



The tadpole of the Swelled Vent Frog *Feirana quadranus* (Anura: Ranidae): Oral, chondrocranial and hyobranchial morphology

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The genus *Feirana* includes three species of microglossid frogs, but much controversy on the classification and species content of this group still exists (Yang *et al.*, 2011). Detailed information on tadpole morphology is of great importance in classifying amphibian species but, unfortunately, morphology of *Feirana* tadpoles remains poorly known. Here, we describe body shape, oral disc, chondrocranial and hyobranchial anatomy of *Feirana* tadpoles using the Swelled Vent Frog *F. quadranus* Liu, Hu & Yang, 1960 as a representative. This species is currently known to occur only in seven provinces (Gansu, Henan, Hubei, Shaanxi, Hunan, Shanxi and Sichuan) in the central part of China (Fei *et al.*, 2005).

We collected *F. quadranus* tadpoles ($N = 121$) in 2011 from Zhuque National Forest Park (33°44'N, 108°34'E) in Tsinling Mountains, Shaanxi. All tadpoles were brought to our laboratory in Anqing, where five were reared through metamorphosis to confirm that the field-caught tadpoles could be identified to *F. quadranus*. The remaining 116 tadpoles were identified for Gosner's (1960) development stages after they were euthanized using a 0.001% benzocaine solution. Fixed tadpoles were stored in 70% alcohol and deposited in the College of Life Sciences, Anqing Normal University for morphological analyses (collection numbers: LFANU1–116). Tadpoles at Gosner's stage 36 were eviscerated, cleared and double-stained with alizarin red and alcian blue (Taylor & Van Dyke, 1985). The internal oral cavity was described according to Wassersug (1980). The structure of chondrocranium was photographed using a Discovery V12 stereoscope microscope (Carl Zeiss, Germany) equipped with a digital camera (Canon Inc., Japan) and then described according to McDiarmid & Altig (1999). Additional five tadpoles at stage 36 were dissected to observe internal oral morphology using a Hitachi S-2300 scanning electron microscopy (Hitachi Co., Japan).

Description of tadpole. Ten *F. quadranus* tadpoles (LFANU42–51) at Gosner's stage 36. Mean values (standard deviation in parentheses; length units are in mm, and mass units in g) are as follow: total length, 59.3 (3.0); snout-vent length, 18.3 (0.7); body width, 12.3 (1.7); maximum body height, 9.1 (1.0); interorbital distance, 5.5 (0.8); internarial distance, 4.0 (0.2); tail height, 11.2 (0.8); tail length, 41.1 (2.8); tail width, 7.1 (0.5); tail muscle height, 8.9 (0.6); body mass, 1.98 (0.40) g. In dorsal view, body is dark brown, oval and elongated (Fig. 1A). Eyes, with a darker coloration of the dermal fringe, are large and dorsolaterally positioned. Interorbital distance is larger than eye-naris distance, and is about half of body width. Snout is nearly triangular but vaulted on the dorsum. Snout tip is nearly rounded. External nares are ovoid and anterolaterally located, partially rimmed with a thin black cutaneous marginal fringe. Nostrils are closer to the anterior border of the eye than to the snout tip. In lateral view, spiracle is sinistral and opens dorsoposteriorly; spiracular opening is oval, and located below the level of the apex of the tail musculature. The tail is almost lanceolate, with the maximum height occurring in the middle of the tail. Tail length is nearly twice of body length, and tail height is about one-third of tail length. The tail musculature extends to the rounded tip. Tail musculature is yellow-brown. There are spots at the end of the tail. The dorsal and ventral tail fins are semitransparent and equal in height. The opening of vent tube continues with the margin of the ventral fin.

Oral disc. The oral disc of *F. quadranus* is composed of lower and upper lips (Fig. 1B). Lower lip has two rows of small and columnar marginal papillae and one row of broad and globose submarginal papillae, while upper lip has no papillae. There are lateral emarginations between the lower and upper lips in the oral disc. Labial teeth row formula (LTRF) is 8(3-8)/3(1) according to Altig's (2007) LTRF formula. Labial teeth have serrated edges and they are long, rod-like and keratinized (Fig. 1C). The black jaw is composed of a curved-edge upper jaw sheath and a V-shaped lower jaw sheath (Fig. 1D).

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