

## Correspondence

### Wasp predation on Malagasy frog egg clutches

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Besides their great species diversity, Malagasy anurans exhibit a wide array of behavioural patterns, including diverse reproductive behaviour. They display 11 different reproductive modes (GLAW & VENCES 2007) out of 29 recognized across the world (DUELLMAN & TRUEB 1986). The clutches reported here belong to the reproductive mode that comprises arboreal eggs deposited on vegetation overhanging ponds or swamps (mode 18 according to DUELLMAN & TRUEB 1986) into which hatching tadpoles drop. In Madagascar, most species of the genera *Blommersia* and *Guibemantis* use this reproductive strategy (GLAW & VENCES 2007) which may represent an antipredatory behavior (ORIANI & JANZEN 1974) or might simply be related to the arboreal habits of these frogs. Being static, frog eggs have limited options for defense, compared with older and much more agile life stages like tadpoles or froglets (CHIVERS et al. 2001). Eggs therefore suffer high levels of predation in the water. Most arboreal egg clutches are deposited on flimsy leaves or branches so that the majority of vertebrate predators are discouraged from reaching them, although they may be preyed upon by snakes and insects.

One such predation event was observed on egg clutches of *Guibemantis*, a genus of mantellid frogs from Madagascar. The clutch was preyed on by a wasp on 2 February 2007 in the morning hours, during warm, humid and mostly cloudy weather with sunny and rainy spells (rainy season in Madagascar) in the Station Forestière d'Analamazaotra (tropical rainforest nature reserve, managed by Association Mitsinjo) near Andasibe village (18°56.143'S, 48°24.879'E, 941 m above sea level, taken by GPS receiver). A wasp of the genus *Ropalidia* was flying around several clutches attached to palm leaves and hanging above the small pond in the Orchid Park. It tried on several occasions to get into the gelatinous clutch (Fig. 1a), and then stuck its head into it (Fig. 1b). The

wasp grasped the first embryo and pulled it out of the gelatinous mass, then placed it on a branch and consumed it (Fig. 1c). Afterwards, the wasp stacked several embryos on the branch before starting to eat them. The embryos in the egg clutch were seen moving away slightly from the predator.

At the Station Forestière d'Analamazaotra, two frog species were observed in February 2008 depositing eggs on the leaves overhanging the pond in the Orchid Park: *Guibemantis liber* and *G. tornieri*. Eggs from most of the frog clutches were identified using DNA barcoding, a rapid molecular technique that has shown reliable results in amphibian species identification (VENCES et al. 2005). We used a fragment of the mitochondrial 16S rRNA gene (Genbank accession numbers GQ244514 and GQ244515) that is known to be sufficiently variable among species of amphibians (VENCES et al. 2005). Based on comparison of morphology and colouration with the barcoded clutches, we presume that the embryos depredated by the wasp in 2007 were those of *G. tornieri*.

In Madagascar, predation on frog egg clutches deposited outside of water hitherto has been recorded only for a few snakes (e.g. some species of the genus *Compsophis*, especially *C. laphystius*; see photos in GLAW & VENCES 2007), and never by wasps. The observed wasp preying on these clutches has been deposited in the American Museum of Natural History, New York, and is still awaiting final determination by J.M.C. and J. KOJIMA who are preparing a revision of the Malagasy genus *Ropalidia*. According to these unpublished data, a preliminary determination assigned the specimen to the *Ropalidia formosa* complex. Presently there are several species masquerading under the name *R. formosa*, and the specimen probably corresponds to a species currently treated as a synonym, but an examination of type specimens is necessary for final conclusions.

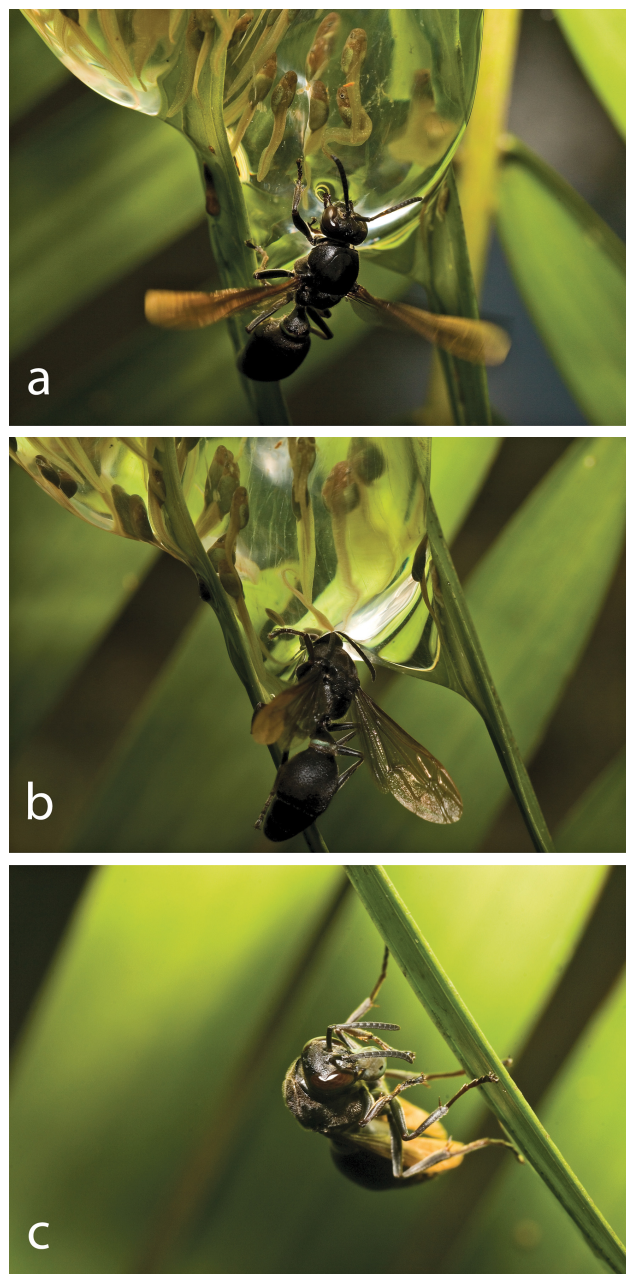


Fig. 1. (a) A wasp of the genus *Ropalidia* attacking an egg clutch of *Guibemantis* cf. *tornieri* near Andasibe, Madagascar, on 2 February 2007; (b) the wasp is protruding its head into egg clutch; (c) the wasp is devouring a snatched tadpole.

Several other invertebrates are known to prey on frog egg clutches. Staphylinid beetles and phorid flies prey on the egg clutches of three species of *Phyllomedusa* (*P. tarsius*, *P. tomopterna* and *P. bicolor*) in Central Amazonia, Brazil (NECKEL-OLIVEIRA & WACHLEWSKI 2007). The ephydrid fly *Typopsilopa* sp. preys on eggs of the East African reed frog *Hyperolius spinigularis*, reduce larval density and cause embryos to hatch prematurely at smaller size (VONESH 2005).

So far, wasp predation on frog clutches has been found only in the Neotropics. There, the social wasp *Polybia rejecta* is known to prey on egg clutches of *Agalychnis callidryas* (WARKENTIN 2000). They are major predators of these ar-

boreal eggs, together with egg-eating snakes (WARKENTIN 1995). The wasp is an early inducing agent of hatching of these frogs. Embryos hatch rapidly up to 30% before their typical undisturbed hatching age when attacked by wasps, resulting in many embryos surviving to emerge prematurely, yet having to face aquatic predators as fully grown hatchlings do (WARKENTIN 2000). Preliminary observations in Andasibe in 2008 suggest that a similar phenomenon may also take place in one Malagasy arboreal egg depositing species, *Guibemantis liber*.

The following observation was made during the sampling of frog egg clutches: when trying to remove one of the tadpoles from the gelatinous mass for species determination, the tadpole hatched, and this process could be induced repeatedly. The combination of deposition of arboreal eggs by unrelated frog species in Madagascar and the Neotropics, their predation by snakes and wasps of unrelated genera, and the possibly similar response of potential premature hatching may provide a fascinating example of convergent evolution of predator-prey interactions in rain-forest environments.

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