

## Short Communications

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### Size at metamorphosis of *Boophis occidentalis* GLAW & VENCES, 1994 in an arid environment of central-southern Madagascar

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**Abstract.** We report the size of tadpoles at metamorphosis of *Boophis occidentalis* measured upon tadpoles and froglets collected in a river of the Isalo Massif, central-southern Madagascar. The tadpoles ranged from 31-70 mm and newly metamorphosed froglets 22-32 mm snout-vent length, thus reaching about 47-60 % of the adult size. We comment on such a large size at metamorphosis in the light of the adaptation and ecological advantages in arid environment where the species lives, and compare it with that of other sympatric species, such as *Scaphiophryne gottlebei*, *S. brevis*, and *Mantella expectata*.

Key words. Amphibia, Mantellidae, Boophinae, tadpole, ecology.

An understanding of basic life history traits of amphibians is a needed element to determine conservation priorities. Despite of this, very little is known about the duration of the larval development and ecology of the more than 230 frog species from Madagascar.

In such a context, we recently gathered information on some poorly known species adapted to arid and subarid environments, which were understudied up to now. One of these is the arboreal western white-lipped treefrog, *Boophis occidentalis* GLAW & VENCES, 1994 (Mantellidae: Boophinae). This species was first found at Tsingy de Bemaraha, West-Madagascar (ANDREONE 1993), and then confirmed from Isalo Massif, central-southern Madagascar (GLAW & VENCES 1994). Further observations carried out at Sahamalaza (North-West-Madagascar) provided new insights into the reproductive and larval biology of this frog (ANDREONE et al. 2002). The described tadpoles were reared in captivity to about 33 mm total length at Stage 26 sensu GOSNER (1960). It was therefore clear that this was not the maximum size reachable by the tadpoles.

During recent survey in the Isalo, we found several advanced tadpoles and metamorphosed froglets of this species, at a site along the Menamaty River, named Andriamanero (22°22.05'S, 45°23.87'E, 634 m above sea level; 20 November 2004). Here the river was quite wide (10-20 m), slow moving, and generally about 20-50 cm deep, with some places up to 150 cm deep. Occasional small sandy and stony islands and large boulders emerged from the river; in some cases these islands were colonized by small trees. The tadpoles were caught with a hand net in slow parts of the river, often from beneath large stones. Metamorphosed froglets either were hidden in the water under these stones or rested on the emergent vegetation.

We collected specimens and fixed them in 90 % ethanol or 10 % formalin. We measured the snout-vent length (SVL) of metamorphosed froglets and the total length (TL), body length (BL) of the tadpoles. To identify and confirm the specific attribution of the tadpoles, we compared two-legged with four-legged individuals and the labial tooth formula with that previously reported for *B.*



**Fig. 1.** Dorsal and lateral view of the tadpole of *Boophis occidentalis* at Stage 40 sensu GOSNER (1960), total length of about 70 mm, from Menamaty River (Andriamanero, Isalo Massif: MRSN A4998).

*occidentalis* (ANDREONE et al. 2002).

Two tadpoles [MRSN (Museo Regionale di Scienze Naturali, Torino) A4998.1-2] at Stage 37 sensu GOSNER (1960) measured 31.0 and 37.6 mm TL, and 12.2 and 15.0 mm BL, respectively. The third tadpole (MRSN A4998.3), Stage 40 sensu GOSNER (1960) had 70.0 mm TL and 23.4 mm BL. The dorsal coloration in all tadpoles examined was greenish-grey with small darker spots that continued onto the tail, whose background was notably paler than the body. The dorsal and ventral tail fins were irregularly spotted, and the belly was whitish. At about one year after capture, the preserved tadpoles still have the same colouration, although with some fading on the tail muscle and the hind legs being brownish.

We also captured a metamorphosing individual with a short tail and five metamorphosed froglets. The metamorphosing individual (MRSN A5002) had 32.2 mm BL plus a tail remnant of 10.7 mm. Its dorsal coloration in life was brownish shading to greenish and intermediate between brownish and purple when preserved. A pale spot was visible near the tympanum. Pale thin lines started at the posterior ridge of the eyelids. The metamorphosed individuals (MRSN A5000, A5004, A5006, A5320-5321) had SVLs of 31.5, 29.4, 29.1, 28.6, and 21.9 mm, respectively. In life, these froglets had a coloration almost identi-

cal to that observed in the adults: light green with whitish-yellowish lines behind the eyelids. In preservative (4 % formalin or 65 % ethanol), they changed to pink-purple, as is common in representatives of the *Boophis albilabris* group (ANDREONE 1993, GLAW & VENCES 1994, ANDREONE et al. 2002).

Seen our observations, metamorphosis SVL of *B. occidentalis* is about 20-30 mm. This is indeed a remarkable size, since adult SVL is about 50-65 mm (ANDREONE et al. 2002). Hence, metamorphs already have 47-60 % of the adult SVL.

A few considerations could indeed be done on the adaptive significance of such a large size by making comparison with other species of amphibians found together with *B. occidentalis*. In the Isalo Massif, *Scaphiophryne gottlebei* BUSSE & BÖHME, 1992 (Microhylidae: Scaphiophryninae) metamorphosed at about 10-15 mm SVL; adults measure 26-32 mm SVL and toadlets were 31-58 % of the adult SVL. Similar figures for *Mantella expectata* BUSSE & BÖHME, 1992 (Mantellidae: Mantellinae) are about 10 mm SVL at metamorphosis, whereas adults reach 21-31 mm SVL (froglets are 30-50 % of the adult SVL). In all three cases, a sizeable portion of adult body length is reached at the moment of metamorphosis, after a larval period lasting about three months (MERCURIO & ANDREONE 2005).

Another species found at Isalo, *Scaphiophryne brevis* (BOULENGER, 1896) (Microhylidae: Scaphiophryninae) follows a different pattern. Reproduction was observed on 23 November 2004, and tadpoles completed metamorphosis within three weeks only. The metamorphosed *Scaphiophryne* toadlets (MRSN A5308) measured about 7-8 mm SVL, while the adults (MRSN A5040-5041) have 35-36 mm SVL. Data in literature (GLAW & VENCES 1994) report a maximum SVL of 42 mm. Thus, the metamorphosis SVL in *S. brevis* corresponds to merely 16-23 % of the adult SVL.

The difference in the toadlet/adult ratio in these species may be explained in consider-

ation of the adaptation to the arid environments, and the different colonised habitats. In general, a larger size at metamorphosis warrants a better ability to feed upon large prey, and means that a lower energetic investment is needed to reach sexual maturity. Furthermore, the exposed body surface is comparatively smaller in larger metamorphs than in small froglets that are subject to a higher evo-transpiration rate. More permanent water bodies allow for a long larval period and consequently the possibility to reach a larger size at metamorphosis. Conversely, temporary water bodies where the water remains for a short period are not conducive to reaching large size at metamorphosis. In such a context we could interpret the difference in the species cited. *Boophis occidentalis* live along permanent rivers, in which water is available almost continuously. *Scaphiophryne gottlebei* lives in narrow, humid and shaded canyons, where water may persist in deep pools for long periods. In contrast, *S. brevis* breeds in temporary, even ephemeral ponds and has small metamorphs. *Mantella expectata* was found in an intermediate kind of habitat, with small, sun-exposed pools, that somehow maintain water for quite a long time (MERCURIO & ANDREONE 2005). In these species the presence of either a long developmental period that results in large size at metamorphosis or of a short larval period is a consequence of different life history traits.

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