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SHORT NOTE

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Description of the tadpole of *Leptopelis* cf. *grandiceps* (Amphibia: Anura: Arthroleptidae) from the Uluguru Mountains, Tanzania

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The tadpole of *Leptopelis* cf. *grandiceps* is described from the Uluguru Mountains of Tanzania. The tadpole resembles other *Leptopelis* tadpoles but differs from known East African *Leptopelis* tadpoles in having a divided first row (P1) of infralabial keratodonts and in having more and longer oral papillae. There are furthermore pronounced differences in oral apparatus morphology between tadpoles of *L.* cf. *grandiceps* previously described from the Ukaguru Mountains and the material described here, which might indicate that the populations are in fact separate species. Tadpole morphology can provide additional characters that can contribute to taxonomic assessments and revisions.

Key words: barcoding, Eastern Arc Mountains, taxonomy

Larval morphology has the potential to inform taxonomic assessments by complementing adult morphology and molecular sequence comparisons. In amphibians this potential is often not realised even though larval morphology can significantly contribute to resolving systematic relationships (Müller et al., 2005a). This is especially the case where disjunct populations of nominally conspecifics show little variation in adult morphology, but can reasonably be expected to represent different species. The genus *Leptopelis* is a widespread and diverse group of sub-Saharan African treefrogs (Schiøtz, 1999). Of the currently recognised 51 species (Frost, 2014), information on tadpole morphology is only available for 22 species (Channing et al., 2012). A lack of information that would help in identifying tadpoles is particularly pronounced for East Africa, where information on tadpoles is only available for four of the fourteen currently described species (Channing & Howell, 2006; Channing et al., 2012). Channing et al. (2012) recently provided the first brief description of the tadpole of *L. barbouri* (Pickersgill (2007) previously described tadpoles he tentatively referred to *L. barbouri*), based on a single specimen from the Ukaguru Mountains, Tanzania. Subsequently, a nomenclatural change was proposed and the name *L. grandiceps* suggested as the valid name for the treefrogs with the characteristic translucent green skin, while *L. barbouri* was relegated to the synonymy of *L. flavomaculatus* (Gvoždík et al., 2014). Pending more comprehensive analyses, Gvoždík et al. (2014) proposed to restrict the name *L. grandiceps* to the population from the East Usambara Mountains, with the other populations provisionally referred to *L.* cf. *grandiceps*. Apart from the East Usambara Mountains, populations of the *L. grandiceps* complex are found distributed across the Eastern Arc Mountains (including Nguu, Nguru, Ukaguru, Uluguru, Rubeho, Udzungwa Mountains), Mount Rungwe and the Livingstone Mountains (IUCN SSC Amphibian Specialist Group, 2013). The species complex ranges from 170 to 2020 m a.s.l. (Gvoždík et al., 2014) and is found along streams in primary rainforest habitats. We here provide a description and measurements of tadpoles of *L.* cf. *grandiceps* based on a series collected from the Uluguru Mountains of Tanzania and highlight differences between these and tadpoles recently described from the Ukaguru Mountains (Channing et al., 2012), with the aim of providing additional characters that can be utilised in a taxonomic reassessment of the *L. grandiceps* complex.

The description is based on a series of five tadpoles (Gosner stages 37–42), all collected near to Mwere stream in the Uluguru North Nature Reserve, Uluguru Mountains, Tanzania, 6.9004°S, 37.6845°E, 1600 m a.s.l., on the 16th December 2012. Tadpoles were found in a small, muddy stream pool filled with leaf litter that formed part of a tiny stream bordered by vertical soil walls. The place was forested, densely overgrown by ferns, bushes and lower trees (10–15 m). Both females with large eggs in oviducts, seemingly close to oviposition, and adult males calling from branches above the stream

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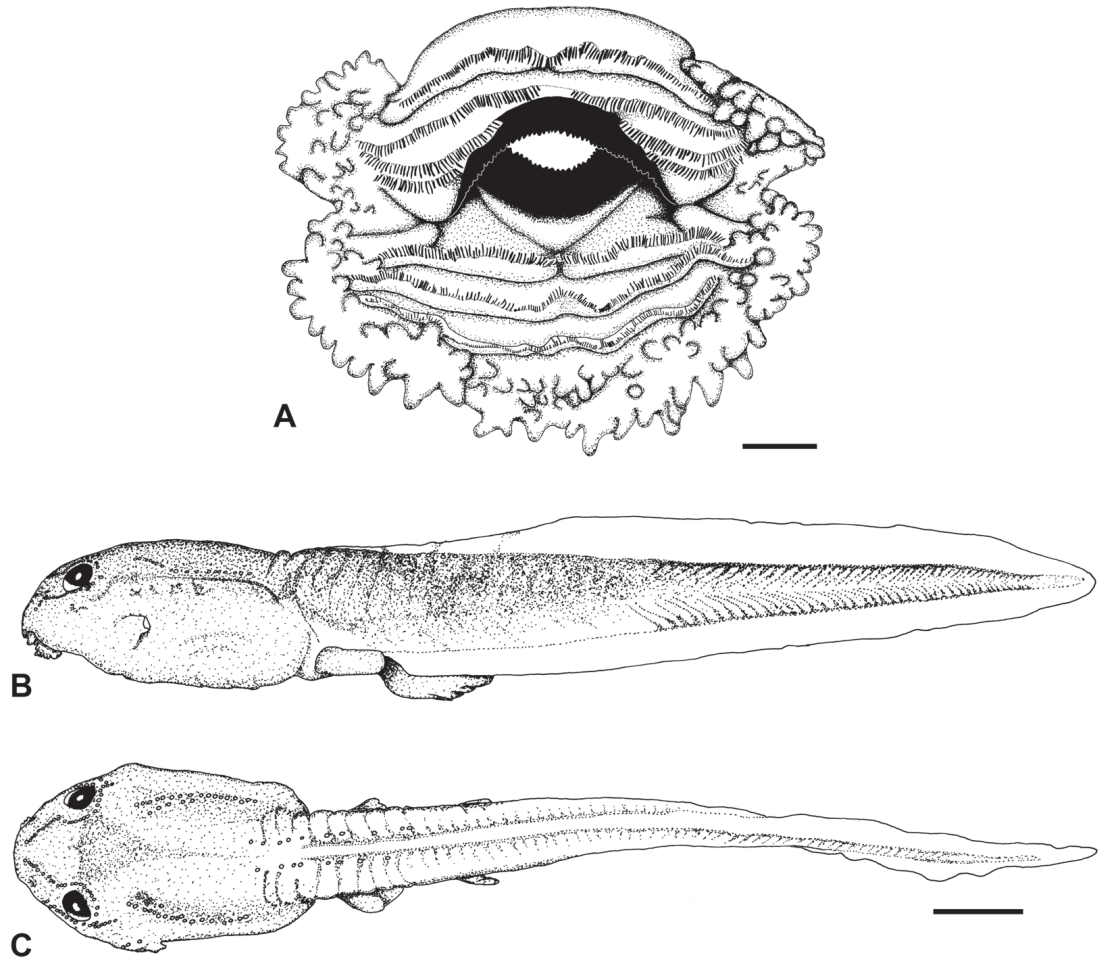

Fig. 1. Oral disc (A), lateral (B) and dorsal (C) view of a Gosner stage 37 tadpole of *L.* cf. *grandiceps* from the Uluguru Mountains, Tanzania. Scale bar equals 0.5 mm in (A) and 5 mm in (B) and (C).

were found at this locality. Tissue samples were taken from tail musculature and preserved in 96% ethanol. Specimens were fixed in 4% neutral buffered formalin, transferred to 70% ethanol, and deposited in the Museo Tridentino di Scienze Naturali (MTSN 7767.1A-E). Tadpoles were DNA barcoded using a fragment of the mitochondrial 16S rRNA gene (Vences et al., 2012) and compared to adults collected at the same locality (MTSN 7754, 7761, 7769). The analysed adult and larval DNA sequences were identical (0.0% sequence divergence), confirming conspecificity. Staging followed Gosner (1960). Standard measurements and labial tooth row formula follow Altig & McDiarmid (1999). Drawings were prepared with the aid of a camera lucida attached to a Zeiss V12 Stereo Discovery microscope.

Tadpole description

An overall slender tadpole with a moderately elongated, slightly dorsoventrally compressed body (wider than deep), with the widest point of body just behind eyes (Fig. 1). The nares are positioned dorsolaterally, slightly closer to tip of snout than eye in lateral view. Eyes positioned dorsally. The spiracle is sinistral, with the inner wall free from the body. The tail is about 2.5 times as long as the body (see Table 1 for measurements) and very muscular. The myomeres are visible in the posterior half of the tail, particularly ventrally, but are otherwise indistinct or obscured by pigmentation. The tailfins are low, with the dorsal fin slightly deeper than the ventral fin. The dorsal fin has a low origin on the base of the tail and rises towards the end of the first third of the tail. The ventral tailfin is very even, with the margin of the fin running more or less parallel to the ventral edge of the muscular tail. The deepest point of the tail is at about half its length. Tip of tail is bluntly pointed, with the muscular tail nearly reaching the tip. Vent tube is dextral and displaced dorsally in that it is completely attached to the lateral side of the ventral tailfin, with a wide, broadly arched opening. The gut is only partly and indistinctly visible from ventral.

Oral disc

The oral disc is positioned subterminally and not visible in dorsal view. The disc is deeply emarginated and has a broad rostral gap in papillation. Two rows of marginal papillae are present anteromedially, posterolaterally and posteriorly. Papillae are relatively elongated (length about 2–3 times width) and evenly sized, with the exception of the posterior-most outer papillae, which are more elongated at about 3–4 times width. Papillae

Table 1. Measurements of *Leptopelis* cf. *grandiceps* tadpoles from the Uluguru Mountains, Tanzania. All measurements in mm.

Gosner stage	37	38	39/40	41	42
total length	53.0	59.0	54.0	58.0	56.0
body length	15.0	16.0	15.5	14.3	13.8
body width	9.3	9.6	9.8	9.5	8.6
body height	6.7	7.1	6.3	6.4	6.0
tail length	38.0	43.3	37.7	43.0	41.0
tail height	6.8	7.2	7.0	5.4	5.3
tail muscle height	4.9	4.8	5.0	3.1	3.1
tail muscle width	4.2	4.5	4.7	3.7	3.7
width of oral disc	3.5	3.5	3.9	2.4	-
interorbital distance	5.4	5.8	5.7	5.6	5.9
internarial distance	3.1	3.5	3.1	2.2	2.2
snout-naris distance	1.1	1.2	0.9	0.6	0.5
snout-eye distance	3.7	3.6	3.3	2.9	2.8
snout-spiracle distance	7.4	8.0	8.9	-	-
naris-eye distance	2.4	2.4	2.4	2.2	2.3
eye diameter	1.3	1.4	1.3	1.3	1.9

are especially densely packed in the outer row, giving the overall impression of three rows of marginal papillae. No submarginal papillae present with the exception of single papillae laterally near P1 in one specimen. Keratodont formula is 4(2-4)/3(1). Supralabial rows progressively smaller towards mouth, infralabial rows of nearly equal length, with P2 being slightly longer than P1 and P3. Interruption of P1 very narrow (barely visible in Fig. 1A). Keratodonts about equally sized in all rows. Jaw sheaths deeply keratinised and serrated. Keratodonts are absent in the tadpoles of Gosner stages 41 and 42, while papillation is reduced in the stage 41 tadpole and nearly completely reduced at stage 42.

Colouration in life

Younger stages (Gosner 37, 38) were brownish with a greenish tone, the latter becoming more intensively green to vivid green in the later stages. Patches of dark slate pigmentation were present along the dorsal side of tail. Iris of the eye was yellowish, becoming golden greyish during metamorphosis, with a dark vermiculation.

Colouration in preservative

Dorsal body finely pigmented and overall dark brown in colour. Pigmentation on tail more blotched, with blotches fusing to form a more reticulated pattern. Pigmentation of tail most strongly developed on dorsal side, with ventrolateral and ventral sides of tail only sparsely pigmented. The tailfins are nearly pigment free, with only a few scattered melanophores present on the sides of the dorsal fin and along its distal edge.

The tadpole of *L.* cf. *grandiceps* (Uluguru Mts.) is overall similar to most other described *Leptopelis* tadpoles, which are generally elongated (Schiøtz, 1999). Very few tadpoles of East African *Leptopelis* have been described, which precludes a broadly comparative discussion, but *L.* cf. *grandiceps* tadpoles from the Uluguru Mountains show a few distinct differences from the other known tadpoles. It differs from other species by having a divided P1, which is undivided in *L. karissimbensis*, *L. mackayi* and *L. vermiculatus* (Drewes et al., 1989; Köhler et al., 2006; Roelke et al., 2009). It further differs by having four supralabial keratodont rows, instead of only three in *L. mackayi* (Köhler et al., 2006) and five in *L. vermiculatus* (Drewes et al., 1989). However, the number of keratodont rows is known to vary ontogenetically and particularly the three supralabial rows described for the Gosner stage 27 larva of *L. mackayi* might not represent the full complement of rows. *Leptopelis* cf. *grandiceps* tadpoles do seem to have a different pattern of oral disc papillation, with more papillae and somewhat longer papillae than in *L. karissimbensis*, *L. mackayi* and *L. vermiculatus*. The latter species furthermore seems to differ from other East African *Leptopelis* by a less elongated body form that resembles a more generalised tadpole (Drewes et al., 1989). Compared to the tadpole of *L.* cf. *grandiceps* described by Channing et al. (2012; as *L. barbouri*) from the Ukaguru Mountains, *L.* cf. *grandiceps* from the Ulugurus differ again by a divided P1, a much more extensive A4, and a different arrangement of marginal papillae (only single row of much larger papillae anteriorly in the Ukaguru specimen). In addition, the jaw sheaths of Uluguru *L.* cf. *grandiceps* are more evenly

serrated instead of having more finely pointed serrations as in *L.* cf. *grandiceps* from the Ukagurus. Uluguru *L.* cf. *grandiceps* tadpoles are overall similar to those described by Pickersgill (2007) from the East Usambara Mountains, but differ in having an emarginated oral disc and two rows of marginal papillae anteromedially. Given the previously unrecognised diversity of other amphibian taxa from the Eastern Arc Mountains (e.g., Müller et al., 2005b; Loader et al., 2010, 2011), it seems possible that the observed differences in tadpole morphology of the two different populations currently assigned to *L.* cf. *grandiceps* do indicate different species.

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