, rive droite de la rivière Lufira (piste Lusinga-Mabwe) [alt. 680 m] : 13-27.IX.1947 (2 ex.), 29.X.1947 (1 ex.), 31.X-5.XI.1947 (1 ex.), 7.II.1949 (1 ex.).

Lukawe (rivière), affluent droit de la Lufira [alt. 700 m] : 27.IX.1947 (2 ex.), 17.X.1947 (1 ex.), 28.X.1947 (1 ex.).

Kaswabilenga, région du cours inférieur de la rivière Lupiala [alt. 700 m] : 2.X.1947 (1 ex.).

Kaluwamba (rivière), affluent gauche de la Lufira [alt. 800 m] : 6.XI.1947 (2 ex.).

Kankunda (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 1.300 m] : 11-19.XI.1947 (7 ex.), 21-22.XI.1947 (6. ex.).

Munoi, bifurcation de la rivière Lupiala, affluent droit de la Lufira [alt. 890 m] : 1-11.VI.1948 (4 ex.).

Masombwe, dans rivière Kipepe, affluent de la Tumbwe et sous-affluent gauche de la Grande Kafwe [alt. 1.120 m] : 9.VII.1948 (1 ex.), 4-16.X.1948 (3 ex.).

Kilwezi (rivière), affluent droit de la Lufira [alt. 800 m] : 20-28.VII.1948 (6 ex.), 27.VII.1948 (1 ex.), 1-7.VIII.1948 (12 ex.). 16-17.VIII.1948 (5 ex.), 24.VIII.1948 (1 ex.), 28.VIII.1948 (1 ex.), 3.IX.1948 (3 ex.), 6.IX.1948 (3 ex.), 11.IX.1948 (4 ex.).

Kipondo (rivière), affluent droit de la Lufira (près de Kilwezi) [alt. 800 m] : 7.VIII.1948 (1 ex.), 27.VIII.1948 (3 ex.), 13.IX.1948 (1 ex.).

Kalungwe (rivière), affluent droit de la Senze et sous-affluent droit de la Lufira [alt. 800 m] : 13.VIII.1948 (1 ex.).

Loie (rivière), affluent gauche de la Lufira [alt. 800 m] : 17.VIII.1948 (1 ex.).

Senze (rivière), affluent droit de la Lufira [alt. 800 m] : 20.VIII.1948 (2 ex.).

Lufira (rivière), affluent droit du Lualaba [alt. 800 m] : 25.VIII.1948 (3 ex.).

Mokey (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 800 m] : 1.IX.1948 (1 ex.).

Kalala (rivière), affluent gauche de la Mokey et sous-affluent gauche de la Muye [alt. 800 m] : 1.IX.1948 (1 ex.).

Muye (rivière), au confluent de la Kabangasi, affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 800 m] : 6.IX.1948 (1 ex.).

Masombwe, sur la rivière Grande Kafwe [alt. 1.120 m] (Ex. P.N.U.) : 4-16.X.1948 (4 ex.).

Kabenga, près Kaziba [alt. 1.250 m] (Ex. P.N.U.) : 30.III-8.IV.1949 (1 ex.), 4.IV.1949 (1 ex.), 6.IV.1949 (1 ex.).

Ganza, salines près de la rivière Kamandula, affluent droit de la Lukoka et sous-affluent gauche de la Lufira [alt. 860 m] : 30.V-4.VI.1949 (5 ex.), 6-10.VI.1949 (4 ex.), 12-18.VI.1949 (1 ex.), 20-25.VI.1949 (5 ex.), 27.VI-2.VII.1949 (6 ex.), 5.VII.1949 (1 ex.).

Mware (rivière), affluent gauche de la Lufira [alt. 950 m] : 20-24.VI.1949 (2 ex.), 11.VII.1949 (1 ex.).

Rana porosissima. 1.078 exemplaires.

Lusinga (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.810 m] : 1941-1943 (1 ex.), 20-25.V.1945 (5 ex.), 22.V.1945 (3 ex.), 14-18.VI.1945 (7 ex.), 18-30.VI.1945 (7 ex.), 10.VII.1945 (2 ex.), 1946 (1 ex.), 20.II-21.III.1947 (7 ex.), 23.III-9.IV.1947 (84 ex.), 8.IV.1947 (1 ex.), 9-17.IV.1947 (3 ex.), 28.IV-21-VII.1947 (32 ex.), XI-XII.1947 (4 ex.), II-III.1948 (3 ex.), 23.IV.1949 (3 ex.).

Mukana. marais près de Lusinga [alt. 1.810 m] : 23-30.V.1945 (17 ex.), 28-29.VI.1945 (4 ex.), 30.V.1945 (6 ex.), 4.VI.1945 (10 ex.), 21.VI.1945 (4 ex.), 12.III.1947 (1 ex.), 29.III.1947 (1 ex.), 14.IV.1947 (3 ex.), 5.VII.1947 (1 ex.), 4.III.1948 (16 ex.), 1.IX.1948 (6 ex.), 19.X.1948 (9 ex.), 3-4.I.1949 (68 ex.).

Lusinga, près Kabwekanono, mare près de la tête de source de la Lufwa, affluent droit de la Lufira, sur la rive gauche de la Lusinga [alt. 1.815 m] : 31.V.1945 (38 ex.).

Kabwekanono, mare près de la tête de source de la Lufwa, affluent droit de la Lufwa. sur la rive gauche de la Lusinga [alt. 1.815 m] : 31.V.1945 (5 ex.), 4.VII.1947 (255 ex.), 14.III.1948 (34 ex.), 30.IX.1948 (4 ex.).

Lusinga, rivière Lufwa, affluent droit de la Lufira [alt. 1.810 m] : 1.VI.1945 (7 ex.).

Lusinga, rivière Petite Kafwe, près Mukana (Kiamakoto), affluent de la Grande Kafwe et sous-affluent droit de la Lufwa [alt. 1.780 m] : 5.VI.1945 (2 ex.).

Lusinga, rivière Karungwe, affluent de la Lusinga et sous-affluent droit de la Lufira [alt. ± 1.700 m] : 6.VI.1945 (1 ex.), 6.VII.1945 (4 ex.).

Lusinga, rivière Kagomwe, affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.700 m] : 8.VI.1945 (3 ex.).

Lusinga, rivière Kamalonge, affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. ± 1.700 m] : 11.VI.1945 (2 ex.), 22.VI.1945 (4 ex.).

Kipangaribwe (rivière), affluent droit de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.600 m] : 2-4.VII.1945 (1 ex.), 6.VII.1945 (1 ex.).

Mitoto (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. ± 1.760 m] : 9.VII.1945 (2 ex.).

Kagomwe (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.700 m] : 12.VII.1945 (1 ex.).

Kanpungu (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.750 m] : 16.VII.1945 (1 ex.).

Karibwe (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.700 m] : 4-6.III.1947 (22 ex.), 2.IV.1947 (1 ex.).

Kasandendeko (rivière), affluent de la Kamitungulu et sous-affluent gauche de la Lusinga [alt. 1.700 m] : 10.III.1947 (1 ex.).

Kayango (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.700 m] : 18.III.1947 (1 ex.).

Luangalele, près du marais Mukana (Lusinga) [alt. 1.850 m] : 19.III.1947 (7 ex.).

Katombwe (Mukana) près de Lusinga (lieu-dit) [alt. 1.812 m] : 22.III.1947 (14 ex.).

Kalumengongo (rivière), affluent droit du Lualaba [alt. 1.830 m] : IV.1947 (1 ex.), 17.I.1949 (6 ex.), II.1949 (20 ex.).

Munte-Mubale (région du confluent). affluent droit de la Lufira [alt. 1.480 m] : 1-9.V.1947 (27 ex.), 10-14.V.1947 (1 ex.), 15-19.V.1947 (12 ex.).

Pelenge (gorges de la rivière), affluent droit de la Lufira [alt. 1.250 m] : 20.V-7.VI.1947 (1 ex.), 8-11.VI.1947 (1 ex.).

Kenia (rivière), affluent droit de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.585 m] (Ex. P.N.U.) : 10.VII.1947 (1 ex.), 12.III.1948 (4 ex.), 20.X.1948 (1 ex.).

Lusinga, marais près tête de source de la Kapero, affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.640 m] : 9.I.1948 (80 ex.).

Lufwa (rivière), affluent droit de la Lufira, tête de source près de Lusinga [alt. 1.700 m] (Ex. P.N.U.) : 15.I.1948 (1 ex.), 17.III.1948 (10 ex.).

Kamitunu (rivière), affluent gauche de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.760 m] : 21.I.1948 (1 ex.).

Kampadika (rivière), affluent de la Grande Kafwe et sous-affluent droit de la Lufwa [alt. 1.810 m] : 22.I.1948 (1 ex.).

Kafwe (rivière Grande), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.790 m] : 18.III.1948 (20 ex.).

Buye-Bala (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.750 m] : 28-31.III.1948 (6 ex.), 1-7.IV.1948 (63 ex.). 8-12.IV.1948 (2 ex.), 18.IV.1948 (2 ex.).

Mubale (tête de source de la rivière), affluent gauche de la Munte et sous-affluent de la Lufira [alt. 1.750 m] : 7.IV.1948 (1 ex.).

Bwalo (rivière affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.750] : 9.IV.1948 (7 ex.).

Katongo (rivière), affluent gauche de la Mubale et sous-affluent gauche de la Munte [alt. 1.750 m] : 10.IV.1948 (5 ex.), 14-15.IV.1948 (8 ex.), 18.IV.1948 (2 ex.).

Mukelengia (rivière), affluent gauche de la Kalumengongo et sous-affluent droit du Lualaba [alt. 1.750 m] : 12.IV.1948 (1 ex.).

Kabwe, sur la rive droite de la rivière Muye, affluent droit de la Lufira [alt. 1.320 m] : 28.IV-2.V.1948 (7 ex.), 6-7.V.1948 (1 ex.), 7.V.1948 (1 ex.), 8-10.V.1948 (11 ex.), 21-25.V.1948 (1 ex.).

Entre Buye-Bala et Katongo, étang à sec [alt. 1.750 m] : 27.IX.1948 (43 ex.).

N'Gozie, mare à gauche de la route Lusinga-Mitwaba, [alt. 1.600 m] (Ex. P.N.U.) : II.1949 (7 ex.).

Dipidi (rivière). affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.700 m] (Ex. P.N.U.) : II.1949 (2 ex.).

Rana subpunctata. 14 exemplaires.

Mabwe, rive Est du lac Upemba [alt. 585 m] : 28.VII-12.VIII.1947 (2 ex.), 6-17.XI.1948 (5 ex.), 18-21.XI.1948 (1 ex.), 22.XI.1948 (1 ex.), 26-30.XI.1948 (2 ex.), 13-16.XII.1948 (3 ex.).

Rana superciliaris. 73 exemplaires.

Kaswabilenga, rive droite de la Lufira (piste Lusinga-Mabwe) [alt 680 m] : 13-27.IX.1947 (1 ex.).

Kande (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 730 m] : 3.X.1947 (1 ex.).

Kilwezi (rivière), affluent droit de la Lufira [alt. 800 m] : 1-7.VIII.1948 (1 ex.), 24.VIII.1948 (1 ex.), 3.IX.1948 (1 ex.).

Loie (rivière), affluent gauche de la Lufira [alt. 800 m] : 17.VIII.1948 (2 ex.).

Senze (rivière), affluent droit de la Lufira [alt. 800 m] : 20.VIII.1948 (2 ex.).

Lufira (rivière), affluent droit du Lualaba [alt. 800 m] : 25.VIII.1948 (2 ex.).

Kipondo (rivière), affluent droit de la Lufira (près de Kilwezi) [alt. 800 m] : 13.IX.1948 (4 ex.).

Ganza, salines près de la rivière Kamandula, affluent droit de la Lukoka et sous-affluent gauche de la Lufira [alt. 860 m] : 30.V-4.VI.1949 (16 ex.), 6-10.VI.1949 (1 ex.), 12-18.VI.1949 (11 ex.), 20-25.VI.1949 (6 ex.), 27.VI-2.VII.1949 (11 ex.), 5.VII.1949 (2 ex.).

Mware (rivière), affluent gauche de la Lufira [alt. 950 m] : 11.VII.1949 (8 ex.).

Lukoka (rivière), affluent gauche de la Lufira [alt. 750 m] : 14.VII.1949 (3 ex.).

Rana taenioscelis. 33 exemplaires

Lusinga, rivière Lufwa, affluent droit de la Lufira [alt. 1.810 m] : 1.VI.1945 (3 ex.), 1-2.VI.1945 (11 ex.).

Lusinga, près du marais de Mukana [alt. 1.810 m] : 4.VI.1945 (4 ex.).

Mubale (rivière) (rive gauche de la tête de source), affluent gauche de la Munte et sous-affluent droit de la Lufira [alt. 1.780 m] : 28.VI.1945 (1 ex.).

Lufwa (rivière), affluent droit de la Lufira, tête de source près de Lusinga [alt. 1.700 m] Ex. P.N.U.) : 15.I.1948 (7 ex.), 17.III.1948 (4 ex.).

Kampadika (rivière), affluent de la Grande Kafwe et sous-affluent droit de la Lufwa [alt. 1.810 m] : 22.I.1948 (1 ex.).

Kafwe (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.790 m] : 18.III.1948 (1 ex.).

Kalumengongo (rivière), affluent droit du Lualaba [alt. 1.830 m] : 17.I.1949 (1 ex.).

Rana upembae. 110 exemplaires.

Kambi (rivière), affluent de la Grande Kafwe et sous-affluent droit de la Lufwa (vers Masombwe) [alt. 1.750 m] : 25-27.VI.1945 (11 ex.).

Kande (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 700 m] : 13-27.IX.1947 (2 ex.), 13-30.IX.1947 (4 ex.), 3.X.1947 (7 ex.). 7-8.X.1947 (2 ex.), 16-23.X.1947 (2 ex.).

Kanonga (rivière), affluent droit de la Fungwe [alt. 695 m] : 13-27.IX.1948 (3 ex.), 14-16.II.1949 (1 ex.), 22-23.II.1949 (1 ex.).

Lupiala (rivière), affluent droit de la Lufira [alt. 700 m] : 9-12.X.1947 (1 ex.), 20.X.1947 (1 ex.).

Tumbwe (rivière), affluent gauche de la Grande Kafwe et sous-affluent droit de la Lufwa [alt. 1.120 m] : 10.I.1948 (1 ex.).

Kaziba (rivière), affluent gauche de la Senze et sous-affluent droit de la Lufira [alt. 1.140 m] : 12-13.II.1948 (2 ex.), 15-21.II.1948 (1 ex.), 19.II.1948 (2 ex.).

Munoi, bifurcation de la rivière Lupiala, affluent droit de la Lufira [alt. 890 m] : 28-31.V.1948 (11 ex.), 1-2.VI.1948 (1 ex.), 1-11.VI.1948 (3 ex.), 3.VI.1948 (1 ex.), 6.VI.1948 (6 ex.), 7.VI.1948 (1 ex.). 8-11.VI.1948 (2 ex.), 12-16.VI.1948 (1 x.).

Ganza, salines près de la rivière Kamandula, affluent droit de la Lukoka et sous-affluent gauche de la Lufira [alt. 860 m] : 30.V-10.VI.1948 (6 ex.), 20-25.VI.1949 (2 ex.), 27.VI-2.VII.1949 (1 ex.).

Kilwezi (rivière), affluent droit de la Lufira [alt. 800 m] : 26-28.VII.1948 (12 ex.), 29-31.VII.1948 (2 ex.), 1-7.VIII.1948 (3 ex.), 11.IX.1948 (2 ex.).

Kalungwe (rivière), affluent droit de la Senze et sous-affluent droit de la Lufira [alt. 800 m] : 19.VIII.1948 (2 ex.).

Kaswabilenga, région du cours inférieur de la rivière Lupiala, affluent droit de la Lufira [alt. 700 m] : 5-9.I.1949 (4 ex.).

Kaswabilenga, rive droite de la Lufira (piste Lusinga-Mabwe) [alt. 680 m] : 21.II.1949 (1 ex.), 16.III.1949 (1 ex.).

Kabenga, près de Kaziba [alt. 1.250 m] (Ex. P.N.U.) : 31.III.1949 (1 ex.), 6.IV.1949 (2 ex.), 7.IV.1949 (4 ex.).

Rana uzungwensis. 157 exemplaires.

Lufira (rivière), affluent droit du Lualaba [alt. 1.810 m] : 1941-1943 (3 ex.).

Lusinga (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.810 m] : 22-25.V.1945 (1 ex.).

Mubale (rive gauche de la tête de source de la rivière), affluent gauche de la Munte et sous-affluent droit de la Lufira [alt. 1.780 m] : 28.VI.1945 (1 ex.).

Kagonwe (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.700 m] : 12.VII.1945 (1 ex.).

Kamitungulu (rivière), affluent gauche de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.760 m] : 7.III.1947 (1 ex.).

Munte-Mubale (région du confluent), affluent droit de la Lufira [alt. 1.480 m] : 1-8.V.1947 (3 ex.), 1-9.V.1947 (1 ex.), 10-14.V.1947 (8 ex.), 15-19.V.1947 (7 ex.).

Pelenge (gorges de la rivière), affluent droit de la Lufira [alt 1.250 m] : 20.V-7.VI.1947 (3 ex.), 20.V-22.VI.1947 (1 ex.), 8-9.VI.1947 (2 ex.), 10-14.VI.1947 (1 ex.), 12-15.VI.1947 (2 ex.), 15.VI.1947 (1 ex.), 16.VI.1947 (2 ex.), 18-19.VI.1947 (1 ex.), 20.VI.1947 (1 ex.).

Kankunda (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 1.300 m] : 18-19.XI.1947 (1 ex.).

Lufwa (rivière), affluent droit de la Lufira, tête de source près de Lusinga [alt. 1.700 m] (Ex. P.N.U.) : 15.I.1948 (6 ex.).

Kampadika (rivière), affluent de la Grande Kafwe et sous-affluent droit de la Lufwa [alt. 1.810 m] : 22.I.1948 (15 ex.).

Kaziba (rivière), affluent gauche de la Senze et sous-affluent droit de la Lufira [alt. 1.140 m] : 1-6.II.1948 (1 ex.).

Kabwekanono, mare près de la tête de source de la Lufwa, affluent droit de la Lufira, sur la rive gauche de la Lusinga [alt. 1.815 m] : 14.III.1948 (6 ex.).

Kafwe (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.790 m] : 18.III.1948 (4 ex.).

Buye-Bala (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.750 m] : 1-7.IV.1948 (2 ex.), 8-12.IV.1948 (2 ex.).

Bwalo (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.750 m] : 9.IV.1948 (12 ex.).

Katongo (rivière), affluent gauche de la Mubale et sous-affluent de la Munte [alt. 1.750 m] : 10.IV.1948 (1 ex.).

Kabwe, sur la rive droite de la Muye, affluent droit de la Lufira [alt. 1.320 m] : 28.IV-2.V.1948 (19 ex.), 1-5.V.1948 (1 ex.), 6-7.V.1948 (1 ex.), 8-10.V.1948 (30 ex.), 8-11.V.1948 (3 ex.).

Munoi, bifurcation de la rivière Lupiala, affluent droit de la Lufira [alt. 890 m] : 28-31.V.1948 (2 ex.), 1-11.VI.1948 (2 ex.).

Kimiala (rivière), affluent de la Luizi et sous-affluent gauche de la Lufwa, près de Sampwe (Kundelungu) [alt. 900 m] (Ex. P.N.U.) : 30.III.1949 (1 ex.), 4.IV.1949 (1 ex.).

Kabenga, près de Kaziba [alt. 1.250 m] (Ex. P.N.U.) : 7.IV.1949 (7 ex.).

Arthroleptis stenodactylus. 3.229 exemplaires.

Lusinga, rivière Kamitungulu, affluent gauche de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.760 m] : I-II.1947. (1 ex.).

Kanonga (rivière), affluent droit de la Fungwe [alt. 695 m] : 11-14.II.1947 (17 ex.), 13-27.IX.1947 (1 ex.), 14-16.II.1949 (27 ex.), 22-23.II.1949 (22 ex.), 24.II.1949 (1 ex.), 26-28.II.1949 (104 ex.).

Kaswabilenga, région du cours inférieur de la Lupiala, affluent droit de la Lufira [alt. 700 m] : 13-27.III.1947 (1 ex.), 22.X.1947 (2 ex.), 31.X.1947 (2 ex.), 31.X-5.XI.1947

(10 ex.), 1-8.XI.1947 (4 ex.), 8-20.XII.1947 (70 ex.), 5-9.I.1948 (52 ex.), 8.XII.1948-3.I.1949 (163 ex.), 5-9.I.1949 (77 ex.), 24.I.1949 (73 ex.), 31.I.1949 (65 ex.), 7.II.1949 (44 ex.). 21.II.1949 (60 ex.), 28.II.1949 (122 ex.), 7.III.1949 (64 ex.), 16.III.1949 (105 ex.).

Mabwe, rive Est du lac Upemba [alt. 585 m] : 28.VII-12.VIII.1947 (10 ex.), 7-9.IX.1947 (1 ex.), 6-17.XI.1948 (1 ex.), 18.XI.1948 (1 ex.), 18-21.XI.1948 (6 ex.), 22-27.XI.1948 (2 ex.), 28.XI.1948 (1 ex.), 1-2.XII.1948 (8 ex.), 3-6.XII.1948 (7 ex.), 5-10.XII.1948 (15 ex.), 13-16.XII.1948 (18 ex.), 17-18.XII.1948 (126 ex.), 20.XII.1948 (5 ex.), 22.XII.1948 (8 ex.), 23.XII.1948 (6 ex.), 24.XII.1948 (13 ex.), 29.XII.1948 (71 ex.), 30.XII.1948 (2 ex.), 3.I.1949 (128 ex.), 4-8.I.1949 (10 ex.), 5.I.1949 (15 ex.), 6.I.1949 (20 ex.), 12.I.1949 (21 ex.), 12-18.I.1949 (3 ex.), 13-14.I.1949 (1 ex.), 14.I.1949 (168 ex.), 19.I.1949 (2 ex.), 21.I.1949 (3 ex.), 24.I.1949 (1 ex.), 25.I.1949 (103 ex.), 28.I.1949 (1 ex.), 1.II.1949 (24 ex.), 2.II.1949 (188 ex.), 4-7.II.1949 (105 ex.), 12-17.II.1949 (173 ex.), 17-22.II.1949 (89 ex.), 6.III.1949 (113 ex.).

Kande (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 730 m] : 3.X.1947 (1 ex.), 4-7.X.1947 (1 ex.), 7-8.X.1947 (3 ex.), 13-14.X.1947 (1 ex.), 13-30.X.1947 (1 ex.), 16-23.X.1947 (3 ex.), 25.X.1947 (3 ex.), 28.X.1947 (1 ex.).

Lukawe (rivière), affluent droit de la Lufira [alt. 700 m] : 7.X.1947 (1 ex.), 17.X.1947 (9 ex.), 28.X.1947 (1 ex.).

Lupiala (rivière), affluent droit de la Lufira [alt. 700 m] : 9-12.X.1947 (4 ex.), 13-15.X.1947 (1 ex.), 20.X.1947 (1 ex.), 24.X.1947 (1 ex.), 28.X.1947 (1 ex.), 31.X.1947 (1 ex.), 5.XI.1947 (2 ex.).

Kankunda (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 1.300 m] : 7-8.XI.1947 (6 ex.), 11-13.XI.1947 (2 ex.), 14-17.XI.1947 (14 ex.), 17.XI.1947 (2 ex.), 18-19.XI.1947 (11 ex.), 20.XI.1947 (1 ex.), 21-22.XI.1947 (15 ex.), 24-26.XI.1947 (8 ex.).

Kateke (rivière), affluent de la Muovwe et sous-affluent droit de la Lufira [alt. 960 m] : 23.XI-5.XII.1947 (87 ex.).

Tumbwe (rivière), affluent gauche de la Grande Kafwe [alt. 1.102 m] : 10.I.1948 (2 ex.).

Kaziba (rivière), affluent gauche de la Senze et sous-affluent droit de la Lufira [alt. 1.140 m] : 1-6.II.1948 (85 ex.), 9-10.II.1948 (16 ex.), 10-11.II.1948 (33 ex.), 10-16.II.1948 (40 ex.), 12-13.II.1948 (67 ex.), 16-18.II.1948 (11 ex.). 19.II.1948 (1 ex.), 21-22.II.1948 (18 ex.), 23-24.II.1948 (1 ex.), 25-26.II.1948 (6 ex.), 27-28.II.1948 (3 ex.).

Kabwe, sur la rive droite de la Muye, affluent droit de la Lufira [alt. 1.320 m] : 1-5.V.1948 (2 ex.), 6-7.V.1948 (1 ex.), 8-11.V.1948 (8 ex.), 18.VI.1948 (6 ex.).

Munoi, bifurcation de la rivière Lupiala, affluent droit de la Lufira [alt. 890 m] : 28-31.V.1948 (1 ex.), 1-2.VI.1948 (15 ex.), 3.VI.1948 (4 ex.), 4.VI.1948 (1 ex.), 6.VI.1948 (6 ex.), 7.VI.1948 (11 ex.), 8-11.VI.1948 (8 ex.).

Kilwezi (rivière), affluent droit de la Lufira [alt. 800 m] : 29-31.VII.1948 (1 ex.), 9-14.VIII.1948 (1 ex.), 12.VIII.1948 (1 ex.), 3.IX.1948 (13 ex.), 9.IX.1948 (2 ex.). 10.IX.1948 (1 ex.).

Loie (rivière), affluent gauche de la Lufira [alt. 700 m] : 17.VIII.1948 (1 ex.).

Mokey (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 800 m] : 1.IX.1948 (1 ex.).

Kiamakoto (entre Masombwe et Mukana). sur la rive droite de la Lukima, affluent droit de la Grande Kafwe [alt. 1.100 m] (Ex. P.N.U.) : 4-16.X.1948 (1 ex.).

Masombwe, sur la Grande Kafwe [alt. 1.120 m] (Ex. P.N.U.) : 4-16.X.1948 (5 ex.).

Bunda-Bunda, près de la rivière Lufwa, affluent droit de la Lufira, (rivière), affluent droit de la Lufira (près de Kilwezi) [alt. 800 m] : 11.XI.1948 (34 ex.).

Kalumengongo (rivière), affluent droit du Lualaba [alt 1.830 m] : 17.I.1949 (2 ex.).

Bowa (rivière), affluent droit de la Kalule Nord et sous-affluent droit du Lualaba, près de Kiamalwa [alt. 1.050 m] : 28.II-1.III.1949 (3 ex.), 2-3.III.1949 (8 ex.), 4.III.1949 (12 ex.).

Kalule Nord (rivière), rive gauche en face de Mujinga Kalenge, affluent droit du Lualaba [alt. 1.050 m] : 4.III.1949 (3 ex.).

Kimiala (rivière), affluent de la Luizi et sous-affluent gauche de la Lufwa, près de Sampwe (Kundelungu) [alt. 900 m] (Ex. P.N.U.) : 30.III.1949 (1 ex.), 31.III.1949 (1 ex.).

Kabenga, près de la rivière Kaziba, affluent gauche de la Senze et sous-affluent droit de la Lufira [alt. 1.260-1.300 m] (Ex. P.N.U.) : 5.IV.1949 (2 ex.), 6.IV.1949 (1 ex.), 7.IV.1949 (1 ex.).

Ganza, salines près de la rivière Kamandula, affluent droit de la Lukoka et sous-affluent gauche de la Lufira [alt. 860 m] : 30.V-10.VI.1949 (3 ex.).

Arthroleptis globosa. 15.364 exemplaires.

Lusinga (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.810 m] : 22.V.1945 (4 ex.), 14-18.VI.1945 (2 ex.).

Lusinga, rivière Dipidi, affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.650 m] : 12.VI.1945 (5 ex.).

Mukana, marais près de Lusinga [alt. 1.810 m] : 21.VI.1945 (2 ex.), 12.III.1947 (1 ex.), 14.IV.1947 (1 ex.), 5.VII.1947 (17 ex.).

Lusinga, rivière Kamalonge, affluent de la Lusinga et sous-affluent droit de la Lufwa [alt 1.760 m] : 22.VI.1945 (2 ex.), 1946 (13 ex.).

Kambi (rivière), affluent de la Grande Kafwe et sous-affluent droit de la Lufwa vers Masombwe) [alt. 1.750 m] : 25-27.VI.1945 (35 ex.).

Munte (rivière), affluent droit de la Lufira (tête de source) [alt. 1.750 m] : 28.VI.1945 (1 ex.).

Lupiala (rivière), affluent droit de la Lufira [alt. 700 m] : 30.VI.1945 (10 ex.), 9-12.X.1947 (83 ex.), 13-15.X.1947 (71 ex.), 14-22.X.1947 (9 ex.), 20.X.1947 (160 ex.), 24.X.1947 (83 ex.), 28.X.1947 (15 ex.), 31.X.1947 (24 ex.), 5.XI.1947 (21 ex.).

Mitoto (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. ± 1.760 m] : 9.VII.1945 (1 ex.).

Kagomwe (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.700 m] : 12.VII.1945 (1 ex.).

Kavizi (rivière), affluent de la Lusinga et sous-affluent de la Lufwa [alt. ± 1.700 m] : 14.VII.1945 (4 ex.).

Kanpungu (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.750 m] : 16.VII.1945 (44 ex.).

Mukukwe (rivière), affluent de la Muye et sous-affluent droit de la Lufira [alt. 1.760 m] : 17.VII.1945 (3 ex.).

Kilolomatembo (rivière), affluent de la Lusinga et sous-affluent de la Lufwa [alt. 1.750 m] : 17.VII.1945 (11 ex.).

Kimapongo (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. ± 1.760 m] : 18.VII.1945 (5 ex.).

Lusinga, rivière Kamitungulu, affluent gauche de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.760 m] II.1947 (16 ex.), 20.II-21.III.1947 (34 ex.), 23.III-5.IV.1947 (20 ex.), 23.III-9.IV.1947 (17 ex.), 9-17.IV.1947 (4 ex.), XI-XII.1947 (4 ex.), 23.IV.1949 (17 ex.).

Kamitungulu (rivière), affluent gauche de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.760 m] : 7.III.1947 (12 ex.), 18.IV.1947 (2 ex.).

Kenia (rivière), affluent droit de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.585 m] (Ex. P.N.U.) : 28.III.1947 (2 ex.), 10.VII.1947 (43 ex.), 12.III.1948 (10 ex.), 20.X.1948 (3 ex.).

Kalumengongo (rivière), affluent droit du Lualaba [alt. 1.830 m] : IV.1947 (178 ex.), 16.IV.1949 (1 ex.).

Munte-Mubale, région du confluent, affluent droit de la Lufira [alt. 1.480 m] : 1-8.V.1947 (20 ex.), 1-9.V.1947 (44 ex.), 10-14.V.1947 (77 ex.), 11.V.1947 (1 ex.), 15-19.V.1947 (62 ex.).

Pelenge (gorges de la rivière), affluent droit de la Lufira [alt. 1.250 m] : 20.V-7.VI.1947 (100 ex.), 20.V-22.VI.1947 (209 ex.), 8-9.VI.1947 (197 ex.), 10-14.VI.1947 (733 ex.), 15.VI.1947 (182 ex.), 16.VI.1947 (148 ex.), 17-18.VI.1947 (576 ex.), 24.VI.1947 (42 ex.), 10-19.III.1949 (1 ex.).

Lusinga [alt. 1.815 m] : 4.VII.1947 (8 ex.).

Kabwekanono, mare près tête de source de la Lufwa, affluent droit de la Lufira, sur rive gauche de la Lusinga [alt. 1.815 m] : 4.VII.1947 (109 ex.), 14.III.1948 (2 ex.), 30.IX.1948 (1 ex.), 4.VII.1949 (2 ex.).

Kande (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 700 m] : 13-27.IX.1947 (2 ex.), 13-30.IX.1947 (138 ex.), 3.X.1947 (149 ex.), 4-7.X.1947 (133 ex.), 13-14.X.1947 (96 ex.), 16-23.X.1947 (38 ex.), 25.X.1947 (55 ex.).

Kanonga (rivière), affluent droit de la Fungwe [alt. 695 m] : 13-27.IX.1947 (639 ex.), 11-14.II.1949 (3 ex.), 14-16.II.1949 (12 ex.), 16-18.II.1949 (8 ex.), 18-19.II.1949 (34 ex.), 1-921.II.1949 (16 ex.), 22-23.II.1949 (6 ex.).

Kaswabilenga, rive droite de la Lufira (piste Lusinga-Mabwe) [alt. 680 m] : 13-27.IX.1947 (105 ex.), 31.X-5.XI.1947 (15 ex.), 1-8.XI.1947 (14 ex.), 5-9.I.1949 (2 ex.), 16.III.1949 (62 ex.).

Lukawe (rivière), affluent droit de la Lufira [alt. 700 m] : 29.IX.1947 (84 ex.), 17.X.1947 (8 ex.), 28.X.1947 (11 ex.).

Kaswabilenga, région du cours inférieur de la Lupiala, affluent droit de la Lufira [alt. 700 m] : 22.X.1947 (3 ex.), 28-30.X.1947 (2 ex.), 31.X-5.XI.1947 (38 ex.), 1-8.XI.1947 (21 ex.), 5.XI.1947 (2 ex.), 8-20.XII.1947 (1 ex.), 8.XII.1948-3.I.1949 (4 ex.), 5-9.I.1949 (16 ex.), 24.I.1949 (15 ex.), 31.I.1949 (5 ex.), 7.II.1949 (8 ex.), 21.II.1949 (42 ex.), 28.II.1949 (102 ex.), 7.III.1949 (21 ex.), 16.III.1949 (13. ex.).

Kalubamba (rivière), affluent gauche de la Lufira [alt. 700-800 m] : 6.XI.1947 (1 ex.).

Kankunda (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 1.300 m] : 11-13.XI.1947 (26 ex.), 14-17.XI.1947 (59 ex.), 17.XI.1947 (3 ex.), 18-19.XI.1947 (21 ex.), 20.XI.1947 (3 ex.), 21-22.XI.1947 (28 ex.), 24-26.XI.1947 (34 ex.).

Kateke (rivière), affluent de la Muovwe et sous-affluent droit de la Lufira [alt. 960 m] : 23.XI-5.XII.1947 (51 ex.).

Tumbwe (rivière), près Kimilombo, affluent gauche de la Grande Kafwe et sous-affluent droit de la Lufwa [alt. 1.120 m] : 10.I.1948 (1 ex.).

Kamitunu (rivière), affluent gauche de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.760 m] : 14.I.1948 (1 ex.).

Kaziba (rivière), affluent gauche de la Senze sous-affluent droit de la Lufira [alt. 1.140 m] : 1-6.II.1948 (208 ex.), 6-7.II.1948 (1 ex.), 9-10.II.1948 (60 ex.), 10-11.II.1948 (27 ex.), 12-13.II.1948 (25 ex.), 16-18.II.1948 (11 ex.), 21-22.II.1948 (65 ex.), 23-24.II.1948 (7 ex.), 25-26.II.1948 (3 ex.), 27-28.II.1948 (2 ex.).

Buye-Bala (tête de source de la rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.750 m] : 28-31.III.1948 (43 ex.), 8-12.IV.1948 (123 ex.), 13.IV.1948 (205 ex.), 18.IV.1948 (85 ex.), 21-22.IV.1948 (3 ex.), 24.IV.1948 (1 ex.), 27.IX.1948 (12 ex.).

Muye (tête de source de la rivière), affluent droit de la Lufira [alt. 1.630 m] : 6.IV.1948 (2 ex.).

Mubale (tête de source de la rivière), affluent gauche de la Munte et sous-affluent droit de la Lufira [alt. 1.780 m] : 7.IV.1948 (21 ex.).

Bwalo (tête de source de la rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.750 m] : 9.IV.1948 (1 ex.).

Katongo (rivière), affluent gauche de la Mubale et sous-affluent gauche de la Munte [alt. 1.750 m] : 10.IV.1948 (26 ex.), 14-15.IV.1948 (34 ex.).

Mukelengia (rivière), affluent gauche de la Kalumengongo et sous-affluent droit du Lualaba [alt. 1.750 m] : 12.IV.1948 (285 ex.).

Manda (rivière), affluent de la Kalumengongo et sous-affluent droit du Lualaba [alt. 1.750 m] (Ex. P.N.U.) : 20.IV.1948 (13 ex.).

Kabwe, sur rive droite de la Muye, affluent droit de la Lufira [alt 1.320 m] : 1-5.V.1948 (41 ex.), 6-7.V.1948 (212 ex.), 8-11.V.1948 (121 ex.), 12-15.V.1948 (29 ex.), 16-17.V.1948 (269 ex.), 18-20.V.1948 (238 ex.), 21-25.V.1948 (35 ex.), 18.VI.1948 (105 ex.).

Munoi, bifurcation de la rivière Lupiala, affluent droit de la Lufira [alt. 890 m] : 28-31.V.1948 (27 ex.), 1-2.VI.1948 (47 ex.), 3.VI.1948 (302 ex.), 4.VI.1948 (299 ex.), 6.VI.1948 (448 ex.), 7.VI.1948 (143 ex.), 8-11.VI.1948 (465 ex.), 12-16.VI.1948 (661 ex.), 17.VI.1948 (93 ex.), 22-23.VI.1948 (93 ex.), 24.VI.1948 (133 ex.).

Kayumbwe (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.670 m] : 7.VII.1948 (16 ex.).

Kiamakoto (entre Masombwe et Mukana), sur la rive droite de la Lukima, affluent droit de la Grande Kafwe [alt. 1.100 m] (Ex. P.N.U.) : 7-9.VII.1948 (10 ex.), 4-16.X.1948 (19 ex.).

Masombwe, près de la rivière Kanakakasi, affluent de la Grande Kafwe et sous-affluent droit de la Lufira [alt. 1.120 m] (Ex. P.N.U.) : 7-9VII.1948 (6 ex.), 4-16.IX.1948 (2 ex.), 4-16.X.1948 (5 ex.).

Kilwezi (rivière), affluent droit de la Lufira [alt. 800 m] : 26-28.VII.1948 (132 ex.), 29-31.VII.1948 (169 ex.), 1-7.VIII.1948 (112 ex.), 9-14.VIII.1948 (185 ex.), 16-17.VIII.1948 (1 ex.), 18-20.VIII.1948 (516 ex.), 24.VIII.1948 (358 ex.), 3.IX.1948 (28 ex.), 6.IX.1948 (52 ex.), 11.IX.1948 (118 ex.).

Senze (rivière), affluent droit de la Lufira et sous-affluent droit du Lualaba [alt. 800 m] : 2-4.VIII.1948 (51 ex.), 20.VIII.1948 (14 ex.), 16.IX.1948 (2 ex.).

Kalungwe (rivière), affluent droit de la Senze et sous-affluent droit de la Lufira [alt. 800 m] : 13.VIII.1948 (37 ex.), 19.VIII.1948 (28 ex.).

Loie (rivière), affluent gauche de la Lufira [alt. 1.000 m] : 17.VIII.1948 (19 ex.), 6.VI.1949 (127 ex.).

Kipondo (rivière), affluent droit de la Lufira, près de Kilwezi [alt. 800 m] : 7.VIII.1948 (95 ex.), 27.VIII.1948 (104 ex.), 10.IX.1948 (57 ex.), 13.IX.1948 (5 ex.).

Lufira (rivière), affluent droit du Lualaba [alt. 800 m] : 25.VIII.1948 (17 ex.).

Mokey (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 800 m] : 1.IX.1948 (119 ex.).

Masombwe, dans rivière Kipepe, affluent de la Tumbwe et sous-affluent gauche de la Grande Kafwe [alt. 1.120 m] : 4-16.IX.1948 (3 ex.).

Muye (rivière), affluent droit de la Lufira (près confluent de la Kabangasi) [alt. 800 m] : 6.IX.1948 (28 ex.).

Masombwe, sur la Grande Kafwe, affluent droit de la Lufira [alt. 1.120 m] : 4-16.X.1948 (104 ex.).

Dipidi (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.700 m] (Ex. P.N.U.) : 20.X.1948 (7 ex.).

Mabwe, rive Est du lac Upemba [alt. 585 m] : 22.XII.1948 (1 ex.), 30.XII.1948 (1 ex.).

Bowa (rivière), affluent droit de la Kalule Nord et sous-affluent droit du Lualaba, près de Kiamalwa [alt. 1.050 m] : 4.III.1949 (3 ex.).

Kabenga (rivière), près de Kaziba, affluent gauche de la Senze et sous-affluent droit de la Lufira [alt. 1.250 m] (Ex. P.N.U.) : 27.III.1949 (12 ex.), 28.III.1949 (6 ex.), 30.III.1949 (1 ex.), 1.IV.1949 (2 ex.), 2.IV.1949 (1 ex.), 4.IV.1949 (1 ex.), 5.IV.1949 (11 ex.), 6.IV.1949 (7 ex.), 7.IV.1949 (25 ex.), 8.IV.1949 (1 ex.).

Munte (rivière), affluent droit de la Lufira [alt. 1.450 m] : 21.IV.1949 (2 ex.).

Ganza, salines près de la rivière Kamandula, affluent droit de la Lukoka et sous-affluent gauche de la Lufira [alt. 860 m] : 10.V-10.VI.1949 (295 ex.), 30.V-10.VI.1949 (293 ex.), 12-18.VI.1949 (142 ex.), 20-25.VI.1949 (120 ex.), 27.VI-2.VII.1949 (550 ex.).

Lukorami (rivière), affluent gauche de la Lufira [alt. 900 m] : 13.VI.1949 (138 ex.).

Mware (rivière), affluent gauche de la Lufira et sous-affluent droit du Lualaba [alt. 950 m] : 20-24.VI.1949 (95 ex.), 11.VII.1949 (19 ex.).

Difirinji (rivière), affluent gauche de la Lufira [alt. 750 m] : 27.VI.1949 (2 ex.).

Kamusanga (rivière), affluent gauche de la Lufira (en face du Mont Sombwe [alt. 700 m] : 12.VII.1949 (87 ex.).

Lukoka (rivière), affluent gauche de la Lufira [alt. 750 m] : 14.VII.1949 (13 ex.).

Arthroleptis sp.

Katombwe (Mukana) près de Lusinga (lieu-dit) [alt. 1.812 m] : 22.III.1947 (1 têtard).

Cacosternum leleupi. 11 exemplaires.

Lusinga (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira (près de Mukana) [alt. 1.810 m] : 4.VI.1945 (1 ex.).

Kabwekanono, mare près tête de source de la Lufira, affluent droit de la Lufira, sur la rive gauche de la Lusinga [alt 1.815 m] : 4.VII.1947 (4 ex.).

Mukana, marais près de Lusinga [alt. 1.810 m] : 5.VII.1947 (2 ex.).

Bwalo (rivière) (tête de source), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.750 m] : 9.IV.1948 (1 ex.).

Mukelengia (rivière), affluent gauche de la Kalumengongo et sous-affluent droit du Lualaba [alt. 1.750 m] : 12.IV.1948 (1 ex.).

Katongo (rivière), affluent gauche de la Mubale et sous-affluent gauche de la Munte [alt. 1.750 m] : 18.IV.1948 (1 ex.).

Kalumengongo (rivière), affluent droit du Lualaba [alt. 1.830 m] : 16.IV.1949 (1 ex.).

Phrynobatrachus anotis. 2.005 exemplaires.

Lusinga (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.810 m] : 22.V.1945 (59 ex.), 28-30.V.1945 (1 ex.), 1-2.VI.1945 (1 ex.), 14-18.VI.1945 (17 ex.), 18-30.VI.1945 (22 ex.), 10.VII.1945 (4 ex.), 1946 (1 ex.), II.1947 (1 ex.), 23.III-5.IV.1947 630 ex.), 9-17.IV.1947 (26 ex.), 20.IV.1947 (5 ex.), XI-XII.1947 (2 ex.), 25.X.1948 (1 ex.).

Kabwekanono, mare près tête de source de la Lufwa, affluent droit de la Lufira, sur la rive gauche de la Lusinga [alt. 1.815 m] : 31.V.1945 (8 ex.), 18.III.1947 (3 ex.), 4.VII.1947 (4 ex.), 14.I.1948 (5 ex.).

Lusinga, rivière Karungwe, affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. ± 1.700 m] : 6.VI.1945 (14 ex.).

Kagomwe (rivière), affluent de la Lusinga et sous-affluent droit de la Lufira [alt. 1.700 m] : 8.VI.1945 (12 ex.), 12.VII.1945 (23 ex.).

Lusinga, rivière Kamalonge, sous-affluent droit de la Lufwa [alt. ± 1.700 m] : 11.VI.1945 (4 ex.), 22.VI.1945 (1 ex.).

Lusinga, rivière Dipidi, affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.650 m] (Ex. P.N.U) : 12.VI.1945 (5 ex.).

Kambi (rivière), affluent de la Grande Kafwe et sous-affluent droit de la Lufwa [alt. 1.750 m] : 25-27.VI.1945 (31 ex.).

Kamatshya (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.750 m] : 6.VII.1945 (24 ex.).

Mitoto (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. ± 1.760 m] : 9.VII.1945 (8 ex.).

Kamitunu (rivière), affluent gauche de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.760 m] : 10-11.VII.1945 (3 ex.), 13.III.1947 (2 ex.), 14.I.1948 (1 ex.), 21.I.1948 (40 ex.), IX.1948 (1 ex.).

Kavizi (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. ± 1.700 m] : 14.VII.1945 (232 ex.).

Babagi (rivière), affluent de la Katembula et sous-affluent de la Muye [alt ± 900 m] : 14.VII.1945 (1 ex.).

Kampungu (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.750 m] : 16.VII.1945 (24 ex.).

Kilolomatembo (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.750 m] : 17.VII.1945 (63 ex.).

Kimapongo (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. ± 1.760 m] : 18.VII.1945 (51 ex.).

Kipangaribwe (rivière), affluent droit de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.600 m] : 24.VII.1945 (74 ex.).

Karibwe (rivière), affluent de la Lusinga et sous-affluent droit de la Luwa [alt. 1.700 m] : 4-6.III.1947 (9 ex.).

Kamitungulu (rivière), affluent gauche de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.760 m] : 7.III.1947 (6 ex.), 18.IV.1947 (9 ex..)

Kasandendeko (rivière), affluent de la Kamitungulu et sous-affluent gauche de la Lusinga [alt. 1.700 m] : 10.III.1947 (157 ex.).

Kamamulongo (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.700 m] : 11.III.1947 (15 ex.).

Mukana, marais près de Lusinga [alt. 1.810 m] : 12.III.1947 (1 ex.), 5.VII.1947 (87 ex.).

Lufwa (rivière), affluent droit de la Lufira, tête de source près de Lusinga [alt. 1.700 m] (Ex. P.N.U.) :17.III.1947 (1 ex.).

Kenia (rivière). affluent droit de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.585 m] (Ex. P.N.U.) : 28.III.1947 (4 ex.), 10.VII.1947 (31 ex.), 12.III.1948 (2 ex.), 20.X.1948 (19 ex.).

Munte-Mubale (région du confluent), affluent droit de la Lufira [alt. 1.480 m] : 1-8.V.1947 (25 ex.), 1-9.V.1947 (7 ex.), 10-14.V.1947 (20 ex.), 15-19.V.1947 (19 ex.).

Pelenge (gorges de la rivière), affluent droit de la Lufira [alt. 1.250 m] : 20.V-7.VI.1947 (4 ex.), 20.V-22.VI.1947 (6 ex.), 8-9.VI.1947 (4 ex.), 10-14.VI.1947 (5 ex.), 15.VI.1947 (3 ex.), 16.VI.1947 (21 ex.), 17-18.VI.1947 (7 ex.).

Dipidi (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.700 m] (Ex. P.N.U.) : 19.I.1948 (5 ex.), 20.X.1948 (3 ex.).

Kaziba (rivière), affluent gauche de la Senze et sous-affluent droit de la Lufira [alt. 1.140 m] : 1-6.II.1948 (11 ex.), 6-7.II.1948 (8 ex.), 9-10.II.1948 (1 ex.), 10-11.II.1948 (3 ex.).

Buye-Bala (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.750 m] : 8-12.IV.1948 (29 ex.).

Manda (rivière), affluent de la Kalumengongo et sous-affluent droit du Lualaba [alt. 1.750 m] (Ex. P.N.U.) : 20.IV.1948 (1 ex.).

Kabwe, sur la rive droite de la Muye, affluent droit de la Lufira [alt. 1.320 m] : 1-5.V.1948 (31 ex.), 6-7.V.1948 (3 ex.), 12-15.V.1948 (2 ex.), 21-25.V.1948 (1 ex.).

Luanana (rivière), affluent gauche de la Kamesia et sous-affluent droit de la Muye [alt. 1.500 m] : 2.V.1948 (1 ex.).

Munoi, bifurcation de la rivière Lupiala, affluent droit de la Lufira [alt. 890 m] : 28-31.V.1948 (2 ex.).

Kayumbwe (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.670 m] : 7.VII.1948 (24 ex.).

Masombwe, sur la rivière Grande Kafwe [alt. 1.120 m] (Ex. P.N.U.) : 4-16.X.1948 (1 ex.).

Masombwe, dans la rivière Kipepe, affluent de la Tumbwe et sous-affluent gauche de la Grande Kafwe [alt. 1.120 m] : 4-16.X.1948 (1 ex.).

Kakolwe (rivière), affluent de la Kenia et sous-affluent droit de la Lusinga [alt. 1.660 m] (Ex. P.N.U.) : 21.X.1948 (1 ex.).

Kimiala (rivière), affluent de la Luizi et sous-affluent gauche de la Lufwa, près de Sampwe (Kundelungu) [alt. 900 m] (Ex. P.N.U.) : 4.IV.1949 (2 ex.).

Kabenga, près de Kaziba [alt. 1.250 m] (Ex. P.N.U.) : 7.IV.1949 (4 ex.).

Ganza, salines près de la rivière Kamandula, affluent droit de la Lukoka et sous-affluent gauche de la Lufira [alt. 860 m] : 30.V-10.VI.1949 (3 ex.), 27.VI-2.VII.1949 (2 ex.).

Phrynobatrachus cryptotis. 11.887 exemplaires.

Lusinga (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.810 m] : 22.V.1945 (42 ex.), 18-30.VI.1945 (23 ex.), 1946 (1 ex.), 23.III-5.IV.1947 (4 ex.), XI.1947 (1 ex.), 9.I.1948 (131 ex.).

Kabwekanono, mare près de la tête de source de la Lufwa, affluent droit de la Lufira, sur la rive gauche de la Lusinga [alt. 1.815 m] : 31.V.1945 (247 ex.), 4.VII.1947 (830 ex.), 14.III.1948 (20 ex.), 18.III.1948 (16 ex.), 30.IX.1948 (191 ex.).

Lusinga, rivière Lufwa, affluent droit de la Lufira [alt. 1.810 m] : 1-2.VI.1945 (1 ex.).

Mabwe, rive Est du lac Upemba [alt. 585 m] : 16-17.VI.1945 (1 ex.), 28.VII-12.VIII.1947 (456 ex.), 30.VIII-4.IX.1947 (136 ex.), 6-17.XI.1948 (5 ex.), 18-21.XI.1948 (25 ex. , 22-27.XI.1948 (1 ex.), 26.XI.1948 (5 ex.), 27.XI.1948 (3 ex.), 28.XI.1948 (5 ex.), 1-2.XII.1948 (9 ex.), 3-6.XII.1948 (31 ex.), 5-8.XII.1948 (10 ex.), 5-10.XII.1948 (17 ex.), 13-16.XII.1948 (19 ex.), 17-18.XII.1948 (48 ex.), 20.XII.1948 (5 ex.), 21.XII.1948 (118 ex.), 22.XII.1948 (35 ex.), 24.XII.1948 (59 ex.), 28.XII.1948 (38 ex.), 29.XII.1948 (39 ex.), 1-6.I.1949 (10 ex.), 3.I.1949 (20 ex.), 4-8.I.1949 (42 ex.), 5.I.1949 (60 ex.), 6.I.1949 (69 ex.), 8.I.1949 (14 ex.), 12.I.1949 (26 ex.), 13-14.I.1949 (15 ex.), 17.I.1949 (17 ex.), 19.I.1949 (20 ex.), 24.I.1949 (16 ex.), 25.I.1949 (72 ex.), 28.I.1949 (15 ex.), 1.II.1949 (11 ex.), 2.II.1949 (9 ex.), 4-7.II.1949 (18 ex.), 8-12.II.1949 (24 ex.), 12-17.II.1949 (8 ex.), 17-22.II.1949 (7 ex.), 6.III.1949 (7 ex.).

Mukana, marais près de Lusinga [alt. 1.810 m] : 21.VI.1945 (1.272 ex.), 12.III.1947 (9 ex.), 14.IV.1947 (7 ex.), 5.VII.1947 (868 ex.), 1.IX.1948 (217 ex.) ,19.X.1948 (68 ex.), 3-4.I.1949 (362 ex.).

Munte (tête de source de la rivière), affluent droit de la Lufira [alt. 1.750 m] : 28.VI.1945 (273 ex.).

Lupiala (rivière), affluent droit de la Lufira [alt. 700 m] : 30.VI.1945 (8 ex.), 5.X.1947 (2 ex.), 9-12.X.1947 (11 ex.), 13-15.X.1947 (32 ex.), 20.X.1947 (6 ex.), 24.X.1947 (2 ex.), 28.X.1947 (25 ex.).

Mukukwe (rivière), affluent de la Muye et sous-affluent droit de la Lufira [alt. 1.760 m] : 17.VII.1945 (1 ex.).

Karibwe (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.700 m] : 4-6.III.1947 (1 ex.).

Kamitungulu (rivière), affluent gauche de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.760 m] : 7.III.1947 (2 ex.).

Luangalele, près de Mukana (Lusinga) [1.850 m] : 19.III.1947 (6 ex.).

Kalumengongo (rivière), affluent droit du Lualaba [alt. 1.780 m] : 16.IV.1949 (133 ex.), IV.1947 (3 ex.).

Munte-Mubale (région du confluent), affluent droit de la Lufira [alt. 1.480 m] : 1-8.V.1947 (230 ex.), 1-9.V.1947 (51 ex.), 10-41.V.1947 (273 ex.), 15-19.V.1949 (126 ex.).

Pelenge (gorges de la rivière) affluent droit de la Lufira [alt. 1.250 m] : 8-9.VI.1947 (18 ex.), 10-14.VI.1947 (1 ex.).

Kenia (rivière), affluent droit de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.585 m] (Ex. P.N.U.) : 10.VII.1947 (6 ex.).

Kaswabilenga, rive droite de la Lufira (piste Lusinga-Mabwe) [alt. 680 m] : 13-27.IX.1947 (72 ex.), 31.X-5.XI.1947 (4 ex.), 5-9.I.1949 (18 ex.), 7.II.1949 (7 ex.), 21.II.1949 (30 ex.), 7.III.1949 (2 ex.).

Kanonga (rivière), affluent droit de la Fungwe [alt 695 m] : 13-27.IX.1947 (465 ex.), 18-19.II.1949 (8 ex.), 19-21.II.1949 (8 ex.).

Kande (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 730 m] : 13-30.IX.1947 (21 ex.), 3.X.1947 (12 ex.), 4-7.X.1947 (29 ex.), 7-8.X.1947 (2 ex.), 13-14.X.1947 (37 ex.), 16-23.X.1947 (40 ex.), 25.X.1947 (46 ex.).

Lukawe (rivière), affluent droit de la Lufira [alt. 700 m] : 27.IX.1947 (1 ex.), 17.X.1947 (18 ex.), 18.VIII.1948 (58 ex.).

Kaswabilenga, rive gauche de la Lufira [alt. 750 m] : 5.XI.1947 (3 ex.).

Kalubamba (rivière), affluent gauche de la Lufira [alt. 700-800 m] : 6.XI.1947 (2 ex.).

Kateke (rivière), affluent de la Muovwe et sous-affluent droit de la Lufira [alt. 960 m] : 23.XI-5.XII.1947 (2 ex.).

Lusinga, marais près de la tête de source de la rivière Kapero, affluent droit de la Lufira [alt. 1.640 m] : 9.I.1948 (394 ex.).

Lufwa (rivière), affluent droit de la Lufira, tête de source près de Lusinga [alt. 1.700 m] (Ex. P.N.U.) : 15.I.1948 (12 ex.), 16.I.1948 (12 ex.), 17.III.1948 (25 ex.).

Mubale (rivière), affluent gauche de la Munte et sous-affluent droit de la Lufira [alt. 1.780 m] : 16.I.1948 (82 ex.), 7.IV.1948 (50 ex.).

Dipidi (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.700 m] (Ex. P.N.U.) : 19.I.1948 (36 ex.), 20.X.1948 (10 ex.), II.1949 (2 ex.).

Kamitunu (rivière), affluent gauche de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.760 m] : 21.I.1948 (2 ex.).

Kampadika (rivière), affluent de la Grande Kafwe et sous-affluent droit de la Lufira [alt. 1.810 m] : 22.I.1948 (117 ex.), 18.IV.1948 (76 ex.).

Kaziba (rivière), affluent de la Senze et sous-affluent droit de la Lufira [alt. 1.140 m] : 6-7.II.1948 (10 ex.), 10-11.II.1948 (4 ex.), 15.II.1948 (1 ex.).

Kafwe (rivière Grande), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.790 m] : 18.III.1948 (17 ex.).

Buye-Bala (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.750 m] : 28-31.III.1948 (101 ex.), 13.IV.1948 (125 ex.).

Lufira (rivière), affluent droit du Lualaba [alt. 1.750 m] : 8-12.IV.1948 (209 ex.), 25.VIII.1948 (44 ex.), 27.IX.1948 (386 ex.).

Bwalo (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.750 m] : 9.IV.1948 (186 ex.).

Katongo (rivière), affluent gauche de la Mubale et sous-affluent gauche de la Munte [alt. 1.750 m] : 10.IV.1948 (295 ex.), 14-15.IV.1948 (92 ex.), 18.IV.1948 (1 ex.).

Mukelengia (rivière), affluent gauche de la Kalumengongo et sous-affluent droit du Lualaba [alt. 1.750 m] : 12.IV.1948 (247 ex.), 15.IV.1948 (365 ex.).

Manda (rivière), affluent de la Kalumengongo et sous-affluent droit du Lualaba [alt. 1.750 m] (Ex. P.N.U.) : 20.IV.1948 (10 ex.).

Kabwe, sur la rive droite de la rivière Muye, affluent droit de la Lufira [alt. 1.320 m] : 1-5.V.1948 (10 ex.), 6-7.V.1948 (10 ex.), 8-11.V.1948 (2 ex.).

Munoi, bifurcation de la rivière Lupiala, affluent droit de la Lufira [alt 890 m] : 28-31.V.1948 (1 ex.), 1-2.VI.1948 (35 ex.), 3.VI.1948 (12 ex.), 6.VI.1948 (11 ex.), 7.VI.1948 (2 ex.), 8-11.VI.1948 (3 ex.), 11-15.VI.1948 (2 ex.), 22-23.VI.1948 (1 ex.), 24.VI.1948 (10 ex.).

Sanga (rivière), affluent du lac Upemba (rive Est) [alt. 700 m] : 21.VI.1948 (96 ex.).

Kiamakoto (entre Masombwe et Mukana), sur la rive droite de la rivière Lukima, affluent droit de la Grande Kafwe [alt. 1.100 m] (Ex. P.N.U.) : 7-9.VII.1948 (180 ex.), 4-16.X.1948 (8 ex.).

Kilwezi (rivière), affluent droit de la Lufira [alt. 800 m] : 29-31.VII.1948 (58 ex.), 1-7.VIII.1948 (11 ex.), 9-14.VIII.1948 (19 ex.), 16-17.VIII.1948 (2 ex.), 3.IX.1948 (18 ex.), 6.IX.1948 (6 ex.), 11.IX.1948 (9 ex.).

Senze (rivière), affluent droit de la Lufira [alt. 800 m] : 2-4.VIII.1948 (137 ex.), 20.VIII.1948 (27 ex.), 16.IX.1948 (9 ex.).

Kipondo (rivière), affluent droit de la Lufira (près de Kilwezi) [alt. 800 m] : 7.VIII.1948 (1 ex.), 27.VIII.1948 (28 ex.), 10.IX.1948 (6 ex.), 13.IX.1948 (7 ex.).

Kalungwe (rivière), affluent droit de la Senze et sous-affluent droit de la Lufira [alt. 800 m] : 13.VIII.1948 (4 ex.), 19.VIII.1948 (3 ex.).

Loie (rivière), affluent gauche de la Lufira [alt. 800 m] : 17.VIII.1948 (1 ex.), 3.IX.1948 (5 ex.).

Mokey (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 800 m] : 1.IX.1948 (10 ex.).

Masombwe, sur la rivière Grande Kafwe [alt. 1.120 m] (Ex. P.N.U.) : 4-16.X.1948 (60 ex.).

Bunda-Bunda, près de la rivière Lufwa, affluent droit de la Lufira, au Nord de Sampwe [alt. 900 m] (Ex. P.N.U.) : 9.X.1948 (1 ex.).

Kaswabilenga, cours inférieur de la rivière Lupiala, affluent droit de la Lufira [alt. 700 m] : 8-20.XII.1948 (2 ex.), 5-9.I.1949 (2 ex.), 31.I.1949 (1 ex.), 16.III.1949 (1 ex.).

Mwema-Mabole, rivière à 10 kilomètres Est de Mabwe [alt. 620 m] : 27.I.1949 (1 ex.).

Kabenga, près de Kaziba [alt. 1.250 m] (Ex. P.N.U.) : 5.IV.1949 (10 ex.).

Munte (rivière), affluent droit de la Lufira [alt. 1.450 m] : 21.IV.1949 (3 ex.).

Ganza, salines près de la rivière Kamandula, affluent droit de la Lukoka et sous-affluent gauche de la Lufira [alt. 860 m] : 30.V-10.VI.1949 (85 ex.), 12-18.VI.1949 (1 ex.), 20-25.VI.1949 (28 ex.), 27.VI-2.VII.1949 (86 ex.).

Kamusanga (rivière), affluent gauche de la Lufira (en face du Mont Sombwe) [alt. 700 m] : 12.VII.1949 (11 ex.).

Phrynobatrachus gutturosus. 1.780 exemplaires.

Kafwe (Petite), rivière près de Mukana-Kiamakoto, affluent droit de la Grande Kafwe et sous-affluent droit de la Lufwa [alt. 1.780 m] : 5.VI.1945 (1 ex.).

Lusinga, rivière Dipidi, affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.650 m] (Ex. P.N.U.) : 12.VI.1945 (14 ex.).

Lusinga, rivière Kamalonge, sous-affluent droit de la Lufwa [alt. ± 1.700 m] : 22.VI.1945 (24 ex.).

Kambi (rivière), affluent de la Grande Kafwe et sous-affluent droit de la Lufwa [alt. 1.750 m] : 25-27.VI.1945 (16 ex.).

Mukukwe (rivière), affluent de la Muye et sous-affluent droit de la Lufira [alt. 1.760 m] : 17.VII.1945 (1 ex.).

Kande (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 1.300 m] : 13-27.IX.1947 (1 ex.), 3.X.1947 (1 ex.), 13-14.X.1947 (2 ex.).

Kanonga (rivière), affluent droit de la Fungwe [alt. 695 m] : 13-27.IX.1947 (3 ex.), 10-18.II 1949 (70 ex.), 11-14.II.1949 (18 ex.), 14-16.II.1949 (54 ex.), 18-19.II.1949 (73 ex.), 19-21.II.1949 (72 ex.), 22-23.II.1949 (17 ex.).

Kaswabilenga, rive droite de la rivière Lufira (piste Lusinga-Mabwe) [alt. 680 m] : 13-27.IX.1947 (1 ex.), 31.X-5.XI.1947 (136 ex.), 16.III.1949 (72 ex.).

Lupiala (rivière), affluent droit de la Lufira [alt. 700 m] : 5.X.1947 (6 ex.), 9-12.X.1947 (8 ex.), 14-22.X.1947 (1 ex.), 20.X.1947 (4 ex.).

Kankunda (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 1.300 m] : 1-8.XI.1947 (2 ex.).

Kateke (rivière), affluent de la Muovwe et sous-affluent droit de la Lufira [alt. 960 m] : 23.XI-5.XII.1947 (246 ex.).

Lusinga, marais près de la tête de source de la rivière Kapero, affluent droit de la Lufwa [alt. 1.640 m] : 9.I.1948 (3 ex.).

Kaziba (rivière), affluent gauche de la Senze et sous-affluent droit de la Lufira [alt. 1.140 m] : 1-6.II.1948 (225 ex.), 6-7.II.1948 (27 ex.), 9-10.II.1948 (26 ex.), 10-16.II.1948 (6 ex.), 12-13.II.1948 (7 ex.), 16-18.II.1948 (8 ex.), 21-22.II.1948 (8 ex.), 23-24.II.1948 (16 ex.), 25-26.II.1948 (4 ex.), 27-28.II.1948 (14 ex.).

Mubale (tête de source de la rivière), affluent gauche de la Munte et sous-affluent droit de la Lufira [alt. 1.780 m] : 7.IV.1948 (1 ex.).

Kafwe, sur la rive droite de la Muye, affluent droit de la Lufira [alt. 1.320 m] : 6-7.V.1948 (7 ex.), 8-11.V.1948 (3 ex.), 16-17.V.1948 (3 ex.).

Munoi, bifurcation de la rivière Lupiala, affluent droit de la Lufira [alt. 890 m] : 4.VI.1948 (1 ex.), 12-16.VI.1948 (79 ex.).

Kiamakoto (entre Masombwe et Mukana), sur la rive droite de la Lukima, affluent droit de la Grande Kafwe [alt. 1.100 m] (Ex. P.N.U.) : 7-9.VII.1948 (1 ex.), 4-16.X.1948 (9 ex.).

Masombwe, sur la Grande Kafwe, affluent droit de la Lufwa [alt. 1.120 m] (Ex. P.N.U.) : 7-9.VII.1948 (11 ex.), 4-16.X.1948 (12 ex.).

Kilwezi (rivière), affluent droit de la Lufira [alt. 800 m] : 26-28.VII.1948 (19 ex.).

Kipondo (rivière), affluent droit de la Lufira (près de Kilwezi) [alt. 800 m] : 7.VIII.1948 (78 ex.).

Mokey (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 800 m] : 1.IX1.948 (5 ex.).

Masombwe, dans la rivière Kipepe, affluent de la Tumbwe et sous-affluent gauche de la Grande Kafwe [alt. 1.120 m] : 4-16.X.1948 (6 ex.).

Mabwe, rive Est du lac Upemba [alt. 585 m] : 22.XII.1948 (2 ex.).

Bowa (rivière), affluent droit de la Kalule Nord et sous-affluent droit du Lualaba, près de Kiamalwa [alt. 1.050 m] : 28.II-1.III.1949 (3 ex.), 2-3.III.1949 (28 ex.), 4.III.1949 (13 ex.).

Kabenga, près de Kaziba [alt. 1.250 m] (Ex. P.N.U.) : 27.III.1949 (3 ex.), 28.III.1949 (4 ex.), 31.III.1949 (121 ex.), 2.IV.1949 (72 ex.), 4.IV.1949 (1 ex.), 6.IV.1949 (1 ex.), 7.IV.1949 (7 ex.), 8.IV.1949 (79 ex.).

Difirinji (rivière), affluent gauche de la Lufira [alt. 750 m] : 27.VI.1949 (2 ex.).

Ganza, salines près de la rivière Kamandula, affluent droit de la Lukoka et sous-affluent gauche de la Lufira [alt. 860 m] : 27.VI-2.VII.1949 (10 ex.), 5.VII.1949 (1 ex.), 14.VII.1949 (8 ex.).

Mware (rivière), affluent gauche de la Lufira [alt. 750 m] : 11.VII.1949 (1 ex.).

Lukoka (rivière), affluent gauche de la Lufira [alt. 750 m] : 14.VII.1949 (1 ex.).

Kamusanga (rivière), affluent gauche de la Lufira (en face du Mont Sombwe [alt. 700 m] : 22.VII.1949 (1 ex.).

Phrynobatrachus natalensis. 8.171 exemplaires.

Lusinga (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.810 m] : 1941-1943 (1 ex.), 22.V.1945 (49 ex.), 1.VI.1945 (1 ex.), 14-18.VI.1945 (33 ex.), 18-30.VI.1945 (10 ex.). 10.VII.1945 (1 ex.), 1946 (1 ex.), 20.II-21.III.1947 (1 ex.), 23.III-5.IV.1947 (4 ex.), 23.III-9.IV.1947 (1 ex.), 12.IV.1947 (1 ex.), 28.VI-21.VII.1947 (1 ex.), XI.1947 (1 ex.), XI-XII.1947 (10 ex.), 25.X.1948 (2 ex.), 23.IV.1949 (2 ex.).

Mukana, marais près de Lusinga [alt 1.810 m] : 28-30.V.1945 (3 ex.), 5.VII.1947 (18 ex.), 4.III.1948 (10 ex.), 19.III.1948 (1 ex.), 1.IX.1948 (3 ex.), 19.X.1948 (3 ex.), 3-4.I.1949 (20 ex.).

Kabwekanono, mare près tête de source de la Lufwa, affluent droit de la Lufira, sur la rive gauche de la Lusinga [alt. 1.815 m] : 31.V.1945 (3 ex.), 4.VII.1947 (26 ex.), 14.I.1948 (4 ex.), 30.IX.1948 (11 ex.).

Lusinga, rivière Lufwa, affluent droit de la Lufira, tête de source, [alt. 1.810 m] (Ex. P.N.U.) : 1-2.VI.1945 (4 ex.).

Kafwe (Petite), rivière près de Mukana-Kiamakoto, affluent de la Grande Kafwe et sous-affluent droit de la Lufwa [alt. 1.780 m] : 5.VI 1948 (8 ex).

Lusinga, rivière Dipidi, affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.650 m] (Ex. P.N.U.) : 12.VI.1945 (6 ex.).

Mabwe, rive Est du lac Upemba [alt. 585 m] : 16-17.VI.1945 (1 ex.), 28.VII-12.VIII.1947 (42 ex.), 30.VIII-4.IX.1947 (13 ex.), 18-21.XI.1947 (1 ex.), 26.XI.1948 (66 ex.), 27.XI.1948 (19 ex.), 28.XI.1948 (11 ex.), 1-2.XII.1948 (5 ex.), 3-6.XII.1948 (6 ex.), 5-10.XII.1948 (37 ex.), 13-16.XII.1948 (34 ex.), 17-18.XII.1948 (21 ex.), 20.XII.1948 (82 ex.), 22.XII.1948 (42 ex.), 24.XII.1948 (19 ex.), 28.XII.1948 (30 ex.), 29.XII.1948 (5 ex.), 1-6.I.1949 (12 ex.), 3.I.1949 (28 ex.), 4-8.I.1949 (14 ex.), 5.I.1949 (39 ex.), 6.I.1949 (17 ex.), 8.I.1949 (1 ex.), 12.I.1949 (2 ex.), 13-14.I.1949 (15 ex.), 17.I.1949 (1 ex.), 19.I.1949 (2 ex.), 21.I.1949 (10 ex.), 24.I.1949 (12 ex.), 25.I.1949 (50 ex.), 28.I.1949 (25 ex.).

Kambi (rivière), affluent de la Grande Kafwe et sous-affluent droit de la Lufwa (vers Masombwe) [alt. 1.750 m] : 25-27.VI.1945 (22 ex.).

Kamatshya (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.750 m] : 6.VII.1945 (2 ex.).

Kamitunu (rivière), affluent gauche de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.760 m] : 10-11.VII.1945 (2 ex.), 13.III.1947 (1 ex.), 14.I.1948 (2 ex.), 21.I.1948 (11 ex.), IX.1948 (5 ex.).

Mukukwe (rivière), affluent de la Muye et sous-affluent droit de la Lufira [alt. 1.760 m] : 17.VII.1945 (21 ex.) .

Karibwe (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.700 m] : 4-6.III.1947 (4 ex.), 2.IV.1947 (1 ex.).

Kasandendeko (rivière), affluent de la Kamitungulu et sous-affluent gauche de la Lusinga [alt. 1.700 m] : 10.III.1947 (2 ex.).

Kenia (rivière), affluent droit de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.585 m] (Ex. P.N.U.) : 28.III.1947 (2 ex.), 10.VII.1947 (7 ex.).

Lusinga (colline de) [alt. 1.810 m] : 12.IV.1947 (1 ex.).

Kalumengongo (rivière), affluent droit du Lualaba [alt. 1.780 m] : 18.IV.1947 (2 ex.), IV.1947 (24 ex.), 17.I.1949 (12 ex.).

Manda (rivière), affluent de la Kalumengongo et sous-affluent droit du Lualaba [alt. 1.750 m] (Ex. P.N.U.) : 20.IV.1947 (1 ex.).

Munte-Mubale (région du confluent), affluent droit de la Lufira [alt. 1.480 m] : 1-8.V.1947 (238 ex.), 1-9.V.1947 (115 ex.), 10-14.V.1947 (106 ex.), 11.V.1947 (2 ex.), 15-19.V.1947 (168 ex.), 1947-1949 (48 ex.).

Pelenge (gorges de la rivière), affluent droit de la Lufira [alt. 1.250 m] : 20.V-7.VI.1947 (8 ex.), 20.V.22.VI.1947 (2 ex.), 21-30.V.1947 (3 ex.), 10-14.VI.1947 (2 ex.), 18-19.VI.1947 (3 ex.).

Kaswabilenga, rive droite de la Lufira (piste Lusinga-Mabwe) [alt. 680 m] : 13-27.XI.1947 (93 ex.), 28-30.X.1947 (1 ex.), 31.X-5.XI.1947 (11 ex.), 8.XII.1948-5.I.1949 (6 ex.), 5-9.I.1949 (16 ex.), 7-9.II.1949 (5 ex.), 21.II.1949 (23 ex.), 7.III.1949 (14 ex.), 16.III.1949 (25 ex.).

Kanonga (rivière), affluent droit de la Fungwe [alt. 695 m] : 13-27.IX.1947 (963 ex.), 13-19.II.1949 (4 ex.), 14-16.II.1949 (4 ex.), 16-18.II.1949 (32 ex.), 19-21.II.1949 (22 ex.).

Kande (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 700 m] : 13-30.IX.1947 (156 ex.), 27.IX.1947 (1 ex.), 3.X.1947 (143 ex.), 4-7.X.1947 (74 ex.), 7-8.X.1947 (33 ex.), 13-14.X.1947 (81 ex.), 16-23.X.1947 (59 ex.), 25.X.1947 (36 ex.).

Lukawe (rivière), affluent droit de la Lufira [alt 700 m] : 27.IX.1947 (10 ex.), 17.X.1947 (19 ex.), 28.X.1947 (41 ex.).

Lupiala (rivière), affluent droit de la Lufira [alt. 700 m] : 9-12.X.1947 (95 ex.), 13-15.X.1947 (43 ex.), 14-22.X.1947 (15 ex.), 20.X.1947 (53 ex.), 24.X.1947 (24 ex.), 30.VI.1949 (1 ex.).

Kalubamba (rivière), affluent gauche de la Lufira [alt. 750 m] : 22.X.1947 (1 ex.), 6.XI.1947 (4 ex.).

Kaswabilenga, rive gauche de la Lufira [alt. 750 m] : 5.XI.1947 (41 ex.).

Kankunda (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 1.300 m] : 11-13.XI.1947 (6 ex.), 14-17.XI.1947 (7 ex.), 18-19.XI.1947 (3 ex.), 20.XI.1947 (4 ex.), 21-22.XI.1947 (7 ex.).

Kateke (rivière), affluent de la Muovwe et sous-affluent droit de la Lufira [alt. 960 m] : 23.XI-5.XII.1947 (157 ex.).

Lusinga, marais près de la tête de source de la rivière Kapero, affluent droit de la Lufwa [alt. 1.640 m] : 9.I.1948 (137 ex.).

Lufwa (rivière), affluent droit de la Lufira, tête de source près de Lusinga [alt. 1.700 m] (Ex. P.N.U.) : 15.I.1948 (3 ex.), 17.III.1948 (25 ex.).

Dipidi (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.700 m] (Ex. P.N.U.) : 19.I.1948 (11 ex.), 20.X.1948 (9 ex.).

Kampadika (rivière), affluent de la Grande Kafwe et sous-affluent droit de la Lufwa [alt. 1.810 m] : 22.I.1948 (17 ex.).

Kaziba (rivière), affluent gauche de la Senze et sous-affluent droit de la Lufira [alt. 1.140 m] : 1-6.II.1948 (215 ex.), 6-7.II.1948 (17 ex.), 9-10.II.1947 (43 ex.), 10-11.II.1948 (26 ex.), 10-16.II.1948 (11 ex.), 12-13.II.1948 (4 ex.), 16-18.II.1948 (19 ex.), 21-22.II.1948 (16 ex.), 23-24.II.1948 (4 ex.), 25-26.II.1948 (2 ex.), 27-28.II.1948 (3 ex.).

Kafwe (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.790 m] : 18.III.1948 (49 ex.).

Buye-Bala (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.750 m] : 28-31.III.1948 (38 ex.), 1-7.IV.1948 (9 ex.), 8-12.IV.1948 (44 ex.), 13.IV.1948 (35 ex.), 18.IV.1948 (87 ex.), 27.IX.1948 (3 ex.).

Muye, tête de source de la rivière affluent droit de la Lufira [alt. 1.630 m] : 6.IV.1948 (10 ex.).

Mubale (rivière), affluent gauche de la Munte et sous-affluent droit de la Lufira [alt. 1.750 m] : 7.IV.1948 (36 ex.).

Bwalo (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.750 m] : 9.IV.1948 (6 ex.).

Mukelengia (rivière), affluent gauche de la Kalumengongo et sous-affluent droit du Lualaba [alt. 1.750 m] : 12.IV.1948 (93 ex.), 15.IV.1948 (61 ex.).

Katongo (rivière), affluent gauche de la Mubale et sous-affluent gauche de la Munte [alt. 1.750 m] : 14-15.IV.1948 (6 ex.).

Kabwe, sur la rive droite de la Muye, affluent droit de la Lufira [alt. 1.320 m] : 28.IV-2.V.1948 (8 ex.), 1-5.V.1948 (2 ex.), 6-7.V.1948 (3 ex.), 8-10.V.1948 (12 ex.), 8-11.V.1948 (2 ex.), 12-15.V.1948 (13 ex.), 16-17.V.1948 (1 ex.), 18-20.V.1948 (4 ex.), 21-25.V.1948 (9 ex.).

Munoi, bifurcation de la rivière Lupiala, affluent droit de la Lufira [alt. 890 m] : 28-31.V.1948 (9 ex.), 1-2.VI.1948 (2 ex.), 1-11.VI.1948 (2 ex.), 3.VI.1948 (6 ex.), 4.VI.1948 (1 ex.), 6.VI.1948 (11 ex.), 7.VI.1948 (2 ex.), 8-11.VI.1948 (8 ex.), 12-16.VI.1948 (49 ex.), 17.VI.1948 (8 ex.), 22-23.VI.1948 (1 ex.), 24.VI.1948 (4 ex.).

Sanga (rivière), affluent du lac Upemba, rive Est [alt. 700 m] : 21.VI.1948 (64 ex.).

Kiamakoto (entre Masombwe et Mukana), sur la rive droite de la Lukima, affluent de la Grande Kafwe [alt. 1.100 m] (Ex. P.N.U.) : 7-9.VII.1948 (157 ex.), 20.IX.1948 (12 ex.), 4-16.X.1948 (286 ex.).

Masombwe, sur la Grande Kafwe [alt. 1.120 m] (Ex. P.N.U.) : 7-9.VII.1948 (34 ex.), 4-16.X.1948 (258 ex.).

Kilwezi (rivière), affluent droit de la Lufira [alt. 800 m] : 26-28V.II.1948 (63 ex.), 27-31.VII.1948 (90 ex.), 1-7.VIII.1948 (27 ex)., 9-14.VIII.1948 (116 ex.), 16-17.VIII.1948 (19 ex.), 24.VIII.1948 (30 ex.), 29-31.VIII.1948 (23 ex.), 30.VIII.1948 (8 ex.), 3.IX.1948 (51 ex.), 6.IX.1948 (93 ex.), 11.IX.1948 (72 ex.).

Senze rivière), affluent droit de la Lufira [alt. 800 m] : 2-4.VIII.1948 (107 ex.), 20.VIII.1948 (41 ex.), 16.IX.1948 (8 ex.).

Kipondo (rivière), affluent droit de la Lufira (près de Kiwelzi), [alt. 800 m] : 7.VIII.1948 (77 ex.), 27.VIII.1948 (65 ex.), 10.IX.1948 (9 ex.), 13.IX.1948 (35 ex.).

Kalungwe (rivière), affluent droit de la Senze et sous-affluent droit de la Lufira [alt. 800 m] : 13.VIII.1948 (201 ex.), 19.VIII.1948 (129 ex.).

Loie (rivière), affluent gauche de la Lufira [alt. 1.000 m] : 17.VIII.1948 (25 ex.), 3.IX.1948 (18 ex.), 6.VI.1949 (3 ex.).

Lufira (rivière), affluent droit du Lualaba [alt. 800 m] : 25.VIII.1948 (75 ex.).

Mokey (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 800 m] : 1.IX.1948 (45 ex.).

Masombwe, dans la rivière Kipepe, affluent de la Tumbwe et sous-affluent gauche de la Grande Kafwe [alt. 1.120 m] : 4-16.IX.1948 (12 ex.).

Muye (rivière) (confluent de la Kabangasi), affluent droit de la Lufira [alt. 800 m] : 6.IX.1948 (2 ex.).

Bunda-Bunda, près de la rivière Lufwa, affluent droit de la Lufira, au Nord de Sampwe [alt. 900 m] (Ex. P.N.U.) : 9.X.1948 (3 ex.).

Kaswabilenga, région du cours inférieur de la Lupiala, affluent droit de la Lufira [alt. 700 m] : 8-20.XII.1948 (1 ex.), 5-9.I.1949 (1 ex.), 24.I.1949 (19 ex.), 31.I.1949 (15 ex.), 28.II.1949 (5 ex.), 7.III.1949 (1 ex.).

Mwema-Mabole, rivière à 10 kilomètres à l'Est de Mabwe [alt. 620 m] : 27.I.1949 (1 ex.).

Kalubamba, chaîne de montagnes entre Mabwe et la Lufira, à 22 kilomètres à l'Est de Mabwe [alt. 987 m] : 27.I.1949 (2 ex.).

Bowa (rivière), affluent droit de la Kalule-Nord et sous-affluent droit du Lualaba, près de Kiamalwa [alt. 1.050 m] : 28.II-1.III.1949 (12 ex.), 2-3.III.1949 (30 ex.), 4.III.1949 (16 ex.).

Kabenga, près de Kaziba [alt. 1.250 m] (Ex. P.N.U.) : 28.III.1949 (11 ex.), 30.III-8.IV.1949 (3 ex.), 31.III.1949 (17 ex.), 1.IV.1949 (1 ex.), 2.IV.1949 (8 ex.), 4.IV.1949 (9 ex.), 5.IV.1949 (11 ex.), 6.IV.1949 (1 ex.), 7.IV.1949 (20 ex.), 8.IV.1949 (19 ex.).

Kimiala (rivière), affluent de la Luizi et sous-affluent gauche de la Lufwa, près de Sampwe (Kundelungu) [alt. 900 m] (Ex. P.N.U.) : 31.III.1949 (8 ex.), 1.IV.1949 (1 ex.).

Munte (rivière), affluent droit de la Lufira [alt. 1.450 m] : 21.IV.1949 (9 ex.).

Ganza, salines près de la rivière Kamandula, affluent droit de la Lukoka et sous-affluent gauche de la Lufira [alt. 860 m] : 30.V-10.VI.1949 (174 ex.), 12-18.VI.1949 (64 ex.), 20-25.VI.1949 (24 ex.), 27.VI-2.VII.1949 (94 ex.), 5.VII.1949 (2 ex.).

Lukorami (rivière), affluent gauche de la Lufira [alt. 900 m] : 13.VI.1949 (6 ex.).

Mware (rivière), affluent gauche de la Lufira [alt. 750 m] : 20-24.VI.1949 (7 ex.), 11.VII.1949 (13 ex.).

Lukoka (rivière), affluent gauche de la Lufira [alt. 750 m] : 14.VII.1949 (13 ex.).

Difirinji (rivière), affluent gauche de la Lufira [alt. 750 m] : 27.VI.1949 (6 ex.).

Kamusanga (rivière), affluent gauche de la Lufira (en face du Mont Sombwe) [alt. 700 m] : 12.VII.1949 (36 ex.).

Phrynobatrachus parvulus. 18.009 exemplaires.

Lusinga (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.810 m] : 22.V.1945 (45 ex.), 28-30.V.1945 (314 ex.), 4.VI.1945 (205 ex.), 14-18.VI.1945 (178 ex.), 18-30.VI.1945 (121 ex.), 10.VII.1945 (4 ex.), II.1947 (2 ex.), 23.III-5.IV.1947 (69 ex.), 23.III-9.IV.1947 (1 ex.).

Lusinga, rivière Lufwa, affluent droit de la Lufira (tête de source) [alt .1.810 m] : 1-2.VI.1945 (66 ex.).

Kafwe (Petite), rivière près de Mukana-Kiamakoto, affluent de la Grande Kafwe et sous-affluent droit de la Lufwa [alt. 1.780 m] : 5.VI.1945 (3 ex.).

Lusinga, rivière Karungwe, affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. ± 1.700 m] : 6.VI.1945 (27 ex.).

Lusinga, près de la rivière Sange [alt. ± 1.760 m] : 7.VI.1945 (6 ex.).

Kagomwe (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.700 m] : 8.VI.1945 (18 ex.), 12.VII.1945 (66 ex.).

Lusinga, rivière Kamalonge, sous-affluent droit de la Lufwa [alt. ± 1.700 m] : 11.VI.1945 (1 ex.), 22.VI.1945 (17 ex.).

Lusinga, rivière Dipidi, affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.650 m] (Ex. P.N.U.) : 12.VI.1945 (67 ex.).

Mukana, marais près de Lusinga [alt. 1.810 m] : 21.VI.1945 (3 ex.), 12.III.1947 (2 ex.), 5.VII.1947 (32 ex.).

Kambi (rivière), affluent de la Grande Kafwe et sous-affluent droit de la Lufwa [alt. 1.750 m] : 25-27.VI.1945 (146 ex.).

Munte (tête de source de la rivière), affluent droit de la Lufira [alt. 1.750 m] : 28.VI.1945 (2 ex.).

Lupiala (rivière), affluent droit de la Lufira [alt. 700 m] : 30.VI.1945 (19 ex.), 5.X.1947 (4 ex.), 13-15.X.1947 (8 ex.), 20.X.1947 (4 ex.), 31.X.1947 (3 ex.).

Buye-Bala (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.750 m] : 30.VI.1945 (7 ex.), 28-31.III.1948 (133 ex.), 8-12.IV.1948 (104 ex.), 13.IV.1948 (66 ex.), 18.IV.1948 (69 ex.).

Kamatshya (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.750 m] : 6.VII.1945 (90 ex.).

Mitoto (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. ± 1.760 m] : 9.VII.1945 (135 ex.).

Kavizi (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. ± 1.700 m] : 14.VII.1945 (80 ex.).

Kampungu (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.750 m] : 16.VII.1945 (6 ex.).

Kilolomatembo (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.750 m] : 17.VII.1945 (233 ex.).

Mukukwe (rivière), affluent de la Muye et sous-affluent droit de la Lufira [alt. 1.760 m] : 17.VII.1945 (1 ex.).

Kamipongo (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. ± 1.760 m] : 18.VII.1945 (64 ex.).

Kipangaribwe (rivière), affluent droit de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.600 m] : 24.VII.1945 (15 ex.).

Karibwe (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.700 m] : 4-6.III.1947 (12 ex.).

Kamitungulu (rivière), affluent gauche de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.760 m] : 7.III.1947 (79 ex.), 13.III.1947 (10 ex.), 18.IV.1947 (138 ex.), 14.I.1948 (4 ex.), 21.I.1948 (170 ex.).

Kasandendeko (rivière), affluent de la Kamitungulu et sous-affluent gauche de la Lusinga [alt. ± 1.700 m] : 10.III.1947 (71 ex.).

Kamamulongo (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.700 m] : 11.III.1947 (22 ex.).

Kenia (rivière), affluent droit de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.585 m] (Ex. P.N.U.) : 11.III.1947 (48 ex.), 28.III.1947 (7 ex.), 10.VII.1947 (199 ex.), 12.III.1948 (65 ex.), 20.X.1948 (50 ex.).

Kayongo (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.700 m] : 18.III.1947 (2 ex.).

Kabwekanono, mare près tête de source de la Lufwa, affluent droit de la Lufira, sur rive gauche de la Lusinga [alt. 1.815 m] : 18.III.1947 (7 ex.), 4.VII.1947 (11 ex.), 14.I.1948 (4 xe.).

Munte-Mubale (région du confluent), affluent droit de la Lufira [alt. 1.480 m] : 1-8.V.1947 (17 ex.), 1-9.V.1947 (6 ex.), 10-14.V.1947 (9 ex.), 15-19.V.1947 (4 ex.).

Pelenge (gorges de la rivière), affluent droit de la Lufira [alt. 1.250 m] : 20.V-7.VI.1947 (1.213 ex.), 20.V-22.VI.1947 (3 ex.), 8-9.VI.1947 (426 ex.), 10-14.VI.1947 (278 ex.), 15.VI.1947 (856 ex.), 16.VI.1947 (1.038 ex.), 17-18.VI.1947 (128 ex.).

Kande (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 730 m] : 13-27.IX.1947 (2 ex.), 13-30.IX.1947 (2 ex.), 3.X.1947 (11 ex.), 4-7.X.1947 (3 ex.), 13-14.X.1947 (6 ex.), 16-23.X.1947 (4 ex.), 25.X.1947 (2 ex.).

Kanonga (rivière), affluent droit de la Fungwe [alt. 695 m] : 13-27.IX.1947 (442 ex.), 11-14.II.1949 (46 ex.), 14-16.II.1949 (198 ex.), 19-21.II.1949 (74 ex.), 22-23.II.1949 (179 ex.).

Kaswabilenga, rive droite de la Lufira (piste Lusinga-Mabwe) [alt. 680 m] : 13-27.IX.1947 (13 ex.), 31.X-5.XI.1947 (38 ex.), 5-9.I.1948 (67 ex.), 7.III.1948 (25 ex.), 16.III.1948 (25 ex.).

Kankunda (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 1.300 m] : 14-17.XI.1947 (1 ex.).

Kateke (rivière), affluent de la Muovwe et sous-affluent droit de la Lufira [alt. 960 m] : 23.XI-5.XII.1947 (9 ex.).

Tumbwe (rivière), affluent de la Grande Kafwe et sous-affluent droit de la Lufwa [alt. 1.120 m] : 10.I.1948 (8 ex.).

Lufwa (rivière), affluent droit de la Lufira, tête de source près de Lusinga [alt. 1.700 m] (Ex. P.N.U.) : 16.I.1948 (1 ex.).

Mubale (rivière), affluent gauche de la Munte et sous-affluent droit de la Lufira [alt. 1.780 m] : 16.I.1948 (9 ex.), 7.IV.1948 (12 ex.).

Dipidi (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.700 m] (Ex. P.N.U.) : 19.I.1948 (76 ex.), 20.X.1948 (64 ex.).

Kampadika (rivière), affluent de la Grande Kafwe et sous-affluent droit de la Lufwa [alt. 1.810 m] : 22.I.1948 (94 ex.).

Kaziba (rivière), affluent gauche de la Senze et sous-affluent droit de la Lufira [alt. 1.140 m] : 1-6.II.1948 (2.505 ex.), 6-7.II.1948 (740 ex.), 9-10.II.1948 (505 ex.), 10-11.II.1948 (55 ex.), 10-16.II.1948 (94 ex.), 121-3.II.1948 (175 ex.), 15.II.1948 (3 ex.), 16-18.II.1948 (298 ex.), 21-22.II.1948 (230 ex.), 23-24.II.1948 (297 ex..), 25-26.II.1948 (46 ex.), 27-28.II.1948 (100 ex.).

Kafwe (rivière Grande), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.790 m] : 18.III.1948 (10 ex.).

Mukelengia (rivière), affluent gauche de la Kalumengongo et sous-affluent droit du Lualaba [alt. 1.750 m] : 12.IV.1948 (11 ex.), 15.IV.1948 (7 ex.).

Katongo (rivière), affluent gauche de la Mubale et sous-affluent gauche de la Munte [alt. 1.750 m] : 14-15.IV.1948 (2 ex.).

Kabwe, sur la rive droite de la Muye, affluent droit de la Lufira [alt. 1.320 m] : 1-5.V.1948 (109 ex.), 6-7.V.1948 (42 ex.), 8-11.V.1948 (17 ex.), 12-15.V.1948 (24 ex.), 16-17.V.1948 (7 ex.), 21-25.V.1948 (10 ex.).

Munoi, bifurcation de la rivière Lupiala, affluent droit de la Lufira [alt. 890 m] : 28-31.V.1948 (36 ex.), 1-2.VI.1948 (3 ex.), 11-15.VI.1948 (3 ex.), 12-16.VI.1948 (122 ex.), 22-23.VI.1948 (3 ex.).

Sanga (rivière), affluent du lac Upemba (rive Est) [alt. 700 m] : 21.VI.1948 (36 ex.).

Kiamakoto (entre Masombwe et Mukana), sur la rive droite de la Lukima, affluent droit de la Grande Kafwe [alt. 1.100 m] (Ex. P.N.U.) : 7-9.VII.1948 (7 ex.), 4-16.X.1948 (11 ex.).

Kilwezi (rivière), affluent droit de la Lufira [alt. 800 m] : 26-28.VII.1948 (12 ex.), 29-31.VII.1948 (44 ex.), 9-14.VIII.1948 (52 ex.), 16-17.VIII.1948 (2 ex.). 24.VIII.1948 (2 ex.), 6.IX.1948 (18 ex.), 11 IX.1948 (36 ex.).

Senze (rivière), affluent droit de la Lufira [alt. 800 m] : 2-4.VIII.1948 (190 ex.), 20.VIII.1948 (20 ex.), 16.IX.194 8(4 ex.).

Kipondo (rivière), affluent droit de la Lufira (près de Kilwezi) [alt. 800 m] : 7.VIII.1948 (35 ex.), 27.VIII.1948 (5 ex.).

Kalungwe (rivière), affluent droit de la Senze et sous-affluent droit de la Lufira [alt. 800 m] : 13.VIII.1948 (9 ex.), 19.VIII.1948 (55 ex.).

Lufira (rivière), affluent droit du Lualaba [alt. 800 m] : 25.VIII.1948 (1 ex.).

Kalala (rivière), affluent gauche de la Mokey et sous-affluent gauche de la Muye [alt. 800 m] : 1.IX.1948 (9 ex.).

Masombwe, sur la Grande Kafwe, affluent droit de la Lufwa [alt. 1.120 m] (Ex. P.N.U.) : 4-16.X.1948 (62 ex.), 7-9.VII.1949 (1.177 ex.).

Masombwe, dans rivière Kipepe, affluent de la Tumbwe et sous-affluent gauche de la Grande Kafwe [alt. 1.120 m] : 4-16.X.1948 (150 ex.).

Bunda-Bunda, près rivière Lufwa, affluent droit de la Lufira, au Nord de Sampwe [alt. 900 m] (Ex. P.N.U.) : 9.X.1948 (2 ex.).

Kakolwe (rivière), affluent de la Kenia et sous-affluent droit de la Lusinga [alt. 1.660 m] (Ex. P.N.U.) : 21.X.1948 (1 ex.).

Kaswabilenga, région du cours inférieur de la Lupiala, affluent droit de la Lufira [alt. 700 m] : 5-9.I.1949 (57 ex.), 24.I.1949 (10 ex.), 28.II.1949 (2 ex.), 16.III.1949 (2 ex.).

Kabenga, près de Kaziba [alt. 1.250 m] (Ex. P.N.U.) : 27.III.1949 (135 ex.), 28.III.1949 (5 ex.), 31.III.1949 (172 ex.), 1.IV.1949 (3 ex.), 2.IV.1949 (166 ex.), 4.IV.1949 (6 ex.), 5.IV.1949 (8 ex.), 6.IV.1949 (69 ex.), 7.IV.1949 (100 ex.), 8.IV.1949 (209 ex.).

Kimiala (rivière), affluent de la Luizi et sous-affluent de la Lufwa, près de Sampwe (Kundelungu) [alt. 900 m] (Ex. P.N.U.) : 30.III.1949 (1 ex.), 31.III.1949 (26 ex.).

Ganza, salines près de la rivière Kamandula, affluent droit de la Lukoka et sous-affluent gauche de la Lufira [alt. 860 m] : 30.V-10.VI.1949 (220 ex.), 12-18.VI 1949 (8 ex.), 20-25.VI.1949 (56 ex.), 27.VI-2.VII.1949 (200 ex.), 5.VII.1949 (475 ex.).

Phrynobatrachus perpalmatus. 2.617 exemplaires.

Mabwe, rive Est du lac Upemba [alt. 585 m] : 28.VII-12.VIII.1947 (7 ex.), 6-17.XI.1948 (53 ex.), 18-21.XI.1948 (64 ex.), 26.XI.1948 (5 ex.), 27 XI.1948 (7 ex.), 1-2 XII.1948 (3 ex.), 3-6.XII.1948 (1 ex.), 5-8.XII.1948 (3 ex.), 5-10.XII.1948 (9 ex.), 13-16.XII.1948 (147 ex.), 17-18.XII.1948 (2 ex.), 20.XII.1948 (8 ex.), 21.XII 1948 (2 ex.), 22.XII.1948 (13 ex.), 24.XII.1948 (42 ex.), 28.XII.1948 (48 ex.), 29.XII 1948 (77 ex.), 1-6.I.1949 (73 ex.), 3.I.1949 (275 ex.), 4-8.I.1949 (46 ex.), 5.I 1949 (17 ex.), 6.I.1949 (53 ex.), 8.I.1949 (138 ex.), 12.I.1949 (155 ex.), 13-14.I.1949 (324 ex.), 17.I.1949 (80 ex.), 19.I.1949 (57 ex.), 24.I.1949 (101 ex.), 25.I.1949 (100 ex.), 28.I.1949 (92 ex.), 1.II.1949 (1 ex.), 2.II.1949 (1 ex.), 4-7.II.1949 (2 ex.), 8-12.II.1949 (7 ex.), 12-17.II.1949 (5 ex.), 17-22.II.1949 (1 ex.), 6.III.1949 (1 ex.).

Kanonga (rivière), affluent droit de la Fungwe [alt 695 m] : 13-27.IX.1947 (570 ex.), 14-16 II.1949 (6 ex.), 16-18 II.1949 (18 ex.), 18-19.II.1949 (2 ex.), 26-28.II.1949 (1 ex.).

Hemisus marmoratus. 301 exemplaires.

Kabwekanono, mare près tête de source de la Lufwa, affluent droit de la Lufira, sur la rive gauche de la Lusinga [alt. 1.815 m] : 31.V.1945 (2 ex.).

Munte-Mubale (région du confluent), affluent droit de la Lufira [alt. 1.480 m] : 1-8.V.1947 (1 ex.), 1-9.V.1947 (8 ex.), 2.V.1947 (1 ex.).

Kaswabilenga, rive droite de la Lufira (piste Lusinga-Mabwe) [alt. 680 m] : 13-27.IX.1947 (3 ex.), 22.X.1947 (1 ex.), 8-20 XII.1948 (6 ex.), 8.XII.1948-3.I.1949 (8 ex.), 5-9.I.1949 (7 ex.), 24.I.1949 (6 ex.), 28.II.1949 (8 ex.), 7.III.1949 (4 ex.), 16.III.1949 (11 ex.).

Lukawe (rivière), affluent droit de la Lufira [alt. 700 m] : 27.IX.1947 (2 ex.).

Lupiala (rivière), affluent droit de la Lufira [alt. 700 m] : 24.X.1947 (1 ex.).

Kaswabilenga, rive gauche de la Lufira [alt. 750 m] : 5.XI.1947 (3 ex.).

Kateke (rivière), affluent de la Muovwe et sous-affluent droit de la Lufira [alt. 960 m] : 23.XI-5.XII.1947 (4 ex.).

Lusinga, marais près de la tête de source de la Kapero, affluent droit de la Lufwa (près de Lusinga) [alt. 1 640 m] : 9.I.1948 (14 ex.).

Lufwi (tête de source), affluent droit de la Grande Kafwe [alt. 1.760 m] : 18.IV.1948 (1 ex.).

Katongo (rivière), affluent gauche de la Mubale et sous-affluent gauche de la Munte [alt. 1.750 m] : 18.IV.1948 (1 ex.).

Kabwe, sur la rive droite de la Muye, affluent droit de la Lufira [alt. 1.320 m] : 6-7.V.1948 (4 ex), 21-25.V.1948 (1 ex.).

Munoi, bifurcation de la rivière Lupiala, affluent droit de la Lufira [alt. 890 m] : 8-11.VI.1948 (1 ex.), 12-16.VI.1948 (1 ex.), 24.VI.1948 (1 ex.).

Masombwe, sur la Grande Kafwe, affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.120 m] : 7-9.VII.1948 (13 ex), 4-16.X.1948 (55 ex.).

Kilwezi (rivière), affluent droit de la Lufira [alt. 800 m] : 3 IX.1948 (1 ex.), 7.IX.1948 (1 ex.), 10.IX.1948 (2 ex.).

Kipondo (rivière), affluent droit de la Lufira (près de Kilwezi) [alt. 800 m] : 11.IX.1948 (1 ex.).

Mabwe, rive Est du lac Upemba [alt. 585 m] : 18-21.XI.1948 (1 ex.), 20.XI.1948 (1 ex.), 22-27.XI.1948 (1 ex.), 26.XI.1948 (2 ex.), 27.XI.1948 (1 ex.), 28.XI.1948 (25 ex.), XI.1948-I.1949 (10 ex.), 1-2.XII.1948 (3 ex.), 3.XII.1948 (1 ex.), 3-6.XII.1948 (4 ex.), 5-8.XII.1948 (4 ex.), 6.XII.1948 (2 ex.), 13-16.XII.1948 (12 ex.), 17-18.XII.1948 (3 ex.), 18.XII.1948 (5 ex.), 23.XII.1948 (7 ex.), 24.XII.1948 (2 ex.), 29.XII.1948 (1 ex.), 30.XII.1948 (3 ex.), 3.I 1949 (3 ex.), 5.I.1949 (2 ex.), 8.I.1949 (1 ex.), 12.I.1949 (1 ex.), 12-18.I.1949 (7 ex.), 18.I.1949 (1 ex.), 24.I.1949 (5 ex.), 25.I.1949 (1 ex.), 28.I.1949 (2 ex.), 29.I.1949 (1 ex), 1.II.1949 (2 ex.).

Kaswabilenga, sur le cours inférieur de la Lupiala, affluent droit de la Lufira [alt. 700 m] : 31.I.1949 (2 ex.).

Bowa (rivière), affluent droit de la Kalule-Nord et sous-affluent droit du Lualaba, près de Kiamalwa [alt. 1.810 m] : 28.II-1.III.1949 (2 ex.).

Kabenga, près de la rivière Kaziba, affluent gauche de la Senze et sous-affluent droit de la Lufira [alt. 1.250 m] (Ex. P.N.U.) : 2.IV.1949 (1 ex.), 5.IV.1949 (8 ex.).

Leptopelis bocagei lebeaui. 291 exemplaires.

Lusinga (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.810 m] : 1946 (2 ex.).

Munte-Mubale (région du confluent), affluent droit de la Lufira [alt. 1.480 m] : 2.V.1947 (1 ex.).

Pelenge (gorges de la rivière), affluent droit de la Lufira [alt. 1.250 m] : 20.VI.1947 (1 têtard).

Mabwe, rive Est du lac Upemba [alt. 585 m] : 28.VII-12.VIII.1947 (1 ex.), 15.XI.1948 (1 ex.), 18-21.XI.1948 (1 ex.), 26-30.XI.1948 (2 ex.), 26.XI.1948 (1 ex), 3-6.XII.1948 (3 ex.), 13-16.XII.1948 (1 ex.), 17.XII.1948 (1 ex.), 17-18.XII.1948 (2 ex), 23.XII.1948 (5 ex.), 24.XII.1948 (2 ex.), 30.XII.1948 (1 ex.), 12.I.1949 (5 ex.), 12-28.I.1949 (1 ex.), 25.I.1949 (3 ex.), 1.II.1949 (1 ex.), 8-12.II.1949 (1 ex.), 12-17.II.1949 (1 ex.), 6.III.1949 (5 ex.).

Kanonga (rivière), affluent droit de la Fungwe [alt. 695 m] : 13-27.IX.1947 (5 ex.), 11-14.II.1949 (4 ex.), 14-16.II.1949 (1 ex.), 18.II.1949 (1 ex.), 26-28.II.1949 (1 ex.).

Kaswabilenga, région du cours inférieur de la Lupiala, affluent droit de la Lufira [alt. 700 m] : 13-27.IX.1947 (3 ex.), 7.II.1948 (4 ex.), 8-20.XII.1948 (6 ex.), 8.XII.1948-3 I.1949 (1 ex.), 5-9.I.1949 (7 ex.), 24.I.1949 (1 ex.), 31.I.1949 (1 ex.), 28.II.1949 (3 ex.), 7.III.1949 (1 ex.), 16.III.1949 (3 ex.).

Kaswabilenga, rive droite de la Lufira (piste Lusinga-Mabwe) [alt. 680 m] : 7.X.1947 (1 ex.), 8.XII1948-3.I.1949 (5 ex.).

Kande (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 730 m] : 7-8.X.1947 (1 ex.), 10-18.X.1947 (1 ex.), 25.X.1947 (1 ex.).

Lupiala (rivière), affluent droit de la Lufira [alt. 700 m] : 9-12.X.1947 (2 ex.).

Kaswabilenga, rive gauche de la Lufira [alt. 750 m] : 5.XI.1947 (2 ex. + 8 têtards).

Kateke (rivière), affluent de la Muovwe et sous-affluent droit de la Lufira [alt. 960 m] : 23.XI-5.XII.1947 (2 ex. + 2 têtards).

Kaziba (rivière), affluent gauche de la Senze et sous-affluent droit de la Lufira [alt. 1.140 m] : 1-6.II.1948 (58 ex. + 1 têtard), 6-7.II.1948 (10 ex.), 7.II.1948 (1 ex.), 9-10.II.1948 (17 ex.), 10-11.II.1948 (1 ex.), 10-16.II 1948 (1 ex.), 12-13.II.1948 (1 ex.), 16-18.II.1948 (5 ex.), 21-22.II.1948 (4 ex.), 23-24.II.1948 (17 ex.), 25-26.II.1948 (8 ex.), 27-28.II.1948 (4 ex.).

Lufwa (rivière), affluent droit de la Lufira, tête de source près de Lusinga [alt. 1.700 m] : 17.III.1948 (46 ex.).

Kafwe (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.790 m] : 18.III.1948 (1 ex.).

Mubale (tête de source de la rivière), affluent gauche de la Munte et sous-affluent droit de la Lufira [alt. 1.750 m] : 7.IV.1948 (1 ex.).

Kabwe, sur la rive droite de la Muye, affluent droit de la Lufira [alt. 1.320 m] : 6-7.V.1948 (1 ex.), 8-11.V.1948 (1 ex.).

Munoi, bifurcation de la rivière Lupiala, affluent droit de la Lufira [alt. 890 m] : 7.VI.1948 (1 ex.).

Masombwe, dans rivière Lukolwe, affluent droit de la Grande Kafwe et sous-affluent droit de la Lufwa [alt. 1.120 m] (Ex. P.N.U.) : 4-16.X.1948 (1 ex.).

Lusinga (colline de) [alt. 1.810 m] : 31.X-31.XII.1948 (1 ex.), 20.III.1949 (1 ex.).

Leptopelis parvus. 19 exemplaires

Kande (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 730 m] : 4-7.X.1947 (1 ex. Type).

Kaswabilenga, région du cours inférieur de la Lupiala, affluent droit de la Lufira [alt. 700 m] : 22.X.1947 (1 ex.).

Kaluwamba (rivière), affluent gauche de la Lufira [alt. 700-800 m] : 6.XI.1947 (1 ex.).

Kankunda (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 1.300 m] : 11-13.XI.1947 (1 ex.), 14-17.XI.1947 (2 ex.), 18-19.XI.1947 (1 ex.), 20.XI.1947 (2 ex.), 21-22.XI.1947 (2 ex.), 24-26 XI.1947 (1 ex.).

Kateke (rivière), affluent de la Muovwe et sous-affluent droit de la Lufira [alt. 960 m].: 23.XI-5.XII.1947 (7 ex.).

Kassina senegalensis. 394 exemplaires

Lusinga, près du marais Mukana [alt. 1.810 m] : 28-30.V.1945 (9 ex.).

Kabwekanono, mare près de la tête de source de la Lufwa, affluent droit de la Lufira, sur la rive gauche de la Lusinga [alt. 1.815 m] : 31.V.1945 (1 ex.), 18.III.1947 (15 ex.), 14.III.1948 (2 ex.).

Lusinga (rivière), affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.810 m] : 4.VI.1945 (2 têtards), 18-30.VI.1945 (1 ex.), 1946 (5 ex.), 23.III-9.IV.1947 (2 ex.), 9-17.IV.1947 (2 ex.), XI-XII.1947 (2 ex.), I.1948 (1 ex.), II-III.1948 (4 ex.), 25.X.1948 (1 ex.), 31.X-31.XII.1948 (2 ex.), 20.III.1949 (1 ex.), 23.IV.1949 (11 ex.).

Mukana, marais près de Lusinga [alt. 1.180 m] : 21.VI.1945 (2 ex.), 12.III.1947 (12 ex.), 29.III.1947 (1 ex.), 5.VII.1947 (1 ex.), 3-4.I.1949 (3 ex.).

Karibwe (rivière), affluent de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.700 m] : 4-6.III.1947 (2 ex.).

N'Gongozi, près de Mukana [alt. 1.810 m] : 15.III.1947 (2 ex.).

Luangalele, près de Mukana (Lusinga) [alt. 1.850 m] : 19.III.1947 (12 ex.).

Manda (rivière), affluent de la Kalumengongo et sous-affluent droit du Lualaba [alt. 1.750 m] (Ex. P.N.U.) : 20.IV.1947 (1 ex.).

Munte-Mubale (région du confluent), affluent droit de la Lufira [alt. 1.480 m] : 1-9.V.1947 (8 ex.), 10-14.V.1947 (22 ex.), 11.V.1947 (1 ex.), 15-19.V.1947 (11 ex.).

Kanonga (rivière), affluent droit de la Fungwe [alt. 695 m] : 13-27.IX.1947 (1 ex.).

Kankunda (rivière), affluent gauche de la Lupiala et sous-affluent droit de la Lufira [alt. 1.300 m] : 21-22.XI.1947 (1 ex.).

Kateke (rivière), affluent de la Muovwe et sous-affluent droit de la Lufira [alt. 960 m] : 23.XI-5.XII.1947 (2 ex.).

Lusinga, marais près tête de source de la Kapero, affluent droit de la Lufwa (près Lusinga) [alt. 1.640 m] : 9.I.1948 (100 ex.).

Mubale (rivière), affluent gauche de la Munte et sous-affluent droit de la Lufira [alt. 1.780 m] : 16.I.1948 (2 ex.), 7.IV.1948 (4 ex.).

Kaziba (rivière), affluent gauche de la Senze et sous-affluent droit de la Lufira [alt. 1.140 m] : 1-6.II.1948 (3 ex.).

Lufwa (rivière), affluent droit de la Lufira, tête de source près de Lusinga [alt. 1.700 m] (Ex. P.N.U.) : 17.III 1948 (1 ex.).

Buye-Bala (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.750 m] : 28-31.III.1948 (17 ex.), 8-12.IV.1948 (19 ex.), 13.IV.1948 (3 ex.), 18.IV.1948 (2 ex.), 21-22.IV.1948 (1 ex.), 24.IV.1948 (1 ex.).

Bwalo (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.750 m] : 9.IV.1948 (64 ex).

Katongo (rivière), affluent gauche de la Mubale et sous-affluent gauche de la Munte [alt. 1.750 m] : 10.IV.1948 (3 ex.), 14-15.IV.1948 (2 ex.), 18.IV.1948 (1 ex.).

Kabwe, sur la rive droite de la Muye, affluent droit de la Lufira [alt. 1.320 m] : 1-5.V.1948 (4 ex.), 8-11.V.1948 (9 ex.).

Munoi, bifurcation de la rivière Lupiala, affluent droit de la Lufira [alt. 890 m] : 28-31.V.1948 (1 ex.).

Masombwe, sur la Grande Kafwe, affluent droit de la Lufwa et sous-affluent droit de la Lufira [alt. 1.120 m] : 19.X.1948 (3 ex.).

Kenia (rivière), affluent droit de la Lusinga et sous-affluent droit de la Lufwa [alt. 1.585 m] (Ex. P.N.U.) : 20.X.1948 (1 ex.).

Mabwe, rive Est du lac Upemba [alt. 585 m] : 1-2.XII.1948 (1 ex.), 24.XII.1948 (3 ex.).

Kalumengongo (rivière), affluent droit du Lualaba [alt. 1.830 m] : 17.I.1949 (2 ex.), II.1949 (1 ex.), 16.IV.1949 (1 têtard).

N'Gozie, mare à gauche de la route Lusinga-Mitwaba [alt. 1.600 m] (Ex. P.N.U.): II.1949 (1 ex.).

Pelenge (gorges de la rivière), affluent droit de la Lufira [alt. 1.250 m] : 10-19.III.1949 (1 ex.).

Kassina wittei. 7 exemplaires.

Lufwa (rivière), affluent droit de la Lufira, tête de source près de Lusinga [alt. 1.700 m] (Ex. P.N.U.) : 15.I.1948 (1 ex.).

Bwalo (rivière), affluent gauche de la Muye et sous-affluent droit de la Lufira [alt. 1.750 m] : 9.IV.1948 (1 ex.).

Mukelengia (rivière), affluent gauche de la Kalumengongo et sous-affluent droit du Lualaba [alt. 1.750 m] : 12.IV.1948 (2 ex.), 13.IV.1948 (1 ex.), 15.IV.1948 (2 ex.).

Kassina sp.

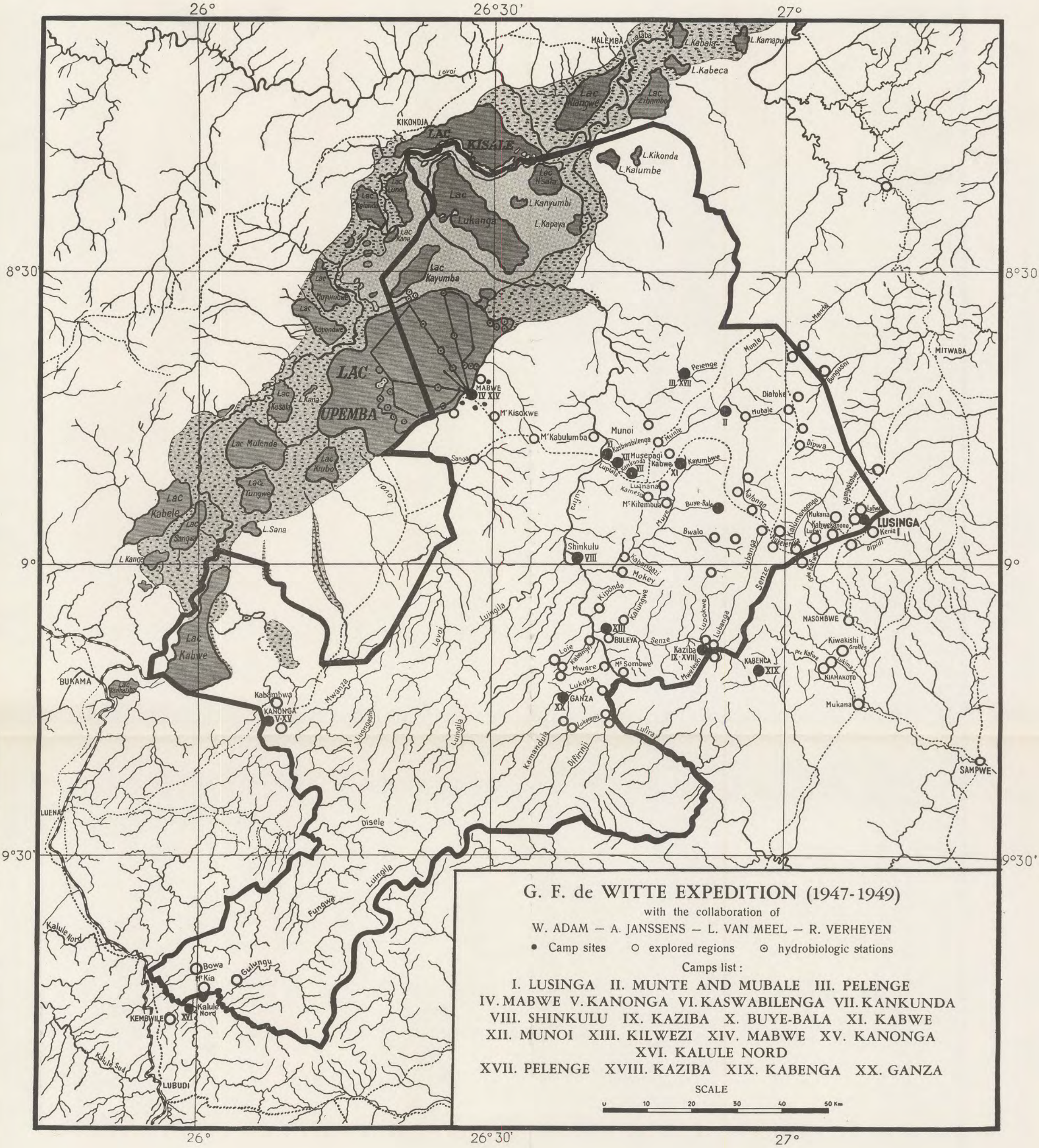
Mukana, marais près Lusinga [alt. 1.810 m] : 3-4.I.1949 (1 têtard).

Phrynomerus bifasciatus. 117 exemplaires.

Mabwe rive Est du lac Upemba [alt. 585 m] : 20.XI.1948 (1 ex.), 26.XI.1948 (1 ex.), 28.XI.1948 (2 ex.), 13-16.XII.1948 (13 ex.), 17.XII.1948 (2 ex.), 23.XII.1948 (11 ex.), 24.XII.1948 (32 ex.), 30.XII.1948 (12 ex.), 12.I.1949 (19 ex.), 12-28.I.1949 (11 ex.), 1.II.1949 (4 ex.), 4-7.II.1949 (5 ex.), 8-12.II.1949 (2 ex.), 6.III.1949 (2 ex.).

APPENDIX D.

INDEX ARRANGED ALPHABETICALLY.



G. F. de WITTE EXPEDITION (1947-1949)

with the collaboration of

W. ADAM — A. JANSSENS — L. VAN MEEL — R. VERHEYEN

• Camp sites ○ explored regions ⊙ hydrobiologic stations

Camps list :

I. LUSINGA II. MUNTE AND MUBALE III. PELENGE
IV. MABWE V. KANONGA VI. KASWABILENGA VII. KANKUNDA
VIII. SHINKULU IX. KAZIBA X. BUYE-BALA XI. KABWE
XII. MUNOI XIII. KILWEZI XIV. MABWE XV. KANONGA
XVI. KALULE NORD
XVII. PELENGE XVIII. KAZIBA XIX. KABENGA XX. GANZA

SCALE

0 10 20 30 40 50 Km