

Caudal autophagy in a sphaerodactyline gecko from the Peruvian Amazon

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Voluntary tail shedding (caudal autotomy), often accompanied with writhing of the shed tail in a way that distracts a predator, is a widespread adaptive strategy that can help lizards avoid predation (Vitt et al., 1977, Bateman & Fleming, 2009). Lizards with autotomised tails may experience reduced agility (Chapple & Swain, 2002) or social status (Martín & Salvador, 1993), and they will have fewer future opportunities to escape predators as caudal autotomy is usually only possible in original tail tissue (Bellairs & Bryant, 1985). In many species, caudal fat is a crucial energy resource so that the loss of the tail could be the difference between life and death (Daniels, 1984). In addition, regenerating a tail itself is costly and substantially increases a lizard's resting metabolic rate (Dial & Fitzpatrick, 1981).

Lizards are known to eat their shed tails (autophagy or self-cannibalism) and this offers an opportunity to recoup some of the energy loss associated with caudal autotomy. Observations of caudal autophagy in lizards remain exceedingly rare, with few documented accounts (e.g. Vitt et al., 1977, Iglesias-Carrasco & Cabido, 2016; Thanou & Kornilios, 2019). Lizard taxa that store substantial energy within their tails, including many geckos, should gain a large benefit from caudal autophagy following autotomy. For geckos, the fat stored in their tails has been widely demonstrated to be crucial to fitness (e.g. Daniels, 1984). Seventy-five years ago, a single observation of caudal autophagy in a New Guinean gekkonid (*Gehyra ocellaris*) was documented (Neill, 1946) but subsequently there appear to be no other accounts of caudal autophagy in any other gecko species.

Gonatodes humeralis is a sphaerodactyline gecko ranging throughout tropical South America, usually found on low tree trunks in primary and secondary forests (Bartlett & Bartlett, 2003). Male *G. humeralis* are brightly colored. A range of taxa, including birds and snakes, prey upon this small, diurnal species. *Gonatodes humeralis* uses antipredator tactics typical of this genus, including tail autotomy and easily torn skin ("regional integumentary loss"; Bauer et al., 1989). It is unknown whether this species stores fat in its tail.

On the late afternoon of 4th July 2019, we captured an adult male *G. humeralis* (snout-vent length = 4.0 cm; mass = 1.5 g) by hand outside of the Amazon Conservatory for Tropical Studies (3° 14' 44" S, 72° 55' 28" W) in the Peruvian Amazon, 67 miles north-east of Iquitos, Peru. It was placed

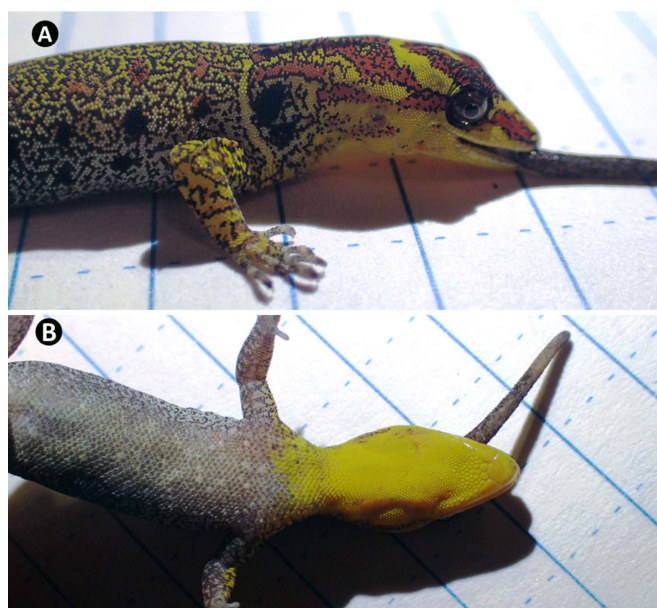


Figure 1. Adult male *Gonatodes humeralis* consuming its autotomised tail, shown in – **A.** Lateral view, and **B.** Ventral view

in a jar with a breathable lid for transport back to the station. When removed from the jar at 20:41 h, we observed that its tail had been autotomised at 1.6 cm posterior to the cloaca and that the individual was in the process of ingesting its shed tail (Fig. 1). Approximately 1 cm of the shed tail extended from its mouth at this time (total shed tail piece = 3.0 cm). The individual was measured and photographed, and we placed it back into the jar. Almost 12 h later (08:05 h, 5th July 2019), we discovered that the individual had regurgitated its shed tail. We then released the individual at its site of capture.

This observation expands knowledge of caudal autophagy to the sphaerodactyline geckos. Upon capture, the gecko's tail was intact and autotomy occurred in the transport container. Other than the initial capture, there was no other stressor that was likely to induce autotomy: the gecko was housed individually, not handled between initial capture and autotomy, and the jar did not present any obvious sites where the tail could become trapped or mechanically stressed. It would appear that autotomy was a result of the stress of capture and transport, as observed previously (Neill, 1946,

Thanou & Kornilios, 2019). Our results also corroborate those by Thanou & Kornilios (2019), in which autophagy was observed despite the stress of capture, and Johnson (2021), in which a salamander's self-cannibalised tail was regurgitated in captivity. Based on our observation, it is plausible that *G. humeralis* may ingest autotomised tails in nature. However, it remains unclear whether caudal autophagy is an adaptive behaviour or whether it is a case of mistaken identity where the lizard responds to a writhing shed tail in the same way as it would respond to any potential prey item that is moving.

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