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Systematics of Microhylid Frogs, Genus *Oreophryne*, from the North Coast Region of New Guinea

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CONTENTS

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ABSTRACT

We discuss the taxonomic status of seven nominal species of *Oreophryne* described from northern New Guinea and New Britain. These include *Cophixalus geislerorum* Boettger (1892) and *Sphenophryne biroi* Méhelÿ (1897), two of the first three species of *Oreophryne* described from New Guinea. Each has been a source of taxonomic confusion—the first known only from a single specimen of indefinite provenance, and the second because of the destruction of the type specimens and the indiscriminate application of the name *biroi* to specimens from virtually the entire length and breadth of New Guinea. We identify a well-characterized species with *geislerorum* and associate *biroi* with a species known from the vicinity of the type locality, designating a neotype to establish formally this association.

We retain two species—*Mehelyia affinis* Wandolleck (1911) and *Mehelyia lineata* Wandolleck (1911)—as junior synonyms of *biroi*, tentatively characterize *Oreophryne parkeri* Loveridge (1955) and refer new specimens to the species, and describe one new species. *Hylella wolterstorffi* Werner (1901) by default remains a valid species of *Oreophryne*, now with a somewhat restricted but still indefinite type locality, and not yet well characterized morphologically.

The specific identity of specimens in some samples of *Oreophryne* from the north coastal region of New Guinea is unclear and is likely to remain so until recordings of advertisement calls become available.

INTRODUCTION

Oreophryne is the most widespread of the eight genera of Genyophryninae, ranging from the southern Philippine Islands to Sulawesi and the Lesser Sunda Islands and through New Guinea to New Britain. In his monograph of the Microhylidae, Parker (1934) recognized 14 species, 7 of them in New Guinea. He described two of the New Guinean forms therein, misidentified one as *Oreophryne celebensis*, and placed four nominal species from New Guinea in synonymy. Parker (1934: 162, footnote) expressed some question about the identity of the single specimen he referred to as *O. celebensis*, but it is most unlikely to be conspecific with a species otherwise known only from Sulawesi. Its true identity must await a better understanding of the numerous species of *Oreophryne* in the western part of New Guinea. At present a total of 28 species of *Oreophryne* are recognized, 17 of which are found on New Guinea and adjacent islands, and 1 on New Britain.[4]

Even with the number of known New Guinean species more than doubled since Parker's time, herpetologists working with the Papuan fauna have long recognized that the diversity of *Oreophryne* there greatly exceeds the number of species formally recognized. For example, Hyndman and Menzies (1990, appendix B) listed 7 species from a relatively restricted area in Western Province, Papua New Guinea, and Richards et al. (2000) recorded 10 species from a site in west-central Papua, Indonesia.[5] These authors associated none of the species in either sample with a recognized species or synonymized species name.

A basic problem in the systematics of New Guinean *Oreophryne* is that several of the earliest proposed names have not been associated with natural populations. Other names are improperly applied or are inappropriately synonymized, and many species remain undescribed. Here we discuss seven nominal species described from localities in northern New Guinea and on New Britain. In chronological order and initial taxonomy, these are: *Cophixalus geislerorum* Boettger (1892); *Sphenophryne biroi* Méhelÿ (1897); *Hylella brachypus* Werner (1898); *Hylella wolterstorffi* Werner (1901); *Mehelyia lineata* Wandolleck (1911); *Mehelyia affinis* Wandolleck (1911); and *Oreophryne parkeri* Loveridge (1955). Currently two of these

[4] In listing 24 species, Zweifel (1985) overlooked the resurrection by Menzies (1976: 62) of *Oreophryne loriae*. Menzies compared the color pattern and advertisement call of *loriae* with those of *O. geislerorum* (as *O. biroi*), but took the characterization of *loriae* no further.

[5] Known as Irian Jaya for many years, this Province of Indonesia has again been given a new name (see Zweifel, 2000: 7). Confusion with Papua New Guinea may be unavoidable.

names are in synonymy, two are recognized as valid but are based on single specimens without precise locality data, one recognized species is known from just two specimens from a single locality, and one name has included several species. Only one of the seven nominal species, *Oreophryne brachypus* of New Britain, appears to be without serious taxonomic problems, and it is poorly known.

Where we can, we associate names with populations, diagnose and describe the valid species, and present data concerning distribution, habits, and vocalizations. We hope to provide a firmer basis for future work on the systematics and ecology of New Guinean *Oreophryne*, but recognize (and document) that even in the limited geographic area of this report much remains to be done.

METHODS

MORPHOLOGY: On most specimens examined we made a suite of measurements with dial calipers read to the closest 0.1 mm or, if appropriate, using a binocular dissecting microscope with an ocular micrometer read to the nearest 0.05 mm. Sex was apparent if the specimen was a male that was calling when captured. Otherwise, we determined males by the presence of vocal sac openings or by examination of gonads, and females by examination of gonads. We limited osteological study to examination of pectoral girdles of selected specimens to verify generic assignment and to determine the extent of the procoracoid cartilage. Color descriptions of living frogs are from field notes and photographs.

We use two principal means of characterizing the morphology of specimens and population samples. One is by ratios of measurements of various body parts with snout–vent length in the denominator. Ratios often change with growth (see Zweifel, 2000: 99, for a discussion), but this source of variation can be reduced by restricting samples to specimens of adult size. In fact, few samples of *Oreophryne* include many juveniles. In instances where samples being compared differ on average but overlap in two ratios, a simultaneous paired comparison often provides satisfactory separation (e.g., fig. 11).

The second method utilizes graphic comparison of regressions of measurements of body parts on snout–vent length. This method has a visual component that may point up subtle differences (occasionally calling attention to errors in measurement) not so apparent when comparing ratios. Tables of regression data are provided for species with adequate samples.

The following abbreviations pertain to measurements made (with some exceptions) on each specimen:

EN Distance between anterior edge of eye opening and center of external naris.

EY Distance between anterior and posterior edges of eye opening. It is sometimes necessary to push the eyeball up from within the mouth in order to approximate the condition in life.

FD Width of disk of third finger measured at a right angle to the axis of the digit with the disk flattened against a glass plate.

FT Length of foot between proximal edge of inner metatarsal elevation and tip of fourth toe (see HD).

HD Length of hand between proximal edge of inner metacarpal elevation and tip of third finger. Both hand and foot measurements may have reduced accuracy owing to the indistinct nature of the metacarpal and metatarsal elevations and to the difficulty of properly spreading the hands and feet of poorly preserved specimens.

HW Head width at widest point, generally at the level of the tympanum or jaw angle.

IN Distance between centers (not medial edges) of external nares.

SVL Length from snout to vent—from tip of snout to cloacal opening, with body flattened if necessary. New Guinean *Oreophryne* (including one described herein and samples unassigned to species) range in adult size from 11.5 to 49 mm SVL, with only the tiny *O. minuta* and three large species of 42, 47, and 49 mm standing out from the bulk of samples in which the range is about 18–35 mm. The species treated in this work fall into the the latter range, with adult sizes from about 20 to 30 mm. Males attain a maximum size roughly 80–95% that of the largest females; data for most species are inadequate to be more specific.

TD Width of disk of fourth toe measured at a right angle to the axis of the digit with the disk flattened against a glass plate.

TL Tibia length, between heel and outer surface of flexed knee.

TY Length of tympanum, including tympanic ring, measured horizontally. In most species the ear is scarcely apparent externally and hence it is difficult to measure.

We determined relative lengths of fingers and toes by appressing them parallel to the third finger or fourth toe; actual lengths were not measured.

Some species of *Oreophryne* lack toe webbing, but none of those studied here falls in that category. Webbing is not extensive in any of these species and does not differ enough among species to provide an objective species recognition character. One species possesses slight webbing between the fingers.

Species of *Oreophryne* include those in which the procoracoid cartilage extends to the scapula and others in which the connection to the scapula is ligamentous. So far as we can determine, the species dealt with here fall into the latter category.

Tape recordings of *Oreophryne* used here were made on a variety of instruments over a period of more than two decades, and some spurious variation among recordings is likely. Typically, these frogs call from overhead sites that may be several meters from the microphone, and their voices on tape are in competition with a cacophony of insect sounds. Collecting voucher specimens is not always possible, and the quality of the recordings is often less than optimum.

The audiospectrograms and waveforms illustrated were produced on a Kay 5500 DSP Sona-Graph. Analyses of calls—measurements of rates, note and call durations, dominant frequencies—were made with the aid of the CECIL computerized speech analysis system (Hunt, 1993). Originals or copies of the tape recordings used are, with one exception, stored and cataloged in the Department of Herpetology, American Museum of Natural History and in the University of Papua New Guinea Library.

A list of institutions whose specimens we examined (or if not examined, cited in the text) follows, with collection abbreviations and names of persons whom we thank for facilitating our study.

AMNH American Museum of Natural History, New York; Charles Myers, Charles J. Cole, Linda Ford

AMS Australian Museum, Sydney; Harold Cogger, A. Greer, Ross Sadlier

BMNH British Museum (Natural History), London; Barry Clarke

BPBM Bernice P. Bishop Museum, Honolulu; Allen Allison, Carla Kishinami

MCZ Museum of Comparative Zoology, Cambridge; John Cadle, José Rosado

MNH Magyar Nemzeti Muzeum, Budapest

MTKD Staatliches Museum für Tierkunde, Dresden

MZB Zoological Museum, Bogor, Indonesia; Curator Mumpuni

MZUT Museo Zoologico, Universita di Torino, Turin

NMBA Naturhistorisches Museum Basel, Basel

NMW Naturhistorisches Museum, Vienna

SMF Natur-Museum und Forschungs-Institut Senckenberg, Frankfurt-am-Main; Konrad Klemmer

UPNG University of Papua New Guinea, Port Moresby

USNM National Museum of Natural History, Washington, D.C.; Ronald Heyer, Ronald Crombie

YPM Yale Peabody Museum, New Haven, CT; F. Sibley

ZMB Universitat Humboldt Museum für Naturkunde, Berlin; R. Günther

ZMUC Kobenhavns Universitet Zoologisk Museum, Copenhagen; Arne Schiøtz

IDENTIFICATION OF GENUS

Segregation of the genera of genyophrynine microhylids is based initially on the structure of the pectoral girdle. Several genera (*Albericus*, *Aphantophryne*, *Cophixalus*, *Copiula*, and *Genyophryne*) lack clavicles, whereas in four genera (*Austrochaperina*, *Liophryne*, *Oxydactyla*, and *Sphenophryne*) the clavicles are elongate bones that extend from near the midline of the girdle almost to the scapula, presumably a plesiomorphic state. *Oreophryne* exhibits an intermediate condition in which the clavicles are tiny, slightly curved bones lying on (ventral to) the procoracoid cartilage and apart from the midline and the scapula. Ideally, the structure of the pectoral girdle is demonstrated by clearing and double staining, but with practice, given well-preserved specimens, the status of the clavicle can be established using only minimal dissection.

Most *Oreophryne* are scansorial frogs with well-developed digital disks and, without

Fig. 1. *Oreophryne biroi*. **Left,** UPNG 7355, SVL 20.5, from Nobanob (Mt. Hanseman), Madang Prov., Papua New Guinea (J. Menzies photo). **Right,** specimen from series AMS R31031–31035, not measured, from Passam, E. Sepik Prov., Papua New Guinea (H. Cogger photo).

knowledge of the pectoral girdle, could be confused with *Cophixalus* of similar habits. So far as is known, all *Oreophryne* in the geographic area considered here have some degree of toe webbing, whereas no *Cophixalus* does. Elsewhere, a specimen without webbing should not be assumed to be a *Cophixalus* without verifying the state of the pectoral girdle.

SPECIES ACCOUNTS

Oreophryne biroi (Méhelÿ)

Figure 1

Sphenophryne biroi Méhelÿ, 1897: 400[6] (type locality, ''from near Friedrich- Wilhelmshafen'' [= Madang, Madang Province, Papua New Guinea]; the two syntypes, MNH 2126B/3 [fide Parker, 1934: 170], collected by Lewis Biró, were destroyed in the Hungarian uprising of 1956; see Designation of Neotype, below).

Méhelyia lineata Wandolleck, 1911: 7 (type locality ''Sacksackhütte'', Torricelli Mountains, West Sepik Province, Papua New Guinea; 10 syntypes under MTKD D2213, 9 destroyed in World War II [Obst, 1977], one remains as BMNH 1947.2.12.63, all collected by O. Schlaginhaufen).

Méhelyia affinis Wandolleck, 1911: 8 (type locality not specifically stated, but presumably the same as that of *Mehelyia lineata*: ''Sacksackhütte'', Torricelli Mountains, West Sepik Province, Papua New Guinea [so given by Obst, 1977: 174]; syntypes a ''not exactly ascertainable number of specimens under MTKD D2214'' [Obst, 1977: 174, specimens destroyed in World War II], also BMNH 1947.2.12.61–62 and NMW 19826, all collected by O. Schlaginhaufen).

Oreophryne biroi: van Kampen, 1923: 118 (part, first use of combination). Parker, 1934: 170 (part, ''cotypes'' of *Sphenophryne biroi* only).

TYPE SPECIMENS AND TYPE LOCALITIES: Méhelÿ (1897) based his description of *S. biroi* on two specimens from the type locality. In a later publication (Méhelÿ, 1901: 252) he referred ''Zahlreiche Exemplare vom Sattleberg'' to this species. Specimens collected by Biró at Sattelberg (a mission station near the tip of the Huon Peninsula of Papua New Guinea) and present in at least two museums have been thought to be syntypes of *S. biroi*. Turin University has a specimen (MZUT An567) donated by the Budapest Museum that is cited as a syntype (Gavetti and Andreone, 1993: 114). Similarly, the Naturhis-

[6] This publication consists of a text in Hungarian followed by the same text in English, where the account of *Sphenophryne biroi* commences on p. 411.

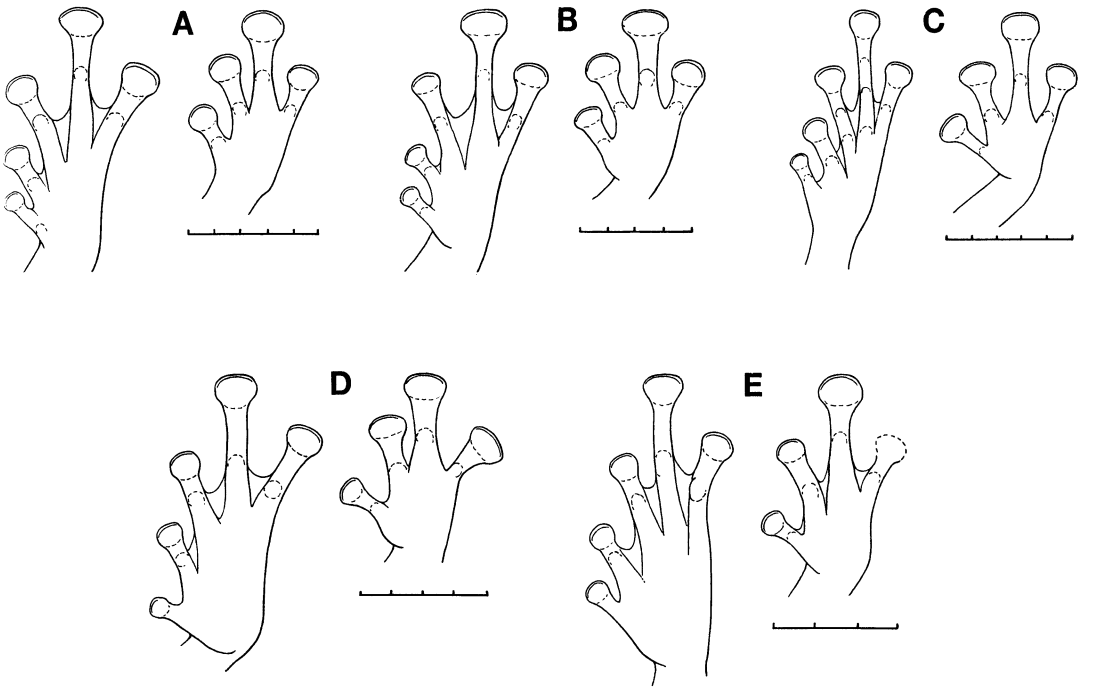

Fig. 2. Plantar and palmar aspects of feet and hands of five species of *Oreophryne*. **A.***O. biroi*, AMNH A-83041. **B.** *O. hypsiops*, AMNH A-83044. **C.** *O. parkeri*, BMNH 1955.1.1.17. **D.** *O. geislerorum*, AMNH A-75041. **E.** *O. brachypus*, AMNH A-84513. Scale in mm.

torisches Museum, Vienna, has a specimen (NMW 19825) received on exchange from Budapest that is listed as a syntype of *S. biroi* (Häupl et al., 1994: 34). Not only were these specimens not included in the material contributing to Méhelÿ's species description (and hence are not syntypes), but they belong to another species, *Oreophryne geislerorum*. Iskandar and Colijn (2000: 51) included BMNH 1901.3.9.2 along with the MZUT and NMW specimens in listing types of *O. biroi*, but the BMNH specimen is a *Cophixalus biroi* ''juv. in egg'' from Sattelberg (Parker, 1934: 175).

The type locality of *affinis* and *lineata* does not appear on maps available to us, but a map in Schlaginhaufen (1914) indicated that his anthropological fieldwork in the Torricelli Mountains took place south of Paup, a coastal village 29 km east-southeast of Aitape.

DIAGNOSIS: A species of *Oreophryne* with a maximum SVL of about 29 mm, ligamentous connection of procoracoid and scapula, third and fifth toes approximately equal in length, fourth toe about one-third webbed, and the following average proportions: HW/SVL 0.391, TL/SVL 0.474, EY/SVL 0.134, EN/SVL 0.100, and IN/SVL 0.092. No other described *Oreophryne* from the New Guinea region possesses this combination of characters. The advertisement call is unique among those of the few species whose calls are known.

MORPHOLOGY: Head somewhat narrower than body; canthus rostralis distinct but rounded, loreal region a steep, slightly concave slope; nostrils visible from above; interorbital space about 1.3–1.4× eyelid width; tympanum small, annulus obscured by overlying skin; no postocular skin fold. Relative lengths of fingers $3 > 2 \approx 4 > 1$, 1st finger > one-half length of 2nd, all fingers with broad terminal disks, no webbing, subarticular elevations low, rounded (fig. 2A); relative lengths of toes $4 > 5 \approx 3 > 2 > 1$, all with broad terminal disks, that of the 4th toe slightly narrower than that of 3rd finger or rarely the two equal, webbing reaching to

proximal subarticular elevations, subarticular elevations low, rounded (fig. 2A).

The figure of the pectoral girdle (Méhelÿ, 1897: pl. 10, fig. 6) confirms the generic placement in *Oreophryne*.

COLOR AND PATTERN: In preserved specimens, the dorsum has fine, light brown mottling on a paler background and indistinct, convergent, lighter dorsolateral bands, sometimes emphasized by indistinct darker borders. The top of the snout usually is paler than the middorsal region and may be abruptly demarcated at a transverse boundary between the eyes (fig. 1). There is a pale, indistinct, diagonal postocular stripe, and lumbar ocelli are only faintly indicated. The loreal region from the tip of the snout to beneath the eye is darker and more densely and evenly pigmented than the dorsum or the top of the snout. The groin and anterior surface of the thighs are pale and virtually unmarked, the posterior of the thighs similar. The upper sides of the legs are largely brown with lighter areas in no definite pattern, whereas the undersides are largely unmarked. The chin, throat, chest, and abdomen have a sparse scattering of melanophores, most concentrated near the jaw symphysis and posteriorly on the abdomen.

In life, two specimens (UPNG 7355, 7356) had the dorsum fawn and the top of the snout to midocular region conspicuously paler. The concealed sides of the thighs were orange, the venter pale with glistening white blotches, and the iris red-gold. One of the specimens had a thin middorsal stripe (J. Menzies, field notes).

VARIATION IN SIZE AND PROPORTIONS: Two adult females are 27.4 and 27.5 mm SVL, and a probable female (not sexed) is 28.5 mm. Adult males range from 22.1 to 24.0 mm SVL.

Ten specimens from East Sepik Province differ slightly from the Madang Province sample in some average proportions while being identical or nearly so in others (tables 1,2; figs. 3, 4). The East Sepik specimens have smaller average HW/SVL and IN/SVL ratios than those from Madang Province, though both sets of data overlap. If the two datasets are considered together, a good segregation of samples is evident (fig. 5). A specimen from West Sepik Province and another from the Cyclops Mountains of extreme eastern Papua show no significant differences from those from more easterly localities. Our assignment of the samples from outside of Madang Province to *biroi* is tentative; sibling species may be present (the name *lineata* is available). Acquisition of advertisement calls from East Sepik localities could play an important part in resolving the question.

COMPARISONS WITH OTHER SPECIES: From its sympatric congener *O. hypsiops* (a new species described below), *O. biroi* differs most conspicuously in its broader head, greater eye diameter, and wider internarial span; the third finger disk is narrower, but the difference is less marked (figs. 6, 7). See Discussion for additional comparisons.

HABITAT AND HABITS: Specimens have been taken in forests. Menzies (field notes) found two ''in much degraded bush on the slopes of Nobanob Hill'' (Mt. Hanseman, Madang Prov.). The lectotype was ''calling from the axil of a *Pandanus* frond not more than a meter above the ground'' (documentation on recording tape).

ADVERTISEMENT CALL: This is a loud, harsh rattle (fig. 8A, table 3). The single recorded sample lasts 3.7 sec and contains 67 brief notes with a duration of 0.014–0.025 sec, each note with two or three pulses. The note repetition rate is 18.1 per second at an air temperature of 25.0°C, the dominant frequency about 2450 Hz. There is a harmonic at 4900 Hz with almost as much energy as the dominant. J. Menzies made the recording at Kowat in the Adelbert Mountains; voucher specimen UPNG 8134.

DISTRIBUTION: The north coast of New Guinea from the vicinity of Madang, Madang Province, Papua New Guinea, north and west at least to the Cyclops Mountains near Jayapura, Papua, Indonesia. The range in elevation is from sea level to at least 1000 m (fig. 9).

LOCALITY RECORDS AND SPECIMENS EXAMINED: INDONESIA: Papua: Mt. Cyclops, 900–l200 m (BMNH 1935.6.5.90). PAPUA NEW GUINEA: West Sepik Prov.: Sacksackhütte, Torricelli Mtns. (BMNH 1947.2.12.61–63, NMH 19826 [syntypes of *M. affinis*], BMNH 1947.2.12.63 [syntype of *M. lineata*]), Rauit, 520 m, 53 km S, 11 km

TABLE 1
Body Proportions in Six Species of *Oreophryne*

	Mean ± σ_m	Range	N	Mean ± σ_m	Range	N
	TL/SVL			HW/SVL		
biroi[a]	0.490 ± 0.013	0.425–0.541	8	0.403 ± 0.007	0.375–0.431	8
biroi[b]	0.458 ± 0.011	0.415–0.524	10	0.378 ± 0.005	0.342–0.396	10
biroi[c]	0.474 ± 0.008	0.415–0.541	20	0.391 ± 0.005	0.342–0.431	20
brachypus	0.410 ± 0.008	0.381–0.442	8	0.356 ± 0.005	0.335–0.372	8
geislerorum	0.406 ± 0.002	0.371–0.446	48	0.346 ± 0.002	0.315–0.384	48
hypsiops[a]	0.442 ± 0.013	0.386–0.503	8	0.343 ± 0.005	0.324–0.373	8
parkeri	0.413 ± 0.012	0.380–0.445	5	0.325 ± 0.012	0.291–0.349	5
wolterstorffi	0.460		1	0.354		1
	EY/SVL			EN/SVL		
biroi[a]	0.135 ± 0.003	0.123–0.142	8	0.101 ± 0.002	0.090–0.110	8
biroi[b]	0.133 ± 0.003	0.119–0.143	10	0.099 ± 0.001	0.088–0.103	10
biroi[c]	0.134 ± 0.002	0.119–0.143	20	0.100 ± 0.001	0.088–0.110	20
brachypus	0.129 ± 0.002	0.119–0.135	8	0.083 ± 0.002	0.077–0.089	7
geislerorum	0.124 ± 0.001	0.110–0.137	48	0.089 ± 0.001	0.076–0.104	48
hypsiops[a]	0.113 ± 0.002	0.106–0.122	8	0.090 ± 0.002	0.082–0.097	8
parkeri	0.109 ± 0.004	0.098–0.120	5	0.079 ± 0.003	0.071–0.087	5
wolterstorffi	0.133		1	0.082		1
	IN/SVL			HD/SVL		
biroi[a]	0.095 ± 0.001	0.090–0.099	8	0.274 ± 0.007	0.239–0.299	8
biroi[b]	0.089 ± 0.001	0.081–0.095	10	0.273 ± 0.005	0.262–0.288	5
biroi[c]	0.092 ± 0.001	0.081–0.099	20	0.273 ± 0.004	0.239–0.299	14
brachypus	0.087 ± 0.002	0.077–0.094	7	0.266 ± 0.005	0.250–0.289	8
geislerorum	0.085 ± 0.001	0.074–0.096	48	0.255 ± 0.002	0.216–0.280	48
hypsiops[a]	0.067 ± 0.002	0.056–0.071	8	0.290 ± 0.004	0.279–0.308	8
parkeri	0.065 ± 0.002	0.059–0.070	5	0.267 ± 0.009	0.247–0.293	5
wolterstorffi	0.077		1	0.274		1
	FD/SVL			TD/SVL		
biroi[a]	0.061 ± 0.002	0.054–0.071	8	0.057 ± 0.002	0.043–0.064	8
biroi[b]	0.061 ± 0.002	0.051–0.068	10	0.056 ± 0.002	0.048–0.064	10
biroi[c]	0.061 ± 0.001	0.051–0.071	19	0.056 ± 0.001	0.043–0.064	19
brachypus	0.065 ± 0.002	0.053–0.070	8	0.063 ± 0.002	0.056–0.071	8
geislerorum	0.062 ± 0.001	0.048–0.073	48	0.061 ± 0.001	0.042–0.071	48
hypsiops[a]	0.072 ± 0.002	0.067–0.079	7	0.066 ± 0.002	0.061–0.071	7
parkeri	0.066 ± 0.002	0.061–0.070	5	0.057 ± 0.001	0.055–0.059	5
wolterstorffi	0.058		1	0.051		1

[a]Sample from Madang Province.
[b]Sample from East Sepik Province.
[c]Total sample.

W Aitape (UPNG 4088), Mt. Somoro, 11 km NE Lumi, 730–1400 m (AMNH A-78143). East Sepik Prov.: Passam, S of Wewak (AMS R31031–31035); Maprik (MCZ A92801, 92802); Kairuru Island, N of Wewak (AMNH A-103192, MCZ A97247, 97248). Madang Prov.: Madang, 5 m (AMNH A-84512); Nobanob, 7 km N, 5 km W Madang (UPNG 7355, 7356); Kowat, Adelbert Mtns., 1000 m, 42 km N, 50 km W Madang (UPNG 8133, 8134, last is neotype); Wanuma, Adelbert Mtns., 670 m, 35 km N, 54 km W Madang (AMNH A-83041); near Wanuma, Adelbert Mtns., 975 m, (AMNH A-83042);

TABLE 2
Regression Statistics for Five Species of *Oreophryne*

	α	β	r	N	α	β	r	N
	TL/SVL				HW/SVL			
biroi[a]	0.633	0.917	0.930	8	0.391	1.009	0.930	8
biroi[b]	1.165	0.704	0.776	10	0.538	0.888	0.934	10
brachypus	0.863	0.759	0.875	9	0.400	0.960	0.962	9
geislerorum	0.858	0.764	0.886	51	0.745	0.759	0.865	51
hypsiops[a]	3.570	0.319	0.767	8	1.020	0.652	0.961	8
parkeri	2.038	0.507	0.706	5	3.258	0.288	0.412	5
	EY/SVL				EN/SVL			
biroi[a]	0.112	1.508	0.927	8	0.078	1.082	0.908	8
biroi[b]	0.194	0.880	0.868	10	0.192	0.790	0.929	10
brachypus	0.170	0.909	0.962	8	0.126	0.869	0.895	8
geislerorum	0.392	0.637	0.858	51	0.224	0.710	0.717	51
hypsiops[a]	0.218	0.789	0.903	8	0.255	0.667	0.834	8
parkeri	0.367	0.622	0.622	5	0.896	0.256	0.376	5
	IN/SVL				HD/SVL			
biroi[a]	0.069	1.102	0.979	8	0.107	1.301	0.938	8
biroi[b]	0.113	0.923	0.912	10	0.117	1.270	0.990	10
brachypus	0.170	0.775	0.910	8	0.158	1.168	0.958	9
geislerorum	0.211	0.714	0.735	51	0.178	1.113	0.887	51
hypsiops[a]	0.062	1.035	0.963	8	0.469	0.847	0.947	8
parkeri	0.738	0.248	0.762	5	0.669	0.720	0.701	5
	FD/SVL				TD/SVL			
biroi[a]	0.031	1.217	0.774	8	0.007	1.649	0.899	8
biroi[b]	0.062	0.990	0.828	10	0.044	1.072	0.783	10
brachypus	0.012	1.542	0.974	9	0.015	1.467	0.953	9
geislerorum	0.024	1.291	0.779	51	0.018	1.372	0.739	51
hypsiops[a]	0.061	1.054	0.725	8	0.204	0.645	0.563	8
parkeri	0.014	1.485	0.959	5	0.030	1.204	0.975	5

[a]Madang Province, Papua New Guinea.
[b]E. Sepik Province, Papua New Guinea.

2.2 km W, 1.0 km N Alexishafen, sea level (YPM 5610).

DISCUSSION: Parker (1934) applied the name *biroi* to specimens collected over much of New Guinea from the neck of the Vogelkop Peninsula in Papua to the southeastern tip of Papua New Guinea, a distance of some 1900 km, including localities in both north and south drainages of the island. Although his sample of 52 specimens might at first be thought adequate, more than half came from a single locality (Sattelberg on the Huon Peninsula) and the remainder included some juveniles. Given the conservative morphology of most *Oreophryne*, it is not astonishing that Parker chose to recognize only a single species in this assemblage, synonymizing three names junior to *biroi*. It is now apparent that he subsumed several species in *biroi*, and it is essential to determine if the name can reasonably be associated, either as a junior synonym or as a valid species name, with a diagnosable natural population represented in the area of the type locality.

The two syntypes were a tiny juvenile of 8.5 mm and an ''adult'' of 17 mm. Neither Méhelÿ nor Parker gave the sex of the ''adult'', so use of the term may merely have

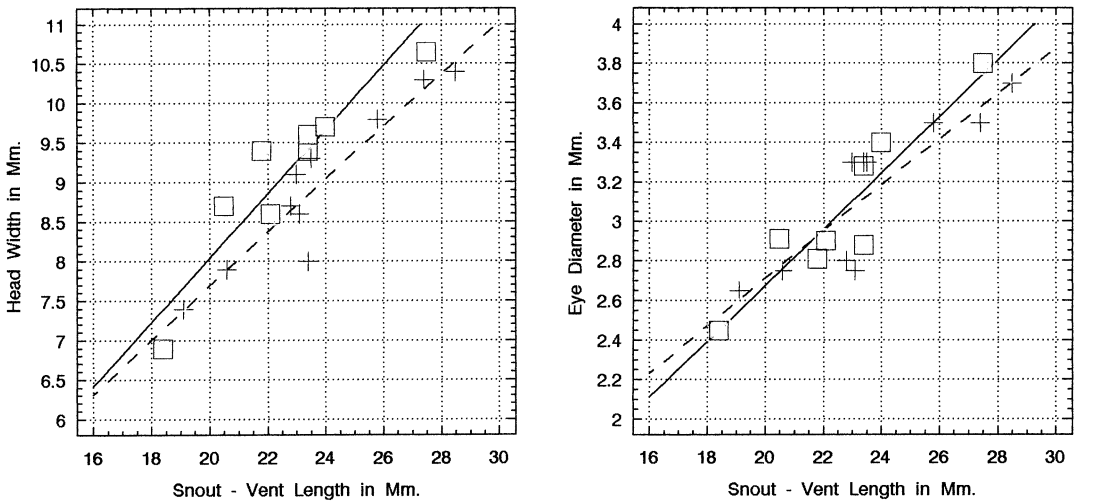

Fig. 3. Regression of head width and eye diameter on snout-vent length in two samples of *Oreophryne biroi* from Papua New Guinea. Squares, specimens from Madang Prov.; crosses, specimens from East Sepik Prov.

emphasized its greater size. That the larger syntype was immature is likely, for among our mixed species sample of about 100 *Oreophryne* from the whole north coast region, there are only two adult male specimens (vocal slits present) with SVL as short as 19.6 and 19.7 mm; all others are greater than 20 mm SVL, and a male *biroi* of 18.4 mm lacks vocal slits.

Méhelÿ's (1897) description is thorough by the standards of the time, but unfortunately lacks all measurements except ''17 mm. long'', probably approximately equiva-

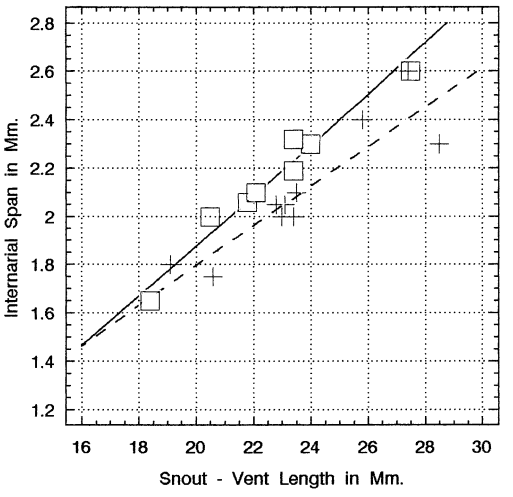

Fig. 4. Regression of internarial span on snout-vent length in two samples of *Oreophryne biroi* from Papua New Guinea. Squares, specimens from Madang Prov.; crosses, specimens from East Sepik Prov.

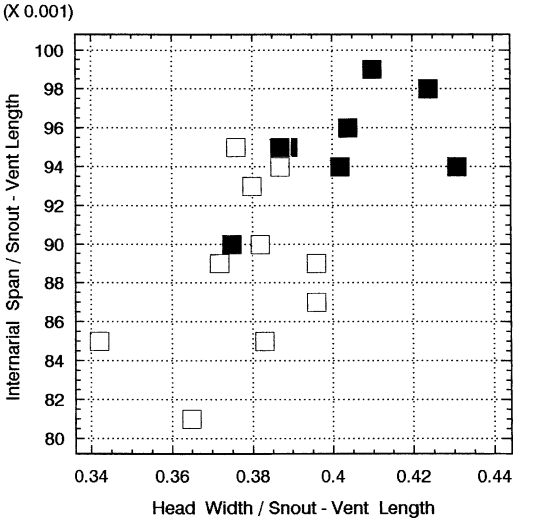

Fig. 5. Head width and internarial span ratios of two samples of *Oreophryne biroi* from Papua New Guinea compared. Solid squares, specimens from Madang Prov.; open squares, specimens from East Sepik Prov.

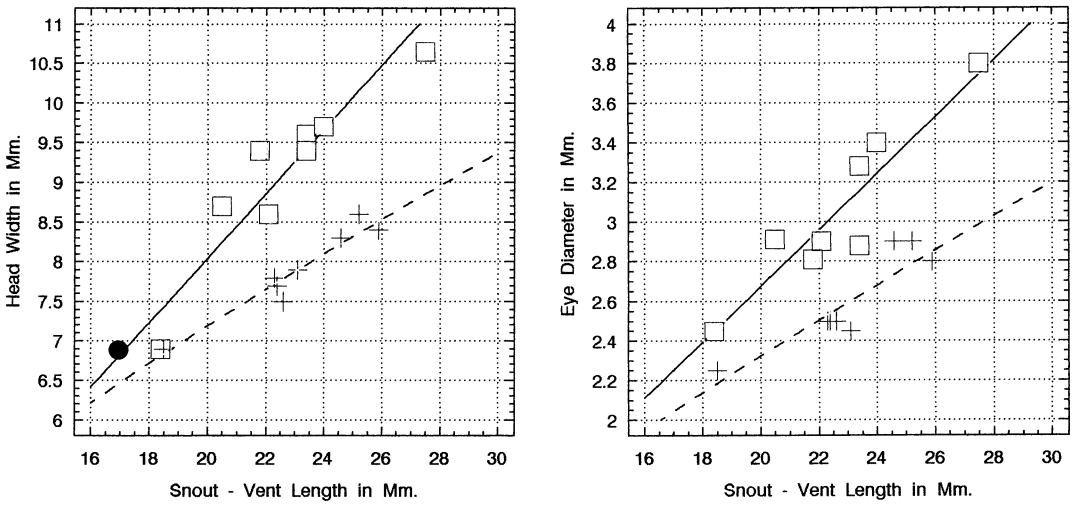

Fig. 6. Regressions of head width and eye diameter on snout-vent length in two samples of *Oreophryne* from Madang Prov., Papua New Guinea. Squares, *O. biroi*; crosses, *O. hypsiops*. The solid spot plots estimated head width of larger syntype of *O. biroi* (not used in calculating regression).

lent to SVL. Several aspects of morphology in the original description are not of diagnostic use, being either common to many species or not given in a sufficiently quantitative fashion. Assuming that the illustration (Méhelÿ, 1897: pl. 10, fig. 3, presumably the larger syntype) depicts proportions accurately, one can estimate a TL 8.7 and a HW of 6.9 mm. The search for the identity of *biroi* is best directed to comparisons of relative tibia length and head width with species of known or possible occurrence in the region of the type locality. Méhelÿ's statement (1897: 412) that the interspace between the nostrils is about equal to that between the latter and the orbit also is important.

Oreophryne geislerorum has been found no closer than about 220 km to the Madang area but it must be considered as it has been confused with *biroi* in the literature and may

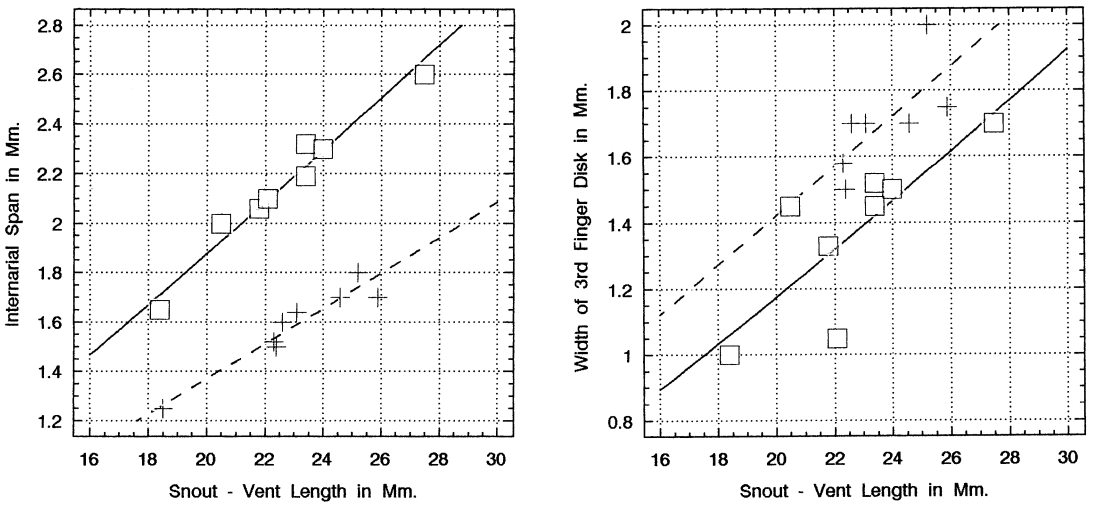

Fig. 7. Regressions of internarial span and width of third finger disk on snout-vent length in two samples of *Oreophryne* from Madang Prov., Papua New Guinea. Squares, *O. biroi*; crosses, *O. hypsiops*.

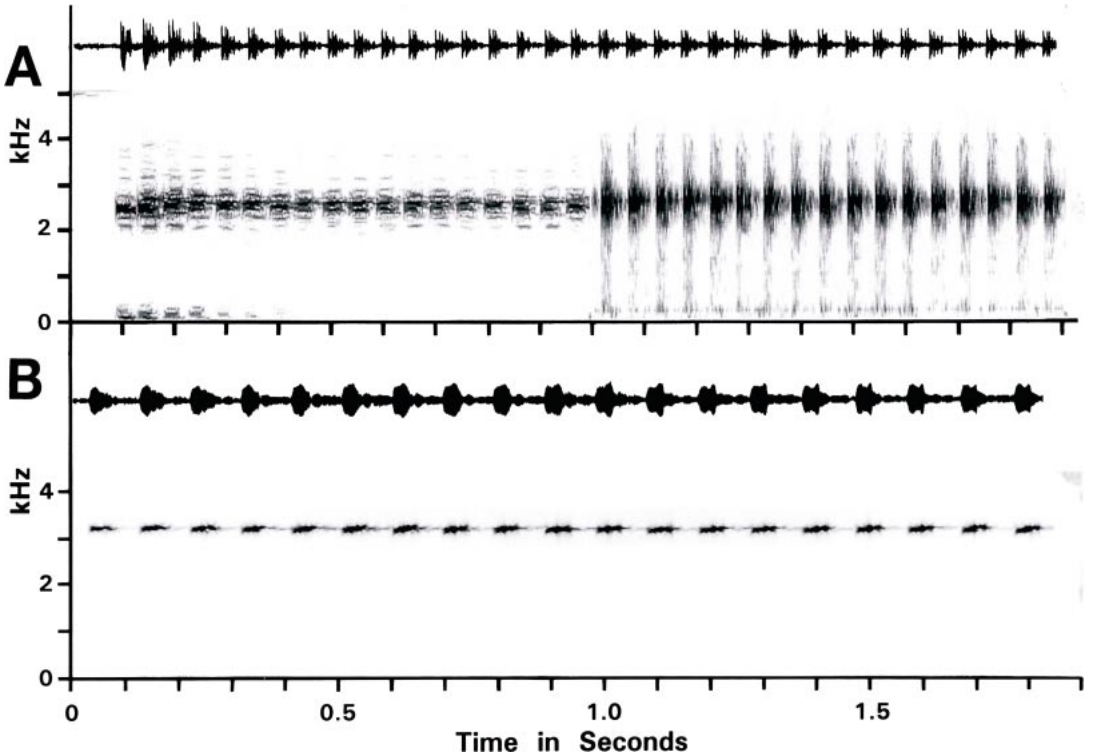

Fig. 8. Audiospectrograms of calls of *Oreophryne*. **A.** *O. biroi*, UPNG 8134, Kowat, Adelbert Mtns., Madang Prov., Papua New Guinea, air 25.0°C; first 35 notes of a 67-note call graphed with 59-Hz and 300-Hz filters. **B.** *O. hypsiops*, AMNH A-83044, vicinity of Sempi, Madang Prov., Papua New Guinea, air 25.8°C; first 19 notes of a longer call graphed with 59-Hz filter.

occur closer to Madang. Both the estimated HW and TL of *biroi* lie well above the extrapolated regression lines for *geislerorum* (fig. 10). The sample of *geislerorum* is large and well distributed by size (giving confidence in the regression data), so it is unlikely that the deviation seen in *biroi* can be explained as variation within *geislerorum*. A combination of HW/SVL and TL/SVL (fig. 11) distinguishes most specimens of these two species. Hence, we conclude that *biroi* is not a junior synonym of *geislerorum*.

We have found two quite distinct species of *Oreophryne* in the vicinity of Madang. The first of these (for convenience, species A) is represented by eight specimens from Madang Province as well as several others tentatively assigned to species A from sites to the northwest. These are relatively broad-headed frogs, and the estimated head width (fig. 6) and tibia length of *biroi* fall on the regression lines for species A. The relative eye–naris and internarial measurements (mean EN/IN, 1.07) are similar to the near equality of EN and IN stated for *biroi*.

The second species (B), represented by eight specimens from Madang Province with others from East and West Sepik provinces tentatively assigned to species B, is sympatric with species A and distinct in both morphology and vocalization. The head width of *biroi* falls above the regression line for the narrow-headed species B (fig. 6). The tibia length regressions for species A and B have different slopes but converge at the small size of the larger syntype of *biroi*, so tibia length does not distinguish *biroi* from species B. The internarial span of species B is narrow, noticeably less than the eye–naris distance (mean EN/IN, 1.32), another difference from *biroi*. It is unlikely that species B is equivalent to *biroi*.

Two problematic species are *Mehelyia affinis* and *Mehelyia lineata*, described by

TABLE 3
Advertisement Call Statistics for Five Species of *Oreophryne*

Specimen	N	Call duration (sec)		Notes per call		Notes per sec		Dominant freq., Hz	Temp., °C	Tape no.[a]
		Mean	Range	Mean	Range	Mean	Range			
Oreophryne geislerorum										
AMNH A–75041[b]	4	0.340	0.326–0.357	32.5	32–33	95.8	89.6–101.2	2900–3200	24.4	144
AMNH A–75044[b]	10	0.311	0.295–0.332	24.6	23–26	79.3	71.9–81.4	3100–3200	23.8	143
AMNH A–81195[b]	10	0.441	0.422–0.460	34.5	33–37	81.0	77.3–84.7	3200–3400	23.8	184
No voucher[c]	10	0.312	0.297–0.320	29.0	26–31	93.0	87.0–99.6	3300–3500		12249[d]
BMNH 1980.669[e]	10	0.282	0.269–0.297	38.0	37–40	134.8	128.9–141.9	3200–3300		12245[d]
AMNH A–76030[f]	10	0.493	0.321–0.541	24.3	18–27	49.7	45.8–56.1	3200–3450		204
AMNH A–75046[g]	10	0.353	0.340–0.373	24.0	23–25	68.1	64.6–71.8	3200–3300	23.0	141
Oreophryne biroi										
UPNG 8134[h]	1	3.70		67.0		18.1		2450	25.0	285
Oreophryne hypsiops										
AMNH A–83044[i]	4	2.58	2.32–2.39	24.3	24–25	10.1	9.8–10.3	3100	25.8	188
UPNG 7030[j]	2	2.97	2.90–3.03	27.5	27–28	9.3	9.2–9.5	3200	24.7	285
UPNG 9474[k]	2	2.85	2.85–2.94	20.5	20–21	7.3	7.25–7.40	2800	24.5	285
No voucher[l]	3	3.26	3.21–3.30	27.5	27–28	8.2	7.9–8.4	3000	24.0	285
No voucher[l]	1	2.71		25.0		9.6		2900	27.0	285
Oreophryne parkeri										
MZB 8156[m]	6	5.51	3.89–6.36	29.0	21–34	5.3	5.2–5.4	2600–2800	24.7	287
MZB 8155[m]	6	4.58	3.88–5.54	24.8	21–30	5.4	5.2–5.5	2750	24.4	288
No voucher[m]	4	4.67	4.55–4.87	26.3	26–27	5.5	5.5–5.6	2900	24.2	288
No voucher[m]	3	4.78	4.58–5.00	24.0	23–25	5.0	5.0	2750–2850	24.4	288

[a]Numbers refer to recording tape reels or cassettes archived in the Department of Herpetology, AMNH, unless otherwise noted.
[b]Lae, Morobe Province, Papua New Guinea.
[c]Buso River, Morobe Province, Papua New Guinea.
[d]British Library of Wildlife Sounds.
[e]South of Buso River, Morobe Province, Papua New Guinea.
[f]Pindu, Morobe Province, Papua New Guinea.
[g]Kokoda, Northern Province, Papua New Guinea.
[h]Kowat, Adelbert Mtns., Madang Province, Papua New Guinea.
[i]Vicinity of Sempi, Madang Province, Papua New Guinea.
[j]Bauman Village, Madang Province, Papua New Guinea.
[k]Yilu Village, Madang Province, Papua New Guinea.
[l]Nobanob, Madang Province, Papua New Guinea.
[m]Sentani, Papua, Indonesia.

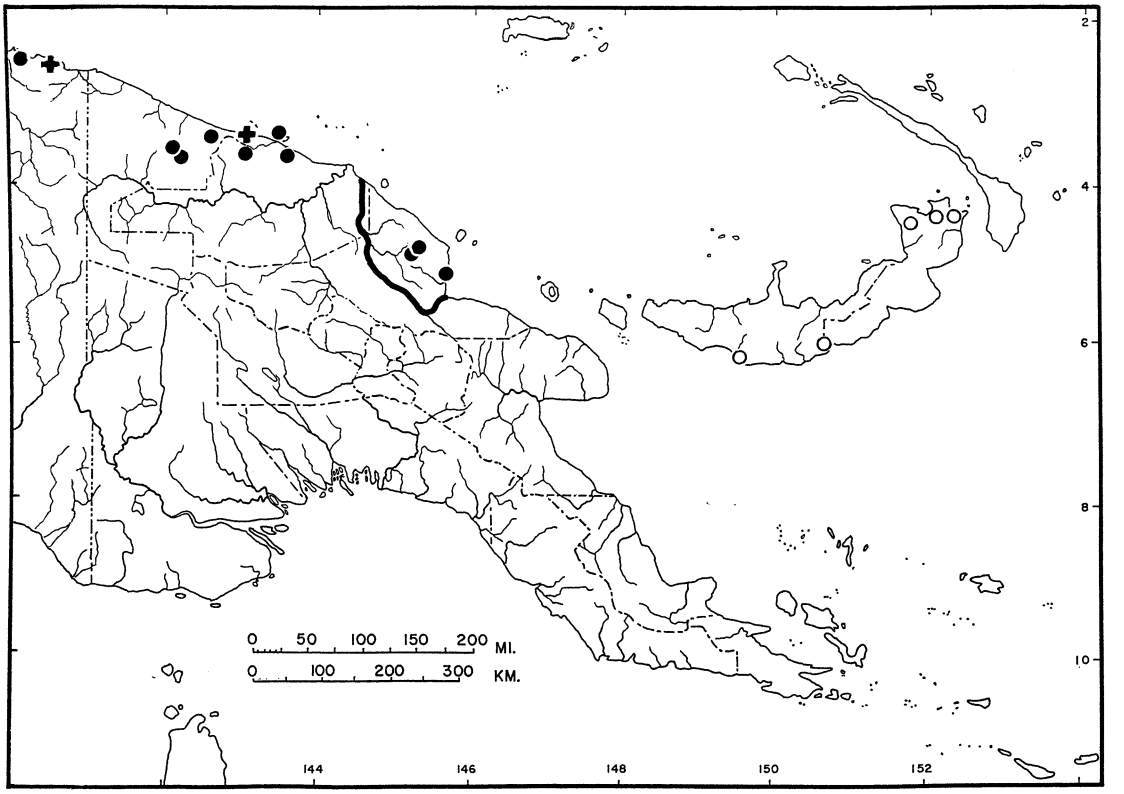

Fig. 9. Distribution of four species of *Oreophryne* in New Guinea and New Britain. Solid circles, *O. biroi*; open circles, *O. brachypus*; crosses, *O. parkeri*. The heavy line marks the course of two expeditions on one of which Ernst Tappenbeck collected the unique specimen of *O. wolterstorffi*.

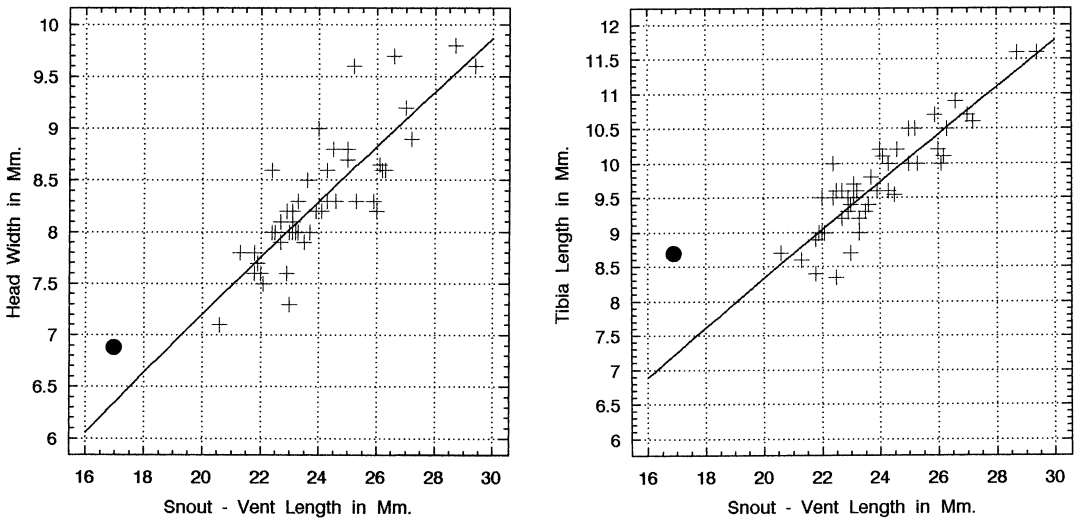

Fig. 10. Regressions of head width and tibia length on snout-vent length in *Oreophryne geislerorum*. The solid spots plot the estimated head width and tibia length of the larger syntype of *O. biroi*.

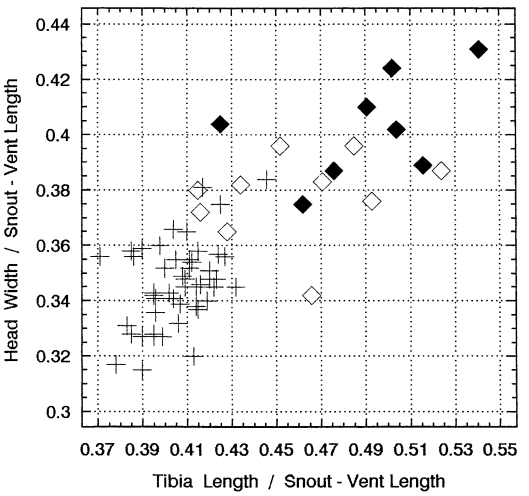

Fig. 11. Head width and tibia length ratios of *Oreophryne geislerorum* (crosses) and *O. biroi* (diamonds) compared. Solid diamonds represent specimens from Madang Prov., open diamonds specimens from East Sepik Prov.

Wandolleck (1911) from the Torricelli Mountains some 500 km northwest of Madang and treated by Parker (1934) as junior synonyms of his composite *biroi*. Wandolleck based his two species on relatively large series of specimens (at least 27 of the former and ten of the latter) from one locality. He noted their great morphological similarity but stated that they differed in the shape of the pterygoid and in features of the ventral pectoral girdle. He considered that the presence of a middorsal stripe in *lineata* distinguished it externally from *affinis*. Parker (1934: 170) dismissed the supposed differences in the pectoral girdle as ''probably due to individual or sexual variation'', but he did not comment on the color pattern.

The near lack of objective measurements in Wandolleck's descriptions (only maximum body lengths of 24 and 27 mm are mentioned), the loss of most of the syntype specimens in World War II (Obst, 1977), and the poor condition of the few remaining syntypes hinder determination of the status of the two species. Only one syntype of *lineata* exists (BMNH 1947.2.12.63).[7] Upon examining it in 1986, R.G.Z. noted ''in very poor condition—toes falling off, right arm off, legs dangling by skin only.'' There are two extant syntypes of *affinis* (BMNH 1947.2.12.61–62) for which we have a complete set of measurements, and one (NMW 19826) with an incomplete set. Their condition, too, is less than perfect.

Measurements of *lineata* (TL not taken) with one exception fall close to the regression line for *biroi* as here conceived and well within the scatter of points. The exception is EY (3.7 mm), which is unusually large for an *Oreophryne* the size of *lineata* (ca. 22.3 mm SVL)—larger, in fact, than for any other specimen of its approximate size among several species examined. Considering the poor condition of the specimen (with implications for accuracy of measurement), we do not think that this aberrant measurement disqualifies *lineata* as a synonym of *biroi*. The specimens of *affinis* present essentially the same picture as does the single *lineata*, largely conforming to the measurements of *biroi*. Again, one specimen has an EY above the scatter of *biroi* points, but another is on the regression line. One of the specimens we assign to *biroi* for which we have color pattern notes has the middorsal pale line described for *lineata*. This particular feature of color pattern is polymorphic in some other species of *Oreophryne* and is a tenuous attribute on which to diagnose a species. However, it is curious that it appeared in a large proportion (at least 27%) of the original combined sample of *lineata* and *affinis*.

With the information available, we do not find it possible to distinguish *lineata* and *affinis* as different species, nor can they be separated from *biroi*. Hence, we maintain their status as junior synonyms of *biroi*. This conclusion could be verified or reversed by the acquisition of recordings of advertisement calls from *biroi*-like frogs from the Torricelli Mountains.

The enigmatic *Oreophryne wolterstorffi* presumably came from within the general range of *O. biroi* but cannot be identified with that species (see species account of *O. wolterstorffi*).

In summary, *geislerorum* is the least likely to be the same as *Oreophryne biroi*, while *affinis* and *lineata* are best left in the syn-

[7] Obst (1977: 174) stated that a paratype had been given to the Berlin Museum in 1935. However, Dr. Rainer Günther (personal commun.) has advised us that no such specimen is now in the collection.

onymy of *biroi* pending new information to the contrary. Between species A and B, species A is a better fit to *biroi* than is species B. The remaining alternative—that *biroi* is a species as yet not rediscovered at its type locality—is the least parsimonious explanation. Therefore, we equate species A with *Sphenophryne biroi* and describe B as new a new species, *O. hypsiops*. There is a practical aspect to this decision; that is, with the syntypes of *biroi* destroyed, a neotype may be designated that conserves the species name and provides for a functional diagnosis of the species. Such a designation conforms to the ''Qualifying conditions'' in the International Code of Zoological Nomenclature (International Commission on Zoological Nomenclature, 1999: 84–85).

DESIGNATION OF NEOTYPE FOR *SPHENOPHRYNE BIROI* MÉHELŸ, 1897: Stabilization of the nomenclature of this species dictates designation of a neotype to replace the destroyed syntypes. We designate UPNG 8134, a male collected by James Menzies (see Locality Records and Specimens Examined). The locality for this specimen falls broadly within the original type locality, ''near Friedrich-Wilhelmshafen'' (= Madang) in an area that was under German colonial development. The specimen is particularly appropriate in that it as yet is the only one with a tape recording of the diagnostic advertisement call.

ERRONEOUS LITERATURE REFERENCES TO *OREOPHRYNE BIROI:* Parker (1934, 1936), with his broad concept of the range of *O. biroi*, identified as that species a number of specimens that are unlikely to be *biroi* as here defined. Some of these are *Oreophryne geislerorum* (see species account); others we deal with here.

A specimen from Mt. Tafa, 8500 ft, in Northern Province, Papua New Guinea (BMNH 1935.3.9.24; Parker, 1936: 72), is a juvenile *Oreophryne anthonyi* (Boulenger), a relatively large species of high elevations known from Mt. Tafa (Zweifel, 1956: 19).

Four specimens from Fergusson Island, Milne Bay Province, Papua New Guinea (BMNH 1904.11.62–65; Parker, 1934: 170) agree well with *Oreophryne insulana* Zweifel (1956), described from nearby Goodenough Island. A mainland specimen from Milne Bay (BMNH 1903.4.30.21; Parker, 1934: 170) is best referred to *Oreophryne* sp., pending resolution of the relationship of *Oreophryne* of this region to *Oreophryne loriae* in the Port Moresby area (Menzies, 1976: 62).

Single specimens identified by Parker (1934: 170) as *O. biroi* from Katow, Western Province, Papua New Guinea (BMNH 1883.10.23.2), Wendessi, Papua (BMNH 1909.10.30.23), and Setakwa River, Papua (BMNH 1913.11.1.132) each differ from *biroi* in at least two significant proportions as well as being from sites remote from the known range of *biroi*. These are best left as *Oreophryne* sp. until the *Oreophryne* of western Papua New Guinea and Papua are better understood.

Parker (1934: 169) included *Oreophryne mertoni* (Roux) of the Aru Islands, Indonesia, in the synonymy of *Oreophryne biroi*, but with question (he had not examined any specimens from that locality). Forcart (1946: 134) compared the holotype of *mertoni* (NMBA 2731) with three specimens of ''*Or. biroi* vom Sattelberg'' (NMBA 2268–2270) and considered Parker's uncertain synonymy of the two species confirmed. But the specimens from Sattelberg must be *O. geislerorum*, which again points up the confusing morphological similarity among various *Oreophryne*. The meager known frog fauna of the Aru Islands comprises eight common lowland species of New Guinea and a supposed endemic genus and species, *Microbatrachus pusillus* Roux, that Zweifel (2000) considered to be unidentifiable. Geographic considerations alone rule out conspecificity of *O. mertoni* and *O. biroi*, and it is likely that *O. mertoni* is an insular representative of a mainland species. Which species cannot at present be said.

Since Parker defined *Oreophryne biroi*, remarkably few literature references to the species have appeared. Loveridge (1948: 423) recorded several specimens as *O. biroi*: a British Museum exchange specimen from Fergusson Island (possibly *Oreophryne insulana*, see above), five specimens from Aitape, West Sepik Province, and one from Gusiko, Morobe Province. The last must be *O. geislerorum*; we discuss the Aitape specimens in the section on Specimens Not Identified to Species. Menzies (1976: 50) used

the name *biroi* for what is *geislerorum* (at this time the latter species was still considered to be a *Cophixalus*) and mistakenly indicated that the species ranges as far northwest as Madang.

Zweifel (1956: 22) identified four specimens from Mt. Dayman, Milne Bay Prov., as *O. biroi*. These bear a considerable similarity to *Oreophryne inornata* of Goodenough Island, but evidently represent a much smaller species, probably undescribed. References to *biroi* in checklists (e.g. Allison, 1993; Iskandar and Colijn, 2000; Scott et al., 1977; Zweifel, 1985; Zweifel and Tyler, 1982) now have no currency.

Oreophryne brachypus (Werner)

Hylella brachypus Werner, 1898: 554 (type locality, ''Ralum'' [Gazelle Peninsula, East New Britain Province, Papua New Guinea]; syntypes ZMB 14666 [adult male], ZMB 15483 [1 adult male and 1 juvenile], collected by A. Rie on January 17 and February 1, 1897). Werner, 1900: 121.

Hyla brachypus: Barbour, 1912: 177. Nieden, 1923: 220. Van Kampen, 1923: 37. Loveridge, 1948: 323. Zweifel, 1960: 2.

Oreophryne brachypus: Tyler, 1964a: 4 (first use of combination). Tyler, 1967: 187.

DIAGNOSIS: The presence of webbing on the hands distinguishes *O. brachypus* from mainland species of northern New Guinea. The advertisement call apparently is unlike any other yet described for a New Guinean *Oreophryne* (see below).

MORPHOLOGY: Snout rounded but almost truncate in dorsal view, loreal region flat or very shallowly concave, nearly vertical, canthus rostralis rounded, nostrils scarcely visible from above and nearly terminal in lateral view. Eyes large, prominent, visible from beneath. Tympanum small, $<$ one-third eye diameter, indistinct at best. Dorsum essentially smooth, only the faintest suggestion of a supratympanic fold. Relative lengths of fingers $3 > 2 \geq 4 > 1$, 1st half length of 2nd; fingers with basal webbing, all with enlarged, grooved terminal disks, disk of 3rd finger twice width of penultimate phalange; subarticular elevations low, rounded, inner metacarpal elevation the same (fig. 2B). Relative lengths of toes $4 > 5 > 3 > 2 > 1$, fifth slightly but distinctly longer than 3rd; all with enlarged, grooved disks, the 1st scarcely broader than penultimate phalange; disks of 3rd finger and 4th toe similar in width, sometimes equal or either may be slightly wider; 5th toe about one-half webbed, as is 3rd between it and 4th; subarticular elevations scarcely exist, inner metatarsal elevation elongate but barely distinguished (fig. 2B).

Tyler (1964a) described and illustrated the holotype, its pectoral girdle (with ligamentous connection of clavicle to scapula), and the Y-shaped terminal phalanges.

COLOR AND PATTERN: ''In life *brachypus* has a dusky brown ground colouration with indistinct and slightly darker markings on it. Of these markings the most common are a narrow transocular bar and a W-shaped patch immediately behind the head'' (Tyler, 1967: 187); ''Upper side brown (in life dark brown or olive green), underside gray, wholly or only throat finely spotted, or white (in life greenish yellow)'' (Werner, 1898: 554). Notes accompanying the ZMUC specimens record a grayish to blackish brown dorsal color in life and a pale gray to gray-violet venter. Ventral surfaces of preserved specimens may be sparsely stippled with dark pigment or may have a denser, more mottled appearance.

VARIATION IN SIZE AND PROPORTIONS: Tyler (1967: 187) reported the average SVL of 16 adult males as 19.9 mm (range 19.2–22.3 mm) and of three adult females as 22.0 mm (range 21.5–22.8 mm). In our series of nine specimens the largest male is 22.5 mm and the largest specimen, presumably a female but not sexed, is 24.0 mm. See tables 1 and 2 for proportions.

ADVERTISEMENT CALL: ''The call consisted of a single note, resembled a long squeak and had a duration of about four seconds'' (Tyler, 1967: 188). Known calls of other *Oreophryne* are groups of repeated shorter notes or pulsed single notes shorter than described for *brachypus* and not likely to be described as a ''squeak''.

COMPARISONS WITH OTHER SPECIES: Apart from possession of finger webbing, *brachypus* has average morphology for *Oreophryne*. The species is most similar to *geislerorum* and cannot reliably be distinguished from that species through any of the standard ratios or combinations of them. Only the mean

EN/SVL ratios differ substantially, but the range of this ratio in *geislerorum* overlaps that of *brachypus* completely. Apparently *brachypus* is a smaller frog than *geislerorum*, males of which species attain almost 27 mm SVL and females 29 mm. The call of *geislerorum*, a harsh sounding series of closely spaced pulses lasting about 0.5 sec, evidently is quite different from the ''long squeak'' of *brachypus*.

HABITAT AND HABITS: Two of the syntypes were found ''in a nest built of living moss ¼ meter high in a large Zingiberacae [ginger]'' (Werner, 1900: 121). Tyler (1967: 183) stated ''The males were located . . . calling from vegetation at heights of from three to eight feet from the level of the ground.'' Photographs in Wolff (1966: pl. 32, fig. 2; pl. 33, fig. 1) give a general impression of habitats around Yalom where the ZMUC specimens were taken.

DISTRIBUTION: Limited information indicates a wide distribution in New Britain, at least from the southwest coast to the northeast tip of the island, and from 140 to 1000 m elevation (fig. 9).

LOCALITY RECORDS AND SPECIMENS EXAMINED: PAPUA NEW GUINEA: East New Britain Prov.: Yalom, 1000 m, 35 km SE Cape Lambert, Gazelle Peninsula (ZMUC E385, 401, 411, 431, 434, 437); Gaulim, 140 m (AMNH A-84513); Keravat, Gazelle Peninsula (Tyler, 1967: 187); Talalo, Nakanai Mtns., 900 m (BPBM 1182–1183); Ralum (type locality). West New Britain Prov.: Pomugu and Aliwoh, both near Kandrian (Tyler, 1967: 187); Garu (UPNG 4107); Awit River, 05°59′S, 150°41′E (AMS 129629, 129630, not examined); 8 km NNE Amelei Village 06°02′S, 150°39′E (AMS 129618, not examined).

REMARKS: From the time of its description in 1898 up to 1964, this species was considered a hylid. Except for Werner's (1900) reprise of the original description, however, evidently none of the reports published subsequent to the original description until Tyler (1964a) was based on examination of the syntypes or other specimens.

The morphology of the few specimens of *brachypus* gives no reason to suspect the presence of more than one species of *Oreophryne* on New Britain, but we urge future collectors to obtain recordings of calls in order to test this assumption and, in any event, to provide for a more objective description of the call.

Fig. 12. *Oreophryne geislerorum*, AMNH A-75042, SVL 26.3, from Lae, Morobe Prov., Papua New Guinea (R. Zweifel photo).

Oreophryne geislerorum (Boettger)

Figure 12

Cophixalus geislerorum Boettger, 1892: 24 (type locality, ''Kaiserwilhelmsland, Neuguinea''; holotype SMF 4197, collected by Bruno and Hubert Geisler in 1890 or 1891; see Type Material and Locality).

Sphenophryne biroi: Méhelÿ, 1901: 252 (specimens from Sattelberg).

Hylella brachypus: Vogt, 1911: 427 (specimen from Sattelberg).

Oreophryne biroi: Parker, 1934: 170 (part, specimens from Sattelberg, Kokoda,and Orrori). Loveridge, 1948: 423 (part, specimen from Gusiko). Menzies, 1976: 62, pl. 12f. Häupl et al., 1994: 34.

Oreophryne geislerorum: Menzies et al., 1980: 233 (first use of combination). Iskandar and Colijn, 2000: 52.

Oreophryne sp.: Zweifel, 1980: 411.

TYPE MATERIAL AND TYPE LOCALITY: The holotype is in moderately good condition, though owing to dissection it lacks elements of the pectoral girdle diagnostic of the genus *Oreophryne*. Additional specimens, part of the same collection (and lacking precise locality data), were sold to at least one other museum (Vienna) where they are cataloged as ''paratypes'' of *geislerorum* (NMW 19828, 3 specimens); Häupl et al., 1994: 19). But Boettger evidently used only the holotype in formulating his description, so the Vienna specimens have no formal status as types, though presumably they are topotypes.

The type locality as given in the original description encompasses about half of mainland Papua New Guinea. Information on the travels of the collectors (Wichmann, 1912: 517–518) suggests that the holotype was obtained somewhere between the eastern tip of the Huon Peninsula and Bogadjim (= Stephansort), about 300 km to the west-northwest on Astrolabe Bay. The known distribution of *geislerorum* does not include localities as far west as Bogadjim. The former German administrative center of Finschhafen, Morobe Province, Papua New Guinea, or the mission station of Sattleberg nearby are more likely candidates for the collection site.

DIAGNOSIS: An *Oreophryne* of maximum length about 29 mm with ligamentous connection of procoracoid and scapula, fifth toe longer than third, fourth toe webbed to subarticular elevation, head width relatively narrow (mean HW/SVL 0.346), and internarial space relatively broad (mean IN/SVL 0.085). Among the north coast species, *geislerorum* shares its broad internarial space with only *biroi* and *brachypus*. The latter is distinguished by its finger webbing and insular isolation. Shorter tibia length and narrower head width of *geislerorum* afford an almost complete separation from *biroi*. The call of *geislerorum* is unique (see Advertisement Call).

MORPHOLOGY: Head slightly narrower than body, nares barely visible from above, canthus rostralis moderately distinct, loreal region steep, flat; interorbital space about 1.5× eyelid width, corneal outline visible from beneath; tympanic annulus barely distinct; a weak, diagonal postorbital-supratympanic fold. Fingers and toes with well-developed terminal disks (fig. 2D). Widths of disks on third toe and fourth finger closely similar, typically equal or the finger disk slightly broader, less often the toe disk slightly broader. Relative lengths of fingers $3 > 4 > 2 > 1$, tip of first finger reaches just past the subarticular elevation of the second, no webbing, subarticular elevations low, rounded, inner metacarpal elevation elongate, slightly more prominent. Relative lengths of toes $4 > 5 > 3 > 2 > 1$, basal webbing, subarticular elevations low, rounded, inner metatarsal elevation low, elongate, slightly more prominent.

COLOR AND PATTERN: A specimen from Kokoda (R.G.Z. field notes) had the following coloration in life: Dorsum yellowish brown with a darker brown patch posterior to and between the eyes; a pair of indistinct dark brown lateral bands on the body, the area between the bands and the head spot somewhat reddish brown. Forelimbs reddish brown distally and yellowish proximally, no distinct markings. An indication of a light wrist band set off by a darker gray-brown band and a band around the distal part of the forearm. Underparts yellow, chin body and legs included, relieved only where the viscera show through slightly darker in the abdominal region. The same yellow present laterally on the body where it gives way to the yellow-brown of the dorsal surfaces. A slight narrow dark brown canthal stripe continued faintly over the tympanum. Ground color of hind limbs light brown with no definite markings but some faint reddish brown splotches. Iris golden brown, pupil horizontal.

A specimen from Lae (R.G.Z. field notes) had a brown dorsal ground color with ill-defined darker markings, most prominent in the scapular region. Anterior to a transverse line drawn through the middle of the eyes the snout was much lighter brown, almost golden. The ventral surfaces from chin to toes were grayish white without markings.

In preservative the specimens remain brown with darker pattern elements but lose the golden or yellow aspects of the living animal.

VARIATION IN SIZE AND PROPORTIONS: The largest of 14 females measures 29.4 mm SVL, the largest of 30 males 26.6 mm. The smallest gravid female is 24.1 mm, and the smallest male with vocal slits 20.6 mm. Proportions are summarized in tables 1 and 2.

ADVERTISEMENT CALL: The call of *Oreophryne geislerorum* (fig. 13A, table 3) is harsh with rapidly repeated notes that are not individually discrete to the human ear though they are readily resolved on waveform display. The duration is about 0.3–0.5 sec and the dominant frequency 3200–3400 Hz. The frogs call at irregular intervals averaging about 7 sec but ranging from 2 to 20 seconds in a sample of 65 calls of five individuals. Notes per call range from 18 to 40 in a sample of 64 calls of seven individuals, but any one frog shows much less variation (table 3). The note rate changes within each call, typ-

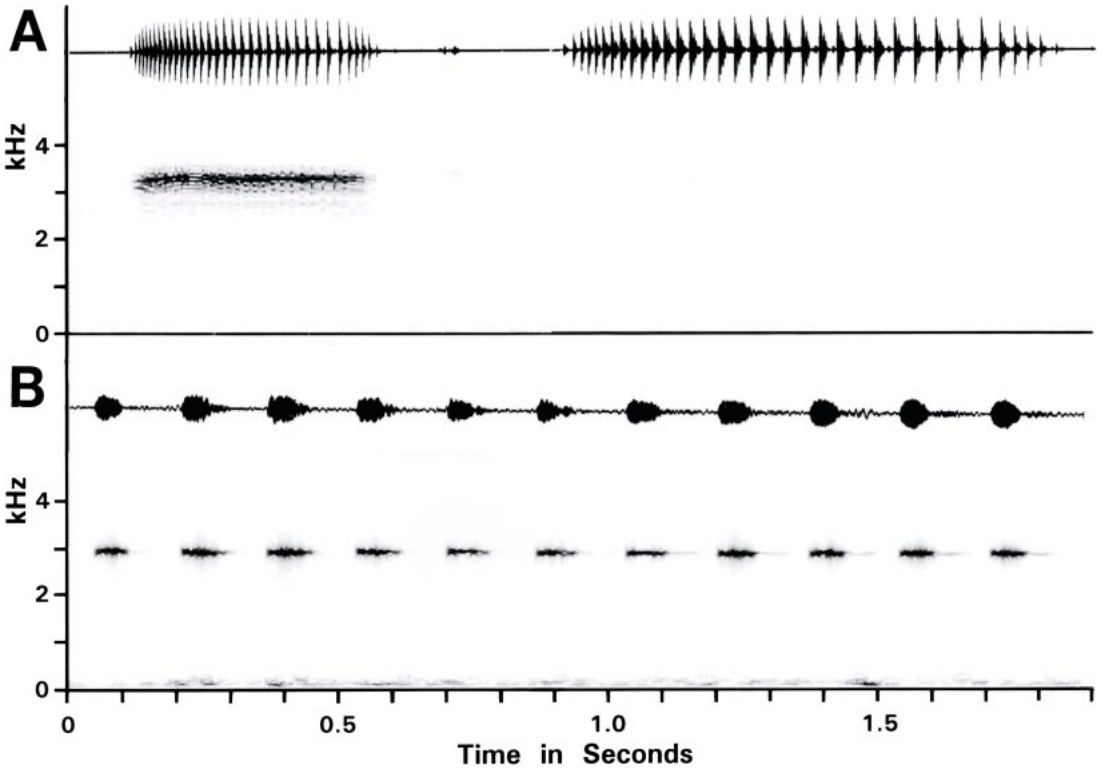

Fig. 13. Audiospectrograms of calls of *Oreophryne* graphed with 59-Hz filter. A. *O. geislerorum*, AMNH A-81195, Lae, Morobe Prov., Papua New Guinea, air 23.8°C; one complete call, wave form at right at 2× expansion. B. *O. parkeri*, MZB 8155, vicinity of Lake Sentani, Papua, air 24.4°C; first 11 notes of a longer call.

ically starting rapidly, then slowing down for the most of the call, and speeding up toward the end. Some individuals have a slower initial rate and fewer notes per call so that rates averaged over the entire call vary greatly, even at closely similar temperatures.

The call of *O. geislerorum* is quite distinctive and different from that of any other *Oreophryne* known to us. However, it is peculiar in the wide variation of note rate, about 50–135 notes per sec (table 3), while notes per call and call duration remain relatively constant. Different rates may have been associated with different (unobserved) behaviors. Differences in body temperatures could be responsible. Unfortunately, temperature was not noted by the recordists of the most divergent calls. Variation in tape speed in the equipment used to record and copy tapes could cause spurious rates, but cannot be the full explanation. (The fastest rate and a more typical one were recorded on the same machine a few days apart.) Another possibility is that *geislerorum* as we define it consists of two or more sibling species, but information available at present is insufficient to explore this option.

COMPARISONS WITH OTHER SPECIES: *Oreophryne geislerorum* is not known to be sympatric with any other *Oreophryne*. Any specimens from the gap between the known range of *geislerorum* on the one hand and the ranges of *biroi* and *hypsiops* on the other (figs. 9, 14) should be readily identified (see Key). If *O. geislerorum* ranges farther to the southeast than is now known, it could contact several species of *Oreophryne* occurring in the Milne Bay area that are outside the scope of this study. These include the insular species *O. inornata* and *O. insulana* and *O. loriae*. Compared to *geislerorum*, *inornata* is a much larger species, up to about 42 mm

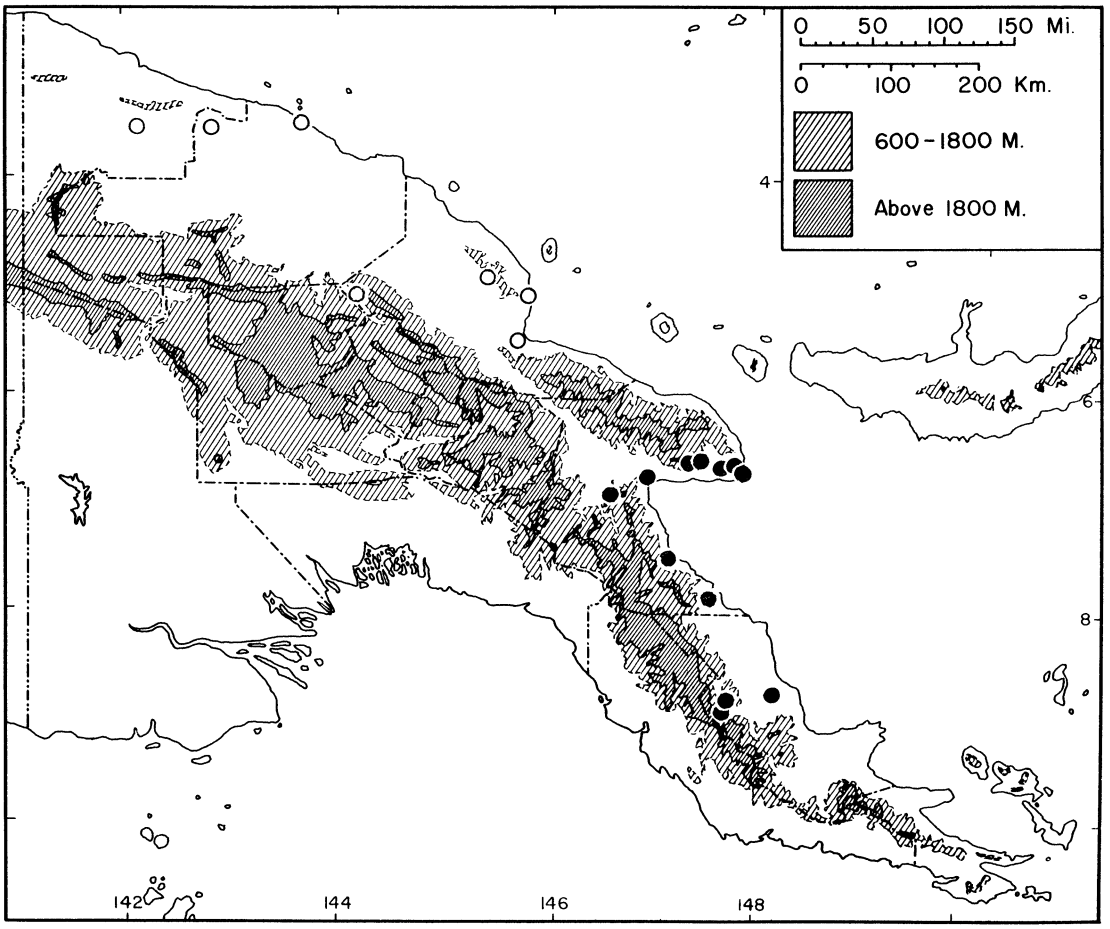

Fig. 14. Distribution of two species of *Oreophryne* in Papua New Guinea. Solid circles, *O. geislerorum*; open circles, *O. hypsiops*.

SVL, and *insulana* is broader headed (mean HW/SVL 0.393 vs. 0.346). Menzies (1976: 62) recorded *O. loriae* from Milne Bay at the southeastern tip of the Papua New Guinea mainland. This species (based on examination of the type series) has much in common morphologically with *geislerorum* and perhaps may best be distinguished from *geislerorum* by its advertisement call, ''a series of 6 to 12 short, rather nasal, buzzes, uttered at a rate of 2 per second'' (Menzies, 1976: 62).

HABITAT AND HABITS: Stocks (1987: 18) published an account of this species, from which we quote: ''*Oreophryne* sp. . . . can be found in shrubs and trees at night, is common in suburban gardens in Lae as well as the tropical rainforest . . . . It frequently calls from banana leaves and lays its eggs inside the stalk of a banana leaf near the main stem.'' Stocks observed a captive female approach a male calling on a banana leaf and follow him as he moved down inside the stalk. ''The resulting eggs are laid in a sticky string which adheres to the stem of the banana leaf. The male remains with the eggs, mainly to drive off insects . . . and often can be found with two strings of eggs at different stages of development.'' An excellent photograph (by Mike McCoy) illustrates a frog with an egg clutch.

Zweifel (1980: 411) found these frogs on the Huon Peninsula ''hiding during daytime in banana plants and in cut bamboo stems in gardens and in second growth [at 1340 m].''

He reported frogs calling ''from sites 4 to 8 feet up in banana and pandanus plants'', but ''neither found nor heard this species at Gang Creek [1340 m] in the tall primary forest.'' Calling sites include both under and upper surfaces of broad leaves (banana and ginger), sometimes ''too high in the trees to be approached'' (R.G.Z., field notes).

DISTRIBUTION: This species ranges from the tip of the Huon Peninsula westward at least to Lae and the Wampit River and from there southeast at least as far as Kokoda and Popondetta, Northern Province. The extent of the range inland from Lae is unknown, but neither *geislerorum* nor any other *Oreophryne* has yet been taken at Wau (1100 m), despite much collecting in the area. Records for Northern Province (verified by recordings of the call) are disjunct (fig. 14), but the Papuan coastal region north of Popondetta has been poorly collected for frogs, and the distribution may be continuous through this region. The range in elevation is from virtually sea level at Lae to 1340 m on the Huon Peninsula. See Remarks.

LOCALITY RECORDS AND SPECIMENS EXAMINED: PAPUA NEW GUINEA: German New Guinea (SMF 4197, holotype); New Guinea (NMW 19828, 3 specimens). Morobe Prov: Huon Peninsula, Sattelberg (Méhelÿ, 1901: 252; Parker, 1934: 170; NMH 19825); Huon Peninsula, Mogisang, 550 m (UPNG 5710, 5711); Huon Peninsula, Manga, Go River, 600 m (UPNG 5725, 5726); Huon Peninsula, Dregerhafen (UPNG 2989, 2990); Huon Peninsula, Gusiko (USNM 119199); Huon Peninsula, Tumnang, 1340 m (AMNH A-58374, 75026–75030, 75032, 75034–75040, 145570–145582, MCZ A28402, 28403); Huon Peninsula, Pindiu, 820–910 m (AMNH A-76025–76030, BPBM 1178); Huon Peninsula, Mindik (BPBM 5285, 5286); Gurakor, 640 m (AMNH A-66992); Lae (AMNH A-75041–75044, 81195; UPNG 3631–3634, 3715–3717, 4098, 4099, 4138, 4394, 4906, 4908); 4 km N Lae (MCZ A92446–92449); S of Buso River (BMNH 1980.669); upper Mo River, Bowutu Mtns (call record only, no specimen). Northern Prov: Kokoda, 370 m (AMNH A-75045, 75046, BMNH 1934.1.5.7–9); ca. 1 km N, 9 km W Popondetta, 300 m (UPNG 3964, 5473); Orrori, 910 m, 16Å km SW Kokoda (BMNH 1934.1.5.10).

DISCUSSION: From the time of its description in 1892 up to 1980, *geislerorum* appeared in the literature as a species of *Cophixalus* of questionable provenance, and at least one author questioned the generic assignment (van Kampen, 1919: 54, ''= *Oreophryne* sp.?''; van Kampen, 1923: 146, ''Probably . . . belongs to *Oreophryne* or *Sphenophryne*''). Menzies et al. (1980) identified *geislerorum* as an *Oreophryne* and recognized the name as the most senior among all New Guinean *Oreophryne*. These authors, however, did not determine whether *geislerorum* was a senior synonym of a species then recognized and did not associate it with a natural population.

Our determination that the name *geislerorum* is properly identified with the species here characterized derives both from morphological considerations and from geography. As noted under Type Material and Type Locality, although the place of collection cannot be precisely inferred, it can be bounded more closely than the more generalized published type locality. In the region thus circumscribed, and in Morobe Province as a whole so far as we know, only this one species of *Oreophryne* occurs.

We have calculated and plotted regression lines for several measurements in a sample of 48 specimens of *geislerorum*. In all measurements, the holotype of *geislerorum* falls within the ranges seen in this series, in most cases close to the regression lines, even on them in two instances. The body size is well centered in the distribution, and relative sizes of finger and toe disks, relative toe lengths, and amount of toe webbing also agree.

REMARKS: The status of *Oreophryne* occurring southeast of Popondetta to Milne Bay remains to be elucidated. Menzies (1976: 62) recorded *O. loriae* at Milne Bay, but several unidentifiable species of *Oreophryne* are present as well. Specimens from Mt. Dayman recorded by Zweifel (1956) as *O. biroi* are neither that species nor *O. geislerorum* and probably not *O. loriae*.

Oreophryne hypsiops, new species

Figure 15

HOLOTYPE: AMNH A-83044 (field tag RZ 8041) from the vicinity of Sempi, 9 km north

Fig. 15. Dorsal view of holotype of *Oreophryne hypsiops*, AMNH A-83044; SVL 22.6 mm.

of Alexishafen, sea-level elevation, Madang Province, Papua New Guinea, collected by R.G. Zweifel on July 13, 1969.

PARATYPES (all from Papua New Guinea): Madang Prov.: UPNG 9474, Yilu Village, 25 km N, 46 km W Simbai, 500 m, collected by J. Menzies; AMNH A-83043, 83045, vicinity of Sempi, 9 km N Alexishafen, collected by R. Zweifel, July 12–13, 1969; UPNG 7354, Nobanob, 7 km N, 5 km W Madang, collected by J. Menzies; UPNG 7030, Bauman Village, 27 km S, 13 km W Madang, collected by J. Menzies; AMNH A-83046, 83047, Adelbert Mtns., Wanuma, 975 m, 35 km N, 54 km W Madang, collected by R. Zweifel, August 5–6, 1969. East Sepik Prov.: BPBM 1171, Dreikikir, 350–400 m, collected by M. and J. Gressitt, June 23, 1961; BPBM 1179, Wewak, 2 m, collected by M. and J. Gressitt, June 26, 1961. West Sepik Prov.: AMNH A-78141, Miliom, 3 km E Lumi, 460 m, July 20–23 1966, collected by Jared Diamond.

ETYMOLOGY: The specific name is a noun in apposition, derived from the Greek *hypsi* (on high) + *ops* (with included meanings of ''eye'' and ''voice'') . The allusion is to a presumably watching frog that often vocalizes frustratingly well above the heads of collectors/recordists.

DIAGNOSIS: An *Oreophryne* with a maximum length of about 26 mm, ligamentous connection of scapula and procoracoid, narrow head (mean HW/SVL 0.343), closely spaced nostrils (mean IN/SVL 0.067), moderate eye-naris distance (mean EN/SVL 0.090), third and fifth toes approximately equal in length, and toes partially webbed, the fourth short of the proximal subarticular elevation. Dorsal and lateral surfaces lacking abundant tiny white spots. This combination of characters together with the distinctive advertisement call will distinguish *O. hypsiops* from other species in the north coast region of New Guinea.

DESCRIPTION OF HOLOTYPE: Adult male (calling when taken) with the following measurements and proportions: SVL 22.6, HW 7.5, TL 9.9, EY 2.55, EN 1.85, IN 1.6, HD 6.3, FT 9.6, FD 1.7 (penultimate phalanx 0.7), TD 1.6 (0.8); HW/SVL 0.332, TL/SVL 0.438, EY/SVL 0.113, EN/SVL 0.082, IN/SVL 0.071, HD/SVL, 0.279, FT/SVL 0.425, FD/SVL 0.075, TD/SVL 0.071.

Head somewhat narrower than body; canthus rostralis rounded, not distinct; loreal region flat and nearly vertical; nostrils barely visible from above, internarial span relatively narrow (mean IN/SVL 0.069), shorter than eye–naris distance (mean EN/SVL 0.086); interorbital space 1.5× eyelid width, tympanic annulus barely visible. Relative lengths of fingers $3 > 2 \approx 4 > 1$, 1, 1st > one-half 2nd, all with well-developed terminal disks, no webbing, low, rounded subarticular elevations (fig. 2B); relative lengths of toes $4 > 5 \approx 3 > 2 > 1$, all with broadened terminal disks, that of 4th toe slightly narrower than that of 3rd finger; low, rounded subarticular elevations, sparse webbing reaching barely to proximal subarticular elevations of toes 1–3 and 5, less on toe 4 (fig. 2B).

In preservative, the dorsal surfaces are

brown, darker laterally than in the middorsal region but not differentiated from the color of the top of the snout. There are moderately conspicuous lumbar ocelli. The loreal region has a paler area between the more darkly pigmented snout tip and the area beneath the eye. The groin and proximal anterior part of the thigh are pale and unmarked, the area proximal to the knee is darker. The cloacal region is dark, the rest of the posterior thigh coarsely mottled dark and light. The upper surfaces of the legs are largely brown with some paler markings in no definite pattern; the underside of the thigh is brown, that of the shank largely pale. The chin, throat, chest, and abdomen are brown with numerous paler light flecks. There are no specific notes on the color of the holotype in life except for its similarity to others captured nearby (see below).

VARIATION IN THE TYPE SERIES: Four males 22.3–23.1 SVL are adult; three females 24.6–25.9 mm SVL are gravid. Proportions are summarized in tables 1 and 2.

The dorsal ground color in life is dark gray to gray-brown with a more or less distinct dark, W-shaped mark in the scapular region. One specimen had an hourglass-shaped rusty area occupying most of the middle of the back. Other features of the dorsal pattern may include a dark interocular bar and a dark mark in the postocular-supratympanic region. Black lumbar ocelli with white anterior edging typically are present. The groin and anterior and posterior surfaces of the thighs are yellow, with light gray mottling in some individuals. The chin, chest, and abdomen are gray, sometimes almost black, darker on the chin than posteriorly, with tiny white flecks. The iris is grayish gold to dark gray-brown.

ADVERTISEMENT CALL: The call of *Oreophryne hypsiops* is a series of 20–28 notes (12 calls from five individuals) with a dominant frequency of 2900–3200 Hz uttered at about 7–10 notes per sec, and lasting about 2.2–3.3 sec (fig. 8B, table 3). The nature of the notes varies considerably, both within and among calls. The high-energy part may be pulsed or not, and ranges from about 0.04 to 0.07 sec in duration. A note may taper off gradually or abruptly, in some instances continuing weakly almost until the initiation of the next note (reverberation?). The range of temperatures at which recordings were made (24–27°C) is not wide enough to demonstrate an influence of temperature on the variables.

Calls appear to be given at relatively long and irregular intervals. In one recorded sequence, the second call was initiated 29 sec after the first, and the third 1 min 53 sec later.

COMPARISONS WITH OTHER SPECIES: *Oreophryne hypsiops* is sympatric with *O. biroi* and is abundantly distinct from that species; see Discussion under *biroi* (figs. 6, 7). See the account of *O. parkeri* for distinctions from that species.

HABITS AND HABITAT: Calling males were generally high, some probably 5 m or more above the ground. One male was seen on the underside of a nearly vertical banana leaf about 3 m above ground and another at a similar elevation atop a broad leaf in a spray of leaves at the top of sapling. A female was found on a much lower banana leaf, and one male on a leaf only about 1 m up.

DISTRIBUTION: The Adelbert Mountains and adjacent coastal region of Madang Province, Papua New Guinea, westward to the south slope of the Schrader Mountains, and probably northwest as far as the vicinity of Lumi, West Sepik Province; from sea level to at least 975 m. The three specimens from East Sepik and West Sepik Provinces conform closely to those from Madang Province in morphology, but the specific identity of frogs in these regions has not been confirmed by recordings of vocalizations.

LOCALITY RECORDS AND SPECIMENS EXAMINED: See Holotype and Paratypes.

Oreophryne parkeri Loveridge

Figure 16

Cophixalus geislerorum: Loveridge, 1948: 423.

Oreophryne parkeri Loveridge, 1955: 3 (type locality, ''Matapan [= Matapau], Australian New Guinea'' [West Sepik Prov., Papua New Guinea]; holotype MCZ A12964, collected by E.A. Briggs ''about January, 1923'').

TYPE LOCALITY: Matapau is a village on the coast at 143°00′E. The spelling ''Matapau'' appeared in Loveridge's (1948: 423) first report on these specimens but was modified to ''Matapan'' in the 1955 description of the species. The former spelling is used in the ''Village Directory'' (Territory of Papua

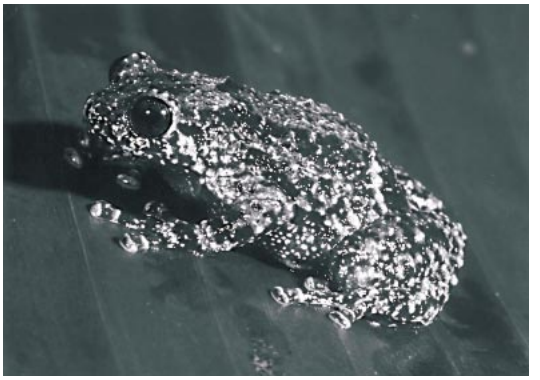

Fig. 16. *Oreophryne parkeri*, MZB 8156, SVL 24 mm (D. Price photo).

and New Guinea, Department of Native Affairs, 1960) as well as on the Suain quadrangle, sheet 7491 of the 1:100,000 topographic map series, and we assume it to be the correct one.

DIAGNOSIS: *Oreophryne parkeri* is distinguished by its combination of narrow head (mean HW/SVL 0.325), small eyes (mean EY/SVL 0.109), short internarial span (mean IN/SVL 0.065), and a color pattern emphasizing numerous tiny white spots over all dorsal surfaces.

MORPHOLOGY: The holotype and only paratype are females with the following measurements and proportions (paratype in parentheses): SVL 28.9 (25.6), HW 8.4 (7.8), TL 11.8 (10.1), EY 3.05 (2.5), EN 2.05 (2.2), IN 1.7 (1.6), HD 7.6 (7.5), FT 11.2 (10.3), FD 2.0 (penultimate phalanx 0.6), TD 1.7, 0.7 (1.4), TY 1.6 (1.3); HW/SVL 0.291 (0.305), TL/SVL 0.408 (0.395), EY/SVL 0.105 (0.098), EN/SVL 0.071 (0.086), IN/SVL 0.059 (0.063), HD/SVL 0.263 (0.293), FT/SVL 0.387 (0.402), FD/SVL 0.069 (0.070), TD/SVL 0.059 (0.055).

The holotype and paratype are in poor condition, appearing somewhat shrunken so that the eye and head width measurements in particular may be shorter than in life. The following description generalizes from study of the type specimens and fresh material from Papua.

Snout bluntly rounded, almost truncate seen from above, vertical in profile, nares just visible from above, canthus rostralis rounded, loreal region sloping, slightly concave; interorbital span 1.4 × 1.7 width of eyelid; tympanum moderately distinct to indistinct. Fingers unwebbed, relative lengths $3 > 4 \approx 2 > 1$, 1st > one-half 2nd, all with well-developed disks, subarticular elevations low, rounded (fig. 2C). Toe webbing reaches the subarticular elevations of the third and fifth toes but not that of the fourth, relative lengths $4 > 5 > 3 > 2 > 1$, 5th only slightly longer than 3rd or the two essentially equal, disks broad but narrower than those of fingers, inner metatarsal elevation very indistinct, outer absent (fig. 2C). Supratympanic and hourglass-shaped interscapular are weakly indicated. A ligament connects the procoracoid and scapula (examined on the holotype only).

The only major discrepancy between our assessment of the holotype and that of the describer involves the size of the eyes. Loveridge (1955: 4) stated ''horizontal diameter of the eye . . . about equal to seven-eighths its distance from the nostril.'' By our measurement, the eye is almost 1.5× the eye–naris distance (1.1× in the paratype).

COLOR AND PATTERN: In preservative, ''Above, brown, uniform except for some dark crossbars on the limbs and light areas in groin. Below, brown, paling posteriorly towards groin; thighs flecked with white, tibiae largely white'' (Loveridge, 1955: 4). The holotype is now faded brown dorsally with no conspicuous markings. The undersides have dense, fine brown mottling, essentially the same from chin through hind legs. The paratype is brown dorsally with paler spotting and mottling; flanks more coarsely mottled; conspicuous lumbar ocelli; top of head brown with no interocular bar; loreal area and upper lips brown with little trace of lighter color but no dark face-mask effect; upper surfaces of thighs faintly mottled, shanks somewhat more so; posterior surfaces of thighs not distinctly patterned; chin and chest pale with dense melanic spotting that disperses on the abdomen.

In life, MZB 8155 (DP 95037) had the following colors and pattern: dorsum from snout to sacral region light brown with irregular darker small spots interrupted by a sharply defined, dark scapular ''W'' ; abundant tiny white spots over all dorsal and lateral surfaces and limbs; moderately distinct

lumbar ocelli with a white anterior border; facial region—lips, below eye, loreal area—mottled dark and light brown with tiny white spots; groin and anterior of thigh white with a yellowish tinge and with a few brown speckles; posterior of thigh brown with white spots around cloacal opening, paler distally; ventral ground color white; throat with dense but pale gray-brown speckle, chest and abdomen more mottled; underside of thigh mottled, of shank largely white. Each phalanx bears a narrow white band just proximal to the disk. The iris was dark brown. MZB 8156 had similar colors and pattern to MZB 8155 but with the skin more rugose with pointy warts emphasized by terminal white spots. The venter was melanistic with light areas of the abdomen appearing as spots rather than as ground color; groin and anterior of thigh more brown than white; posterior of thigh coarsely mottled in brown and white.

VARIATION IN SIZE AND PROPORTIONS: The holotype, a gravid female (fide Loveridge, 1955; not verified by us as the specimen is stuffed with cotton) measures 28.9 mm SVL and the paratype, probably female, 25.6 mm SVL. Males of 23.0 and 23.8 mm SVL are adult. See tables 1 and 2 for body proportions.

ADVERTISEMENT CALL: The call is a train of 21 to 34 notes uttered in about 5 sec at a rate of about 5 per sec with a dominant frequency of 2600–2900 Hz (table 3, fig. 13B). The aural impression is of ''peeps'', sometimes slightly harsh. The envelope of individual notes can vary, even within a single train. At the simplest, a note can be unpulsed with the amplitude dropping abruptly but evenly near the end at about 0.07 sec. At the other extreme, the body of the note may have two or three distinct pulses with an additional weak pulse or two in a tail tapering off almost to the initiation of the succeeding note. The recordings were made within a narrow temperature span (24.2–26.3°C), so the call durations and note repetition rates can be expected to vary more than we report here.

COMPARISONS WITH OTHER SPECIES: Its narrow internarial span distinguishes *O. parkeri* from other north coast species except *O. hypsiops*. These two are similar in all proportions with broad overlaps in all ratios except for TD/SVL. No specimen of *hypsiops* showed the spotted pattern seen in the *parkeri* from Papua. The advertisement calls are similar, but differ in duration and in note repetition rate with no overlap in these parameters (table 3). We attach significance to the large size of the holotype of *parkeri* (female, SVL 28.9 mm) compared to that of the largest female *hypsiops* (25.9 mm), while recognizing that *hypsiops* may prove to be a synonym of *parkeri* with the Papua specimens representing an undescribed species.

Oreophryne albopunctata (van Kampen) from the Lorentz River in Papua, far to the southwest across the central ranges, resembles *parkeri* in three of the critical proportions (HW, EY, IN) but has a more typical, wider internarial distance—IN/SVL 0.083 and 0.084 in the two syntypes.

HABITS AND HABITAT: The holotype was ''taken near running water in Sago Palm Forest'' (Loveridge, 1948: 423) or ''taken from running water in sago-palm forest'' (Loveridge, 1955: 3). Considering that no *Oreophryne* is known to be even partially aquatic, the former alternative is the more likely. At Sentani these frogs called from about 3 to 6 m above ground in banana plants and sago palms in an area of garden regrowth.

DISTRIBUTION: Known only from the type locality, a coastal village lying about midway between Aitape and Wewak, and from Sentani, Papua (fig. 9).

LOCALITY RECORDS AND SPECIMENS EXAMINED: PAPUA NEW GUINEA: West Sepik Prov.; Matapau (MCZ A12964 [holotype], BMNH 1955.1.1.17, paratype, formerly MCZ A12963). INDONESIA: Papua: Sentani (east end of airport, MZB 8155, 8156); Iffar, Lake Sentani (BMNH 1935.6.5.88).

REMARKS: It is unfortunate that *Oreophryne parkeri* was described from two poorly preserved specimens. One problem we faced was whether to recognize the Papua specimens and *parkeri* as two species or to pool the specimens as *parkeri*. We have taken the latter conservative course, influenced by the probability that some, at least, of the seemingly distinctive morphology of the type and paratypes of *parkeri* may be due to their poor state of preservation. New material from the vicinity of the type locality is needed to verify our assignment of the specimens from Papua to this species (and, indeed, to verify

the distinction from *hypsiops*); recordings of the advertisement call would be virtually essential.

Oreophryne wolterstorffi (Werner)

Hylella wolterstorffi Werner, 1901: 613 (type locality ''German New Guinea'' ; holotype ZMB 16853, collected by Ernst Tappenbeck in 1896 or 1898; see Type Locality).
Hyla wolterstorffi: Van Kampen, 1923: 40. Loveridge, 1948: 323.
Oreophryne wolterstorffi: Tyler, 1964b: 676.

TYPE LOCALITY: The type locality of *wolterstorffi* is indefinite. Dr. Rainer Günther (personal commun.) advised us that the Berlin Museum has no data accompanying the holotype other than ''Neu Guinea'' and ''Tappenbeck''. The collector, Ernst Tappenbeck, explored in 1896 westward from the coastal region of Astrolabe Bay (south of Madang) as far as the upper reaches of the Ramu River, and in 1898 traveled upstream (south) from the mouth of the Ramu more than 300 km, overlapping a segment of the river he had previously explored from the south (Wichmann, 1912: 643–644; Souter, 1963: 76–78); see figure 9 for the combined routes. We cannot even approximate where or on which of these routes the type specimen may have been taken.

DEFINITION AND DIAGNOSIS: A small *Oreophryne*, probably with a ligamentous connection of procoracoid and scapula (Tyler, 1964b: 676), and with relatively large eyes, narrow head, short eye–naris span, unwebbed fingers, fifth toe longer than third, and scant toe webbing. These and other characters in combination provide a tentative diagnosis distinguishing *wolterstorffi* from other species in the north coast region. See Comparisons with Other Species.

MORPHOLOGY: The holotype (sole specimen) has the following measurements and proportions[8]: SVL 22.6, HW 8.0, TL 10.4, EY 3.0, EN 1.85, IN 1.75, HD 6.2, FT 9.0, FD 1.3 (penultimate phalanx 0.5), TD 1.15 (0.4), TY 0.75; HW/SVL 0.354, TL/SVL 0.460, EY/SVL 0.133, EN/SVL 0.082, IN/SVL 0.077, HD/SVL 0.274, FT/SVL 0.398, FD/SVL 0.058, TD/SVL 0.051.

[8] Measured by R.G.Z. in 1997; there are minor differences from data in Tyler (1964b).

Head slightly narrower than body; canthus rostralis rounded, loreal region moderately steep, slightly concave; snout narrowly rounded seen from above, vertical in profile; interorbit 3.1 mm, eyelid 2.0 mm; tympanic ring scarcely visible. Fingers $3 > 2 > 4 > 1$, 1st longer than one-half of 2nd, all with broad disks, no webbing; toes $4 > 5 \approx 3 > 2 > 1$, all with well-developed disks, webbed to subarticular elevation between toes 4 and 5, to anterior edge of subarticular elevation between 3 and 4.

COLOR AND PATTERN: The faded dorsal color and pattern are now pale yellowish brown with white dorsolateral streaks and white on top of snout and loreal region. Werner (1901: 613) stated: ''Upperside brownish white, gray spotted. A dark brown stripe passes horizontally from the posterior corner of the eye to above the eardrum, but not beyond the head. Snout and face pale to between the eyes, posterior of head dark brown, the two colors sharply separated from one-another. Limbs indistinctly flecked with brown.'' Abdomen and undersides of thighs marbled white and pale brown.

VARIATION IN SIZE AND PROPORTIONS: Not known.

COMPARISONS WITH OTHER SPECIES: *O. wolterstorffi* and *O. geislerorum* are similar, but as seen in regression plots the TL of *wolterstorffi* is longer than in *geislerorum* (out of range), and its short EN and IN are at the edge of the *geislerorum* ranges. See following Discussion.

Oreophryne brachypus of New Britain is closely similar to *geislerorum* in most aspects of morphology; *wolterstorffi* differs in its greater TL and absence of hand webbing.

Oreophryne hypsiops occurs on the route of Tappenbeck's 1896 expedition south of Madang (fig. 9). Although resembling *hypsiops* in its narrow head width, *wolterstorffi* has a larger EY, broader IN, and a shorter EN (though matched by one specimen of *hypsiops*). Both FD and TD are narrower in *wolterstorffi*.

Oreophryne biroi differs from *wolterstorffi* in its greater HW and, especially, greater EN and IN. This is true both of the sample from Madang Province and of the larger sample that also includes specimens from East and West Sepik provinces and Papua.

Oreophryne parkeri has much shorter TL, narrower HW, larger EY, and smaller IN than does *wolterstorffi*.

ADVERTISEMENT CALL: Not known.

HABITAT AND HABITS: Not known.

DISTRIBUTION: The species is known only from the indefinite type locality, ''German New Guinea'' (see above); the approximate path followed by the collector is indicated in figure 9.

LOCALITY RECORDS AND SPECIMENS EXAMINED: German New Guinea (ZMB 16853, holotype).

DISCUSSION: We are unable to associate the holotype of *wolterstorffi* with any species described from New Guinea nor with any undescribed species of which we are aware. The first of Tappenbeck's expeditions may have taken him to within 200 km of the known range of *geislerorum* in the Markham River drainage northwest of Lae. *O. geislerorum* may range northwest of its present known limit, if not in the relatively dry Markham-Ramu trough, then in adjacent uplands that have not been well collected for frogs. Given the large size of the *geislerorum* regression sample (48 specimens), it would be remarkable if one additional individual would be at the edge of the range of variation or well out of it (TL) in three proportions. Also, the differences deviate in opposite directions with respect to the size of *wolterstorffi*, which has the TL of a much larger *geislerorum* and the IN of a smaller one. Synonymization of *wolterstorffi* under *geislerorum* does not appear justified, though if the latter should be discovered within the area traversed by Tappenbeck, and if no additional typical *wolterstorffi* are found, the issue may be reopened.

The smaller eye and narrower internarial span of *Oreophryne parkeri* seem to rule out identity with *wolterstorffi*. The poor condition of the *parkeri* types must be kept in mind, but the distinctive narrow internarial span of *parkeri* is not likely to have been significantly modified. Also, the distance between the localities for *parkeri* and the closest point at which *wolterstorffi* may have been collected—the mouth of the Ramu River in Papua New Guinea, about 660 km—argues against conspecificity.

For the present, *Oreophryne wolterstorffi* remains a species of indefinite provenance whose validity remains to be established.

KEY TO THE SPECIES

The following key should serve reasonably well to identify *Oreophryne* from New Britain and the coastal region and adjacent uplands of Papua New Guinea between Popondetta on the east through East Sepik Province on the west. Some specimens from West Sepik Province present confusing combinations of characters and cannot be satisfactorily identified to species. The southeastern tip of Papua New Guinea and islands of Milne Bay Province are not included as none of the species treated herein is known to occur there.

1. IN/SVL < 0.072 2
   IN/SVL > 0.072 3
2. TD/SVL < 0.060, dorsal and lateral body surfaces with abundant tiny white spots . . . . . *parkeri*
   TD/SVL < 0.060 dorsal and lateral body surfaces lacking tiny white spots . . . *hypsiops*
3. Fingers with slight webbing (New Britain) . . . . . *brachypus*
   Fingers without webbing (mainland northern New Guinea and nearby islands) 4
4. HW/SVL ≥ 0.37 . . . . . *biroi*
   HW/SVL < 0.37 5
5. TL/SVL < 0.45 . . . . . *geislerorum*
   TL/SVL >0.45 . . . . . *wolterstorffi*

SOME PROBLEMATIC SPECIMENS

PAPUA NEW GUINEA, West Sepik Province: Six specimens from three localities near Lumi on the inland slope of the Torricelli Mountains are a diverse group. The localities are Mt. Nibo, 12 mi NE Lumi, 2300–5100 ft (AMNH A-78139, 78140), Miliom, 2 mi E Lumi, 1500 ft (AMNH A-78141), and Mt. Somoro, 7 mi NE Lumi, 2400–4650 ft (AMNH A-78142–78144). The following comparisons are based on visual inspections of measurements of the Lumi area specimens superimposed on regression plots for the Madang Province plus East Sepik Province samples of *Oreophryne biroi* and *Oreophryne hypsiops*.

One specimen, AMNH A-78141, is closely similar to *hypsiops* in all proportions and is included in the account of that species. An-

other, AMNH A-78143 is sufficiently like *biroi* to be tentatively placed with that species. Four remaining specimens combine the critical diagnostic proportions of *biroi* and *hypsiops*—head width, eye size, and internarial span—in ways that disagree with their assignment to either species. AMNH A-78139 has a narrow head, agreeing in this respect with *hypsiops*, but large eyes and a broad internarial space rule out that species. The last two proportions are resemblances to *Oreophryne biroi* but these appear negated by the narrow head width. AMNH A-78140 combines large eyes (as in *biroi*) with narrow internarial span (characteristic of *hypsiops*) and an intermediate head width. AMNH A-78142 is perhaps closest to *hypsiops*, having small eyes and intermediate head width and internarial span. AMNH A-78144 is closer to *biroi*, having large eyes but with intermediate head width and internarial span. *Oreophryne parkeri* also must be considered. Only AMNH A-78141 is similar enough to be considered as possibly representing *parkeri*, and this one is more readily assigned to *hypsiops*.

The diversity in this small sample suggests that at least three species may be present. This does not necessarily imply sympatry among several species, for in most instances (see above) precise elevations at which specimens were collected were not recorded.

Five specimens from Aitape, a coastal locality in West Sepik Province, present a situation similar to those from the vicinity of Lumi discussed above. Loveridge (1948: 423) referred them to *Oreophryne biroi* (MCZ A26220–26222 and exchange specimens BMNH 1947.1.3.88–89). These small frogs (16–20 mm SVL) are not well preserved, and we cannot be certain that only a single species is represented. Having relatively narrow heads, small eyes, and closely spaced nostrils, most of these specimens are more like *hypsiops* and *parkeri* than like *biroi*, but in many instances the proportions are outside of or marginal to those of typical (Madang Prov.) *hypsiops*. One specimen resembles *biroi* in most critical proportions, but has a narrower internarial span. We consider it best to leave these specimens unassigned to species. The West Sepik *Oreophryne* are unlikely to be sorted out until advertisement calls become known.

PAPUA NEW GUINEA: East Sepik Province. Five specimens (AMNH A-77545–77549) from an elevation of 1370 m on Mt. Hunstein, south of the immediate coastal region, cannot with confidence be assigned to any of the five species identified from the coastal ranges. Their proportions in general resemble those of *O. biroi*: relatively broad head, large eyes, and wide internarial span. AMNH A-77549, an adult female of 31.5 mm SVL, is larger than any other *Oreophryne* examined from the north coastal region, the next largest being a 28.5-mm female *biroi*. Despite the general similarities, there are deviations from *biroi* that make us suspect that not only does this sample not represent *biroi* (only one specimen fits *biroi* moderately well in critical proportions), but the sample may include more than one species.

Oreophryne hypsiops and *O. parkeri*, species with small eyes and narrow internarial span, cannot be confused with the Mt. Hunstein specimens. The geographically more distant *O. geislerorum* differs from the Mt. Hunstein frogs in its narrower head and shorter internarial span. *O. wolterstorffi*, known from only a single specimen of unknown provenance, has a much shorter internarial span than do any of the Mt. Hunstein specimens.

In addition to the foregoing comparisons with north coast species, we compared the morphological data for the Mt. Hunstein frogs with those data for several samples of *Oreophryne* from south of the central ranges but found no matches.

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