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Notes on the Feeding Behavior and Caudal Luring by Juvenile *Alsophis portoricensis* (Serpentes: Colubridae)

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Caudal luring, the waving or wriggling of a conspicuously colored tail by an otherwise cryptically colored snake in the presence of prey (Heatwole and Davison, 1976), has been reported for species of viperid, elapid, and boid snakes (Neill, 1960; Heatwole and Davison, 1976; Murphy et al., 1978) and recently for the colubrid snakes *Tropidodryas striaticeps* (Sazima and Puerto, 1993) and *Alsophis dorsalis* (Greene, pers. comm.). This behavior has been documented most frequently for juvenile crotaline vipers (Neill, 1960). Caudal luring may function by luring a potential prey to striking distance (Neill, 1960; Greene and Campbell, 1972; Heatwole and Davison, 1976) and/or distracting the prey's attention, thereby facilitating close approach of the predator's head to within striking distance (Greene and Campbell, 1972; Murray et al., 1991; Sazima and Puerto, 1993).

With the exception of *Acanthophis antarcticus laevis* (Carpenter et al., 1978), caudal luring has been documented exclusively in snakes that bear a conspicuously colored tail. Conspicuously colored tails and luring behavior are exhibited mostly by juveniles, and in most cases both are lost before adulthood (Heatwole and Davison, 1976). A lack of ontogenetic diet change was associated with retention of caudal luring by adult *Bothrops bilineatus* (Greene and Campbell, 1972), *Cerastes vipera* (Heatwole and Davison, 1976), *Acanthophis a. antarcticus* and *Acanthophis a. laevis* (Carpenter et al., 1978), and *Sistrurus miliarius barbouri* (Jackson and Martin, 1980).

Alsophis portoricensis is the larger of two colubrids that inhabit the Puerto Rican Bank. It is largely a ground-dwelling, diurnal snake that uses mainly visual cues to locate prey. Here we report the use of caudal luring by juveniles of this species. This is the

third known case of caudal luring for a colubrid and the second report for *Alsophis*.

We observed 12 feeding episodes by four juvenile *Alsophis portoricensis* within two months after they hatched in the laboratory (body mass [BM] 1.5-2.1 g). Each individual was presented with three different prey species: two species of lizards, *Anolis cristatellus* (Polychridae) and *Sphaerodactylus macrolepis* (Gekkonidae), and the frog *Leptodactylus albilabris* (Leptodactylidae). Snakes were weighed (BM \pm 0.1 g) immediately after each trial, and prey were measured (snout-vent length [SVL] to nearest mm) and weighed (BM \pm 0.1 g) prior to the feeding trials. Feeding trials were conducted in the snake cage (40 cm long \times 30 cm high \times 20 cm wide) with a soil substrate. Prey was introduced by hand into the snake cage. Both the snakes and the lizards were maintained at a temperature of 25-27 C. Using a stop watch and an audio tape recorder, we recorded all behaviors exhibited by the snakes and the prey during each feeding episode.

Caudal luring was exhibited on three of the 12 feeding trials by two of the four individuals. Of the two individuals that lured, one did so when presented with *Anolis cristatellus* and *Sphaerodactylus macrolepis*, and the other when presented with *S. macrolepis*. None of the snakes lured when presented with *Leptodactylus albilabris*. The first episode of caudal luring was recorded on 31 August 1992. *Alsophis* (BM 2.1 g) began to exhibit caudal luring 300 sec after the *A. cristatellus* (SVL 20 mm, BM 0.3 g) was introduced into the cage. The snake continued twitching its tail in a waving fashion while maintaining the rest of its body immobile for the next 150 sec. During this period, the prey oriented toward the twitching tail of the snake and fixated on it; at 460 sec the lizard moved toward the snake, and the snake attacked it.

On 4 September 1992, one *Sphaerodactylus macrolepis* was offered to each snake. An *Alsophis* (BM 2.1 g) began to flick its tongue 40 sec after the prey (SVL 25 mm, BM 0.4 g) was introduced into the cage. The snake remained immobile for the next 300 sec while the lizard was moving around the cage; 600 sec later the snake began to twitch its tail while remaining immobile, and the prey responded by orienting toward the snake's twitching tail, and began to move toward it. The lizard kept moving toward the twitching tail and was grabbed by the snake at 790 sec. The snake finished swallowing it at 990 sec. The other *Alsophis* (BM 1.7 g) began to flick its tongue 90 sec after the *S. macrolepis* (SVL 28 mm, BM 0.6 g) was introduced into the cage, while the prey remained immobile. At 900 sec after introduction, the snake began to twitch its tail, which lasted for the next 95 sec. However, the lizard did not react to the twitching tail. At 1200 sec, the snake attacked and grabbed the lizard, and finished swallowing it at 1940 sec. The other two *Alsophis* individuals (BM 1.5 g and 1.8 g) did not exhibit caudal luring to any of the prey. Caudal luring was never exhibited before the prey was introduced into the cage or after the snake finished eating it.

Although two of the four juvenile *Alsophis portoricensis* never exhibited caudal luring, they subdued their prey in the same manner as those that did lure. In all feeding episodes, when presented with *Leptodactylus* or *Sphaerodactylus*, the snake seized and swal-

lowed them directly without envenomating them, but when presented with *Anolis*, the snake subdued the prey with venom before swallowing it. The variation in the use of venom to subdue prey seems to be in response to the lack of strong retaliation presented by *Leptodactylus* and *Sphaerodactylus* compared with the strong retaliation employed by *Anolis* when handled by *Alsophis* (Leal and Rodríguez-Robles, unpubl.). Retaliatory power, along with visual and chemical stimuli, may be used as clues by *A. portoricensis* to assess prey and to "decide" if it will envenomate or not (Rodríguez-Robles and Leal, 1993). Variation in the use of venom to subdue prey also has been reported for adult *A. portoricensis* (Rodríguez-Robles and Leal, 1993).

Alsophis portoricensis exhibited caudal luring from a loosely coiled or looped posture in which the tail was in the same direction as the snake's head. The snakes never exhibited the vertical positioning of the tail that has been reported in *Bothrops bilineatus* (Greene and Campbell, 1972), *Vipera russelli* (Henderson, 1970), and *Tropidodryas striaticeps* (Sazima and Puerto, 1993). Instead, with the body immobile and the tail horizontal, *A. portoricensis* twitched its tail spasmodically. The tail undulated vertically with the tip sometimes curving into a U-shape, and there were occasional rotations through nearly 360° about the longitudinal axis. This movement is similar to that described for *Sistrurus miliarius barbouri* (Jackson and Martin, 1980) and *Bothrops jaracussu* (Sazima, 1991).

Although caudal luring has been associated with a combination of a conspicuously colored tail and its movements (Neill, 1960; Heatwole and Davison, 1976), the observation that *Alsophis portoricensis* is able to attract prey by the movement of an inconspicuously colored tail indicates that the movement of the tail itself is sufficient as a lure. The use of an inconspicuously colored tail as a lure also has been suggested for *Acanthophis antarcticus laevis* (Carpenter et al., 1978). In that case, luring was inferred (Pough, 1988), because the prey was not in the cage of the snake and there was no observation of prey being attracted by the snake's tail.

Many snakes twitch or vibrate their tails in response to a threat (Greene, 1973), but we never observed juvenile *Alsophis portoricensis* moving their tail when approached or handled by a person. Instead, the snakes spread their neck and occasionally emitted a short hiss, a behavior which is commonly exhibited by adults. Nonetheless, adult *A. portoricensis* may rarely exhibit erratic movement of the tail when handled (J. A. Rodríguez-Robles, pers. comm.).

Although caudal luring is an ambush hunting technique compatible with a sit-and-wait foraging strategy, it is possible that juvenile *Alsophis portoricensis* also forage actively. There seem to be no literature reports of foraging by *A. portoricensis*, although based on its size, shape, and diurnal activity, the species is assumed to be an active forager (Henderson and Sajdak, 1986; Henderson and Crother, 1989). Sazima and Puerto (1993) also suggested a combination of sit-and-wait and active foraging for the colubrid *Tropidodryas striaticeps*.

Heatwole and Davison (1976) proposed that ontogenetic changes in diet may account for the lack of caudal luring in adult crotaline snakes. We suggest

that different predation pressures on juvenile and adult *Alsophis portoricensis* may account for the presence of caudal luring in juveniles. The small size of hatchlings probably exposes them to greater predation pressure than adults, and the sit-and-wait foraging strategy may reduce predation risk (Huey and Pianka, 1981). Caudal luring is a way by which these small, diurnal, surface-feeding juveniles may lessen predation. After hundreds of hours observing *A. portoricensis* feeding in captivity by ourselves and J. Rodríguez-Robles (pers. comm.), we have not observed caudal luring by adults. We conclude that caudal luring is a juvenile behavior in *A. portoricensis*.

That two juvenile *Alsophis portoricensis* did not use caudal luring, although they did feed, indicates that variation exists in hunting behavior. Variability in luring tendencies also has been observed in juvenile *Agkistrodon contortrix* (Fitch, 1960), *Bothrops jararaca* (Sazima, 1991), and *Tropidodryas striaticeps* (Sazima and Puerto, 1993). Individual variation in use of caudal luring may be a response to differences in hunger level at the time that the prey was presented (Greene and Campbell, 1972; Murray et al., 1991; Chiszar et al., 1990).

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