Bonner zoologische Beiträge	Band 52 (2004)	Heft 1/2	Seiten 149–154	Bonn, August 2004

A New Species of Tree Frog (Amphibia; *Hyperolius*) from the Bakossi Mountains, South-West-Cameroon

Stefan LÖTTERS[1)] & Andreas SCHMITZ[2)]

[1)] Johannes-Gutenberg-Universität, Zoologisches Institut, Mainz, Germany
[2)] Muséum d'histoire naturelle, Geneva, Switzerland

Abstract. We describe a new species of tree frog (Anura; Hyperoliidae: *Hyperolius*) from the Bakossi Mountains, South West Cameroon. It is currently known only from its type locality. The new species shows sexual dichromatism with adult males usually displaying hour glass pattern on the dorsum and adult females having dorsal spotting. The new species is most similar to *H. guttulatus, H. phantasticus, H. platyceps, H. riggenbachi, H. sylvaticus nigeriensis* and the *H. viridiflavus* complex. Characters to distinguish these and the new species include aspects of the dorsal colour pattern, adult size, skin texture as well as presence/absence of a female gular fold and sexual dichromatism, respectively.

Key words. Anura, Hyperoliidae, *Hyperolius dintelmanni* sp.n., Cameroon, taxonomy.

1. INTRODUCTION

Hyperolius is a species-rich genus of tree frogs from sub-Saharan Africa (FROST 2002). According to SCHIØTZ (1999), the majority of species occurs in humid tropical forests of Central Africa. About 25 taxa have been reported from Cameroon, mainly from its south-western portion (AMIET 1972, 1973, 1975, 1979a, 1979b, 1980; PERRET 1959, 1966; SCHIØTZ 1999; FROST 2002). Nevertheless, even this region is far from well studied. One example are the Bakossi Mountains, for which herpetological collections are limited (STUART 1986; SCHMITZ et al. 1999). To the best of our knowledge, the *Hyperolius* species from the Bakossi Mountains have not been studied at all. During fieldwork in 1997 and 1998 in this region, the junior author and colleagues collected several *Hyperolius* specimens in different colour morphs. Two of them vary slightly in size but share other external features including a smooth skin, moderate foot webbing and presence of hand webbing. Of one of these morphs (Fig. 1), several juveniles and males and one female are available. The other morph (Fig. 2) is represented by two females. The single female of the morph first mentioned is somewhat deviant in colour pattern from the remaining specimens of this series (i.e. juveniles and males) and more similar to the second morph. Since both colour forms are almost identical in other morphological characters and because they were collected at the same locality and time, we consider them as variants of one polymorphic species. We interpret their different colour patterns as the so-called juvenile/male (PhJ) and the female (PhF) colour phases, as known in about half of the species of *Hyperolius* (SCHIØTZ 1999). The single "intermediate" female, is considered as an individual just undergoing mature female colour change.

Fig. 1. Dorsal view of male holotype (in PhJ) of *Hyperolius dintelmanni* sp. nov. (ZFMK 67871).

Fig. 2. Lateral view of female paratype (in PhF) of *Hyperolius dintelmanni* sp. nov. (ZFMK 67890).

Because these specimens are not identifiable as any of the species described so far, we conclude that they belong to a species new to science and probably endemic to the Bakossi Mountains. The purpose of this paper is to describe it.

2. MATERIAL AND METHODS

Material examined is deposited in the Natural History Museum, British Museum, London (BMNH), Muséum d'Histoire Naturelle, Genève (MHNG), Museum für Naturkunde, Berlin (ZMHB), Muséum Royal de l'Afrique Centrale, Tervuren (MRAC), and Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn (ZFMK). Specimens used for comparisons are listed in Appendix 1. Live specimens were fotographed in the field for colour descriptions before preserving them in 70 % ethanol. Measurements were taken in mm at the nearest 0.1 mm with dial callipers for adults only. Males were considered adult when their gular flap was recognisable; specimens of about equal size to males without gular flap were regarded as adult females. Specimens smaller than half snout-vent-length (SVL) of the smallest adult, were termed juveniles. The diagnostic scheme follows LÖTTERS et al. (2004): (1) SVL of males and females; (2) tibia length (TIBL)/SVL, head width at angles of jaws (HW)/SVL; (3) dorsal skin texture: smooth or warty; (4) dorsal and lateral snout shape fide HEYER et al. (1990: 409) and if nostrils are visible from above or not; (5) distance from anterior corner of eye to nostril (E-N)/horizontal eye diameter (EYE); (6) tympanum: visible or invisible (i.e. covered by thick skin), horizontal tympanum diameter (TYMP)/EYE; (7) foot length from proximal edge of outer metatarsal tubercle to tip of Toe IV (FOOT)/TIBL; (8) foot and (if present) hand webbing formula, using the system as described by GLAW & VENCES (1994); (9) dorsal and ventral colour pattern (PhJ, PhF) and iris colour in life.

3. TAXONOMY

3.1. *Hyperolius dintelmanni* sp. nov. – (Figs. 1-5)

Holotype: ZFMK 67871, an adult male in PhJ, from the Edib Hills (ca. 1,200 m above sea level), Bakossi Mountains, South-West Cameroon (4°57' N, 9°39' E); leg. A. Schmitz, 1 December 1997.

Paratypes: ZFMK 67441-447, 67872-873, one adult female in transition from PhJ to PhF, three adult males and five juveniles in PhJ, ZFMK 67890, 67453, two adult females in PhF, all from the type locality; leg. O. Euskirchen and A. Schmitz, December 1997 to January 1998.

Description of holotype: Body slender with sacrum width about one sixth of SVL; head short and broad with distance from tip of snout to posterior corner of eye about one fourth of SVL; HW about one third of SVL; snout tip in dorsal and lateral views rounded; nostril dorsolateral, protruding and visible from above; choanae rounded; maxillary teeth present, vomerine teeth lacking; tongue about as long as wide, free for half of its length and anteriorly bifurcated; canthus rostralis convex from nostril to tip of snout, concave and longer from nostril to anterior corner of eye; EYE > E-N; loreal area barely concave; tympanic membrane covered by thick skin but tympanic annulus visible in most specimens (visible in holotype), TYMP < EYE. Gular flap relatively small (Fig. 4). Tibia long, about half of SVL, tibiotarsal articulation extending to nostril when hind limb adpressed forward along body; FOOT < TIBL; relative length of toes: I < II < III < V < IV; metatarsal tubercles not well defined, rounded, inner somewhat larger in size; rest of sole smooth with distinct subar-

Fig. 3. Ventral view of female paratype (in PhF) of *Hyperolius dintelmanni* sp. nov. (ZFMK 67890).

Fig. 4. Gular region of holotype of *Hyperolius dintelmanni* sp. nov. (ZFMK 67871). Bar equals 5.0 mm.

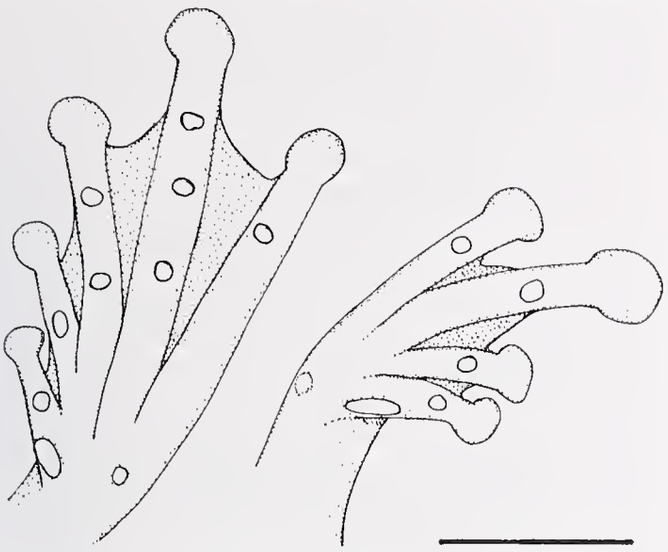

Fig. 5. Sole and palm of paratype of *Hyperolius dintelmanni* sp. nov. (ZFMK 67441). Bar equals 5.0 mm.

ticular tubercles present at joints of phalanges of all toes; tips of toes broadened; foot webbing formula: I(½), 2i(1) 2e(0), 3i(1) 3e(0), 4i/e(1), 5(0). Relative length of fingers: I < II < IV < III; palmar tubercle ill-defined, rounded, thenar tubercle well visible, somewhat ovoid; rest of palm wrinkled with well visible subarticular tubercles at joints of phalanges of all fingers; tips of fingers broadened, in Finger III and IV for more than twice the width of finger; hand webbing formula: 1(1), 2i/e(1), 3i/e(1), 4(1). Surface of dorsal skin smooth with few tubercles below tympanic area, ventral skin wrinkled.

Variation. The paratypes generally coincide with the description given above, except that juveniles and adult females lack a gular flap and the tibiotarsal articulation may extend only to the posterior corner of the eye when hind limb adpressed forward along body; foot webbing formula varies as follows: 1(½-1), 2i(1) 2e(0-½), 3i(1) 3e(0-½), 4i(1) 4e(1), 5(0-½).

Coloration: In preservative, in PhJ, dorsal surface dark brown with more or less symmetric hour glass pattern or marbling in tan (with hour glass pattern in holotype), consistently with a dark brown cloacal region, with extremities dark brown, and with a tan spot on distal inner calf and both metatarsus and metacarpus. In PhF, dorsal surfaces are brown, darker laterally, with numerous tan to yellowish spots (smaller in diameter than eye, partly confluent), each with a dark brown centre; spots absent on flanks resulting in a dark brown lateral band which continues on and below lip as a thin line; upper and outer femur as well as inner tibia with large tan blotches. Ventrally, both phases are tan, with the outer sole and palm brown or tan (tan in holotype) and males having a greyish tan to grey gular flap (greyish tan in holotype); in PhF ventral surfaces of cloacal region, legs (in part) and arms black.

In live specimens, PhJ is dorsally olive to translucent dark green on extremities, with light green and towards the periphery yellowish pattern (Fig. 1); the ventral body of this phase is yellowish to greyish in the gular region. In live specimens, PhF is dorsally dark brown to black with greenish spotting and bright red areas on upper legs, feet and hands (Fig. 2); lower legs and feet and hands are almost entirely bright red, while the ventral body of PhF is yellowish (Fig. 3). In both colour phases, the iris is bronze.

Etymology: The specific name is a patronym for HORST DINTELMANN (Bonn) in recognition of his support of taxonomic research and forthcoming conservation projects in Cameroon.

3.2. Diagnosis

(1) SVL in mm of males 29.5-33.8 (31.5 ± 1.93; n = 4), of females 27.3-29.8 (28.4 ± 1.27; n = 3); (2) TIBL/SVL 0.46-0.51 (0.49 ± 0.02; n = 7), HW/SVL 0.29-0.35 (0.33 ± 0.02; n = 7); (3) dorsal skin texture smooth; (4) dorsal and lateral snout shape rounded, nostrils visible from above; (5) E-N/ EYE 0.76-0.97 (0.83 ± 0.04; n = 7) (6) tympanic membrane covered by thick skin but tympanic annulus sometimes visible through skin in both females and males, TYMP/EYE 0.41-0.47 (0.44 ± 0.03; n = 7); (7) FOOT/TIBL 0.87-0.94 (0.91 ± 0.03; n = 7); (8) foot webbing formula: 1(½-1), 2i(1) 2e(0-½), 3i(1) 3e(0-½), 4i(1) 4e(1), 5(0-½); hand webbing formula: 1(1), 2i/e(1), 3i/e(1), 4(1); (9) PhJ dorsally olive to translucent dark green on extremities, with light green (more yellowish at periphery) hour glass pattern or marbling, ventrally yellowish; PhF in life dorsally black with greenish spotting and bright red areas on legs, ventrally yellowish with red bright red legs, soles and palms; iris bronze (see Figs. 1-3).

In PhJ, *H. dintelmanni* is most similar to *H. platyceps* (BOULENGER, 1900) and the PhJ of *H. sylvaticus nigeriensis* SCHIØTZ, 1967, both known from Cameroon (AMIET 1979a; SCHIØTZ 1967, 1999). The new species can be distinguished from them by having the dorsal pattern non-divided (see Fig. 1, versus in *H. platyceps* falling into an anterior hour glass-shaped pattern and a posterior transversal bar and in PhJ *H. sylvaticus nigeriensis* falling into anterior and posterior dorsal patches; compare with photographs in SCHIØTZ 1967, 1999). In addition, *H. dintelmanni* differs from *H. platyceps* by larger male adult size (adult SVL ≥ 29.5 mm versus ≤ 27 mm) and from *H. sylvaticus nigeriensis* by lacking a dark area behind the eye (versus present in PhJ of *H. sylvaticus nigeriensis*) and by having skin of dorsal surface smooth (versus tubercular in *H. sylvaticus nigeriensis*). Moreover, males and females of *H. platy-*

ceps do have the same dorsal pattern (versus presence of sexual dichromatism in *H. dintelmanni*). Females of *H. sylvaticus nigeriensis* differ strongly in both dorsal pattern (e.g. *H. dintelmanni* is completely lacking the light yellow dorso-lateral stripe typical for female *H. sylvaticus nigeriensis*; comp. SCHIØTZ 1967), as well as in ventral coloration of the gular region and the underside of the limbs.

Relatively large adult size and presence of hand webbing also require a comparison with *H. guttulatus* GÜNTHER, 1858, *H. phantasticus* (BOULENGER, 1899), *H. riggenbachi* (NIEDEN, 1910) and the *H. viridiflavus* (DUMÉRIL & BIBRON, 1841) complex, all known from Cameroon (SCHIØTZ 1999). Most members of the *H. viridiflavus* complex have tubercular skin (versus smooth in *H. dintelmanni*), their females develop a transverse gular fold (absent in *H. dintelmanni*) and an hour glass pattern as present in PhJ of *H. dintelmanni* is not known except in *H. tuberculatus* (MOCQUARD, 1897) (i.e. in both males and females versus in males only in *H. dintelmanni*). Moreover, *H. tuberculatus* males exhibit a relatively large bright yellow gular flap (LÖTTERS et al. 2004), while *H. dintelmanni* males have a relatively small (Fig. 4) greyish gular flap. The female colour phase of some forms within the *H. viridiflavus* complex (e.g. "bayoni", "variabilis" "viridiflavus" from eastern Africa; see SCHIØTZ 1999) may develop dorsal spotting like PhF of *H. dintelmanni* but, as mentioned, these forms exhibit tubercular dorsal surfaces, while the new species has a smooth skin. *Hyperolius guttulatus*, *H. phantasticus* and *H. riggenbachi* all lack a dorsal hour glass pattern and, except PhF *H. guttulatus*, dorsal spotting. However, spotted *H. guttulatus* have relatively small light spots without black centres as present in the relatively large light spots (Fig. 2) in PhF of *H. dintelmanni*. In all three species, the gular flap is relatively large (see SCHIØTZ 1999) versus relatively small in *H. dintelmanni* (Fig. 4).

3.3. Distribution and ecology

Hyperolius dintelmanni is known only from the type locality at elevations of 1,100-1,250 m above sea level. There have been several surveys in adjacent areas (Mt. Kupe, Mt. Nlonako etc.) which have failed to record this new species (HERRMANN & HERRMANN 1999; SCHMITZ et al. 1999; HERRMANN et al. 2000). All specimens of the new species were found at the outer margins of disturbed primary forest patches in the Edib Hills. Most specimens were sitting at night on lower grass vegetation (< 1 m above ground) in areas with ferns.

4. DISCUSSION

Western Central Africa is relatively rich in species (e.g. AMIET 1987; WHITE 1993). More than one fifth of all *Hyperolius* species described is known from this region, mainly from Cameroon (SCHIØTZ 1999; FROST 2002). Considering that collections of amphibians from this country are known from only 16 % of the squares in a 20 x 20 km² overlaid grid (AMIET 1983), one may expect that many more species of *Hyperolius* (or amphibians in general) will be found to exist in this country in the future. However, besides limited collections, a major problem is that *Hyperolius* taxonomy is difficult (e.g. SCHIØTZ 1999). LÖTTERS et al. (2004) suggest to focus on standardised diagnosis schemes (as used here), preferably combined with bioacoustic, tadpole and gene sequence data. Unfortunately, at the present time such information is sparse for most Cameroonian *Hyperolius* species including *H. dintelmanni*. Future investigations shall not focus to discover new records and species alone but also to fill these gaps.

Acknowledgements. Fieldwork in Cameroon was conducted with the invaluable help of O. Euskirchen and C. Wild. Permission to collect was given by the WWF Mount Kupe Forest Project. W. Böhme generously promoted the junior author's work on Cameroonian herpetofauna. Material for comparison was made available though B.T. Clarke (BMNH), J. Mariaux (MHNG) and R. Günther (ZMHB). Access to BMNH was kindly made available to the senior author through the SYS-RESOURCE MR1 of the Natural History Museum (BMNH) with financial support by the IHP Programme of EC.

Zusammenfassung. Wir beschreiben eine neue Baumfrosch-Art (Anura: Hyperoliidae: *Hyperolius*) aus den Bakossi-Bergen in Süd-West-Kamerun. Sie ist bisher nur von der Typuslokalität bekannt. Die neue Art zeigt einen Sexualdichromatismus, wobei die Männchen ein dorsales Sanduhrmuster aufweisen, während die Weibchen eine Fleckenzeichnung besitzen. Die neue Art ist *H. guttulatus, H. phantasticus, H. platyceps, H. riggenbachi H. sylvaticus, nigerieusis* und dem *H. viridiflavus*-Komplex am ähnlichsten. Merkmale, um diese Arten und die neue Art zu unterscheiden schließen Aspekte des dorsalen Zeichnungsmusters, Größe der Adulti, Hauttextur sowie das Vorhandensein/Fehlen einer Kehlfalte bei Weibchen beziehungsweise von Geschlechtsdichromatismus mit ein.

REFERENCES

AMIET, J.-L. (1972): Notes faunistiques, éthologiques et écologiques sur quelques amphibiens anoures du Cameroun. Annals Faculté Science Cameroun Université Yaoundé **9**: 127-153.

AMIET, J.-L. (1973): Notes faunistiques, éthologiques et écologiques sur quelques amphibiens anoures du Cameroun (2e Série). Annals Faculté Science Cameroun Université Yaoundé **13**: 135-161.

AMIET, J.-L. (1975): Écologie et distribution des amphibiens anoures de la région de Nkongsamba (Cameroun). Annals Faculté Science Cameroun Université Yaoundé **20**: 33-107.

AMIET, J.-L. (1979a): A propos d'*Hyperolius platyceps* Boulenger, *Hyperolius kuligae* Mertens et *Hyperolius admetzi* Ahl (Amphibiens, Anoures). Annals Faculté Science Cameroun Université Yaoundé **25**: 221-256.

AMIET, J.-L. (1979b): Description de l'adulte et de la larve d'*Hyperolius bopeleti* n. sp. (Amphibia Anura, Hyperoliidae). Annals Faculté Science Cameroun Université Yaoundé **26**: 113-124.

AMIET, J.-L. (1980): Un *Hyperolius* nouveau du Cameroun: *Hyperolius endjami* n. sp. Revue Suisse de Zoologie **87**: 445-460.

AMIET, J.-L. (1983): Un essai de cartographie des anoures du Cameroun. Alytes **2**: 124-146.

AMIET, J.-L. (1987): Aires disjointes et taxons vicariantes chez les anoures du Cameroun: implicacions paléoclimatiques. Alytes **6**: 99-115.

FROST, D. R. (2002): Amphibian species of the world: An online reference. V2.21 American Museum Natural History, New York. [http://research.amnh.org/herpetology/amphibia/index.html]

GLAW, F. & VENCES, M. (1994): A fieldguide to the amphibians and reptiles of Madagascar. Second edition. Vences u. Glaw Verlags GbR, Köln.

HERRMANN, P. & HERRMANN, H.-W. (1999): The ALSCO Cameroon Chameleon Expedition: a rainforest survey on Mount Nlonako. Sonoran Herpetologist **12**: 94-97.

HERRMANN, H.-W., BÖHME, W. & HERRMANN, P. A. (2000): The ALSCO Cameroon Expedition 1998: the sampling of a mountain rainforest. Bonner zoologische Monographien **46**: 95-103.

HEYER, W. R., RAND, A. S., DA CRUZ, C. A. G., PEIXOTO, O. L. & NELSON, C. E. (1990): Frogs of Boracéia. Arquivos de Zoologia 1: 237-410.

LÖTTERS, S., SCHICK, S., SCHEELKE, K., TEEGE, P., KOSUCH, J., ROTICH, D. & VEITH, M. (2004): Bio-sketches and partitioning of sympatric reed frogs, genus *Hyperolius* (Amphibia; Hyperoliidae), in two humid tropical African forest regions. Journal Natural History **38**: 1969 – 1997.

PERRET, J.-L. (1959): Batraciens nouveaux du Cameroun. Revue Suisse de Zoologie **66**: 711-721.

PERRET, J.-L. (1966): Les amphibiens du Cameroun. Zoologische Jahrbücher, Abteilung Systematik **8**: 289-464.

SCHIØTZ, A. (1967): The treefrogs (Rhacophoridae) of West Africa. Spolia zoologica Musei hauniensis **25**: 1-346.

SCHIØTZ, A. (1999): Treefrogs of Africa. Chimaira, Frankfurt.

SCHMITZ, A., EUSKRICHEN, O. & BÖHME, W. (1999): Zur Herpetofauna einer montanen Regenwaldregion in SW-Kamerun (Mt. Kupe und Bakossi-Bergland). I. Einleitung, Bufonidae, und Hyperoliidae. Herpetofauna **21**: 5-17.

STUART, S. N. (1986): Conservation of Cameroon montane forests. International Council for Bird Preservation, i-iii, Cambridge.

WHITE, F. (1993): Refuge theory, ice-age aridity and the history of tropical biotas: an essay in plant geography. Fragmenta floristica et geobotanica **2**: 385-409.

Authors' addresses: Stefan LÖTTERS: Zoologisches Institut, Universität Mainz, Saarstrasse 21, 55099 Mainz, Germany, e-mail: loetters@uni-mainz.de

Muséum d'histoire naturelle, G.P.6434, CH-1211 Geneva,
Switzerland, e-mail: andreas.schmitz@mhn.ville-ge.ch

Received: 31.10.2003
Revised: 09.12.2003
Accepted: 17.12.2003
Corresponding editor: R. VAN DEN ELZEN

Appendix 1

In addition to the new species, the following material was examined:

Hyperolius acutirostris – Cameroon: ZMHB 8470, 65177 (formerly also under ZMHB 8470) (syntypes).

Hyperolius bolifambae – Osomba, Nigeria: BMNH 1966.273.

Hyperolius cinnamoneoventris complex – Andarada, Angola: MRAC 60559-60; Anhoca, Angola: BMNH 1904.5.2.116-118; Congulu, Angola: BMNH 1936.8.1.223-224; Dundo, Angola: MRCA 60557-58; Matala, Angola: MRAC 60291; River Kakueje, Angola: MRCA 60556; Lambaréné, Gabon: ZFMK 73111-112, ZMHB 8830 (syntype of *H. fimbriolatus* PETERS, 1876), 65178 (formerly also under ZMHB 8830; syntype of *H. fimbriolatus*), ZMHB 8829, 53264-265 (three syntypes of *H. olivaceus* PETERS, 1876); Kakamega, Kenya: Forest: ZFMK 77431-433.

Hyperolius fusciventris – Sierra Leone: BMNH 1947.2.9.59-60 (syntypes of *H. aylmeri* NOBLE, 1924).

Hyperolius guttulatus – Africa: BMNH 1947.2.9.30-31 (syntypes); BMNH 1947.2.9.56 (holotype of *H. reticulatus*); Sapoba Forest Reserve, Nigeria: BMNH 1980.1570.

Hyperolius cf. *kuligae* – Rumpi Hills, Cameroon: BMNH 1985.594-596.

Hyperolius mosaicus – Ngam, Sangmelima, Cameroon: MHNG 965.12-21 (holotype and nine paratypes); Monts Cristal, Gabon: ZFMK 73140-142.

Hyperolius ocellatus – Monts Cristal, Gabon: ZFMK 73218-219.

Hyperolius pardalis – Bitye, Cameroon: BMNH 1947.2.26.2-10 (nine syntypes); Monts Cristal, Gabon: ZFMK 73151-155.

Hyperolius phantasticus – Benito River, French Congo (= Equatorial Guinea): BMNH 1947.2.920 (holotype); Monts Cristal, Gabon: ZFMK 73194-196.

Hyperolius platyceps – Benito River, French Congo (= Equatorial Guinea): BMNH 1947.2.9.57-58 (syntypes); Cameroon: BMNH 1903. 7.28.27,

1908.5.30.71, 1937.12.1.24; Zenia, Cameroon: BMNH 1947.2.48 (holotype of *Rappia pleurotaenia* BOULENGER, 1906).

Hyperolius riggenbachi – Bamenda, Cameroon: BMNH 1976.2428-2439; Obudu Plateau, Nigeria: BMNH 1980-1591.