Predation upon *Mantella aurantiaca* in the Torotorofotsy wetlands, central-eastern Madagascar

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**Abstract.** Malagasy poisonous frogs of genus *Mantella* are small, diurnal frogs with skin glands containing alkaloids and characterised by aposematic colouration. Due to their noxiousness and warning colouration, it is thought that they do not have many natural predators. Until now, only one successful and one aborted predation on *Mantella* frogs were reported. Herein, we account about two successful predations on *M. aurantiaca* in Torotorofotsy wetland, in central-eastern Madagascar. The first predation was observed by lizard *Zoonosaurus* sp. and the second predation by a snake probably belonging to *Thamnosophis lateralis*. Both predators did not seem to mind the taste of the *M. aurantiaca* and ingested it.

**Keywords.** Amphibia: Mantellidae, poison frogs, *Thamnosophis, Zoonosaurus*

Only little is known about predation on poisonous frogs in general, in particular for those containing skin alkaloids. Until now, there are around 30 reports published on predation on poisonous frogs, mostly belonging to the families Bufonidae and Leptodactylidae (e.g. Guimaraes, Pinto and Juliano, 2004; Cuello, Jara and Vidoz, 2005; Menin, 2005; Smith and Green, 2005), and only ten published and several unpublished reports on predation and unpalatability or toxicity of frogs from the alkaloid-containing poison frogs in the family Dendrobatidae (Daly and Myers, 1967; Brodie and Tumbarello, 1978; Myers, Daly and Malkin, 1978; Fritz, Rand and De Pamphilis, 1981; Szelistowski, 1985; Hedstrom and Bolanos, 1986; Master, 1998; Master, 1999; Summers, 1999; Gray, Ouellet and Green, 2002). Most of the predations observed were by snakes, and then follow predations by birds and spiders. Among the predators mentioned, there were also unsuccessful predation attempts, including the one by the large, predatory ant, *Paraponera clavata*.

Alkaloids are known to occur independently in dendrobatid frogs of New World tropics, in the bufonid genus *Melanophryniscus* of southeastern South America, in Malagasy poison frogs of the genus *Mantella* (family Mantellidae) of Madagascar, and the myobatrachid genus *Pseudophryne* of Australia (Daly, Hight and Myers, 1984; Daly et al., 2002). All of these frogs are also characterized by varying degrees of aposematic colouration. For Malagasy poison frogs there are only two published records of predation: Heying (2001) reported a successful predation from Nosy Mangabe in northeastern Madagascar on *Mantella laevigata* by a gerrhosaurid lizard (*Zonosaurus madagascariensis*), and an aborted predation of the same species by a boid snake (*Acraenophis madagascariensis*).

Here we report two successful predations on *Mantella aurantiaca* (Fig. 1), both observed in the Torotorofotsy wetlands, one of the few known sites where *M. aurantiaca* occurs. The site is located in central-eastern Madagascar, near the village of Andasibe.

The first predation event was observed by R.D. on 13 December 2004 during sunny weather. A lizard of the genus *Zonosaurus* sp. and the second predation by a snake probably belonging to *Thamnosophis lateralis*. Both predators did not seem to mind the taste of the *M. aurantiaca* and ingested it.

The predation event was observed by R.D. on 13 December 2004 during sunny weather. A lizard of the genus *Zonosaurus* (probably *Z. madagascariensis*, more common in this area than the superficially similar *Z. aeneus*) was observed predating on and eating one individual of *M. aurantiaca* that was caught out of a group of calling males. The frog was taken away by the lizard from the site of capture to be consumed a few meters away. The reptile did not appear to be affected by any possible effects of amphibian toxins.

The second predation was observed on 22 January 2007 during sunny weather. During a field study three of us (O.J., G.S. and F.R.) were set on the ground

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under a camouflage net to observe the activity and movements of the frogs. After 30 minutes, we observed a *Thamnosophis* (formerly *Bibilava*) snake. The specimen probably belongs to the species *T. lateralis* which is one of the most common species in eastern and central Madagascar (Glaw and Vences, 2007). Potentially, *T. lateralis*, could be confused with *T. epistibes*, a similar species which also inhabit this area. The snake started predating on and swallowing one individual of *M. aurantiaca*. The snake did not seem to mind the taste of *M. aurantiaca*, and after eating the frog, it left. This might indicate that *M. aurantiaca* toxins from Torotorofotsy are not lethal for this species. This assumption was confirmed during snake feeding experiments performed in Andasibe in 2007 and 2008, where snakes caught in the wild were fed with two frogs at the same time (one non-conspicuous non-poisonous frog, *Guibemantis liber*, and one *Mantella aurantiaca*, caught in Torotorofotsy) giving the snake the opportunity to chose among the prey. Most of the snakes preferred non-conspicuous non-poisonous frog over *M. aurantiaca*, but those snakes that consumed *M. aurantiaca* did not show any effects of intoxication (Jovanovic, unpublished observations).

In general, anurans are known to be preyed upon by so many predators that it has been stated that ‘practically anything will eat an amphibian’ (Duellman and Trueb, 1994). Recently, a survey of records of vertebrate amphibian predators was published by Toledo, Ribeiro and Haddad (2007). Based on numerous unpublished data as well as published articles and natural history notes, these authors found that snakes were the most representative group, being referred to in about 45% of the reports and should be considered the main anuran predators. Anurans were preyed upon even when they had a large amount of skin toxins, e.g. bufonids, *Bufo proboscideus* (Menin, 2005) and *Leptodactylus pentadactylus* (Roberts, 1997) or highly toxic skin secretions, e.g. *Dendrobates auratus* (Hedstrom and Bolanos, 1986; Master, 1998; Gray, Ouellet and Green, 2002), *Oophaga pumilio* (Daly, pers. comm.; Donnelly, pers. comm.), *Eupemphix nattereri* (Bezerra, 1998) and *Phyllobates terribilis* (Myers, Daly and Malkin, 1978). It is also stated that birds and mammals must invest more than ectothermal predators (such as snakes) to overcome amphibian defensive strategies (Toledo, Ribeiro and Haddad, 2007). As a consequence, it is possible that snakes have been (or are) driving the diversification of anuran defensive strategies (Toledo, Ribeiro and Haddad, 2007). Probably only some of the

Figure 1. Adult *Mantella aurantiaca* in its natural habitat in Torotorofotsy (S 18°52.573’ E048°22.243’), Madagascar. January 2007. Photo: Goran Safarek.
snake and spider species are those driving the evolution of defensive mechanisms in anurans, but surely there are other groups of animals, like birds which are visually oriented predators that probably have a strong influence on the evolution of some of aposematic anuran species (Toledo, Ribeiro and Haddad, 2007).

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Reference

