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Tadpole of *Leptopelis ragazzii* (Boulenger, 1896), Shoa Forest Tree Frog (Anura, Arthroleptidae)

Kaulquappe von *Leptopelis ragazzii* (Boulenger, 1896), Ragazzis Waldsteigerfrosch (Anura, Arthroleptidae)

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Abstract

The tadpole of poorly studied *Leptopelis ragazzii* (Boulenger, 1896), a high-altitude tree frog species from the Ethiopian highlands, is described for the first time and compared with closely related sympatric species – *L. gramineus* (Boulenger, 1898) and *L. vannutellii* (Boulenger, 1898).

Kurzfassung

Die Larve des bis jetzt wenig erforschten *Leptopelis ragazzii* (Boulenger, 1896), einer Baumfroschart aus den Höhenlagen des Äthiopischen Hochlandes, wird zum ersten Mal beschrieben und mit den nah verwanden sympatrischen Arten *L. gramineus* (Boulenger, 1898) und *L. vannutellii* (Boulenger, 1898) verglichen.

Key Words

Arthroleptidae, Ethiopia, Harenna Forest, larva, *Leptopelis gramineus*, *Leptopelis vannutellii*, tadpole

Introduction

Leptopelis ragazzii (Boulenger, 1896) is a high-altitude species of tree frog that has a wide but patchy distribution in the southern Ethiopian highlands. It is often reported from both sides of the Great Rift Valley where it seems not to occur at elevations below 2,200 m a.s.l. (though one specimen was obtained at 1,930 m – Largen 1977) and to be confined to moist montane forests. In parts of its range it is sympatric with other two members of the genus – *L. gramineus* (Boulenger, 1898) and *L. vannutellii* (Boulenger, 1898) – that, however, occupy different habitats. Altogether seven species of *Leptopelis* Günther, 1859 are known in this geographic region of which five are endemic. Although *L. ragazzii* is among the longest known to science, it has not been adequately studied, and a missing formal description of the tadpole is one of the gaps in the knowledge of this species. Overall, tadpoles are known in 38 of the currently recognised 53 species of this genus.

Apart from the usually acknowledged taxonomic and phylogenetic relevance, in the case of *L. ragazzii* furthering our knowledge of tadpoles and breeding biology in general is certainly helpful for recognition of habitats critically important to the long-term survival of this spe-

cies which is considered to be vulnerable (Weinsheimer et al. 2010; IUCN SSC Amphibian Specialist Group 2013).

Leptopelis ragazzii tadpoles were often reported in the course of various surveys and research activities in a number of localities, but to date no detailed description of the tadpole has been published. During our fieldwork in the Harenna Forest, southern Ethiopia, we found, besides adult *L. ragazzii*, tadpoles in advanced development stages and could study their morphology.

Material and methods

The description is based on 3 specimens in development Stage 25, 1 in Stage 24, and 1 in Stage 28 (Gosner, 1960) found on November 4th, 5th and 6th, 2018, in the north-eastern Harenna Forest (Bale Zone, Ethiopia), at 06.92935N, 40.13629E, 2,610 m a.s.l., in a shallow river flowing fast through dense forest of tall trees. The voucher specimens are housed in the Zoological State Collection Munich, Germany (ZSM 285/2018 and 286/2018) and in the Museum of Nature at V. N. Karazin National University, Kharkiv, Ukraine (MNKNU Г-2000 – 2 specimens, and Г-2001). The specimens were euthanised by brief immersion in 0.1% solution of sodium thiopental and, after fixation in 10% formalin, transferred to 70% ethanol for final preservation.

We identified the genus by morphological characters according to the key to genera of African (sub-Saharan) Anura from Channing et al. (2012) and verified with descriptions of the tadpoles of closely related *Leptopelis* species (Largen 1977). The species identity was reasoned from the observation of an adult animal in direct proximity of the waterbody as well as from the evidence that no other amphibians occur in this particular locality and habitat (Fig. 1). Moreover, we found our vouchers to be morphologically identical (except ontogenetic difference) with 2 tadpoles in stage 36 that had been collected in a different population of *L. ragazzii,* during a survey in Kaffa province (NABU 2017), more than 400 km from our study area, and now housed in Zoological Research Museum Alexander König (ZFMK), Bonn (not accessioned).

Since in this area the range of grassland dwelling and fossorial *L. gramineus* overlaps with the range of *L. ragazzii* that is, however, arboreal and occupies forest habitats, we compared our vouchers also with the following tadpoles of *L. gramineus* in museum collections: ZSM 17/2017 and 18/2017, MNKNU Г-2002 and Г-2003.

For terminology in describing tadpoles we follow terms and descriptive characters by McDiarmid and Altig 1999; Altig 2007; McDiarmid and Altig 2009; Channing et al. 2012. Terminology for oral features was adopted from Dubois (1995). The development stage of tadpoles was determined according to the table of Gosner (1960). Measurements were taken with a micrometrical ocular, with accuracy of ± 0.1 mm. The measured parameters followed those used in other recent *Leptopelis* tadpole descriptions (Roelke et al. 2009; Barej et al. 2015; Penske et al. 2015; Schweiger et al. 2017). The following abbreviations are used for the morphometric parameters: **G** – Gosner stage, **TL** – total length, **SVL** – snout-vent length, **BW** – body width, **BH** – body height, **AH** – tail axis height at base, **AW** – maximum tail axis width, **VF** – ventral fin height, **DF** – dorsal fin height, **IOD** – interorbital distance, **SED** – direct snout-to-eye distance, **ED** – eye diameter, **SSD** – spiracle-to-snout distance, **SL** – spiracle length, **ODW** – oral disc width; **KF** – keratodont formula.

The illustrations (Figs 2, 3) were performed in Adobe Illustrator by one of the authors (AT) from one of the voucher specimens (ZSM 286/2018), soon after its preservation. The mouthparts of *L. gramineus* shown in Fig. 3 were depicted from the specimens of a parapatric population from Bale Mountains high plateau (ZSM 18/2917 and 19/2017).

Figure 1. Adult *L. ragazzii* (left), brown phase, captured in grass about 30 cm from the stream where we discovered swimming larvae (right).

Description of the Tadpole

The tadpole occupies lotic habitats and is eel-like, free swimming and benthic.

Body morphology

See Table 1 for absolute morphometric values of five voucher specimens. Body is ovoid (Fig. 2), with width 0.50 of length (BW/SVL), feebly compressed (BH/SVL 0.77). Maximum body width is on the level of the spiracle's posterior end. The snout is nearly round in dorsal view. Eyes are 0.08 of body length in diameter (ED/BL); positioned dorsolaterally (IOD/BW = 0.57). No nares are visible. Spiracle is sinistral, anterior to mid-body (SSD/SVL = 0.39), feebly visible in dorsal view; tube length 0.10 of body length (SL/SVL).

The tail length is 0.78 in total. Tail tip is narrow, but blunt. Muscle axis strong and pronounced. Dorsal fin originates posteriorly to the dorsal tail-body junction with maximum height at approximately 2/3 of the tail length and is slightly curved; ventral fin originates on the ventral terminus of the body and is lower than the tail muscle with maximum height of approximately 1/2 of the tail length; maximum height in ventral fin a little greater (DF/VF = 0.94); maximum tail height including fins approximately equals body height; tail axis width (in dorsal view) 0.38 of body width (AW/BW); maximum height of tail axis (at base) 0.57 of body height (AH/BH); tail axis height (at base) higher than maximum height of dorsal fin (DF/AH = 0.62). Vent tube dextral, basicaudal.

Oral morphology

The oral disc (Fig. 3) is positioned subterminally, but its anterior row of papillae is feebly visible in dorsal view. The disc is posteriorly emarginate, with posterior labium protruding (hanging down). There is one row of globular marginal papillae. The papillae are larger and longer posteriorly; the anterolateral and lateral papillae are smaller.

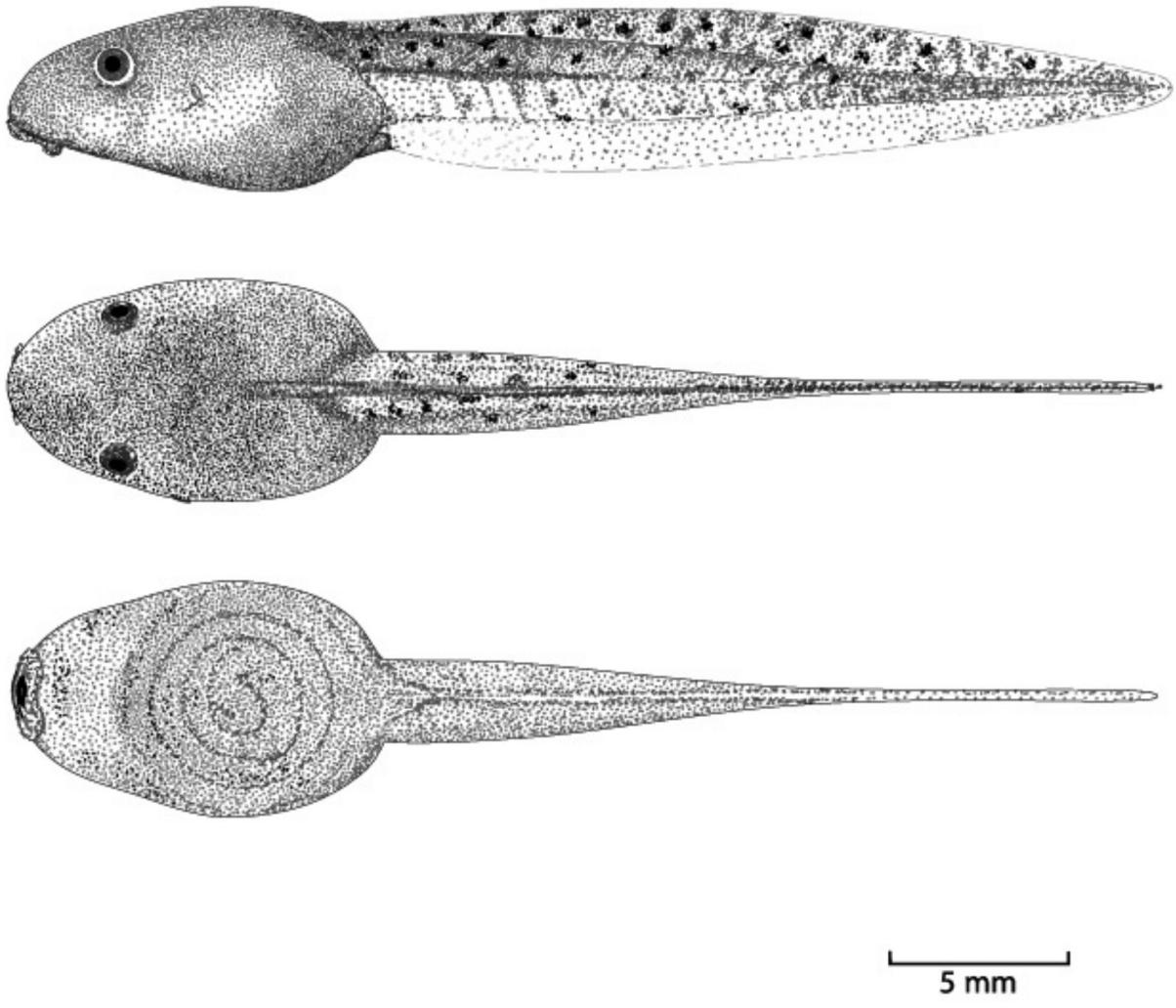

Figure 2. Tadpole of *L. ragazzii* (ZSM 286/2018) in Stage 25 – lateral, dorsal and ventral aspect.

Table 1. Morphometrics of tadpoles (in millimetres); for abbreviations see "Material and methods".

Accession #	G	SVL	TL	BW	BH	AH	AW	VF	DF	SED	IOD	ED	SSD	SL	ODW	KF
MNKNU Г-2000(1)	24	7.5	14.5	4.6	3.4	1.3	1.3	0.9	0.8	1.4	2.7	0.6	3.2	0.8	0.8	1
																2+2
																2
MNKNU Г-2000(2)	25	9.5	30.8	4.8	3.7	2.9	1.8	2.0	1.8	2.6	3.3	1.0	4.3	1.0	2.3	1
																2+2
																1+1
																1
MNKNU Г-2001	25	9.8	35.5	4.9	3.8	2.2	1.6	1.8	1.7	2.0	2.8	0.8	3.9	1.0	2.6	1
																2+2
																2
ZSM 285/2018	28	12.4	26.8	6.8	5.3	3.2	1.9	1.4	1.4	2.8	3.0	1.0	5.4	1.2	2.5	1
																2+2
																1+1
																2
ZSM 286/2018	25	10.6	24.1	6.4	5.1	2.3	1.5	1.4	1.2	2.3	3.2	1.0	4.3	1.1	2.4	1
																2+2
																3

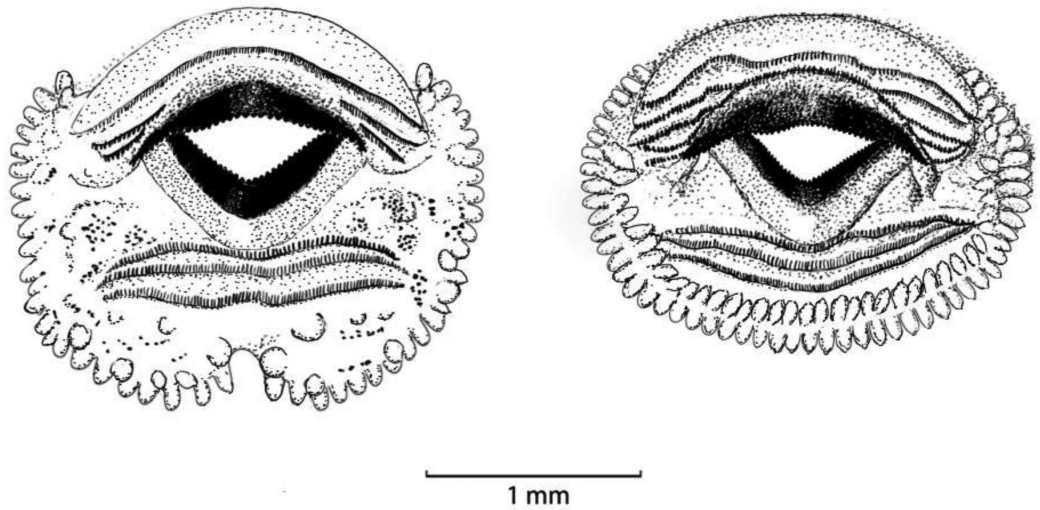

Figure 3. Mouthparts of *L. ragazzii* (left) and *L. gramineus* (right) tadpoles.

There are two or three continuous posterior keratodont rows. The number of anterior rows seems to remain constant: one continuous and two interrupted. The following keratodont formulas occur: 1:2+2 / 2; 1:2+2 / 1+1:1; 1:2+2 / 1+1:2; 1:2+2 / 3.

Jaw sheaths are moderately strong; posterior strongly V-shaped and overall heavier than anterior; the latter is wavy.

Colouration

The tadpole is generally grey or grey-brown in appearance, both in preservative and in life. Dorsum is darker than venter that is also grey coloured. Larger and older specimens in the series have more dark speckles on dorsal fin, hence the overall appearance of the animal becomes darker and more speckled in advanced development stages. Median line of the tail muscle is dark pigmented. The venter skin is opaque, intestines are not visible under normal light, or (in smaller specimens) may be noticed only as shaded contours. The iris is grey.

Discussion

The easiest, and quite reliable method of distinguishing the larvae of Ethiopian *Leptopelis* is through assessment of their geographical or ecological separation, as no spe-

cies seem to occur syntopically even if their ranges overlap. Attempts at identification by external morphology only may fail or lead to a wrong conclusion.

Like the adult frogs, the tadpoles of *L. ragazzii* and *L. vannutellii* are very similar in size and shape (for an illustration of *L. vannutellii* tadpole see Channing et al. 2012). In fact, there is no obvious morphological difference between them that the species identification can rely upon.

The tadpole of *L. ragazzii* also resembles the tadpole of *L. gramineus*, from which it slightly differs by general body and tail shape (see illustration of *L. gramineus* in Largen (1977) and Channing et al. (2012)), higher tail, especially ventral fin (VF/AH 0.68 versus 0.47), oral morphology as well as by colouration. The tadpoles of *L. gramineus* appear to be smoother coloured: melanophores are arranged in fine dots rather than in large speckles. The oral disc of the *L. gramineus* tadpole is not emarginate, and the posterior labium does not hang down as much as in *L. ragazzii*. There are up to four interrupted anterior rows versus usually two in *L. ragazzii* (Fig. 3).

Just like in *L. vannutellii* and *L. gramineus* (Largen 1977; Schweiger et al. 2017), considerable variation of keratodont rows occurs in the tadpoles of *L. ragazzii*. The non-sympatric *L. yaldeni* Largen, 1977 has also the same keratodont row number and layout (Largen 1977). Thus, it is not possible to distinguish these species by this character that is traditionally considered as diagnostic for many anuran larvae.

In the tadpoles of this genus, the nares seem to appear at later stages, from Stage 34 on (compare Schweiger et al. 2017). In the comparison specimens (Stage 36) from Kaffa (ZFMK, not accessioned) the nares are feebly visible. They also differ in colouration from our vouchers, being rather red-brown than grey.

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