

**NOTE AND RECORD**

# Ophiophagy and cannibalism in African vine snakes (Colubridae: *Thelotornis*)

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## 1 | INTRODUCTION

Cannibalism, the consumption of conspecifics, occurs throughout the animal kingdom (Polis, 1981). The ingestion of one's own kind is hypothesised to arise as a by-product of intraspecific competition and/or through the added benefit of energetic gains from the meal (Van Allen et al., 2017). In snakes, cannibalism has been documented in several lineages (Polis & Myers, 1985) including elapids (Maritz, Alexander, & Maritz, 2019), colubrids (Göçmen, Werner, & Elbeyli, 2008), lamprophiids (Shine, Branch, Harlow, Webb, & Shine, 2006) and viperids (Funk, 1965). However, instances of cannibalism are rarely recorded in wild animals, leading to these events being dismissed as rare and of little ecological importance (Maritz, et al., 2019). This is particularly true for African snakes for which detailed dietary studies are often lacking or incomplete.

African vine snakes (*Thelotornis* spp.) are a group of venomous colubrids that include five distinct taxa which inhabit savannah and forested regions across sub-Saharan Africa (Broadley, 2001; Uetz, Freed, & Hošek, 2019). Members of the genus are largely arboreal but the inclusion of terrestrial prey in their diet suggests they occasionally come to ground to feed (Akani, Luiselli, & Angelici, 2002; Shine, Harlow, Branch, & Webb, 1996). Only southern vine snakes (*T. capensis capensis*) and forest vine snakes (*T. kirtlandii*) have been subjected to detailed dietary analysis (Akani et al., 2002; Shine et al., 1996). These two studies found that vine snakes eat a diet dominated by arboreal vertebrates, particularly geckos, agamas and chameleons, but that birds are relatively scarce in their diets. Notably, both species are occasionally ophiophagous (i.e.,

consume snakes) but importantly, neither study detected incidents of cannibalism.

Here, we report on the first case of cannibalism in *Thelotornis*. Then, given that cannibalism is potentially more likely to arise in ophiophagous lineages, we review the instances of ophiophagy within the genus.

## 2 | METHODS

The Museu de História Natural de Maputo (Mozambique) is in the process of having its collection upgraded and digitised. The herpetological collection includes mostly historical material (pre-1970), but also some recently collected material (Conradie et al., 2016; Jones et al., 2017; Portik, Mulungu, Sequeira, & Mcentee, 2013). In April 2019, W. Conradie was invited to identify specimens in the herpetological collection. During examination of preserved snake material, an adult eastern vine snake (*T. mossambicanus*) was discovered that had been preserved in the process of consuming a conspecific (bottle no. 42).

We additionally reviewed diet data for *Thelotornis* derived from published (scientific and grey) literature and from photographic records shared via Facebook. Most Facebook feeding records were collected using the public group 'Predation Records—Reptiles and Amphibians (sub-Saharan Africa)' (<https://www.facebook.com/groups/888525291183325>). Taxonomic assignments within the genus *Thelotornis* have been subjected to several changes in the last 50 years (Broadley, 1979, 2001). Within our review, we treat species assigned to *T. kirtlandii capensis* or *T. capensis capensis* from

outside of western Zimbabwe or southern Mozambique as *T. mossambicanus*. In localities where two species of *Thelotornis* potentially coexist, we treat diet records conservatively by assigning them only at the genus level.

### 3 | RESULTS AND DISCUSSION

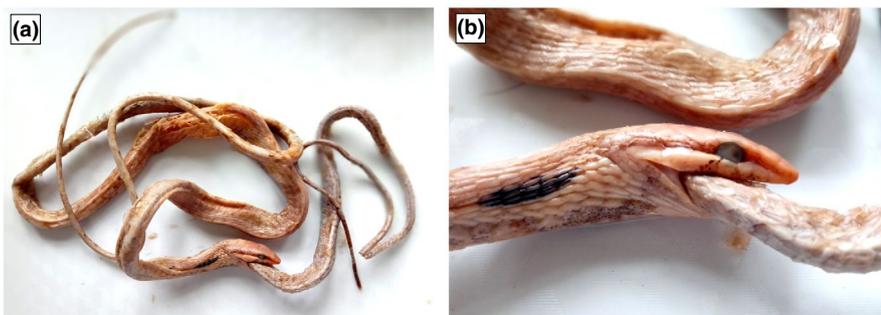
While inspecting the reptile collection at the Museu de História Natural de Maputo (Mozambique), a specimen of an eastern vine snake (*Thelotornis mossambicanus*) was discovered that had been preserved in the process of ingesting a conspecific (Figure 1). The identification of the cannibalistic individual was based on the uniform unpatterned dorsal head scales and temporal shields with fine black stippling (Broadley, 1979, 2001) (Figure 1b). For the prey, the main identifying features were not visible due to the inseparability of the two specimens. However, we assume the ingested snake was a conspecific because *T. mossambicanus* does not occur in sympatry with any other members of the genus (Broadley, 2001). The specimens were collected in Mozambique, but a precise collection locality was not catalogued when they were deposited. However, *T. mossambicanus* occurs predominantly north of 20°S. Little information was stored with specimens at the time of preservation limiting our understanding of the specifics of the situation.

The cannibalistic individual was identified as a female with a total length of 1,100 mm (snout-vent length: 700 mm and tail length: 400 mm). At the time of preservation, the female had ingested one-third of the conspecific with the remaining portion protruding from the mouth. The prey was identified as a male, based on an enlarged tail base (where the hemipenes are stored), with an approximate total length of 570 mm. Although undocumented in snakes, post-copulatory sexual cannibalism would provide an energetic supply to the female to aid with egg provisioning. Alternatively, the event may have occurred independently of copulation, rather being motivated by opportunism or intraspecific competition. Combative behaviour has been observed in southern vine snakes (*T. c. capensis*) (Uys, 2011), which could allow for opportunistic cannibalism. Notably, among cannibalism events in wild snakes, females consume both sexes (Franch & Sebastián, 2013; Göçmen et al., 2008; Krey, O'Shea, Farajallah, Setiadi, & Suryobroto, 2015) suggesting cannibalism may occur under several circumstances.

Our review revealed that all *Thelotornis* species include snakes in their diet (Table 1). Several of the snake species recorded in the diet of *Thelotornis* are highly venomous including black mamba (*Dendroaspis polylepis*) and boomslang (*Dispholidus typus*) both of which exhibit arboreality. Interestingly, three of the taxa (*sans T. c. oatesii*) include green snakes (*Philothamnus* spp.) in their diet and these records represent 47.8% of observations of ophiophagy in the wild (Table 1). Much like *Thelotornis*, many *Philothamnus* species are expert climbers but can also be found occupying terrestrial habitats (FitzSimons, 1962). Notably, the only study on the behavioural ecology of *T. c. capensis* found that they frequently inhabit the shrub-tree interface (<1.5 m) during the warmest months where they are hypothesised to lay awaiting potential prey (Jacobsen, 1982). Thus, this microhabitat interface may provide the platform for the majority of *Philothamnus*-*Thelotornis* interactions.

Cannibalism has never been reported in the genus *Thelotornis* despite their appetite for snakes (Table 1; Figure 2). Although cannibalism may occur infrequently, rare prey types can be important food sources and have significant fitness benefits for the predator (Wiseman, Greene, Koo, & Long, 2019). No studies to date have examined the diet of *T. mossambicanus*, partially due to the recent description of the species. However, Akani et al. (2002) examined the diet of *T. kirtlandii* in southern Nigeria ( $N_{\text{prey}} = 62$ ) and revealed that snakes represent only 1.6% of prey items. Additionally, Shine et al. (1996) investigated the diet of *T. c. capensis* using museum specimens ( $N_{\text{prey}} = 50$ ) and found that snakes constitute 8.0% of their diet. With the addition of new data from social media and published ad hoc observations, snakes make up 13% of all prey items reported for *T. c. capensis* (data not shown). Although a bias towards photographs of ophiophagy in our social media dataset is a concern, we found no significant difference between the proportion of snakes ingested in the museum dataset versus the social media dataset ( $\chi^2 = 3.14, p = .076$ ). Notably, the collection of snake diet data is not trivial and the resulting limited sample sizes may contribute to the apparent absence of cannibalism within other *Thelotornis*. Further investigation into the cannibalistic tendencies within this clade is warranted.

Among the tribe Dispholidini (to which *Thelotornis* belongs), ophiophagy is only known from boomslang (*Dispholidus typus*) (Haagner, 1990; Smith, Layloo, Maritz, & Maritz, 2019) and African vine snakes (see Table 1; this study). Importantly, these are the only lineages from which cannibalism is known suggesting ophiophagy



**FIGURE 1** Cannibalism in the eastern vine snake (*Thelotornis mossambicanus*). (a) A museum record of a female *Thelotornis mossambicanus* swallowing a conspecific male. (b) The unpatterned dorsal head scales and temporal shields with fine black stippling are indicative of *T. mossambicanus* [Colour figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

**TABLE 1** Recorded observations of ophiophagy in the genus *Thelotornis*

Snake species	Prey species (no. recorded)	Reference
<i>Thelotornis capensis capensis</i>	Colubridae	Shine et al. (1996)
	<i>Dispholidus typus</i>	Haagner and Clarke (1992)
	<i>Duberria lutrix</i>	Shine et al. (1996)
	<i>Lycodonomophus rufulus</i>	Shine et al. (1996)
	<i>Philothamnus hoplogaster</i>	Shine et al. (1996)
	<i>Philothamnus natalensis</i>	Mckibbin (2017) <sup>a</sup>
	<i>Philothamnus occidentalis</i> (2)	de Klerk (2018) <sup>a</sup> ; Vollet, Vollet, and Ping (2015) <sup>a</sup>
	<i>Philothamnus semivariegatus</i> (2)	Maritz and Barends (2017) <sup>a</sup> ; Kinsella and Maritz (2016)
	<i>Psammophis subtaeniatus</i>	de la Harpe-Parker (2017) <sup>a</sup>
<i>Thelotornis capensis oatesii</i>	<i>Aparallactus lunulatus</i>	McDonald (2018)
	<i>Dendroaspis polylepis</i>	Gartner and Theart (2018) <sup>a</sup>
	<i>Dispholidus typus</i>	Vrdoljak and Perry (2019) <sup>a</sup>
	<i>Psammophis subtaeniatus</i>	Nobrega (2018) <sup>a</sup>
	Serpentes	Shine et al. (1996)
<i>Thelotornis kirtlandii</i>	<i>Hapsidophrys smaragdina</i>	Akani et al. (2002)
	<i>Philothamnus carinatus</i>	Bogert (1940)
	<i>Philothamnus</i> sp. (2)	Akani et al. (2002)
<i>Thelotornis mossambicanus</i>	<i>Afrotyphlops mucruso</i> <sup>b</sup>	Loveridge (1923)
	<i>Philothamnus angolensis</i> (2)	Loveridge (1953)
	<i>Thelotornis mossambicanus</i>	This study
<i>Thelotornis</i> sp. <sup>c</sup>	<i>Crotaphopeltis torneri</i>	Barbour and Loveridge (1928)
	<i>Dasypeltis atra</i> <sup>b</sup>	Barbour and Loveridge (1928)
	<i>Natriciteres olivacea</i> <sup>b</sup>	Barbour and Loveridge (1928)
	<i>Philothamnus hoplogaster</i> <sup>b</sup>	Barbour and Loveridge (1928)

<sup>a</sup>Facebook observation.<sup>b</sup>In captivity.<sup>c</sup>Recorded as *Thelotornis kirtlandii* but refers to either *T. mossambicanus* or *T. usambaricus*.

**FIGURE 2** Ophiophagy in African vine snakes (*Thelotornis* spp.). African vine snakes eat a diversity of snakes in the wild including (a) *Philothamnus natalensis* (Photograph: Richard Mckibbin), (b) *Aparallactus lunulatus* (Photograph: Sean McDonald) and (c) *Psammophis subtaeniatus* (Photograph: Sean de la Harpe-Parker) [Colour figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

may contribute to cannibalistic tendencies (This study; FitzSimons, 1962). Although other members of Dispholidini (*Xyelodontophis*, *Thrasops* and *Rhamnophis*) do not display ophiophagy or cannibalism (Spawls, Howell, Hinkel, & Menegon, 2018), few detailed diet studies on these genera exist, which can lead to an underrepresentation of rare, but important, predation events.

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## DATA AVAILABILITY STATEMENT

Data are available upon reasonable request from the authors.

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