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.

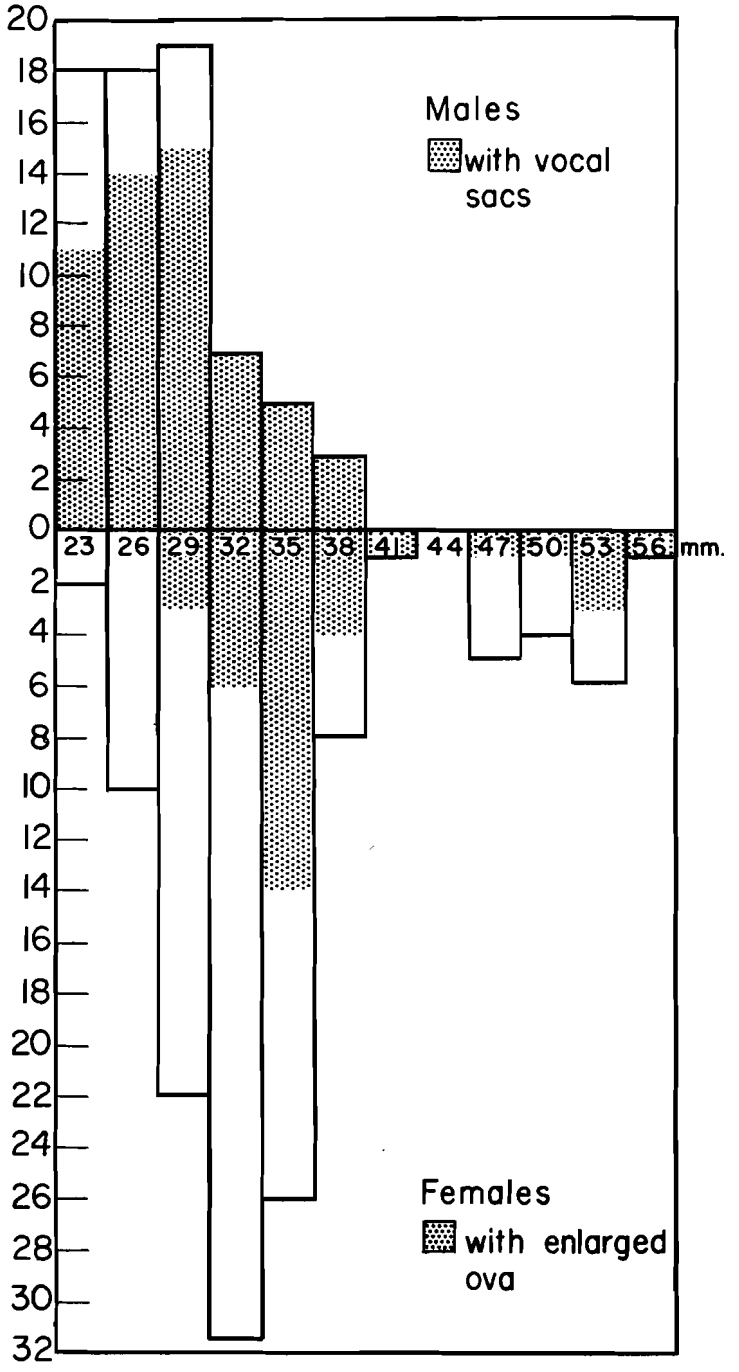

FIG. 65. — Size frequency distribution of *Hemisus marmoratus* from Parc National de l'Upemba.

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

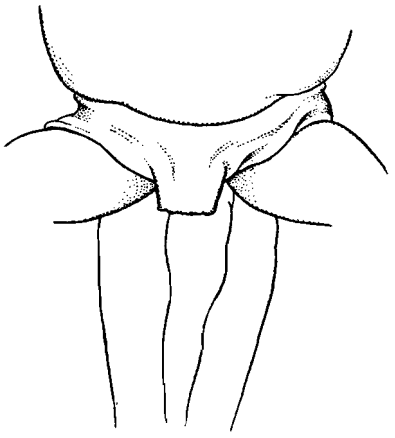

FIG. 66. — Ventral view of anal region of larval *Hemisus marmoratus* from Parc National de l'Upemba.

(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

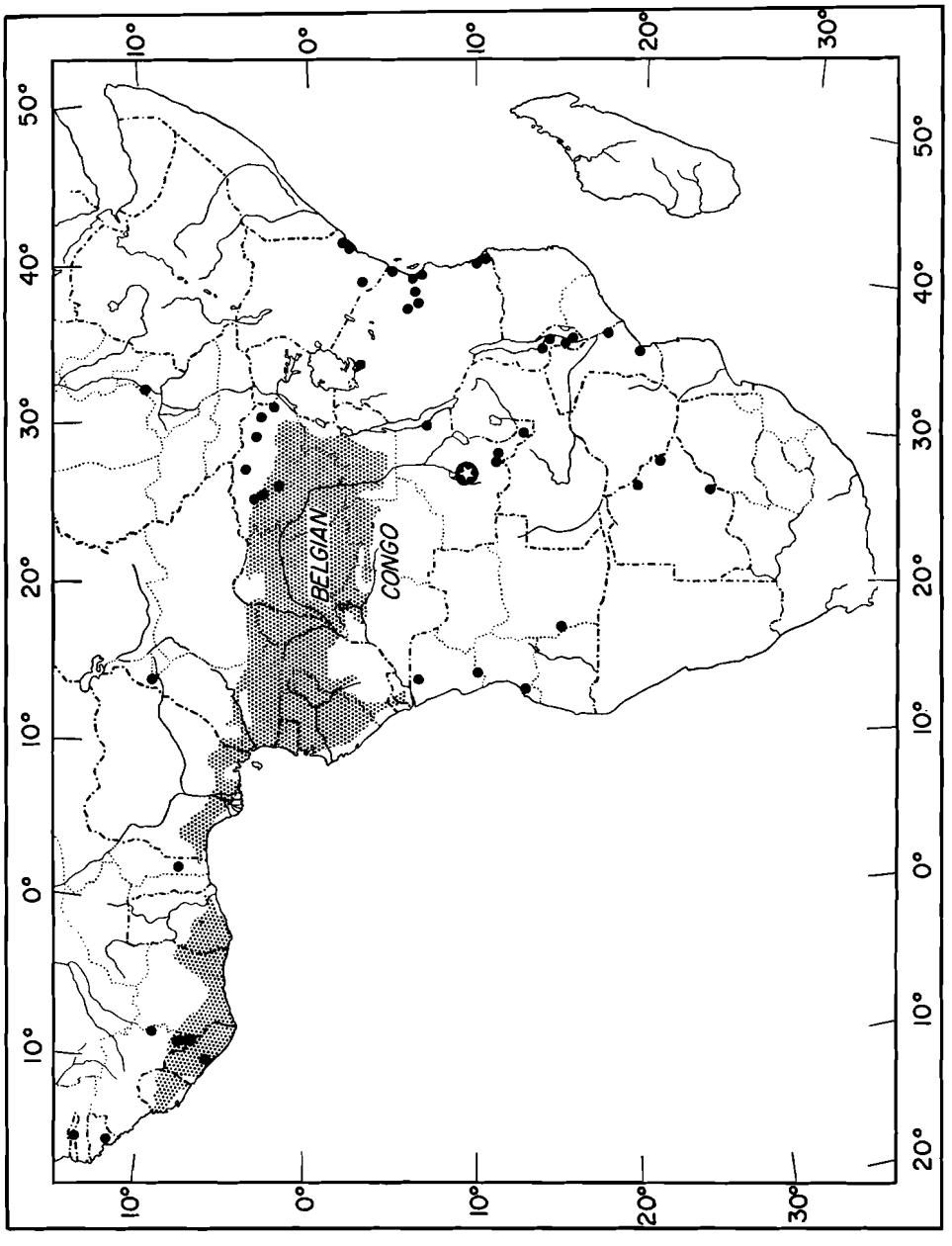

FIG. 67. — Distribution of *Hemisus marmoratus*.
Parc National de l'Upemba indicated by symbol with open star.

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.

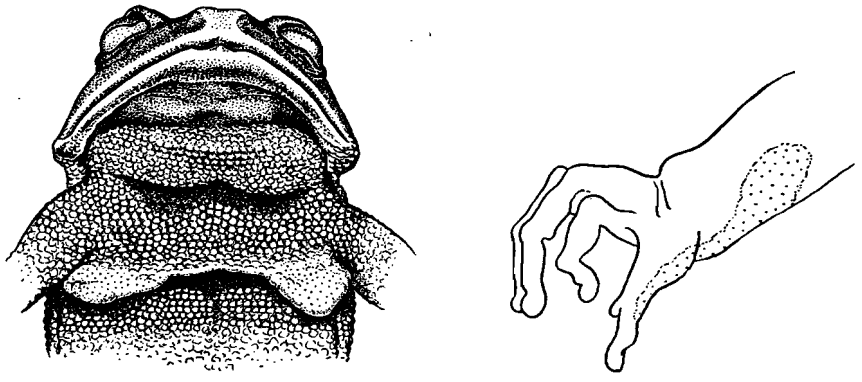

FIG. 68. — Male *Leptopelis bocagei lebeaui* from Parc National de l'Upemba.
Left, ventral view showing pectoral glands (×2).
Right, hand and lower arm showing nuptial pad (×3).

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

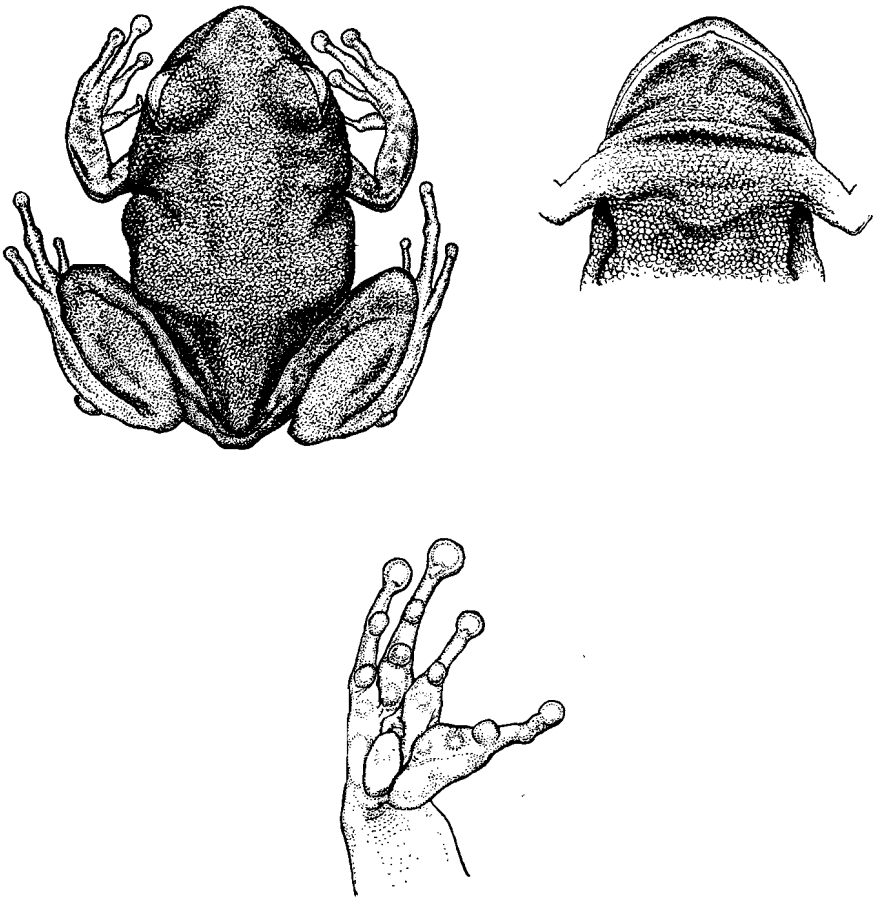

FIG. 69. — Male paratype of *Leptopelis parvus* new species.
Left, dorsal view (×2). Right, ventral view (×2). Below, underside of hand (×4).

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*.

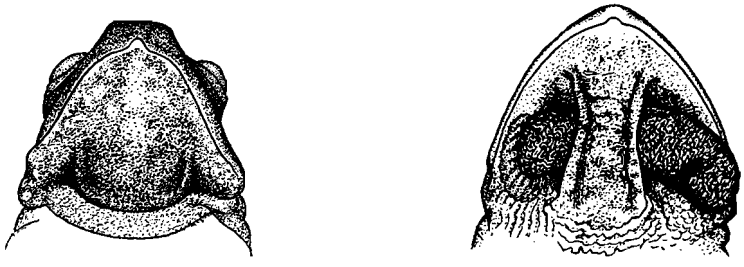

FIG. 70. — Ventral views of male *Kassina wittei*, left (×5), and *K. senegalensis*, right (×3).

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).

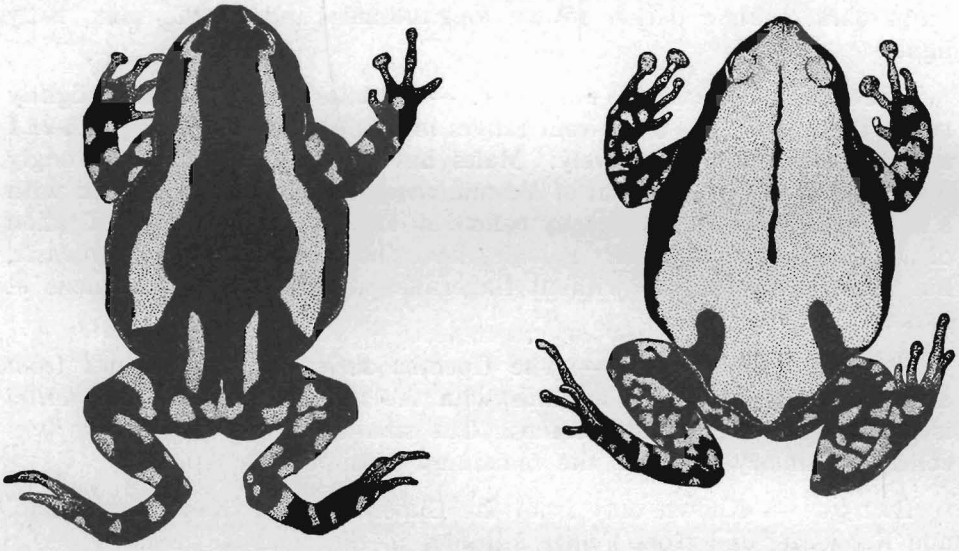

FIG. 71. — Dorsal views of *Phrynomerus bifasciatus* (left, ×1) and *P. microps* (right, ×1).

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

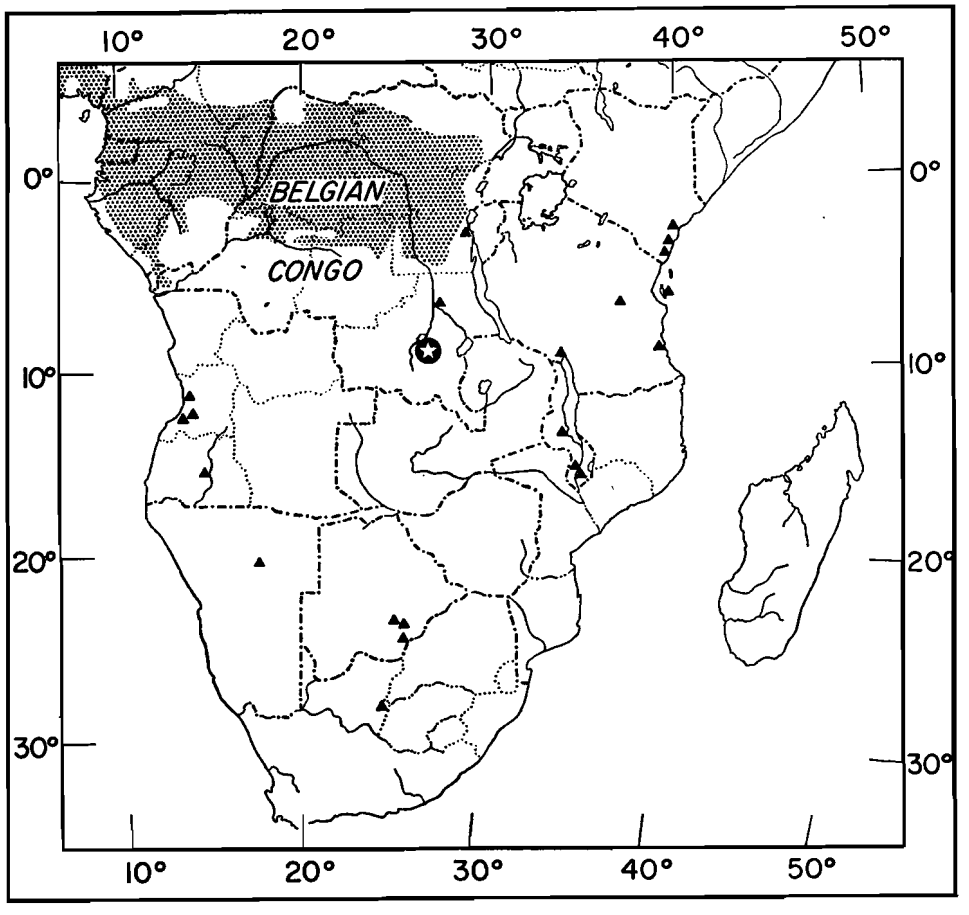

FIG. 72. — Distribution of *Phrynomerus bifasciatus*.
Parc National de l'Upemba indicated by symbol with open star.

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).