

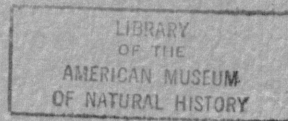
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(Genus *Cophixalus*) from Papua New Guinea,
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A New Cryptic Species of Microhylid Frog (Genus *Cophixalus*) from Papua New Guinea, with Notes on Related Forms

RICHARD G. ZWEIFEL¹

ABSTRACT

A new species of frog, *Cophixalus kairiensis*, found on Mt. Kairi, Morobe District, Papua New Guinea, is virtually identical with its sympatric congener *C. parkeri* in size and proportions. The two taxa differ slightly in color pattern and greatly in

mating call. Distributional and diagnostic information is presented on these two species and on two other poorly known species, *C. biroi* and *C. cheesmanae*, which are possibly related to the new species.

INTRODUCTION

The meager array of distinguishing characteristics that frogs offer to systematists is significantly increased when there is opportunity to tape-record the species-specific vocalizations of the males. Not infrequently, previously unsuspected arrays of sibling species are revealed. Recent examples involving the frog fauna of New Guinea include both hylid (Menzies and Zweifel, 1974) and microhylid (Menzies and Tyler, 1977) species. In the present instance, the existence of two sympatric, sibling species was immediately evident upon

hearing their mating calls, and was reinforced by noting correlated differences in color and pattern. Given the morphological similarity of the two species and the effects of preservation on color and pattern, it is quite unlikely that the two would have been distinguished in the absence of field studies. The purposes of this paper are to describe the one new species of the sibling pair and to present diagnostic and distributional information on two other species that may be related to the new form and on which there is little published information.

METHODS

Measurements were made with Vernier calipers or ocular micrometer and are expressed in millimeters. Measurements and their abbreviations are as follows: length from snout to vent

(SV); length of tibia, from heel to knee² (TL);

²Not from heel to fold of skin on knee, as in my previous papers, but to outer surface of flexed knee—a slightly longer measurement.

¹Chairman and Curator, Department of Herpetology, the American Museum of Natural History.

distance from anterior edge of eye opening to center of external naris (EN); internarial distance, from center to center of external nares (IN); head width at widest point at the jaw articulation (HW); diameter of orbit, measured between anterior and posterior edges of eye opening (Eye).

ACKNOWLEDGMENTS

My fieldwork was supported by the National Science Foundation (grant GB-2217 in 1964; R/V Alpha Helix Expedition in 1969) and by the National Geographic Society (1968). I examined specimens deposited in several museums; following is a list of the museums (abbreviations used in the text and names of curators who kindly made specimens available are in parentheses): Australian Museum, Sydney (AM, Dr. Allen E. Greer); American Museum of Natural History, New York (AMNH); Bernice P. Bishop Museum, Honolulu (BBM, Dr. Alan A. Ziegler); British Museum, Natural History (BMNH, Dr. Alice G. C. Grandison); Museum of Comparative Zoology, Harvard University, Cambridge (MCZ, Dr. Ernest E. Williams); National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM, Dr. George Zug); South Australian Museum (SAM, Mr. Michael Tyler); Yale University, New Haven (YPM).

Cophixalus kaindiensis, new species

Figure 1B

HOLOTYPE: AMNH 82904 (field no. RZ 9139), an adult male, collected by R. G. Zweifel (in company with H. Cogger, R. Storez, and R. Mackay) near the summit of Mount Kaindi, about 2300 m., 5 km. west of Wau, Morobe Province, Papua New Guinea, on September 6, 1969.

PARATYPES: AMNH 82905-82916 and YPM AA1215-1217, collected at the same time and place as the holotype, AMNH 81066-81070, collected by R. G. Zweifel (in company with J. Sedlacek) at the type locality on July 22, 1968, and USNM 197459, collected by George Zug at the type locality on November 18, 1971.

DOUBTFULLY ASSOCIATED SPECIMENS: USNM 197458 and 209656, collected by

George Zug "along the second creek below the summit" of Mt. Kaindi on November 18, 1971; BBM 5155, 5176, 5177, 5182, 5184, collected by P. H. Colman on the summit of Mt. Kaindi May 26, June 27 and July 7, 1967.

DIAGNOSIS: The largest of 20 adult males in the type series measures 27.7 mm. snout-vent length, the only female, 27.0 mm. *Cophixalus kaindiensis* differs from other *Cophixalus* of similar size in its distinctive mating call and in having the following combination of morphological characters (mean, standard error of mean, range): TL/SV 0.441 ± 0.004 (0.41 – 0.47) N = 20; EN/IN 0.776 ± 0.006 (0.70 – 0.80) N = 20; EN/SV 0.077 ± 0.001 (0.070 – 0.083) N = 20; IN/SV 0.099 ± 0.001 (0.088 – 0.106) N = 20; fifth toe shorter than third, but reaching about halfway up disc of third; in life, a reddish brown suffusion in the groin and on the anterior and posterior surfaces of the thigh, often with darker markings superimposed.

DESCRIPTION OF HOLOTYPE: An adult male (calling when captured) with a subgular vocal sac not evident externally.

Head moderately wide (HW/SV, 0.366), with slightly oblique, shallowly concave loreal region, canthus rostralis distinct but rounded, and nostrils much closer to tip of snout than to eyes; internarial distance considerably greater than distance from eye to naris (EN/IN, 0.75; IN/SV, 0.103; EN/SV 0.077); eyes moderately large (Eye/SV, 0.117), eyelid two-thirds width of interorbital space; entire tympanic ring visible, but tympanum not prominent, horizontal diameter less than one-half that of eye.

Dorsal surfaces of body and legs slightly warty; a faint W-shaped fold in the scapular region; a fold of skin from posterior corner of eye passes above and down behind tympanum.

Fingers unwebbed, relative lengths $3 > 4 > 2 > 1$, first finger more than one-half length of second; all fingers with well-developed discs with terminal grooves; disc of third finger more than twice width of penultimate phalanx; low, rounded subarticular tubercles and an indistinct inner metatarsal tubercle present. Toes unwebbed, relative lengths $4 > 3 > 5 > 2 > 1$, fifth almost as long as third (reaching halfway up disc of third, fig. 2); toe discs smaller than those on fingers, that of fourth toe about twice

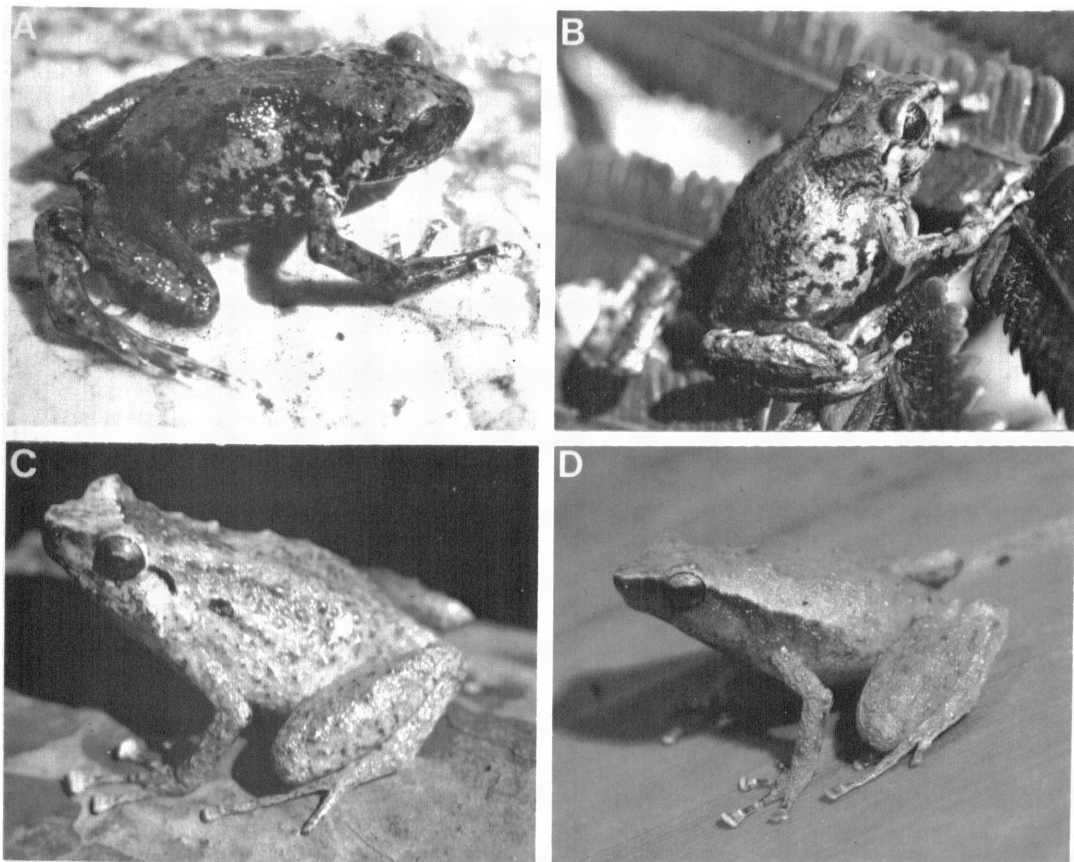


FIG. 1. Four species of *Cophixalus* from Papua New Guinea. A. *C. parkeri*, AMNH 81141, SV 26 mm., Mt. Kaindi, Morobe Prov. B. *C. kaindiensis*, AMNH 81069, SV 26 mm., Mt. Kaindi, Morobe Prov. C. *C. biroi*, AMNH 82918, SV 25 mm., Wanuma, Adelbert Mountains, Madang Prov. D. *C. cheesmanae*, AMNH 81075, SV 22 mm., ca. 24 km. N Lae, Morobe Prov.

width of penultimate phalanx; low, rounded subarticular tubercles; no metatarsal tubercles. Hind legs moderately long (TL/SV, 0.429).

Maxillae and premaxillae serrate, but without true teeth; maxillae eleutherognathine (not meeting in front of premaxillae); sternum cartilaginous; clavicles, procoracoids, and omosternum absent. A serrate, transverse pharyngeal fold present.

Ground color of dorsal surfaces of body and limbs brown in preservative; indistinct warts on body slightly paler than ground color, outlined in a slightly darker shade; W-shaped mark in scapular region with light outer arms; a pale vertebral hairline; upper surface of snout much

paler than body, with abrupt transition on a transverse line connecting the eyes; a dark area below canthus rostralis; a dark line following fold over tympanum; sides of body with jagged, ill-defined dark spots on paler background; ventral region—chin through under surfaces of thighs—mottled, more dark than light, with no obvious difference between throat and belly; under side of lower leg largely pale; anterior and posterior surfaces of thighs much like belly, but with relatively more light area.

In life, the dorsal ground color was brown. A strong reddish suffusion was present in the groin and on the anterior and posterior surfaces of the thighs, areas that appear unpigmented in

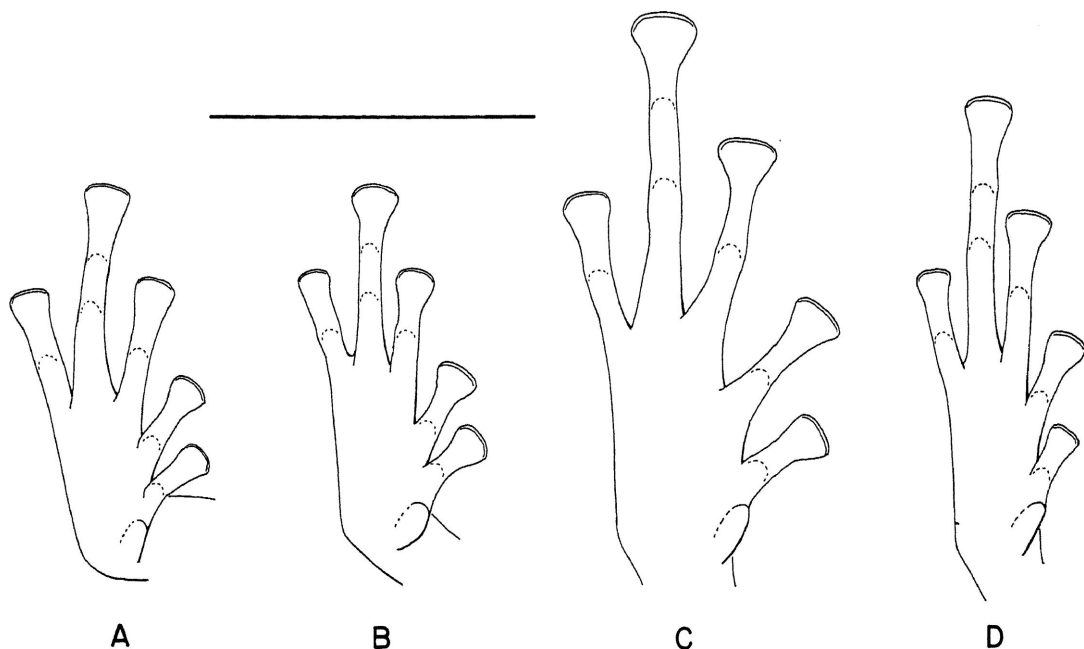


FIG. 2. Hind feet of *Cophixalus* in plantar view, to show relative lengths of third and fifth toes. A. *C. parkeri*. B. *C. kairiensis*. C. *C. biroi*. D. *C. cheesmanae*. Scale line indicates 1 cm.

the preserved specimen. The under sides of the body were light gray with darker gray mottling.

MEASUREMENTS: SV, 27.3; TL, 11.7; HW, 10.0; Eye, 3.2; EN, 2.1; IN, 2.8; disc of third finger, 1.8 (penultimate phalanx, 0.8); disc of fourth toe, 1.3 (penultimate phalanx, 0.7).

VARIATION IN THE TYPE SERIES: Variation in proportions is treated in the diagnosis. The dorsal ground color in life was one or another shade of brown—tan in some individuals, darker brown in others. All had the reddish suffusion in the groin and on the thighs described for the holotype, though in the smallest frog (SV 16.1) the color was less intense. The body has obscure small dark spots and vermiculations, but these are quite variable among individuals. The sides of the body may be light with few markings, or fairly heavily spotted. One specimen other than the holotype has a pale vertebral hairline. Several have a pale, rather ill-differentiated bar between the eyelids, whereas one specimen has a distinct, dark-edged pale bar that crosses from eyelid to eyelid. The intensity and coarseness of the ventral

mottling are variable (fig. 3), but in no specimen is the pattern of the throat clearly different from that of the chest and belly. The groin and anterior and posterior surfaces of the thighs vary from virtually clear to heavily pigmented. Similarly, the undersides of the hind legs may be heavily mottled to almost unpigmented.

COMPARISONS WITH OTHER SPECIES: *Cophixalus kairiensis* is most appropriately compared with six other Papuan species of similar size and habitus: *C. biroi* (Méhely), *C. cheesmanae* Parker, *C. cryptotympanum* Zweifel, *C. nubicola* Zweifel, *C. parkeri* Loveridge, and *C. verrucosus* (Boulenger). Extensive comparison with only one—*parkeri*—is required.

In the field I confused *C. kairiensis* with *C. biroi* because of their general morphological similarity, the reddish color in the groin and on the hind legs common to the two, and because of the similarity of their calls. The calls are different, however (see account of *C. biroi*), and the relative lengths of the third and fifth toes will readily distinguish individuals (fig. 2).

The shorter fifth toe of *biroi* reaches at most to the base of the disc of the third toe. Differences in other proportions also are evident (see account of *biroi*).

Cophixalus cheesmanae differs from *C. kairiensis* in its longer legs, longer snout with vertical lores, color pattern, and mating call—see separate species account of *cheesmanae*.

Cophixalus cryptotympanum occurs on Mt. Kairi, though I have not taken it together with *C. kairiensis*.¹ It differs from *C. kairiensis* in mating call (a prolonged series of peeps—see Zweifel and Parker, 1977, for an audiospectrogram) as well as in some proportions. The most useful diagnostic character is the relative length of the third and fifth toes, in which *cryptotympanum* resembles *biroi*.

Cophixalus nubicola is known only from an elevation of 3100 meters on Mt. Michael, about 180 km. northwest of Mt. Kairi. It is distinguished from *C. kairiensis* in having much shorter legs (no overlap in TL/SV ratios) and lower EN/IN ratio: 0.683 ± 0.011 ($0.64 - 0.71$), $N = 6$ (type series remeasured for this study).

Cophixalus verrucosus is a species of foothill regions (probably not found above 1200 m.—*vide* Menzies, 1976) readily distinguished by dark brown and yellow mottling of the posterior surfaces of the thighs.

Cophixalus parkeri is closely similar to *C. kairiensis* in size and proportions. Such slight average differences as exist are insufficient alone to permit specific identification of specimens. The species are markedly different in their mating calls—a series of short peeps in *kairiensis* (see description that follows) and a group of short buzzing notes, usually four, in *parkeri* (see Zweifel and Parker, 1977, for an

audiospectrogram and description). Where the two species are sympatric on Mt. Kairi, they differ in color and pattern. The reddish color in the groin and on the thighs of *kairiensis* is not present in *parkeri*, but this difference disappears and is of no use in preserved specimens. However, the two also differ in ventral pattern (fig. 3). The abdomen of *parkeri* is boldly marked in dark gray (brown in preservative) and white. The marks may be relatively small maculations or large blotches, but in any case the abdominal pattern gives way abruptly to a much finer, more nearly uniform dark pigmentation on the chin and throat. The abdominal pattern of *kairiensis* in life is much less contrasty than that of *parkeri*, though in preservative the two converge. In *kairiensis*, however, the throat and abdomen have virtually the same pattern, and this difference that persists in preserved specimens serves fairly well to segregate them.

The foregoing comparison is based on adult males identified in the field by their calls. An adult female *kairiensis* had the typical ventral pattern and groin and thigh color. Two small individuals—SV 16 and 22 mm.—had the reddish groin and leg color, but the ventral surfaces were more densely pigmented. A *Cophixalus* from the type locality that I cannot assign to species has dark gray ventral surfaces with small light flecks (neither *parkeri* nor *kairiensis* shows quite this pattern), and no distinction between throat and abdominal patterns (as in *kairiensis*). In life the groin and thighs were dark gray with no reddish color. The specimen appears to be an adult male and is of a size (SV 25 mm.) at which others are readily assigned to species. No call data are available (the frog was captured in the daytime).

Specimens of *C. kairiensis* discussed above were all either collected by me or examined while they were alive. USNM 197459 is included as a paratype on the basis of color notes furnished by the collector, Dr. Zug. USNM 197458 and 209656, and BBM 5155, 5176, 5177, 5182, and 5184 appear to be *kairiensis*, but in the absence of specific color notes or information on calls, I exclude them from the paratypic series and designate them as doubtfully associated specimens.

¹In an earlier paper (Zweifel, 1962) I noted that specimens from the Highlands region of Papua New Guinea averaged much larger than those in the type series of *cryptotympanum* from Mt. Dayman, some 640 km. to the southeast. I could find no differences in proportions to support the proposition that there were two species involved. Specimens from Mt. Kairi resemble those from the Highlands in size and also do not differ from the type series in proportions. The question of whether these are two species is not likely to be settled until mating calls of the southeastern (typical) population are recorded.

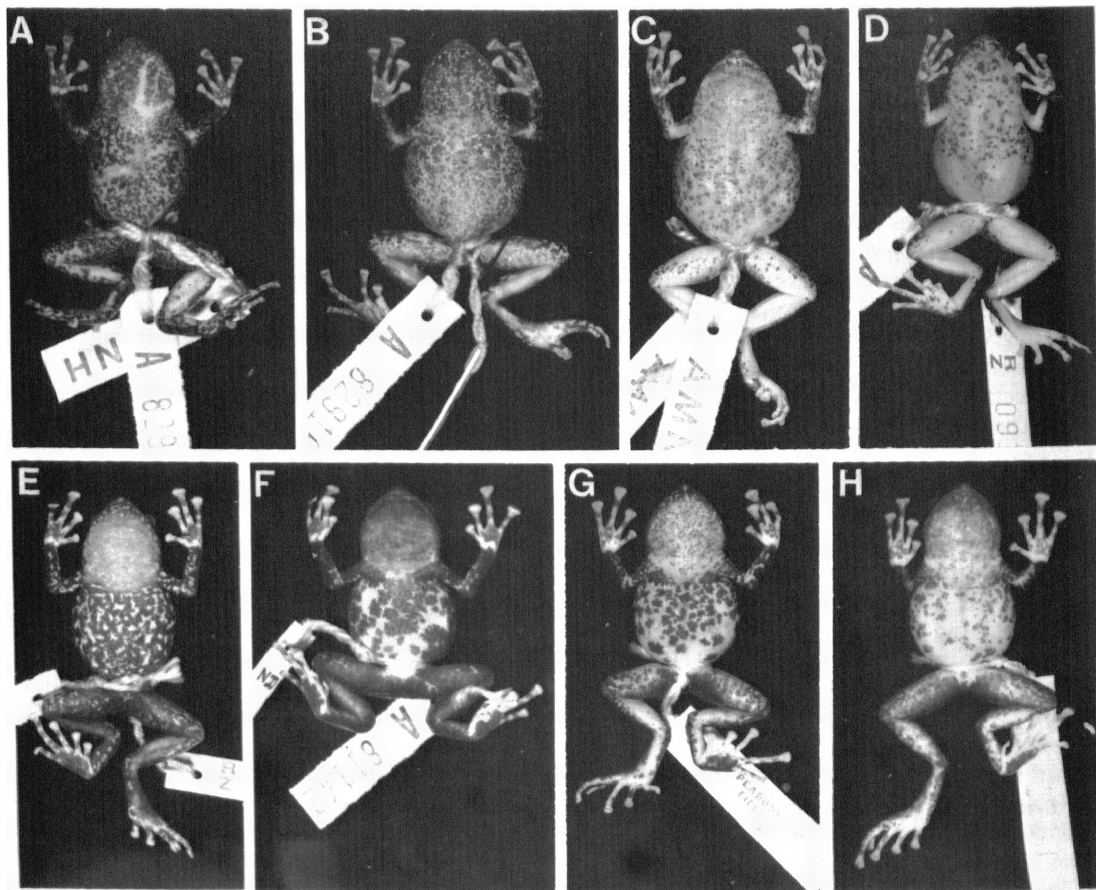


FIG. 3. Ventral surfaces of *Cophixalus* from Mt. Kaindi, XI. A-D *C. kaindiensis*. E-H, *C. parkeri*. The pattern of the throat of *kaindiensis* is much the same as that of the rest of the venter, whereas the throat has a finer, more uniform pattern in *parkeri*.

IDENTITY OF *C. PARKERI* ON MT. KAINDI: The congruent differences in mating calls and pigmentation between the microsympatric populations on Mt. Kaindi here referred to *C. kaindiensis* and *C. parkeri* are adequate evidence that two species are involved. However, it may reasonably be asked whether the name *parkeri* is properly associated with the Mt. Kaindi population. In view of the morphological similarity of the two species on Mt. Kaindi, it is possible that what is here called *kaindiensis* might actually be true *parkeri* and Mt. Kaindi "*parkeri*" actually the undescribed species, or perhaps neither is the same species as *parkeri*.

Prior to the discovery of the population on Mt. Kaindi, *C. parkeri* was recorded at lo-

calities in Western Highlands, Chimbu, and Eastern Highlands provinces (Zweifel, 1962),¹ the closest to Mt. Kaindi being Mt. Otto, about 220 km. northwest (fig. 4). Collections made by Fred Parker and myself at Orumba (AMNH 76508, 76509) and Koko (AMNH 74959-74961, 76510-76512 + 3) on a ridge southwest of Goroka, Eastern Highlands Province in 1964 reduce the gap slightly to 200 km.

¹Tyler (1963) recorded *C. parkeri* from the Wahgi-Sepik Divide in Western Highlands Province. The terrestrial habits and mating call he described are not consonant with this specific determination. I have examined 13 of his specimens (AM R16844-16851, R17596-17600) and identify them as *Cophixalus cryptotympanum*.

Two specimens (BBM 6214, 6215) from Mt. Missim, 2400 m., 21 km. northeast of Mt. Kaindi, appear to be *C. parkeri*, though the pattern characters are not as clear-cut as in the Mt. Kaindi specimens. Presumably this population is disjunct from that on Mt. Kaindi.

As judged from the preserved specimens and confirmed by my notes on living individuals from Koko, *parkeri* from the Eastern Highlands localities do not have the ventral pattern of Mt. Kaindi *parkeri* but rather a more uniform pattern like that of *kaindiensis*. Furthermore, the Koko specimens showed a slight pinkish tinge in the groin and on the hind legs. An exception is a specimen (BBM 1167) from Daulo Pass, west of Goroka, which has bold black and

white markings on the abdomen and a uniformly dark throat, but two others from the same locality (AMNH 79490, 79491) are like other Eastern Highlands specimens.

The evidence of pigmentation would seem to refute my specific assignments of the Mt. Kaindi frogs. However, calls heard at Orumba (unfortunately not tape-recorded) were clearly not the peeping call of *kaindiensis*, and so far as memory and field notes can serve to verify, the call and the individual calling behavior agree with that of *parkeri* on Mt. Kaindi: "the call is a sharp BRRRT repeated several times in succession . . . frogs of one local group may call almost simultaneously, to be answered by another group a few yards away" (field notes,

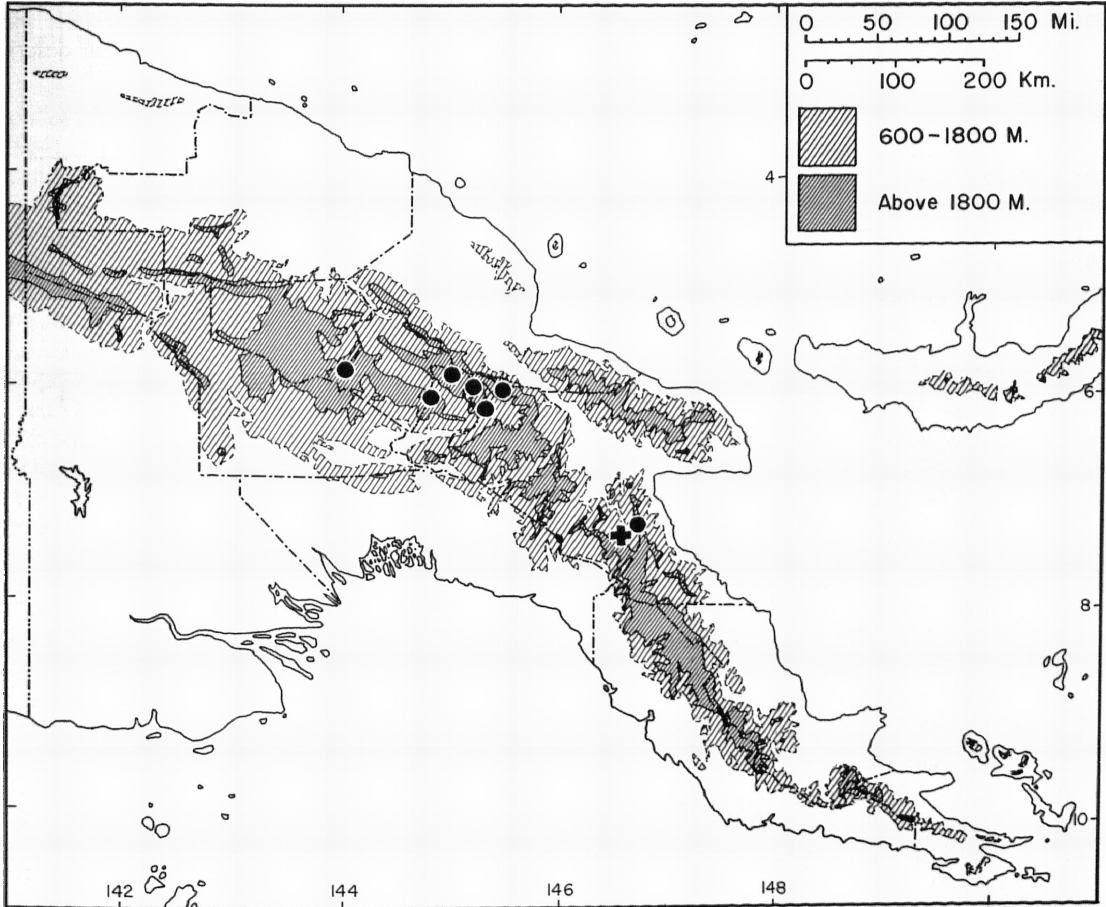


FIG. 4. Distribution of *Cophixalus kaindiensis* (cross) and *C. parkeri* (cross and spots) in Papua New Guinea, based on specimens examined.

RGZ). I attribute more significance to the call than to pigmentation as a criterion of relationships.

There are also indications in two proportions—EN/IN and TL/SV—that *parkeri* of Mt. Kaindi is more like *parkeri* from Orumba and Koko (the geographically closest samples) than like sympatric *kaindiensis*, though the differences are slight (fig. 5).

I think that the weight of evidence favors the assignments of names used here, but satisfactory resolution of the question must await information on *parkeri* at the type-locality (Mt. Wilhelm, 8000 ft. elevation, Chimbu Province). It would not be astonishing to discover that *parkeri* as presently understood includes other undescribed sibling species.

CALL: The call of *Cophixalus kaindiensis* (fig. 6) is a series of peeping notes, each about 0.1 sec. in length, with a dominant frequency

of about 2700 to 3000 Hz. Twenty-seven calls averaged 11 notes per call, range 8-17 (these include 16 calls given by five frogs that were the primary objects of the recordings, plus 11 from an uncertain number of frogs discernible in the background of the recordings). The note repetition rate for calls of five frogs recorded at air temperatures of from 13.6° to 15.1° C. ranged from 112 to 125 notes per minute, mean 118, with no correlation with temperature evident in that narrow temperature range ($r = -.10$). Calls seemed to be uttered at irregular intervals, with several minutes sometimes elapsing between calls.

ECOLOGICAL NOTES: The type locality is in heavily mossed forest (near a microwave repeater station) at an elevation of about 2300 meters; the summit of Mt. Kaindi (about 2360 m., according to Brass [1964]) is a short walk away on the same ridge. For a general descrip-

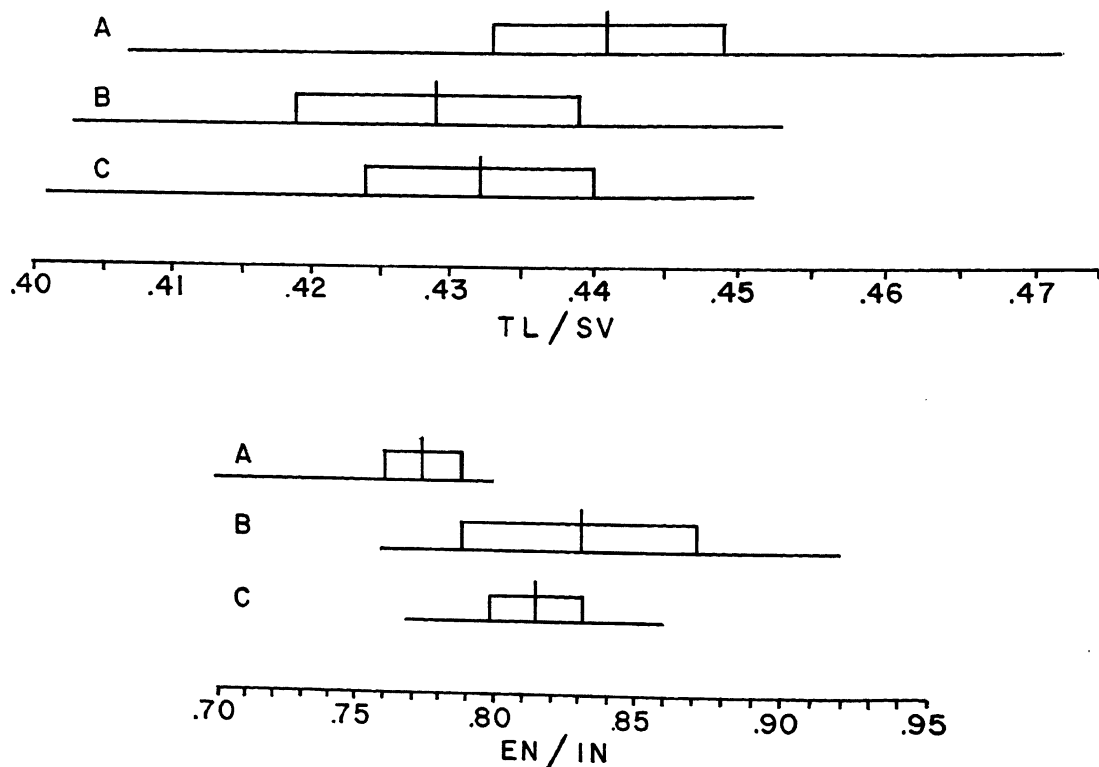


FIG. 5. Comparison of TL/SV and EN/IN in three samples of *Cophixalus*. Horizontal line indicates range, vertical line marks mean, and boxes enclose two standard errors on each side of mean. A. *C. kaindiensis*, N = 20. B. *C. parkeri*, Mt. Kaindi, N = 9. C. *C. parkeri*, Koko and Orumba, N = 16.

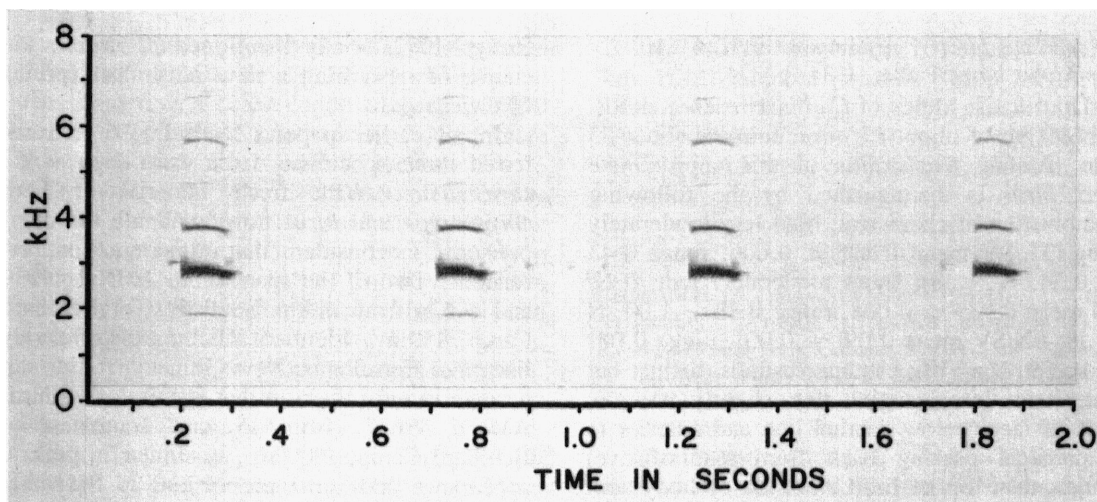


FIG. 6. Audiospectrogram of call of *Cophixalus kairiensis* (50 Hz filter). Last four notes of a 13-note call recorded at the type locality on July 22, 1968, air temperature 13.6° C. Specimen AMNH 81066, recording on AMNH Herpetology Department tape no. 183.

tion of the habitat on Mt. Kairi, see Brass (1964). I captured *Cophixalus kairiensis* only in this mossy forest on the ridge. In 1964 Mr. G. Sluder and I spent four days at Edie Creek, 2060 meters, on Mt. Kairi, and encountered neither *C. kairiensis* nor *C. parkeri*. The Sixth Archbold Expedition (Brass, 1964) based at Edie Creek for more than two weeks in 1959 and likewise did not collect either species. Whether this reflects a normal altitudinal restriction of *C. kairiensis*, or results from disturbance of the forest at the lower elevation, is unclear. Two "doubtfully associated" specimens (see above) came from an elevation of about 2000 meters.

All individuals of *C. kairiensis* in whose capture I participated were taken at night, mostly while they were calling. Except for one found in a hole in a mossy road bank, they were on ferns, shrubs, and low on small trees. At least four other species of *Cophixalus* occur on Mt. Kairi, three in sympatry with *C. kairiensis*. *Cophixalus parkeri* calls from identical situations in sympatry with *kairiensis*. A much larger species, *Cophixalus riparius*, occasionally is found at ground level but more often calls from high in the trees. Tiny *Cophixalus variegatus* utilizes similar calling sites to *C. kairiensis* and *C. parkeri* and is the most abundant (or at least most obvious) species of

frog in the forest. We did not find *Cophixalus cryptotympanum* sympatric with *kairiensis*. It is common at Edie Creek and at lower elevations along the road between Wau and Edie Creek. In these places it occurs along ditches with running water and around seeps. However, I have taken it elsewhere in forest away from seeps or ditches, and it would not be astonishing to find it in sympatry with *kairiensis* on Mt. Kairi.

Differences in size, habitat, or both distinguish *C. kairiensis* from *cryptotympanum*, *riparius*, and *variegatus*, but no such obvious differences exist between the siblings *kairiensis* and *parkeri*.

ETYMOLOGY: The specific name derives from that of the mountain on which the species was discovered, combined with the Latin suffix meaning "native to."

DISTRIBUTION: *Cophixalus kairiensis* is known only from the forested summit region of Mt. Kairi (fig. 4).

Cophixalus biroi (Méhely)

Figure 1C

Phrynxalus biroi Méhely, 1901, pp. 197, 247 (type locality, "Sattelberg," Morobe Province, Papua New Guinea; several syntypes collected by Lewis Biró, formerly in Hungarian Museum, now destroyed; one syntype, BMNH 1901.3.9.2 ["juv. in egg"—Parker, 1934, p. 175]; see Remarks).

Hylophorbus biroi: van Kampen, 1919, p. 54.

Cophixalus biroi: Parker, 1934, p. 174.

DIAGNOSIS: Males of *C. biroi* reach a snout-vent length of about 27 mm., females about 33 mm. Among *Cophixalus* of this approximate size, *biroi* is distinguished by the following combination of characters: hind legs moderately long (TL/SV mean 0.495 ± 0.006 , range 0.43 – 0.54, N = 18); snout moderately long (EN/IN mean 0.939 ± 0.008 , range 0.88 – 1.00, N = 18; EN/SV mean 0.091 ± 0.001 , range 0.081 – 0.099, N = 18); canthus rostralis distinct but not sharp, loreal region flat, slightly oblique; side of face (below canthal line and anterior to a diagonal passing back from rear of eye) darker than top of head and side of body, but not uniformly dark; a short dark line from posterior corner of eye above tympanum; anterior and posterior surfaces of thighs reddish brown in life, sometimes with a pattern of gray-brown flecks; fifth toe relatively short, its disc reaching only to base of third toe disc (fig. 2).

DESCRIPTIVE NOTES: Terminal discs of the fingers and toes are broad—about three times the width of the penultimate phalanx on the third finger and twice the width on the fourth toe. The dorsal surface of the body is light brown in life with little pattern evident, though the area anterior to a transverse mid-ocular line is abruptly paler. The under sides are light gray with a darker gray mottling, most dense on the chin. The iris is golden, with reddish brown triangular areas anterior and posterior to the horizontal pupil.

REMARKS: The literature on this species is sparse. The original description was based on numerous specimens from the type locality, but only one of them an adult (Méhely, 1901; Parker, 1934), and all now destroyed except for a “juv. in egg” recorded by Parker. James Menzies reports (in litt.) that there are two specimens in the Vienna Museum labeled as types of *biroi*, collected in 1902 by Biró at Astrolabe Bay, Madang Province. Inasmuch as the date of collection is more recent than the date of publication of *biroi*, they cannot be type material.

Van Kampen (1923, p. 138) gave a record for Tor River, Irian Jaya; I have not seen the specimen. Parker (1934) examined the type series and provided a description. Zweifel and

Parker (1977) briefly mentioned *C. biroi* in the course of describing a new Australian species of *Cophixalus*.

In an earlier paper (Zweifel, 1956), I referred three specimens from Irian Jaya to *C. cheesmanae*. With fresh material of both *cheesmanae* and *biroi* now available for comparison, I consider that determination erroneous. Two of the specimens, AMNH 49539 and 49574 from 4 km. southwest of Bernhard Camp, 850 m., Idenburg River, are sufficiently like *biroi* from Papua New Guinea that I do not hesitate to refer them to that species. The third, AMNH 49637, from 15 km. southwest of Bernhard Camp, 1800 m., is similar in general appearance and most proportions to the other two, but differs in its relatively broader inter-narial distance (EN/IN = 0.75—well below the minimum of 0.88 for *biroi*) and in its relatively longer fifth toe—reaching halfway up the disc of the third. These differences, and its provenance at a higher elevation than any recorded for *biroi*, cause me to regard it as not being *biroi*, and possibly undescribed.

The call of *Cophixalus biroi* (see Zweifel and Parker, 1977, fig. 5E, for an audiospectrogram) is a series of peeping notes, each about 0.1 sec. in length, with a dominant frequency of about 2700–2750 Hz. Notes are uttered at irregular intervals and in variable numbers, with long pauses between groups of notes. One individual, recorded at an air temperature of 19.9° C. at Wanuma, Adelbert Mountains, gave from four (possible an incomplete series) to 19 notes in a group, with the number of notes per minute ranging from 26 to 43. A second frog recorded at 21.2° C. at the same locality gave 28 notes in an incomplete group at 65 per minute, and 38 in a complete group at 45 per minute.

Structurally, the notes of *C. biroi* and *C. kainiensis* are much alike, but the rapidly repeated, regularly-spaced notes in the call of *kainiensis* mark a considerable difference from the slowly and irregularly produced notes of *biroi*.

I have collected *C. biroi* at Gang Creek on the Huon Peninsula and at Wanuma, Adelbert Mountains. The specimen from Gang Creek was calling about a meter above ground level in a bush in primary forest at 1370 meters

elevation. In the Adelbert Mountains, frogs called from similar levels in bushes or small trees bordering a forest-canopied gorge at 730 meters. *Cophixalus cheesmanae* called here along with *biroi* from similar perches.

DISTRIBUTION AND SPECIMENS EXAMINED: Records for *C. biroi* are scattered along the north slope of New Guinea, from the Huon Peninsula on the east to the Tor River on the west (fig. 7). Those for which altitudinal data are available indicate foothill or low mountain habitats from 700 to 1600 meters in elevation.

PAPUA NEW GUINEA: Morobe Province: Sattelberg, 800 m. (Méhely, 1901, type locality); Gang Creek, Mt. Rawlinson, 1370 m. (AMNH 74904); Areganang, 1600 m. (AMNH 81063-81065); Sakimbang, 1390 m. (AMNH 84504). Madang Province: Wanuma, Adelbert Mountains, 730 m. (AMNH 82917-82919). West Sepik Province: Mt. Somoro, 730+ m., Torricelli Mountains, 16 km. NE Lumi (AMNH

78100-78107); Mt. Nibo, 700+ m., about 5 km. E Mt. Somoro (AMNH 78108-78112). **INDONESIA:** Irian Jaya: Idenburg River, 4 km. SW Bernhard Camp, 850 m. (AMNH 49539, 49574); Tor River (van Kampen, 1923, p. 138).

Cophixalus cheesmanae Parker

Figure 1D

Cophixalus cheesmanae Parker, 1934, p. 175 (type locality, "Kokoda [Northern Province] [1,200 ft.], British New Guinea [Papua New Guinea]"; holotype male, BMNH 1947.2.11.97 [formerly BMNH 1934.1.5.5], collected by Miss L. E. Cheesman).

DIAGNOSIS: Among *Cophixalus* of similar size—males to about 31 mm. SV length, females to about 39 mm.—*C. cheesmanae* is distinguished by the following combination of characters: hind legs relatively long (TL/SV mean 0.531 ± 0.004 , range 0.48 – 0.57, N = 25); snout relatively long (EN/IN mean $1.10 \pm$

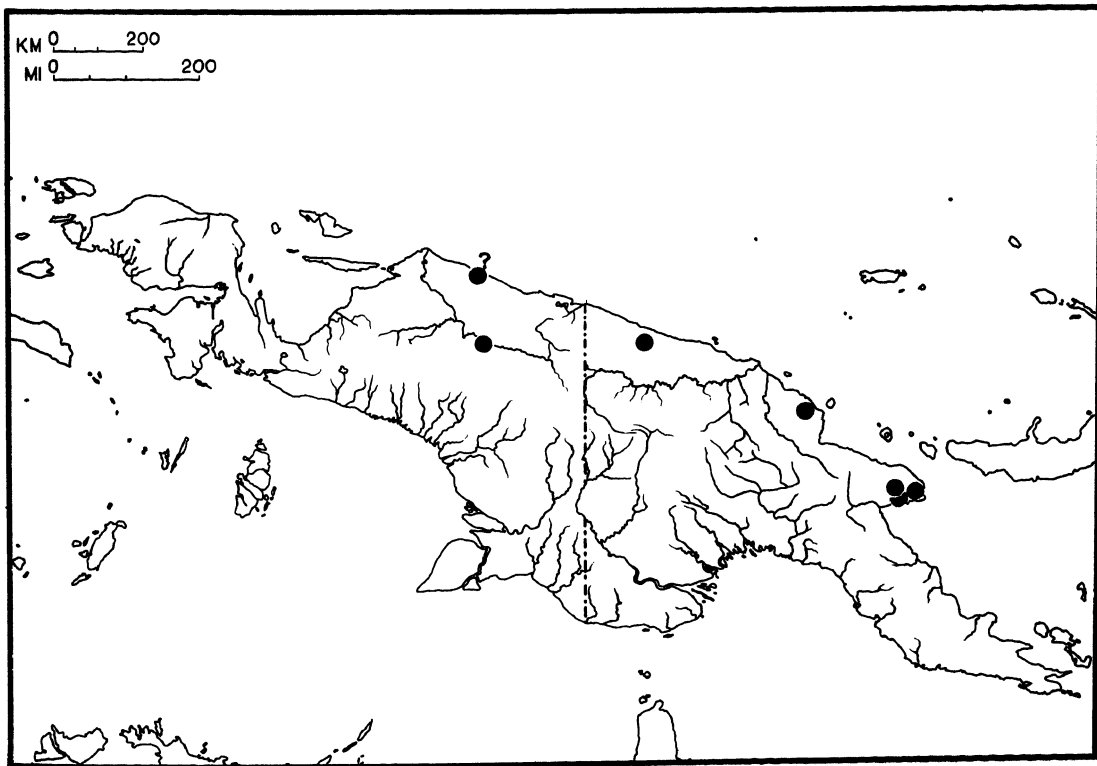


FIG. 7. Distribution of *Cophixalus biroi* in New Guinea. Questioned locality is Tor River, Irian Jaya (specimen not examined by author).

0.010, range 0.97 – 1.20, $N = 25$; EN/SV mean 0.100 ± 0.001 , range 0.093 – 0.108, $N = 25$; loreal region flat and vertical; side of face dark, the color usually continuing posteriorly along the body and separated abruptly from the lighter dorsal color along a sharp line passing diagonally from the posterior corner of the eye; a unicolor area on the posterior and anterior side of the thigh, often deep port wine color in life but sometimes paler or darker, the area virtually or completely without melanic pigmentation in preserved specimens. The color pattern alone should serve to identify either living or preserved *cheesmanae*.

DESCRIPTIVE NOTES: Terminal discs of the fingers and toes are well developed; that of the third finger is about three times the width of the penultimate phalange, and that of the fourth toe about twice. The fifth toe is shorter than the third (fig. 2). The dorsal ground color is variable in life—my notes record greenish gray, yellowish brown, and reddish brown. Some individuals have a white vertebral hairline, continued along the dorsal surface of the thigh and back of the shank. The lower surfaces of the body are typically gray with indistinct darker splotching and mottling. The greenish gray iris has a reddish brown streak passing through the horizontal pupil and is conspicuous against the color of the head.

REMARKS: This species has received little mention in the literature. I reported (Zweifel, 1956) the first specimens since the original description, and have since had the opportunity to collect the species at several localities, including the type locality, and to examine the holotype. In that report I identified three specimens from Irian Jaya (Idenburg River) as *cheesmanae*, noting some differences from the only two *cheesmanae* from Papua New Guinea then available to me. I am now satisfied that the questionable specimens are not *cheesmanae* (see foregoing account of *C. biroï*).

Most specimens of *cheesmanae* that I obtained were found at night in primary forest, sitting on fern fronds or on the upper surfaces of leaves of herbaceous or shrubby vegetation. Individuals were found in the daytime under a rock in a stream bed (but not in the water) and in leaf litter.

Menzies (1976) presented a description and an illustration in color. For an audiospectrogram of the mating call, see Zweifel and Parker (1977).

DISTRIBUTION AND SPECIMENS EXAMINED: The principal area of distribution is the north coastal region of Papua New Guinea from the Adelbert Mountains on the northwest to the region of Mount Suckling on the southeast (fig. 8). The elevational range occupied is from near sea-level to 1330 meters. Menzies (1976) has directed attention to the presence of this species in the region of the middle Purari River, where Fred Parker collected numerous specimens at several localities. This is the only area where *cheesmanae* has been found in the southward flowing drainages of Papua New Guinea. In view of the known altitudinal distribution of the species, it is likely that this population is disjunct, for the minimum elevation of the divide between the northern and southern watersheds in that general region is close to 1800 meters. Curiously, the distribution of *cheesmanae* is nearly paralleled by that of *Sphenophryne palmipes* Zweifel, a semi-aquatic microhylid found at similar elevations along the north coast and apparently disjunct in the Purari drainage.

PAPUA NEW GUINEA: Milne Bay Province: Peria Creek Crossing, Kwagira River, 50 m. (AMNH 57386). Northern Province: Kokoda, 370 m. (AMNH 74905-74921, BMNH 1947.2.11.97, 1947.2.11.98 [holotype and paratype], MCZ 87254); Mambu River, about 8 km. NE Kokoda (USNM 197460); Saiho (MCZ 87255). Morobe Province: Garaina, 700 m. (AMNH 81071-81074, 82930-82934, YPM AA159-160); Salamaua Track, 1330 m. (BBM 6216); Gurakor, 670 m. (AMNH 66993); Lae (AMNH 52589); about 24 km. (by road) N Lae, 200 m. (AMNH 81075, 81076); Boana (MCZ X23553-23557); Finschhafen (SAM 4249 [16 specimens]). Madang Province: Wanuma, Adelbert Mountains, 670 m. (AMNH 82920-82929, 83002). Chimbu Province: Soliabeda, 370-550 m. (AMNH 79956, MCZ Y40869, Y40897, Y40918 [3 specimens], Y40922 [3 specimens]); Pio River, 300 m. (AMNH 79957, MCZ Y40964, Y40968, Y40992 [4 specimens]); Nimi River, 425 m.

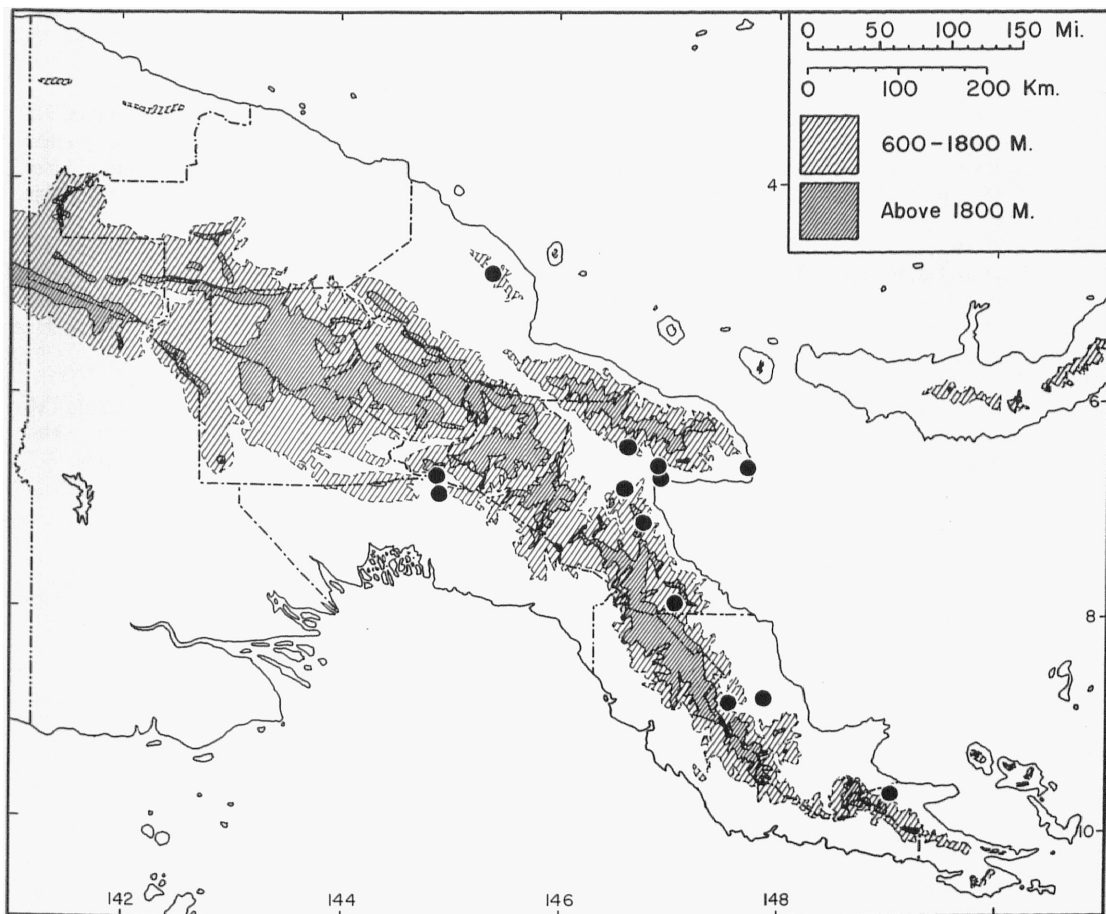


FIG. 8. Distribution of *Cophixalus cheesmanae* in Papua New Guinea. All spots represent specimens examined.

(AMNH 101882-101891, MCZ Y10075 [35 specimens]). Gulf Province: Weiana and vicinity, 400-700 m. (MCZ Y10014, Y10049 [9 specimens]); Uruu (MCZ Y10144).

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