

Review of ophiophagy in neotropical cat-eyed snakes, genus *Leptodeira*, with the first report of ophiophagy in *L. ornata* (Bocourt, 1884)

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Leptodeira is a genus of currently 18 species (Barrio-Amorós, 2019; Torres-Carvajal et al., 2020; Costa et al., 2022a, b) with a complex and still incompletely resolved taxonomic history. The feeding habits of these snakes have been reported in some detail, and *Leptodeira* species appear to have a preference for anurans (including highly poisonous toads) and their eggs, as well as lizards, fish, and even some insects, crabs and non-arthropod invertebrates (e.g., Duellman, 1958; Vitt, 1996; Savage, 2002). However, there are not many reports of *Leptodeira* preying on other snakes.

Ophiophagy by *Leptodeira*. We were able to locate eight literature records of ophiophagy in the genus *Leptodeira*, of which six were observed in nature (Table 1). Wright and Wright (1957) appear to have been the first to mention snakes as prey for the genus *Leptodeira* but these authors did not provide any specific examples or citations. Skehan (1959) reported an example of a cat-eyed snake of 50.2 cm in total length (probably *L. rhombifera* Günther, 1872) that was offered and consumed an 18-cm-long juvenile *Lampropeltis triangulum* (Lacépède, 1789) in captivity (reported as *L. doliatus triangulum*; taxonomy according to Ruane et al., 2014). Cantor and Pizzato (2008) reported two

cases of ophiophagy for *L. annulata* (Linnaeus, 1758) in Brazil, one involving *Oxyrhopus guibei* Hoge and Romano, 1977 and the other *Atractus zebrinus* (Jan, 1862). It is interesting to note that while the *A. zebrinus* was consumed tail-first, the *O. guibei* was consumed head-first, as is common for almost all ophiophagous snakes with the exception of members of the genus *Erythrolamprus sensu stricto* that consume their snake prey tail-first (Greene, 1976, 1997; Marques and Puerto, 1994; Hartmann et al., 2009; Braz and Marques, 2016).

Montalbán Huidobro and Aréchaga Ocampo (2010) reported on a female *L. maculata* (Hallowell, 1861) in Guerrero, Mexico, that had a male of its own species in its stomach. This was not only a case of ophiophagy but also the first case of cannibalism for the genus *Leptodeira*. McKelvy et al. (2013) observed a cat-eyed snake in Tortuguero, Costa Rica (listed as *L. septentrionalis* and now considered “*L. aff. ornata* 3” by Costa et al., 2022) that regurgitated tail-first a still living *Ninia sebae* (Duméril et al., 1854) that died 2 h later. In Guerrero, Mexico, Palacios-Aguilar et al. (2020) reported a *Salvadora mexicana* (Duméril et al., 1854) as prey of *L. maculata*, which expelled it tail-first, evidencing that it was swallowed head-first. Finally, in Costa Rica, Escalante et al. (2021) observed a cat-eyed snake (listed as *Leptodeira* sp. and now considered “*L. aff. ornata* 3” by Costa et al., 2022) that regurgitated a juvenile *Chironius flavopictus* (Werner, 1909), but did not mention whether the snake had been eaten head- or tail-first. We here report a further case of ophiophagy by a member of the genus *Leptodeira*, the first assigned to *L. ornata sensu stricto*, based on the range of this taxon relative to the clade called *L. aff. ornata* 2 by Costa et al. (2022).

Ophiophagy by *Leptodeira ornata*. On 8 August 2023 we observed an Ornate Cat-eyed Snake, *L. ornata*, preying on a juvenile Chocoan Parrot Snake, *Leptophis bocourti* Boulenger, 1909, in a remnant of

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Table 1. Listing of ophiophagy observed in cat-eyed snakes of the genus *Leptodeira*. We provide the species of the *Leptodeira* predator, the prey species, the direction (Dir) of ingestion (head-first – HF, tail-first – TF, mid-body – MB, not reported – NR), and the reference. The asterisk (*) indicates the only known case of cannibalism in the genus.

Species	Prey	Dir	Reference
<i>annulata</i>	<i>Oxyrhopus guibei</i>	HF	Cantor and Pizzato, 2008
<i>annulata</i>	<i>Atractus zebrinus</i>	TF	Cantor and Pizzato, 2008
* <i>maculata</i> (as <i>L. cussiliris</i>)	<i>Leptodeira maculata</i>	NR	Montalbán Huidobro and Aréchaga Ocampo, 2010
<i>maculata</i>	<i>Salvadora mexicana</i>	HF	Palacios-Aguilar et al., 2020
<i>ornata</i>	<i>Leptophis bocourti</i>	MB	this paper
aff. <i>ornata</i> (as <i>L. septentrionalis</i>)	<i>Ninia sebae</i>	TF	McKelby et al., 2013
aff. <i>ornata</i> (as <i>Leptodeira</i> sp.)	<i>Chironius flavopictus</i>	NR	Escalante et al., 2021
cf. <i>rhombifera</i> (as <i>L. doliatus triangulum</i>)	<i>Lampropeltis triangulum</i>	NR	Skehan, 1959

humid Chocó rainforest in Bosque Protector La Perla, a protected forest in La Concordia, Santo Domingo de los Tsáchilas, Ecuador (0.0242°S, 79.3867°W; elevation 246 m). The cat-eyed snake was coiled along the stem of a plant about 60 cm high, maintaining an upright position with its head raised and resting at the junction of two branches. It held its prey towards the

posterior end of the middle third of its body (Fig. 1A), presumably injecting venom, while the parrot snake attempted to defend itself by writhing and repeatedly biting its predator. Despite the defensive behaviours, the cat-eyed snake remained motionless for about 30 min until its prey stopped defensive movements; all movements of the parrot snake had ceased by the



Figure 1. (A) An Ornate Cat-eyed Snake, *Leptodeira ornata*, seen holding its prey, a Chococoan Parrot Snake, *Leptophis bocourti*, by its midbody. The parrot snake can be seen defending itself by biting the cat-eyed snake. (B) The cat-eyed snake holding its limp, dead prey. (C) The cat-eyed snake shown with the nearly completely ingested parrot snake, which it had swallowed beginning at midbody and ending at the head. Photos by Amanda B. Quezada.

40-min mark of the observation. The cat-eyed snake then began to swallow the parrot snake at the bite site, without adjusting the position of its head on the prey's body (Fig. 1B). The regular jaw movements of the cat-eyed snake pulled the parrot snake in, resulting in a folding of the prey's body. Thus, the parrot snake was devoured with its body folded and, based on the slightly posterior position of the bite site and the fold, the head was the last part of the parrot snake that disappeared (Fig. 1C). The entire ingestion process took about 1 h. During ingestion, the cat-eyed snake moved with its prey through the branches to the opposite side of the plant, maintaining an upright position but with its head facing downward. After completing ingestion, the cat-eyed snake remained suspended from the branches, and we discontinued our observation. The cat-eyed snake measured approximately 60 cm in total length, and the parrot snake approximately 40 cm. *Leptophis bocourti* was identified by having small black spots on the back of the head and along the body, and by the absence of a loreal scale (Torres-Carvajal and Terán, 2021; Albuquerque and Fernandes, 2022).

In sum, members of the genus *Leptodeira* are generalist feeders that mainly consume anurans and their eggs. However, these snakes exhibit a varied diet that includes a diverse selection of small animals, such as lizards, invertebrates, crabs and, sometimes, other snakes. Cat-eyed snakes are not specialist feeders, and as the emerging body of knowledge demonstrates, during ophiophagy they may capture their prey by any part of the body before proceeding with ingestion, head-first, tail-first, or even beginning at midbody.

References

- Albuquerque, N.R., Fernandes, D.S. (2022): Taxonomic revision of the parrot snake *Leptophis ahaetulla* (Serpentes, Colubridae). *Zootaxa* **5153**: 001–069.
- Barrio-Amorós, C.L. (2019): On the taxonomy of the snakes in the genus *Leptodeira*, with an emphasis on Costa Rican species. *Reptiles & Amphibians* **26**: 1–15.
- Braz, H.B., Marques, O.A. (2016): Tail-first ingestion of prey by the false coral snake, *Erythrolamprus aesculapii*: does it know where the tail is? *Salamandra* **52**(2): 211–214.
- Cantor, M., Pizzato, L. (2008): Natural history notes. *Leptodeira annulata* (Banded Cat-Eyed Snake). Diet. *Herpetological Review* **39**: 470–471.
- Costa, J.C., Graboski, R., Grazziotin, F.G., Zaher, H., Rodrigues, M.T., Prudente, A.L.D.C. (2022a): Reassessing the systematics of *Leptodeira* (Serpentes, Dipsadidae) with emphasis in the South American species. *Zoologica Scripta* **51**: 415–433.
- Costa, J.C., Graboski, R., Grazziotin, F.G., Zaher, H., Rodrigues, M.T., Prudente, A.L.D.C. (2022b): Corrigendum to: Reassessing the systematics of *Leptodeira* (Serpentes, Dipsadidae) with emphasis in the South American species. *Zoologica Scripta* **51**: 614–615.
- Escalante, R.N., Acuña, C.A., Acuña, A.A. (2021): Second report of ophiophagy in a cat-eyed snake (*Leptodeira* sp.) in Costa Rica. *Reptiles & Amphibians* **28**(1): 102–103.
- Greene, H.W. (1976): Scale overlap, a directional sign stimulus for prey ingestion by ophiophagous snakes. *Zeitschrift für Tierpsychologie* **41**: 113–120.
- Greene, H.W. (1997): *Snakes: the Evolution of Mystery in Nature*. Berkeley, California, USA, University of California Press.
- Hartmann, P.A., Hartmann, M.T., Martins, M. (2009): Ecologia e história natural de uma taxocenose de serpentes no Núcleo Santa Virgínia do Parque Estadual da Serra do Mar, no sudeste do Brasil. *Biota Neotropica* **9**: 173–184.
- Marques, O.A.V., Puerto, G. (1994): Dieta e comportamento alimentar de *Erythrolamprus aesculapii*, uma serpente ofiófaga. *Revista Brasileira de Biologia* **54**: 253–259.
- McKelvy, A.D., Figureoa, A., Lewis, T.R. (2013): First record of ophiophagy in the widely distributed snake *Leptodeira septentrionalis* (Kennicott, 1859) (Ophidia, Colubridae). *Herpetology Notes* **6**: 177–178.
- Montalbán Huidobro, C.A., Aréchaga Ocampo, S. (2010): Natural history notes. *Leptodeira cussiliris* (Duellman's Cat-eyed Snake). Diet, Cannibalism. *Herpetological Review* **41**(2): 237.
- Palacios-Aguilar, R., Butler, B.O., Cortés-Ortiz, B., Santos-Bibiano, R. (2020): *Leptodeira maculata* (Southwestern Cat-eyed Snake). Diet/Ophiophagy. *Herpetological Review* **51**(3): 621–622.
- Ruane, S., Bryson, R.W., Pyron, R.A., Burbrink, F.T. (2014): Coalescent species delimitation in milksnakes (genus *Lampropeltis*) and impacts on phylogenetic comparative analyses. *Systematic Biology* **63**: 231–250.
- Skehan, P. (1959): Ophiophagy in *Leptodeira*. *Herpetologica* **15**(3): 160.
- Torres-Carvajal, O., Terán, C. (2021): Molecular phylogeny of neotropical parrot snakes (Serpentes: Colubrinae: *Leptophis*) supports underestimated species richness. *Molecular Phylogenetics and Evolution* **164**: 107267.
- Torres-Carvajal, O., Pazmiño-Otamendi, G., Salazar-Valenzuela, D. (2019): Reptiles of Ecuador: a resource-rich portal, with a dynamic checklist and photographic guides. *Amphibian & Reptile Conservation* **13**(1): 209–229.
- Vitt, L.J. (1996): Ecological observations on the neotropical colubrid snake *Leptodeira annulata*. *Herpetological Natural History* **4**(1): 69–76.
- Wright, A.H., Wright, A.A. (1957): *Handbook of Snakes of the United States and Canada*. Ithaca, New York, USA Comstock Publishing.