A NEW TREE-FROG FROM MALAWI (HYPEROLIINAE, AMPHIBIA)

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ABSTRACT

Hyperolius spinigularis sp. nov. from Mlanje district of Malawi at ca. 655 metres, characterised by presence of prominent black asperities on male venter and particularly on gular disc. Descriptions and variations of external morphology, colour patterning, sexual dimorphism and dimensions. Juveniles described and compared with sympatric *H. nasutus nasutus* Günther and *H. puncticulatus* (Pfeffer). Notable absence of mating call discussed in relation to restricted habitat preferences. Notes on mating and egg deposition with brief description of tadpoles and their possible diagnosis. Observations on hibernation in captivity and disappearance of secondary sexual characters. Systematical note and comparison with *H. köhleri* Mertens.

HYPEROLIUS SPINIGULARIS N. SP.

TYPES

All the Type material was collected by the author from dense vegetation surrounding an overgrown pool in a dambo area on Chisambo Tea Estate, Mlanje, Malawi, at ca. 655 metres above sea-level and is deposited in the Umtali Museum, Rhodesia.

HOLOTYPE: An adult male (UM. 19815), collected on 19th January 1969.

PARATYPES: 31 males, 22 females (UM. 19816–19868), collected between 26th December 1968 and 24th January 1969.

5 juveniles (UM. 20634–20638), collected on 27th August 1969.

50 eggs and tadpoles in various stages of development (UM. 19869), laid and reared in captivity ex Paratype material.

Other Material. 14 males, 7 females collected by the author from the Type locality between 27th February and 3rd March 1968. Of this material 2 males and 2 females are deposited in the Umtali Museum (UM. 17962–17965), and 2 males and 2 females in the Zoological Museum, Copenhagen (R 078298–078301).

2 males collected on Ruo Estate, Mlanje, by Mr. J. B. T. Stephens and the author on 9th January 1969.

5 captive juveniles collected from the Type locality by the author on 2nd September 1969.

Diagnosis. A small to medium sized *Hyperolius* (18,7–31,0 mm snout to vent length) with a broad head and protruding eyes exhibiting great sexual dimorphism in size. During the breeding season the males are distinguishable from all other previously described members of the genus by the presence of prominent black asperities covering the weakly bi-lobed gular disc, mentum, abdomen and undersurface of the hind limbs. The female venter is devoid of

asperities. The dorsal skin surface in both sexes is covered with minute asperities which may be inconspicuous or even absent, especially in the female. Resembling *H. chlorosteus* Boulenger from West Africa in colour patterning; the light subtriangular frontal patch is diagnostic amongst Central African forms when present. Favours moderate to densely overgrown dambo areas at medium altitudes.

Although covered with asperities, *H. spinigularis* is easily distinguished from members of the related genus *Afrixalus* by its horizontally elliptic pupil.

DESCRIPTION OF HOLOTYPE

Habitus moderate with a broad head and protruding eyes. Snout rather blunt though somewhat rounded. Canthus rostralis rather angular, being slightly convex on the horizontal plane and slightly concave on the vertical plane. Distance between eye and naris greater than that between naris and tip of snout, subequal to interorbit but greater than internarial distance. Upper eyelid subequal to distance between eye and tip of snout. Width of head equalling 0,345 length of body (snout-vent). Tibio-tarsal articulation of the adpressed hind limb reaching centre of eye.

Dorsal skin surface granular with a single minute black asperity surmounting many of the granules, especially on the top of the head. Ventral skin surface strongly granular with black asperities restricted to the mentum, gular disc, abdomen and undersurfaces of the femur, tarsus and foot. Ventral asperities much more prominent than those of the dorsum, being compound by nature on the gular disc and anterior abdomen – one large central asperity being closely ringed by ca. 6 or 8 smaller and weaker ones.

Gular disc, weakly bi-lobed and rather thick by nature completely covering the very small gular sac, equalling in width 0,75 the distance between the angle of the jaws; its breadth being 1,5 times its length.

Webbing just reaching distal subarticular tubercle of the outer finger; reaching distal subarticular tubercle of the 4th toe on both sides.

Colour pattern in life: A pale apple green dorsally covered with minute brown chromatophores which, under certain conditions, almost masked the ground colouration being most heavily concentrated around the nares and on the canthus. The hands and feet were a pale yellow and the digital discs green. Ventrally, a pale translucent blue-green becoming silvery white over the abdomen and an opaque blue-green on the gular disc.

The black horizontally elliptic pupil was bordered brown in a silvery grey iris.

A white cantho-dorso-lateral band, originating and interfusing with its opposite number on the snout, passed along the canthus, over the eye and along the flanks before breaking up slightly and tapering off near the groin. On the canthus the band equalled the width of the digital disc of the first finger whilst behind the eye it broadened out to the width of the disc of the third finger.

Colour pattern in alcohol: A dirty cream colour with the patterning remaining white and the chromatophores and asperities retaining their natural colours.

Dimensions. Snout to vent 23,2 mm, width of head 8,0 mm, length of the folded tibia 11,0 mm, length of foot 10,2 mm.

DESCRIPTION OF PARATYPES

Head and body proportions in close agreement with those of the Holotype though in some specimens the distance between the eye and naris being rather less than the interorbit, and the upper eyelid rather less than the distance between the eye and the tip of the snout. In a few females the tibio-tarsal articulation of the adpressed hind limb reached the anterior margin of the eye, rarely just beyond.

Snout to vent measurement in the males ranging from 18,7–23,2 mm and in the females from 24,0–31,0 mm; averaging 21,1 and 27,5 mm respectively.

Dermal granulations as well as character and distribution of the asperities of the males (*vide* Plate 5) in close agreement with that of the Holotype though a few had heavy concentrations of asperities on the upper surface of the tibia. Dorsal skin surface of the females only weakly granular, the asperities being very weak or even absent; ventral skin surface strongly granular but devoid of asperities.

Gular disc and sac of the majority of males similar to that of the Holotype. In a few of the Paratype series, the gular disc and asperities of the male venter, as well as the dorsal asperities in both sexes are greatly reduced or even absent. This would appear to be related to the breeding cycle of the species. *Vide* infra *Hibernation.*

Webbing of all the material conforming to that of the Holotype.

Colour patterning of adults in life: All the females and 90% of the males resembled the Holotype in basic coloration. Depending on light conditions the hands and feet were either pale orange with pale orange or yellow digital discs or otherwise were pale yellow with pale yellow or green digital discs. In the remaining 10% of the males the ground coloration was red-brown on both the dorsum and ventrum whilst the extremities of the limbs were a pale red. The brown dorsal chromatophores varied considerably in intensity from specimen to specimen according to light conditions but were concentrated around the nares, along the canthus, supraocularly and along the borders of the dorsal patterning. In 17% of the males the juvenile patterning was retained in that the dorsum and exposed parts of the hind limbs were covered with small aggregations of chromatophores similar to those found in *H. pusillus* Cope (*vide infra*). The majority of specimens had a short yellow longitudinal dash on the occiput which was occasionally bordered on either side by a short transverse bar of similar colour.

Dorsal patterning was a pale cream or white and of two distinct pattern types which cannot be correlated with either sex or age.

Pattern type "A". (*Vide* Plates 1 and 2.) This is the predominant pattern type found in 69% of all specimens (males 75%, females 61%) and is as described for the Holotype. In some specimens, especially small males, the cantho-dorso-lateral band was reduced to a mere hair-line and very exceptionally the dorso-lateral part of the band was almost indistinguishable, whilst in some of the larger females the dorso-lateral part of the band was as much in width as three quarters of the diameter of the eye.

Pattern type "B". (*Vide* Plates 3 and 4.) Found in 29,5% of all specimens (males 23%, females 39%) and consisted of a subtriangular frontal patch and a heavy, irregular and often broken dorso-lateral band. The dorso-lateral band swelled out opposite the occiput, shoulders

PLATE 1
Adult female showing typical patterning (Pattern Type A).

PLATE 2
Adult male showing typical patterning (Pattern Type A). The dermal granulations of the male are clearly visible. This specimen also illustrates the dorsal chromatophores concentrated into small blotches similar to those found in *H. pusillus* (Cope).

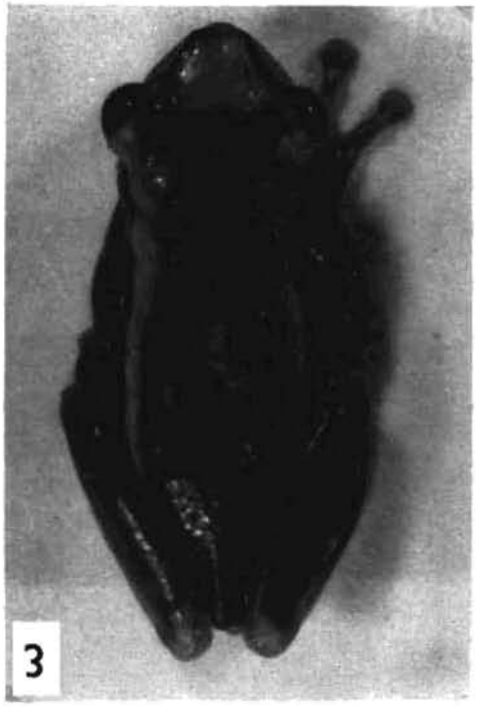
and lumber regions. Each bulge of which was separated from the next by a constriction at which point the band was frequently broken, before tapering out on the posterior flanks. Of this pattern type 87% had a lumber patch which on occasion merged into the dorso-lateral bands.

In both pattern types white heel spots were to be found; 30% of all specimens having a spot on both heels, 27% on one heel only and 43% having no heel spot.

In 44% of all specimens the canthal band/frontal patch was interfused with the dorso-lateral bands supraocularly on both sides whilst they were broken over one eye in 16% and over both eyes in 40%.

Aberrant pattern types. One male was of a pattern type intermediate to "A" and "B" in that although it had a frontal patch, the dorso-lateral bands were perfectly regular. A single female of pattern type "B" had, in addition to a pair of heel spots, a white spot on one elbow and a female of pattern type "A", seen in the wild but not collected, had its entire dorsum covered with small white spots.

Juvenile colour patterning. Colour patterning very much as described for the adults. Of



PLATES 3 AND 4
Adult females of Pattern Type B showing extremes of patterning.

the small series collected six were of pattern type "A" and four of pattern type "B". Juveniles differ from adults in that their patterning is of a pale, indistinct golden-yellow colour, that the extremities of their limbs are not differentially coloured, that there are no asperities to be found on either dorsal or ventral surfaces and that their entire dorsal surface is covered with aggregations of brown chromatophores as described for the 17% of adult males which retain their juvenile patterning.

Of the sympatric *Hyperolius* species – *H. marmoratus albofasciatus* Hoffman, *tuberilinguis* Smith, *nasutus nasutus* Gunther and *puncticulatus* (Pfeffer) – the juveniles of *spinigularis* could be mistaken for the juveniles of the last two species possibly. However, the juveniles of *puncticulatus* are generally some shade of pale brown and generally have four, exceptionally two, dusky longitudinal streaks down their backs between the cantho-dorso-lateral bands. The juveniles of *nasutus* though rather similar in colour patterning can be readily distinguished by their much finer habitus – the body length: width of head ratio being more than 3,0 in *nasutus* but less than 2,75 in *spinigularis*.

Sexual dimorphism. Females attaining a much larger size than the males. Asperities of the dorsum weaker in the female and absent from the female venter. Males are easily distinguished from the females during the breeding season by their characteristic bi-lobed gular disc.

Voice. Although the author has observed this species nightly during the last rains, not once was a male either heard or seen to call in the wild. However, males kept in captivity

PLATE 5
Ventral view of a male illustrating the typical ventral asperities of the male and also the weakly bilobed gular disc.

were noted on several occasions to emit a weak, rasping, quite high pitched "tcheek . . . tcheek tcheek"; but this must be regarded as a territorial warning since the male concerned each time was being harassed by another. Once a solitary male started to call in a much more deliberate manner which may have been a breeding call.

The lack of voice in this species within the dambos is possibly due to the species having modified its breeding habits to such an extent that the males no longer find it necessary to attract the females with their voices. This could account for the very small vocal sac and leathery vocal disc which could be in the process of degenerating from active use. During the last two breeding seasons the species was restricted in both years to the same very small areas of less than 5 square metres extent along the periphery of pools and streams within the dambos and within these small areas the species showed a marked preference to certain broad leaved vegetation. It is possible, therefore, that since the species shows this preference for certain types of vegetation within these restricted breeding grounds and that since the frogs probably return to these same grounds year after year that the proximity of the two sexes at mating time has obviated the necessity of a mating call.

Breeding. H. spinigularis, when compared with sympatric species, has a short breeding season which lasted for ten weeks during the last rains from the end of December to the middle of March. The males are the first to appear at the breeding grounds at the onset of the breeding season whilst the females appear, in a gravid condition, sporadically throughout the season. Soon after appearing at the breeding grounds the gravid female is gripped by a

male with his forelimbs gripping her axillae and his hindlimbs folded forwards so that his hind feet rest in the female's groin. Between 150 and 200 unpigmented eggs of 1,8–2,0 mm diameter, each enclosed in a gel capsule of ca. 3,5 mm diameter, are laid in a single mass amongst grass stems or on the underside of leaves just above water level on the edge of the pool or stream. One female in nature laid her egg mass on the undersurface of a banana petiole ca. 5 metres above a small stream. On the two consecutive nights after laying the eggs she was observed returning to them and ejecting a watery fluid over the egg mass from her vent.

The great majority of the males and all the gravid females were collected at the breeding sites whilst the majority of the spent females were collected in the lush vegetation away from the breeding sites. This would suggest that once egg laying had taken place the females retire from the breeding sites whilst the males stay around the sites until they finally leave to enter their hibernaculum.

Tadpoles. After 5 or 6 days the gel surrounding the eggs in the egg mass becomes very thin and the young tadpoles wriggle their way to the bottom of the mass and then drop into the water underneath. At this stage the brown tadpoles had a total length of 4,7 mm. The tadpoles develop a dental formula of $\frac{1}{1+1}$ which is typical for the genus. Unfortunately the $\frac{2}{}$ tadpoles being reared in captivity died from accidental over-exposure to the sun but it would seem that a small, black "V" on the tip of the snout may be diagnostic.

The metamorphosing froglets measure between 12,7 and 14,1 mm at the time of losing the last traces of their larval tails.

Hibernation. Though no hibernating specimens have been found in nature, several captive specimens appeared to enter hibernation at about the same time as the species left the environs of the dambos in the wild. The specimens concerned went off their food and became more and more lethargic before concealing themselves amongst the roots of grasses in their vivarium. These specimens tucked themselves into the middle of root clumps or into cavities under them just above the water surface in an inclined position (head uppermost), often with their hind parts touching or partly submerged in the water. It was found that as they progressively became less active, prior to concealment, the asperities covering the body as well as the male's gular disc and sac gradually disappeared. This condition is to be found in a few of the Type series; one male having lost all traces of its gular disc and sac.

It was noted that each time the frogs sloughed their cuticle the asperities were also sloughed leaving a weak spine underneath which grew to its former size prior to the next slough. On entering hibernation the external vocal apparatus is reabsorbed into the surrounding tissues but whether this is the case with the asperities or whether they are gradually sloughed away is not known.

Habitat preferences. The species prefers rather overgrown dambo areas in protected situations at medium altitudes. The majority of specimens collected were found on broad-leaved vegetation within the breeding sites mentioned earlier. Only spent females were found rather further away from the breeding areas and a few males were observed amongst vegetation in the centre of the small pools at the beginning and end of the breeding season. In one

particular location the frogs favoured squatting high up on the petioles of bananas growing beside a stagnant drainage dyke.

Systematic remarks. Systematically *H. spinigularis* holds a unique position amongst described members of the genus on account of its dermal asperities. A rough parallel is to be found in *H. köhleri* Mertens, an aberrant form from the Cameroon volcano. The males of this species also have a bi-lobed gular disc and are characterised by the presence of tubercles which are restricted to the flanks, under the hind limbs and on the latero-dorsal aspect of the digits. However, the tubercles of *köhleri* are of a dark, cornified, flat-topped cone shape and quite distinct from the spines of *spinigularis*.

A. Schiøtz informs me (in litt.) that he has recently collected in the Usambara region of Tanzania a rather similar frog to *spinigularis*.

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