Herpetology Notes, volume 2: 95-97 (2009) (published online on 10 July 2009)

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

Olga Jovanovic[1]*, Miguel Vences[1], Goran Safarek[2], Falitiana C.E. Rabemananjara[3], Rainer Dolch[4]

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Juliano, 2004; Cuello, Jara and Vidoz, 2005; Menin, 2005; Smith and Green, 2005), and only ten published and several unpublished reports on predation and unpalatability or toxicity of frogs from the alkaloid-containing poison frogs in the family Dendrobatidae (Daly and Myers, 1967;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, Highet 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 (*Acrantophis 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* (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

1 Zoological Institute, Technical University of Braunschweig, Spielmannstr. 8, 38106 Braunschweig, Germany
2 Trg kralja Kresimira 10, 48000 Koprivnica, Croatia
3 Département de Biologie Animale, Université d' Antananarivo, Madagascar
4 Association Mitsinjo, Lot 104 A Gare, Andasibe 514, Madagascar
* Corresponding author. Email olgajo@tu-bs.de

Figure 1. Adult *Mantella aurantiaca* in its natural habitat in Torotorofotsy (S 18°52.573' E048°22.243'), Madagascar. January 2007. Photo: Goran Safarek.

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 ectothermic 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

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).

Acknowledgments. We thank the University of Antananarivo, ICTE/MICET, and Association Mitsinjo, at Andasibe for providing logistic assistance. We are grateful to the Malagasy authorities for research permits. This work was financially supported by the Volkswagen Foundation and by a scholarship of the German Academic Exchange Service (DAAD) to O. Jovanovic.

Reference

Bezerra, A.M.R. (1998): *Physalaemus nattereri*. Predation. Herp. Rev. 29: 98.

Brodie, E.D. Jr., Tumbarello, M.S. (1978): The antipredator functions of *Dendrobates auratus* (Amphibia, Anura, Dendrobatidae) skin secretion in regard to a snake predator (*Thamnophis*). J. Herpetol. 12: 264-265.

Cuello, M.E., Jara, F., Vidoz, Q. (2005): *Atelognathus patagonicus*. Predation. Herp. Rev. 36: 298.

Daly, J.W, Myers, C.W. (1967): Toxicity of Panamanian poison frogs (*Dendrobates*): some biological and chemical aspects. Science 156: 970-973.

Daly, J.W, Highet, R.J., Myers, C.W. (1984): Occurence of skin alkaloids in non-dendrobatid frogs from Brazil (Bufonidae), Australia (Myobatrachidae) and Madagascar (Mantellinae). Toxicon 22: 905-919.

Daly, J.W., Kaneko, T., Wilham, J., Garraffo, H.M., Spande, T.F., Espinosa, A., Donnelly, M.A. (2002): Bioactive alkaloids of frog skin: Combinatorial bioprospecting reveals that pumiliotoxins have an arthropod source. Proc. Natl. Acad. Sci. USA 99: 13996-14001.

Duellman, W.E., Trueb, L. (1994): Biology of Amphibians. The Johns Hopkins University Press Ltd. Baltimore.

Fritz, G., Rand, A. S., De Pamphilis, C. W. (1981): The aposematically colored frog, *Dendrobates pumilo*, is distasteful to the large, predatory ant, *Paraponera clavata*. Biotropica 13: 158-159.

Glaw, F., Vences, M. (2007): A Field Guide to the Amphibians and Reptiles of Madagascar, 3rd Edition, Ed., Vences and Glaw Verlag, Cologne.

Gray, H.M., Ouellet, M., Green, D.M. (2002): Traumatic injuries in two neotropical frogs, *Dendrobates auratus* and *Physalaemus pustulosus*. J. Herpetol. 36: 117-121.

Guimaraes, L.D., Pinto, R.M., Juliano, R.F. (2004): *Bufo granulosus*. Predation. Herp. Rev. 25: 259.

Hedstrom, I., Bolanos, F. (1986): *Dendrobates auratus* (poison arrow frog). Predation. Herp. Rev. 17: 88-89.

Heying, H.E. (2001): *Mantella laevigata* (climbing *Mantella*). Aborted predation. Herp. Rev. 32: 34.

Master, T. L. (1998): *Dendrobates auratus* (Black-and-green poison dart frog). Predation. Herp. Rev. 29: 164-165.

Master, T.L. (1999): Predation by rufous motmot on black-and-green poison dart frog. Wilson Bull. 111: 439-440.

Menin, M. (2005): *Bufo proboscideus*. Predation. Herp. Rev. 36: 299.

Myers, C.W., Daly, J.W., Malkin, B. (1978): A dangerously toxic new frog (*Phyllobates*) used by Emberá indians of western Columbia, with discussion on blowgun fabrication and dart poisoning. Bull. Am. Soc. Inf. Sci. 161: 307-366.

Roberts, W.E. (1997): *Leptodactylus pentadactylus* (Rana Ternero, Smoky Frog). Predation. Herp. Rev. 28: 84-85.

Smith, M.A., Green, D.M. (2005): *Bufo fowleri* (Fowler‘s Toad). Predation. Herp. Rev. 36: 159-160.

Summers, K. (1999): *Dendrobates auratus* (Green Poison Frog). Predation. Herp. Rev. 30: 91.

Szelistowski, W.A. (1985): Unpalatability of the poison arrow frog *Dendrobates pumilio* to the ctenid spider *Cupiennius coccineus*. Biotropica 17: 345-346.

Toledo, L.F., Ribeiro, R.S., Haddad, C.F.B. (2007): Anurans as prey: an exploratory analysis and size relationships between predators and their prey. J. Zool. 271: 170-177.

Accepted by Angelica Crottini; Managing Editor: Vincenzo Mercurio