

# NATURAL HISTORY NOTES

## CAUDATA — SALAMANDERS

### *AMBYSTOMA BARBOURI* (Streamside Salamander).

**REPRODUCTION.** A disjunct population of *Ambystoma barbouri* inhabits the Nashville Basin of Middle Tennessee, USA (Anderson et al. 2014. Southeast. Nat. 13:101–107). In Tennessee, *A. barbouri* typically deposit eggs on the underside of submerged, flat rocks within riffle, run, and pool habitat of stream channels (Neimiller et al. 2009. Southeast. Nat. 8:37–44). This behavior has also been observed for *A. barbouri* in Indiana, Kentucky, and Ohio (Kraus and Petranks 1989. Copeia 1:94–110).

A population of *A. barbouri* is known from a first-order stream within a cedar glade of the Inner Nashville Basin of Tennessee (specific locality information is withheld due to the sensitive nature of this species). On 22 January 2023, several *A. barbouri* egg masses were identified from the interior of an algal mat sitting on the bedrock of the channel bottom. Larval *A. barbouri* were also observed upstream and downstream within the channel. Limited flat slabrock was observed within the remainder of the stream channel.

This observation documents a novel reproduction substrate for *A. barbouri* in the Inner Nashville Basin of Tennessee. Neimiller et al. (2009, *op. cit.*) reported a single *A. barbouri* egg mass attached to submerged grass along the edge of an in-stream pool (Fig. 1). Egg deposition on the underside of logs and in leaf packs has also been reported for Kentucky *A. barbouri* when flat slabrock substrate is lacking (Petranks 1982. Herpetologica 38:252–262). Terrestrial egg deposition under flat rocks within cedar glade habitat has also been reported for an *A. barbouri* population within the Nashville Basin (Mattison and Miller 2011.



FIG. 1. Egg deposition of *Ambystoma barbouri* within an algal mat of a first-order stream in the Inner Nashville Basin of Tennessee, USA.

Herpetol. Rev. 42:578). Further study is needed to better describe additional egg deposition substrate for *A. barbouri* in Tennessee in environments lacking in-stream flat slabrock.

Survey work for this observation was conducted under Tennessee Wildlife Resource Agency (TWRA) Permit #5247.

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### *AMBSYTOMA BARBOURI* (Streamside Salamander).

**REPRODUCTIVE BIOLOGY and HABITAT USE.** *Ambystoma barbouri* is known from Indiana, Kentucky, Ohio, and central Tennessee with small, disjunct populations in western West Virginia, USA (Petranks 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington, D.C. 587 pp.). *Ambystoma barbouri* were originally confirmed from only three localities in central Tennessee, based on the morphology of several historical specimens that were previously identified as stream-breeding forms of *A. texanum* (Smallmouth Salamander; Scott et al. 1997. Herpetol. Rev. 28:155). Populations from several of the earliest known *A. barbouri* breeding streams were determined to be extirpated in later surveys, causing concern for the status of the species in Tennessee (Niemiller et al. 2006. Am. Midl. Nat. 156:394–399). Since 2010, surveys by Middle Tennessee State University (MTSU), Tennessee Department of Environment and Conservation (TDEC), Tennessee State University (TSU),

TABLE 1. Observations of anthropogenic egg deposition substrates used by *Ambystoma barbouri* in central Tennessee, USA. Precise locations are withheld due to the species' status in Tennessee. HM = Helen Morrison (City of Hendersonville); DW = David Withers; JT = Jared Thompson; AH = Anna Humphrey.

County (Site)	Nest substrate	Date observed	Observer(s)
Sumner (Site A)	Riprap	10 Jan 2019	HM, DW
Sumner (Site B)	Plastic bag	24 Jan 2020	DW
Davidson (Site A)	Rubber boot	26 Jan 2021	DW
Sumner (Site C)	Ceramic tiles	10 Feb 2022	HM, JT, DW
Davidson (Site A)	Cinderblock	14 Feb 2023	DW
Sumner (Site D)	Riprap	24 Feb 2023	JT, DW
	High aggregate asphalt		
	Plastic bag		
Robertson	Plastic bag	12 Feb 2024	AH
Sumner (Site E)	Riprap	13 Feb 2024	AH
Davidson (Site B)	Cinderblock	14 Feb 2024	AH
	Particle board		
Davidson (Site C)	Trash bag	21 March 2024	AH
	Plastic water meter lid		
	Metal gutter		

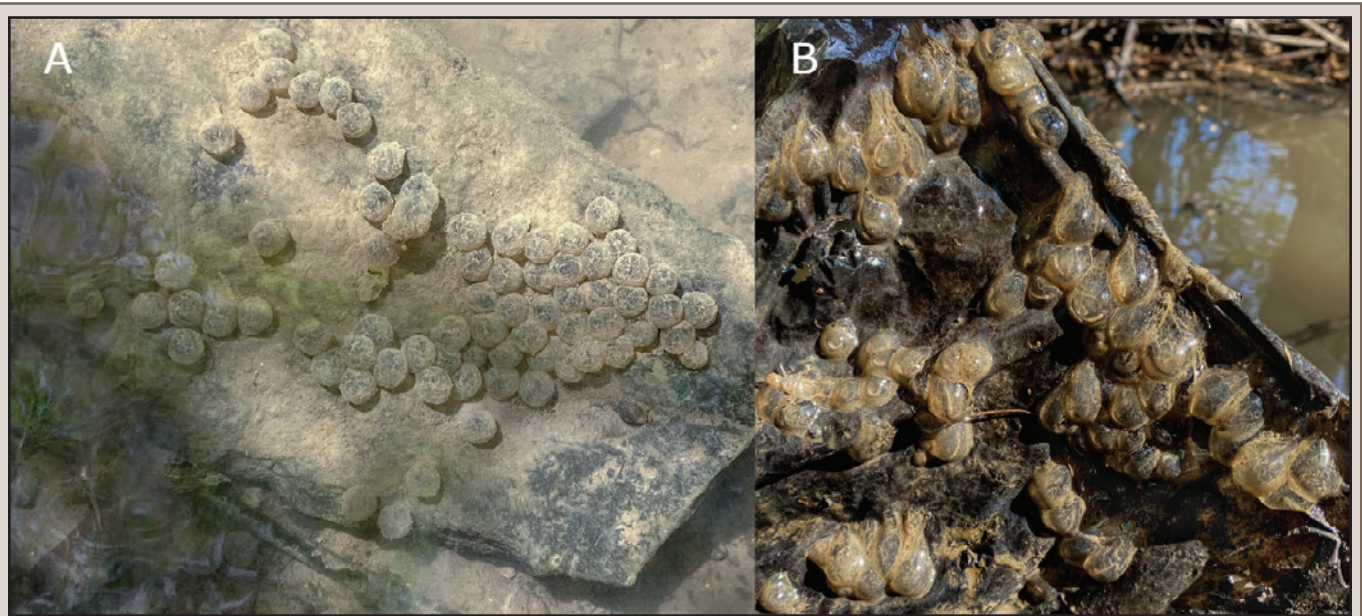


FIG. 1. *Ambystoma barbouri* nests found at Davidson County, Tennessee, USA (Site C): A) nest deposited on the upper surface of a rock; B) highly developed eggs deposited on a trash bag.

Tennessee Technological University (TTU), Tennessee Wildlife Resources Agency (TWRA), private consultants, and the Tennessee Valley Authority (TVA) have found *A. barbouri* extant in ten counties within the Nashville [Central] Basin and Highland Rim physiographic regions in Central Tennessee. TSU and TTU, with assistance from TDEC and TWRA, are currently researching the effects of urbanization on local population persistence and genetic variation within Tennessee's *A. barbouri* populations, respectively. We surveyed known breeding streams in nine counties in the known Tennessee breeding season from 2019–2024, focusing primarily on urban streams. We detected eggs using cover object surveys—searching beneath benthic cover objects with an area  $\geq$  ca. 10 cm<sup>2</sup>—and inspecting floating debris and vegetation.

*Ambystoma barbouri* typically deposit eggs in a single layer on the underside of flat rocks or logs, or singly on vegetation where these options are limited (Petranka 1998, *op. cit.*). In surveys of highly urbanized stream systems, we observed atypical nesting behavior. Many of the surveyed streams had significant anthropogenic impacts, including culverts and buried infrastructure, streambank modifications, alterations to hydrology and hydroperiod, and litter. One result of site urbanization was heavy sedimentation, and we observed one nest deposited entirely on top of a flat limestone rock in a pool at Davidson County Site C (Fig. 1A). The rocks in this pool were highly embedded, with no space between the rock and bedrock substrate to allow for typical egg deposition. Despite studies that suggest a lower survival of *A. barbouri* eggs laid on the upper, exposed portion of a rock (Sih and Maurer 1992. *J. Herpetol.* 26:114–116), no eggs appear to be predated. Cryptic egg deposition may be less advantageous at this site as no sunfish (*Lepomis* sp.), the primary nest predator of *A. barbouri*, were observed during multiple surveys.

Due to limited rocks and a high density of anthropogenic litter, we also observed *A. barbouri* eggs on many unnatural cover objects (Table 1) in some systems. We note that several nests on anthropogenic objects were highly developed (> Harrison Stage 30; Fig. 1B), indicating that these substrates can support successful egg development. We propose that these observations

are evidence of *A. barbouri*'s ability to adapt to urbanization. However, further work is necessary to evaluate the survival and success of *A. barbouri* larvae in the modified hydrology of these urban systems.

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**AMBYSTOMA OPACUM (Marbled Salamander). ABERRANT HATCHING PHENOLOGY.** The distinctive fall-breeding biology of *Ambystoma opacum* is well known (Noble and Brady 1933. *Zoologica* 11:89–132; Seibert *in* Pflingsten and Downs [eds.] 1989. *Bull. Ohio Biol. Surv.* 7:1–315; Greenwald *in* Pflingsten et al. [eds.] 2013. *Ohio Biol. Surv. Bull. New Ser.* 17:xiv + 1–899). Courtship typically occurs on the bottom of dry ponds during rain events in the early fall (September in Indiana, USA: Minton 2001. *Amphibians and Reptiles of Indiana*. Indiana Academy of Science. Indianapolis, Indiana. 404 pp.), although it may also occur terrestrially before the adults reach the ponds (Krenz and Scott 1994. *Herpetologica* 50:46–50). In Indiana, females oviposit in late September or early October under debris on the sides of the ponds (McAtee 1907. *Proc. Biol. Soc. Washington* 20:1–16; Petranka and Petranka 1981. *Copeia* 1981:387–391; Palis 1996. *Herpetol. Rev.* 27:134) and typically remain with the eggs into the fall before abandoning the nest (Petranka 1990. *J. Herpetol.* 24:229–234; see below). Their departure is often coincident with fall rains that typically fill the ponds and stimulate the larvae to hatch when the nests are inundated (Noble and Brady 1933, *op. cit.*). In Indiana, larvae are normally obvious in filled ponds in November (JBI, pers. observ.; Minton 2001, *op. cit.*), and then overwinter in the ponds and metamorphose in the late spring of the following year (Seibert *in* Pflingsten and Downs 1989, *op. cit.*).

PHOTO BY JOHN B. IVERSON



FIG. 1. Ephemeral pond (ca. 8 × 7 m) in Wayne County, Indiana, USA, on 2 March 2024. Constructed (hand-dug) in April 2011, the pond was full in late winter every subsequent year but 2024. Coverboard (1.2 × 1.2 m) under which eggs of *Ambystoma opacum* were found was immediately to the right of this image (i.e., just above the normal full water line).

However, on 2 March 2024, we discovered an unusual deviation from this general pattern as we were surveying pond basins for amphibians at a site ca. 9 km southwest of Richmond, Wayne County, Indiana (precise location withheld for conservation purposes). Because of ongoing drought over the previous year, many of the local small, ephemeral ponds still lacked water (even after 20 mm of rain the previous week), a condition never observed at this site in March, since the ponds were constructed between 2011 and 2016.

At one normally highly productive, but empty pond (Fig. 1), we found *A. texanum* and *A. maculatum* under coverboards around the pond perimeter. In addition, under one moisture-saturated plywood coverboard we found an intact nest of well-hydrated eggs of *A. opacum* (with no attending female). In our combined 76 years of fieldwork with this species we had never found an intact nest of *A. opacum* eggs beyond the end of November in this region. We placed several eggs in pond water to check their viability, and to our surprise, the larvae hatched within 15 min of immersion (Fig. 2).

This specific nest site was also unusual in that the coverboard was located above the normal high-water line (at the overflow

pipe) and could only be immersed in water during extreme flood conditions, even in a year with normal rainfall. A thin layer of leaf litter over the coverboard may have insulated the nest itself from lethally low temperatures and helped prevent dehydration.

On 8 March 2024, the pond was nearly full after a 6.1 cm rain on 5–6 March, but a few intact eggs with visible embryos remained in the nest site under the coverboard and above the water line, along with many empty eggs and a few dead or nearly dead larvae on the saturated soil in the nest. Four of the remaining eggs hatched within 20 min after immersion in the pond's water, although their prospects for survival were uncertain. An additional 4.6 cm of rain fell on 8–9 March, finally flooding the pond, and on 10 March there was no evidence of eggs or larvae under the coverboard. However, visual searching of the pond at night on 13 March revealed abundant small (ca. 20 mm total length) larvae, indicating the successful hatching of other clutches as well. Five of six nearby ponds of similar size and hydroperiod (i.e., without water on 2 March) also had a few to many small larvae present. The size of these larvae also suggested recent, rather than autumn hatching (Bishop 1941. *New York State Bull.* 324:133–365; King 1935. *Ohio J. Sci.* 35:4–15).

These late observations might have two explanations. First, perhaps the drought during the previous fall resulted in a delay of nesting until late fall or winter, and the nest we observed was from a late-nesting female. However, all northern studies of nesting in *A. opacum* have found egg deposition to take place in September or October (review in Greenwald *in* Pflingsten et al. 2013, *op. cit.*; King 1935, *op. cit.*), and no northern study has found a female attending her eggs after mid-December (King 1935, *op. cit.*). In addition, JBI observed courtship and oviposition at our site in late September of the previous year. Hence, the nest we studied was not likely the product of oviposition that occurred during the winter.

The second, and most parsimonious explanation for our observation is that the eggs were deposited normally during September or October in the previous fall, but were never inundated over the dry winter, and yet remained viable despite air temperatures as low as -22°C on 15 January (<https://www.extremeweatherwatch.com/cities/richmond-in/year-2024>) and dry conditions (“extreme drought” according to the Palmer Drought Severity Index as of 24 February 2024; <https://www.drought.gov/location/47330>). This suggests egg viability after more than 5 mo in the field.

The terrestrial survival of *A. opacum* eggs in the field beyond December has been reported at least twice previously. King (1935,

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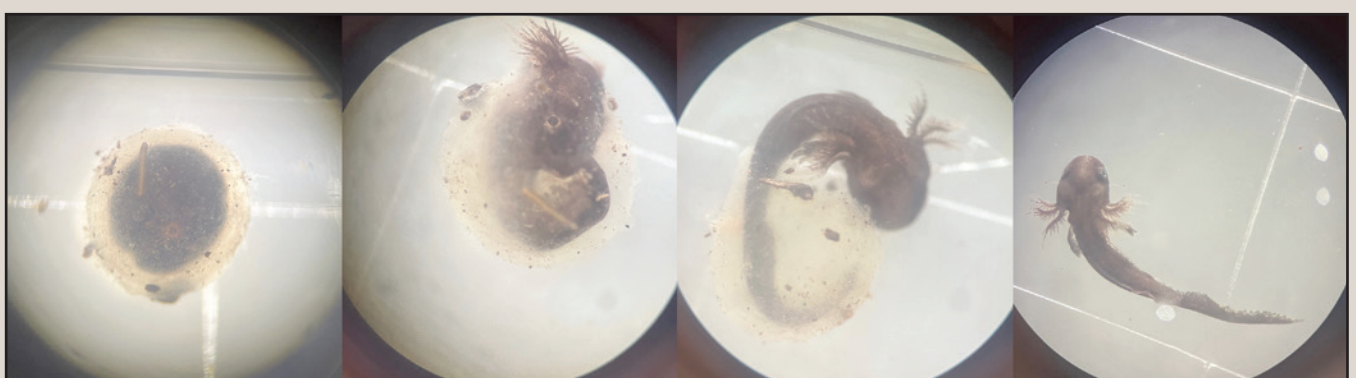


FIG. 2. Hatching sequence of eggs of *Ambystoma opacum* collected on 2 March 2024 in Wayne County, Indiana, USA, after immersion in water. Grid is 13 mm; larva is 15 mm total length.

*op. cit.*) reported finding nests on 5 February with viable eggs during a dry winter in southwest Ohio (ca. 105 km southeast of our site), although he did not describe the criteria for viability. In addition, following a dry winter, Noble and Brady (1933, *op. cit.*) found unhatched but viable eggs in six nests in Virginia between 5 and 14 March, most of which hatched following immersion in water. They also reported that eggs retained in the laboratory at 7–9°C for seven months hatched successfully after immersion in water and that others kept for over a year had viable embryos, but they did not hatch after immersion. In addition, Hassinger (1970. *Amer. Midl. Nat.* 84:474–495) found larvae on 27 January in New Jersey in ponds that had just filled with water and speculated that if oviposition had occurred in September (as normal), then the eggs would have been developing for about 120 d. Finally, Lantz (1930. *Ann. Mag. Nat. Hist. Ser.* 10:322–325) kept an egg viable for 207 d in captivity. Clearly, the eggs of *A. opacum* have the capacity to survive through the winter if dehydration or cold temperatures are not too severe, although Jackson et al. (1989. *Can. J. Zool.* 67:2277–2281) found that egg survival increased with length of time the female remained with the nest (see also Petranka 1990, *op. cit.*; and Croshaw and Scott 2005. *Amphibia-Reptilia* 27:359–364), and the maximum reported brooding time (nest attendance) is less than two months (“a month or two”: Bishop 1941, *op. cit.*; 44 d; Jackson et al. 1989, *op. cit.*; 42 d; Graham 1971, *op. cit.*). Brooding normally lasts only 2–4 weeks (Petranka 1998. *Salamanders of the United States and Canada*. Smithsonian Institution Press. Washington, D.C. 587 pp.).

The extreme tolerance of the eggs of *A. opacum* to desiccation is known. Bishop (1941, *op. cit.*) reported that their eggs “may shrink to one-third the normal size without injury”. Marangio and Anderson (1977. *J. Herpetol.* 11:169–176) demonstrated that 35 late-embryo eggs of *A. opacum* placed on a wet paper towel in a petri dish lost 53% of their initial weight in 24 hours and only a few eggs did not survive. Clearly, the eggs of this species are well adapted to tolerate fall and winter drought.

Numerous authors have suggested that unhatched *A. opacum* nests must succumb to freezing as winter approaches (e.g., McAtee 1907, *op. cit.*; King 1935, *op. cit.*; Graham 1971. PhD. Dissertation, Rutgers University, New Brunswick, New Jersey. viii + 148 pp.; Seibert in Pflingston and Downs 1989, *op. cit.*). However, unpublished research by Noah Gordon, Jon Costanzo, Christopher Conner, and Richard Lee (pers. comm.) found that eggs of *A. opacum* from Missouri can survive subzero temperatures via supercooling and/or freeze tolerance. Our observations reflect this capability and suggest that the eggs of *A. opacum* are more cold-tolerant than generally assumed. Together, these many observations beg for more laboratory studies to quantify the ability of this species to tolerate sub-freezing temperatures, and how that capacity may vary with the dehydration state of the eggs. They also give hope that this species may be able to persist in the face of the increased frequency of droughts and temperature variation due to climate change.

Finally, during dry winters when ponds do not fill until March, the eggs of *A. opacum* may hatch after the reproductive migrations of other *Ambystoma*. This would allow the *A. opacum* larvae to face many fewer competitors or predators. This would allow the *A. opacum* larvae to face fewer competitors as other species may have passed over an unfilled pond or oviposited in shallowly filled ponds that quickly dried up. For example, at our site, the first two (primary) waves of spring *Ambystoma* migration in 2024 were on 27–28 February and 5–6 March, yet our study

pond did not fill until 7–8 March. This pond historically is also a major breeding site for *Lithobates sylvaticus*, *A. maculatum*, and *A. texanum*, but this year only a few eggs of the latter species were observed in the pond when resurveyed on 16 and 20 March. Thus, *A. opacum* may be at a distinct advantage in at least this pond in 2024, despite the unusually dry weather.

Noah Gordon generously shared his unpublished work. This research was conducted under Indiana DNR permit #4076. In all our work we abided by the recommendations of the Guidelines for the Use of Live Amphibians and Reptiles in Field Research by the American Society of Ichthyologists and Herpetologists, The Herpetologists’ League, and the Society for the Study of Amphibians and Reptiles.

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**ANEIDES LUGUBRIS (Arboreal Salamander). DIET.** *Aneides lugubris* is a large, arboreal salamander endemic to California, USA, and Baja California, Mexico (Lynch and Wake 1974. *Cat. Am. Amphib. Rept.* 159:159.1–159.2). Although adapted for arboreality, with large toe pads and a prehensile tail, *A. lugubris* can often be found on the ground at the base of trees, under logs, pots, and along roads (Flaxington 2021. *Amphibians and Reptiles of California*. Fieldnotes Press, Anaheim, California. 300 pp.). *Aneides lugubris* actively forages on wet nights, preying mainly on invertebrates and salamanders of the genus *Batrachoseps* (Stebbins 1951. *Amphibians of Western North America*. University of California Press, Berkeley, California. 539 pp.) and is known for consuming prey items that are disproportionately larger than similarly sized sympatric salamanders (Lynch 1985. *J. Herpetol.* 19:328–352).



FIG. 1. An adult *Aneides lugubris* attempting to predate an adult *Coniia tenuis* in California, USA.

At 2122 h on 3 May 2024, we observed an adult *A. lugubris* attempting to predate an adult *Contia tenuis* (Common Sharp-tailed Snake; Fig. 1). The predation attempt occurred on a path in San Rafael, California (38.03223°N, 122.54186°W; WGS 84). We do not know if the *A. lugubris* was successful in this attempt; it seems unlikely that the snake could be fully consumed by the salamander, given the size of the prey relative to the predator. To our knowledge, this observation represents the first documented occurrence of a predation attempt by *A. lugubris* on a squamate.

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**EURYCEA BISLINEATA (Northern Two-lined Salamander).**

**HABITAT.** *Eurycea bislineata* is a common, small salamander species native to parts of eastern North America (Petranka 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington, D.C. 587 pp.). This species is typically associated with small to medium-sized streams but can occasionally be found some distance from water (Bishop 1941. New York State Mus. Bull. 324:1–361; Petranka 1998, *op. cit.*; Hulse et al. 2001. Amphibians and Reptiles of Pennsylvania and the Northeast. Cornell University Press, Ithaca, New York. 419 pp.). Few observations of this species associated with lakes appear to have been published. Bishop (1941, *op. cit.*) noted a population associated with shoreline substrate at a lake in New York and Bahret (1996. J. Herpetol. 30:399–401) described a unique population from a fishless lake in New York that used this waterbody as a breeding site.

On 4 June 2024 at ca. 1900 h, I observed an adult *E. bislineata* of unknown sex (ca. 4 cm SVL) along the southern shoreline of Briar Creek Lake, Columbia County, Pennsylvania, USA (41.06552°N, 76.28369°W; WGS 84). The *E. bislineata* was submerged in several mm of water and appeared to be foraging for small aquatic insects and larval *Anaxyrus americanus* (American Toad) during ca. 5 min of observation, before retreating under submerged cover (woody debris). Briar Creek Lake is a 51-acre impoundment of East Branch Briar Creek, a small/medium-sized stream in an agricultural matrix, and has a warm-water fish community consisting of species such as *Micropterus salmoides* (Largemouth Bass) and *Lepomis* sp. (sunfishes) (Pennsylvania Fish and Boat Commission 2010. Briar Creek Lake Biologists Report. [https://pfbc.pa.gov/images/reports/2010bio/4x05\\_21briar.htm](https://pfbc.pa.gov/images/reports/2010bio/4x05_21briar.htm), 6 June 2024). The *E. bislineata* was observed ca. 0.75 km and 0.5 km, respectively, from the inlet and outlet sites of Briar Creek Lake, thus suggesting the salamander was utilizing the lakeshore as its residence rather than being in close association with a stream. This observation is of note given the paucity of reports of *E. bislineata* in association with lakes (Bishop 1941, *op. cit.*; Bahret 1996, *op. cit.*) and suggests this habitat may be more commonly used by this species than previously realized.

The findings and conclusions in this note are those of the author and may not necessarily reflect those of the Pennsylvania Fish and Boat Commission.

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**EURYCEA CIRRIGERA (Southern Two-lined Salamander).** **PRE-DATION.** On 10 July 2024, while sorting fishes from the Fish Collection of the Illinois Natural History Survey (INHS), ES-B observed a partially digested salamander protruding from the anus

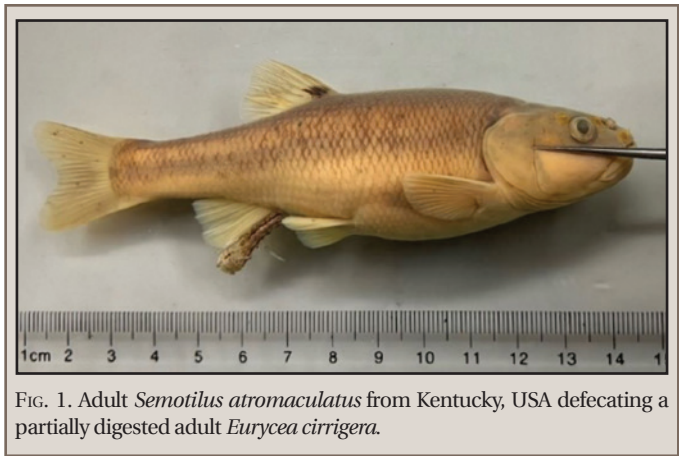


FIG. 1. Adult *Semotilus atromaculatus* from Kentucky, USA defecating a partially digested adult *Eurycea cirrigera*.

of a fish (Fig. 1). The predator was a *Semotilus atromaculatus* (Creek Chub; Leuciscidae; INHS 170844) breeding adult with a standard length of ca. 106 mm, a total length of ca. 133 mm, and a wet mass of 33.3 g. The *S. atromaculatus* was collected in Coles Fork, ca. 0.8 km upstream from Buckhorn Creek, Knott County, Kentucky, USA, on 8 April 2000, by an unknown collector. After careful examination, the salamander was identified as an adult *Eurycea cirrigera* (Plethodontidae) (ca. 17.33 mm SVL; Fig. 1). No gills were observed on the specimen (INHS 46611). Although the specimen was in poor condition (i.e., partially digested), a tan color and two dark dorsal stripes (one stripe on each side of the body) extending to the anterior section could be observed (key characteristic). The venter had no spots or other markings, and it appeared whitened and semi-translucent, possibly due to the preservation solution (70% EtOH). Adult *E. cirrigera* are known to be semiaquatic and may inhabit diverse water bodies (Muncy et al. 2014. Copeia 2014:366–371). The species is known to be nocturnal; therefore, the hours of activity of *E. cirrigera* may overlap with the feeding hours of adult *S. atromaculatus*: early evening to about sundown (Barber and Mickle 1971. Trans. Amer. Fish. Soc. 2:283–289). *Semotilus atromaculatus* are opportunistic feeders (Stair et al. 1984. Environ. Pollut. Ser. A. 35:331–343), and adult specimens could feed on other amphibians (e.g., frogs; Washenko and Gee 1973. J. Fish. Res. Board Can. 30: 357–362). Published records indicate that *Lepomis* (sunfish) and *Etheostoma* (darters) that occur in streams will consume larval *Eurycea* (Petranka 1998. J. Herpetol. 1:48–55). However, to our knowledge, this is the first published report of *S. atromaculatus* consuming an adult *E. cirrigera*. Thanks to the effort of an unknown collector and the preserved specimens, we have documented a predatory interaction between *S. atromaculatus* and *E. cirrigera* that otherwise would be challenging to observe in the wild. Additionally, this unusual evidence highlights the importance of natural history collections as a crucial source of ecological information for various species.

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**PLETHODON CINEREUS (Eastern Red-backed Salamander).**

**PLASTIC INGESTION.** A hallmark of the modern era is the proliferation of plastic waste and its relative ubiquity across both aquatic and terrestrial environments (Laist 1987. Mar. Pollut. Bull. 18:319–326; Yang et al. 2021. Sci. Total. Environ. 780:146546). When this plastic waste is consumed by wildlife it can lead to a range of deleterious effects, including physical damage through internal



FIG. 1. *Plethodon cinereus* from Newfoundland, Canada, with its stomach removed (left) and the strands of microplastic recovered from the individual's stomach contents (right).

abrasions and blockages, decreased foraging success due to false satiation, compromised buoyancy, and toxic effects from leached contaminants (Wright et al. 2013. *Environ. Pollut.* 178:483–492). Ingested plastics have also been seen to bioaccumulate and biomagnify trophically (Miller et al. 2020. *PLoS ONE* 15:e0240792). Sea turtles have garnered much of the attention regarding plastic ingestion in herpetofauna, however, it has also been reported for some marine and estuarine squamates and crocodylians (Staffieri et al. 2019. *Environ. Sci. Pollut. Res.* 26:1238–1249) and freshwater species of both turtles (Clause et al. 2021. *Sci. Rep.* 11:5672) and snakes (e.g., *Helicops angulatus*; Franca et al. 2018. *Herpetol. Rev.* 49:342–343). Comparatively, there are far fewer reports of terrestrial herpetofauna consuming plastic, but it has been observed in both *Gopherus agassizii* (Mohave Desert Tortoise; Walde et al. 2007. *West. N. Am. Nat.* 67:147–149) and *G. polyphemus* (Gopher Tortoise; MacDonald and Mushinsky 1998. *Herpetologica* 44:345–353; Blakley and Rothermel 2021. *Herpetol. Rev.* 52:631–632). However, there is a paucity of information about whether amphibians are known to ingest plastic waste.

Here, we provide evidence of plastic ingestion by *Plethodon cinereus* from an extralimital population. *Plethodon cinereus* is a medium-length (50–120 mm total length) terrestrial plethodontid salamander, native to northeastern North America (Conant and Collins 1998. *A Field Guide to Reptiles and Amphibians of Eastern and Central North America*. Houghton Mifflin Company, Boston, Massachusetts. 640 pp.), with a recently described invasive population on the Canadian island of Newfoundland (Baxter-Gilbert et al. 2022. *Can. Field-Nat.* 136:5–9). These salamanders are commonly found in and around wooded areas, often associated with damp habitats and cover objects, such as leaf litter, moss, logs, sections of bark, and rocks (Conant and Collins 1998, *op. cit.*), as well as under an array of anthropogenic debris. *Plethodon*

*cinereus* populations exhibit generalist diets, consuming a large variety of invertebrates (Maglia 1996. *Copeia* 1996:576–586; Anthony et al. 2008. *J. Anim. Ecol.* 77:646–653).

While examining the stomach contents of 133 *P. cinereus* collected in June 2022 from an introduced population in Newfoundland, for the purposes of determining their invasive diet, we found plastic material within nine individuals, 7% of those examined. In total, 35 fibrous pieces of plastic varying in color were found (i.e., one clear, five red, and 29 dark blue; Fig. 1). The size of the consumed plastic ranged from 0.2 to 5.2 mm in length and 0.013 to 0.55 mm in width, so the majority of these can be categorized as microplastics (i.e., <5 mm; Akdogan and Guven 2019. *Environ. Pollut.* 254:113011) and two of them being considered plastic waste (i.e., >5 mm). Microplastics are classified as either primary (i.e., manufactured at that size) or secondary (i.e., created through the breakdown and fragmentation of larger plastic pieces) (Rocha-Santos and Duarte 2015. *TrAC, Trends Anal. Chem.* 65:47–53; Yurtsever and Yurtsever 2019. *Chemosphere* 216:271–280). All the plastic materials found within our examined *P. cinereus* appear to be secondary microplastics. Given that all the individuals collected were from suburban backyards outside of the city of Conception Bay South (47.4858°N, 52.9758°W; WGS 84; see Baxter-Gilbert et al. 2022, *op. cit.*) the presence of secondary microplastics in the soil is unsurprising. *Plethodon cinereus* is known to consume soil and other substrate materials while foraging, and thus we presume that these plastic fibers were within the soil and then accidentally ingested.

It is unclear what effect these microplastics have on the salamander's health. However, we did note that all individuals had invertebrate prey items in their stomachs and appeared in good health upon capture. Additionally, it is unknown if these plastic fibers have been accumulating in the salamander's digestive tract

over time, or if the microplastics would be easily passed with fecal matter. This is an area we would suggest for future research. If these plastic fibers are unable to be easily passed and accrue over time, they could lead to reduced nutritional uptake or impaction. Furthermore, there remains the potential for chemical leaching as these secondary microplastics are further broken down as they pass through the salamander's digestive tract. Either way, there remains the potential for these ingested plastics to have long-lasting negative effects on salamander health. Given that increasing studies have found that microplastics pose a significant threat to wildlife health (Sarkar et al. 2023. *Int. J. Environ. Res. Public Health* 20:1745) and are found across most ecosystems (e.g., from the deep sea to the high Arctic, but increasing in concentration in urban areas), the potential for this widespread form of pollution to negatively impact amphibians is notable and merits further investigation.

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**TARICHA TOROSA (California Newt). DIET.** *Taricha torosa* is found along the Pacific Coast of California ranging from Mendocino County to San Diego County (McGinnis and Stebbins 2018. *Field Guide to Reptiles and Amphibians of California*. Houghton Mifflin, Harcourt Publishing, Boston, Massachusetts. 560 pp.). *Taricha torosa* is relatively common north of Monterey County but is declining rapidly from south of Monterey County to northern San Diego County (Thomson et al. 2016. *California Amphibian and Reptile Species of Special Concern*. University of California Press, Berkeley, California. 390 pp.). Ritter (1897. *Proc. Calif. Acad. Sci.* 1:73–114) described *T. torosa* larvae feeding on decomposing organic matter and suggested the possibility of cannibalism. Storer (1925. *A Synopsis of the Amphibia of California*. University of California Press, Berkeley, California. 343 pp.) reported captive *T. torosa* feeding on mosquito larvae. Additional feeding behavior was also looked at by Marchetti and Hayes (2020. *West. N. Am. Nat.* 80:165–174) and Marchetti et al. (2022. *West. N. Am. Nat.* 82:77–85), which showed that larvae tend to have an ontogenetic change in foraging behavior as they grow—larger larvae eat larger food items. Marchetti et al. (2022, *op. cit.*) found larval stomach contents to be largely comprised of arthropods and gastropods, with chironomids (non-biting midges) being the most abundant prey item, while gastropods represented the second most common prey item. Thus, *T. torosa* larvae appear to be primarily predators of small aquatic invertebrates. Here, we report two separate observations that not only support the hypothesis of Ritter (1897, *op. cit.*) but indicate larval *T. torosa* may be capable of preying on other amphibian larvae.

In September 2023, while conducting a translocation study for *Rana draytonii* (California Red-legged Frog) in an artificial stock pond, we observed *T. torosa* larvae (ca. 45 mm total length) opportunistically scavenging on a dead *Pseudacris regilla* larva (Pacific Chorus Frog) (Gosner Stage 43–45) at a pond in Napa County, California, USA (38.45410°N, 122.16979°W; WGS 84; Fig. 1). As we continued surveying the pond, we also observed a similar sized *T. torosa* larva feeding on the rear leg of a live *P. regilla* larva (Gosner Stage 41–42) and dragging it down into the mid-water column of the pond. We did not observe the outcome.

*Taricha* consumption of anuran eggs has been previously documented. Westphal et al. (2021. *Herpetol. Rev.* 52:820) reported *T. granulosa* larvae consuming anuran (i.e., *R. draytonii*) eggs and



FIG. 1. A dead *Pseudacris regilla* larva being opportunistically consumed by two larval *Taricha torosa* in Napa County, California, USA.

Rathbun (1998. *Herpetol. Rev.* 29:165) also reported adult *Taricha* feeding on anuran eggs. Our observations of *T. torosa* larvae consuming *P. regilla* larvae are noteworthy as this is the first report of *Taricha* consumption of anuran larvae.

González-Mollinedo and Mármol-Kattán (2019. *Herpetol. Rev.* 50:762) reported that larval scavenging could increase the transmission risk of chytridiomycosis to the scavenging individual. Alvarez and Wilcox (2021. *Herpetol. Rev.* 52:821) suggested that there should be consideration when research is conducted on populations of larvae known to scavenge on other larvae that are known to be infected by chytridiomycosis, ranavirus, endoparasites or other pathogens. Our observation suggests that larval *T. torosa* do predate and engage in necrophagia with sympatric larval amphibians as they reach a size where doing so promotes growth.

We thank the Land Trust of Napa County for providing support for this project and access to the site. Jeff Wilcox provided a very helpful review of the manuscript, for which we are grateful. Handling was permitted under Endangered Species Conservation Fund (Section 6) Traditional Section 6 (FY2021) Recovery of the California Red-legged Frog in the Lake Berryessa Tributaries Core Area, Napa County, California through translocation, invasive predator management, and monitoring. Grant Agreement Number—Q2130003.

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## ANURA — FROGS

**BOANA ALBOMARGINATA (White-banded Tree Frog). MOUTH-GAPING BEHAVIOR.** *Boana albomarginata* (Hylidae) is distributed throughout the Brazilian Atlantic Rainforest, from the state of Paraíba to Santa Catarina (Frost 2024. Amphibian Species of the World: an Online Reference. Version 6.1; <https://amphibiansoftheworld.amnh.org>, 28 May 2024). Visual displays, such as limb lifting and leg kicking, have been reported for the species, presumably related to reproduction (Hartmann et al. 2005. *J. Nat. Hist.* 39:1675–1685). Here, we present the first record of a visual defensive display for *B. albomarginata*. During fieldwork at Parque Estadual Paulo César Vinha, Espírito Santo, Brazil (ca. 20.60348°S, 40.42594°W; WGS 84; 8 m elev.) on the night of 12 May 2024, our field team found a juvenile *B. albomarginata* inside a bromeliad plant. When disturbed by our lantern lights, the animal performed a series of mouth-gaping displays (Fig. 1; video available at <https://doi.org/10.26153/tsw/55863>), interchanged with face-wiping. The mouth-gaping behavior has been reported for *Boana raniceps* (Guerra et al. 2018. *Herpetol. Notes* 11:433–436). There was no perceptible sound emission during this display. We believe that the blue inner mouth may be related to an aposematic strategy, similar to the colors of the mouth and tongue in other species that display mouth-gaping behavior (Toledo et al. 2011. *Ethol. Ecol. Evol.* 23:1–25; Ferreira et al. 2019. *Behav. Ethol. Sociobiol.* 73:1–21).

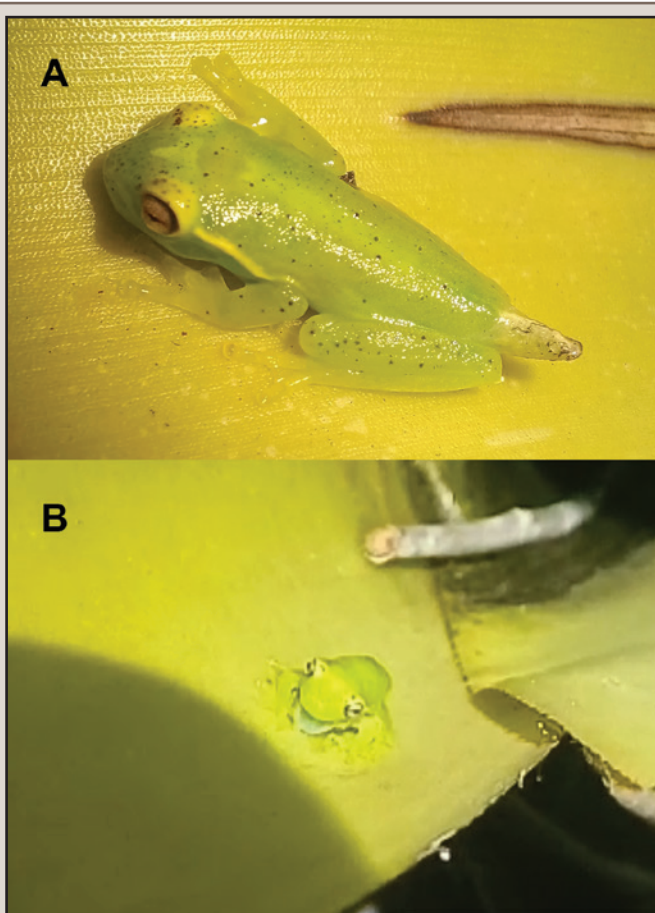


FIG. 1. Postures of *Boana albomarginata* from Espírito Santo, Brazil: A) natural posture; B) mouth-gaping display (frame from video).

We thank the Parque Estadual Paulo César Vinha for logistical support and for permission to do the fieldwork. The authors received financial support from Coordenação e Aperfeiçoamento de Pessoal de Nível Superior (CAPES) and Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq).

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**DENDROPSOPHUS ELEGANS (Elegant Forest Treefrog) and DENDROPSOPHUS MERIDIANUS (Southern Treefrog). SHELTER SHARING.** Terrestrial amphibians are very susceptible to water loss (Schwarzkopf and Alford 1996. *Funct. Ecol.* 10:193–200; Seebacher and Alford 2002. *J. Herpetol.* 36:69–75; Gastón and Akmentis 2023. *Zoology* 159:126105), a stressful condition (Heatwole 1968. *Comp. Biochem. Physiol.* 28:245–269; Moore and Gatten 1989. *Herpetologica* 45:101–110) that motivates the adoption of behavioral strategies to minimize evaporation. Some examples are the selection of microhabitats (Seebacher and Alford 2002, *op. cit.*), regulation of the period of activity (Duellman and Trueb 1986. *Biology of Amphibians*. McGraw-Hill Book Company, New York, New York. 670 pp.; Wells 2007. *Ecology and Behavior of Amphibians*. The University of Chicago Press,

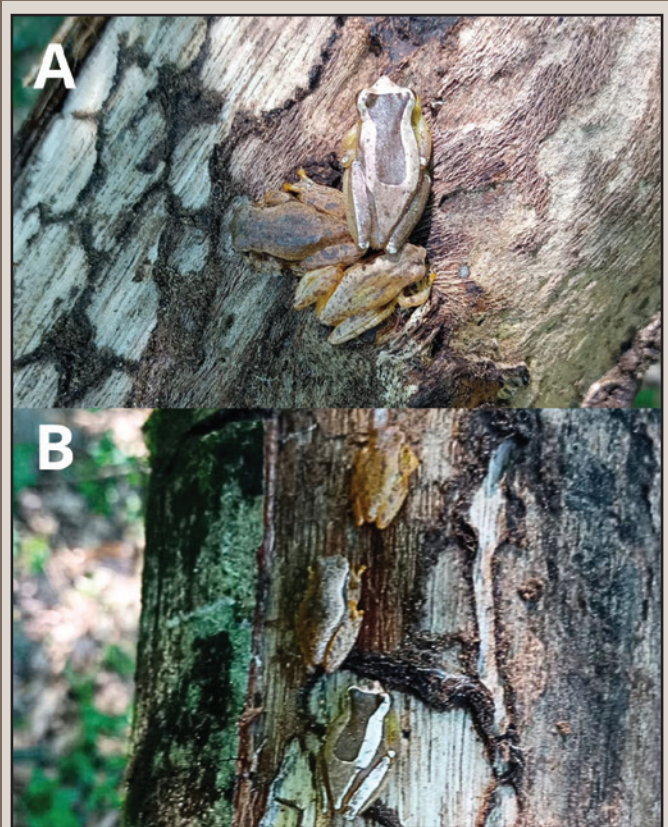


FIG. 1. *Dendropsophus elegans* and *Dendropsophus meridianus* in the shelter, after removal of the bark, in Rio de Janeiro, Brazil: A) first encounter; B) second encounter.

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Chicago, Illinois. 1148 pp.), or a body positioning display, reducing the surface area in contact with the air (Duellman and Trueb 1986, *op. cit.*). Amphibians are mostly nocturnal and search for moist shelters during the day (Duellman and Trueb 1986, *op. cit.*; Schwarzkopf and Alford 1996, *op. cit.*; Seebacher and Alford 2002, *op. cit.*; Forti et al. 2022. *Zoology* 155:126052).

During entomology fieldwork, on 7 November 2023, JRMM found three anurans of two different species, sharing the same shelter (Fig. 1). Two *Dendropsophus meridianus* and one *D. elegans* were found under tree bark near a lake on the 'Yellow Trail' at the Reserva Ecológica de Guapiaçu, Municipality of Cachoeiras de Macacu, Rio de Janeiro, Brazil (22.45222°S, 42.77138°W; WGS 84; 34 m elev.). The bark was removed by the observer, exposing the three specimens at ca. 1100 h (Fig. 1A); the bark was replaced on the tree. One hour later at 1200 h, the individuals remained but were in different positions (Fig. 1B). All three were in resting positions, indicating inactivity (see Forti et al. 2022, *op. cit.*). The individuals were collected and deposited in the amphibian collection of the Zoology Department, Biology Institute, Federal University of Rio de Janeiro (ZUF RJ 17131, 17179, 17180).

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**DRYOPHYTES EXIMIUS (Mountain Treefrog). TADPOLE DIET.** Anuran tadpoles consume the food available in their habitat, allowing them to grow and develop rapidly (Altig et al. 2007. *Freshwater Biol.* 52:386–395). However, the range of foods consumed is so wide that it is difficult to know exactly the main elements that make up their diet, since it is unknown if the consumption is part of their diet or is accidental (Rossa-Feres et al. 2004. *Rev. Bras. Zool.* 21:745–754).

*Dryophytes eximius* is a hylid frog endemic to Mexico, inhabiting the grasslands and temperate forests of mountainous regions. *Dryophytes eximius* tadpoles generally develop in temporal or permanent shallow water bodies during the rainy season (Lemos-Espinal and Dixon 2016. *Amphibians and Reptiles of Hidalgo, Mexico*. CONABIO, Mexico City, Mexico. 763 pp.).

On 2 November 2022 at 1215 h, during an evening tour in grassland in San Jose "El Vidrio", Municipality of Nicolas Romero, Estado de México, México (19.6455°N, 99.3831°W; WGS 84; 2644 m elev.), we observed several *D. eximius* tadpoles in a temporal, shallow water body (Fig. 1). The tadpoles were actively consuming cattle manure floating in the water (Fig. 2). At this site, livestock activity is carried out on a small scale, and cattle are taken here to graze.

Manure contains organic and inorganic elements whose proportion varies depending on the type of feed consumed by the livestock, along with the individual's age and health status (Cesoniene et al. 2019. *Environ. Sci. Pollut. Res. Int.* 32:32678–32688). Although it may play an important role in enriching soil, it is considered detrimental to water bodies due to the amount of nitrogen and phosphorus it may contain, which favors eutrophication, leading to amphibian declines.



FIG. 1. Temporal shallow water body containing *Dryophytes eximius* tadpoles in Estado de México, México.



FIG. 2. *Dryophytes eximius* tadpoles consuming cattle manure in Estado de México, México.

In this case, the manure is present in small quantities and comes from a few cattle that feed on grasses and weeds. The nitrogen and phosphorus may be present in low concentrations and may not present a threat to the tadpoles (Ortiz-Santaliestra et al. 2011. *Environ. Toxicol. Chem.* 30:1440–1446). In addition, this timely and unusual resource is a material whose homogeneous and soft consistency would facilitate ingestion by tadpoles; more importantly, manure exploitation can provide

the necessary nutritional requirements for tadpoles to complete their development in this ephemeral environment (Echeverría et al. 2007. *Gayana* 71:8–15).

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**ISCHNOCNEMA HENSELII. DEFENSIVE BEHAVIOR.** Anuran amphibians face several predatory pressures that shape their defensive strategies (Souza et al. 2020. *Herpetol. Notes* 13:667–669). Examples of these strategies include the production of toxic substances that turn species unpalatable, aposematic coloration, camouflage, immobility, specific postures, and escape behaviors, among others, that increase their chance of survival (Wells 2007. *The ecology and behavior of amphibians*. University of Chicago Press, Chicago, Illinois. 1148 pp.). Currently, around 30 types of defensive behaviors have been described (Toledo et al. 2011. *Ethol. Ecol. Evol.* 1:1–25).

*Ischnocnema henselii* (2.3 to 3.6 cm) is a brachycephalid distributed in the Brazilian Atlantic Forest, in the southern and southeastern regions of Brazil (Frost 2024. *Amphibian Species of the World: an Online Reference*. Version 6.1; amphibiansoftheworld.amnh.org, 20 May 2024). This species inhabits only forested areas, exhibits nocturnal activity, and displays cryptic behavior and is commonly found vocalizing under leaf litter (Haddad et al. 2005. *BioScien.* 3:207–217).

Here, we report the first record of *I. henselii* exhibiting the defensive behavior known as limb interweave. Limb interweave is known in only six genera across five families of anurans from four zoogeographic regions (Afrotropical, Nearctic, Neotropical, and Palearctic), with the family Hylidae being the most represented (Ferreira et al. 2019. *Behav. Ecol. Sociobiol.* 69:1–21). To date, this behavior has not been documented in the family Brachycephalidae.

On 10 May 2024, during a herpetological survey in the Municipality of Prudentópolis, Paraná, Brazil, we found an adult *I. henselii*. The environment was Brazilian Atlantic Forest in the Araucaria Pine Forest formation (25.06139°S, 50.98056°W; WGS

84; 1047 m elev.). This individual was located near a stream, and when handled for photographic records, the *I. henselii* interweaved its hind limbs into an “X” shape (Fig. 1). It returned to its original posture after ca. 15 s. Limb interweave is a behavior observed in other anuran species, and is associated with mimesis of injury, resulting in predator disinterest. Additionally, this behavior may assist in the dispersion of skin secretion (Campos et al. 2023. *Herpetol. Review.* 54:98–99). Similar behaviors have been reported in *Hylomantis aspera* (Gally et al. 2014. *Herpetol. Notes* 7:623–625), *Leptodactylus chaquensis* (Lourenço-de-Moraes et al. 2014. *Herpetol. Notes* 7:391–392), *Haddadus binotatus* (Rojas-Padilla et al. 2019. *Herpetol. Rev.* 50:113–114), *Bokermannohyla oxente* (Souza et al. 2020. *Herpetol. Notes* 13:667–669), *Boana semilineata*, and *B. geographica* (Campos et al. 2023, *op. cit.*). This is the first report of limb interweave as a defensive behavior for *I. henselii* and for the family Brachycephalidae.

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**KALOPHRYNUS HETEROCHIRUS (Variable Sticky Frog) and KALOPHRYNUS INTERMEDIUS (Intermediate Sticky Frog).**

**ENDOPARASITES.** *Kalophrynus heterochirus* is distributed throughout Borneo; *K. intermedius* is known from Brunei, Sarawak, and upper Central Kalimantan, Borneo, both inhabit leaf litter (Inger et al. 2017. *A Field Guide to the Frogs of Borneo*. Third Edition. Nat. Hist. Publ. [Borneo], Kota Kinabalu, Malaysia. 228 pp.). We know of no reports of helminths from *K. heterochirus* or *K. intermedius* and herein establish a helminth list for each of these species.

Nine *Kalophrynus* consisting of six *K. heterochirus* and three *K. intermedius* from Borneo, were borrowed from the Amphibian and Reptile Collection of the Field Museum of Natural History (FMNH), Chicago, Illinois, USA. Six *K. heterochirus* (mean SVL: 24.17 mm ± 4.01 SD, range: 18–27 mm), consisting of FMNH 146265 (3.23333°N, 113.1000°E; WGS 84) and 150428 (3.3500°N, 113.4500°E; WGS 84), both collected 1963 in Sarawak, 4th Division, Bintulu District; FMNH 157739 and 157743, both collected 1964 in Sarawak, 4th Division, Bintulu District (3.1000°N, 113.63333°E; WGS 84); FMNH 237084, Sabah, Sipitang District (4.9000°N, 115.7500°E; WGS 84); FMNH 237085 Sabah, Tenom District (5.21667°N, 115.9500°E; WGS 84), both collected 1989, were examined. Three *K. intermedius* (mean SVL: 27.67 mm ± 0.47 SD, range: 27–28 mm) consisting of FMNH 223027, collected 1984 in Sarawak, 7th Division, Belaga District (2.71667°N, 113.9000°E; WGS 84); FMNH 23705 and 23706, both collected in 1989, Sabah, Sipitang District (4.9000°N, 115.7500°E; WGS 84) were examined.

Specimens had been fixed in 10% formalin and stored in 70% ethanol. The body cavity of each specimen was opened by a longitudinal incision, the gastrointestinal tract was removed, and the contents were examined using a dissecting microscope. Only nematodes were found. Each nematode was removed with jeweler’s forceps, cleared in lactophenol, examined under a compound microscope, and identified from *K. heterochirus*: one female *Foleyellides malayensis* in the body cavity of FMNH 150428 (prevalence [infected specimens/examined specimens ×

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FIG. 1. Limb interweave defensive behavior displayed by *Ischnocnema henselii* in southern Brazil.

100] = 17%), and in the large intestines, 1 female *Oswaldocruzia* sp. in FMNH 237084 and two female *Oswaldocruzia* sp. in FMNH 237085 (prevalence = 33%). Males of *Oswaldocruzia* are needed for species identifications.

For *K. intermedius* (from FMNH 223027), we identified 1 female *Oswaldocruzia* sp. in the large intestine, 5 (3 males, 2 females) *F. malayensis*, and 1 juvenile Ascarididae all in the body cavity (prevalence for all helminths = 33%). Both FMNH 237075 and 237076 did not contain helminths.

We identified *F. malayensis* utilizing Petit and Yuen (1979. Bull. Musé. Nat. d'Hist. Natur. Paris 1, Sect A:213–218) and Anderson et al. (2009. Keys to the Nematode Parasites of Vertebrates. CABI Publishing, Oxfordshire, United Kingdom. 463 pp.). *Oswaldocruzia* sp. and juvenile Ascarididae gen. sp. were identified using Anderson et al. (2009, *op. cit.*). Adults are necessary for ascarid identification.

Parasites were deposited in the FMNH Invertebrate Zoology Collection, Chicago, Illinois, USA as from *K. heterochirus*: *Oswaldocruzia* sp. FMNH Invertebrate Zoology Catalogue (FMNH 16796, 16797); *F. malayensis* (FMNH 16795) and from *Kalophrynus intermedius*: *Oswaldocruzia* sp. (FMNH 16798); *F. malayensis* (FMNH 16800); juvenile Ascarididae gen. sp. (FMNH 16799). All represent new host records.

We thank Rachunliu Kamei (FMNH) for permission to examine *K. heterochirus* and *K. intermedius* and Joshua Mata (FMNH) for facilitating the loan Z-54739.

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**KALOPHRYNUS MEIZON (Bornean Sticky Frog). ENDOPARASITES.** *Kalophrynus meizon* is found in all parts of Borneo and is endemic to the island; it feeds on tiny invertebrates including ants and termites (Inger et al. 2017. A Field Guide to the Frogs of Borneo. Third Edition. Nat. Hist. Publ. [Borneo], Kota Kinabalu, Malaysia. 228 pp.). We know of no reports of helminths from *K. meizon* and herein present a helminth list for this species.

Twenty *K. meizon* (8 males, 11 females, 1 unsexed) (mean SVL: 48.8 mm ± 5.6 SD, range: 35–58 mm) (collected 1970–1990) were borrowed from the herpetology collection of the Field Museum of Natural History (FMNH), Chicago, Illinois, USA; FMNH 195105, 195107, 223120, Sarawak, Kapit District (1.63333°N, 113.56666°E; WGS 84); FMNH 223116–223119, Sarawak, Belaga District (2.71666°N, 113.9000°E; WGS 84); FMNH 230846–230849, Sabah, Lahad Datu District (5.2000°N, 117.83333°E; WGS 84); FMNH 235008, 237070, Sabah, Sipitang District (4.9000°N, 115.7500°E; WGS 84); FMNH 240993, 240994, 247768–244770, 244772, 244773, Sabah, Lahad Datu District (5.2000°N, 117.83333°E; WGS 84).

The specimens had been fixed in 10% formalin and stored in 70% ethanol. The body cavity of each specimen was opened by a longitudinal incision, the gastrointestinal tract was removed, and the contents were examined using a dissecting microscope. Nematodes and a pentastome were found. Each helminth was removed with jeweler's forceps, cleared in lactophenol, and examined under a compound microscope for identification.

We identified six *Aplectana macintoshii* females in the large intestines (two in FMNH 195106, four in FMNH 223138), ten *Cosmocerca ornata* females in the small intestines (one from FMNH 223119, two from FMNH 230847, one from FMNH

230848, one from FMNH 237070, one from FMNH 244769, three from FMNH 244772, one from FMNH 244773), one *Falcaustra* sp. female in the small intestine of FMNH 235008, three *Oswaldocruzia* sp. females in the large intestines (one from FMNH 195107, one from FMNH 230846, one from FMNH 230849). Males of *Oswaldocruzia*, as well as *Falcaustra*, are needed for species identifications. One *Kiricephalus pattoni* nymph was found in the body cavity of FMNH 231116.

*Aplectana macintoshii* was identified by study of Baker (1980. Mus. Nat. d'Hist. Natur. 2:955–998). *Cosmocerca ornata* was identified using Anderson et al. (2009. Keys to the Nematode Parasites of Vertebrates. CABI Publishing, Oxfordshire, United Kingdom. 463 pp.), Bala (2016. J. Environ. Appl. Biores. 4:49–51), and Kirillova and Kirillov (2021. Inland Water Biol. 14:316–330). *Falcaustra* sp. and *Oswaldocruzia* sp. were identified using Anderson et al. (2009, *op. cit.*). *Kiricephalus pattoni* was identified by study of Riley and Self (1980. Syst. Parasitol. 1:127–140).

Parasites from *K. meizon* were deposited in the FMNH Invertebrate Zoology Collection as *Aplectana macintoshii* (FMNH 16781, 16783); *Cosmocerca ornata* (FMNH 16784, 16786, 16787, 16791–16794); *Falcaustra* sp. (FMNH 16790); *Oswaldocruzia* sp. (FMNH 16782, 16788, 16785); *Kiricephalus pattoni* (FMNH 16789). All represent new host records.

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**LEPTODACTYLUS MYSTACINUS (Moustached Frog). DIET.** Anurophagy in anurans has been widely documented, although it only represents a small portion of the diet (Caicedo-Martínez et al. 2021. Food Webs 27:1–2; Souza et al. 2023. Food Webs 37:1–16). Here, we report the predation of *Physalaemus gracilis* by *Leptodactylus mystacinus*.

The predation event occurred in the Municipality of Mariana Pimentel, Rio Grande do Sul, southern Brazil. The study area (30.35864°S, 51.61930°W; WGS 84; 162 m elev.) is in the South American pampas biome in the physiographic region known as “Depressão central” (Pacheco 1956. Bol. Geogr. Rio Grande



FIG. 1. *Physalaemus gracilis* being preyed upon by a *Leptodactylus mystacinus* in Rio Grande do Sul, Brazil.

Sul 1:7–17). At 1530 h on 2 November 2023, we found an *L. mystacinus* preying upon a *P. gracilis* under an abandoned refrigerator door on the edge of a riparian forest. During the observation, the *L. mystacinus* had the *P. gracilis* in its mouth, with only the head visible. The *P. gracilis* showed no signs of life. Due to the disturbance by the researcher, the *L. mystacinus* partially released the *P. gracilis*, allowing the identification of the prey. Subsequently, the *L. mystacinus* resumed ingesting the *P. gracilis*, gradually consuming it completely (Fig. 1).

Although anurophagy by species of the genus *Leptodactylus* is already known, there is only one documented record of anurophagy by *L. mystacinus*, where it preyed upon *Physalaemus albonotatus* (Lopes and Vaz-Silva 2012. Herpetol. Bras. 3:113–115). With this observation, we add another item to the diet of *L. mystacinus*.

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**LEPTODACTYLUS RHODOMERUS (Red-thighed Thin-toed Frog). THANATOSIS.** Thanatosis or death-feigning is a common anti-predator behavior in amphibians and has been documented for different members of the genus *Leptodactylus* (Ramalho et al. 2019. Herpetol. Notes 12:269–272). Here, we report a case of thanatosis in *L. rhodomerus*. On 20 March 2024 at 1200 h, we observed a juvenile *L. rhodomerus* (ca. 4.5 cm SVL) on a trail of the Tesoro Escondido Reserve in the tropical Chocó rainforest of western Ecuador (0.51659°N, 79.14610°W; WGS 84). The animal was encountered after one of the co-authors had lightly stepped on the frog, leading it to start death-feigning. The animal opened its mouth and rapidly turned on its back to display its venter (Fig. 1). After turning the *L. rhodomerus* on its belly, it immediately rolled over again. It repeated this behavior three times but shut its mouth after the second time. When the *L. rhodomerus* was rotated a fifth time, it remained upright but slightly raised the posterior part of its body with its snout touching the soil, probably to expose the glands on the back side of its legs (De Castro et al. 2017. Herpetozoa 29:214–218). It remained in this position for ca. 2 min. Death-feigning, as well as partial raising of the body, has



FIG. 1. Juvenile *Leptodactylus rhodomerus* from Ecuador exhibiting thanatosis.

been documented for multiple *Leptodactylus* species (Sena et al. 2021. Herpetol. Notes 14:257–261). However, to the best of our knowledge, our observation is the first record of both thanatosis and the partial raising of the body as defensive behaviors in *L. rhodomerus*.

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**LITHOBATES SPHENOCEPHALUS (Southern Leopard Frog). DIET.** At 0945 h on 7 June 2024 on Brays Island, South Carolina, USA (32.54708°N, 80.80162°W; WGS 84; 1.1 m elev.) a large adult *Lithobates sphenoccephalus* predated an *Armases cinereum* (Squareback Marsh Crab) (Fig. 1) along a dike separating a small, man-made, vegetated freshwater-wetland and tidal saltmarsh. *Armases cinereum* is a small, common crustacean in the supralittoral zone of the saltmarshes in the southeastern United States (Ruppert and Fox 1988. Seashore Animals of the Southeast. University of South Carolina Press, Columbia, South Carolina. 263 pp.). We are submitting this observation as the first report of *L. sphenoccephalus* consuming an *A. cinereum*.

*Lithobates sphenoccephalus* inhabits a variety of freshwater wetland habitats and can tolerate slightly brackish systems (Christman 1974. Copeia 1974:773–778). This species is an opportunistic predator known to consume a variety of invertebrates, including hard-shelled invertebrates such as beetles, crayfish, and gastropods (Forstner et al 1998. Herpetol. Rev. 29:208). While the predation event presented is not surprising, the circumstances are unique. *Armases cinereum* and most other crab species within *L. sphenoccephalus*' range are restricted to tidal and fully saline habitats like saltmarshes, while *L. sphenoccephalus* is less frequent in these habitats. This



FIG. 1. *Lithobates sphenoccephalus* consuming an *Armases cinereum* on Brays Island, South Carolina, USA.

encounter was observed with an impounded freshwater wetland and saltwater-influenced marsh separated by less than 10 meters by a dike. Hydrological alterations in developed or agricultural areas may increase the overlap between these two species.

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**NIDIRANA OKINAVANA (Yaeyama Harpist Frog). SKELETOCHRONOLOGY.** Among the methods for estimating the age of amphibians, skeletochronology using bone tissue is highly reliable and is currently considered to be the most effective method (Halliday and Verrell 1988. *J. Herpetol.* 22:253–265; Castanet and Smirina 1990. *Ann. Sci. Nat. Zool.* 11:191–196). In particular, the skeletochronology using parts of the phalanges is an excellent method for estimating age without sacrificing animals. This method is based on the characteristics of the amphibians with a cycle of active and dormant periods and uses their ring-shaped marks on bones (LAG: line of arrested growth) formed by cessations of the growth during dormancy. The formation of LAGs is dependent on seasonal changes and occurs during hibernation for species living in the temperate zone (e.g., Hemeelaar and Van. 1980. *Neth. J. Zool.* 30:129–135). In Japan, especially in the humid temperate zone of the northern part of the Kyushu region, the dormant period is once a year, so the number of rings on bones as LAGs directly indicates the age (Kusano et al. 1995. *Jpn. J. Herpetol.* 16:29–34). On the other hand, there are no reports of LAG formation for amphibians inhabiting the humid subtropical zone of Japan. *Nidirana okinavana* are distributed on Iriomote Island in Japan, which has a subtropical climate. In this study, we validated the efficacy of skeletochronology as an age estimation technique for *N. okinavana*.

Field surveys were conducted on Iriomote Island in Okinawa Prefecture from 2008 to 2014 and in 2018. We sampled a total of 103 frogs in spring (March) and autumn (September–October). Following the methods in the previous studies (e.g., Kusano et al. 2010. *Curr. Herpetol.* 29:23–31), the fourth toe of the hind limb was used. The sections were observed under a microscope to confirm the presence or absence of rings on the phalanx.

As a result, the phalangeal histology revealed that rings in 5 *N. okinavana* were completely absent but present in 99 individuals (Fig. 1). Comparing the seasonal occurrences of the ring formation, the *N. okinavana* captured in autumn were a mixture of individuals with and without the rings. Furthermore,

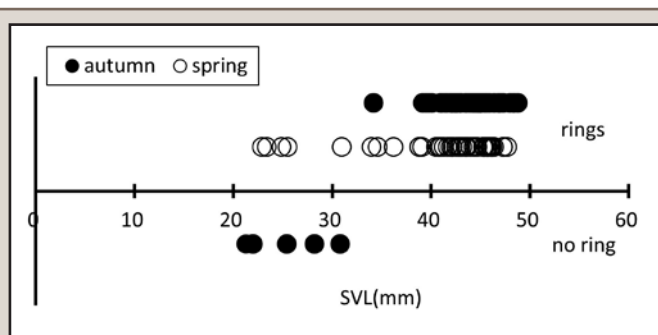


FIG. 1. Relationship between the presence or absence of rings and SVL in two different seasons of *Nidirana okinavana* on Iriomote Island in Japan. The upper side shows frogs with rings and the lower side shows frogs without rings.

there were no rings in the small-sized (short SVL) *N. okinavana* captured in autumn. On the other hand, for *N. okinavana* captured during the spring season, rings were observed on all phalanges. Even small-sized frogs had rings formed on the outermost parts of their bones.

Even though LAGs are known to be formed in tropical species during dormancy in the dry season (Khonsue et al. 2000. *Zool. Sci.* 17:253–257; Kumbar and Pancharatna 2002. *Copeia.* 3:870–872), severe dry seasons do not occur on Iriomote Island. For this reason, rings are unlikely to be formed during the dry season there. The average temperature, instead, on Iriomote Island is the lowest in January, and it is suggested that during this period, *N. okinavana* becomes dormant, and the ring is formed. The small-sized *N. okinavana* caught in the autumn without rings are probably juveniles, and the small-sized frogs with rings sampled in the spring are possibly from the same cohort. Thus, it is possible that the ring is equivalent to a LAG because it was formed when the cohort of juveniles entered dormancy during the winter. Our research suggests that LAGs form in the phalanges of *N. okinavana*, and therefore, the age of these frogs can be estimated using skeletochronology.

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#### **OSTEOPILUS SEPTENTRIONALIS (Cuban Treefrog).**

**PREDATION.** There are numerous reports of spider predation on vertebrates, many involving nursery web spiders of the family Pisauridae (Nyffeler and Gibbons 2022. *J. Arachnol.* 50:121–134). Pisaurid spiders are known to feed on many vertebrates, including fishes (Nyffeler and Pusey 2014. *PLoS ONE* 9:e99459), reptiles (Nyffeler and Gibbons 2021. *J. Arachnol.* 49:1–27), and amphibians, particularly anurans (Nyffeler and Altig 2020. *J. Arachnol.* 48:26–42). For example, Baba et al. (2019. *J. Arachnol.* 47:154–158) observed the pisaurid *Dolomedes orion* (Okinawan Fishing Spider) preying on *Rana ulma* (Ryukyu Brown Frog; Ranidae) in Japan and Patrikeev (2022. *Herpetol. Rev.* 53:288–289) observed a *D. triton* (Six-spotted Fishing Spider) consuming a *Hyla femoralis* (Pine Woods Treefrog; Hylidae) in Virginia, USA. Species of pisaurid spiders are not web-spinning and, like most other families of frog-eating spiders, are cursorial hunters (Nyffeler and Altig 2020, *op. cit.*). In a review, Nyffeler and Altig (2020, *op. cit.*) reported 28 events where pisaurid spiders were observed preying upon frogs of the family Hylidae, more than any other frog family.

*Osteopilus septentrionalis* is a large hylid frog native to Cuba (Meshaka 2001. *The Cuban Treefrog in Florida: Life History of a Successful Colonizing Species.* University Press of Florida, Gainesville, Florida. xxiii + 191 pp.) that first arrived in the USA in the Florida Keys in the 1920s (Barbour 1931. *Copeia* 1931:140) and has since become widespread throughout the state (Krysko et al. 2019. *Amphibians and Reptiles of Florida.* University of Florida Press, Gainesville, Florida. xvi + 706 pp.). Across Florida, several species of birds (e.g., *Egretta caerulea*, *Quiscalus quiscula*, *Tyto alba*) and both native (e.g., *Agkistrodon*, *Coluber*, *Pantherophis*, *Thamnophis*) and non-native squamates (e.g., *Gekko*) have been observed consuming postmetamorphic *O. septentrionalis* (Meshaka 2001, *op. cit.*; Krysko and Love 2016.

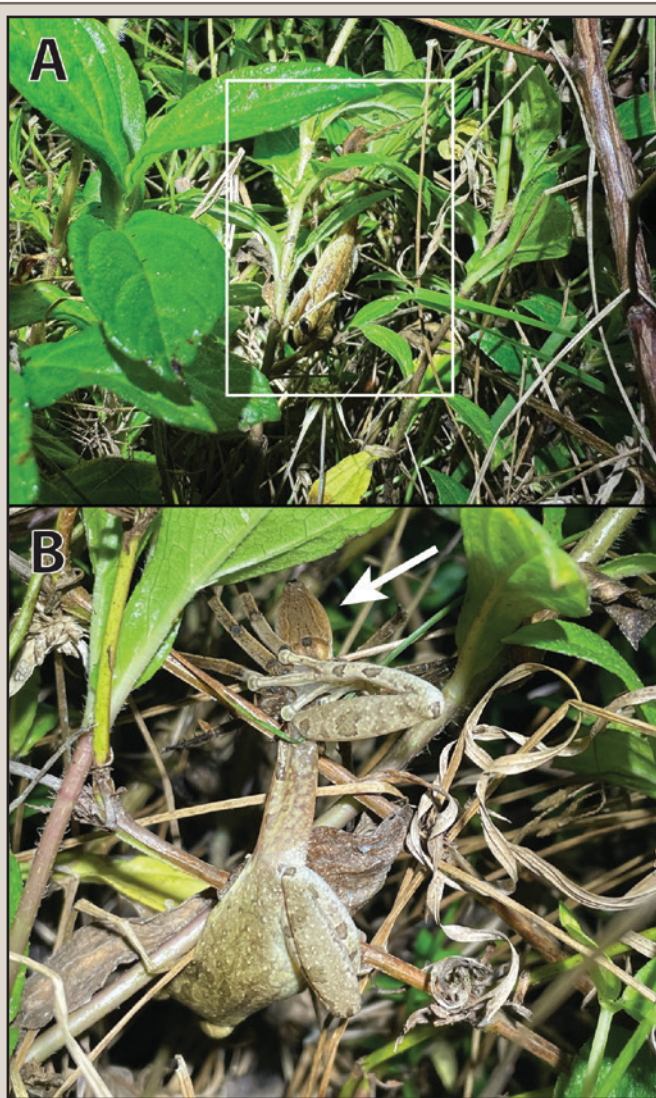


FIG. 1. An adult *Dolomedes triton* that captured a subadult *Osteopilus septentrionalis* in Miami-Dade County, Florida, USA: A) lateral view of the predation event (white box) showing the *O. septentrionalis* oriented downwards within creeping-oxeye (*Sphagneticola* sp.); B) dorsal view of the predation event showing the *D. triton* (white arrow) holding the *O. septentrionalis* and anchored within the vegetation.

Rept. Amphib. 23:44–45). Additionally, cannibalism has been recorded in the species as well, with mature individuals known to consume subadults (Meshaka 2001, *op. cit.*). Predation on *O. septentrionalis* by invertebrates is limited, with only three observations of predation by jumping spiders (Salticidae) reported (Nyffeler et al. 2017. *J. Arachnol.* 45:238–241). Here, we describe an additional spider predator of introduced *O. septentrionalis* in Florida.

At 2302 h on 11 March 2024, we observed an adult *D. triton* that had captured a subadult *O. septentrionalis* (4.0 g, 44 mm SVL) at Glenn Garrett Memorial Park, Miami-Dade County, Florida, USA (25.39717°N, 80.57288°W; WGS 84). As we were hiking along a mowed-grass trail, we heard an anuran emitting a distress call, which we then investigated. Within a stand of creeping-oxeye (*Sphagneticola* sp.) ca. 1 m in height, we discovered this predation event taking place. The *D. triton* had ahold of the *O. septentrionalis* near its right knee; the frog was oriented downward, unsuccessfully attempting to escape the

spider (Fig. 1). After observing this predation event for ca. 10 min, we collected both specimens and deposited them at the Biodiversity Collections, The University of Texas at Austin (*O. septentrionalis*: TNHC 117391 [DRD 11459]; *D. triton*: UTIC 310956). Although we did not observe direct mortality and consumption of the *O. septentrionalis*, we strongly believe that if we had not interfered, the *D. triton* would have killed and consumed the frog, given the numerous reported predation events on anurans by this spider family (Nyffeler and Altig 2020, *op. cit.*). Pisaurid spiders have a relatively large body size (up to 3.7 cm; Ubick et al. [eds.] 2005. *Spiders of North America: an Identification Manual*. American Arachnological Society. v + 377 pp.) and strong venom, both of which make them effective at immobilizing and killing vertebrate prey (Blackman and Lotz 1987. *Anim. Behav.* 35:641–651). To our knowledge, this is the first reported predation of *O. septentrionalis* by the pisaurid spider *D. triton*.

The collection of non-native species is not regulated by the Florida Fish and Wildlife Conservation Commission, and collection methods followed an approved ENMU IACUC protocol (2023-DAV-005). Funding was provided, in part, by an ENMU Faculty Research and Instructional Development Grant awarded to DRD. We thank Travis J. LaDuc and Alex Wild for accessing these specimens and members of the Davis Herpetology Lab for helpful comments on this manuscript.

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**PELOPHYLAX CHOSENICUS** (Seoul Pond Frog) and **LITHOBATES CATESBEIANUS** (American Bullfrog). **INTERSPECIFIC AMPLEXUS**. In 2005, the endemic *Pelophylax chosenicus* was designated as a Class II endangered Korean wildlife species and is restrictively distributed in the southwestern part of South Korea (Do et al. 2017. *Korean J. Environ. Ecol.* 31:381–396). The invasive *Lithobates catesbeianus* was introduced in the 1960s as a food resource, and it has since spread throughout the entire country through escaping and intentional releases. On 21 May 2024, in a rice paddy located in Hwaseong Province, South Korea (37.02274°N, 126.80202°E; WGS 84; 1 m elev.), we found one case of interspecific amplexus between *P. chosenicus* and *L. catesbeianus*. A male *P. chosenicus* was on top, clasping onto the waist of a small female *L. catesbeianus*. Anurans commonly use “release calls” to escape from misdirected amplexus by males of different species, but the *L. catesbeianus* did not employ this behavior during the observation (Cooper 2011. *Amphibia-Reptilia* 32:213–221). Cases of interspecific amplexus are frequently discovered between native species and invasive *L. catesbeianus* (Theis and Caldart 2015. *Herpetol. Notes* 8:449–451). This interspecific amplexus is probably due to the insufficient ability of *L. catesbeianus* to recognize native species as different species.

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FIG. 1. Interspecific amplexus between a male *Pelophylax choseni-cus* (on top) and a female *Lithobates catesbeianus* (on bottom) in Hwaseong Province, South Korea.

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**PELTOPHRYNE PELTOCEPHALA (Eastern Cuba Giant Toad).** **PREDATION.** *Peltophryne peltocephala* is a large bufonid endemic to Cuba (Rivalta González et al. 2014. *Smithson. Herpetol. Inf. Serv.* 145:1–48) and common on Naval Station Guantanamo Bay in a variety of habitats. Due to heavy rains on 17–18 November 2023 from Potential Tropical Cyclone 22, usually dry streambeds were flowing with water (from gushing to, as time passed, gently flowing). From 9–18 December 2023, at night, we observed numerous adult *P. peltocephala* on low-traffic roads with calling males alongside or in the gently flowing drainages. These drainages also had tadpoles and in the surrounding area, metamorphs and juveniles. *Peltophryne peltocephala* is a known explosive breeder (Powell and Henderson 2009. *Natural History of West Indian Reptiles and Amphibians*. University Press of Florida, Gainesville, Florida. 495 pp.) and its only known predator is the dipsadine snake *Caraiba andreae*, recorded once eating a juvenile (Fong 2004. *Herpetol. Rev.* 35:57).

At 1320 h on 5 December 2023 (sunny, air temperature ca. 22–31 °C), at Hidden Beach (19.8963°N, 75.1304°W; WGS 84; 2 m elev.; substrate mostly cobble and sand), on Naval Station Guantanamo Bay, Cuba, RAW observed an unknown predator (now known to be a tiger beetle) dart out from under a rock, grab a *P. peltocephala* metamorph and take it partially back under the rock. It attacked from the crevices in and under the damp cobble rock as the juvenile toad jumped across the rocks in the

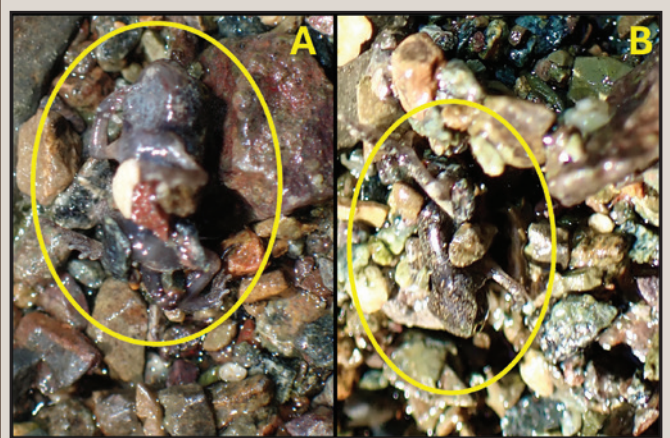


FIG. 1. A) Predated *Peltophryne peltocephala* metamorph from Hidden Beach, Naval Station Guantanamo Bay, Cuba, photographed on 5 December 2023. The toad is on its dorsum with the abdomen cut open; B) toad flipped over by the tiger beetle and partially dragged under the cobble by the legs. The toad's head and body are visible. The flipping of the toad only took about a second.

area. The beetle swiftly attacked, and a brief scuffle ensued. The juvenile toad was cut open, disemboweled, and left lying on its back lifeless (Fig. 1A). At 1321 h, the toad was turned over by the beetle and dragged under the rock with its abdomen under the cobble rocks and head and legs left at the surface (Fig. 1B).

On 20 December 2023 at 1402 h, at Hidden Beach, while RAW was photographing *P. peltocephala* juveniles and metamorphs, she observed a second and third similar predation event and this time was able to see the predator, an adult *Cicindela trifasciata* (S-Banded Tiger beetle). The *P. peltocephala* was moving across the gravel and was swiftly attacked by the beetle. She noted several *C. trifasciata* in the area and at least one mating pair. There were many (hundreds) of metamorphs (Fig. 2A) and juveniles around the flowing stream (which dried up on 18 December 2023, only to flow again on 20 December 2023 following another rain event). This provided easy and abundant prey for the beetles. Cuba has at least 10 species of tiger beetle (Cassola and Pearson 2001. *Biota Colomb.* 2:3–24) and four of these, *Cicindela trifasciata*, *Euonota boops*, *Tetracha acutipennis*, and *Tetracha carolina*, have been documented at Naval Station Guantanamo Bay (<https://www.inaturalist.org>, 26 May 2024). *Cicindela trifasciata* is a wide-ranging species found in the southern United States, the Greater and Lesser Antilles, Central and the west coast of South America. On 20 December 2023 at Hidden Beach, *C. fasciata* were also observed mating/mate guarding (Fig. 2B).

Arthropods are known predators of anurans (Wells 2007. *The Ecology and Behavior of Amphibians*. University of Chicago Press, Chicago, Illinois. 1148 pp.), but for large anurans, the tadpoles, metamorphs, and juveniles are most vulnerable. While there are several reported instances of predation by ground beetle (Carabidae) adults and larvae on amphibians (Valdez 2020. *Global Ecol. Biogeogr.* 29:1691–1703; Quah et al. 2023. *Herpetol. Notes* 16:443–451), we could only find two records indicating predation on anurans by tiger beetles (Cicindelidae) in the peer-reviewed literature: *Spea multiplicata* tadpoles (McCormick and Polis 1982. *Biol. Rev.* 57: 29–58) and *Physalaemus cuvieri* metamorphs (Oda et al. 2014. *Entomotropica* 29:183–186). Other reports of predation include adult tiger beetles on *Rhinella marina* tadpoles (Hawkeswood 2011. *Calodema* 138:1–3) and the Pfennig lab website (<https://www.davidpfenniglab.com/>



FIG. 2. A) Metamorph *Peltophryne peltoccephala*, representative of those on Hidden Beach, 5 December 2023; B) mating *Cicindela trifasciata*, Hidden Beach, Naval Station Guantanamo Bay, Cuba, 20 December 2023.

spadefoots, 26 May 2024) has a photograph of adult tiger beetles preying on mud-encased *Spea multiplicata* tadpoles in a drying pond. We mention the carabid reports because Cicindelidae has, at times, been treated as a subfamily in the Carabidae (Duran and Gough 2020. *Syst. Entomol.* 45:726–729). We believe this to be the first report of a beetle preying on an amphibian in Cuba, the second report of predation on *P. peltoccephala*, and the third peer-reviewed literature report of predation by tiger beetles on anurans.

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**PITHECOPUS GONZAGAI. DEFENSIVE BEHAVIOR.** *Pithecopus gonzagai* (Phyllomedusidae) is distributed in Brazil in the states of Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Maranhão, and probably Ceará and Piauí (Frost 2020. *Amphibian Species of the World: an Online Reference*. Version 6.1; amphibiansoftheworld.amnh.org, 9 Feb 2024). It inhabits open areas on the shores of lentic environments, mainly lagoons, during the rainy season of the year (Andrade et al 2020. *Eur. J. Taxon.* 723:108–134). It is a nocturnal, arboreal species with different types of calls, such as reproductive, defensive, and aggressive calls (Toledo et al. 2015. *Acta. Ethol.* 18:87–99). *Pithecopus gonzagai*, as well as other anuran species, are predated by vertebrates and invertebrates, developing various defense strategies that are displayed to avoid predation (Toledo et al. 2011. *Ethol. Ecol. Evol.* 23:1–25). Here, we report the first record of contraction and regurgitation for *P. gonzagai*.

On 25 November 2019, at 2057 h at the Tapacurá Ecological Station located in São Lourenço da Mata, in Pernambuco, Brazil (8.04059°S, 35.20012°W; WGS 84) we found a *P. gonzagai* on top of dry branches about 1.5 m above the ground. As soon as we caught it, the individual regurgitated a lepidopteran (Fig. 1). Another *P. gonzagai* was encountered in the same area at ca. 1930 h. When we took it to the laboratory, the *P. gonzagai* was manipulated and demonstrated contracting behavior (Fig. 2).

The contraction of the limbs associated with the head flexed ventrally, with the dorsal or ventral surface facing the substrate, is a defensive strategy to avoid predation. Contraction has

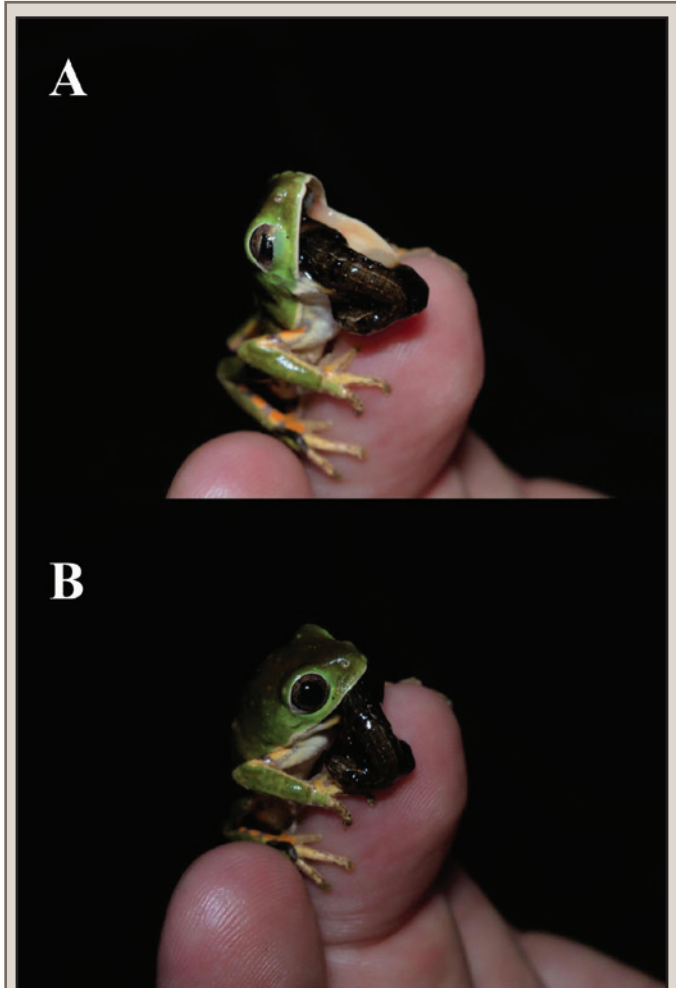


FIG. 1. *Pithecopus gonzagai* regurgitating a lepidopteran in Pernambuco, Brazil.

been documented in a variety of species (Bokermann 1965. *R. Bras. Biol.* 25:257–264; Sazima 1974. *J. Herpetol.* 8:376–377; Toledo et al. 2010. *J. Nat. Hist.* 44:1979–1988; Escobar-Lasso and



FIG. 2. *Pithecopus gonzagai* from Pernambuco, Brazil, displaying contraction.

González Durán 2012. *Herpetol. Notes* 5:79–84; Borteiro et al. 2014. *Herpetol. Notes*. 7:393–395; Santos et al. 2022. *Herpetol. Notes* 15:153–164) and is very common in frogs capable of producing harmful secretions when swallowed by a predator; these secretions can cause regurgitation of the prey. Thus, by protecting the vital parts of its body, injuries during subjugation and ingestion can be avoided (Toledo et al. 2011, *op. cit.*). Regurgitation is a behavior that has not been well documented, but there are records for *Spea intermontana* (Scaphiropodidae) (Waye and Shewchuk 1995. *Herpetol. Rev.* 26:98–99). These are the first records of contraction and regurgitation for both the species *P. gonzagai* and the genus.

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**POLYPEDATES TERAIENSIS (Terai Treefrog). GROUP SPAWNING.** *Polypedates teraiensis*, known to predominantly occur in the Himalayas and northeast India, is a seasonal breeder breeding from March to August, with the onset of rain (Tamuly and Dey 2014. *Curr. World Environ.* 9:182–187; Lalchhanhimi and Lalremsanga 2017. *Sci. Vision* 17:25–32). A number of recent lab-based studies were conducted on the developmental biology of the tadpoles of this species (Chakravarty et al. 2011. *Alytes* 27:85–115; Borah et al. 2019. *J. Photochem. Photobiol. B.* 191:44–51) without much documentation of the breeding process; only a lone study has briefly documented the courtship and breeding behavior in the natural environment (Lalchhanhimi and Lalremsanga 2017, *op. cit.*). In the laboratory, amplexant pairs have been recorded laying eggs in foam nests within 12 h (Chakravarty et al. 2017, *op. cit.*); in natural conditions, the same process was completed in 41 min (Lalchhanhimi and Lalremsanga 2017, *op. cit.*).

On 22 April 2024, PN encountered a group of adult *P. teraiensis* in a garden water tank situated at Dera Natung Government College, Itanagar in Arunachal Pradesh, Northeast India (27.076°N, 93.603°E; WGS 84) at ca. 1145 h. The ambient temperature recorded was between 26–27°C. Upon arrival, PN observed a male and a female *P. teraiensis* engaged in amplexus on the tank wall, positioned ca. 20 cm above the water surface.

Another amplexant pair of *P. teraiensis* appeared soon after, ca. 63 cm away, and emerged from the water. The female of



FIG. 1. Multiple amplexus of *Polypedates teraiensis* observed at Dera Natung Government College, Itanagar in Arunachal Pradesh, north-east India: A) observation made on 22 April 2024; B) observation made on 23 April 2024.

the second amplexant pair approached the first amplexant pair. In the meantime, after ca. 15 min, a second male initiated amplexus with the female of the first pair. With this, the breeding activity unfolded rapidly, resulting in the formation of foam nests facilitated by coordinated hind limb movements of all five individuals. Within minutes, three more male *P. teraiensis* joined the group, increasing the total to two females and six males (with two males on one female and four males on another female; Fig. 1A). The hind limb movement of all the frogs occurred every 15–20 s, averaging 3–4 beats/s.

The first female secreted white cloacal fluid along with eggs, while the males released seminal fluid for fertilization. The females' up-and-down hind limb movements facilitated foam nest construction, aided by the rhythmic hind limb motions of the males. The breeding activity was initiated at ca. 1202 h and concluded at ca. 1253 h for the first female, after which it departed the area. Meanwhile, the second female continued with three males for an additional 3 min, completing the breeding process in 54 min.

On 23 April 2024, PN encountered another group spawning at the same spot at ca. 0915 h. This time, six males were observed attempting amplexus with a lone female positioned on a metal pole (Fig. 1B) in the middle of the water tank. The breeding process was completed in 44 min, and the ambient temperature was 23°C.

Group spawning of frogs has been documented in a number of instances, where multiple males release sperm in the water when the female releases her eggs (*Crinia georgiana*: Byrne and Roberts 2004. Behav. Ecol. 15:872–882; *Chiromantis xerampelina*: Byrne and Whiting 2008. Anim. Behav. 76:1157–1164; *Rhacophorus omeimontis*: Liao and Lu 2010. J. Nat. Hist. 44:2929–2940; Roberts and Byrne 2011. Adv. Stud. Behav. 43:1–53). This case of group spawning in *P. teraiensis* was similar; no physical aggression or intra-male competition was observed for the custody of the females, a fact also observed in other frog species (Liao and Lu 2010, *op. cit.*).

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**PSEUDACRIS REGILLA (Pacific Chorus Frog). PREDATION.** Among the smallest frogs widely distributed in western North America (Storer 1925. A Synopsis of the Amphibia of California. University of California Press, Berkeley, California. 343 pp.), *Pseudacris regilla* ranges from coastal British Columbia, Canada, to Baja California, Mexico, and inland throughout the Great Basin in Nevada, Oregon, and Idaho, USA (Stebbins 2003. A Field Guide to Western Reptiles and Amphibians. Houghton-Mifflin Company, Boston, Massachusetts. 560 pp.). This is a highly vagile frog, often found far from water in vegetation and under various objects (Storer 1925, *op. cit.*), yet individuals gather in large numbers in ponds, streams, and wetlands to reproduce each spring, and their cacophonous vocalizations can be heard from great distances (Storer 1925, *op. cit.*). As biphasic amphibians, the larval form of *P. regilla* are fast-growing forms that exploit the rich, temporary resources provided by explosive algal growth in resource-rich aquatic habitats each spring (Wilbur 1980. Ann. Rev. Ecol. Syst. 11:67–93). At metamorphosis, froglets are vulnerable to predation due to small size and incomplete development of aerobic capacity, which retards sustained movement (Pough and Kamel 1984. Oecologia 65:138–144). Some birds tend to attack frogs at

their breeding sites during this time of transition (Wells 2007. The ecology and behavior of amphibians. University of Chicago Press, Chicago, Illinois. 1148 pp.). One such bird species is *Euphagus cyanocephalus* (Brewer's Blackbird), which is a dietary generalist, but can commonly be found seasonally in wetland habitats (Martin 2020. Birds of the World: an Online Reference. Version 1.0; <https://birdsoftheworld.org>, 19 June 2024). *Euphagus cyanocephalus* has been observed preying upon small vertebrates, including small *Rana pipiens* (Northern Leopard Frog; Beasley and Carothers 1974. Wilson Bull. 86:478–479.) Here, we report a novel case of an *E. cyanocephalus* feeding a *P. regilla* froglet to nestlings in a wetland setting.

On 15 June 2024, we conducted an amphibian-focused workshop at the Big Gun Mitigation site near Michigan Bluff in Placer County, California, USA. The mitigation site is owned by Westervelt Ecological Services and is the focal point of *Rana draytonii* (California Red-legged Frog) monitoring efforts. The site features several ponds, the largest of which are artifacts of placer (hydraulic) mining that occurred in the 1800s. Habitat in the general vicinity includes vast tracts of coniferous forest interspersed with residential houses, small towns, roadways and highways, and the American River. During the late afternoon, while conducting dip net surveys for larval *R. draytonii* at Pond 4, we observed an adult male *E. cyanocephalus* land on a willow (*Salix* sp.) branch ca. 3 m away at the shoreline. In his bill, we could clearly see a *P. regilla* froglet held with legs and head protruding from its bill on either side. We discovered the *E. cyanocephalus* nest in that same willow during a previous visit and observed three nestlings in the nest cup. After a few moments the male *E. cyanocephalus* flew into the willow toward the nest, and a noisy commotion was heard from the vicinity of the nest. Shortly thereafter, the male retreated to perch where we first observed him; his bill empty. He remained a short while and then flew off after the commotion from the nest site settled.

Westervelt Ecological Services manages the Big Gun Mitigation site and has generously offered access to the site for many years. We acknowledge permitting through the California Department of Fish and Wildlife (SCP-000040) and the US Fish and Wildlife Service (TE-24524).

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**RHINELLA HORRIBILIS (Mesoamerican Cane Toad). PARASITES.** *Rhinella marina* and *R. horribilis* are closely related terrestrial bufonids that are widely invasive and difficult to distinguish (Mittan-Moreau et al 2022. Mol. Ecol. 31:6440–6456). Recent studies indicate that along with being invasive species, cane toads have transported their parasites to new areas (Selechnik et al. 2017. Inter. J. Parasitol. Parasites Wildl. 6:375–385). In Florida, USA, invasive toads appear to be primarily derived from *R. horribilis* rather than *R. marinus* (Mittan-Moreau et al. 2022, *op. cit.*).

Here, we report the infection of *R. horribilis* from two locations with *Rhabdias pseudosphaerocephala*, a nematode worm that infects both species of cane toads from various parts of the toads' native and invasive ranges (Kuzmin et al. 2007. J. Parasitol. 93:159–165; Pizzatto et al. 2013. Int. J. Parasitol. 43:753–761). This lung-dwelling parasite has not been previously reported from the United States. *Rhabdias pseudosphaerocephala* has a simple life

TABLE 1. *Rhabdias pseudosphaerocephala* in *Rhinella horribilis* from southeastern (SE) and southwestern (SW) Florida, USA. Mean intensity, median intensity and a mean abundance are all in units of *Rhabdias*/toad. SEM is presented in parentheses.

Sample	N	Prevalence	Mean intensity	Median intensity	Mean abundance
SE Florida all toads	18	55.6%	5.50 (1.51)	4.5	3.06 (1.06)
SW Florida all toads	109	68.8%	17.49 (2.10)	12.0	10.25 (1.64)
SW Florida females	23	56.5%	6.46 (3.20)	3.0	3.65 (1.90)
SW Florida males	66	68.2%	20.47 (2.85)	16.0	13.95 (2.27)

cycle that infects cane toads when L3 larvae move from the soil onto the cane toad skin, penetrates the periorbital region, and migrates to the lungs (Finnerty et al. 2018. *Ecol. Evol.* 8:4606–4618).

*Rhinella horribilis* were collected by hand from two sites in Florida, USA. In April 2022, *R. horribilis* were collected in an incorporated region of southwest Florida located in south Fort Myers (26.49286°N, 81.78355°W; WGS 84). The second collection site was 170 km east of the Fort Myers site, located in a residential area with large permanent retention ponds in Jupiter (26.95094°N, 80.15536°W; WGS 84). Vouchers of parasite tissue specimens not used for DNA analyses from the Fort Myers location and host vouchers are archived at the Museum of Southwestern Biology, Division of Parasites (MSB:PARA:46016–46030). Parasites were identified by molecular analysis. For each sample, the entire nematode was placed in a microcentrifuge tube. The Cox-1 (500 base pairs) mitochondrial gene was amplified using standard PCR protocols, sequenced, and uploaded to GenBank under the accession numbers OR622943–OR622950.

The *R. horribilis* samples from southeast and southwest Florida both exhibited high prevalence of *R. pseudosphaerocephala* with more than half of the toads in each sample infected (Table 1). In southwest Florida, the frequency of infection was slightly higher in males than females, but nominal logistic analysis indicated

that there was no statistically significant association between infection status and sex ( $C^2 = 1.001$ ,  $P = 0.317$ ). Embryonated eggs were commonly found in the lungs as well as in the esophagus and intestines.

This work provides the first record and distribution of *R. pseudosphaerocephala* in *R. horribilis* in the United States. Oliver et al. (1993. *J. Parasitol.* 79:786–790) identified ticks on *R. horribilis* in Florida, but to our knowledge, no publications have examined their endoparasites. The relatively high prevalence in two locations in Florida separated by 170 km suggests this parasite may be pervasive in Florida. The high prevalence observed in *R. horribilis* in Florida is not surprising because *R. pseudosphaerocephala* appears to be endemic to bufonids. Previous studies indicate *R. pseudosphaerocephala* commonly infect *R. horribilis* throughout their distribution in Australia, Mexico, and Panama (Falcón-Ordaz et al. 2023. *J. Parasitol. Biodivers.* 32:doi:10.32873/unl.dc.manter32; Kelehear et al. 2009. *Parasitology* 136:919–927) but found limited potential for host switching to native species in Australia (Pizzatto et al. 2012. *J. Wildl. Dis.* 48: 951–961). Further field and laboratory studies on native anurans are needed to determine the potential for *R. pseudosphaerocephala* spillover in Florida.

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**SCAPHIOPUS HOLBROOKII (Eastern Spadefoot). BURROW DEPTHS.** *Scaphiopus holbrookii* is a fossorial amphibian that digs burrows in well-drained soils (Pearson 1955. *Eco. Monographs* 25:233–267). They frequently emerge at night from burrows during the active season (approximately March to August, depending on latitude) to feed within small distances of burrow entrances (Devan-Song et al. 2021. *J. Herpetol.* 55:137–150). Reports on *in situ* burrow depths are limited.

We conducted upland surveys for *S. holbrookii* across lowland forested sites in Arkansas, Tennessee, and Virginia, USA. All surveys were conducted on non-breeding nights with no or

LEFT PHOTO BY MADELYN ALBRITTON, RIGHT PHOTO BY M. A. WALDEN



FIG. 1. Left: *Scaphiopus holbrookii* next to burrow entrance at Village Creek State Park, Arkansas, USA. Right: *S. holbrookii* back-filled its burrow as it retreated below the surface at Colonial National Historical Park, Virginia, USA.

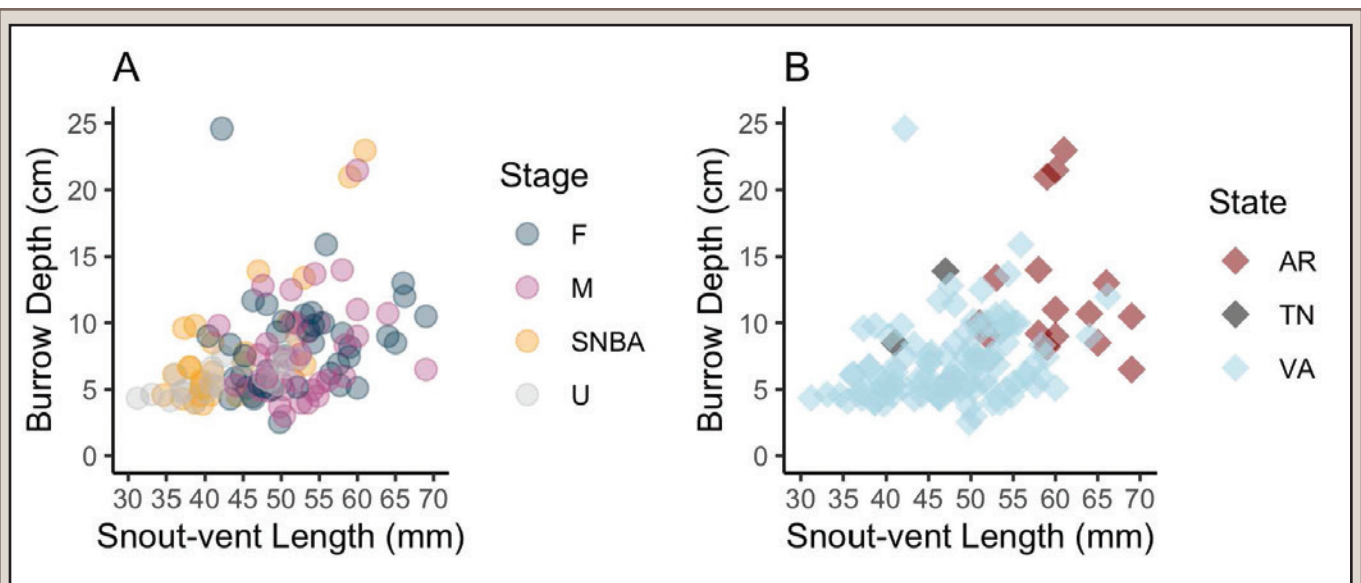


Fig. 2. *Scaphiopus holbrookii* burrow depths by life stage (A) and US state (B). F = Female, M = Male, SNBA = subadult or non-breeding adult, and U = undetermined. AR = Arkansas, TN = Tennessee, and VA = Virginia. Note that the x-axis for SVL begins at 30 mm.

minimal precipitation. Arkansas and Tennessee surveys were conducted in June and July 2023 at Village Creek State Park in eastern Arkansas (35.170°N, 90.706°W; WGS 84) and Meeman-Shelby Forest State Park in western Tennessee (35.340°N, 90.041°W; WGS 84). Virginia surveys were conducted between April 2016 and May 2017 in Colonial National Historical Park in southeastern Virginia (37.229°N, 76.501°W; WGS 84). *Scaphiopus holbrookii* were located by eyeshine between 2000 h and 2200 h in Arkansas and Tennessee, and between 2000 h and 0300 h in Virginia.

Upon detecting an individual, we searched the surrounding habitat, in a roughly 60 cm radius from where it was found, for unoccupied burrow entrances (Fig. 1). This was done first visually, by scanning the ground surface, and then tactilely, by feeling the ground surface in the area for unevenness and moving leaf litter to visually detect burrow entrances. Burrow depth, which may be different from vertical depth from the surface due to the slight angle of some burrows, was measured by gently inserting a thin stick into the burrow until the end of the burrow could be felt and measuring the length of the stick with a ruler. The SVL, mass, and sex were recorded for each frog captured. In Virginia, we used the same methods as described above, except that only visual scans were used, not tactile exploration of the soil surface.

Tactile exploration was highly successful in detecting burrows. We detected and measured the burrow depths for 18 of 34 *S. holbrookii* captured in Arkansas and two of two captured in Tennessee using both visual and tactile exploration, and 109 out of >4000 *S. holbrookii* captured in Virginia using visual exploration only (Fig. 2). Overall burrow depth for all *S. holbrookii* averaged 7.9 cm ( $\pm 0.340$  cm SE; range: 4–26 cm; N = 129); with 8.9 cm ( $\pm 0.623$  cm SE; N = 42) for females, 7.9 cm ( $\pm 0.587$  cm SE; N = 39) for males, and 7.9 cm ( $\pm 0.901$  cm SE; N = 29) for subadults and non-breeding adults. Previous studies (e.g., Jansen et al. 2001. J. Herpetol. 35:141–145) have documented burrow depths of *S. holbrookii* between 5–30 cm, however, individuals have been recorded as deep as 2 m below ground at the northern end of the species range (Driver 1936. Copeia 1936:67–69).

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**SPEA HAMMONDII (Western Spadefoot). LEUCISM.** There is a paucity of reports on leucism in the Scaphiropodidae, and specifically for *Spea* (Ray et al. 2020. Herpetol. Rev. 51:306–307). Gibson and Sattler (2010. Catesbeiana 30:73–81) and McKnight and Ligon (2013. Herpetol. Rev. 44:131–132) reported leucism in *Scaphiopus hurterii* and *S. holbrookii*, respectively. More recently, Ray et al. (2020, *op. cit.*) documented the larvae of *Spea bombifrons* as leucistic in Yellowstone National Park. Here, we report leucism in *S. hammondii* from a large vernal pool in Madera County, California, USA.

Like many in the genus, *S. hammondii* is known to frequently utilize vernal pools and cattle stock ponds for breeding in much of its range in California and northern Baja California (Flaxington 2021. Amphibians and Reptiles of California: Field Observations, Distribution, and Natural History. Field Notes Press, Anaheim, California. 294 pp.). We conducted visual encounter and dip net surveys of several large vernal pools, that functioned as cattle stock ponds at a property in Madera County, California, in April 2023 (specific location withheld). We were able to quickly collect dozens of larvae, from among what appeared to be many hundreds or thousands of larvae present. Larvae were placed in bins for counting, species determination, and for an assessment of developmental stage. All larvae from two pools appeared typical in coloration and development. At a third pool, we noted a single individual appeared atypical in appearance, and a close investigation revealed that it appeared to be leucistic (Fig. 1).

Leucism is considered a genetic defect in that there is an observable absence of melanophores and xanthophores, and iridophores are nearly absent (Bechtel 1995. Reptile and Amphibian Variants Colors, Patterns, and Scales. Krieger Publishing Company, Malabar, Florida. 206 pp.). The resulting coloration is typically pale, white, or nearly so, with pigmented eyes (i.e., not albino). This single leucistic *S. hammondii* larva was among 100s

PHOTO BY JEFF A. ALVAREZ



FIG. 1. A typical and leucistic *Spea hammondii* tadpole, collected from Madera County, California, USA, April 2023.

of typically colored larvae. Since there are no previously published accounts of leucism for this species, this suggests that leucism in *S. hammondii* is rare. Caro (2005. *BioScience* 55:125–136) suggested that aberrant colors are maladaptive in mammals. For a spadefoot that spends much of its adult life stage underground or foraging at night, a color variation may not incur negative consequences. As larvae, leucism may be maladaptive in that visual predators may be able to focus on a single specimen that is unable to blend into pond substrates (Endler 1978. *Evol. Biol.* 11:319–364). *Spea hammondii* is a declining species and was recently proposed for listing as threatened under the federal Endangered Species Act. Any confounding contributions to its decline should be recognized and, if needed, further investigated.

Westervelt Ecological Services granted access to their property in Madera County and supported the fieldwork for this project. Francesca Canizzo, Kimberly Comer, Marina Olson, Maresa Scofield, Melony Wood, Brighton Heard, Greg Webber, Keyanna Pinto, and Amy Hernandez assisted with field collections. The Wildlife Project offered support for the preparation of the manuscript.

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**TRACHYCEPHALUS TYPHONIUS (Veined Treefrog). NECROPHILIA.** *Trachycephalus typhonius* is a hylid found in Brazil, French Guiana, Guyana, and Suriname (Frost 2024. *Amphibian Species of the World: an Online Reference*, Version 6.1; <https://amphibiansoftheworld.amnh.org>, 25 May 2024). *Trachycephalus typhonius* are robust, with a coloration ranging from gray to reddish-brown, with males having lateral vocal sacs located behind the jaws (Mora et al. 2022. *Rev. Latinoamer. Herpetol.* 5:91–97). Members of this genus are explosive breeders, commonly found in large mating aggregations around water bodies after rainfall (de Moura and Loebmann 2014. *Herpetol. Bras.* 3:60–61). Necrophilia is a reproductive behavior that involves sexual interactions between living males and a dead partner (either females or males) (Pintanel et al. 2021. *Neotrop. Biodivers.* 7:53–56). This interaction frequently occurs among anurans, especially during peak reproductive periods, when males accidentally drown females during amplexus (de Moura and Loebmann 2014, *op. cit.*).

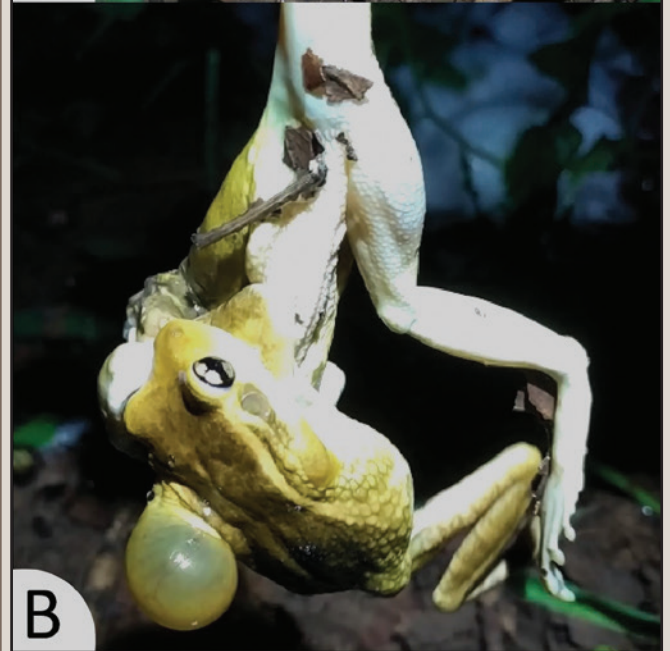
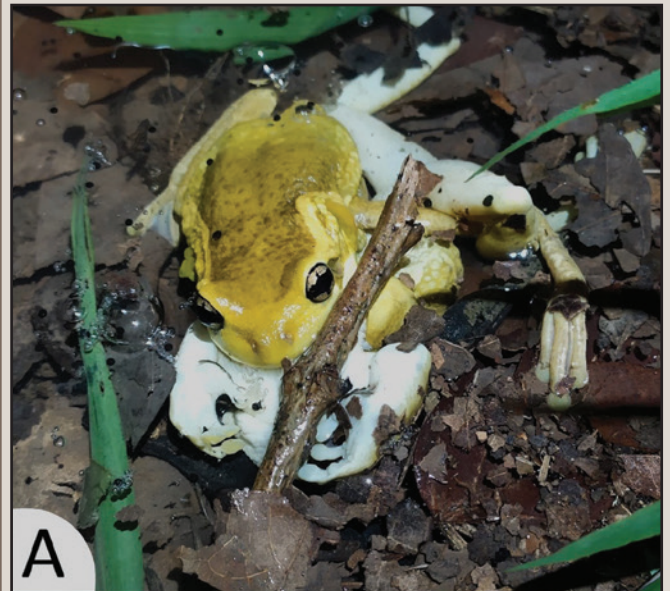


FIG. 1. A) Male and dead female *Trachycephalus typhonius* when first observed in Ceará, Brazil; B) A male *T. typhonius* vocalizing during female manipulation.

On 29 February 2024, at 0317 h, in the Municipality of Guaramiranga, Ceará, northeastern Brazil (4.22015°S, 38.95479°W; WGS 84), we observed a male *T. typhonius* in amplexus with a dead female. Both specimens were collected and housed at the Museu de História Natural do Ceará Prof. Dias da Rocha (female: MHNCE-A759; male: MHNCE-A760). During the field expedition, we visited the pond twice. On the second visit, we noticed the remains of four individuals of *T. typhonius* at the margin. One of them was a headless female, which was held tight by a living male in a ventral amplexus (Fig. 1). The male refused to release the female even under manipulation, emitting a distinct vocalization. The interaction with the observer lasted for about 90 s, after that, the male realized the observer's presence, released the female, and jumped into the water. Necrophilia in anurans is well-documented in the literature and appears to be

particularly common in the genus *Trachycephalus* (de Moura and Loebmann 2014, *op. cit.*; Pintanel et al. 2021, *op. cit.*). Our record is unprecedented because this individual was found in amplexus with a headless female. Based on this observation, it seems that *T. typhoni* goes through an intense reproductive frenzy, where additional factors, possibly hormonal, may influence their reproductive behavior.

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**ZHANGIXALUS ARBOREUS** (Forest Green Tree Frog). **NEST HEIGHT.** *Zhangixalus arboreus* spawns by building foam nests on the tips of tree branches up to 5 m above ponds, rice fields, marshes, and reservoirs (Matsui and Maeda 2018. Encyclopedia

of Japanese Frogs. Bun-ichi Sogo Shuppan Co., Ltd., Tokyo, Japan. 271 pp.). Here, we report the highest nesting sites for *Z. arboreus* to date. The site is located among mountains in Shizuoka City, Shizuoka Prefecture, Japan (35.0700°N, 138.2119°E; WGS 84; 780 m elev.). The breeding pond (ca. 10.8 m in length, ca. 5.3 m wide, ca. 1.1 m water depth) was mainly surrounded by planted *Cryptomeria japonica* (Japanese Cedar), *Hovenia trichocarpa* (Japanese Raisin Tree), and by bamboo, which was only on the south side. Vegetation height around the pond is about 20 m (Fig. 1). We found at least 20 *Z. arboreus* foam nests on both *C. japonica* and *H. trichocarpa* during a 36-d survey (28 May–2 July 2023). The highest nest was produced on the tip of a branch of *H. trichocarpa*. The seven highest foam nests averaged 15.8 m above the ground (range: 15.1–16.5 m). We measured the height of the nesting sites from the foam nests to the water surface using a laser meter (BOSCH GLM 50-23G) and a double Pythagorean theorem. This is a new record for the height of foam nests for *Z. arboreus*. Even the lowest foam nests were about 8 m above the pond on *C. japonica*.

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#### TESTUDINES — TURTLES

**CHELONOIDIS CARBONARIUS** (Red-footed Tortoise). **NECROPHAGY.** The Red-footed Tortoise (*Chelonoidis carbonarius*) is a terrestrial species native to tropical forests and savannas of northern South America (Uetz et al. [eds.] 2024. The Reptile Database; <http://www.reptile-database.org>, 4 Jul 2024). This tortoise has an omnivorous diet consisting of plant materials (e.g., various fruits, flowers, and leaves) and animal foods such as invertebrates (e.g., insects, millipedes, snails) and vertebrates, typically in the form of carrion (Wang et al. 2011. S. Am. J. Herpetol. 6:11–19). Here, we report a *Chelonoidis carbonarius* consuming a deceased marsupial (*Philander canus*).

On 2 July 2024, during survey fieldwork at Mara Rosa, Goiás, Brazil (13.96941°S, 49.18934°W; SIRGAS 2000; 406 m elev.), we observed a *C. carbonarius* consuming a *Philander canus* (Common Four-eyed Opossum) carcass (Fig. 1). This was most

PHOTO BY MAYU ASADA



FIG. 1. Breeding site (shown by black arrow) of *Zhangixalus arboreus* in Shizuoka City, Shizuoka Prefecture, Japan. The height of the man in the photo is 183 cm.



FIG. 1. *Chelonoidis carbonarius* consuming *Philander canus* carcass in Mara Rosa, Goiás, Brazil.

likely an act of scavenging an already dead animal, but this observation is apparently the first record of the Red-footed Tortoise consuming this opossum species (Wang et al. 2011, *op. cit.*). This report contributes to the knowledge of the trophic ecology and natural history of *C. carbonarius*.

We thank DBO Engenharia for logistics support during the fieldwork. Special thanks to Elias Gonzaga, Kesley Lemes, André Luis for additional support during the fieldwork.

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**CHELUS FIMBRIATA (Amazon Matamata). POPULATION.** One of the most unique freshwater turtles in the South American chelid *Chelus fimbriata* (Pritchard 2008. Chelon. Resear. Monogr. 5:1–10). Until recently this was the only recognized living species in the genus; however, in 2020, Vargas-Ramirez et al. (2020. Mol. Phylogenet. Evol. 148:106823) described the Orinoco Matamata, *C. orinocensis*. Despite its easily distinguishable characteristics, few studies have been conducted on the species' ecology (Cunha et al. 2021. Chel. Conserv. Biol. 20:109–115). *Chelus fimbriata* has not appeared to have large populations in the areas where it occurs. However, information about this species is still scarce due in part to the difficulty of capturing these animals in the wild.

The data below is based on studies in an area between the towns of Barcelos and Santa Isabel do Rio Negro in the middle Rio Negro Basin, Amazonas, Brazil. This area is characterized by a diverse array of aquatic habitats, including small streams, tributaries of the Rio Negro, interfluvial swamps, lakes, and flooded forest areas, locally known as “igapó.” The climate is tropical-humid, with seasonality reflected in the river’s hydrology. River levels fluctuate in response to seasonal precipitation variations, a phenomenon known as the flood-pulse (Junk et al. 1989. Can. J. Fisher. 106:110–127). Large rivers like the Rio Negro and their associated aquatic systems, including the seasonally flooded igapó, exhibit a monomodal flood-pulse pattern. This research was intended to increase knowledge on Matamata population structure, contributing to a better understanding of the biology and ecology of this species.

Between 24 February and 3 March, 2014, 27 individuals (Fig. 1) were largely captured by manual free diving. Additional animals were captured at night using the regional method called “*Jaticá*” (a long-handled harpoon used for turtle fishing by locals; although we did not observe its use, it is likely that the method causes injuries to the animal) The turtles were captured in four distinct environments, with the majority being captured in a lake. All the captured turtles were adults, consisting of 26 adult males and one adult female, distributed as follows: 11 individuals in Lake Ariaú, nine in the Babi Stream, five in the Urupaú Stream, one in the Floresta Community, and one in the Daulai Stream. In the Floresta

Community, a hatchling was also observed (Fig. 2). The males measured on average 347.4 mm SCL (N = 26; range: 265–384 mm); 272.5 mm SCW (range: 214–311 mm); 302.0 mm SPL (range: 232–340 mm); 103.1 mm head width (range: 84–117 mm), with an average weight of 5.2 kg (range: 2.3–7.8 kg); the males are very similar in terms of size and body condition. The only female measured 359 mm SCL, 294 mm SCW, 315 mm SPL, 111 mm head width, and weighed 5.9 kg. The animals were measured, weighed, photographed, marked, and returned to the wild, except for five individuals (INPA-H34099, 35617, 35943, 36848, and 35944) that were deposited in the Herpetological Collection of the National Institute of Amazonian Research (INPA), Manaus, Amazonas, Brazil.



FIG. 1. *Chelus fimbriata* captured in the middle Rio Negro region, Amazonas, Brazil.



FIG. 2. Hatchling *Chelus fimbriata* from Floresta Community, Amazonas, Brazil.

PHOTOS BY FÁBIO CUNHA

TABLE 1. Limnological variables (pH, dissolved oxygen, temperature, electric conductivity, and dissolved organic carbon [DOC]) and coordinates of the three sampling sites in the middle Rio Negro region, Amazonas, Brazil.

Sites	pH	Dissolved oxygen (mg/L)	Temperature (°C)	Electric conductivity (µS/cm)	DOC (mg/l)	Latitude	Longitude	Elevation (m)
Ariaú Lake	4.9	2.1	27.1	13.7	9.8	0.24194°S	63.97889°W	33
Urupaú Stream	4.7	3.7	26.3	18.1	12.0	0.23889°S	63.00222°W	45
Babi Stream	5.3	4.2	27.5	10.8	8.2	0.24278°S	63.06444°W	47

The three sites with the most significant captures are located ca. 10 km from each other, which was considered a small perimeter for the number of animals within the studied population. Details regarding the limnological characteristics of the capture locations are provided in Table 1. The observed sexual pattern of 26:1 (M:F) is likely associated with the species' reproductive cycle. These captures occurred approximately seven months before the low-water minimum, typically in November in the region, and nesting is timed to ensure that the hatchlings emerge during this time. The species' incubation period is around 200 days. This phenomenon is mentioned in Mendizábal and Correa-Viana (2015. Mem. Fund. La Salle. Cien. Nat. 72:177–178) and Vogt (2008. Turtles of the Amazon. Wust Ediciones, Lima, Peru. 104 pp.). Information on the biology and ecology of freshwater turtle species in the Amazon can contribute to formulating critical conservation strategies, especially in areas with significant anthropogenic impact on habitats.

This study complied with relevant national and international legislation and guidelines for the capture and collection of fauna (Biodiversity System, Chico Mendes Institute for Biodiversity Conservation/MMA SISBIO/ICMBio N° 59171).

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**GLYPTEMYS INSCULPTA (Wood Turtle). MORTALITY.** The detrimental effects of high mortality rates on population viability may not be immediately evident in species with delayed sexual maturation and long lifespans. Here, we report an alarmingly high mortality rate for a population of Wood Turtles (*Glyptemys insculpta*) at a study site in Michigan, USA (precise location withheld for conservation purposes), over a two-month timespan. From June–August 2022 we observed mortality in six adult *G. insculpta*, involving two females on 16 June, three males on 18–26 July, and one female on 22 August. Five individuals were part of a telemetry study analyzing movement ecology and all were observed alive and healthy 2–3 d prior to their death. Notably, all five telemetered individuals were decapitated and missing limbs and internal organs. However, the shells were found intact with no abnormal scratches or markings and VHF transmitters still attached. One female on 16 June was not part of the study but had previously been scute notched and was gravid. This female was the victim of a vehicle collision around 1100 h while using the road to move into upland habitat, presumably in search of a nesting site.

Raccoons, opossums, mink, weasels, and river otters inhabit this area though none were directly observed during the time of our observations. The predator(s) was dexterous enough to decapitate and remove organs and tissues while leaving no shell markings and large enough to overpower adults. Four of the five telemetered *G. insculpta* were found in mesic northern forest habitat (ca. 180, 183, 188, and 329 m from the river) and one was found within riparian habitat (ca. 74 m from the river). We believe the predator adapted to the presence of prey which was evident during the 9-d span when the three males were predated in the same vicinity. A subset of telemetered *G. insculpta* at this site were regularly recorded moving into upland forested habitat during or after rain events and were more vulnerable as upland habitat in this study site lacks the abundance of refugia found in riparian habitats. Few publications have assessed the causes and

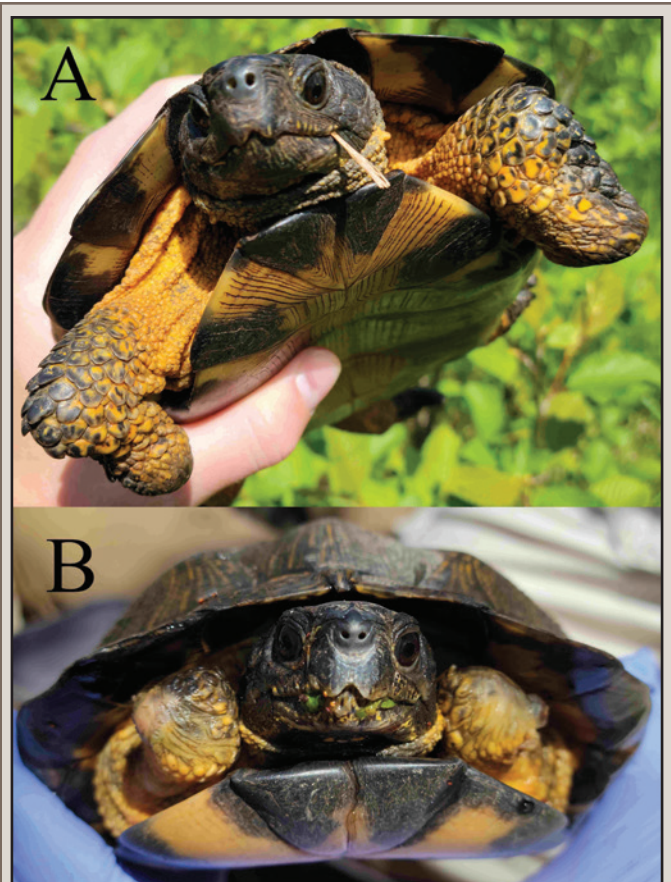


FIG. 1. Two old *Glyptemys insculpta* predated in 2022 in Michigan, USA: A) male 146 who was missing both front feet, annuli count 22+, carapace length 205 mm; B) female 166 who was missing most of both front legs, annuli count 19+, carapace length 183 mm.

effects of predation on adult *G. insculpta* as compared to studies of road and agricultural fatalities or nest predation. We have not found literature records of such a high level of predation for the species over a short time period; the most similar instance was eight individuals predated between March and October from 2012–2015 in Iowa (Lapin et al. 2019. Herpetol. Conserv. Biol. 14:668–679).

Of the 63 *G. insculpta* encountered during our study, 41% (N = 26) possessed stub tails, carapacial damage (cracks or missing pieces), or missing limbs (partial or entire) that were old, healed injuries. This indicates a reoccurrence of predation events in this area that is affecting this population. Similar predation effects have been recorded in Michigan, noticeably increasing over time, during a study in the 1980s, with Northern Raccoons (*Procyon lotor*) being the primary suspect (Harding 2008. World Chelon. Trust Newsl. 3:1–4). At our site, two of the mortalities were among the oldest individuals in the study group and both notably lacked portions of both front feet from previous predation events, hindering their ability to defend themselves or turn themselves over if flipped on their back (Fig. 1). As shown through earlier research and with the present study, *G. insculpta* with old injuries can overcome the limitations of limb loss if mobility is not completely compromised, indicating some resilience to non-lethal predation, though these turtles do exhibit greater vulnerability and long-term mortality than uninjured conspecifics (Harding 1985. Herpetol. Rev. 16:30).

*Glyptemys insculpta* exhibit long lifespans and delayed maturation which amplifies the negative effects of any loss to a population (Gibbons et al. 2000. *BioScience* 50:653–666). The Kaplan-Meier survival estimate for this population using telemetry data (not including the road mortality) is 0.875 (CI: 0.727–1.00), which is unsustainable for this site (Methner 2022. M.S. Thesis, Grand Valley State University, Allendale, Michigan. 95 pp.). This level of predation over a relatively short time span, combined with the effects of road mortality and nest predation, will likely lead to local extirpation of *G. insculpta*. We recommend further monitoring and assessment of predation risk for *G. insculpta* and quantifying predator abundance in turtle habitats, to assess the impact of predation on population stability.

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**HEOSEMYS GRANDIS (Giant Asian Pond Turtle). DIET.** *Heosemys grandis* is a large (48.0 cm maximum straight carapace length [SCL]), semi-aquatic geoemydid turtle species found across the southeast Asian mainland in Cambodia, Laos, Malaysia, Myanmar, Thailand, and Vietnam (Turtle Taxonomy Working Group 2021. *Chelonian Res. Monogr.* 8:1–472). Although widely distributed, there have been no publications to date on its diet in the wild. In captivity, this omnivorous species is known to consume nearly anything it is offered, including fruits, vegetables, meat, and fish.

On 26 May 2024 at 1341 h, we observed an adult male *H. grandis* biting at and consuming the foam nest of *Polypedates megacephalus* (Big-headed Treefrog; Anura: Rhacophoridae) in a captive enclosure at Cuc Phuong National Park, Ninh Binh Province, Vietnam. *Polypedates* is a genus of frogs collectively known as whipping frogs due to the characteristic foam nests in which their eggs are laid. In this case, a *P. megacephalus* suspended its nest above the concrete pond of the *H. grandis* enclosure at the Turtle Conservation Centre—an ex-situ conservation facility jointly operated by Cuc Phuong National

Park and Indo-Myanmar Conservation's Asian Turtle Program (Fig. 1). One *H. grandis* was able to position itself, with some difficulty, at the edge of the pond and reach the arboreally suspended nest to take several bites of the foamy contents. This, to our knowledge, is the first documentation of this behavior, as well as the first time the lead author has seen this occur in nearly a decade of working at this facility. This observation demonstrates that *H. grandis* is capable of consuming frog eggs in suspended foam nest.

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**LEPIDOCHELYS KEMPII (Kemp's Ridley Sea Turtle). NEST SITE FIDELITY.** Sea turtles demonstrate nesting site fidelity, typically returning to their natal beach to nest as adults (Miller 1997. *In* Lutz and Musick et al. [eds.], *The Biology of Sea Turtles* Volume I, pp. 51–82. CRC Press, Boca Raton, Florida). This behavior can provide insight on nesting populations and the movements of females within those populations. *Lepidochelys kempii* is the most critically endangered sea turtle in the world (Wibbels and Bevan 2019. *IUCN Red List of Threatened Species* 2019: e.T11533A155057916, 3 Sept 2024). This species has a very limited nesting range, with the majority of the population nesting at one primary beach near Rancho Nuevo, Tamaulipas, Mexico, with secondary nesting beaches in south Texas, USA (Pritchard and Marquez 1973. *IUCN Monograph* No 2: *Marine Turtle Series*, 30 pp.; Hildebrand 1982. *In* Bjorndal [ed.], *Biology and Conservation of Sea Turtles*, pp. 447–453. Smithsonian Institution Press, Washington, D.C.; Miller 1997, *op. cit.*).

These secondary nesting beaches primarily consist of North Padre Island (spanning Nueces, Kleberg, Kenedy, and Willacy counties; NPI), South Padre Island (across Willacy and Cameron counties; SPI), and Boca Chica Beach (BCB) in Cameron County (Fig. 1; Shaver et al. 2016. *Gulf Mex. Sci.* 33(2):158–178; Shaver et al. 2020. *Herpetol. Notes* 13:907–923). NPI, SPI, and BCB host 86.1% of all *L. kempii* nests documented in Texas (1979–2024) and are the only major nesting sites for *L. kempii* in the USA. Therefore, understanding site fidelity on, and movements between, these three south Texas beaches is critical to understanding the nesting behaviors of *L. kempii* within the USA.

Boca Chica Beach represents the southernmost nesting beach for *L. kempii* in the USA. Since 1979, 158 *L. kempii* nests have been documented on BCB, though this number is likely an underestimate as BCB was intermittently patrolled 3–5 days per week until 2021, when efforts increased to seven days a week. Of these 158 nests, 21 nests have been attributed to five high-fidelity females who have been documented nesting exclusively on BCB. These 21 nests represent 13.3% of all *L. kempii* nests laid on BCB.

The five high-fidelity females were identified through Inconel tags (National Band and Tag Company, Newport, Kentucky, USA), passive integrated transponder (PIT) tags (Biomark, Boise, Idaho, USA; ADEQID BM Technologies, Coventry, England, UK), and/or kinship analysis, wherein unobserved females were assigned to nests via genetic analysis of tissue samples collected from dead embryos and hatchlings (Frey et al. 2014. *Endanger. Species Res.* 23:63–71). Two additional females were initially matched to nests laid on BCB in 2005 and 2006, however after inclusion of additional genetic material from recent years, those



FIG. 1. *Heosemys grandis* reaching out over a captive pond to consume the foam nest and eggs of *Polypedates megacephalus* in Ninh Binh Province, Vietnam (A) and a close-up view of the predation event on the arboreally suspended nest of *P. megacephalus* (B).

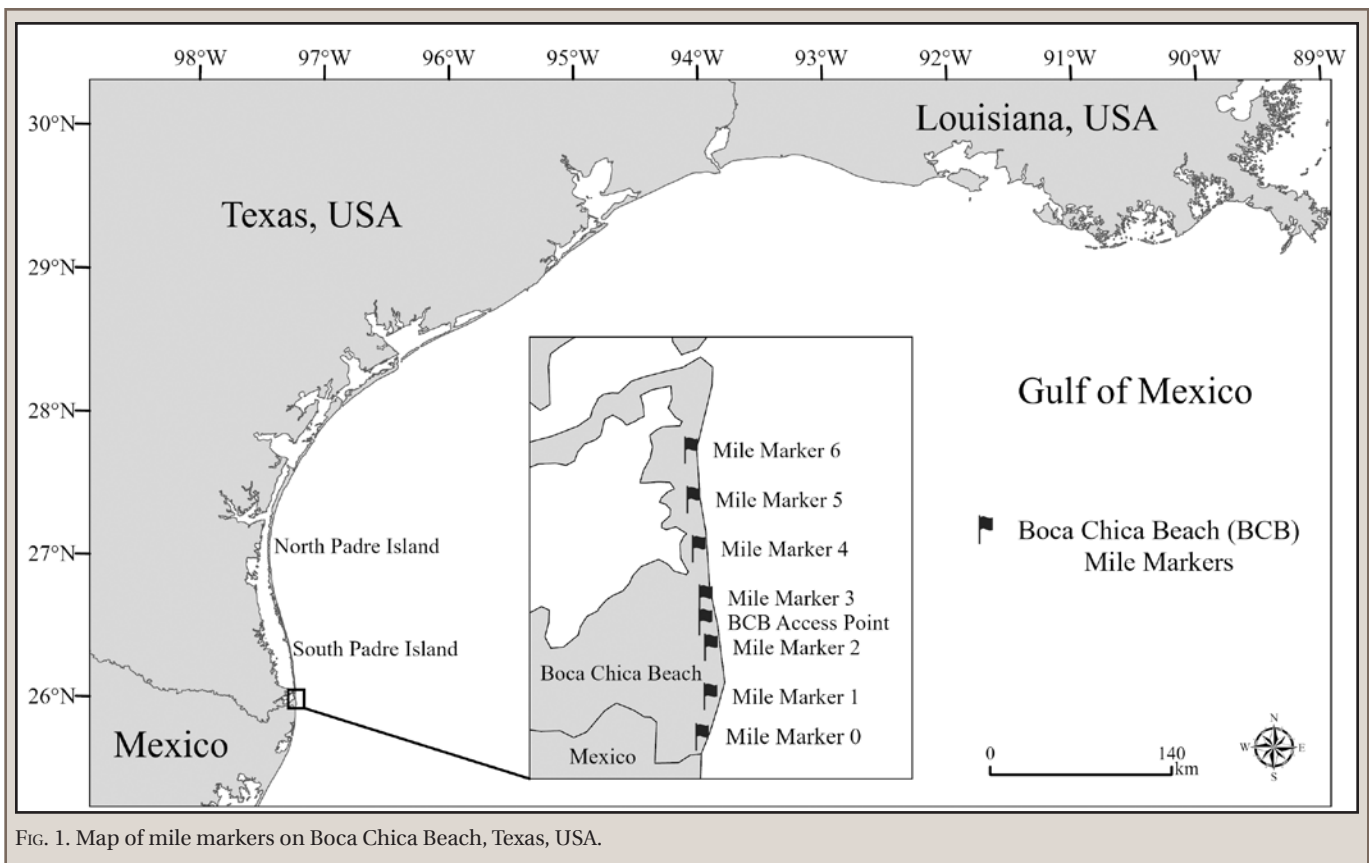


FIG. 1. Map of mile markers on Boca Chica Beach, Texas, USA.

initial results are no longer conclusive, and the two females were not included in the analysis.

Turtle #111 was the most prolific nester of the five females, laying nine nests on BCB between 2004–2022, with an average clutch size of  $108.9 \pm 15.3$  eggs (Table 1). This female was observed during 66.7% (6/9) of her nesting events. Of the nine nests, three nests were laid consecutively during 2022. During nest #2, this female abandoned three chambers before laying in the fourth chamber. Hatching success for Turtle #111's nests was high during the 2008–2010 season ( $93.8 \pm 2.3\%$ ) but then decreased to  $76.5 \pm 10.2\%$  during the 2012–2018 seasons, and even further to 0% in 2022. The nine nests had a mean hatching success of 58.7% and of these, the six nests that hatched had a mean incubation period of  $49.8 \pm 1.9$  days.

Turtle #273 laid the second highest number of nests ( $N = 5$ ) on BCB, with an average clutch size of  $106.6 \pm 8.2$  eggs (Table 1). This female was observed during 60.0% (3/5) of her nesting events recorded between 2007–2017. Mean hatching success for the female's five nests was 77.8% and mean incubation period was  $48.2 \pm 1.3$  days. The remaining three high-fidelity females laid fewer nests on BCB: Turtle #639 laid three nests on BCB between 2017–2018 while Turtles #159 and #571 each laid two nests on BCB between 2007–2008 (Turtle #159) and in 2017 (Turtle #571). Observation frequencies for these females during nesting events ranged from 33.3% (1/3) to 100% (2/2). Hatching success of these females' nests ranged between 0–98.1%, and mean incubation period varied between 48.0–51.0 days (Table 1).

As part of the ongoing, long-term, mark-recapture efforts to establish *L. kempii* population level parameters, straight (SCL) and curved (CCL) carapace length measurements were recorded for every female observed nesting in Texas. Maximum and minimum SCL and CCL measurements were recorded during

the first yearly encounter of every female unless time and/or equipment did not allow for full documentation to be completed during that nesting event. Attempts were then made at each subsequent encounter to obtain any remaining measurements.

Carapace measurements of the five high-fidelity females were recorded at varying degrees of completion. Curved minimum carapace measurements were recorded during six encounters with Turtle #111, both encounters of Turtle #159, three encounters for Turtle #273, neither encounter for Turtle #571, and one encounter for Turtle #639 (Table 2). The five high-fidelity nesting females demonstrated a remigration interval of  $2.73 \pm 1.6$  years. Of the females that demonstrated more than a year interval between nesting seasons, their remigration intervals have generally increased since 2010 (with the exception of Turtle #639, which was identified only in 2017 and 2018, and hasn't been identified since 2018).

Only one paved road provides access to BCB, and historically nesting was geographically described as either north or south of this access road. In 2022, mile markers were placed along the beach to provide more detailed beach locations and better align with location recording practices already in place across NPI and SPI beaches. These mile markers divide BCB into 7 sections: mile 0 starting at the Rio Grande at the southern end of the beach (USA/Mexico border) and mile 6 at the northern end of the beach (closest to SPI).

To investigate historic use of BCB by nesting *L. kempii*, the GPS locations of nests recorded prior to the installation of mile markers on BCB were retro-actively matched to the new mile marker locations established in 2022. Then, BCB mile markers were assigned to all nests laid by the high-fidelity females on BCB. In terms of site fidelity, Turtles #159 and #639 exhibited similar behavior; both laying nests at opposite ends of BCB (mile

TABLE 1. Summary of nesting, incubation, and hatching information for the 21 high-fidelity *Lepidochelys kempii* nests documented on Boca Chica Beach, Texas, USA, including the nest number by female, lay date, clutch size, percent hatched, and total number of incubation days. \*The date of first emergence was used for clutches split into multiple nest chambers.

Nest no.	111			159			273			571			639							
	Lay date	Clutch size	Hatch %	No. ID*	Lay date	Clutch size	Hatch %	No. ID*	Lay date	Clutch size	Hatch %	No. ID*	Lay date	Clutch size	Hatch %	No. ID*				
1	11 May 2004	116	76.7	48	27 June 2007	114	0	-	7 June 2007	102	71.6	47	26 April 2017	109	94.5	52	8 May 2017	115	70.4	49
2	18 May 2006	119	93.3	48	16 May 2008	105	98.1	48	27 May 2009	105	95.2	47	15 May 2017	103	90.3	50	30 April 2018	105	88.6	52
3	28 June 2008	118	91.5	53	-	-	-	-	10 June 2012	101	76.2	49	-	-	-	-	5 June 2018	76	85.5	46
4	2 June 2010	129	96.1	50	-	-	-	-	11 May 2017	104	98.1	50	-	-	-	-	-	-	-	-
5	5 May 2012	98	86.7	51	-	-	-	-	26 May 2017	121	62.0	48	-	-	-	-	-	-	-	-
6	17 May 2018	89	66.3	49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	5 June 2022	83	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	24 June 2022	116	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	13 July 2022	112	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean	-	108.9	58.7%	49.8	-	109.5	46.6%	-	-	106.6	77.8%	48.2	-	106.0	92.5%	51.0	-	98.7	80.1%	49.0

TABLE 2. Summary of remigration intervals, curved maximum carapace measurements, and observation method for the 21 high-fidelity *Lepidochelys kempii* nests documented on Boca Chica Beach, Texas, USA.

Nest no.	111			159			273			571			639		
	Remig. interval (y)	Carapace size (cm)	Obs. Method	Remig. interval (y)	Carapace size (cm)	Obs. Method	Remig. interval (y)	Carapace size (cm)	Obs. Method	Remig. interval (y)	Carapace size (cm)	Obs. Method	Remig. interval (y)	Carapace size (cm)	Obs. Method
1	-	-	Genetics	-	67.9	M-R	-	-	Genetics	-	-	M-R	-	-	Genetics
2	2	72.0	M-R	1	67.5	M-R	2	68.7	M-R	-	-	M-R	1	67.5	M-R
3	2	-	Genetics	-	-	-	3	70.4	M-R	-	-	-	-	-	Genetics
4	2	74.9	M-R	-	-	-	5	70.0	M-R	-	-	-	-	-	-
5	2	-	Genetics	-	-	-	-	-	Genetics	-	-	-	-	-	-
6	6	75.0	M-R	-	-	-	-	-	-	-	-	-	-	-	-
7	4	75.0	M-R	-	-	-	-	-	-	-	-	-	-	-	-
8	-	74.9	M-R	-	-	-	-	-	-	-	-	-	-	-	-
9	-	75.5	M-R	-	-	-	-	-	-	-	-	-	-	-	-
Mean	3.0	74.6	-	-	67.7	-	3.3	69.7	-	-	-	-	-	-	-

0 and mile 6). Turtles #273 and #571 nested across BCB, with nest locations ranging from mile 0 to mile 5. All nests by Turtle #111 were laid within miles 5 and 6. Across all 21 high-fidelity nest sites, the majority of nests (85.7%) were laid at the either the northern or southern ends of BCB (i.e., miles 0–1 or 5–6).

Sea turtle nesting site fidelity can provide local and population-wide insights on the nesting population. Turtle #111 is the first BCB exclusive nester to be documented since 2018. Identification via observation of tags and genetic sampling indicate these five females have not nested at other beaches in Texas. Due to the intermittent nature of nesting patrols on BCB prior to 2021, the five high-fidelity females may have nested there with greater frequency but either nested undetected or were not genetically matched to clutches laid there if hatchlings emerged, or nest contents were lost before genetic samples could be acquired.

Future research to expand the genetic sampling of nesting females at the primary nesting site in Mexico could generate insight on the importance of BCB as a secondary nesting site by females nesting at the primary nesting beach. The five turtles documented nesting exclusively at BCB during the study period may also be nesting at other beaches, including those in Tamaulipas, Mexico. Additionally, nesting at the southern end of BCB (miles 0–1) suggests these high-fidelity females could be utilizing the beach located directly across the Rio Grande (USA–Mexico border) from BCB. The high-fidelity of these five females to BCB indicates the intensive, mandated work being done in south Texas to protect the nesting habitats, females, and nests of this endangered species is critically important for the future of the secondary nesting colony that is becoming established in south Texas (Shaver et al. 2020, *op. cit.*). Continuation and strengthening of the on-going mark-recapture program and routine patrols to detect nesting turtles and their nests in Texas is required to protect the significant portion of *L. kempii* turtles in the USA that utilize south Texas as nesting habitat.

All activities (nest detection, relocation, monitoring, tagging, sampling, and photographing) were conducted under state (Texas Parks and Wildlife Department Scientific SPR-0412-044; SPR-0190-122) and federal (U.S. Fish and Wildlife Service Endangered Species PER0013385; ES840727) permits, with ethical approval from the National Park Service Institutional Animal Care and Use Committee (201909289).

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**MESOCLEMMYS RANICEPS (Amazon Toad-headed Turtle). PHENOTYPIC CHANGE.** For nearly two decades, the question of the validity of *Mesoclemmys heliostemma* (McCord et al. 2001. Rev. Biol. Trop. 49:1–57) in relation to that of *Mesoclemmys raniceps* has been a source of uncertainty. *M. heliostemma* was (likely incorrectly) “revalidated” by Molina et al. (2012. Zootaxa 3575:63–77) and was the focus of a purported distribution extension by Morcatty and Cobra (2015. Herpetol. Rev. 46:381–382). A notable publication described a range extension of the two taxa in sympatry, with the color morph “*M. heliostemma*” on the right margin of the Jutafí River and *M. raniceps* on the left margin of the Jutafí River, both in the Municipality of Jutafí, Amazonas, Brazil (Morcatty and Cobra 2015, *op. cit.*; Morcatty 2015. Herpet. Rev. 46:382).

Cunha et al. (2019. Chelon. Conserv. Biol. 18:195–205) attempted to clarify the uncertainty by presenting results on the reproductive biology of *M. raniceps*, where a clutch from a known female *M. raniceps* resulted in hatchlings with morphological

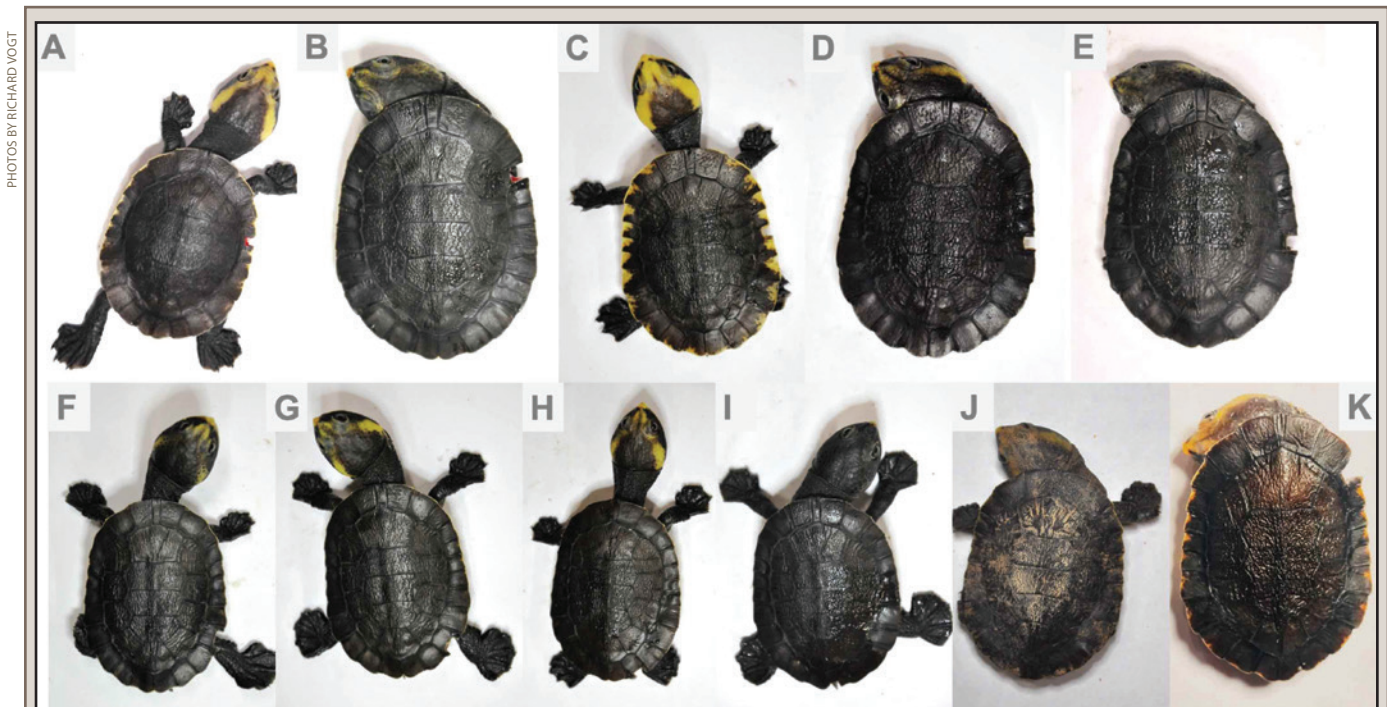


FIG. 1. A–K) Hatchlings of *Mesoclemmys raniceps* incubated at room temperature in Manaus, Amazonas, Brazil. Note individual I, the only completely black hatchling from the same clutch.

A–D: PHOTOS BY COURTESY OF COMMUNITY MEMBERS; E: PHOTO BY WELLINGTON COELHO

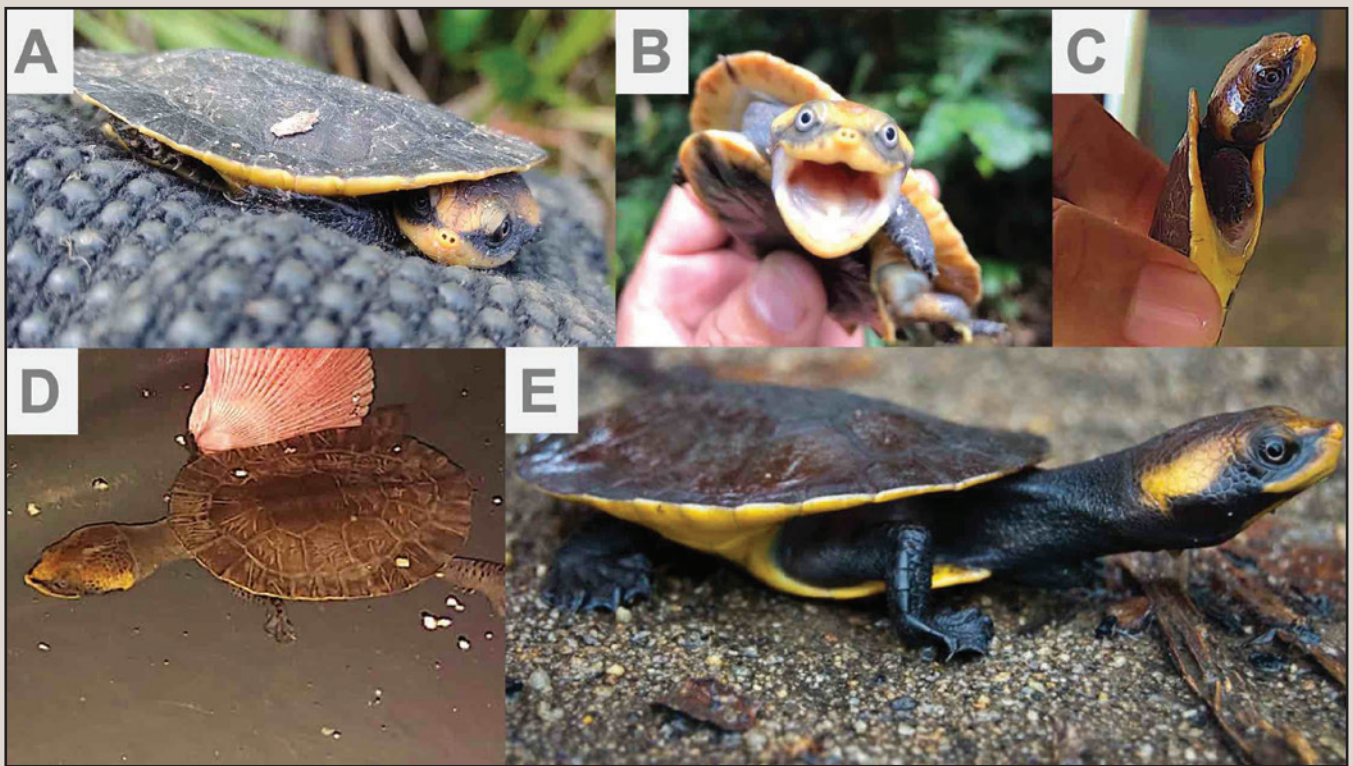


FIG. 2. A–D) Hatchlings of *Mesoclemmys raniceps* found by community members in the rural area of Juruti Municipality, west of Pará, Brazil (2.40577°S, 56.05918°W; WGS 84; 83 m elev.); E) hatchling found in the Municipality of Trairão, West of Pará, Brazil (4.71029°S, 55.99469°W; WGS 84; 168 m elev.).

A, B) PHOTOS BY VICTOR VASCONCELOS; C–H: PHOTOS BY FÁBIO CUNHA

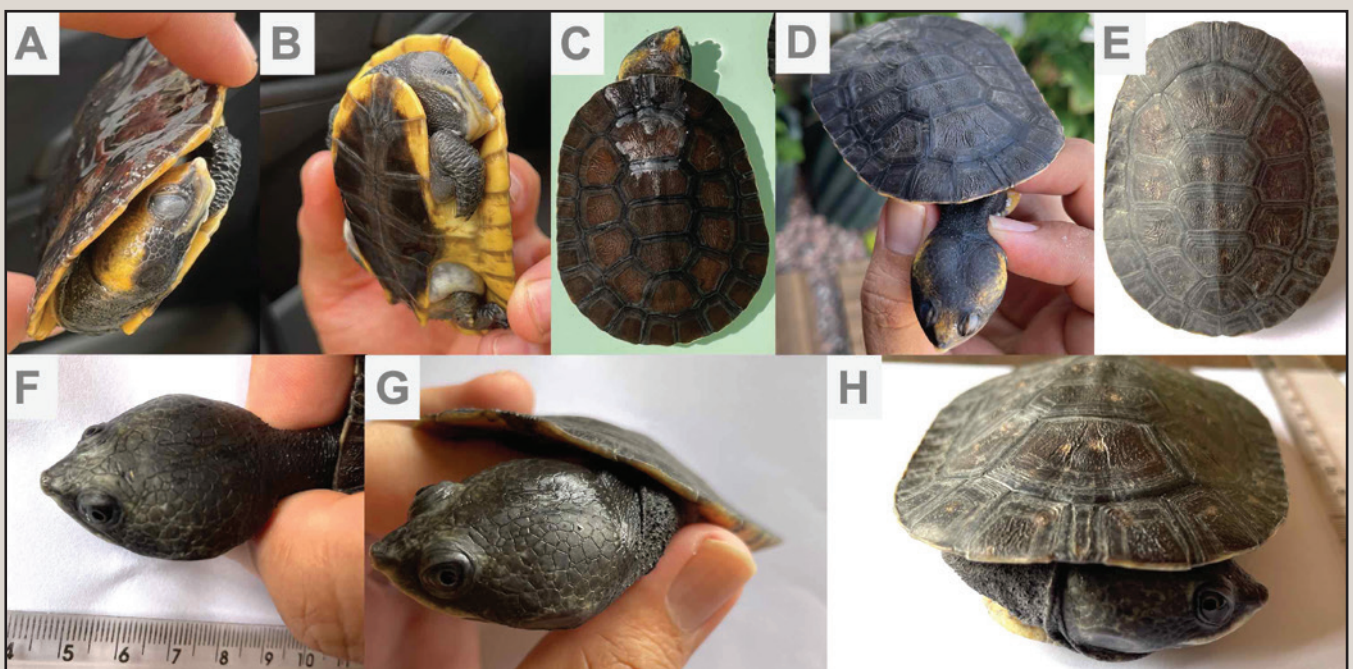


FIG. 3. *Mesoclemmys raniceps* found in Guajará Municipality, southwestern Amazonas, Brazil (7°17'S, 72°36'W; WGS 84; 176 m elev.): A, B) hatchling with prominent yellow-orange facial stripes, 30 May 2023; C, D) the same animal on 16 June 2023, showing slightly faded yellow-orange facial stripes; E–H) the same animal (113 mm SCL) without any yellow-orange facial stripes on 28 May 2024.

characteristics and coloration of both *M. raniceps* (entirely black; Fig. 1) and the morph color “*M. heliostemma*” phenotype with orange-yellow facial stripes (Fig. 1). As a result, “*M. heliostemma*” has been synonymized under *M. raniceps* since then, as noted by

the Turtle Taxonomy Working Group (TTWG) (2021. *Chelonian Res. Monogr.* 8:1–472). Nevertheless, as mentioned by Gallego-Garcia et al. (2023. *Zootaxa* 5263:566–574), some authors still recognize the purported taxon “*M. heliostemma*.”

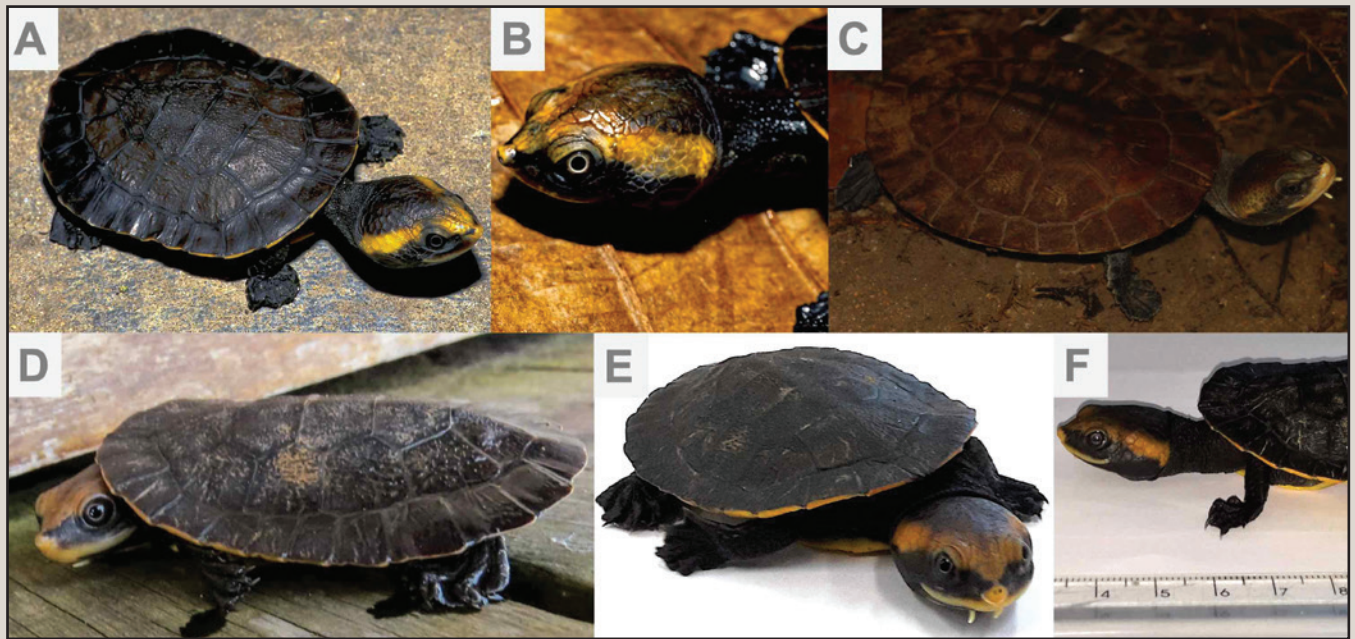


FIG. 4. A, B) Paratype RMNH 31998 of *M. raniceps* morph color “*M. heliostemma*” published in McCord et al. (2001) from the Pico da Neblina region, Amazonas, Brazil; C) hatchling MPEG-1241 from the Tocantins River, Itupiranga Municipality, Pará, Brazil (5.07353°S, 49.31117°W; WGS 84; 119 m elev.); D–F) hatchling (HERPETO 0717) *M. raniceps* morph “*M. heliostemma*” reported by Morcatty and Cobra (2015) from the Jutaf Municipality, Amazonas, Brazil (3.98805°S, 67.82666°W; WGS 84; 68 m elev.).

Here, we present evidence which appears to falsify the interpretation of Gallego-Garcia et al. (2023, *op. cit.*) and supports that of Cunha et al. (2019, *op. cit.*) and TTWG (2021, *op. cit.*). For some species of North American turtles, it is known that environmental variables influence coloration as phenotypic characteristics of the species (e.g., Vogt 1981. Natural History of Amphibians and Reptiles in Wisconsin. Milwaukee Public Museum, Milwaukee, Wisconsin. 205 pp.). The same author described a similar phenomenon for an Amazonian species, without providing many details (Vogt et al. 2020. *Herpetol. Rev.* 51:317).

We present a series of images of juvenile animals exhibiting the morph color “*M. heliostemma*” phenotype (Fig. 2). We provide a temporal series of a *M. raniceps* hatchling that displays vibrant yellow-orange facial stripes in the dorsolateral region of the head, starting at the base of the neck and extending to the tip of the snout (Fig. 3A–D), similar to the paratype RMNH 31998 of morph color “*M. heliostemma*” (Fig. 4A–B, see McCord et al. 2001. *Rev. Biol. Trop.* 49:1–57). This hatchling, collected on 30 May 2023, in the Guajará Municipality of southwestern Amazonas, Brazil (7.28333°S, 72.59999°W; WGS 84; 176 m elev.), still showed this characteristic on 16 June 2023 (Fig. 3A, B). However, one year later, on 28 May 2024, the same animal no longer exhibited the characteristic stripes of the morph color “*M. heliostemma*” phenotype (Fig. 3D–H) and resembled the lack of pattern seen in *M. raniceps*. The hatchling has been in an *ex-situ* condition without constant exposure to light, which may be the potential reason for the coloration change. The fact that individuals with such morphological variation (phenotype: exhibiting bright yellow-orange facial stripes) are found in the same locations as hatchling and adult individuals of *M. raniceps* suggests that variation in the climatic conditions of the incubation microenvironment can influence morphological characteristics and coloration, which are often erroneously used

as diagnostic characters for some species, as discussed by Cunha et al. (2019, *op. cit.*).

Many species of Amazonian turtles have significant knowledge gaps for their natural history, especially pronounced in the genus *Mesoclemmys* and *Phrynops*, with many species being considered species complexes (Carvalho et al. 2022. *Diversity* 14:1–16). Understanding biodiversity is the primary path to conserving ecosystems, and this condition becomes even more important and necessary for tropical ecosystems that are undergoing drastic changes in their natural landscapes, especially in areas with significant anthropogenic landscape alteration.

This study complied with relevant national and international legislation and guidelines for the capture and collection of fauna (Biodiversity System, Chico Mendes Institute for Biodiversity Conservation/MMA SISBIO/ICMBio N° 59171).

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**PODOCNEMIS UNIFILIS (Yellow-spotted Amazon River Turtle). CARAPACE ABNORMALITIES.** Variation in carapace shape, color, and scute pattern has been described for hatchlings of *Podocnemis unifilis* from the Brazilian Amazon region (Cunha and Vogt 2020. *Herpetol. Rev.* 51:581; Cunha et al. 2020. *Herpetol. Rev.* 51:582). However, the causes of these anomalies are not yet well understood. The stability of the scute pattern is linked to the fundamental mechanisms of morphogenesis, ensuring the maintenance of bilateral symmetry and the determination of



FIG. 1. Dorsal view of *Podocnemis unifilis* hatchling with aberrant carapace scutellation and structure from Sabina Community, Murruru River Region, Juruti Municipality, Pará, Brazil.

scute positions by primary embryonic segmentation. The main source of variability is reportedly the presence of vacant septal depressions in turtle embryos, where extraordinary placodes can develop in response to minor disturbances in embryogenesis. These aberrations are quite common and can lead to asymmetry in scutation (Cherepanov 2014. *Paleontol. J.* 48:1–9). It was reported for North American species (*Chrysemys picta* and *Chelydra serpentina*) that non-embryonic variations may be related to a latitudinal gradient; additionally for these species there was no relation to environmental pollution (Davy and Murphy 2009. *Can. J. Zool.* 87:433–439).

The observation reported here occurred in the Municipality of Juruti, in western Pará (Northern Amazon), Brazil. Morphological aberrancy in the carapace was observed in a hatchling *Podocnemis unifilis* on 27 April 2019 in Sabina Community, Murruru River Region (3.35492°S, 56.52464°W; WGS 84; 64 m elev.). The hatchling showed an alteration in the number of marginal scutes of the carapace. Additionally, the left marginal carapace scutes 2–6 were fused together. Significant structural anomalies affected the vertebral and costal scutes. There was a misalignment of the vertebral scutes and the central keel (and presumably the vertebral column) showing a curvature to the right (i.e., scoliosis, Fig. 1). Despite the deformities, the hatchling exhibited behavioral responses of a normal hatchling, therefore it was released along with other (normal) hatchlings from the conservation management program.

This study complied with applicable national and international legislation and guidelines for the capture and collection of fauna (Biodiversity System, Chico Mendes Institute for Biodiversity Conservation/MMA SISBIO/ICMbio N° 59171-6).

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**PSEUDEMYIS PENINSULARIS (Peninsula Cooter) and TRACHEMYS SCRIPTA (Pond Slider). DIET.** *Pseudemys peninsularis* is a mostly herbivorous species found throughout central and southern Florida, USA, and *Trachemys scripta* is an omnivorous, widely distributed species found in both native and nonnative assemblages throughout the USA (Allen 1938.

*Proc. Florida Acad. Sci.* 3:105–108; Bouchard and Bjorndal 2006. *Physio. And Biochem. Zool.* 79:150–158). Both species are commonly observed in both natural and anthropogenically influenced environments throughout their range (Krysko et al. 2019. *Amphibians and Reptiles of Florida.* University of Florida Press, Gainesville, Florida. 728 pp.), and both species have been documented consuming a number of different forms of plant and animal material as a part of their diverse diets (Ernst and Lovich 2009. *Turtles of the United States and Canada.* Johns Hopkins University Press, Baltimore, Maryland. 827 pp.). Here, we report what may be the first documented case of the consumption of the invasive *Ficus microcarpa* (Indian Banyan Fig) by individuals of both *T. scripta* and *P. peninsularis*, in an urban environment.

At ca. 1415 h on 10 October 2023 in Lee County, Florida, CJ observed ca. 15 turtles feeding on fruit falling from a Banyan Fig (later confirmed to be *F. microcarpa* by I. Talty) into the water near the tree. These individuals fed on the fruits for ca. 20 min, when CJ stopped observing. Both species were visually confirmed to partake, but we are unsure of subspecies as both *T. scripta scripta* (Yellow-bellied Slider) and *T. scripta elegans* (Red-eared Slider) have been documented in this particular habitat, with both showing high degrees of melanism (JD, pers. obs.). Additionally, *P. nelsoni* (Florida Red-bellied Turtle) has been observed in the same ponds and could also have been consuming the fruits, but visual confirmation did not occur.

*Ficus microcarpa* is native to eastern Asia and is recognized as category I invasive species in the state of Florida (Florida Invasive Species Council 2023). In its native habitat the fruit of this tree is consumed by different animal species including many birds, mammals, and insects (Wang et al. 2014. *Royal Entom. Soc. Eco. Entom.* 39:492–500; David et al. 2015. *Trop. Ecol.* 56:41–55). Additionally, a number of species have also been documented consuming the fruit of *F. microcarpa* outside of its native range (Silva et al. 2012. *Rev. Agrogeog.* 2012:51–58). *Ficus microcarpa* is understood to be a classic example of a plant adapted for seed dispersal by vertebrates (Kaufmann et al. 1991. *Am. J. Bot.* 78:971–977), and many turtle species have been documented as seed dispersal vectors (Falcón et al. 2020. *Biol. Rev.* 95:142–166), including representatives of the *Trachemys* genus (Kimmons et al. 2010. *Chelon. Conserv. Biol.* 9: 289–294; Johnston et al. 2015. *Florida Acad. Sci.* 78:57–72) and presumably *Pseudemys* given the frequency of seeds in the diets of some populations (Letter et al. 2019. *J. Herpetol.* 53:204–208). Thus, the consumption of *F. microcarpa* by both *Pseudemys* and *Trachemys* might aid in the dispersal of the invasive plant as is seen with other nonnative species (Falcón et al. 2020. *Biol. Rev.* 95:142–166). Overall, this dynamic indicates a potential need for studies to further define the relationship between aquatic turtle species and *F. microcarpa*.

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**RHINOCLEMMYS PULCHERRIMA ROGERBARBOURI (Painted Wood Turtle). NEST and INCUBATION TIME.** Wood turtles of the genus *Rhinoclemmys* are the only representatives in the Americas of the most speciose turtle family Geoemydidae (Le and McCord 2008. *Zool. J. Linn. Soc. Lond.* 153:751–767). There are currently nine recognized species of *Rhinoclemmys*, and a notable feature of the genus is their typically small clutch size, with most species only depositing one or two eggs per clutch (Lovich and Gibbons 2021. *Turtles of the World: a Guide to Every*



FIG. 1. A) A shallow *Rhinoclemmys pulcherrima rogerbarbouri* nest with two eggs found in Sonora, Mexico on 20 November 2022; B) chicken wire installed to protect the nest; C) hatchling *R. p. rogerbarbouri* emerging from egg on 20 July 2023.

Family. Princeton University Press. Princeton, New Jersey. 242 pp.). *Rhinoclemmys pulcherrima* has four recognized subspecies and ranges from northern Mexico to Brazil (Turtle Taxonomy Working Group 2021. Chelonian Res. Monogr. 8:1–472). *Rhinoclemmys pulcherrima* has not been studied in the wild, and most of what is known about this species' life history is based on captive individuals (Legler and Vogt 2013. Turtles of Mexico. University of California Press, Berkeley, California. 393 pp.). For example, females in a captive population of *R. p. pulcherrima* in Mazunte, Oaxaca have been observed laying one to three eggs per clutch in shallow nests, with multiple clutches per year, and eggs undergoing diapause or embryonic aestivation (Legler and Vogt 2013, *op. cit.*). Despite these observations, *R. pulcherrima* nests and incubation times have not been observed in the wild.

On 20 November 2022, while tracking a female *R. p. rogerbarbouri* using radiotelemetry we found a shallow nest with two eggs in front of a dead and fallen columnar cactus where the turtle had been observed a few days prior (Fig. 1A). This observation was made within the Natural Protected Area Sierra de Alamos-Río Cuchujaqui in southeastern Sonora, Mexico (27.00361°N, 108.80450°W; WGS 84). There were two observable eggs in the nest, and it appears that there was minimal effort by the female to conceal the nest as both eggs were exposed. This observation was made 5 m uphill from a stream where the same female *R. p. rogerbarbouri* had been observed since she was first found in 2019. We protected the nest with chicken wire (Fig. 1B) and checked the nest periodically. On 20 July 2023 upon reviewing the nest, a small hatchling was observed emerging from its egg (Fig. 1C). The hatchling weighed 18.2 g, had a midline carapace length (CL) of 45 mm, carapace width of 35 mm, and carapace height of 19.2 mm. The undeveloped egg was left undisturbed until 2 September 2023 when we removed it to measure and it weigh it (unhatched egg measurements: 22.3 g, 53.9 × 31.3 mm). The female that presumably laid the eggs weighed 800 g and had a CL of 179 mm.

To our knowledge, this is the first nest and incubation record of *R. p. rogerbarbouri* in the wild. Our observations demonstrate that *R. p. rogerbarbouri* may not invest significant effort into

nest building, instead digging a shallow nest with eggs visible on the surface, as reported for other *Rhinoclemmys*, such as *R. p. pulcherrima*, *R. areolata*, and *R. rubida*, (1A; Legler and Vogt 2013, *op. cit.*). The 242-d incubation period we observed suggests that *R. p. rogerbarbouri* eggs can go through diapause or embryonic aestivation in the wild, and agrees with captive observations of *R. p. pulcherrima*, showing that they are opportunistic nesters, producing multiple clutches per year over extended time periods, with some clutches going into diapause (Legler and Vogt 2013, *op. cit.*).

We would like to thank the office of the Comisión Nacional de Áreas Naturales Protegidas (CONANP) in Alamos, Sonora for facilitating our research within the National Protected Area Sierra de Alamos-Río Cuchujaqui, and Raúl Álvarez for letting us conduct this research on his property. This research was possible due to the support of the Turtle Survival Alliance and the US Fish and Wildlife Service.

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**TERRAPENE NELSONI KLAUBERI (Northern Spotted Box Turtle). NESTING BEHAVIOR.** North American box turtles of the genus *Terrapene* are one of the most widely studied turtle genera in the world, especially *T. carolina* and *T. ornata* (Dodd 2002. North American Box Turtles: a Natural History. University of Oklahoma Press, Norman, Oklahoma. 231 pp.). The nesting ecology in both *T. carolina* and *T. ornata* is known in detail (reviewed by Dodd 2002, *op. cit.*), and both begin nesting in late spring or early summer (May and June) (Converse et al. 2002. Am. Midl. Nat. 148:416–422). In most cases female *Terrapene* lay one clutch per year (e.g., Burke and Capitano 2011. Am. Mid. Nat. 165:137–142), but *T. c. bauri* females have been shown to lay up to three clutches per year (Dodd 1997. Chelon. Conserv. Bio. 2:370–377). Egg laying activity in *T. carolina* and *T. ornata* generally occurs in the evening and into the night (Dodd 2002, *op. cit.*), with females digging small holes with their hind legs that measure

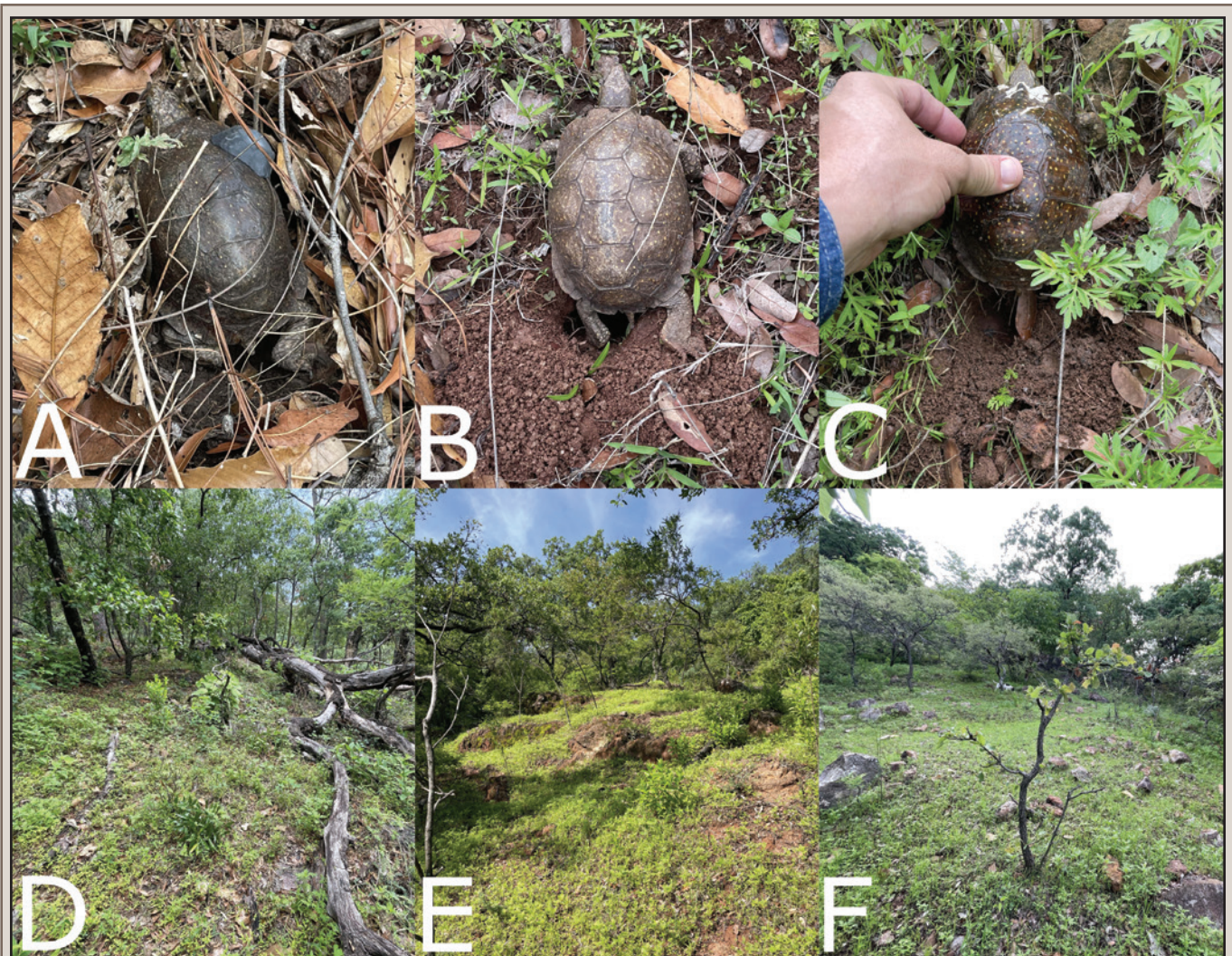


FIG. 1. *Terrapene nelsoni klauberi* nesting in Sonora, Mexico: A) female #45 digging a nest on 5 July 2023; B) female #95 digging a nest on 12 July 2023; C) female #39 digging a nest on 23 July 2024; D) habitat where #45 was digging; E) habitat where #95 was digging; F) habitat where #39 was digging.

about 5 cm wide and up to 5–10 cm deep, and depositing two to six eggs (Dodd 2002, *op. cit.*). There is considerable variation in where females choose to make their nests, but open sunny areas are a general theme for both *T. carolina* and *T. ornata* (Belzer and Seibert 2007. *Turtle Tortoise Newsl.* 10:1–15.).

In Mexico there are four recognized species of endemic box turtles, *T. coahuila*, *T. mexicana*, *T. yucatanana*, and *T. nelsoni* (Legler and Vogt 2013. *The Turtles of Mexico*. University of California Press, Berkeley, California. 326 pp.). Unlike their North American counterparts, virtually nothing is known about the nesting ecology of *Terrapene* in Mexico. Data have been reported on clutch size in *T. n. nelsoni* in Nayarit, which are shown to have one to four eggs when gravid (Milstead and Tinkle 1967. *Copeia* 1967: 180–187). In this note we present the first observations of *T. nelsoni klauberi* attempting to nest in the wild, and additional observations of abandoned nest cavities, and a female that made a large-distance movement when gravid.

In July 2022 and 2023 we palpated 19 and 26 female *Terrapene nelsoni klauberi* respectively, at a long-term study site in the Municipality of Alamos, Sonora, Mexico (27.0255°N, 108.9413°W;

WGS 84), and we detected four gravid females in each year. Of these, we observed nesting attempts by three different females, two in 2023 and one in 2024.

The first nesting attempt was by female #45 on 5 July 2023 at 1844 h when we encountered her in the field digging a small nest in leaf litter. Female #45 was equipped with a radiotransmitter, and she was palpated and confirmed to be gravid. The nest cavity was not measured, but it was an estimated 2 cm deep when observers arrived (Fig. 1A, D). This female was observed again on 8 July 2023, still gravid, at 1117 h, attempting to dig a nest in front of a log. On 11 July 2023 she was observed about 194 m up the hill on a steep embankment and no longer had palpable eggs; it is unknown where she laid her eggs. No nest was found in front of the log where she was observed on 8 July.

The second observation occurred on 12 July 2023 at 1837 h, when female #95 was seen excavating a nest cavity on a south facing hill slope with grass and sparse vegetation (Fig. 1B, E). The nest cavity appeared to be nearly fully formed, but upon approach by the observer the female stopped nesting. Palpation confirmed that #95 was gravid. Nest measurements were 5.4 cm wide by 6.5 cm deep. A small hatchling *T. n. klauberi* that weighed

13.4 g was observed about 30 meters uphill from where #95 was digging a nest cavity in 2024.

The third observation was made on 20 July 2024 at 1840 h, when female #39, found by a turtle dog, was seen excavating a nest on an open hillside (Fig. 1C). By the time the observer approached, the female had begun to walk away from the nest. The nest cavity was 4.5 cm wide by 4.5 cm deep, in the middle of an open south-facing hillside surrounded by forest (Fig. 1F). Female #39 was first observed in 2024 on 23 June, then again on 12 July 2024, and both times she was palpated and did not have eggs. One day before the nesting observation, on 20 July 2024, female #39 was palpated when she was found at the edge of an open grassy area and one to two eggs could be detected. Female #39 was the only gravid female in 2024 that was also observed gravid in 2023.

Additional nesting observations include two abandoned nest cavities, one observed on 23 July 2023, and another on 21 July 2024, both measured 4.5 cm wide and were on open hillsides surrounded by forest. A long-distance movement potentially related to nesting behavior was observed on 9 July 2023, when female #26, palpated as gravid, was 557 m south of her home range where she has been observed in 2018, 2019, 2021, and 2022. On 25 July 2023, we observed #26 back in her normal home range and no eggs were present when palpated. This observation suggests that female #26 made a long-distance movement to lay her clutch in 2023.

These observations shed light on the nesting behavior of *T. n. klauberi*, highlighting similarities and differences when compared to *T. carolina* and *T. ornata*. One key difference in *T. n. klauberi* is that turtles don't become active until the end of the dry season at end of June, and all of our observations were made following the first weeks of rain in 2023 and 2024. In temperate climates, *T. carolina* and *T. ornata* emerge from winter dormancy April–May depending on the latitude, and peak nesting activity doesn't occur until June (Dodd 2002, *op. cit.*). If female *T. n. klauberi* also need several weeks following emergence to develop eggs, it is possible that our observations represent the first nesting females of the season, and peak nesting activity could occur later in summer. This could explain the low proportion of palpated females that were found to be gravid.

As noted, open sunny areas appear to be an important component of *Terrapene* nesting locations. Several authors have reported open sunny areas, even near roads, as preferred nesting sites for *T. carolina* (Burke and Capitano 2002. *Am. Midl. Nat.* 165:137–142). The majority of the habitat at our *T. n. klauberi* study site is dominated by pine-oak forest, and there are few areas that are open and sunny. In our observations, the areas where female #95 and #39 were observed forming nests were on two of the few open savannah-type areas in our study site (Fig. 1D–F). Female #45 was observed nesting in an area where a tree had fallen, resulting in a sunny spot (Fig. 1D).

Long-distance movements have been observed in female *T. carolina*, with females travelling over 700 m to nesting sites (Stickel 1950. *Ecol. Monogr.* 20:351–357). Our observation of female #26 far from her home range suggests that some females in the population may disperse long distances to nest. We observed a similar behavior by female #45 that had moved up a very steep hill and repeat palpation showed that she no longer had eggs in 2023. This behavior could promote gene flow and could help explain why not all resident females are sampled each year at our field site.

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**TRACHEMYS SCRIPTA ELEGANS (Red-eared Slider). BASKING BEHAVIOR.** In Australia, *Trachemys scripta elegans* (Red-eared Slider; RES) is an invasive species and is considered a significant biosecurity threat to native species of freshwater turtles. The illegal exotic pet trade and subsequent release of unwanted pet turtles presents an ongoing source of RES into the environment. Surveillance and monitoring of waterways is critical to detect any new incursions to prevent establishment or spread in the wild.

Artificial basking platforms monitored with camera traps are used by Queensland biosecurity staff to detect RES at high-risk sites. These platforms use the natural basking behaviour of turtles to aid detection and have been extremely effective for detecting adults, but not juveniles. Recently, a new platform was specifically designed to detect the presence of juvenile RES. The platform has a mesh base that sits approximately an inch below the surface of the water, supporting shallow water aquatic basking. As a pilot trial, two platforms were deployed in collaboration with Fairfield City Council, Fairfield, Sydney, New South Wales (33.8771°S, 150.9617°E; WSG 84) on 19 January 2023. Monitoring cameras (Swift 3C wide angle) collected time lapse data (three images every 10 min) on each platform for 30 (platform 1) and 38 (platform 2) days post deployment. Platform 1 was fitted with air and water temperature loggers (HOBO, Onset computer corporation) to record ambient conditions.

Fourteen RES basking events and one native *Chelodina longicollis* (Eastern Long-necked Turtle) were recorded during the study period. All RES had an estimated carapace size of 10–15 cm. Interestingly, most (71%) RES basking events occurred at night between 2345 h and 0500 h, with only one basking event captured in daylight after sunrise at 0715 h. The juvenile RES were positioned on the submerged mesh portion of the platform. The Eastern Long-necked Turtle was an adult that basked aerially on the leg of the platform, not aquatically on the mesh.

As far as the authors are aware, this is the first published record of nocturnal basking for *T. scripta elegans* and the first record of nocturnal basking well outside a tropical zone. Nocturnal basking by freshwater turtles has been documented both around the globe and in Australia in (or just outside) the tropical zones but never previously recorded for RES (McKnight et al. 2023. *Glob. Ecol. Conserv.* 43:e02444). Basking events were usually captured when both the daily air and water temperature were at or near their lowest and when relative humidity peaked. The average water temperature during basking events was 23.76 °C (range: 20.97–26.27 °C) and average air temperature 20.17 °C (range 17.28–27.09 °C). The reason for nocturnal basking at this site remains unclear, however it may be an adaptation to avoid predators (Nordberg and McKnight 2020. *Ecol.* 101:c03048), especially in small turtles (Barhadiya et al. 2020. *Rept. Amphib.* 27:426–427). Large predatory fish species are present in this river catchment and may pose a significant nocturnal threat to juvenile turtles. The nocturnal and aquatic basking occurred at our site when the water temperature was warmer than the air

temperature. It is possible the platform design provides a barrier between the turtle and predator which would allow juvenile turtles to preferentially remain in a shallow pool of warm water rather than exiting the water during this period. Alternatively, nocturnal basking has been suggested to be a mechanism of cooling and to escape unfavourably warm water (Kidman et al. 2023. *Austral. Ecol.* 48:1532–1546). At our site, water temperature peaked at 31.4 °C and regularly reached above 30 °C during the day. Although nocturnal basking has not been reported in temperate regions, it is possible small bodies of water (such as the pond where this study occurred) easily reach temperatures above the range preferred by turtles, which has been reported as 26 °C (Kidman et al. 2024. *J. Therm. Biol.* 121:103834). Further investigation into the adult population of turtles at this site would inform if they also exhibit nocturnal basking behaviours.

All research was undertaken with the approval of an animal ethics board review (NSW DPI Animal Ethics Committee; approval number OAEC-0532-907).

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#### CROCODYLIA — CROCODILIANS

**ALLIGATOR MISSISSIPPIENSIS (American Alligator). DIET.** American alligators are opportunistic, generalist predators that feed on a broad array of vertebrate and invertebrate prey (Wolfe et al. 1987. *Northeast Gulf Sci.* 9:1–8; Shoop and Ruckdeschel 1990. *Am. Midl. Nat.* 2:407–412; Elsey et al. 1992. *Proc. Annu. Conf. Southeast. Assoc. Fish Wildl. Agencies* 46:57–66, and references therein). Alligators living in coastal areas are known to feed in estuarine and marine environments, with their diet consisting primarily of crustaceans, fish, small mammals, and wading birds (Platt et al. 1990. *Northeast Gulf Sci.* 11:123–130; Nifong and Lowers 2017. *Southeast. Nat.* 16:383–396; Silliman et al. 2018. *Current Biol.* 28:R527–R548). Over 20 mammal species have been identified from stomach contents, scat, or direct feeding observations in *A. mississippiensis* (Elsy et al. 1992, *op. cit.*, and references therein; Shoop and Ruckdeschel 1990, *op. cit.*; Rainwater et al. 2022. *Herpetol. Rev.* 53:491–493); however, there are few accounts of marine mammals in their diet (Silliman et al. 2018, *op. cit.*). Here we describe multiple observations of a previously unreported marine mammal, Tamanend's Bottlenose Dolphin (*Tursiops erebennus*), in the diet of *A. mississippiensis* from coastal South Carolina, USA.

Our first observation occurred on 1 July 2016 when a dead female *T. erebennus* (ca. 200 cm total length; Fig. 1) was reported by a recreational boater in Foster Creek near its confluence with the Back River (32.9756°N, 79.9436°W; WGS 84; 1.5 m elev.), Berkeley County. Upon discovery, the boater observed an adult (ca. 300 cm total length) *A. mississippiensis* biting and tearing at the dolphin carcass, retreating to the riverbank for ca. 2–4 min, and then returning to the carcass to repeat this sequential behavior several times. A team from the South Carolina Marine Mammal Stranding Network (SCMMSN) and National Ocean Service (NOS) arrived ca. 2 h later to inspect the carcass and retrieve the head of the dolphin, and during this procedure, the alligator moved ca. 5 m away from the carcass where it remained and appeared to



FIG. 1. Remains of a Tamanend's Bottlenose Dolphin (*Tursiops erebennus*) scavenged by an American Alligator (*Alligator mississippiensis*) in coastal South Carolina, USA (1 July 2016).



FIG. 2. Head of a Tamanend's Bottlenose Dolphin (*Tursiops erebennus*) scavenged by an American Alligator (*Alligator mississippiensis*) in coastal South Carolina, USA (4 July 2016). Note the absence of the lower jaw, presumably bitten off by the alligator.

be watching the process. The cause of death of the dolphin was suspected to be from prolonged freshwater exposure (Colbert et al. 1999. Investigation of unusual mortalities of Bottlenose Dolphins along the Mid-Texas Coastal Bay Ecosystem during 1992. NOAA Technical Report NMFS 147, U.S. Department of Commerce, Seattle, Washington, USA), and not attributed to the alligator.

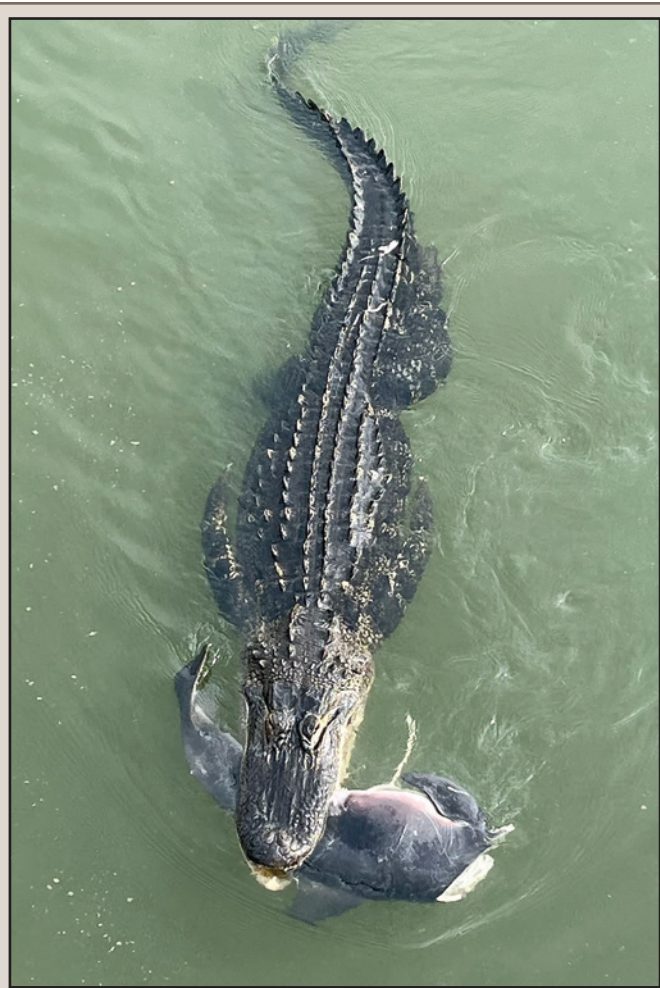


FIG. 3. An adult American Alligator (*Alligator mississippiensis*) in coastal South Carolina, USA with the partial carcass of a Tamenand's Bottlenose Dolphin (*Tursiops erebennus*) grasped in its jaws (3 August 2022).

The second observation occurred on 3 July 2016 when a male (ca. 215 cm total length) *T. erebennus* was found dead by local fishermen in the Back River (32.9851°N, 79.9415°W; WGS 84; 1.5 m elev.) Berkeley County. The fishermen reported a large alligator scavenging the dolphin carcass, and inspection of the carcass by SCMMSN and NOS personnel on 4 July 2016 revealed the lower jaw of the dolphin had been removed (Fig. 2), presumably bitten off by the alligator. The cause of death of this dolphin was likewise suspected to be from prolonged freshwater exposure (Colbert et al. 1999, *op. cit.*).

The third observation occurred on 3 August 2022 in the May River (32.2062°N, 80.8797°W; WGS 84; 1.5 m elev.), Beaufort County. A member of the public sent a SCMMSN volunteer a text and photograph of an alligator (ca. 330 cm total length) carrying a dead *T. erebennus* in its mouth (Fig. 3) while swimming past a dock. The dolphin (ca. 100 cm total length) was of unknown sex and appeared to have the head missing. This dolphin's cause of death was unclear, and it was unknown if the animal's head was severed by the alligator, a boat strike, or some other traumatic event.

To our knowledge these are the first reports of *A. mississippiensis* scavenging dolphins, and while rare, there are similar examples of this species and other crocodylians

scavenging marine mammals. Silliman et al. (2018, *op. cit.*) reported two alligators feeding on a dead West Indian Manatee (*Trichechus manatus*), Godahewa et al. (2023, *Herpetol. Rev.* 54:122–123) observed five adult American Crocodiles (*Crocodylus acutus*) feeding on the carcass of a partially beached manatee, and Gallagher et al. (2018, *J. Ethol.* 36:205–209) observed an adult Estuarine Crocodile (*C. porosus*) feeding on the floating carcass of a Humpback Whale (*Megaptera novaeangliae*). Scavenging by crocodylians likely occurs more frequently than reported because traditional methods of determining diet (e.g., stomach flushing, scat analysis) are generally unable to differentiate scavenged from predated food items, except under special circumstances (Platt et al. 2010, *Can. Field-Nat.* 124:265–267); rather, confirmation of scavenging requires direct observation of carrion consumption.

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**CROCODYLUS SIAMENSIS (Siamese Crocodile). PARASITISM.** *Crocodylus siamensis* is a medium-sized (up to 4 m total length), critically endangered crocodylian that occurs (or formerly occurred) in freshwater habitats of mainland Southeast Asia and the Sundaic islands of Java and Borneo (Platt et al. 2019, *In* Manolis and Stevenson [eds.], *Crocodyles: Status Survey and Conservation Action Plan*, Fourth Edition, pp. 1–13. IUCN Crocodile Specialist Group, Darwin, Australia). Little is known about the natural history of *C. siamensis* (Platt et al. 2019, *op. cit.*), and information on their ectoparasites is particularly sparse to non-existent. Here, we report a recent observation of leech ectoparasitism of an adult *C. siamensis* in Lao PDR.

Our observation was made in a complex of natural wetlands and rice fields at Noa Neua Village (16.9835°N, 104.9103°E; WGS 84; 148 m elev.) in Xiabouli District of Savannakhet Province on 24 May 2024. These wetlands are shallow, non-alluvial depressions with open water and some aquatic vegetation, surrounded by rice fields grazed by domestic Water Buffalo (*Bubalus bubalis*) during fallow periods (Platt et al. 2020, *Herpetol. Rev.* 51:588–590). At present the wetlands are inhabited by a single large (ca. 3 m total length) female crocodile (Platt et al. 2020, *op. cit.*) that has become habituated to humans as a result of frequent feeding by villagers.

We arrived in Noa Neua at ca. 0930 h and after a brief search found the crocodile in a small irrigation pond (ca. 15 m × 10 m × 70 cm deep) on the periphery of the wetlands. While photographing the crocodile we observed a large leech (ca. 150 mm total length) attached just below the crocodile's right eye (Fig. 1). The eye was opaque and reduced in size, but we suspect this was likely



FIG. 1. Asian Buffalo Leech (*Hirudinaria manillensis*) attached to the right eye of an adult female Siamese Crocodile (*Crocodylus siamensis*) in an irrigation pond at Noa Neua Village, Savannakhet Province, Lao PDR. Note the opaqueness of the eye, likely resulting from a past intraspecific aggressive encounter.

a result of injuries sustained during a previous aggressive encounter with a conspecific and unrelated to the leech (e.g., Rainwater et al. 2011. *J. Wild. Dis.* 47:415–426). We observed the leech feeding for 30 min (ca. 1030–1100 h), and it became visibly engorged during this period. At 1100 h, the crocodile submerged, swam beneath a floating mass of organic debris and resurfaced near a villager proffering food. At this point the leech detached from the crocodile, moved a short distance posteriorly along the maxilla, entered the water, and was lost to our view.

We later identified the leech as *Hirudinaria manillensis* (Asian Buffalo Leech) based on the large body size, red-orange venter, and two prominent lateral stripes (Jeratthitkul et al. 2020. *ZooKeys* 933:1–14; Jiranuntskul et al. 2022. *Zool. Stud.* 61:84). *Hirudinaria manillensis* is a sanguivorous freshwater leech common in rice fields and wetlands throughout much of south and southeast Asia that feeds primarily on mammals, particularly water buffalo, cattle, and occasionally humans, but is also known to parasitize fishes, amphibians, and reptiles (Tai and Chen 2010. *Leech Fauna of Taiwan*. National Taiwan University Press, Taipei, Taiwan. 118 pp.).

Our observation is noteworthy for two reasons: first, to our knowledge this is the only report of leech ectoparasitism of wild *C. siamensis*, although this has been observed among captive individuals (Watermolen 2021. *Bull. Chicago Herpetol. Soc.* 56:136–143), and second, our observation compliments a previous, albeit questionable (possible misidentification) record of *H. manillensis* parasitizing *Crocodylus porosus* in Malaysia (Jeffery et al. 1990. *J. Vet. Malaysia* 2:39–41). Leech parasitism is widely reported among New and Old World crocodylians (e.g., Webb and Manolis 1983. *Aust. Wildl. Res.* 10:407–420; Brantley and Platt 1991. *Herpetol. Rev.* 22:4–5; Leslie et al. 2011. *J. South Afr. Vet. Assoc.* 82:155–159) and therefore is not unexpected for *C. siamensis*. The absence of previous records of leech parasitism for *C. siamensis* is almost certainly due to the lack of field studies and our poor understanding of the life history of this rare crocodylian.

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#### SQUAMATA — LIZARDS

**ASPIDOSCELIS DEPPII (Blackbelly Racerunner). SPIDER FEEDING BEHAVIOR.** *Aspidoscelis deppii* is opportunistic feeder that eats a wide variety of invertebrates such as termites, orthopterans, and spiders (Vitt et al. 1993 *Can. J. Zool.* 71:2391–2400). Like most whiptail lizards, head size and prey size are correlated (Schall 1993. *In* Wright and Vitt [eds.], *Biology of Whiptail Lizards [Genus Cnemidophorus]*, pp. 319–343. Oklahoma Museum of Natural History, Norman, Oklahoma) and in *A. deppii* large prey relative to their body size are less frequently consumed (Vitt et al. 1993, *op. cit.*). Here we report three separate observations of *A. deppii*, feeding on large spiders, all of which were much larger than the lizards head, within dry deciduous forests of the Isthmus of Tehuantepec, Oaxaca, Mexico (16.5827°N, 94.9930°W; WGS 84; ca. 40 m elev.).

The first observation was on 11 July 2008 at 1106 h, when we observed an adult *A. deppii* carrying a dead legless, hairless tarantula, gripped by the spider’s cephalothorax (Fig. 1A). The lizard was moving in dense underbrush and moved out of sight before consumption. We estimate the spider’s body, cephalothorax and abdomen, to be ca. 4 cm in length, almost twice the size of the lizard’s snout.

On 10 February 2009, at 1126 h, we observed an adult *A. deppii* foraging around a pile of leaves by repeatedly circling the pile, stopping periodically to dig, then circling again. This behavior was repeated a couple of times before the lizard emerged with an adult Tiger Rump Tarantula (*Davus pentaloris*) clenched in its mouth by the upper side of the cephalothorax. The lizard then violently thrashed back and forth, knocking the prey against the ground for ca. 1–2 min (Fig. 1B) before abruptly flinging the tarantula a few cm away on bare ground. The lizard appeared to cautiously inspect and probe the injured and now slow-moving tarantula with forelimb pokes eliciting only minor defensive responses by raising its front legs to expose its chelicera towards the attacker. Undeterred, the lizard again attacked by biting the upper cephalothorax, avoiding the chelicera, for another round of violent thrashing until the spider appeared dead (Fig. 1C; video available from <https://doi.org/10.26153/tsw/55864>). As the lizard was manipulating the tarantula for consumption, a second larger male *A. deppii* approached and after a few seconds unsuccessfully chased the smaller lizard, with its meal, as the latter fled into dense underbrush where we lost sight of both. During the chase a few of the tarantula’s legs fell off and were eaten by the larger, interloping male.

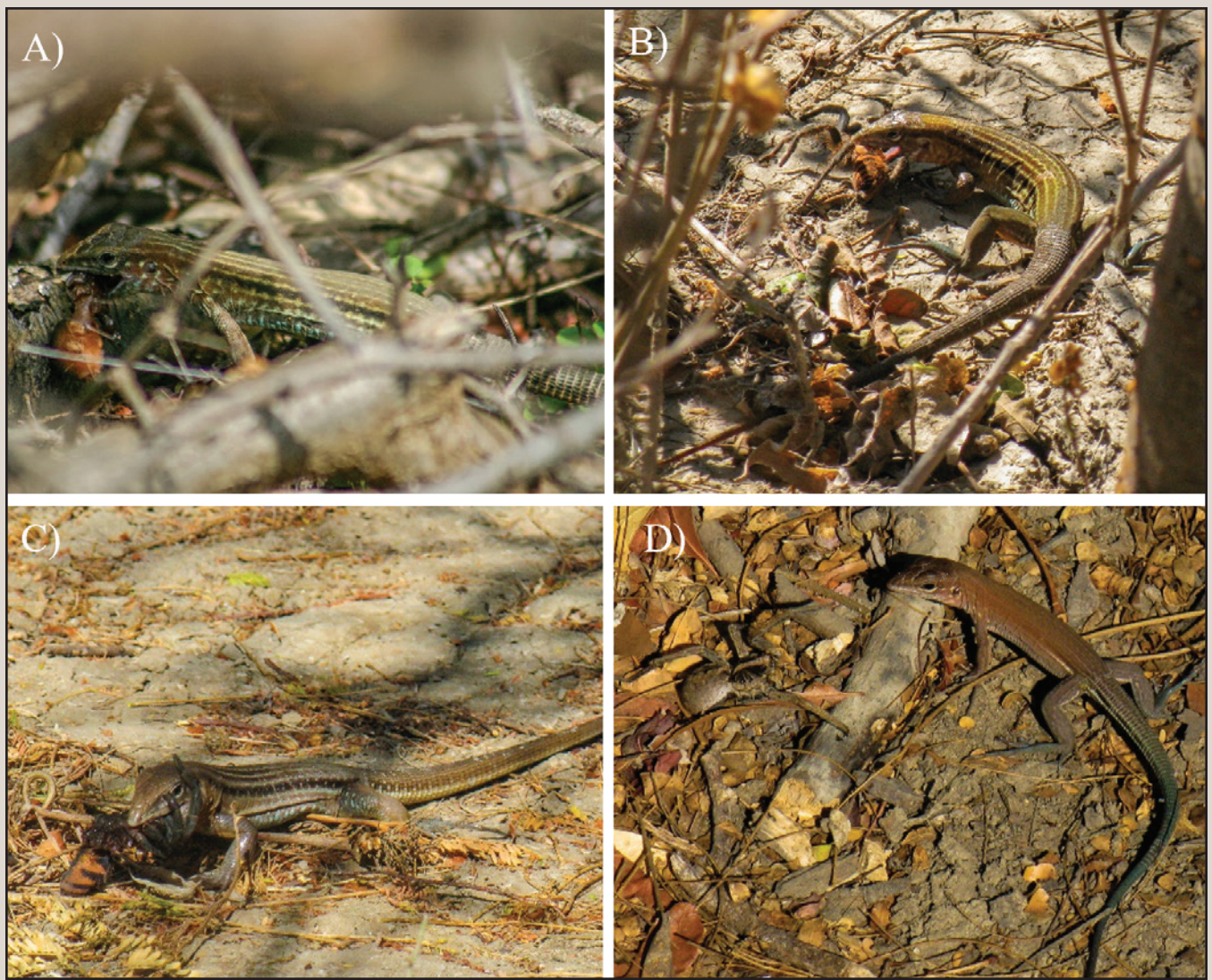


FIG. 1. *Aspidoscelis deppii* feeding on large spiders from the Isthmus of Tehuantepec, Oaxaca, Mexico: A) adult *A. deppii* consuming a tarantula; B, C) an adult *A. deppii* wrestling a Tiger Rump Tarantula (*Davus pentaloris*), thrashing it from side to side; D) a juvenile *A. deppii* facing a wolf spider (Lycosidae).

Our third observation occurred on 18 February of 2009, at 1315 h, when we watched a juvenile *A. deppii* pursue and attack a wolf spider (Lycosidae) along a dirt trail bordered by dense vegetation (Fig. 1D). When approached, the spider turned and shifted its body to face the lizard, raising its front legs and exposing its chelicera, which were a few cm apart, and made a couple of short jumps towards the attacking lizard. The lizard circled the spider, which mirrored the lizard's movements with its chelicera always aimed towards the attacker, waiting for an opening to safely attack. During the attack the spider lost two legs.

Our observations describe the hunting, attacking, and subduing behaviors of adult and juvenile *A. deppii* on large dangerous arachnid prey, in a manner similar to those reported in *A. exanguis* (Rocha et al. 2013. *Herpetol. Rev.* 44:663). While Vitt et al. (1993, *op cit.*) found spiders in the stomach contents of *A. deppii*, they did not report spider body size, and we observed lizards taking arachnid prey equal to or larger than their heads, suggesting consumption of large prey may be more common than previously reported.

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**BASILISCUS VITTATUS (Brown Basilisk). PREDATION.** *Basiliscus vittatus* is native to Central and South America but has been introduced into at least 11 counties in Florida, USA (Krysko et al. 2019. *Amphibians and Reptiles of Florida*. University Press of Florida, Gainesville, Florida. 706 pp.). Documented predators in Florida include two species of game fish, *Ardea alba* (Great Egret; Flaherty and Friers 2014. *Southeast. Nat.* 13:N57–N58), and three species of snake (Meshaka et al. 2004. *The Exotic Amphibians and Reptiles of Florida*. Krieger, Malabar, Florida. 166 pp.). Because *B. vittatus* is diurnally active along brushy shorelines of canals, rivers, and bodies of water in Florida, it is susceptible to predation by wading bird species besides *A. alba*. Here, we

PHOTO BY: A) MARY LENOIR-FINKELSTEIN; B) JANICE JOHNSTON; C) KEN POMERANCE; D) RON HUDSON; E) MICHIKO S. BEAUCHAMP; F) RON HUDSON; G) KELLY GESTRING



FIG. 1. Predation of *Basiliscus vittatus* in Florida, USA, by: A) *Ardea Herodias*; B) *Egretta caerulea*; C) *Butorides virescens*; D) *Buteo lineatus*; E) *Lanius ludovicianus*; F) *Lynx rufus*; G) *Channa aurolineata*.

document predation of *B. vittatus* by three additional wading bird species, as well as a raptor, shrike, mammal, and fish.

On 30 December 2022, we observed an *A. herodias* (Great Blue Heron) predating an adult *B. vittatus* at Green Cay Nature Center and Wetlands, Boynton Beach, Palm Beach County (26.4867°N, 80.1591°W; WGS 84; 6 m elev.; Fig. 1A). On 24 October 2021, we observed an immature *Egretta caerulea* (Little Blue Heron) predating a *B. vittatus* at the Arthur R. Marshall Loxahatchee National Wildlife Refuge, Palm Beach County (26.4990°N, 80.2149°W; WGS 84; 8 m elev.; Fig. 1B). On 31 July 2016, we observed a *Butorides virescens* (Green Heron) predating a *B. vittatus* at Peaceful Waters Sanctuary, Wellington, Palm Beach County (26.6322°N, 80.2338°W; WGS 84; 6 m elev.; Fig. 1C). On 11 January 2021, we observed a *Buteo lineatus* (Red-Shouldered Hawk) carrying an adult male *B. vittatus* at Wakodhatchee Wetlands, Delray Beach, Palm Beach County (26.4777°N, 80.1429°W; WGS 84; 6 m elev.; Fig. 1D). In addition to our direct observation, there are over 10 Facebook posts of *B. lineatus* predating *B. vittatus* at Green Cay Nature Center and Wetlands or Wakodhatchee Wetlands, urban nature preserves with artificial wetlands used to filter water.

On 22 January 2014, we observed a juvenile *B. vittatus* that was likely impaled by a *Lanius ludovicianus* (Loggerhead Shrike) on barbed wire atop a chainlink fence in the Everglades and Francis S. Taylor Wildlife Management Area, Miami-Dade County (25.9426°N, 80.4403°W; WGS 84; 5 m elev.; Fig. 1E). True shrikes (Laniidae) often impale their prey on sharp objects as a caching behavior (Yosef and Pinshow 2005. *Behav. Proc.* 69:363–367), and at least 19 lizard species have been reported as prey for *L. ludovicianus* (Smith et al. 2006. *J. Kansas Herpetol.* No. 19:9; Clark 2011. *Sonoran Herpetol.* 24:20–23), but to our knowledge, not *B. vittatus*.

At 1142 h on 28 April 2022, we observed a juvenile *Lynx rufus* (Bobcat) carrying an adult male *B. vittatus* that it captured after a chase of ca. 10 s at Wakodhatchee Wetlands (26.4778°N, 80.1449°W; WGS 84; 7 m elev.; Fig. 1F). Finally, on 18 August 2005, we found an adult male *B. vittatus* (total length = 560 mm, 113.5 g) in the stomach of a nonnative *Channa aurolineata* (Goldline Snakehead; total length = 753 mm, 2765 g) from the Cypress Creek Canal (C-14) in Coral Springs, Broward County (26.2304°N, 80.2212°W; WGS 84; 2 m elev.; Fig. 1G). This large, predatory fish, which is native to Asia, was first collected in Florida in 2000 from Broward County and reported as *C. marulius* (Bullseye Snakehead; Shafland et al. 2008. *Southeast. Nat.* 7:627–636) but was subsequently described as *C. aurolineata* (Adamson and Britz 2018. *Zootaxa* 4514:452). It has also been reported preying on the nonnative *Iguana iguana* (Green Iguana) in Florida (Enge et al. 2024. *Herpetol. Rev.* 55:###–###).

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#### *CALOTES VERSICOLOR* (Changeable Lizard). PREDATION.

*Calotes versicolor* is distributed widely across southeast Asia and in Pakistan (Huang et al. 2013. *PLoS ONE* 8:e64754; Gowande et al. 2021. *Verteb. Zool.* 71:669–696) and has also become established outside of its native range (Enge and Krysko 2004. *Florida Sci.* 67:226–230; Radder 2006. *Curr. Sci.* 91:1354–1363). This lizard is often found on trees, shrubs, and walls in urban settings, as well as rural gardens, and along streams (Minton 1966. *Bull. American Mus. Nat. Hist.* 134:27–184; Khan and Mahmood 2004. *Pak. J. Bio. Sci.* 7:1942–1945; Das 2010. *A Field Guide to the Reptiles of South-east Asia*. New Holland, London. 376 pp.). The known predators of *C. versicolor* include two snakes, *Dendrelaphis kopsteini* and *Boiga trigonata*, one lizard, *Varanus salvator*,

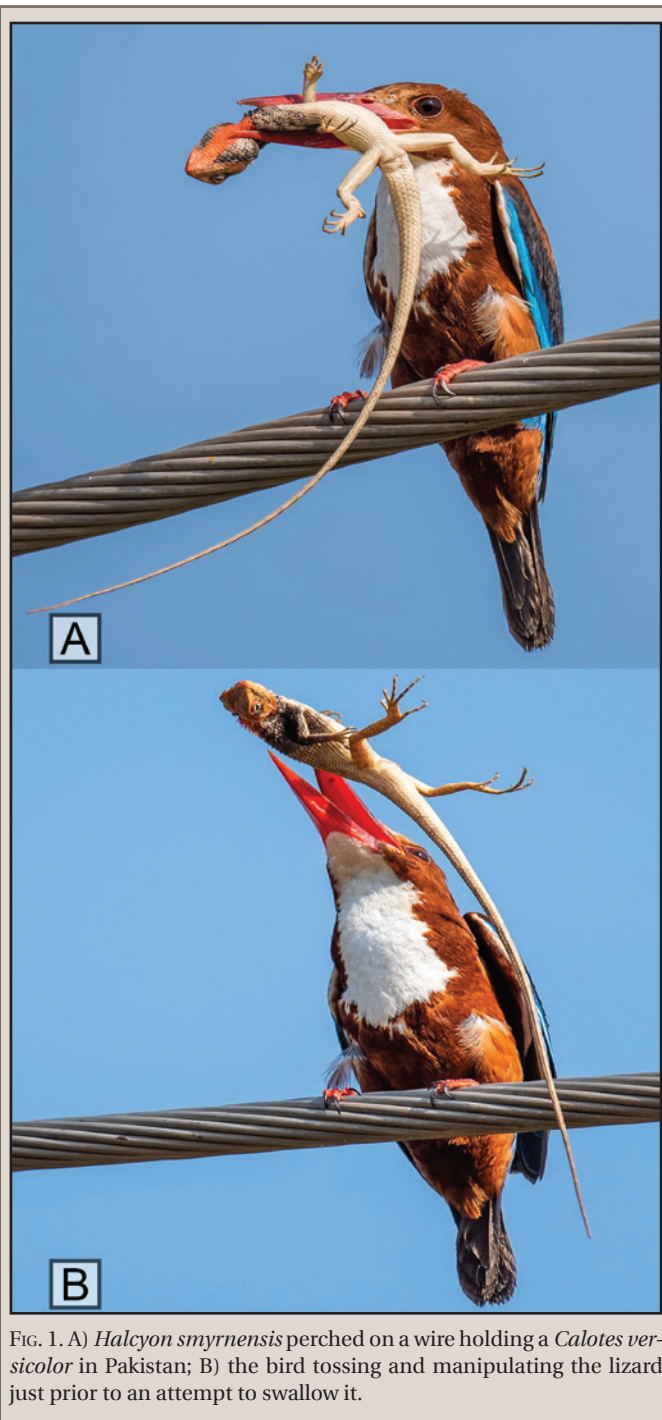


FIG. 1. A) *Halcyon smyrnensis* perched on a wire holding a *Calotes versicolor* in Pakistan; B) the bird tossing and manipulating the lizard just prior to an attempt to swallow it.

and one raptor, Shikra (*Accipiter badius*; Sharma et al. 2012. Herpetol. Rev. 43:645; McCleary and Ichtiarani 2015. Herpetol. Notes 8:303–304; Motiwala et al. 2022. Rept. Amphib. 29:111–112; Yan and Lup 2023. Nat. Singa. 16:e2023022). Here, I report predation on *C. versicolor* by a novel avian predator.

On 4 June 2021, at 1100 h, I observed a White-breasted Kingfisher (*Halcyon smyrnensis*) capture an adult *C. versicolor* from a farm field in Islamabad, Pakistan (33.7296°N, 73.1402°E; WGS 84; 558 m elev.). The kingfisher dove at the ground and, after capturing the lizard, flew to a steel wire where it perched holding its prey, which appeared dead (Fig. 1A). The bird sat here for 2 min before tossing the lizard in the air with its beak and attempting to swallow it headfirst for 20 s (Fig. 1B). The lizard's size made it impossible for the bird to swallow it in one go. I did not observe the bird consume the lizard because after 4 min the *H. smyrnensis* flew out of view with the *C. versicolor* in its beak, when I approached too close for more photographs.

To my knowledge, this is the first record of *H. smyrnensis* preying on *C. versicolor*, although an unidentified *Calotes* species was reported by Ali and Ripley (1983. Handbook of Birds of India and Pakistan. Oxford University Press, Delhi. 310 pp.). This record provides additional insights into the reptile fauna of Pakistan.

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#### **CALUMMA OSHAUGHNESSYI (O'Shaughnessy's Chameleon).**

**MORTALITY.** Madagascar is considered a hotspot for chameleon diversity, home to about 44% of all known chameleon species (Tolley et al. 2013. Proc. Roy. Soc. B. 280:20130184). Unfortunately, chameleons are also one of the most endangered groups of reptiles worldwide, with up to half of chameleon species vulnerable to extinction (Tolley et al. 2022. Oryx 56:451–456). Malagasy chameleons face multiple threats including habitat loss, climate change, and introduction of invasive species (Jenkins et al. 2014. PLoS ONE 9:e100173), but the risk invasive plants pose to chameleons is not well understood. For example, *Desmodium uncinatum* (Silverleaf Desmodium), introduced to Madagascar as cattle forage, possesses sticky, hooked hairs on its stems that have been reported to entrap and kill insects, bats, and other small animals in India and Australia (Torralba-Burrial et al. 2006. Entomol. Gener. 30:301–305; Jacomassa et al. 2017. Mammalia. 82:65–67; Kiran et al. 2018. Natl. Acad. Sci. Lett. 42 269–270). Here, we report two mortality events of *Calumma oshaughnessyi* by *D. uncinatum* in Ranomafana National Park in Madagascar.

The first mortality was observed on 13 March 2023 when we discovered a partially decomposed juvenile (not measured) *C. oshaughnessyi* attached to the stem of a *D. uncinatum*. The lizard's limbs and tail were still partially wrapped around the stem, while its hands and feet appeared to also grip the stem (Fig. 1). Judging by the state of decomposition, we estimate the lizard had been dead for a few days. The second mortality was observed along a roadside on the night of 3 March 2024 and was another juvenile *C. oshaughnessyi* (ca. 10 cm total length). This lizard was attached to the *D. uncinatum* stem in the same manner as the first lizard, i.e., hands, feet and tail gripping the stem (Fig. 2). This lizard was fully intact, but very soft to the touch, suggesting some degree of decomposition had occurred. Removal of the chameleon from the plant was difficult and produced tears to the skin on the hands, feet and tail. We inspected the lizard for signs of trauma or other injuries but saw none besides those

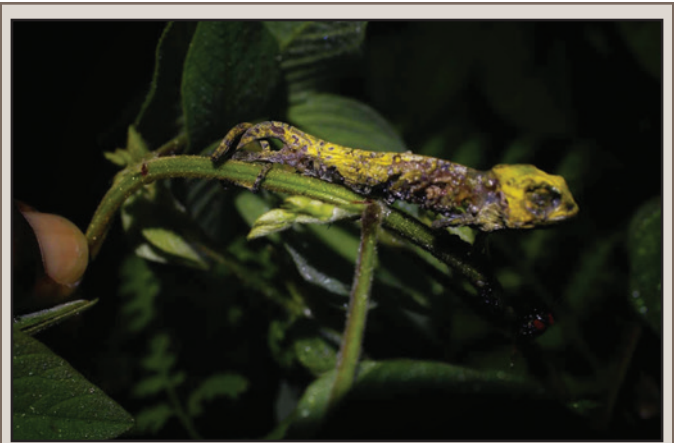


FIG. 1. Juvenile *Calumma oshaughnessyi* at advanced stages of decomposition entangled in *Desmodium uncinatum* from Madagascar.



FIG. 2. Closeup (A) and wide (B) image of a juvenile *Calumma oshaughnessyi* entangled in *Desmodium uncinatum* from Madagascar.

caused during removal from the stem. In both cases we suspect the lizards, once on these stems, could not extricate themselves from the plant's Velcro-like spines and likely died from starvation or exposure, although this was not verified histologically.

To our knowledge this is the first published report of chameleon mortality from this non-native invasive plant, *D. uncinatum*, as well as the first published report of animal entanglement in *D. uncinatum* in Madagascar, although local guides report that they often find tiny chameleons, frogs and other small animals entangled and dead on this plant. The ecological impacts of entrapment of chameleons or other small animals in *D. uncinatum* is not currently quantified, but there are numerous reports of invertebrates and small vertebrates entrapped and dying from this species in other contexts and countries besides those reported here (Sands 2018. Aust. J. Entomol. 57:150–172; Erdei et al. 2024. Elife. 13:e88695). Due to the plant's habit of growing in dense clumps near the ground, *D. uncinatum* has the potential to cause high mortality in chameleons, especially if chameleon eggs hatch near the plants. Thus, the impact of *D. uncinatum* on chameleon population dynamics is worthy of further study.

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**DIPSOSAURUS DORSALIS DORSALIS (Northern Desert Iguana).** **DIPLOCHORY.** Diplochory or “two-phase dispersal” is a seed dispersal mechanism in which the seed of a plant is moved sequentially by more than one dispersal mechanism or vector. The most well-known examples of lizard diplochory involve lizards which feed on seeds then are subsequently predated by birds which act as the secondary seed dispersers (Nogales et al. 2007. *J. Ecol.* 95:1394–1403). *Dipsosaurus dorsalis dorsalis* is a large, omnivorous iguanid lizard species found in the southwestern United States and northwestern Mexico and although their diet is primarily herbivorous and includes seeds, they have been known to consume a wide variety of invertebrates, including ants (Dibble et al. 2008. *West. N. Am. Nat.* 68:521–523). Here we present a description *D. d. dorsalis* collecting and consuming seeds from the mound of a Rough Harvester Ant (*Pogonomyrmex rugosus*) nest.

On 26 May 2024 at 0933 h we observed a juvenile *D. d. dorsalis* (ca. 15 cm SVL) feeding on seeds near the entrance of a large *P. rugosus* nest mound near Ocotillo, Imperial County, California, USA (32.7168°N, 116.0767°W; WGS 84; 114 m elev.). The ants were inactive during the time the *D. d. dorsalis* was foraging, presumably due to the high surface temperature of the soil. The *D. d. dorsalis* was actively foraging, consuming what appeared to be seeds at a refuse heap, from the exterior edges of the ant mound where discarded objects are often left by ants (Rissing 1986. *Oecologia* 68:231–234). Upon using a long-range camera lens to focus on the *D. d. dorsalis* from a distance of ca. 15–20 m, we observed the lizard foraging on seeds, as well as seeds stuck to its face. The seeds were identified as those belonging to the Strawberry Hedgehog Cactus (*Echinocereus engelmannii*), which was prevalent in the area and whose seeds have a sticky coating. On the same day, a second juvenile *D. d. dorsalis* (ca. 21 cm SVL) was captured in the same general area and we found these same cacti seeds inside the lizard’s mouth, although it is unclear whether these consumed seeds came from the ant nest or directly from the plant.

To our knowledge, this is the first description of *D. d. dorsalis* foraging and consuming seeds from the refuse heap of harvester ants. We have yet to find an example of diplochory in the literature involving live lizards as secondary seed dispersers. Further investigation may provide insights into whether



FIG. 1. Juvenile *Dipsosaurus dorsalis dorsalis* consuming seeds from the nest mound of Rough Harvester Ants (*Pogonomyrmex rugosus*).

the *D. d. dorsalis* were also engaging in kleptoparasitism. Kleptoparasitism is defined as a form of feeding in which one animal deliberately takes food from another. Kleptoparasitism is well-documented in many types of organisms, including lizards (Iyengar 2008. *Biol. J. Linn. Soc.* 93:745–762). Because the ants were inactive during our observation, it is impossible to know whether the *D. d. dorsalis* were also taking both the ants and the seeds while foraging, taking seeds directly from ants, or simply taking discarded seeds (as observed).

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**HELODERMA SUSPECTUM (Gila Monster).** **FIRST RECORD OF MATING IN THE WILD.** There is little documentation of the reproductive and copulatory behaviors in wild *Heloderma suspectum* outside a single observation of probable courtship and mating attempts that occurred outside of a rock shelter (Zylstra et al. 2015. *Herpetol. Rev.* 46:258–259). Most of what is known on the species mating and copulation behaviors is from observing captive animals (Gates 1956. *Herpetologica* 12:184; Beck 2005. *Biology of Gila Monsters and Beaded Lizards*. University of California Press, Berkeley, California. 211 pp.; Schwandt 2019. *The Gila Monster, Heloderma suspectum: Natural History, Husbandry, and Propagation*. Frankfurt am Main, Germany. 272 pp.), but these may not reflect behaviors in the wild. Herein, we report on mating and copulation of wild *H. suspectum* in a rock shelter at Red Cliffs National Conservation Area, Utah, USA (1051 m elev.; coordinates withheld).

At 0902 h on 21 May 2024, we located an adult male *H. suspectum* (hereafter, the male) and began following it as part of a long-term study on the species’ ecology and habitat use. At 1737 h, the male entered a shallow, northeast-facing rock shelter and dug soil out to enlarge an interior hole that was 32.7 cm straight in from the shelter entrance, which he entered. At 1832 h we observed the male and an adult female *H. suspectum*, (hereafter, the female), seeming to rest their heads pressed together at the entrance of the enlarged dirt hole in the back of the shelter. It was unknown whether the female was present in the shelter prior to the male entering, or if she had entered the shelter after the male (undetected by us) via one of two known (or an unknown) connected shelter entrance. From 1832 h to 1855 h, the male repeatedly “stroked” the female’s head and upper body by moving his head with lateral movements, that we interpreted as courtship behaviors, of which she was receptive, until they separated and moved out of view. At 1858 h, the male followed the female to the shelter entrance, where she laid down for 14 s and appeared receptive to the male’s attempts to mount her from behind, which he was unable to do because of the low ceiling of the shelter. During a 4-min period, from 1900–1904 h, the female slowly turned around as the male continually repositioned himself on, and next to her, until he followed her into the interior of the dirt hole out of view. During the 1858–1904 h activity, the male tongue flicked repeatedly at, and on the female’s body and tail, and not directly at her; while the female also tongue-flicked occasionally at the male’s head as he approached, and mostly not directly at the male, when he tried to mount or maintain a position on top of her.

At this time, at 1948 h, we installed four infrared-equipped Browning Dark Ops HD Pro X trail cameras 0.25 m above the



FIG. 1. Sequence of mating events of a pair of wild *Heloderma suspectum* in a rock shelter at Red Cliffs National Conservation Area, Utah, USA: A) mating position, with the hind limb of male clasp the base of the female's tail during copulation; B) male pressing his cloaca (with left hemipenis inserted) against the female cloaca in thrusting movement during copulation; C) probable wet semen remnants stuck to the male's cloaca and tail region with dirt partially adhered to it following copulation (white arrow).

ground and 1.0 m from (and facing) the entrance of the shelter to further document this event. We programmed the cameras to record eight photographs for each trigger event, with a 2-s delay between photos and 1-s between trigger events, continuously every 24 h. We also remained at the shelter to continue our monitor.

From 2109 h to 2113 h, we heard loud breathing and body against rock “scratching” sounds from within the shelter, indicative of probable male mating attempts, but the pair was out of view and we can't confirm this. During a 3-min period, from 2126–2129 h, the male followed the female to the shelter entrance where he again “stroked” the female's head and upper body with his head, and they both repeatedly tongue-flicked at each other with their heads in close proximity. This mutual tongue flicking lasted until the female repositioned her body and laid mostly still, while the male continued to tongue flick while nudging her body and tail with his head, and trying to mount her backwards (i.e., with his head above her tail) and from the rear, until he separated and reentered the dirt hole. At 2134 h, the male reentered the shelter entrance where the female was laying, and repeatedly nudged and “stroked” her head with his head for 49 s, while also repeatedly tongue-flicking at, and on her head, as she laid mostly still. During a 2-min period, from 2135–2137 h, the male mounted the female backwards, and from the rear

while clasping a hind limb around the base of her tail, apparently trying to rotate her pelvis towards him, with the male repeatedly tongue-flicking and female only occasionally. Though the female now exhibited signs of resistance, she appeared to be receptive to the male's movements, except on two occasions when the male mounted her backwards and struggled to maintain his position on top of her body. When this occurred, the female opened her mouth and “jerked” her head towards the male but did not bite.

At 2137 h, the female lifted her tail, the first time we saw this, so the male could more easily align his cloaca with hers, but due in part to the low shelter ceiling, the male was unable to make prolonged cloacal contact in this position. The pair continued to reposition themselves at the shelter entrance for 9 min, and at 2146 h the female again raised her tail, this time with the male using his left fore and hind limb to clasp the base of the female's trunk and tail (respectively). In this more stable position, the male moved his cloaca over the female's and inserted his left hemipenis into her cloaca (Fig. 1A). The pair remained mostly motionless in this position for 26 min, from 2147–2213 h, with their eyes closed; the only visible activity were regular periods of thrusting movements as the male further pressed his cloaca against the female's cloaca (Figs. 1A, B). We documented 77 total male thrusting movements during 17 distinct thrusting periods. The thrusting periods ( $N = 17$ ) had a relatively consistent number of male thrusts (mean =  $4.5 \pm 1.1$  SD; range: 3–6 thrusts), duration (seconds; mean =  $9.8 \pm 1.7$  SD; range: 6–12 s), and frequency (seconds; mean =  $90.1 \pm 23.9$  SD; range: 65–178 s). Each thrusting period consisted of a series of relatively quick thrusts followed by a final prolonged thrust with the male firmly pressing his cloaca against the female's cloaca. We also observed apparent minor contractions of the male's cloacal region immediately following some thrusting periods, which lasted for several seconds. At 2213 h, after 27 min, the pair separated and we observed what appeared to be wet semen remnants stuck to the male's cloaca and tail region, with some dirt partially adhered to it, suggesting successful intromission (Fig. 1C). The female then moved deeper into the shelter out of view, with the male following. We continued monitoring the shelter until 0030 h with no further activity observed on this night. We left the trail cameras at the shelter entrance until 30 June 2024 and captured images of the male *H. suspectum* basking and digging at the shelter on 22 May 2024, the female, then the male, exiting the shelter on 23 May 2024, the male entering and exiting the shelter on 25 May 2024, and a different male *H. suspectum*, confirmed by his unique dorsal patterns and prior male-male combat behavior (Beck 2005, *op. cit.*), was at the shelter 1–2 June 2024. No additional activity was recorded at the shelter entrance through 30 June 2024. A 4-min video recorded by DTP of our *H. suspectum* copulation observations can be viewed at <https://doi.org/10.26153/tsw/55866>.

To our knowledge this is the first observation of mating and copulatory behaviors in wild *H. suspectum*, and we confirmed Beck's (2005, *op. cit.*) hypothesis that these behaviors take place in shelters, accounting for the rarity of such observations. We suspect our ability to observe this rare event was due in part to the shallow rock shelter ceiling being taller at the entrance, and the location and positions of the male and female in the shelter, which allowed an unobstructed view of the mating activity. The sequence of events and behaviors exhibited by this mating pair were surprisingly consistent with those documented in captive *H. suspectum* (Gates 1956, *op. cit.*; Beck 2005, *op. cit.*; Schwandt 2019, *op. cit.*), including duration. The entire mating event we

observed took 27 min, which is also consistent with those under captive conditions which can last a few minutes to 2.5 h (Gates 1956, *op. cit.*; Beck 2005, *op. cit.*; Schwandt 2019, *op. cit.*).

We thank C. M. Gienger for reviewing this manuscript and our supplemental video file. Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the United States Government.

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**OPHISAURUS VENTRALIS (Eastern Glass Lizard). SEXUAL MATURITY.** *Ophisaurus ventralis* is a common, yet secretive legless lizard that occurs in the southeastern United States (Palmer and Braswell 1995. Reptiles of North Carolina. University of North Carolina Press, Chapel Hill, North Carolina. 104 pp.). Despite *O. ventralis* being one of the more commonly encountered species within the genus *Ophisaurus*, little is known about its life history, including the age at which individuals become sexually mature. Meshaka and Layne (2015. Herpetol. Conserv. Biol. Monogr. 5:1–535) suggested that individuals in southern Florida may reach sexual maturity within one year, however, this represents the southern limit of their range which may not be representative of populations in other regions. The age at which a lizard reaches sexual maturity is important for determining growth rates, longevity, reproductive output, and other variables used to understand the population dynamics of a species (e.g. Brooks 1967. Ecol. Monogr. 37:71–87). Here, we assessed sexual maturity and the relative age of road-killed *O. ventralis* individuals from North Carolina.

Between 2006 and 2023 we collected nine road mortality *O. ventralis* from Bladen, Moore, Richmond and Sampson counties in the Coastal Plain and Sandhills of southeastern North Carolina that were sampled for use as museum specimens and later shared for this research study (Table 1). We measured and dissected each lizard and examined their sex organs under a compound microscope to determine their state (present or absent) and level of development, where male lizards were considered sexually mature if spermatozoa were present and females by the presence of vitellogenic ovarian follicles. Mean SVL measurements are present with standard deviations.

Of the nine lizards dissected, four had detectable sex organs, two males (mean SVL = 14.05 ± 3.47 cm) and two females (mean SVL = 13.9 ± 1.56 cm), while sex organs, and therefore sex, was

not discernable for five lizards (mean SVL = 12.38 ± 3.21 cm; Table 1). The lack of sex organs in most individuals can likely be attributed to the organs being destroyed or lost when the animals were crushed by automobiles.

The male collected in June 2022 had what appeared to be sperm within the vas deferens, despite its small size (11.6 cm SVL) and the small female (12.8 cm SVL) collected in late May 2007 appeared to have at least one vitellogenic ovarian follicle. Factors such as the cause of death and age of the specimens could have interfered with the perceived condition of the sex organs, although the placement of material within the male's vas deferens and the relatively large size of the female's ovarian follicle suggest that the organs in both were mature and capable of reproduction. This would make these two individuals the smallest ever recorded to be capable of reproduction.

Palmer and Braswell (1995, *op. cit.*) detailed the seasonal habits of this species in North Carolina and noted that hatchlings appear by late summer in August and September. Assuming that our smaller male and female hatched around this time, and given they were found the following spring, this would suggest that both individuals were less than a year old when they died. Indeed, Fitch (1989, *op. cit.*) created a distribution of sizes for different age classes of the closely related and similarly sized *O. attenuatus* from a population in Kansas and, when compared with the age classes mentioned, also puts these animals within their first year of life. This is in line with the suggested age of maturity of *O. ventralis* in southern Florida (Meshaka and Layne 2015, *op. cit.*). However, since the smaller female in our sample only had one follicle that could be considered vitellogenic, it may be more likely that females wait to reproduce until their second spring. This may be supported by the larger female in our sample (15 cm SVL; Table 1), which had multiple vitellogenic ovarian follicles and, in theory, would be just over a year old. Overall, it seems that females attain sexual maturity somewhere in the range of 12–15 cm, while males appear to reach maturity at a slightly smaller size, but more field studies for *O. ventralis* are needed. Our sample, to our knowledge, includes the smallest individuals of *O. ventralis* yet recorded to be capable of reproduction and thus helps further our understanding of the life history of this species.

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TABLE 1. Road-killed *Ophisaurus ventralis* specimens with collection details and sex organ condition. Coordinates are in WGS 84.

Date Collected	Sex	SVL (cm)	Sex organs visible	Organ condition	County	Coordinates	Elev (m)
6 October 2021	Female	15.0	Yes	Several vitellogenic ovarian follicles	Bladen	34.6661, -78.3385	13
20 September 2017	Unknown	17.3	No	–	Sampson	34.7767, -78.3840	40
23 June 2006	Unknown	9.3	No	–	Moore	35.0698, -79.5543	97
5 October 2023	Male	16.5	Yes	No sperm	Sampson	34.6634, -78.2683	23
6 April 2022	Unknown	11.0	No	–	Bladen	34.6315, -78.3270	10
13 October 2022	Unknown	10.5	No	–	Sampson	34.6465, -78.2359	11
16 May 2023	Unknown	13.8	No	–	Bladen	34.5811, -78.2856	9
26 May 2007	Female	12.8	Yes	One vitellogenic ovarian follicle	Richmond	35.0171, -79.5448	100
1 June 2022	Male	11.6	Yes	Sperm in vas deferens	Bladen	34.6642, -78.3365	12

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**PHYMATURUS PALLUMA. MELANISM.** The genus *Phymaturus* is comprised of 52 species (Uetz et al. 2024. The Reptile Database, <http://www.reptile-database.reptarium.cz>, 31 May 2024) split into two species groups, the *patagonicus* group with 29 species and the *palluma* group with 23 species (Scolaro et al. 2021. North-West. J. Zool. 17:57–64; Lobo et al. 2022. Cuad. Herpetol. 36:197–231). Melanism is common in both species groups ranging from completely melanistic individuals to partially melanistic individuals (Scolaro et al. 2016. Bol. Mus. Nac. Hist. Nat. Chile 65:137–152; Lobo and Nenda 2015. Cuad. Herpetol. 29:5–25). In members of the *palluma* group, melanism is mostly restricted to the head and neck regions of males (Lobo and Nenda 2015, *op. cit.*), although females in at least one species, *P. verdugo*, may exhibit dark coloration on the dorsum and flanks (Corbalán et al. 2018. Can. J. Zool. 96:1317–1325). Here, we report an observation of a completely melanistic *P. palluma*, of the *palluma* species group, at the Punta de Vacas gorge, Aconcagua Provincial Park (32.8453°S, 69.7619°W; WGS 84; 2500 m elev.), Mendoza, Argentina.

While conducting herpetological surveys on 25 February 2023 we captured a young female (76.3 cm SVL) *P. palluma* (Fig. 1A) exhibiting dark, melanistic coloration in contrast to the typical brown color with dark reticulations of females of this size living in the area (Fig. 1B). Of note, the female we found displayed melanistic coloration over the entire body, including dorsal and ventral surfaces, although reticulations could be discerned beneath the darkened dorsal surface, similar to melanic lizards of the *patagonicus* group (Lobo and Nenda 2015, *op. cit.*). Ventral area is lighter than dorsum, and small spots are also visible. After photographing, we released the individual at the exact site of capture.

Melanism, or partially melanistic individuals have previously been reported in male *P. palluma* but restricted to only their head a neck region (Lobo and Nenda 2015, *op. cit.*). To our knowledge this is the first reported individual exhibiting a complete dark color pattern in *P. palluma* and the first record of such melanism in the *palluma* group of the genus *Phymaturus*.

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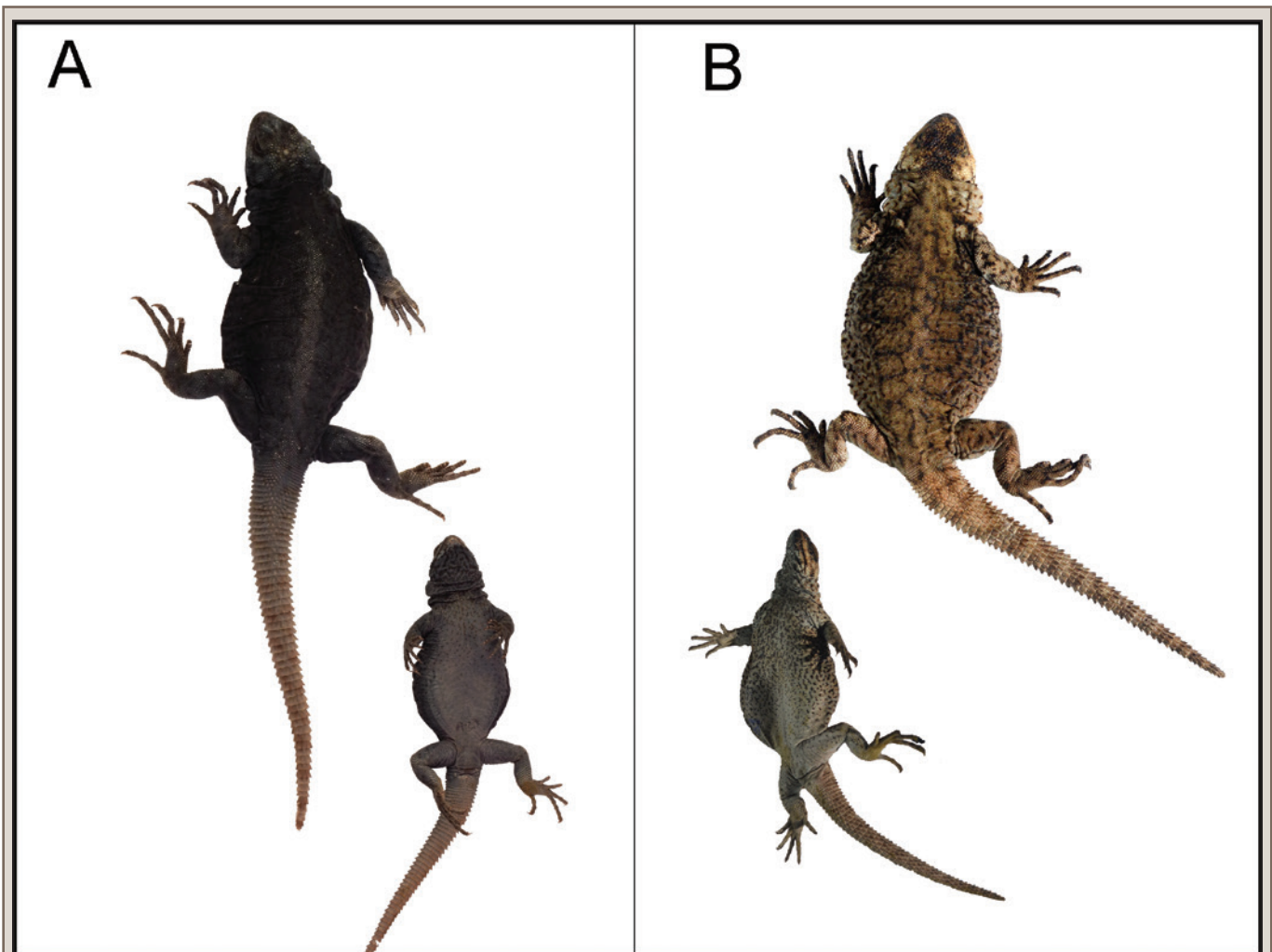


FIG. 1. A) Melanic individual of *Phymaturus palluma* found in Aconcagua Provincial Park (Mendoza, Argentina); B) normal reticulated pattern of an individual of *P. palluma* of similar size found in the same area.

**UTA STANSBURIANA** (Western Side-Blotched Lizard).

**PREDATION.** Few species of blood-feeding midges have been reported to feed on North American lizards, although one species, *Leptoconops californiensis* (family Ceratopogonidae), is known to feed on six lizard species that inhabit sand dunes of northwest Mexico and southwest United States (Mullens et al. 1997, J. Med. Entomol. 34:735–737; Turner and Olson 2005, Sonoran Herpetol. 18:54–55). In these instances, adult female *L. californiensis* were observed feeding on the lizard's dorsal surfaces from the head to the upper portion of the tail (Turner and Olson 2005, *op. cit.*). Here, we report a case of blood-feeding by *L. californiensis* on *Uta stansburiana* in sand dunes ca. 7 km east-southeast from Puerto Peñasco's airport (31.7518°N, 114.3501°W; WGS 84; 64 m elev.).

On 16 March 2024, at 1404 h we observed an adult male *U. stansburiana* with several *L. californiensis* midges biting the posterior dorsal area near the back-right leg (Fig. 1). Using our camera zoom we were able to observe the midges feed and watched as their abdomens filled with blood. We watched the midges feed on this lizard for 10 min until the lizard ran away, likely due to our presence. During this same period we also observed more midges feeding on two other nearby lizards, one *Callisaurus draconoides* and one *Phrynosoma mcallii*, which has previously been reported (Mullens et al. 1997, *op. cit.*). To our knowledge, this is the first report of *L. californiensis* feeding on *U. stansburiana*, and we suspect it is a common occurrence as these two species are common and overlap in desert dune habitats of the Sonoran, Mojave, and Colorado deserts.

Field work was supported by CFE/ASELEC (contract ALAND-RTA-AMB-002/2023) as part of a long-term study on *Uma rufopunctata* and *U. cowlesi* populations in the sand dunes of northern Sonora, Mexico.



FIG. 1. *Leptoconops californiensis* feeding on *Uta stansburiana* in the desert dunes of the Gran Desierto region, Sonora, Mexico.

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**SQUAMATA — SNAKES****ACHALINUS SPINALIS** (Japanese Odd-scaled Snake).

**REPRODUCTION.** *Achalinus spinalis* is a small xenodermid that is widely distributed in Japan (Honshu, Shikoku, Kyushu), central and southern China, and northern Vietnam. However, ecological information on this species is lacking. *Achalinus spinalis* egg-laying season has been estimated to be June–August, based on the period when gravid females have been observed (e.g., Yamasaki and Mori 2017 Curr. Herpetol. 36:28–36), but little is known about precisely when females of this species oviposit. The number of oviductal eggs has been reported in few previous studies (e.g., Totsune and Utsunomiya 1999, Bull. Herpetol. Soc. Japan 1:5–7); however, the number of eggs typically laid by *A. spinalis* has not been reported. Furthermore, the above cited reports have been limited to populations at low latitudes (southern Japan), and there are no published reports on populations at high latitudes (northern Japan). Here, we report the timing of egg-laying and the number of eggs laid by an *A. spinalis* in Aomori Prefecture, Japan.

We captured an adult female *A. spinalis* from a moist scree slope on the side of a forest path in Hirosaki City, Aomori Prefecture, Japan, on 17 June 2023. The female (324 mm SVL) was kept at room temperature (20 °C), and we found six eggs on the

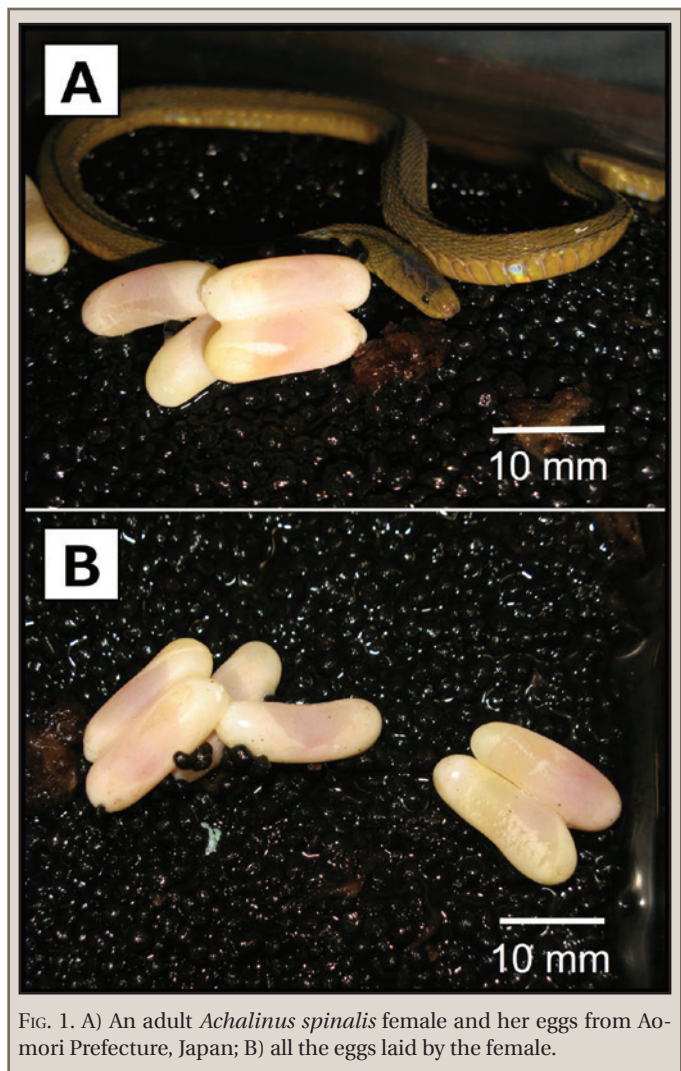


FIG. 1. A) An adult *Achalinus spinalis* female and her eggs from Aomori Prefecture, Japan; B) all the eggs laid by the female.

PHOTOS BY S. YASUDA

PHOTOS BY S. YASUDA



FIG. 2. *Achalinus spinalis* egg with visible blood vessels.

morning of 22 July 2023 (Fig. 1). These eggs were laid between 19 and 21 July 2023, since no eggs were found on 18 July 2023. The eggs were elongated in appearance (ca. 20.0 mm length × ca. 7.5 mm width). Considering that we observed blood vessels in all the eggs on 24 July 2023 (Fig. 2), the eggs were considered fertilized, and this female had presumably already mated when it was collected. However, the eggs were deemed nonviable on 1 August 2023. This is the first record of egg laying of *A. spinalis* in Aomori Prefecture, which is the northern limit of the distribution range of *A. spinalis*.

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**BOTHROPS AMMODYTOIDES (Yarará Ñata). DIET.** *Bothrops ammodytoides* is a viper endemic to Argentina with the southernmost distribution of any viper in the world (Carrasco et al. 2010. *Amphibia-Reptilia* 31:323–338; Williams and Vera 2023. *Serpientes de la Argentina*. Ediciones LBN, Balcarce, Buenos Aires. 351 pp.). It is terrestrial, lives in rocky and sandy areas from sea level to ca. 3700 m elev. (Carrasco et al. 2010, *op. cit.*), and feeds on rodents, birds, amphibians, and lizards (Cei 1993. *Reptiles del Noroeste, Nordeste y Este de la Argentina*. Herpetofauna de las Selvas Subtropicales, Puna y Pampas. Mus. Reg. Sci. Nat. Torino. 945 pp.; Avila and Morando 1998. *Herpetol. Rev.* 29:169; Scolaro 2006. *Reptiles Patagónicos Norte: Una Guía de Campo*. Universidad Nacional de la Patagonia San Juan Bosco, Comodoro Rivadavia. 112 pp.; Gómez Alés et al. 2013. *Herpetol. Rev.* 44:157). Here, we report a new prey item in the diet of *B. ammodytoides*.

At 2000 h on 26 March 2024, we captured an adult *B. ammodytoides* (Fig. 1A) in the Andes Mountains, in the Department of Iglesia, Province of San Juan, Argentina (30.66979°S, 69.54862°W; WGS 84; 3075 m elev.). The study area belongs to the Puna Phytogeographic Province and is

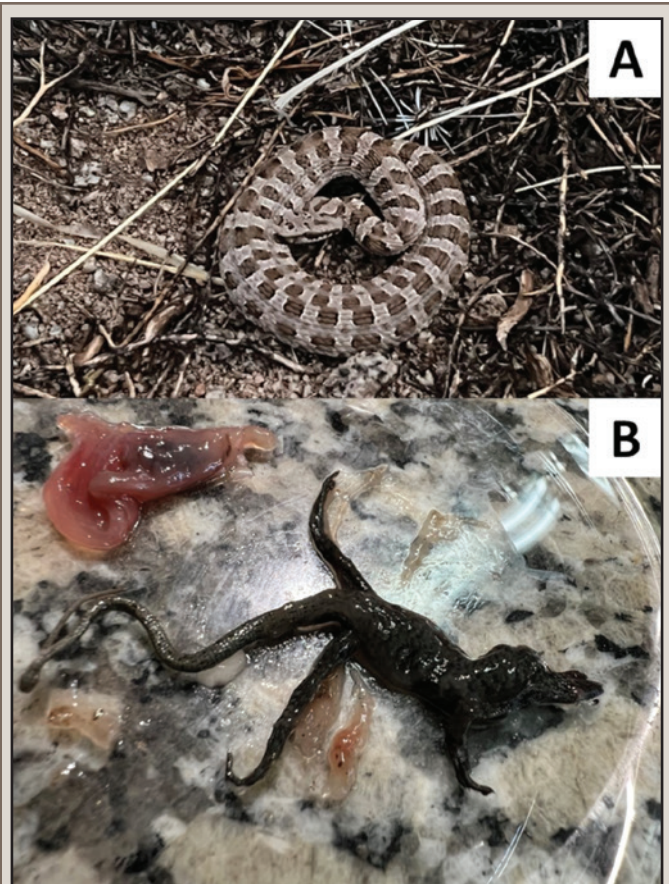


FIG. 1. A) *Bothrops ammodytoides* from San Juan Province, Argentina; B) *Liolaemus parvus*, a new lizard prey in the diet of *B. ammodytoides*.

characterized by extreme cold and dry climatic conditions (Márquez et al. 2018. *In* Acosta and Blanco [eds.], *Provincias Fitogeográficas de San Juan*, pp. 15–19. Editorial Brujas, Córdoba). At the time of capture, the snake was coiled on the bare ground and showed evidence of having consumed prey. It was subsequently sacrificed and deposited, along with the prey item, in the Colección Herpetológica de Universidad Nacional de San Juan (UNSJ). Dissection of the snake (26.8 mm total length, 19.7 g) revealed the prey item, a juvenile *Liolaemus parvus* (ca. 35 mm SVL, 0.8 g), with the head fully digested (Fig. 1B); representing 4% of the snake's body mass. Despite the wide geographic distribution of *B. ammodytoides* (Williams and Vera 2023, *op. cit.*) and that it is assumed to have a generalist diet (Williams et al. 2021. *Revista del Museo de La Plata* 6:26–124), specific reports of the prey consumed by this species are scarce. Therefore, this record constitutes a new prey item in the diet of *B. ammodytoides* and contributes to the knowledge of its trophic ecology.

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**CHIRONIUS MULTIVENTRIS (Brazilian Sipo Snake). DIET.** *Chironius* contains 23 species, endemic to the Neotropics (Entiauspe-Neto et al. 2020. Herpetol. Monogr. 34:98–115). These aglyphous snakes are oviparous, diurnal racers that inhabit the terrestrial or arboreal environments of Central and South American savannas and rainforests, covering a vast geographic area (Nogueira et al. 2019. S. Am. J. Herpetol. 14:1–274). Although most species of *Chironius* do not solely feed on anurans (i.e., bathracophagous), their diet often consists of a diverse array of anuran prey. This suggests that some species within the genus may possess a high level of dietary specialization (Roberto and Souza 2020. Herpetol. Notes 13:1–5). *Boana boans* (Giant Gladiator Treefrog) is a nocturnal and arboreal species that is widely distributed throughout the tropical forests of the Amazon basin and cis-Andean northern South America (Frost 2023. Amphibian Species of the World: an Online Reference. Version 6.2. amphibiansoftheworld.amnh.org, 5 Dec 2023). While several *Chironius* species have been reported to prey on *Boana* frogs, only *C. carinatus* has been confirmed to prey specifically on *B. boans* (Roberto and Souza 2020, *op. cit.*). Here, we describe predation by *Chironius multiventris* on *B. boans* in Amazonas, Brazil.

At 1603 h on 10 February 2023, at Maroaga Cave in Presidente Figueiredo, Amazonas, Brazil (2.04925°S, 59.97094°W; SAD 69; 146 m elev.), a *C. multiventris* was sighted with a *B. boans* in its mouth initiating ingestion headfirst, without constriction (Fig. 1). The treefrog exhibited some familiar defensive behaviors, which included emitting distress calls, attempting to resist the snake using its limbs, and inflating its body by filling its lungs with air, all already reported in the species (Toledo et al. 2011. Ethol. Ecol. Evol. 23:1–25). Despite its efforts, the *B. boans* was subdued after ca. 6 min. To our knowledge this is the first record of *C. multiventris* preying on *B. boans*, although it's not uncommon for this species to feed on other frogs (Roberto and Souza 2020, *op. cit.*).



FIG. 1. *Chironius multiventris* preying on a *Boana boans* in Maroaga Cave, Presidente Figueiredo, Amazonas, Brazil.

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**CLONOPHIS KIRTLANDII (Kirtland's Snake). CLIMBING BEHAVIOR.** *Clonophis kirtlandii* is a small terrestrial/fossorial natricine inhabiting moist soil habitats and urban lots in the midwestern United States (U.S. Fish and Wildlife Service 2017. Species status assessment report for Kirtland's snake [*Clonophis kirtlandii*]. 43 pp.). This species is notoriously secretive and is typically found beneath natural and artificial cover and using crayfish burrows as subterranean refugia (Ernst and Ernst 2003. Snakes of the United States and Canada. Smithsonian Institution Press, Washington D.C. 668 pp.). *Clonophis kirtlandii* is thought to be primarily nocturnal although it is sometimes active on the surface during daylight hours (Ernst and Ernst 2003, *op. cit.*).

At ca. 2100 h (after sunset; air temperature = 19 °C) on 24 October 2023 in Jefferson County, Indiana (precise locality withheld due to state endangered status), DC observed a *C. kirtlandii* climbing on a chain link fence ca. 25 cm above the ground (Fig. 1). The snake was initially located by her dog, and it appeared that the snake was attempting to escape as it moved through the fence and vegetation away from the dog. After photographing the snake, DC and the dog left the site, and returned ca. 30 mins later and did not locate the snake.

To our knowledge, climbing behavior has not been reported for *C. kirtlandii*. Though this encounter resulted from a disturbance scenario, climbing to escape a perceived predator appears to be a novel escape strategy for a species that often retreats into underground burrows or dense ground vegetation (U.S. Fish and Wildlife Service 2017, *op. cit.*). Given the propensity of this species to inhabit urban areas, anthropogenic structures such as fences may offer cover and escape opportunities from urban predators such as domestic cats—one of few documented predators identified for this secretive and understudied species (U.S. Fish and Wildlife Service 2017, *op. cit.*).



FIG. 1. *Clonophis kirtlandii* climbing in a chain link fence after fleeing a domestic dog in Jefferson County, Indiana, USA.

PHOTO BY DONNA CARSON

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**CROTALUS HORRIDUS (Timber Rattlesnake). HEAD MUSCLE QUIVERING BEHAVIOR.** Numerous snake species from temperate regions, such as North American pitvipers, often form social groups in winter shelters (e.g., dens) or during gestation (e.g., birthing rookeries or crèches). With few exceptions, details of social behaviors of snakes at these sites were rarely reported in literature before the 2000s. However, over the past two decades, robust investigations of the social behaviors of snakes at such aggregation sites have steadily increased (reviewed in Doody et al. 2021. *The Secret Social Lives of Reptiles*. Johns Hopkins Press, Baltimore, Maryland. 440 pp.).

Here, using videographic records of *Crotalus horridus* from two different birthing rookeries, we document and describe subtle behavior that occurred during social encounters. We term this new behavior “head muscle quivering” (HMQ). The two cases we describe below are from a collection of videographic records obtained by one of us (JJC) at two different sites (Pennsylvania and Maryland; precise locations withheld to protect populations). Video clips of the observations can be viewed at (available from <https://doi.org/10.26153/tsw/55865>). We define HMQ as “uni- or bilateral quivering or twitching of the dorsolateral and/or ventral head muscles associated with the paired venom glands.” In *C. horridus* and other vipers, each venom gland is located at the dorsolateral margin of the upper jaw. Connective tissues provide sites of attachment for specialized muscles, namely the compressor glandulae and the smaller pterygoideus glandulae (Young et al. 2001. *Anat. Rec.* 264:415–426). Presumably, these are the muscles that quiver during HMQ. In our cases, HMQ occurred only when a snake made physical contact with another snake.

Case 1: Lycoming County, Pennsylvania, USA. At this site the rattlesnake birthing rookery is about 1500 feet asl (457 m) and is oriented approximately to the southwest. The region is predominantly secondary growth eastern deciduous forest with a few conifer species. The rookery itself was associated with large sandstone slabs that are part of the weathering-resistant sandstone that forms the ridges in the area. Video filming of snakes occurred on 2 September 2020, from 1200–1500 h. Air temperature was 21–23 °C, conditions were overcast, and there was a slight breeze. During filming, two pregnant female *C. horridus* were observed at the rookery. Pregnancy was assumed based on the large girth of their lower body. The two pregnant females were in the company of neonates, which were the progeny of other females. Two or three other adult *C. horridus* were observed sheltering beneath the sandstone slab more consistently than the two pregnant females. All individuals took shelter under the same slab when weather conditions were unfavorable. HMQ occurred in one adult *C. horridus* encountering a neonate at 0:13 s and lasted 1.5 s, occurred bilaterally, and ended with a rapid partial tongue flick. The right pupil moved during HMQ and just prior to the tongue flick. Owing to its extreme brevity, HMQ was barely perceptible as it was exhibited on the dorsum of a newborn (pre-shed) *C. horridus*. The only noticeable change of behavior by the newborn *C. horridus* was that it moved away from the adult after it exhibited HMQ.

Case 2: Frederick County, Maryland, USA. The rattlesnake birthing rookery at this site was ca. 500 feet asl (152 m) and

west-facing. The immediate area has large, quartzite boulders and slabs in secondary growth eastern deciduous forest with some conifers. Video recording of snakes, where HMQ was detected, occurred on 28 August 2023, from 1200–1700 h. Air temperature was 26–28 °C. Weather conditions were cloudy, with intermittent sunlight, a slight breeze, and no precipitation. An adult *C. horridus* and an adult *Agkistrodon contortrix* (Eastern Copperhead) were filmed at the rookery. Based on their lower body girth, both individuals were presumed to be pregnant. HMQ was exhibited by the adult *C. horridus* at 0:07 s while its head was on the neck region of the coiled *A. contortrix*. The behavior was barely perceptible, occurred bilaterally on the neck region of the *A. contortrix*, involved ventrolateral muscles, and lasted only 1 s. Left pupil movement occurred before and during HMQ, and the only noticeable behavior of the *A. contortrix* was that its head can be seen to vibrate slightly. The two snakes remained coiled together until the *C. horridus* moved away 60 min later.

It is premature to ascribe a function to HMQ. Plausible hypotheses to test range from an involuntary movement made in the presence of other snakes to a voluntary social behavior used in communication. Nonetheless, because the dorsal scales of snakes are replete with mechanoreceptors (Jackson and Sharawy 1980. *J. Morphology* 163:59–67; Crowe-Riddell et al. 2016. *Open Biol.* 6:160054), it is likely that HMQ generates mechanical signals that can be detected by the mechanoreceptors of the recipients that affect their behavior. Whether HMQ occurs in other snake species remains a question for future research.

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**DISPHOLIDUS TYPUS (Boomslang). ARBOREAL COMBAT.** Male-male combat (MMC) behavior is known in a plethora of snake species, including representatives of most snake families (Shine 1994. *Copeia* 1994:326–346). It usually involves “topping” behavior, in which the combatants coil around each other with heads raised, and each combatant tries to shove its opponent’s head toward the ground (Carpenter 1977. *Am. Zool.* 17:217–223; Abu Baker et al. 2021. *Herpetol. Notes* 14:735–744; Senter 2022. *Curr. Herpetol.* 41:35–81). Although MMC is known in many arboreal and semi-arboreal snake species, most observations of the behavior have occurred on the ground. Such is the case in observations of the python species *Morelia spilota* (Covacevich 1975. *Vict. Nat.* 92:252–253; Hammond 1988. *Herpetol. Rev.* 19:37), the elapids *Dendroaspis angusticeps* (Haagner 1986. *J. Herpetol. Assoc. Af.* 32:36; Marais & McGahey 2010. *Af. Herp News* 52:15–16), *D. jamesoni* (Leloup 1964. *Bull. Soc. Roy. Zool. Anv.* 33:13–27), and *D. polylepis* (Grant 1956. *Af. Wild Life* 10:111–113; Curry-Lindahl 1956. *Af. Wild Life* 10:340–341), and the colubrids *Boiga irregularis* (Green and Mason 2000. *Herpetologica* 56:166–175), *Chironius bicarinatus* (Almeida-Santos and Marques 2002. *Amphibia-Reptilia* 23:528–533), *Pantherophis alleganiensis* (Sealy and Dow 2002. *Herpetol. Rev.* 33:212–213), *P. spiloides* (Rigley 1971. *J. Herpetol.* 5:55–56), and *Philothamnus hoplogaster* (Marais and Midlane 2010. *Af. Herp News* 52:13–15).

Documentation of the execution of MMC in arboreal situations is rare but occasionally occurs. It is known in the boa species *Corallus caninus* (Osborne 1984. Herpetol. Rev. 15:50), *C. hortulana* (Santos et al. 2020. Herpetol. Rev. 51:611–612), and *Sanzinia madagascariensis* (Carpenter et al. 1978. Herpetologica 34:207–212) and the colubrid species *Pantherophis spiloides* (Jackson and Smolinsky 2011. Herpetol. Rev. 42:300–301) and *Thelotornis mossambicanus* (Bennefield 1982. J. Herpetol. Assoc. Af. 28:13–14). Here, I report an instance of arboreal MMC in another colubrid species, *Dispholidus typus*.

In 2013, Bruce Whittaker of the safari guide company Top Safari Guides filmed a pair of *D. typus* in combat in a tree at the Asfaal picnic spot, Kruger National Park, South Africa (29.29027°S, 31.53111°E; WGS 84; video: <https://doi.org/10.26153/tsw/58577>). The footage includes three video clips. In the first clip, the snakes coil around each other in the branches above Whittaker. The continuous coiling creates a motion that carries the snakes forward through the branches. In the second clip, this continues, and one can see each snake repeatedly hooking its head and anterior neck around that of its opponent, with each combatant apparently trying to gain the superior position. The motion of the hooking propagates posteriorly down the bodies of the combatants as a series of mutual coils. In the third clip, this continues, and the continuous coiling motion carries the snakes forward through the branches. Throat inflation, the typical threat display of *D. typus* (Spawls and Branch 1995. The Dangerous Snakes of Africa. Ralph Curtis, Sanibel Island, Florida. 192 pp.; Chippaux and Jackson 2019. Snakes of Central and Western Africa. Johns Hopkins University Press, Baltimore, Maryland. 429 pp.), is not visible in any of the clips, although the view of the snakes' throats is often obscured by foliage. Continuous motion and obscuration by foliage make it difficult to count the number of coils, but during the second half of the second clip there are moments when the snakes are coiled around each other with at least three full turns. In the middle of the second clip (at the 33 s mark in the online video) is a moment when the snakes' anterior sections fall, which appears to be due to a deliberate downward push. During the third clip is another moment when the snakes' anterior sections fall, another possible instance of a deliberate downward push.

The behaviors that occurred during this observation of arboreal MMC are typical of snake MMC that occurs on the ground: head raising, neck hooking, downward pushing, and continuous coiling that generates forward locomotion (e.g., Hammond 1988, *op. cit.*; Almeida-Santos and Marques 2002, *op. cit.*; Abu Baker et al. 2021, *op. cit.*). At no point in the footage do the snakes use their tails to gain purchase on the branches or engage in any other behaviors specific to arboreal locomotion. The arboreal MMC in this case therefore appears to be unmodified from the typical terrestrial version of MMC in snakes.

The coloration of *D. typus* is highly variable, with variants that differ between and within sexes, age groups, and geographic areas (Spawls and Branch 1995, *op. cit.*; Chippaux and Jackson 2019, *op. cit.*). The latter two sources of variation and the variation within each sex makes it challenging to sex a boomslang solely on the basis of color. In this case, the dorsal coloration of one of the combatants was a shade of green that approximately matched the leaves of the tree in which the MMC took place, and that of the other combatant was light gray. The ventral coloration of each snake was a lighter shade of its dorsal coloration.

I would like to thank Bruce Whittaker for information on the episode reported here and for permission to write this report.

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**ERYTHROLAMPRUS POECILOGYRUS. DIET.** The genus *Erythrolamprus* currently comprises 55 known species, distributed from Central America to South America (Uetz et al. 2023. The Reptile Database, <http://www.reptiledatabase.org>, 9 April 2024), 36 of which are found in Brazil (Guedes et al. 2022. Herpetol. Brasileira 12:56–161). *Erythrolamprus poecilogyrus* is a species with terrestrial habits, oviparous reproduction, and records of activities during the day and night (Guedes et al. 2014. Zootaxa 3863:1–19). It feeds mainly on amphibians (Andrade et al. 2020. Herpetol. Notes 13:1065–1068). However, due to its presence in diverse environments, it exploits different food resources, including fish, small rodents, and lizards (Andrade et al. 2020, *op. cit.*; Lizarro et al. 2021. Herpetol. Rev. 52(1):155–156; Oliveira et al. 2021. Herpetol. Notes 16:299–300). In this work, we record three new species of anuran amphibians in the diet of *E. poecilogyrus*.

In October 2018, during research activities in the Perobas Biological Reserve, Municipality of Tuneiras do Oeste, State of Paraná, southern Brazil (23.8541°S, 52.7347°W; WGS 84), an individual of *E. poecilogyrus* (600 mm SVL, 220 mm tail length) was found regurgitating three small anuran amphibians. Individuals were collected, preserved in 70% ethanol, and identified as: *Elaschistocleis cesarii*, *Scinax fuscioravius* and *Dendropsophus nanus*. To our knowledge, this is the first report of *E. poecilogyrus* feeding on these anuran species.

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FIG. 1. Anuran prey items (*Elaschistocleis cesarii*, *Scinax fuscioravius*, and *Dendropsophus nanus*) regurgitated by an *Erythrolamprus poecilogyrus* from the Perobas Biological Reserve, Municipality of Tuneiras do Oeste, State of Paraná, southern Brazil.

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**FARANCIA ABACURA (Red-bellied Mudsnake). PARASITES.** *Farancia abacura* is a large, aquatic dipsadine colubrid that inhabits fresh and brackish waters with muddy bottoms, such as cypress swamps, marshes, sloughs, and tidal bays, in the southeastern United States (Smith 1938. Copeia 1938:110–117; Ernst and Ernst 2003. Snakes of the United States and Canada. Smithsonian Institution Press, Washington, D.C. 668 pp.). Their diet consists primarily of giant aquatic salamanders (*Amphiuma* spp., *Siren* spp., and *Pseudobranchius* spp.) and occasionally other salamanders or anurans (van Hynning 1932. Copeia 1932:37; Carr 1940. Univ. Fla. Publ. Biol. Sci. Ser. 3:1–118; Buck 1946. Herpetologica 3:111; Durso et al. 2013. J. Zool. 291:185–193; Steen et al. 2019. Fla. Sci. 82:129–133).

Here, we report infection of three individual *Farancia abacura* by the invasive pentastome parasite *Raillietiella orientalis*. This parasite was first reported in Florida in 2018 and is presumed to have spilled over from *Python bivittatus* (Burmese Python) to native snakes (Miller et al. 2020. Ecosphere 11:e03153). *Raillietiella orientalis* is likely spreading to new areas via a diverse assemblage of intermediate hosts, and evidence suggests that anurans are particularly competent vectors (Palmisano et al. 2023. Southeast. Nat. 22:N17–N22). Infections are confirmed in 14 other native snake species based on published accounts (Farrell et al. 2019. Herpetol. Rev. 50:73–76; Metcalf et al. 2019. Herpetol. Rev. 50:389; Miller et al. 2020, *op. cit.*; Luna et al. 2022. J. Parasitol. 108:582–594; Palmisano et al. 2023, *op. cit.*) and we know of three additional unpublished host species reports (A. Durso, T. Farrell, S. Horvath, J. Palmisano; unpublished data). Infections are associated with snake mortality, lesions of the lung, pneumonia, and sepsis, but physiological and population-level impacts on host snakes are largely unknown.

On 3 June 2020, we collected a dead female *F. abacura* (71.5 cm SVL, 134.2 g) from the intersection of Rattlesnake Hammock Road and Skyway Drive in Collier County, Florida, USA (26.10929°N, 81.70267°W; WGS 84). The specimen was frozen until January 2024 when it was thawed and dissected. A single adult female *R. orientalis* was found in the lung. On 3 October 2022, we collected a dead adult male *F. abacura* (83 cm SVL, 435 g) from Staley Road in Lee County, Florida (26.65847°N, 81.77575°W; WGS 84; <https://www.inaturalist.org/observations/137399168>, 20 Sept 2023). Dissection revealed one female *R. orientalis* in the lung and a second adjacent to the snake's trachea. On 24 April 2023, we collected a dead adult female *F. abacura* (121 cm SVL, ca. 1200 g) from FGCU Boulevard in Lee County, Florida (26.46097°N, 81.77574°W; WGS 84; <https://www.inaturalist.org/observations/160340641>, 20 Sept 2023). We found two female *R. orientalis* adjacent to the snake's trachea. A male *F. abacura* (62 cm SVL, 176 g; <https://www.inaturalist.org/observations/156578846>, 20 Sept 2023) found dead on 24 April 2023 in the same place did not have any *R. orientalis* or other pentastomes in its lung.

We identified the pentastomes as *R. orientalis* based on morphological features (a flattened, triangular head with distinct anterior and posterior hooks) and molecular analysis. For the latter we used conventional PCR using CO1 mtDNA primers

(Palmisano et al., *in prep.*) and Sanger sequencing. Our sequences (Collier County: GenBank accession = PQ083389; Staley Rd: GenBank accession = PQ083387; FGCU: GenBank accession = PQ083388) were 100% identical to several other *R. orientalis* CO1 sequences in GenBank. The highest matches were MG559642, MG559644 and MG559645 from *Agkistrodon conanti*, MG559643 from *Thamnophis sirtalis*, and MG559646 from *Pantherophis guttatus* (Miller et al. 2018. Ecol. Evol. 8:830–840).

From studies of captive *F. abacura*, the species can host the native pentastome *Kiricephalus coarctatus* (Deakins 1973. Pentastome pathology in captive reptiles. Ph.D. Dissertation, University of Oklahoma, Norman, Oklahoma. vii + 52 pp.), but *F. abacura* has not previously been documented as a host of *R. orientalis*. Miller et al. (2020, *op. cit.*) examined 9 *F. abacura* but all were uninfected. Finding *R. orientalis* in a dietary specialist suggests that potential intermediate hosts could include *Siren*, *Amphiuma*, or other salamanders, although this has not been confirmed, and *F. abacura* do occasionally eat frogs (Durso et al. 2013, *op. cit.*).

The average mass of the *R. orientalis* taken from *F. abacura* was relatively low (ca. 2 mg each) compared to our unpublished data on *R. orientalis* infecting other snake species in the same region, as was their number per host. This pentastome can exhibit morphological differences among host species (Westfall et al. 2019. PLoS ONE 14:e0209252). The small size and low number of *R. orientalis* per host might suggest that *F. abacura* is not an ideal host, although it could also be that these individuals had not yet reached their full adult size, a process that can take up to 80 d in other raillietiellids (Ali and Riley 1983. Parasitology 86:147–160). We still have a great deal to learn about the biology of *R. orientalis* and its hosts.

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**FARANCIA ERYTROGRAMMA (Rainbow Snake). SPRING HATCHLING EMERGENCE.** On the evening of 11 April 2021 (1900–2200 h), we observed 11 hatchling *F. erythrogramma* at sites in Currituck County, North Carolina and Virginia Beach, Virginia, USA (exact locality withheld to protect the species). It was an abnormally warm day with a high of 27 °C and a low of 18 °C, a drop in barometric pressure to 999.9 hPa, and there had been a rain event the night before totaling 17 mm. At the North Carolina site, one *F. erythrogramma* had been found under artificial cover before sunset, two others were found crossing a short stretch of road after sunset, and another single hatchling was found shortly thereafter on another road ca. 3 km away. We believe these represent multiple different clutches due to the distance between the observations. The same evening in Virginia Beach, we found seven *F. erythrogramma* under an illuminated street light adjacent to an agricultural field at ca. 2200 h. These observations are most likely a spring emergence of hatchlings that overwintered in the nest (Gibbons 1977. Herpetologica 33:276–281). The hatchlings



FIG. 1. Several hatching *Farancia erythrogramma* found under a streetlight on 11 April 2021, in Virginia Beach, Virginia, USA.

under the streetlight were observed in the same location again on 28 and 30 April. On both subsequent nights, only three *F. erythrogramma* were observed. We suspect they may have remained there as a result of being disoriented by the streetlight, similar to how hatchling sea turtles can be disoriented by city lights when trying to find their way to the ocean post emergence (Salmon 2003. *Biologist* 50.4:163–168).

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**LIODYTES PYGAEA (Black Swampsnake). ATTEMPTED PREDATION and DEFENSIVE BEHAVIOR.** *Liodytes pygaea* (formerly *Seminatrix pygaea*) is a small, highly-aquatic, black natricine snake with a red venter, native to the southeastern USA (Dorcas et al. 1998. *Cat. Am. Amphib. Reptil.* 679:1–5; Ernst and Ernst 2003. *Snakes of the United States and Canada*. Smithsonian Institution Press, Washington, D.C. 688 pp.). Known avian predators include *Butorides virescens* (Green Heron; Durso and

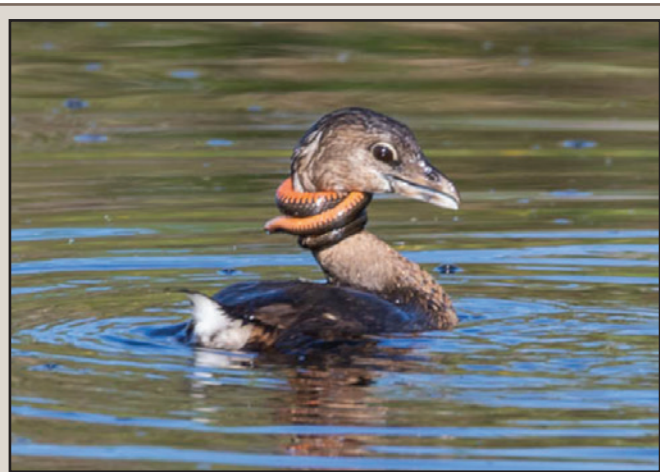


FIG. 1. *Liodytes pygaea* defensive strategy against *Podilymbus podiceps* (Pied-billed Grebe), in Florida, USA.

Rosenthal 2016. *Herpetol. Rev.* 47:484–485), *Ardea alba* (Great Egret), *Botaurus lentiginosus* (American Bittern), *Eudocimus albus* (White Ibis), and *Buteo lineatus* (Red-shouldered Hawk; Durso et al. 2017. *Herpetol. Rev.* 48:683–685). Here, we present documentation of *L. pygaea* defensive strategy against and attempted predation by *Podilymbus podiceps* (Pied-billed Grebe).

At 0919 h on 10 February 2017, JY observed and photographed an adult *L. pygaea* wrapped around the neck of an adult *P. podiceps* (Fig. 1) in a canal at the Lake Apopka Wildlife Drive, Orange County, Florida, USA (28.6689°N, 81.5765°W; WGS 84). During the observation, the *P. podiceps* appeared to be struggling with the snake wrapped tightly around its neck. This potential defensive strategy by *L. pygaea* has not been documented in other predation observations. The *P. podiceps* was able to grip the snake in its bill and unwrap it, diving under water at 0921 h. At 0927 h, the *P. podiceps* was observed again without its prey; we could not confirm if the snake was consumed, but *P. podiceps* would represent a previously undocumented predator of *L. pygaea*.

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**NERODIA FLORIDANA (Florida Green Watersnake). PREDATION.** *Nerodia floridana* is a medium-sized, semi-aquatic snake found in the southeastern USA (Ernst and Ernst 2003. *Snakes of the United States and Canada*. Smithsonian Institution Press, Washington, D.C. 688 pp.). Known avian predators of *N. floridana* include *Buteo lineatus* (Red-shouldered Hawk; Krysko 2002. *Am. Midl. Nat.* 148:102–114), *Mycteria americana* (Wood Stork), *Botaurus lentiginosus* (American Bittern), and *Ardea herodias* (Great Blue Heron; Durso et al. 2017 *Herpetol. Rev.* 48:863–864). Here, we present documentation of *N. floridana* predation by *Podilymbus podiceps* (Pied-billed Grebe).

At 0925 h on 20 January 2022, LW observed and photographed a juvenile *N. floridana* being eaten by an adult *P. podiceps* (Fig. 1) at the Wakodahatchee Wetlands, Palm Beach County, Florida, USA (28.6689°N, 81.5765°W; WGS 84). The *P. podiceps* surfaced with the snake in its bill and consumed it in 70 s.



FIG. 1. *Nerodia floridana* being eaten by *Podilymbus podiceps* (Pied-billed Grebe) in Florida, USA.

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**NERODIA RHOMBIFER (Diamondback Watersnake). DIET.** *Nerodia rhombifer* is a large natricine up to 160 cm in total length, with females being significantly larger than the males (Heimes 2016. Herpetofauna Mexicana. Vol I. Snakes of Mexico. Edition Chimaira, Frankfurt am Maim, Germany. 572 pp.). This species ranges from east-central USA to southern México in the state of Chiapas (Gibbons and Dorcas 2004. North American Watersnakes: a Natural History. University of Oklahoma Press, Norman, Oklahoma. 438 pp.; Heimes 2016, *op. cit.*). It is a dietary generalist that is known to consume invertebrates, amphibians, reptiles, birds and mammals; however, its main prey are fish, having been documented to feed on members of at least 22 families (Gibbons and Dorcas 2004, *op. cit.*; Kalki et al. 2018. Bull. Chicago Herpetol. Soc. 53:249–252).

On 15 June 2021, at ca 1400 h, a large adult female *N. rhombifer* was sighted along the shore of an artificial drainage in the Municipality of Gomez Fariás, Tamaulipas, México (22.9775°N, 99.1239°W; WGS 84; 95 m elev.); the snake was carrying a fish out of the water to eat. Upon getting closer to examine the scene, the snake was alerted and made a dash for the water, leaving its prey behind; the dying fish was then photographed (Fig. 1), preserved in 70% ethanol, and deposited in the Ichthyological Collection of the Facultad de Ciencias Biológicas of the Universidad Autónoma de Nuevo León (as UANL 22707). Upon collection, the fish was immediately recognized as a member of the family Cichlidae by the incomplete lateral line and overall morphology; later it was identified as *Nosferatu pantostictus* using keys (Miller 2009. Peces Dulceacuicolas de México. CONABIO, Ciudad de México, México. 559 pp.) and descriptions (Maza-Benignos and Lozano-Vilano 2013. Zootaxa 3734:101–129). Other cichlid fish documented as prey of *N. rhombifer* are *Mayaheros urophthalmus* from Veracruz, México (Aldridge et al. 2003. Herpetologica 59:43–51) and *Oreochromis aureus* from Texas, USA (Zamora and Valdez 2007. Herpetol. Rev. 38:468–469); this makes *Nosferatu pantostictus* a new prey item and the third confirmed cichlid prey species for *N. rhombifer*.

PHOTO BY ROBERTO GARCÍA-BARRIOS



FIG. 1. Lateral view of *Nosferatu pantostictus* (UANL 22707) caught by the adult female *Nerodia rhombifer* in Tamaulipas, México. Scale bar = 5 cm.

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**PHILODRYAS NATTERERI (Corre-campo). DIET.** *Philodryas nattereri* is a common snake in northwestern Brazil, widely distributed in the South American open formations (Nogueira et al. 2019. S. Am. J. Herpetol. 14:1–274). This species exhibits diurnal and semi-arboreal habits and opportunistic and generalist predation behavior (Vitt 1980. Pap. Avul. Zool. 34:87–98; Sales et al. 2020 Cuad. Herpetol. 34:285–293), with records of “lizards”, small mammals, bats, birds, toads, and snakes (including cannibalism) in its diet (Vitt and Vangilder 1983. Amphibia-Reptilia 4:273–296; Mesquita et al. 2011. Herpetol. J. 21:193–198; Sales et al. 2020, *op. cit.*; Coelho-Lima et al. 2021. Herpetol. Notes 14:843–846; de Sousa et al. 2023 Austral Ecol. 48:1036–1041). Herein, we describe the first record of *P. nattereri* preying on a bird of the order Psittaciformes, specifically *Forpus xanthopterygius*.

At 1435 h on 23 May 2024, a *P. nattereri* (ca. 100.0 cm SVL) was found preying on an *F. xanthopterygius* on the ground under an Asteraceae bush (Fig. 1) in an anthropized rural area, close to seasonal forest formations, within the Cerrado domain (13.95443°S, 42.51915°W; WGS 84; 899 m elev.), in the Municipality of Caetitê, Bahia, northeastern Brazil. The prey was caught by the head and took ca. 13 min to be swallowed completely. The snake was identified based on the species’ typical color pattern (Vanzolini et al. 1980. Répteis das Caatingas. Academia Brasileira de Ciências, Rio de Janeiro, Brazil. 313 pp.), which has previously been recorded in the region (Coelho-Lima et al. 2021, *op. cit.*). The bird was identified based on the intense bluish color on the wings and dorsal region (indicating that it is a male) and the short, wedge-shaped tail, typical of this species (Sick et al. 1997. Ornitologia Brasileira. Nova Fronteira, Rio de Janeiro. 862 pp.; Bocalini and Silveira 2015. Rev. Bras. Ornitol. 23:64–75).

*Forpus xanthopterygius* is found in almost all Brazilian states, as well as other countries in South America (Bocalini and Silveira 2015, *op. cit.*) and can be found foraging on the ground (Sick et al. 1997, *op. cit.*; Oliveira 2023. Regnellia Scientia 9:143–147), which likely allowed this predator-prey interaction with *P. nattereri*. Other birds have been recorded in the diet of this snake, but not yet a Psittaciformes (Sales et al. 2020, *op. cit.*).

We thank Eliene Malheiro for kindly providing us with the videos and images of the predation interaction.

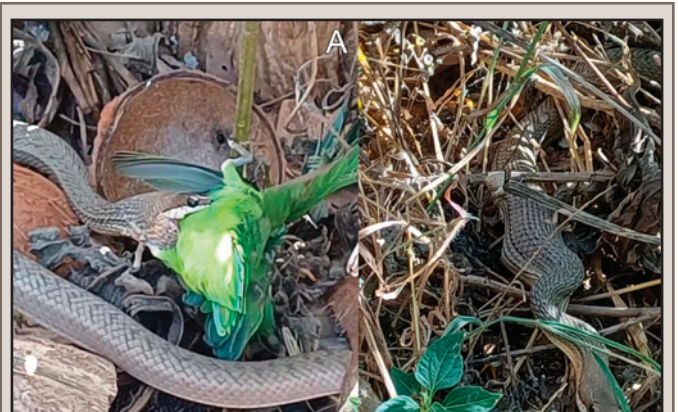


FIG. 1. *Philodryas nattereri* preying on a *Forpus xanthopterygius* in the Municipality of Caetitê, Bahia, Brazil: A) predator biting the prey; B) predator after complete ingestion of the prey

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**PYTHON BIVITTATUS (Burmese Python). PREDATION.** On 16 January 2024, KAO and ASR were conducting radiotelemetry on *P. bivittatus* as part of a scout snake program conducted by University of Florida's Institute of Food and Agricultural Sciences (IFAS). At ca. 1545 h, while navigating South Florida Water Management's Water Conservation Area 3, Broward County, Florida, USA, KAO observed the conspicuously large flat head of a lizard, raised above the grass on L-67C levee bank (26.0337°N, 80.4710°W; WGS 84). The grass on the levee bank was ca. 0.33 m in height with the lizard raising its head ca. 0.1 m above the grass. Based on these dimensions, we estimate the total length of the observed lizard to be ca. 1.5–2 m using morphological ratios from Thompson et al. 2018 (Aust. J. Zool. 56:351–362; contact ASR for R script). Given the absence of native lizard species of this size in Florida, we presumed the lizard was a nonnative species and prepared to remove it. However, immediately after noticing our presence, the lizard fled into the marsh adjacent to the levee bank.

We subsequently exited the vehicle to perform a visual survey at the location of the sighting. Approximately 3 min into conducting the search, ASR discovered a wounded *P. bivittatus* that was visible beneath the grass on the levee bank. The *P. bivittatus* exhibited avulsive injuries at the base of its neck resulting in the removal of a ca. 4.5 cm patch of skin at the injury site. We photographed the *P. bivittatus* in-situ (Fig. 1), before placing it into a snake bag to be removed from the site. The *P. bivittatus* was still alive at the time of collection and exhibited typical defensive behavior, including striking, despite its injuries. The *P. bivittatus* was then transported to the University of Florida IFAS Fort Lauderdale Research and Education Center (FLREC), where it was euthanized using a captive bolt followed by pithing. Post-euthanasia, we captured detailed images of the python's injuries (Fig. 2). The *P. bivittatus* measured 100 cm SVL, 114.5 cm total length, and was determined by necropsy to be a non-reproductive female in otherwise good health.

We identify the predating lizard as member of the genus *Varanus* as it possessed the long slender snout characteristic of the group. Further evidence to support this identification can be seen in Fig. 2. The clean shearing injuries (white arrow) at the bite site are suggestive of the large, recurved teeth of varanid lizards which routinely inflict lacerations during predation events (King and Green 1993. In King and Green [eds.], *Goannas: the Biology of Varanid Lizards*, pp. 16–24. UNSW Press, Sydney, Australia). While *V. niloticus* are an established invasive *Varanus* spp. in south Florida (Engeman et al. 2011. *Curr. Zool.* 57:599–612) this observation occurred ca. 9.25 km from their nearest local population. Thus, while we are confident the observed lizard was a member of the genus *Varanus*, we are unable to provide a species level identification. In Florida, documented predators



FIG. 1. In-situ photograph of a *Python bivittatus* that was abandoned by a predating lizard in Florida, USA. Note disturbance to grass presumably caused by the predation attempt.



FIG. 2. Avulsive injuries sustained by the *Python bivittatus* during the predation attempt, including lacerations to muscle tissue (gray triangles) and sheer cut (white arrow) at the base of the injury. Damage to the cranium was sustained during euthanasia.

of *P. bivittatus* include *Lynx rufus* (Bobcat), *Drymarchon couperi* (Eastern Indigo Snake), *Agkistrodon conanti* (Florida Cottonmouth), *Coluber constrictor* (North American Racer), *Crocodylus acutus* (American Crocodile), and *Alligator mississippiensis* (American Alligator), but no lizard species (Guzy et al. 2023. *Neobiota.* 80:1–119). Thus, the observation of any lizard attempting to predate *P. bivittatus* in Florida is novel and provides an example of a nonnative lizard successfully preying upon an invasive snake.

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**SISTRURUS TERGEMINUS (Western Massasauga). DIET.** *Sistrurus tergeminus* is a small species of rattlesnake that is native to North America and commonly feeds on mammals and squamates, along with other prey. Birds have been previously

PHOTO BY JOSHUA J. MEAD



FIG. 1. *Sistrurus tergeminus* ingesting a *Molothrus ater* (Brown-headed Cowbird) in Cheyenne Bottoms, Kansas, USA.

documented in their diet; however, they have constituted a very small portion of the diet in previous studies, if present at all (Patton et al. 2009. *J. Kansas Herpetol.* 30:13–20). Cheyenne Bottoms (Barton County, Kansas, USA) is the largest interior wetland in the continental USA and a significant stopover point for migratory birds through the central flyway. On 26 August 2016 at 1915 h, a Brown-headed Cowbird (*Molothrus ater*) was seen fluttering next to an adult male *S. tergeminus* (668 mm SVL, 85 mm tail length). This was believed to be shortly after envenomation and the bird quickly succumbed to the venom. Following several minutes of prey manipulation, ingestion of the prey began at 1934 h (Fig. 1) and ended at 1958 h, for a total duration of 24 min. The *S. tergeminus* was not disturbed prior to or during ingestion, which took place within grass on a dike road. This is the first documentation of *S. tergeminus* consuming *M. ater*, and one of the few documentations of birds within its diet.

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**STORERIA DEKAYI (Dekay's Brownsnake). ABERRANT COLORATION.** *Storeria dekayi* is a small semi-fossorial natricine found throughout most of eastern North America (Ernst and Ernst 2003. *Snakes of the United States and Canada*. Smithsonian Institution Press, Washington, D.C. 668 pp.). The color of *S. dekayi* is usually tan, yellowish-brown, brown, or reddish-brown often with a lighter middorsal band occupying the three medial scale rows and half of the adjoining scale rows. Two parallel rows of brown or black dorsolateral spots extend from the neck to the tail. These are fused by a transverse brown or black line in some specimens creating a ladder-like pattern. There may be a smaller row of dark dots below the larger ones. The lateral scales may be tipped with black and white creating a checkerboard-like pattern on some individuals. The ventral scales are yellowish, pinkish, brown, or gray with no pattern except for one or two rows of small black dots on the lateral edges (Wright and Davis 2021. *In* Davis et al. [eds.], *Ohio Biol. Surv. Bull. New Ser.* 20:673–688). Heckman (1960. *Herpetologica* 16:213) reported melanistic *S. dekayi* from



FIG. 1. Piebald *Storeria dekayi* from Champaign County, Ohio, USA.

New York and Minton (2001. *Amphibians and Reptiles of Indiana*. Indiana Academy of Science. Indianapolis, Indiana. 404 pp.) described nearly patternless, dark reddish individuals with a light pink belly from northern Indiana, USA. Albinos have been reported from Illinois (Smith 1961. *The Amphibians and Reptiles of Illinois*. *Ill. Nat. Hist. Surv. Bull.* 28:1–298; Thrall 1972. *Trans. Ill. Acad. Sci.* 64:400). Two leucistic *S. dekayi* have been encountered in Ohio (Wright and Davis 2013, *op cit.*). One from Stark County was white and patternless with black eyes. The other, from Ashtabula County, had typical patterning, but with pale markings, a paler background color, and red eyes.

On 9 June 2023, we encountered a unique subadult *S. dekayi* under a metal coverboard in Champaign County, Ohio, USA (specific locality withheld), at a site where tan, brown, and reddish-brown individuals are abundant. Approximately 60% of the dorsum was white with the remaining 40% randomly mottled with dark brown. The head was similarly marked. The belly was white, unpatterned, and lacked any trace of the rows of black dots on the lateral edges of the ventral scales. Bechtel (1995. *Reptile and Amphibian Variants, Colors, Patterns, and Scales*. Krieger Publishing Co., Malabar, Florida. 206 pp.) describes snakes having this pattern as “piebald,” which he defines as “spotted or patched, usually in black and white.” Between 2015 and 2023, using over 200 artificial cover objects, we have had 3132 encounters with *S. dekayi* at this site and have found no other individuals with this or any other color aberration. Photographs are accessioned into the Cincinnati Museum Center’s photodocumentation collection (CMC HP 18564–18566; Fig. 1).

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