NATURAL HISTORY NOTES

CAUDATA — SALAMANDERS

AMBYSTOMA MACULATUM **(Spotted Salamander). POLYEMBRYONY.** Polyembryony (twinning) in caudates has been previously reported in *Ambystoma tigrinum* (Eastern Tiger Salamander) and *Hemidactylium scutatum* (Four-toed Salamander), but only in small numbers of instances at a time (three and one eggs, respectively; Lindberg 1995. Herpetol. Rev. 26:142; Hamed et al. 2015. Herpetol. Rev. 46:227). Two instances of polyembryony in *Ambystoma maculatum* egg masses were observed in a vernal wetland pool in Calhoun County, Alabama, USA (33.78409°N, 85.77069°W; WGS 84) while monitoring eggs for symbiotic algae. On 9 January 2019, one egg mass of ca. 60 eggs showed more than 8 polyembryonic eggs at Harrison Stage 1 (Fig. 1A; Harrison 1969. Organization and Development of the Embryo. Yale University Press, New Haven, Connecticut. 290 pp.). A second egg mass of similar size was observed on 28 January 2019 near the first showing more than five polyembryonic eggs at ca. Harrison Stage 20 (Fig. 1B). More exact counts were not taken in an effort to disturb the egg masses as little as possible. The masses were deposited on the substrate of the mixed hardwood stand. All polyembryonic eggs showed two embryo per outer egg capsule. However, embryo do appear to have distinct separation in the innermost vitelline membrane, each with its own compartment. By comparing subsequent observations of the first egg mass, we see similar developmental rates between polyembryonic eggs and their singular siblings, both reaching approximately Harrison Stage 20 by 28 January 2019 (Fig. 1C). Hatching of both egg masses occurred between 8 February 2019 and 16 February 2019.

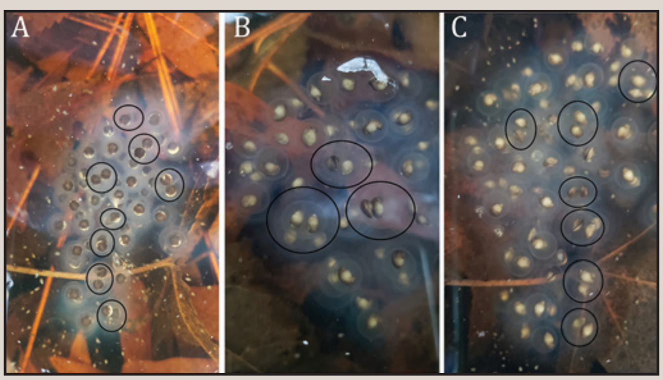

FIG 1. A) *Ambystoma maculatum* egg mass #1 showing eight polyembryonic eggs; B) *A. maculatum* egg mass #2 showing three polyembryonic eggs at later developmental stage; C) *A. maculatum* egg mass #1 showing seven polyembryonic eggs at a later developmental stage.

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ANDRIAS JAPONICUS **(Japanese Giant Salamander). DIET.** *Andrias japonicus* is one of the largest amphibians in the world and a top predator in Japanese river ecosystems. This species feeds on various animals from insects to mammals (Tochimoto 2002. Hyogo Biol. 12:134–139). The prey consumed varies between populations and may include terrestrial animals, such as snakes or frogs (Okada et al. 2008. Herpetol. Conserv. Biol. 3:192–202). At 1715 h on 17 May 2019, we found an *A. japonicus* eating a *Bufo japonicus* (Japanese Toad; Fig. 1A) in the upper stream of the Yura River (width ca. 7 m, depth ca. 20 cm) in the Ashiu Forest

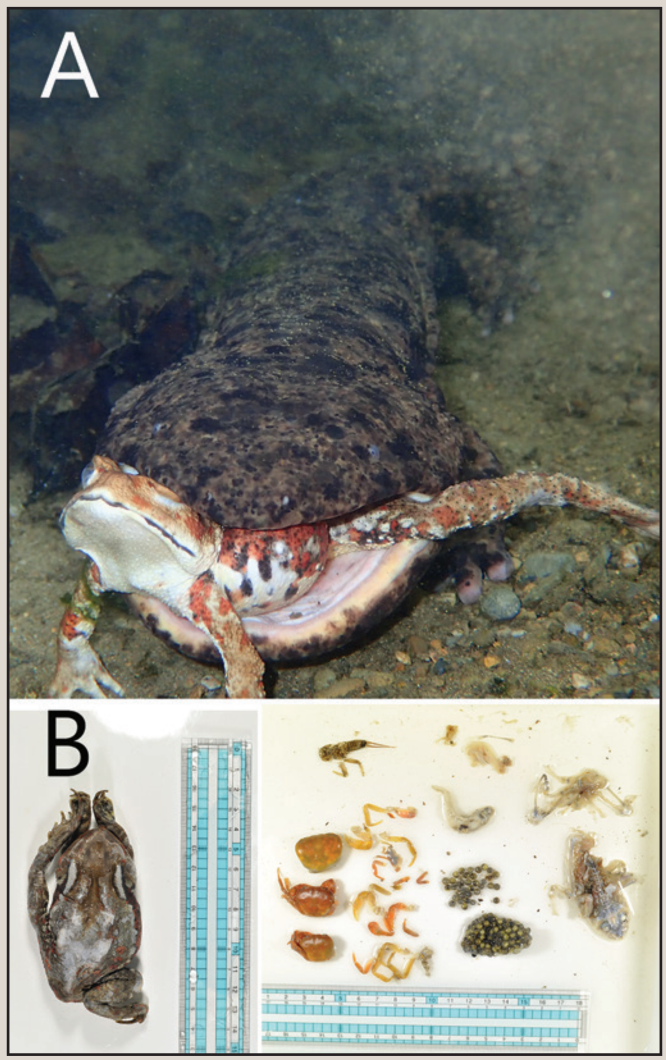

FIG. 1. A) Japanese Giant Salamander (*Andrias japonicus*) eating a Japanese Toad (*Bufo japonicus*) in the upper stream of the Yura River; and B) the stomach contents regurgitated from the salamander, including the toad and the other small animals.

Research Station of Kyoto University, Nantan City, Kyoto Prefecture, Japan (35.340°N, 135.762°E; WGS 84; 630 m elev.). After the salamander swallowed the toad, we caught and kept it in a tank until the next day. We measured the salamander (685 mm total length), examined the stomach contents regurgitated by gentle massage, and injected a PIT tag for individual identification. The *A. japonicus* weighed 1815 g after regurgitation. The SVL of the toad was 89 mm. The other stomach contents included three freshwater crabs (*Geothelphusa dehaani*), a plecopteran larva (*Oyamia* sp.), a freshwater goby (*Rhinogobius* sp.), a pharyngeal bone of a cyprinid fish, and a digested frog with an egg mass (unknown rhacophorid species; Fig. 1B). We released the giant salamander back to the stream where we found it at on 18 May 2019.

It may be rare to find a *B. japonicus* in a stream, and this should be the first report of predation on this species by *A. japonicus*. We guess that the salamander attacked the toad at the edge of the riverbank. Moreover, species of *Bufo* including *B. japonicus* have toxic steroids (bufadienolides) in the skin secretions that inhibit the sodium-potassium pump, causing arrhythmia (Melero et al. 2000. Molecules 5:51–81). Introduced *Rhinella marina* (Cane Toad) have been reported to kill endemic predators with their toxins in several countries and regions (Kidera and Ota 2008. Cur. Herpetol. 27:23–27; Letnic et al. 2008. Biol. Conserv. 141:1773–1782). However, the giant salamander did not die after swallowing the *B. japonicus* and seemed to be unaffected by the toxins. Furthermore, an *A. japonicus* showed no effect from toxins after eating a poisonous *Rhabdophis tigrinus* (Tiger Keelback Snake; Tanaka and Mori 2000. Curr. Herpetol. 19:97–111), which obtain and store toxins from their bufonid prey (Hutchinson et al. 2013. J. Zool. 289:270–278). Thus, *A. japonicus* may have resistance to the bufadienolides and may be able to feed on toads.

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***CALOTRITON ARNOLDI* (Montseny Brook Newt). AGONISTIC BEHAVIOR.** Behavioral observations on *Calotriton arnoldi* are scarce due to the rarity of this micro-endemic amphibian. Its sister species, *C. asper* (Pyrenean Newt), is not considered territorial but exhibits agonistic behavior between males consisting of biting the trunk, head, and extremities. Herein, we report male-male combat in *C. arnoldi*. On 31 May 2019, we observed and filmed agonistic behavior between two male *C. arnoldi* (www.youtube.com/watch?v= S9ZAfiw2ewc) that was very similar to observations of agonistic behavior in *C. asper*. Although the cause of male-male combat in this genus is uncertain, it may be related to female access. The biting behavior observed is enhanced by the large size of male heads and can produce serious lesions leading to the amputation of limbs that can be fully regenerated.

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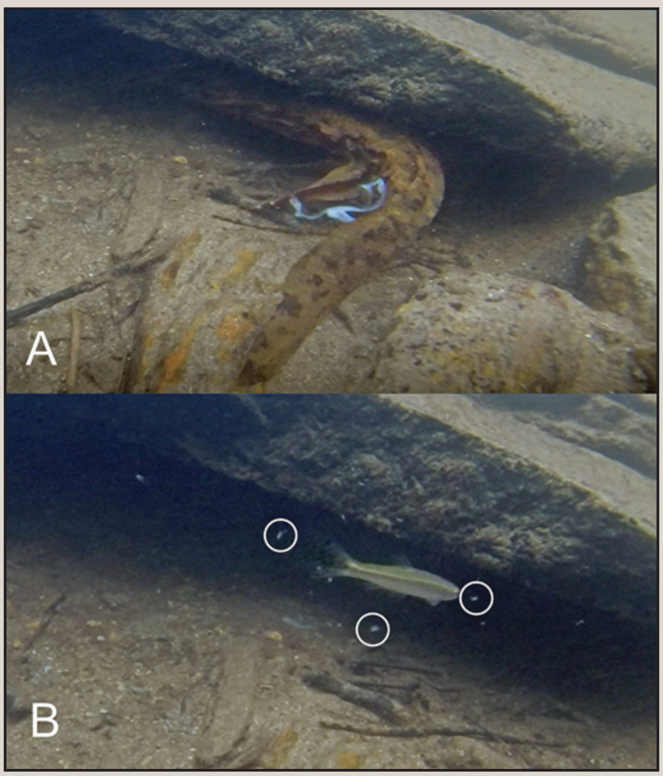
***CRYPTOBRANCUS ALLEGANIENSIS* (Hellbender). MILT PREDATION.** Spermatophagy or ingestion of seminal products has been documented in marine and terrestrial habitats across several invertebrate taxonomic groups as part of ritualized courtship or nuptial gifts whereby males provide spermatophores to females for consumption (Sakaluk 1984. Can. J. Zool. 63:1652–1656; Wegener et al. 2013. Behav. Ecol. 24:668–671). However, few reports exist of consumption of spermatozoa products produced by freshwater herpetofauna. *Notophthalmus viridescens* (Eastern Newt) has been observed in ponds to consume *Ambystoma maculatum* (Spotted Salamander) spermatophores (Hartzell 2018. Herpetol. Rev. 49:511). *Cryptobranchus alleganiensis* is a fully aquatic salamander found throughout Appalachia, breeding via external fertilization during the fall (Nickerson and Mays 1973. The Hellbenders: North American Giant Salamanders. Milwaukee Public Museum, Milwaukee, Wisconsin. 106 pp.).

On 9 September 2018 at 1405 h, we observed two adult *Notropis* sp. (shiner) consuming milt or seminal fluid from an adult male *C. alleganiensis* actively extruding ejaculate (Fig. 1A). This took place in a tributary of the French Broad River of western North Carolina, USA (specific locality on file with the North Carolina Wildlife Resources Commission and withheld due to conservation concerns). The feeding took place for ca. 26 s and was captured on a GOPRO 4 action camera positioned at the rock shelter entrance during a breeding season snorkel survey. In total, eight individual floating clumps of milt were consumed by two fish (one fish consumed two while the other consumed six floating clumps) immediately after the *C. alleganiensis* entered a rock shelter after extruding the milt (Fig. 1B). This observation of spermatophagy is unusual and provides documentation of potential nutritional sources for aquatic organisms which may



PHOTOS BY S. UNGER

Fig. 1. A) Closeup of *Cryptobranchus alleganiensis* male releasing milt as it entered its shelter; and B) milt being consumed by a *Notropis* sp. outside the shelter immediately afterwards.

congregate opportunistically near *C. alleganiensis* shelters during the breeding season. Video available at https://youtu.be/UuRQkWQZE2A.

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DICAMPTODON ENSATUS **(California Giant Salamander). LARVAL DIET.** *Dicamptodon ensatus* is a large ambystomatid salamander of coastal northern California known to prey on a variety of vertebrates (Bury 1972. Am. Midl. Nat. 87:524–526; Petranka 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington, D.C. 587 pp.). Documentation of the prey consumed by larval *D. ensatus* is needed since, relative to congeners, little is known about the diet of larvae (Petranka 1998, *op. cit.*). On 21 November 2019 around 1400 h, in Jack London State Historic Park in Sonoma County, California, USA, we encountered a number of larvae and recently transformed *D. ensatus* in small pools and among streamside rocks over the course of a few 100 m. At the Vineyard Trail crossing of nearby Asbury Creek (38.34713°N, 122.54525°W; WGS 84), a larval *D. ensatus* (ca. 150 mm total length) was observed consuming an adult *Pseudacris regilla* (Pacific Treefrog; ca. 35 mm SVL; Fig. 1). The treefrog appeared recently dead, but the initiation of the predation event was not witnessed. The habitat was a closed canopy, mixed oak-redwood forest community, providing considerable shade. Bury (1972, *op. cit.*) reported the consumption of *P. regilla* by an adult *D. ensatus* in captivity, but to our knowledge, this is the first such observation in the field for a larval *D. ensatus*.

Fig. 1. Larval *Dicamptodon ensatus* consuming an adult *Pseudacris regilla*.

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HYNOBIUS NEBULOSUS **(Japanese Clouded Salamander). MORTALITY.** *Hynobius nebulosus* is a lentic-breeding salamander in Japan endemic to Kyushu Island. This species breeds in small pools or ditches. The female lays one egg sac, attaching the end of the sac to the substrate. The male then grasps and holds the female and pulls the sac from the body, an action referred to as midwife behavior (Usuda 1993. Japan. J. Herpetol. 15:64–70). On 25 February 2000 at 1400 h, I found a dead female *H. nebulosus* (62 mm SVL) with a partly protruded egg sac in a ditch adjacent to vegetable fields in Futajima, Kitakyushu City, Fukuoka Prefecture, Japan (33.8956°N, 130.7478°E; WGS 84; 23 m elev.). The air temperature at the site was 15.2°C, water temperature was 10.8°C, and ground temperature was 16.3°C. Since the female failed to lay the whole egg sac and the egg sac started to absorb water and swell, she may have died from trauma caused by increased abdominal pressure by the expanded sacs left in the oviducts. There were two breeding males at the same site, which could have performed the midwife behavior. The female might have failed to attach the end of the egg sac to a suitable substrate leading to its incomplete deposition.

Fig. 1. A dead female *Hynobius nebulosus* with partly protruded egg sac. Tadpoles of *Bufo japonicus* preyed on the dead body and eggs.

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LISSOTRITON VULGARIS **(Smooth Newt). TAIL BIFURCATION and ECTROMELY.** *Lissotriton vulgaris* is a small species of the family Salamandridae. On 18 June 2018 we captured a deformed individual in a minnow trap in a pond formed by the flooding of a former clay mining area. The study area is located within a floodplain forest located between the cities of Leipzig and Schkeuditz, Germany (51.37980°N, 12.24232°E). We captured an adult male *L. vulgaris* (72 mm total length, 2.1 g) with a bifurcated tail tip. To our knowledge, no individual of this species has previously been found with this rare anomaly (Henle et al. 2012. J. Herpetol. 46:451–455; Henle et al. 2017. Mertensiella 25:57–164). The bifurcation point was located at the end of the tail (22 mm from the cloaca) and the two tail branches had about the same length, measuring 11 mm each (Fig. 1). The additional tip originated dorsally from the normal tip. This newt showed no other deformities. No other individuals with anomalies were caught in 2018 among the *L. vulgaris* (106 adults) or sympatric *Triturus cristatus* (Great Crested Newt; 36 adults), and *Bombina bombina* (European Fire-bellied Toad;19 adults and subadults) sampled. The tail bifurcation frequency for *L. vulgaris* in 2018 was 0.9%.

During fieldwork in 2019, a number of anomalies were observed in the same study area. In that season, we caught a total of 493 adult *L. vulgaris*. Although no individual showed any sign of tail bifurcation, one male exhibited ectromely with

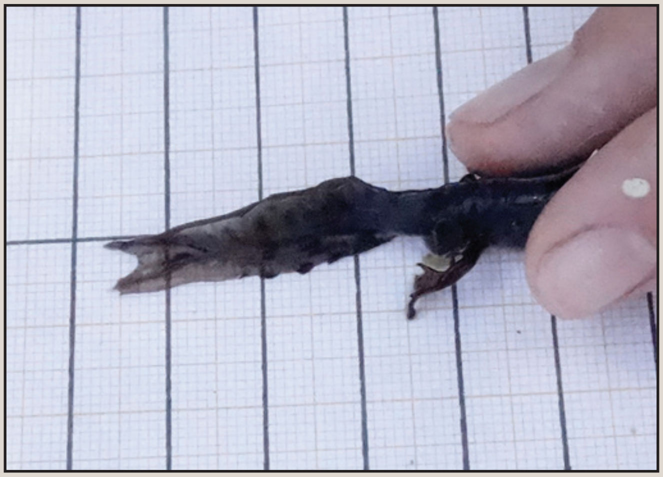

FIG. 1. Adult male *Lissotriton vulgaris* with bifurcated tail.

parts of its left hind leg missing (0.2 %). Furthermore, we caught 199 adult *T. cristatus* of which two showed cases of oligodactyly (1 %); a female with two missing toes on its left hind leg and a male with two missing toes on its right hind leg. We also captured 205 subadult and adult *B. bombina* with one of them showing ectromely in its left foreleg (0.5%) and 36 metamorphic toadlets with one of them showing ectromely in its left hind leg (2.8 %).

The potential reasons for tail duplications in amphibians have been discussed but remain hypothetical in most observed cases (Henle et al. 2012, *op. cit.*; Henle et al. 2017, *op. cit.*). One hypothesis is hyper-regeneration after mechanical damage caused by predators (Dawson 1932. Anat. Rec. 52:139–149). Complete removal of the tail tip does not result in bifurcation (Barfurth 1891. Arch. Mikro. Anat. Entw. 37:392–490; Dziurzynski 1911. Bull. Internat. de l'Acad. des sci. de Cracovie 1911:187–228). However, Dawson (1932, *op. cit.*), in experiments with adult *Notophthalmus viridescens*, showed that oblique dissection of tails with parts of the spinal cord removed and the cut not too deep led to tail duplication. A total of eight and twelve ponds were included in the investigation in 2018 and 2019, respectively. However, the deformed individuals found in 2019, as well as the individual with the bifurcated tail found in 2018, were all captured in the same pond within the study area. Further research is needed on potential reasons for the occurrence of tail bifurcations and other anomalies in this pond.

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***NOTOPHTHALMUS VIRIDESCENS* (Eastern Newt). MASS MORTALITY.** Impervious surfaces impact herpetofauna in varying ways, from serving as barriers to dispersal across heterogeneous landscapes to acting as a site for increased local mortality due to interactions with vehicles. Past work has estimated that herpetofaunal mortality may reach rates as high as 1300 individuals/km/year along roads in the southeastern United States (Aresco 2003. *In* Irwin et al. [eds.], Proceedings of the International Conference on Ecology and Transportation, pp. 433–449. Lake Placid, New York). Although the impacts of roads on herpetofauna have been intensively studied, relatively less is known about how impervious surfaces not open to vehicle traffic may impact reptile and amphibian taxa, particularly those that undergo seasonal migrations.

Notophthalmus viridescens is one amphibian that undergoes seasonal migratory behavior at multiple points throughout its life cycle, including postmetamorphic movements from aquatic to terrestrial habitat and fall migrations back to wetland habitats at the end of its immature and terrestrial eft stage (Hurlbert 1969. Ecol. Monogr. 39:465–488). This species is therefore potentially susceptible to impacts from impervious surfaces that may interrupt migratory pathways. On 8 October 2019, we observed 65 dead *N. viridescens* scattered across a recently constructed, 1500-m^2 concrete spillway at Bark Camp Lake in Scott County, Virginia, USA (36.86796°N, 82.52039°W; WGS84). This observation occurred during the local fall migration of *N. viridescens* efts from upland habitats to nearby wetlands. Dead *N. viridescens* were mostly located near the center of the spillway and generally faced the same direction (mean = 198° azimuth) as the corridor leading from the forest to the lake (207° azimuth), suggesting that mortality occurred during movement towards the water. Most of the dead *N. viridescens* appeared to be migrating efts, further supporting that mortality occurred during movements across the concrete spillway from nearby uplands to the lake.

Although we did not directly observe the cause of mortality, desiccation on the concrete surface of the spillway is the most plausible mechanism for this mortality event. We recorded 0% canopy cover and only 7% ground cover (scattered leaves and fine woody debris) on the spillway, with full sun exposure substantially increasing temperatures on the concrete surface. All of the dead *N. viridescens* were heavily desiccated, with no visible signs of physical trauma or lesions indicating infection by a pathogen or parasite. We also observed no dead or desiccated *N. viridescens* in either the adjacent forest or lake margin and instead observed multiple live individuals moving through both habitats.

To our knowledge, our observation represents the first reported mass mortality event related to impervious surfaces in *N. viridescens*, particularly for surfaces without vehicle traffic. Such impervious surfaces located adjacent to aquatic habitats that are critical to the life cycles of *N. viridescens* and other amphibians may form barriers to dispersal and sources of mortality for migrating individuals, and managers may wish to consider enhancing shading over such habitats and/or providing passage around or beneath these features for migrating amphibians when designing future construction projects. More broadly, our observation indicates that impervious surfaces may result in mass mortality for some herpetofauna even in the absence of vehicle traffic, heightening such surfaces' conservation concern.

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***PLETHODON MONTANUS* (Northern Gray-cheeked Salamander). ARBOREAL BEHAVIOR.** Plethodontid salamanders are commonly thought to frequent the forest floor and streamsides. However, a recent review has shown that many plethodontids are facultatively arboreal. The review notes that this behavior is often overlooked in plethodontid salamanders when it is in fact an important component of their ecology (McEntire 2016. Copeia 104:124–131). A previous study noted the arboreal behavior of *Plethodon jordani* (Red-cheeked Salamander), a species

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FIG. 1. *Plethodon montanus* climbing a *Quercus alba* in Roan Mountain State Park, Carter County, Tennessee, USA.

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FIG. 2. Two *Plethodon montanus* climbing an *Acer pensylvanicum* in Rocky Fork State Park, Unicoi County, Tennessee, USA.

closely related to *P. montanus,* and *P. glutinosus* (Northern Slimy Salamander) on humid foggy nights with heights ranging from 0.04 to 0.87 m (Hairston et al. 1987. Evol. Ecol. 1:247–262). We report observations of arboreal behavior for *P. montanus,* a Species of Greatest Conservation Need in the state of Tennessee. To our knowledge this is the first such reporting for the species.

On 12 May 2019 at 2130 h, we observed three *P. montanus* exhibiting arboreal behavior at Roan Mountain State Park, Carter County, Tennessee, USA. The first individual encountered was 1.2 m above the ground on the trunk of a *Quercus alba* (White Oak; ca. 200 cm DBH; Fig. 1). The trunk was completely covered in moss. Two other individuals were seen on a dead tree trunk (species unidentifiable) beside each other 0.9 m above the ground. It was raining with a relative humidity of 100% and a temperature of 16°C. On 18 July 2019 at 2200 h we observed one *P. montanus* exhibiting arboreal behavior at Rocky Fork State Park, Unicoi County, Tennessee, USA. The individual was 0.5 m above the ground on the trunk of a mature *Betula alleghaniensis* (Yellow Birch) that was covered in moss. We observed the individual for 10 min. Within the observation period the individual preyed upon an unidentified species of flying insect. The temperature was 17.1°C with a relative humidity of 97.8%. On 20 August 2019 at 2245 h we observed two *P. montanus* exhibiting arboreal behavior at Rocky Fork State Park, Unicoi County, Tennessee, USA. The salamanders were 1.2 m above the ground with one individual being ca. 30 cm above the other on an *Acer pensylvanicum* (Striped Maple) trunk (ca. 8 cm DBH; Fig. 2). It was a clear night with a relative humidity of 100% and a temperature of 18.1°C.

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PSEUDOTRITON RUBER RUBER **(Northern Red Salamander). ABERRANT COLORATION.** Color patterning in post-larval *Pseudotriton ruber ruber* is typically characterized by a bright red to red/purple background color on the dorsum with numerous, irregular black spots and a pink to red belly, all of which may vary based on age of the specimen (Bishop 1941. New York State Mus. Bull. 324:1–361; Petranka 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington, D.C. 587 pp.). Reports of color aberrations are rare in the literature for *P. ruber*. Hensley (1959. Publ. Mus. Michigan State Univ. Biol. Ser. 1:133–159) reported a "partially albinistic" specimen collected in Pennsylvania and more recently Larson and Muller (2011. Herpetol. Rev. 42:406.) reported a leucistic larva from North Carolina. Herein, I report a novel observation of an atypical color pattern from a specimen of *P. r. ruber*. On 2 January 2020 at 1200 h, I caught, photographed, and released an adult *P. r. ruber* of

FIG. 1. *Psuedotriton ruber ruber* with an aberrant color pattern (top) and specimen collected at the same site bearing a typical color pattern (bottom).

unknown sex bearing an atypical color pattern (Fig. 1) within a spring seep in Conyngham Township, Columbia County, Pennsylvania, USA (40.8364°N, 76.3854°W; WGS 84). The atypical *P. r. ruber* bore the spot pattern typical of this subspecies and exhibited normal eye coloration; however, the dorsal and ventral ground color was milky white instead of the typical red/purple colorations of these regions in this subspecies (Fig. 1).

This observation occurred during research approved by Bloomsburg University IACUC (Protocol # 158) and salamanders were captured and released with a Pennsylvania Fish and Boat Commission license.

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ANURA — FROGS

***ANAXYRUS QUERCICUS* (Oak Toad). ABERRANT COLORATION.** The original description of *Anaxyrus quercicus* noted two of their distinguishing morphological characteristics as the presence of "a yellowish vertebral line, on each side of which are black blotches" (Holbrook 1840. North American Herpetology. Vol. 4. J. Dobson and Son, Philadelphia, Pennsylvania. 138 pp.). The species description remains consistent throughout the literature, with sources referencing the presence of a pale vertebral line and multiple (typically 4 or 5) paired, irregularly shaped dark blotches on either side of the midline (Ashton and Franz 1979. Cat. Am. Amph. Rept. 222:1–2; Powell et al. 2016. Field Guide to Reptiles and Amphibians of Eastern and Central North America. Houghton Mifflin Harcourt, Boston, Massachusetts. 494 pp.). Within populations, body color can vary dramatically, ranging from pale gray to nearly black, and sometimes taking on an orange, red, or brown tint (Powell et al. 2016, *op. cit.*). Most *A. quercicus* also display dark banding on their limbs and sides, other dark blotches along the back (sometimes paired, but not touching the midline), reddish-brown warts or tubercles, and/or reddish-orange coloration around the parotoid glands (Wright 1932. Life-Histories of Frogs in the Okefenokee Swamp, Georgia. Cornell University Press, Ithaca, New York. 119 pp.). These patterns likely serve as disruptive coloration, helping to conceal the toads from potential predators (Cott 1940. Adaptive Coloration in Animals. Methuen and Co. Ltd., London. 49 pp.).

Here we describe an unspotted, gray morph of *A. quercicus*, found in Florida scrub habitat at Archbold Biological Station (ABS) in Highlands County, Florida, USA (Fig. 1). Individuals of this morph possess a pale middorsal line and sometimes many small reddish warts, though they lack paired dark blotches or defined banding anywhere on the dorsal surface. Like other *A. quercicus*, these toads vary in their body coloration and can manipulate their color to become lighter or darker (MEAH, unpubl. data). However, the base skin color of all unspotted toads we observed was gray. We found one unspotted individual at ABS (27.18448°N, 81.35829°W; WGS 84) on 3 May 2017 and an additional 14 unspotted *A. quercicus* on the same property between July and October 2018. Six of these toads were found during visual encounter surveys conducted from 12 September–8 October 2018, which also yielded 100 *A. quercicus* possessing the typical spotted coloration. Based on this, the prevalence of the unspotted morph at ABS appears to be low (5.7%). The mean SVL of spotted individuals was 17.6 ± 2.9 mm (range: 11.5–28.0 mm, N = 90), similar to a random subsample of unspotted individuals (mean 16.7 ± 1.7 mm, range: 14.9–18.7 mm, N = 6) found during

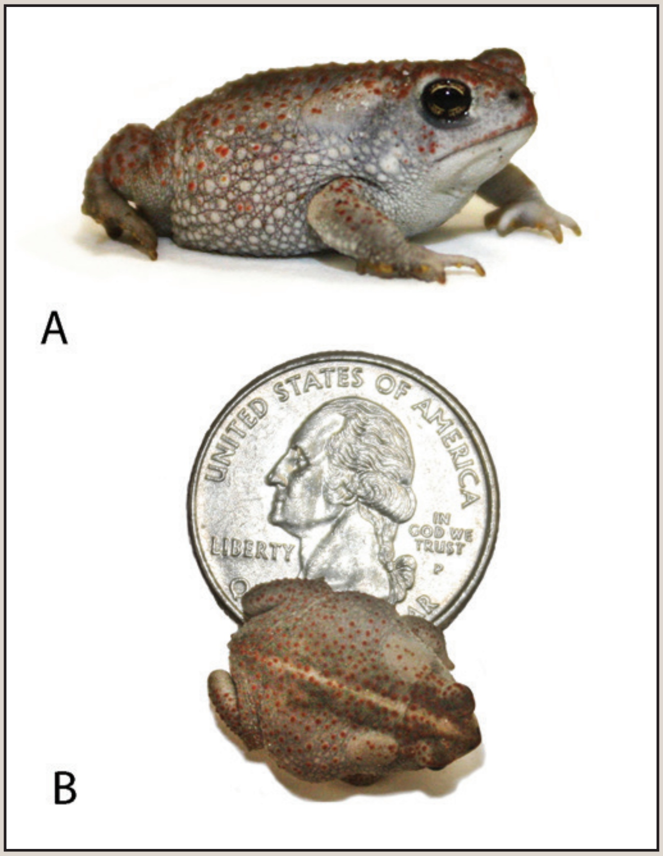

Fig. 1. A) Profile and B) dorsal views of *Anaxyrus quercicus* individual exhibiting unspotted, gray coloration. The individual (21.1 mm SVL) was captured on 12 July 2018 at Archbold Biological Station, Highlands County, Florida, USA. Profile view is not shown to scale.

the September–October 2018 surveys. Based on the description in Wright (1932, *op. cit.*) of limited sexual dimorphism in this species, we concluded that the two largest of the 14 unspotted morphs were female. However, due to variability in size at sexual maturity, we were unable to determine the sex of the remaining 12 individuals, which ranged from recently metamorphosed juveniles to small adults (Wright 1932, *op. cit.*; Dodd 1994. Ethol. Ecol. Evol. 6:331–349). Our handling of toads was authorized under Florida Fish and Wildlife Conservation Commission scientific collecting permit #LSSC-10-00043D.

To investigate the distributional extent of the unspotted morph, we reviewed 402 Research Grade observations of *A. quercicus* on the iNaturalist citizen science website (www.inaturalist.org; 17 Oct 2019). Of these, five strongly resemble the unspotted gray morph; one was found on ABS property, three from neighboring Polk County, and one from nearby Charlotte County. One additional record from farther north in Walton County, Florida, also appeared to lack paired dorsal spots, but was brownish in coloration rather than gray. To our knowledge, only one publication makes reference to *A. quercicus* lacking distinctive paired blotches; Powell (2016, *op. cit.*) noted that *A. quercicus* are "occasionally black with very little pattern beyond the light middorsal line," although we suspect the toads in question may have had paired spots that were simply obscured by their overall dark base color. Given the paucity of records, we surmise that the unspotted gray morph is either narrowly restricted within central, peninsular Florida, or that it exists in extremely low prevalence elsewhere.

In the future, it would be interesting to examine the mechanisms of inheritance behind the presence/absence of spots on *A. quercicus*, and to investigate selective pressures allowing this unspotted morph to persist in this restricted geographic area. A plain appearance would at first seem to make these toads more visible to predators in comparison with their disruptively colored brethren. However, in cryptic species, the existence of polymorphism may reduce overall detection by requiring predators to use multiple search images (Karpestam et al. 2016. Sci. Rep. 6:22122).

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***ATELOPUS NAHUMAE* (San Lorenzo Harlequin Frog) and *ATELOPUS LAETISSIMUS* (Santa Marta Harlequin Frog). INTERSPECIFIC AMPLEXUS.** In anurans, amplexus can happen between individuals of the same sex within a species and between individuals of different species (Flores-Hernández and Martínez-Coronel. 2014. Acta Zool. Mex. 30:395–398; Costa-Campos et al. 2016. Acta Zool. Mex. 32:385–386). Interspecific amplexus usually occurs in sympatric species with overlapping breeding seasons and can decrease mating success (Ferreira et al. 2019. Herpetol. Notes 12:705–708; Streicher et al. 2010. Herpetol. Rev. 41:208; Marco and Lizana 2002. Ethol. Ecol. Evol. 14:1–8; Wells 2010. The Ecology and Behavior of Amphibians. University of Chicago Press, Chicago, Illinois. 1148 pp.). Many cases of interspecific amplexus have been reported for neotropical anurans with the Hylidae and Bufonidae having the highest number of cases described (Haddad et al. 1990. Rev. Bras. Biol. 50:739–744; Flores-Hernández and Martínez-Coronel 2014, *op. cit.*; Costa-Campos et al. 2016, *op. cit.*; Ferreira et al. 2019, *op. cit.*).

Here we present the first observation of interspecific amplexus between *Atelopus nahumae* and *A. laetissimus*, two endemic species from the Sierra Nevada de Santa Marta (SNSM), Colombia. We recorded interspecific amplexus between a male *A. nahumae* and a female *A laetissimus* (Fig. 1) at 2030 h on 24 June 2019 in a cloud forest at the San Lorenzo Experimental Station, municipality of Santa Marta, on the western slope of the SNSM (11.11527°N, 74.05096°W; WGS 84; 2100 m elev.). *Atelopus nahumae* is diurnal and *A. laetissimus* is nocturnal. *Atelopus nahumae* occurs between 1500–2800 m elev. and *A. laetissimus* occurs between 1900–2800 m elev. (Granda-Rodríguez et al. 2008. Herpetotropicos 4:85–86; Carvajalino-Fernández et al. 2008. Actual. Biol. 30:97–103; Rueda-Solano et al. 2016. J. Therm. Biol. 58:91–98). These species are sympatric, have similar ecological niches, and there are multiple contact zones between the forest and the stream in the SNSM, which could allow for interspecific amplexus events. Female *A. laetissimus* being amplexed by males of other species of *Atelopus* could have genetic consequences for congeners within the SNSM. Genetic studies are required to detect if interspecific amplexus could lead to hybridization or introgression of genes between species (Correa et al. 2012. J. Herpetol. 46:568–577). These findings could have important conservation implications for *Atelopus* populations in the SNSM.

Fig. 1. Interspecific amplexus between a female *Atelopus laetissimus* (bottom) and a male *Atelopus nahumae* (top) along San Lorenzo stream in a cloud forest in the Sierra Nevada de Santa Marta, Colombia.

We thank L. Valencia of Global Wildlife Conservation for the constructive criticisms that have improved this manuscript.

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***BUFOTES BATURAE* (Batura Toad) and *BUFOTES LATASTII* (Ladakh Toad). ENDOPARASITES.** *Bufotes baturae* and *B. latastii* are toads endemic to central Asia (Dufresnes et al. 2019. Mol. Phylogenet. Evol. 141:106615). *Bufotes baturae* is a triploid hybrid species between *B. turanensis* and *B. latastii* distributed from extreme northern Pakistan through northeastern Afghanistan to southeastern Tajikistan. *Bufotes latastii* is an evolutionarily old member of the genus that diverged from the *B. viridis* subgroup at least 15 million years ago (Dufresnes et al. 2019, *op. cit.*) occurring in mountain valleys of northern Pakistan and the western Ladakh of India (Litvinchuk et al. 2018. Alytes 36:314–327). Both species occur at high altitudes in the vicinity of shallow pools or streams in mountain valleys (Khan 2006. Amphibians and Reptiles of Pakistan. Krieger Publishing Company, Malabar, Florida. 311 pp.). We know of no published helminth records for *B. baturae* and hereby establish the initial helminth list for this species. We know of one published helminth report for *B. latastii*, the digenean *Lepoderma himalayii* from Srinagar, Kasmir (Jordan 1930. Proc. Ind. Soc. Cong. 17:246). In this note we add to the helminth list of *B. latastii.*

During field work in northern Pakistan we collected 14 adult specimens of *Bufotes* spp. in Khyber-Pakhtunkhwa and Gilgit-Baltistan Provinces. Seven specimens (six females, one male) of *B. baturae* were collected by hand on 5 September 2018 at Chitral (35.8189°N, 71.7723°E; WGS 84; 1464 m elev.), one female of *B. baturae* was collected on 8 September 2018 at Langar Valley (36.1207°N, 72.6521°E; WGS 84; 3266 m elev.), one adult male of

B. baturae was collected at Teru on 8 September 2018 (36.1622°N, 72.8491°E; WGS 84; 2949 m elev.), and five adult specimens (three females, two males) of *B. latastii* were collected on 10 September 2018 at Besal, (35.0430°N, 73.9360°E; WGS 84; 3268 m elev.). The toads were euthanized, preserved in 96% ethanol and maintained in 70% ethanol. The body cavity was opened by a longitudinal incision and the digestive tract was removed and opened. The esophagus, stomach, and small and large intestine were examined for helminths utilizing a dissecting microscope. Five female nematodes were found (accession field number DJ7788) in one adult male *B. baturae* from Chitral (specimen DJ7782 deposited in the Department of Zoology, Comenius University in Bratislava), two female nematodes (DJ7789) in one adult female from Chitral (DJ7784), three female nematodes (DJ7810) in one adult female *B. baturae* from Langar Valley (DJ7803), five adult female nematodes (DJ7811) in one adult male *B. baturae* from Teru (DJ7804), and two female nematodes (DJ7925) in one adult female *B. latastii* from Besal (DJ7819; deposited in the Pakistan Museum of Natural History, Islamabad). Parasites were placed on a glass slide in a drop of lactophenol, a coverslip was added, and identification was made from this temporary wet mount. Identification as *Aplectana akhrami* in all toads was made using Anderson et al. (2009. Keys to the Nematode Parasites of Vertebrates, Archival Volume, CAB International, Wallingford, Oxfordshire, UK. 463 pp.) and by comparison to the original description by Islam et al. (1979. Pak. J. Zool. 11:69–73). *Aplectana akhrami* is previously known only from *Duttaphrynus* (as *Bufo*) *stomaticus* from Pakistan (Islam et al., *op. cit.*). Vouchers of *A. akhrami* were deposited in the Harold W. Manter Parasitology Laboratory (HWML), The University of Nebraska, Lincoln, Nebraska, USA as *A. akhrami* in *B. baturae* (HWML 110813) and *B. latastii* (HWML 110814). *Bufotes baturae* and *B. latastii* represent new host records for *A. akhrami*.

This study was supported by the Slovak Research and Development Agency under the contract number APVV-15-0147.

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***ELEUTHERODACTYLUS BRITTONI* (Grass Coqui). MICROHABITAT USE**. *Eleutherodactylus brittoni* is a widely distributed frog in Puerto Rico. This species is the third smallest coqui on the island with male SVL ca. 16 mm and female SVL ca. 17 mm. This coqui has a noticeable preference for open grassy areas (Rivero 1998. Los Anfibios y Reptiles de Puerto Rico. Editorial de la Universidad de Puerto Rico, San Juan, Puerto Rico. 510 pp.; Drewry and Rand 1983. Copeia 1983:941–953). Historically, this species has been found in lower elevations but has also been reported from intermediate elevations between 183–240 m (Schwartz and Henderson 1991. Amphibians and Reptiles of the West Indies: Descriptions, Distributions, and Natural History. University of Florida Press, Gainesville, Florida. 714 pp.). As part of a study to understand microhabitat use for *E. brittoni* across different elevations, we observed this species calling from vegetation where they have never been reported. Historically, *E. brittoni* were found in microhabitats made up of forbs, ferns, and tall grasses (Drewry and Rand 1983, *op. cit.*; Ríos-López and Villanueva-Rivera 2013. Life Excit. Biol. 1:118–135). On our study sites (N = 5) a total of 35 male *E. brittoni* were found calling from a variety of species from 13 plant families. The elevations ranged from 33–835 m, with vegetation ranging from urban secondary forest to pristine mountain forest. Within a variety of microhabitats in our study, *E. brittoni* exhibited a preference for herbaceous vines from the family Convolvulaceae (23% of occupancy), sapling trees from the family Meliaceae (19% of occupancy), and juvenile plants from the family Commelinaceae (13% of occupancy). In general, all of the plants were relatively small (<1.3 m in height) which confirms the findings of Drewry and Rand (1983, *op. cit.*). More research is needed to understand the vegetation preference of *E. brittoni*, but their historical preference for ferns and grasses could have been a preference for vegetation height and not necessarily any particular group of plants. The microhabitats available for *E. brittoni* in Puerto Rico may have changed significantly in the past decade, especially after hurricane Maria (Hu and Smith 2018. Remote Sens. 10:827). Encountering these frogs in vegetation different from what has previously been reported could suggest a change in microhabitat availability forcing this species to alter its microhabitat use. Our data suggests possible clinal variation in *E. brittoni* microhabitat use, since there is a change in vegetation composition across elevations.

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***ELEUTHERODACTYLUS COQUI* (Common Coqui). DIET.** *Eleutherodactylus coqui*, an endemic frog of Puerto Rico, is characterized as an extreme sit-and-wait predator of mainly foliage invertebrates, and occasionally litter invertebrates (Woolbright and Stewart 1987. Copeia 1987:69–75; Beard 2007. Copeia 2007:281–291). However, non-invertebrate prey found occasionally in *E. coqui* stomachs includes hatchling lizards and a juvenile *E. coqui* (Stewart and Woolbright 1996. *In* Reagan and Waide [eds.], The Food Web of a Tropical Rain Forest, pp 274–320. The University of Chicago Press, Chicago, Illinois). *Eleutherodactylus coqui* move less than 5 cm to capture prey and as individuals get larger, they tend to consume larger prey rather than more prey items (Woolbright and Stewart 1987, *op. cit.*; Joglar 1998. Los Coquíes de Puerto Rico: Su Historia Natural y Conservación. Editorial Universidad de Puerto Rico. San Juan, Puerto Rico. 232 pp.; Beard 2007, *op. cit.*). Here we report observations of interspecific and intraspecific predation by *E. coqui*. Both incidents were observed during routine visual encounter surveys conducted near the USDA Forest Service Sabana Field Research Station (18.3250°N, 65.7300°W; WGS 84) in the Luquillo Experimental Forest, Luquillo, Puerto Rico. Surveys were conducted as part of an ongoing field warming experiment, the Tropical Responses to Altered Climate Experiment (TRACE; Kimball et al. 2018. Ecol. Evol. 8:1932–1944), where three small (4 m diameter) experimental plots are being heated at 4°C above ambient temperature while three plots are maintained as controls.

The observation of *E. coqui* cannibalism occurred on 5 December 2018. Two *E. coqui* frogs, an adult (2.1 cm SVL, 0.67 g) and a juvenile (1.1 cm SVL, 0.12 g) were captured in a heated experimental plot. The two frogs were placed in the same plastic sampling bag and measured as part of our survey methods. The next day, 6 December 2018, we observed that the juvenile was missing, and the adult had a full abdomen. Because we are certain that both individuals were in the bag when we sealed it, and holes

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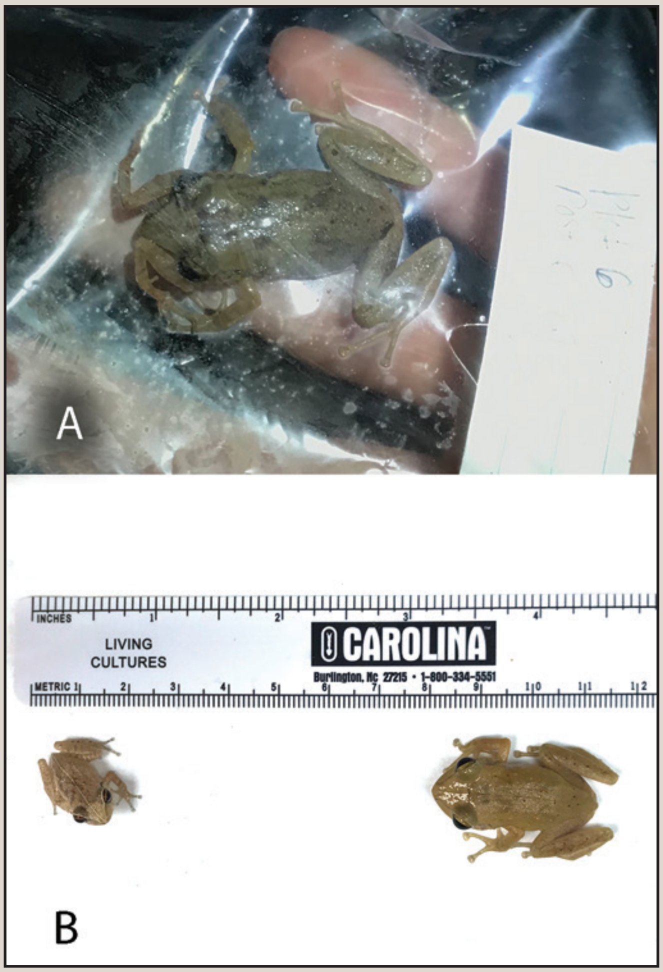

Fig. 1. A) *Eleutherodactylus coqui* preying on an *E. antillensis* (only hind legs protruding from predator's mouth) in sample bag as found at capture; B) *E. coqui* (right) after releasing *E. antillensis.*

were not present, we conclude that the adult E. *coqui* ate the juvenile.

The observation of interspecific predation took place on 9 January 2019 at 1908 h in an experimental plot and involved an adult female *E. coqui* (3.3 cm SVL, 2.09 g) consuming an *E. antillensis* (2.1 cm SVL, 0.59 g). When encountered in the field, the *E. antillensis* was completely engulfed in the mouth of the *E. coqui*, except for the hind legs. The *E. coqui,* with the *E. antillensis* in its mouth, was coaxed into a plastic bag. Photos were taken immediately after initial observation and capture (Fig. 1A). After 4 min in the bag, the *E. coqui* released the *E. antillensis* from its mouth alive (Fig. 1B). Both individuals were released the following day in the same plot where they were captured.

These observations are noteworthy for three reasons. First, the observations provide evidence of both interspecific and intraspecific *E. coqui* predation events. Previous literature mentions juvenile frogs as a potential food source for *E. coqui* adults, but in one study only a single *E. coqui* juvenile was found in stomach content surveys of 173 *E. coqui* adults and it was concluded that consumption of other frogs is "so rare that it appears accidental" (Stewart and Woolbright 1996, *op. cit.*). Second, the observed predation events indicate the ability of *E. coqui* individuals to consume anurans more than half their length, as evidenced by the SVL of the individuals involved. Joglar (1998, *op. cit.*) mentions a single occasion when a female *E. coqui* (42 mm SVL) was found to consume a large conspecific male (29 mm SVL). Our observations add to our understanding of gape-size limitation and prey consumption by noting that *E. coqui* will also consume heterospecifics over half their size. Although these events are seemingly rare, noting our additional observations allows us to start to acknowledge the frequency of rarity. Finally, Puerto Rico was struck by two major hurricanes in 2017 (6 September and 20 September) and it is known that invertebrate populations decline post-hurricane (Willig and Camilo 1991. Biotropica 4:455–461). Therefore, we suggest that a decrease in prey abundance post-hurricanes could be driving the inclusion of alternative prey, other frogs, in the diet of *E. coqui.*

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***ELEUTHERODACTYLUS PLANIROSTRIS* (Greenhouse Frog). HABITAT USE.** *Eleutherodactylus planirostris* is a leaf-litter frog native to Cuba and potentially other nearby Caribbean islands. It has numerous established non-native populations including regions of the West Indies, Hawaii, and most of peninsular Florida. This ground-dwelling species often uses moist cover in a wide range of habitats, usually favoring mesic areas (Meshaka and Layne 2005. Florida Sci. 68:35–43). Here we report the use of arboreal refugia by *E. planirostris* to escape intermittent flooding of tree islands at Loxahatchee Wildlife Refuge, Palm Beach County, Florida, USA (26.49157°N, 80.21838°W; WGS 84).

We installed 240 treefrog pipes on eight different tree islands (30 pipes per tree island) within the Loxahatchee Impoundment Landscape Assessment (LILA). Between spring 2018 and spring 2019, each pipe was checked 10 times and no *E. planirostris* were found in any of the pipes. However, in the summer of 2019 we surveyed the pipes a total of 480 times and noted five *E. planirostris* in the pipes on three separate tree islands. The wet season of 2019 had a dramatic increase in rainfall and higher water levels compared to the wet season of 2018. Consequently, this was the first time that some of the tree islands were completely submerged. At the time of observation, the tree islands where the *E. planirostris* were found were all submerged by about 0.25 m of water, suggesting that the frogs may be escaping the temporary flooding by climbing into the pipes, which were affixed to the trees. The pipes were hung vertically with the sole entrance at the top being approximately 1–2 m from ground level. Prior reports documented *E. planirostris* utilizing a variety of ground level refugia including coconut husk piles that could be up to 2 m high (Stewart and Martin 1980. Biotropica 12:107–116). However, our observations differ from previous accounts since the frogs were dispersing into arboreal habitat likely to escape flooding. This behavior may benefit *E. planirostris* by improving survivorship in areas prone to temporary flooding either from seasonal inundation or from intermittent catastrophic flooding (e.g., hurricanes). This adaptation has likely facilitated their invasion across the Caribbean. However, it remains unclear how long the frogs can remain in arboreal refugia or if they are able to efficiently feed while utilizing arboreal refugia.

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***EUPSOPHUS CALCARATUS* (Chiloe Island Ground Frog). DEFENSIVE BEHAVIOR.** *Eupsophus calcaratus* is a medium-sized alsodid anuran widely distributed in Chile (Charrier 2019. Guía de Campo Anfibios de los Bosques de la Zona Centro Sur y Patagonia de Chile. Ed. Corporación Chilena de la Madera, Chile. 300 pp.). This species has a characteristic cutaneous spur (calcar) at the heels, but this structure is also present in specimens of *E. roseus* (Correa et al. 2017. PLoS ONE 12:e0181026), with which it has an overlapping distribution (Correa et al. 2019. ZooKeys 863:107–152). *Eupsophus calcaratus* mainly inhabits the leaf litter, mossy areas, and swamps in Patagonian forests (Charrier 2019, *op. cit.*).

On 17 January 2020 at 1210 h, we observed defensive behaviors of a *E. calcaratus* (23.3 mm SVL) during a predation attempt by the bird *Scelorchilus rubecula* (Rhinocryptidae). During a quick attempt of five pecks from the bird, the frog arched, inflating its body and stretching all four limbs to the ground, emitting up to three long, high-pitched squeals after the second peck. After these joint deployments, which are well described in different anurans (Ferreira et al. 2019. Behav. Ecol. Sociobiol. 73:69) the bird ceased the predation attempt and flew away. We captured the frog for identification and it appeared to lack any apparent physical damage (Fig. 1). The *E. calcaratus* did not repeat any of these defensive displays upon capture and remained motionless. This observation occurred in Tantauco Park, close to the mouth of the Inio River on the island of Chiloé, Chile (43.35828°S, 74.10739°W; WGS 84; 69 m elev.).

In several years of having captured this species while monitoring amphibians on Chiloé, *E. calcaratus* has never displayed this defensive behavior when hand captured. Although it is common to observe rynocryptid birds (*S. rubecula* and *Pteroptochos tarnii*) foraging on the ground in the forests of Chiloé, based on our knowledge this is the first reported case of attempted predation and successful escape by *E. calcaratus* after exhibiting this type of defensive behavior.

PHOTO BY JOSÉ M. SERRANO

Fig. 1. *Eupsophus calcaratus* from the Island of Chiloé, Chile immediately after the predation attempt. The pair of eyespots on the lower back is a coloration pattern not observed on the mainland (Correa et al. 2019, *op. cit.*).

We are grateful for the facilities provided by the workers of Tantauco Park in helping develop our studies on amphibian behavior and conservation. We thank A. Valenzuela-Sánchez for species identification.

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***HADDADUS BINOTATUS* (Clay Robber Frog). PREDATION.** *Haddadus binotatus* (Craugastoridae) is an anuran endemic to the Atlantic Forest of Brazil. The species can be found in abundance in forest leaf litter from Bahia (12°S) to Rio Grande do Sul (29°S; Haddad et al. 2013. Atlantic Forest Amphibian Guide: Diversity and Biology. Anolis Books, Sao Paulo, Brazil. 543 pp.). Spiders of the genus *Ctenus* are active-hunting, generalist predators that forage in the leaf litter of tropical forests in search of prey (Rego et al. 2005. Biota Neotrop. 5:1–8).

At 2235 h on 30 September 2018 during a survey of herpetofauna in the city of Bananal, São Paulo, southeastern Brazil (22.65542°S, 44.30370°W), a specimen of *Ctenus* sp. was recorded predating a young *H. binotatus.* Both were on a leaf ca. 40 cm above the ground (Fig. 1); the moment of capture was not observed. A similar report refers to predation of an individual *Adenomera marmorata* (Leptodactylidae) by a *C. ornatus* in Mendes, Rio de Janeiro (Amaral et al. 2015. Herpetol. Notes 8:329–330). Similar observations were recorded for lizards in the Amazon region such as the predation by a *Ctenus* sp. of a juvenile *Norops fuscoauratus* (Medina-Rangel 2013. Herpetol. Rev. 44:511–512). The abundance of *H. binotatus* and spiders of the genus *Ctenus* in tropical rainforests should allow for frequent interactions between these groups, but predation is not observed or reported frequently (Barbo et al. 2009. Herpetol. Notes 2:99–100). This record contributes to the knowledge of the ecological interactions of amphibians and their invertebrate predators. To our knowledge, this is the first report of predation of *H. binotatus* by *Ctenus* sp.

We thank the University of Alabama, the São Paulo Zoo, and the Federal University of São Carlos for financial support. We

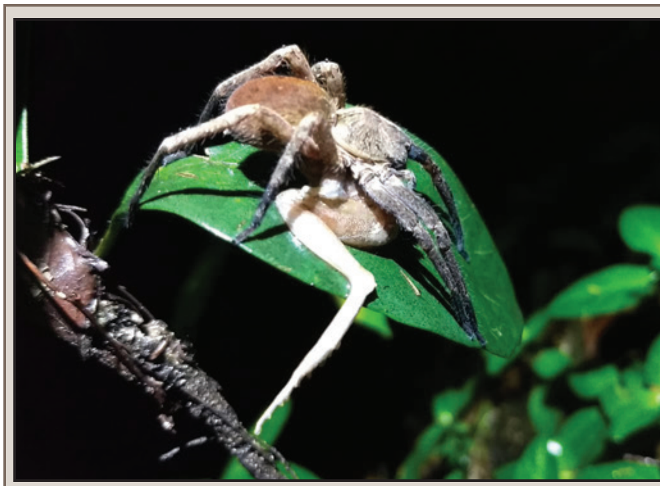

Fig. 1. Predation of a juvenile *Haddadus binotatus* by a spider, *Ctenus* sp. (Ctenidae).

also thank the Brazilian Institute of Environment and Renewable Natural Resources - IBAMA for the field sampling permit (SISBIO# 63917-1).

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***HYLA SAVIGNYI* (Savigny's Treefrog). REPRODUCTION.** *Hyla savignyi* is known to occur in Cyprus, Georgia, Iran, Iraq, Turkey, Syria, Lebanon, Israel, and Jordan (Bar and Haimovitch 2011. A Field Guide to Reptiles and Amphibians of Israel. Herlizya, Israel. 245 pp.). There is a report in Bar and Haimovitch (2017, *op. cit.*) that eggs hatch within 10 d of being laid and tadpoles become adults in 2–3 mo. In Palestine, *H. savignyi* mating occurs between January and March (www.mahmiyat.ps/site/index; accessed 31 Oct 2019). In this note we add information on *H. savignyi* reproduction in Israel from a histological examination of gonadal material from museum specimens.

A sample of 17 *H. savignyi* adults was examined consisting of 10 males (mean SVL = 39.7 mm ± 4.2 SD, range: 34–45 mm) and seven adult females (mean SVL = 37.9 mm ± 5.3 SD, range: 30–47 mm), all collected between 1959–1985 in Israel and deposited in the Steinhardt Museum of Natural History at Tel Aviv University (SMNHTAU-Am), Tel Aviv, Israel. One (SMNHTAU-Am 778) was from the Southern Coastal Plain Region (31.96°N, 34.81°E; WGS 84), two (SMNHTAU-Am 1567A, 1567B) were from the Lower Galilee Region (32.87°N, 35.3°E; WGS 84), others (SMNHTAU-Am 970–972A, 972B, 1390A–1390F, 1726–1728, 1731) were all from the Central Coastal Plain Region (32.1°N, 34.9°E; WGS 84). A small slit was made in the left side of the abdomen and the left testis was removed from males and the left ovary was removed from females for histological examination. Gonads were embedded in paraffin, sections were cut at 5 µm and stained by Harris hematoxylin followed by eosin counterstain. Histology slides were deposited in The Steinhardt Museum of Natural History at Tel Aviv University (SMNHTAU).

All *H. savignyi* males exhibited spermiogenesis in which lumina of the seminiferous tubules contained open packets of sperm. A ring of germinal cysts was located on the inner periphery of each seminiferous tubule. By month, numbers of *H. savignyi* exhibiting spermiogenesis were: January (N = 3), February (N = 1), April (N = 6). The smallest reproductively active males both measured 34 mm SVL and were from April (SMNHTAU-Am 1390B, 1390F).

Considering reproduction of our 7 *H. savignyi* females, three females were in spawning condition and contained mature oocytes, one from January (SMNHTAU-Am 972: 40 mm SVL; from central Israel) and two from March (SMNHTAU-Am 1567A: 47 mm SVL; 1567B: 39 mm SVL; from northern Israel). Four females from November were not reproductively active and contained previtellogenic oocytes. One of the March females in spawning condition (SMNHTAU-Am 1567A) exhibited massive follicular atresia (spontaneous degeneration of an oocyte) and would have been removed from the breeding population. The granulosa cell layer on the inner periphery of the follicle was enlarged, vacuolated, and contained ingested vitellogenic granules. See Saidapur and Nadkarni (1973. Acta Anat. 86:559–564) and Ogielska et al. (2010. Acta Zool. 91:319–327) for a detailed description of follicular atresia in the frog ovary. Atresia is important in amphibian reproduction by influencing the number of ovulated oocytes (Uribe Aranzábal 2011. *In* Norris and Lopez [eds.], Hormones and Reproduction of Vertebrates, Vol. 2, Amphibians, p. 69. Elsevier, Amsterdam).

In conclusion, our findings support Degani (2016. Int. J. Biol. 8:1-12) who reported *H. savignyi* reproduction in Israel takes place March-April in northern Israel (two gravid *H. savignyi* March females from northern Israel), but occurs during winter in central Israel (one gravid *H. savignyi* January female from central Israel). There are other reports that *H. savignyi* reproduces during spring in different areas: Armenia (Arakelyan et al., 2011. Herpetofauna of Armenia and Nagorno-Karabakh. Society for the Study of Amphibians and Reptiles, Ithaca, New York. 149 pp.); Cyprus (Baier et al. 2009. The Amphibians and Reptiles of Cyprus. Edition Chimaira, Frankfurt AM, Germany. 364 pp.); Iran (Anderson. 1963. Proc. California Acad. Sci. 31:417–498).

We thank Shai Meiri (SMNHTAU) for permission to examine *H. savignyi* and the Steinhardt Museum of Natural History at Tel-Aviv University for providing the *H. savignyi* to study.

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***LEPTODACTYLUS LATRANS* (Butter Frog). DIET.** *Leptodactylus latrans* is a widely distributed anuran in South America that feeds on terrestrial invertebrates including Coletoptera, Orthoptera, Scorpiones, and Araneae (Solé et al. 2009. Herpetol. Notes 2:9–15). On 13 December 2018, during field work in palm groves in the Municipality of Tapes, Brazil (30.53606°S, 51.37531°W), we collected two individuals of *L. latrans*. Both were euthanized using lidocaine and dissected for gut content analysis. They were then deposited in the scientific collection of the Laboratory of Ecology of Terrestrial Vertebrates (CHLEVT 2632: 55.05 mm SVL, 16 g; CHLEVT 2700: 59.32 mm SVL, 16 g). Gut contents were evaluated under stereomicroscope revealing the presence of previously reported prey (invertebrates) and an unreported vertebrate species. Both *L. latrans* contained one individual *Pseudopaludicola falcipes* (Hensel's Swamp Frog, Leptodactylidae). *Pseudopaludicola falcipes* made up 73% and 100%, respectively, of the total volume of consumed prey. There are previous reports of predation of anurans by *L. latrans*, including arboreal species (*Hypsiboas pardalis*; Heitor et al. 2012. Herpetol. Notes 5:23–25), semiaquatic species (*Physalaemus crombiei*; Teixeira and Vrcibradic 2003. Cuad. Herpetol. 17:113–120), and terrestrial species (*Rhinella granulosa*; França et al. 2004. Stud. Neotrop. Fauna Environ. 39:243–248). Our record reinforces the predatory behavior of *L. latrans* towards small anurans regardless of their habitat.

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***LEPTODACTYLUS LATRANS* (Butter Frog). FEEDING ATTEMPT.** *Leptodactylus latrans* is a well-known generalist predator (Pazinato et al. 2011. Biotemas 24:147–151). It is a large species (90–110 mm SVL) commonly found near bodies of water or swamps (Santoro and Brandão 2014. North-West J. Zool. 10:365–373). *Rhinella granulosa* is a highly toxic bufonid characterized by warty skin and small paratoid glands.

On 17 October 2015 a predation attempt on *R. granulosa* by *L. latrans* was observed in a rural area in the Municipality of Santa

Fig. 1. Predation attempt by *Leptodactylus latrans* upon *Rhinella granulosa* in the Atlantic Forest, Espírito Santo, southeastern Brazil. A) *Rhinella granulosa* almost entirely swallowed by *L. latrans*; B) *R. granulosa* after being released by the predator exhibiting toxins secreted by its paratoid glands.

Maria of Jetibá, Espírito Santo, southeastern Brazil (19.99791°S, 40.70626°W; WGS 84; 784 m elev.). The interaction took place in an artificial pond surrounded by herbaceous vegetation. The area of the pond was ca. 24 m^2. The adult male *L. latrans* had the adult *R. granulosa* almost entirely within its mouth (Fig. 1A). Both were submerged near the edge of the pond in 20 cm of water. Although swallowed anteroposteriorly to its pelvic girdle, the *R. granulosa* kept itself inflated. The *L. latrans* displayed a series of movements in its attempt to swallow the *R. granulosa*, but after 4 min of observation, the *L. latrans* regurgitated the *R. granulosa*. The *R. granulosa* secreted toxins from its parotoid glands (Fig. 1B) that probably impaired the *L. latrans,* which remained in the pond emitting noises interpreted as agonistic calls. The opportunistic habit of anuran predation by *L. latrans* is well documented, including the families Hylidae, Leptodactylidae (França et al. 2004. Stud. Neotrop. Fauna E 39:243–248), Leiuperidae, Microhylidae, other bufonids, and even conspecifics (Teixeira and Vrcibradic 2003. Cuad. Herpetol. 17:111–118).

Many studies report the predation of anurans by other vertebrates, but few report successful defensive responses of the prey, such as immobility, crouching, body flexion, and releasing secretions or damage to the predator (Toledo et al. 2011. Ethol. Ecol. Evol. 23:1–25). The defensive behavior of *R. granulosa* is characterized by flattening of the body and stretching the legs, which has been suggested to be a plesiomorphic characteristic of the Neobatrachia (Mângia and Santana 2013. Herpetol. Notes 6:45–46). We note in this report that the defensive behaviors displayed by *R. granulosa* were effective, making it difficult to be ingested by *L. latrans*. The release of toxins by the parotoid glands may have caused lesions in the gastrointestinal tract of *L. latrans*, evidenced by the agonistic calls emitted from the *L. latrans* after releasing the *R. granulosa*.

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***LITHOBATES GRYLIO* (Pig Frog). HABITAT USE.** *Lithobates grylio* is a large aquatic ranid distributed in marsh systems throughout the southeastern United States (Wright 1932. Life-Histories of the Frogs of Okefinokee Swamp, Georgia; North American Salientia [Anura] no. 2. Macmillan Company, New York, New York. 364 pp.). Due to the elusive nature of this species, little is known about its reproductive life history strategies. Previous research indicates that males migrate from the shoreline to deeper waters during the reproductive season, from April to September (Lamb 1984. Am. Midl. Nat. 111:311–318). It remains unclear how males utilize this aquatic habitat for advertisement and breeding. In other species of frogs, microhabitat selection while calling is important for reproductive success (Wells 1978. Ecology 58:750–762). This field study focused on microhabitat occupancy of calling and non-calling reproductively mature male *L. grylio* during the breeding season.

Fieldwork took place in the Fritchie Marsh in Slidell, Louisiana, USA (30.24771°N, 89.72294°W) from June–September 2019. The site was divided into four distinct microhabitats (shoreline, open water, sparse vegetation, and dense vegetation). The open water microhabitat lacked any floating vegetation and the water depth exceeded 1 m. Sparse vegetation surrounded the periphery of the floating vegetated islands, while dense vegetation made up the center (1 m from the periphery) of the islands. Floating vegetation was comprised of *Alternanthera philoxeroides* (Alligator Weed) and *Ludwigia peploides* (Swamp Primrose). A spotlight was used to make behavioral observations lasting 1 min. Mature males were readily identified by the presence of an enlarged tympanum (Ugarte et al. 2007. Copeia 2007:436–448). Two male ethotypes were identified: calling and non-calling. After the behavioral observations concluded, frogs were caught by hand and sex was confirmed by tympanum size.

Calling males exhibited a high posture and inflated abdomen, while the low posture of non-callers more closely resembled that of females and juveniles (Fig. 1). Female capture rates were not recorded during this study, but field observations indicated that female *L. grylio* mainly inhabit the shoreline microhabitat. During the field season, only one female was captured in the open water habitat, and upon capture the female released eggs. A chi-square test to analyze the relationship between microhabitat and ethotype showed significant microhabitat differences between the two ethotypes [x^2 (2, N = 47) = 19.892, P < 0.01; Table 1]. Calling males were only collected in vegetated microhabitats, while non-callers occurred more frequently in the open water microhabitat

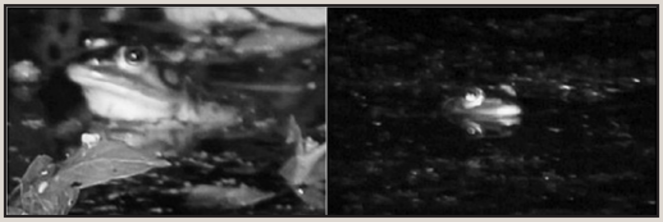

Fig. 1. Field photographs of *Lithobates grylio* depicting a calling male in sparse vegetation (left) and a non-calling male in open water (right).

Table 1. Microhabitat selection of male *Lithobates grylio* during the reproductive season.

	Shoreline	Open Water	Sparse Vegetation	Dense Vegetation
Calling N =	0	0	12	11
Non-calling N =	0	14	7	3

that separated the shoreline and floating islands. Reproductively active males were not observed on the shoreline, which is consistent with previous work suggesting that males migrate to deeper water during the reproductive season (Lamb 1984, *op. cit.*).

Males in our study called exclusively from islands of vegetation in the center of the marsh's waterway which corroborated previous observations on the oviposition sites of *L. grylio* (Wright 1932, *op. cit.*). In other species, male call site occupancy and territory defense is a predictor of oviposition site (Wells 1978, *op. cit.*). Though territoriality has never been directly observed in *L. grylio*, studies have hypothesized that this species defends call sites (Lamb 1984, *op. cit.*). Our study shows that the call site occupancy of calling male *L. grylio* mirrors that of other territorial ranids.

In the future, attention should be paid to the behavior of the non-calling males positioned in the open water microhabitats. These males exhibit smaller body size and lower body condition than the calling males in the vegetation (Walkowski et al. 2019. Copeia 107:509–516). In other anurans, low body condition is a predictor of alternative reproductive tactics, like satellite or gauntlet behavior (Gerhardt et al. 1987. Anim. Behav. 35:1490–1503; Krupa 1989. Anim. Behav. 37:1035–1043; Forester and Thompson 1998. Behaviour 135:99–119). Both behavioral strategies involve the interception of a gravid female by a non-calling male. Our study did not record an instance of female interception, but microhabitat occupancy suggests that females must travel from the shoreline past non-calling males in the open water to the islands of vegetation where calling males advertise.

All procedures performed in this study were approved by Southeastern Louisiana University's Institutional Animal Care and Use Committee (IACUC Protocol 0027). The Duane and Catherine Shafer Endowment funded parts of this research.

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***MINERVARYA* SP. PREDATION.** At ca. 1500 h on 14 March 2019, we flipped a rock in a dry streambed at the Agumbe Rainforest Research Station (13.5193°N, 75.0956°E; WGS 84) in Agumbe, Karnataka, India, to find a tarantula feeding on a small frog (Fig. 1). The tarantula had already consumed the anterior portion of the frog and only the hind limbs and a portion of the torso were remaining. We took photographs to document the incident and then gently replaced the rock. The spider was identified as belonging to the subfamily Eumenophorinae (Araneae: Theraphosidae) and the frog was identified as belonging to the genus *Minervarya* (synonymous with *Zakerana* and *Fejervarya*; Dinesh et al. 2015. Zootaxa 3999:79–94) due to the presence of "fejervaryan lines" on the venter. Many arthropods have been reported to predate small vertebrates such as frogs and lizards (McCormick and Polis 1982. Biol. Rev. 57:29–58). Frog predation by mygalomorph spiders has been documented before (Butler and Main 1959. West Austral. Nat. 7:52; Kaston 1965. Amer. Midl. Nat. 73:336–356; Stewart 1985. J. Herpetol. 19:391–401), however, this observation represents the first report of a tarantula feeding on a *Minervarya* sp.

Fig. 1. A eumenophorin tarantula (Theraphosidae) consuming a *Minervarya* sp.

We thank Zeeshan A. Mirza and Rajesh V. Sanap for identifying the tarantula and the Madras Crocodile Bank Trust for supporting the research carried out at the Agumbe Rainforest Research Station.

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***NANORANA MINICA* (Small Paa Frog). DEFORMITY.** Morphological abnormalities among amphibians are attributed to chemical contamination, UV-B radiation, predation, and parasitic infections such as the trematode *Ribeiroia ondatrae* (Blaustein and Johnson 2003. Front. Ecol. Environ. 1:87–94). Several reports on anuran abnormalities such as polymely, ectrodactyly, ectromely, polydactyly, swollen digits, anopthalmy, and edema have been documented in *Limnodynastes tasmaniensis*, *Leptodactylus chaquensis*, *Lithobates pipiens*, *L. sylvaticus*, *Pelophylax saharicus*, *Pseudacris regilla* and in many other anuran species from different parts of the world (Henle et al. 2017. Mertensiella 25:57–164). Among Indian amphibians several reports of abnormalities have been recorded in frogs like *Hoplobatrachus tigerinus* (Kurulkar and Deshpande 1932. J. Bombay Nat. Hist. Soc. 35:462), *Fejervarya* sp., *F. limnocharis*, *Euphlyctis hexadactylus*, *Hyla annectans*, *Amolops gerbillus*, *Polypedates* sp. (Mathew and Sen 2006. Cobra 63:6–10), *Indirana beddomii*, *Minervarya rufescens* (Nair and Kumar 2007. FrogLog 13:10–11). Ectrodactyly has been frequently reported in dicroglossid frogs (Gurushankara et al. 2007. Appl. Herpetol. 4:39–45) mainly from coffee plantations, water bodies near industries, and agricultural paddy fields.

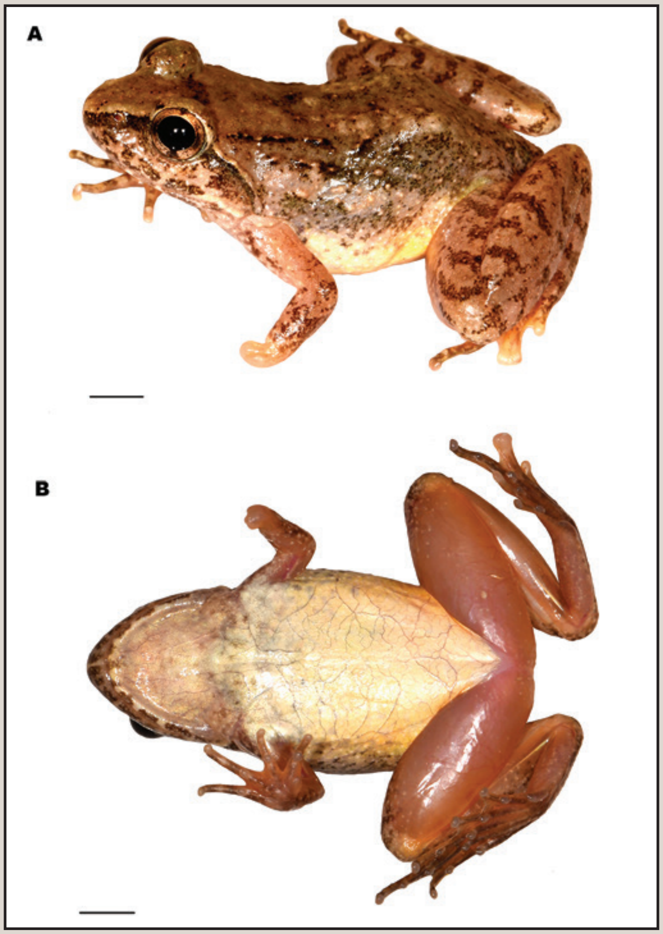

FIG. 1. *Nanorana minica* with adactyly in the left forelimb and swollen fourth toe in the left hindlimb (scale bar = 5 mm).

On 12 September 2019 at 2200 h we photographed one *Nanorana minica* with a deformed left forelimb and swollen fourth digit on the left hindlimb (Lee Kong Chian Natural History Museum, National University of Singapore [ZRC(IMG)] 1.187; 40.79 mm SVL; Fig. 1) in Benog Wildlife Sanctuary, Mussoorie, India (30.4685°N, 78.0232°E; WGS 84; 1660 m elev.). The individual was located in a grass bed 10 m from a natural stream within a forested area. The forelimb deformity, adactyly, is a specific form of ectrodactyly characterized by a partial or complete absence of one or all digits. The hindlimb deformity can be caused by a thickening of the musculature or the epidermis of the digit (Henle et al. 2017, *op. cit.*). This is the first report of limb deformities in *N. minica* and the first report for the genus *Nanorana* from forested habitat.

We thank the Director of the Uttarakhand Forest Department and Bitupan Baruah of the Wildlife Institute of India for facilitating our research. Thanks to Chan Kin Onn for providing the ZRC reference number.

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***ODONTOPHRYNUS MAISUMA*. HINDLIMB MALFORMATION.** Many records of amphibian malformations in Brazil have been documented (Ferreira et al. 2014. Herpetol. Rev. 45:307;

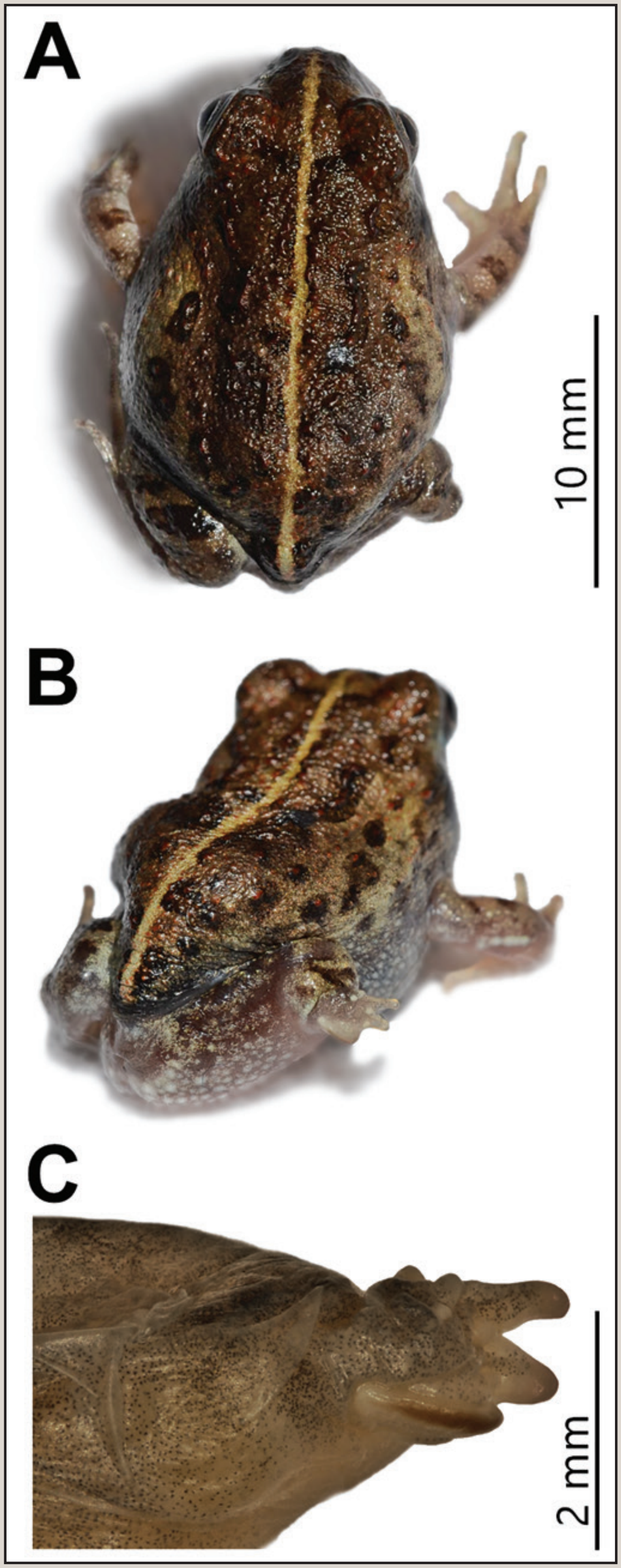

FIG. 1. A juvenile *Odontophrynus maisuma* with malformed right hind limb. A) Dorsal view of individual; B) posterior view; C) closeup of the malformed hind limb in the fixed specimen.

Silva-Soares and Mônico 2017. Phyllomedusa 16:117–120; Brassaloti and Bertoluci 2018. Phyllomedusa 17:285–288; Mônico et al. 2019. Neotrop. Biol. Conserv. 14:213–220). *Odontophrynus maisuma* is a toad endemic to the coastal dunes distributed from Santa Catarina (southern Brazil) to southern Uruguay (Iop et al. 2016. Anfíbios Anuros dos Campos Sulinos, Rede Campos Sulinos: UFRGS, Porto Alegre, Rio Grande do Sul, Brazil. 22 pp.; Frost 2019. Amphibian Species of the World: An Online Reference. Version 6.0; https://amphibiansoftheworld.amnh.org; 22 Jan 2020).

On 1 October 2019, during a diurnal survey, we collected a malformed juvenile *O. maisuma* (19 mm SVL) near the region of Farol de Santa Marta, Municipality of Laguna, Santa Catarina, Brazil (28.6036°S, 48.8287°W; WGS 84; ca. 5 m elev.). The individual had a malformation of the right hind limb (Fig. 1A, 1B) characterized by a combination of several deformities: the femur is normal, but the tibiofibula is absent (Fig. 1B); there is an apparent fusion of the tarsal bones; only two digits are present (ectrodactyly); and all digits were shortened (brachydactyly; Fig. 1C). The causes of malformations in amphibians are the result of factors associated with environmental contamination, UV-B radiation, intrinsic genetics and others (Lunde and Johnson 2012. J. Herpetol. 46:429–441), and it is difficult to determine the cause in uncontaminated areas. However, all records are important to report. To our knowledge, this is the first record of a malformation for *O. maisuma*. The specimen was deposited in the Amphibians Collection of Universidade Federal do Rio Grande do Sul, Brazil (UFRGS 7434).

We thank Instituto Chico Mendes de Conservação da Biodiversidade for the sampling permit (No. 12.613), the field team, and Filipe Michels Bianchi for the photography of the specimen using an Electronic Magnifier Digital Microscope. We also thank Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) for scholarships.

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RANA DRAYTONII **(California Red-legged Frog) and *ANAXYRUS BOREAS*** **(Western Toad). INTERSPECIFIC AMPLEXUS.** Reproduction in anurans from temperate zones is primarily seasonal, but courtship and mating behaviors vary greatly and are influenced mainly by hormones and acoustic signals (Vitt and Caldwell 2009. Herpetology: An Introductory Biology of Amphibians and Reptiles. Third edition. Academic Press, San Diego, California. 697 pp.). In a single microhabitat, breeding overlap between several species is common. While uncommon, interspecific amplexus is known to occur when the reproductive seasons of amphibian species overlap in time and space (Streicher et al. 2010. Herpetol. Rev. 41:208). Here, we report the second case of interspecific amplexus between *Rana draytonii* and *Anaxyrus boreas*.

On 4 February 2019 at 2056 h, we observed a male *R. draytonii* engaging in axillary amplexus with a male *A. boreas* (Fig. 1) in a cattle pond at Rancho Meling, Sierra San Pedro Mártir, Municipality of Ensenada, Baja California, Mexico (30.96532°N, 115.74175°W; WGS 84; 625 m elev.). At the time of amplexus, the male *R. draytonii* (94 mm SVL, 49.5 g) was vocalizing and the male *A. boreas* (96.1 mm SVL, 90 g) was making release calls. Water temperature was 13.2°C, air temperature 9.2°C, and the

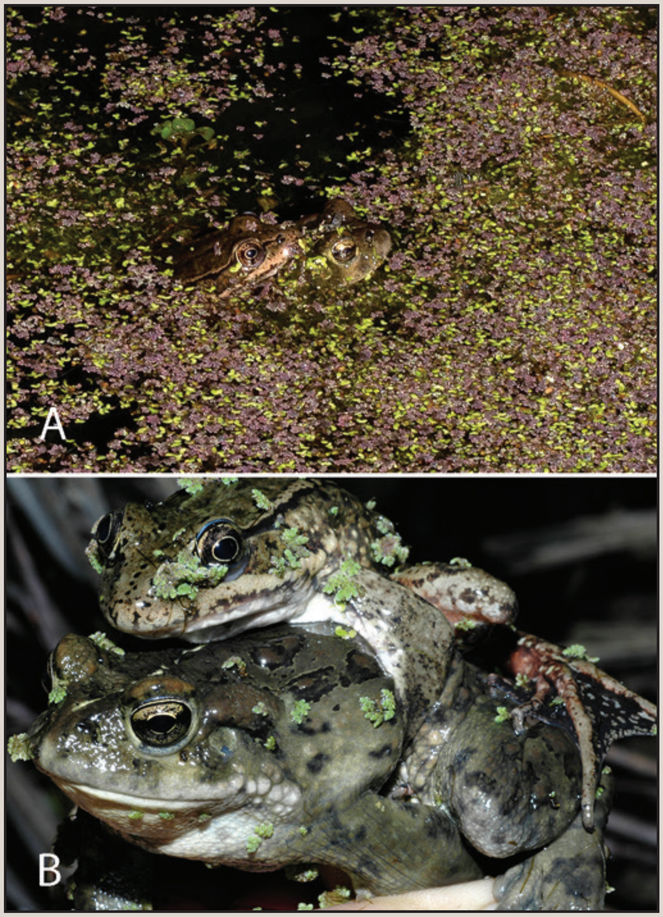

Fig. 1. Male *Rana draytonii* in amplexus with a male *Anaxyrus boreas*: A) in situ; B) close up after capture, at Rancho Meling, Baja California, Mexico. 1A)

water depth was 43 cm. We heard four additional *R. draytonii* calling, as well as several *Pseudacris regilla* while conducting the monitoring survey at the site.

The first case of interspecific amplexus between these two species was in Contra Costa County, California, USA, but in the reverse position, with *A. boreas* amplexing a female *R. draytonii* (Alvarez 2011. Herpetol. Rev. 42:408–409). There is no evidence that interspecific amplexus affects either species, but one cost could be decreased reproductive effort should too much time and energy be expended during these mating attempts (Höbel 2005. Herpetol. Rev. 36:439–440).

We thank D. Lang and the Meling family for their hospitality and support, and for allowing access to the site. Permits were issued by the Secretaría de Medio Ambiente and Recursos Naturales (SEMARNAT) to J.H.V.V. (SGPA/DGVS/007139/18). Additional photographic vouchers were deposited at the San Diego Natural History Museum (SDSNH_HerpPC_5417-5420).

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RAORCHESTES CHALAZODES **(White-spotted Bush Frog). DIET.** Most anurans are generalist predators and forage opportunistically (Duellman and Trueb 1994. Biology of Amphibians.

Fig. 1. *Raorchestes chalazodes* consuming *Satiella dekkanensis* on a leaf of *Ochlandra travancorica.* A) close up of *R. chalazodes* and discarded shell; B) close up of *S. dekkanensis.*

Johns Hopkins University Press, Baltimore, Maryland. 670 pp.). Their prey items are predominantly invertebrates, such as insects and spiders, but they are occasionally known to ingest other invertebrates such as molluscs. However, the diets of most anuran species are not well documented. Here, I report an observation of the diet of a narrow endemic and critically endangered bush frog, *Raorchestes chalazodes* from the southern Western Ghats, India. At 2200 h on 15 June 2015, I was studying the reproductive behavior of *R. chalazodes* along the Manimuthar River within the Kalakad Mundanthurai Tiger Reserve (KMTR, 8.54°N, 77.37°E; WGS 84l, 1200 m elev.) and encountered an adult male *R. chalazodes* feeding on a mollusc. The frog was perched on a leaf of *Ochlandra travancorica* (Travancore Bamboo), nearly 2 m above ground and had ingested about a third of the mollusc when encountered (Fig. 1). The frog completely ingested the mollusc in about 45 min, occasionally holding the mollusc with its right hand. After consuming the mollusc, the frog walked up the leaf surface and the discarded shell was observed (Fig. 1A). The air temperature was 19°C, relative humidity was 72%, and there were moderate winds during the observation. Based on the shell and photographs, the snail was identified as *Satiella dekkanensis*, commonly known as a Semi-slug, characterized by the absence of a hard shell (Fig. 1B). This air-breathing gastropod mollusc (Helicarionidae) is commonly found within the wet-evergreen forests of the southern Western Ghats and the geographic range appears to be restricted to KMTR (Raheem et al. 2014. Trop. Nat. Hist. 4:1–294). These snails are arboreal, pale green in coloration, and are found in the study site at encounter rates of 10–12 individuals/100 m. The snails are abundant during the monsoon months from late April to October.

Individuals of *R. chalazodes* are locally abundant and exclusively breed inside the hollows of *O. travancorica* bamboo. The males provide extensive parental care to developing embryos and stay within the bamboo internode for over a month, during which time they may not forage or feed. However, in the absence of a caregiving adult, the males are known to cannibalize eggs (Seshadri and Bickford 2018. Behav. Ecol. Sociobiol. 72:1–14). It is likely that the adult males forage specifically for relatively large prey such as the Semi-slug before the breeding season. Comparing the body mass of adult males before and after embryos hatch and undertaking detailed studies on its diet using non-lethal techniques such as stomach-flushing may provide interesting insights into the diet and costs of parental care in this critically endangered and endemic species of arboreal frog.

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***RHEOHYLA MIOTYMPANUM* (Small-eared Treefrog). PREDATION.** *Rheohyla miotympanum* is a small hylid endemic to Mexico with a wide distribution across the Sierra Madre Oriental throughout the states of Coahuila, Nuevo León, Tamaulipas, San Luis Potosí, Querétaro, Hidalgo, Puebla, and Veracruz; it is one of two species of treefrogs native to the state of Nuevo León. Known predators of this species are the spiders *Cuppienius salei* (García-Vinalay and Pineda 2017. Mesoam. Herpetol. 4:625) and *Dolomedes holti* (De Luna and Montoya 2017. Herpetol. Rev. 48:417).

The White-nosed Coati (*Nasua narica*) is a medium-sized mammal that feeds mainly on fruits and invertebrates, but occasionally hunts small terrestrial vertebrates (Ceballos 2014. Mammals of Mexico. Johns Hopkins University Press, Baltimore, Maryland. 974 pp.). At 1345 h on 30 November 2019 while performing a spider survey in La Estanzuela Natural Park (25.5408°N, 100.2721°W; WGS 84; 748 m elev.), we flipped a dead log which startled an adult *R. miotympanum* that was resting on the other side. The frog jumped to the sidewalk and was spotted by a male coati that had been following us in search for food; the coati smelled the frog, which proceeded to jump but was caught midair by the paws of the coati and was quickly subdued and consumed in less than 20 sec. This is, to our knowledge, the first record of *R. miotympanum* being preyed upon by *N. narica*.

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***RHINELLA MARINA* (Cane Toad). MORPHOLOGICAL ABNORMALITY.** Malformations in amphibians are caused by many factors including exposure to pollution such as metals, pesticides, or other chemical products during ontogenesis (Ouellet et al. 1997. J. Wildl. Dis. 33:95–104; Lannoo 2008. The Collapse of Aquatic Ecosystems: Malformed Frogs. University of California Press, Berkeley, California. 288 pp.). These malformations can reduce the capacity of individuals to move and feed, and increase the risk of predation (Johnson and Lunde 2005. *In* Lannoo [ed.], Amphibian Declines: The Conservation Status of United States Species, pp. 124–138. University of California Press, Berkeley).

Rhinella marina is a neotropical, nocturnal toad, distributed widely in South America. It is a terrestrial species generally found in open and disturbed habitats (Valencia and Garzón 2011. Guía de Anfibios y Reptiles en Ambientes Cercanos a las Estaciones del OCP. Quito: Fundación Herpetológica Gustavo Orcés, Quito, Ecuador. 268 pp.; Acevedo et al 2016. Zootaxa 4103:574–586). In April and May 2016, two individuals with malformations were recorded in the province of Orellana, Ecuador. The first was found on 22 April 2016, at 1946 h, at Tiputini Parish, Aguarico Canton (0.79310°S, 81.56602°W; WGS 84; 205 m elev.), where an individual with an abnormal right forelimb was observed in the leaf litter. The fingers were absent and the individual exhibited difficulty with its movement. The second individual was encountered on 7 May 2016, at 1027 h, at Capitán Augusto Rivadeneira Parish, Aguarico Canton (0.66612°S, 81.96235°W;

FIG. 1. *Rhinella marina* with a malformation in the right forelimb.

FIG. 2. Abnormality of the right eye in *Rhinella marina.*

WGS 84; 208 m elev.). A juvenile individual seen on the ground, possessed an abnormal right eye, it was more than double the normal size and the entire eye was red. Although it is not possible to establish the causes for these malformations, exposure to chemical pollutants, genetic issues, or trauma from predation attempts or intraspecific combat could be possibilities.

We thank A. Guijarro, M. Chico and L. Luje for the information provided about malformations.

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***SCINAX AURATUS* (Santa Ines Snouted Treefrog). ANTIPREDATOR BEHAVIOR.** *Scinax auratus* (Hylidae) is an anuran endemic to the Brazilian Atlantic Rainforest. It is distributed from the extreme northeastern Minas Gerais (Salto da Divisa) through eastern Bahia and Sergipe to Paraíba (Frost 2019. Amphibian Species of the World: An Online Reference. Version 6.0; https://amphibiansoftheworld.amnh.org; accessed 13 Sept 2019). One of the aspects most used by researchers to recognize behavioral displays of animals is their pattern, as these are reproducible and

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FIG. 1. Thanatosis, or death feigning behavior, in *Scinax auratus.*

communicable. This requires the use of images and a very detailed description of the behavior displayed by the animal (Barret and Seeley 2015. Anim. Behav. 103:171–177). Antipredator mechanisms are among the most observed behavioral patterns. The antipredatory mechanisms of amphibians primarily result in secretions being released from the skin (Brodie 1977. Copeia 1977:523–535; Brodie 1983. *In* Margaris et al. [eds.], Plant, Animal, and Microbial Adaptation to Terrestrial Environments, pp. 109–133. Plenum Publishing Corp., New York, New York). Often, these secretions can be noxious and toxic (Daly et al. 1987. Toxicon 25:1023–1095; Bevins and Zasloff 1990. Ann. Rev. Biochem. 59:395–414; Erspamer 1994. J. Herpetol. 28:499–502) or adhesive (Arnold 1982. Copeia 1982:247–253; Evans and Brodie 1994. J. Herpetol. 28:499–502), especially for arboreal species. Anurans also emit distress calls. These defensive acoustic signals can surprise and startle the predator (Hoare and Labra 2013. Ethology 119:860–868; Toledo et al. 2011. Ethol. Ecol. Evol. 23:1–25). In addition, thanatosis occurs when the animal death-feigns to avoid being eaten (Toledo 2011, *op. cit.*).

On 15 July 2019 during herpetological surveys in the Tapacurá Ecological Station, Municipality of São Lourenço da Mata, Pernambuco, Brazil (35.19778°W, 8.03889°S), we encountered an individual *S. auratus* in herbaceous vegetation. When we tried to capture it, it displayed thanatosis (Fig. 1) as described by Toledo (2011, *op. cit.*) or death feigning as described by Ferreira et al. (2019. Behav. Ecol. Sociobiol. 73:1–21). As far as we know this is the first record of thanatosis or death feigning in *S. auratus.*

We thank Leonardo Pessoa Cabus Oitaven and Melk Wilk Aniceto Pereira for their assistance during an expedition at the Tapacurá Ecological Station during the related event. The collection of animals was in accordance with the federal and institutional procedures according to protocol number 55436-1 (ICMBio) and 23082.005335/2017- 11 (CEUA-UFRPE).

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***SCINAX IMBEGUE* (Snouted Treefrog). PREDATION.** Invertebrate predation on anuran amphibians is a widespread phenomenon (Wells 2007. The Ecology and Behavior of Amphibians. University of Chicago Press, Chicago, Illinois. 1148 pp.). Spiders are some of the most common invertebrate predators in the neotropics and prey on anurans during all life stages (Toledo et al. 2007. J. Zoology 271:170–177; Menin et al. 2005. Phyllomedusa 4:347). *Scinax imbegue* is a small-sized tree frog endemic to the Atlantic Forest of southern and southeastern Brazil (Nunes et al. 2012. Copeia 2012:554–569). Populations of *S. imbegue* are abundant and typically breed in permanent ponds and lakes during the wetter parts of the year (Nunes et al. 2012, *op. cit.*; Fiorillo et al. 2018. Biota Neotropica 18:1–15). There is only one published predation record of *S. imbegue* by a spider: *Phoneutria keyserlingide* (Zornosa-Torres et al. 2019. Herpetol. Rev. 50:552). Herein, we report an additional spider predator, *Lycosa erythrognatha*, of *S. imbegue*.

At 0040 h on 24 April 2019 (air temp. = 21.1°C, relative humidity = 80%), an adult *L. erythrognatha* (11.66 mm total length) was found consuming a juvenile *S. imbegue* (12.61 mm SVL; Fig. 1) in the Parque Estadual Fontes do Ipiranga, Municipality of São Paulo, São Paulo State, Brazil (23.63889°S 46.61972°W; WGS 84; 770 m elev.). We observed the spider holding the *S. imbegue* with its pedipalps and chelicerae by the left side of its body (Fig. 1A, B) on bamboo 13 cm from the ground and 220 cm from the edge of the lake. Other juvenile *S. imbegue* occupied bromeliads located 150 cm from the predation event. During the encounter, we approached with flashlights, and the spider released the tree frog partially digested (Fig. 1C). The specimen of *S. imbegue* was deposited at the Coleção de Anfíbios, Departamento de Zoologia, Universidade Estadual Paulista, Campus de Rio Claro (CFBH 44896).

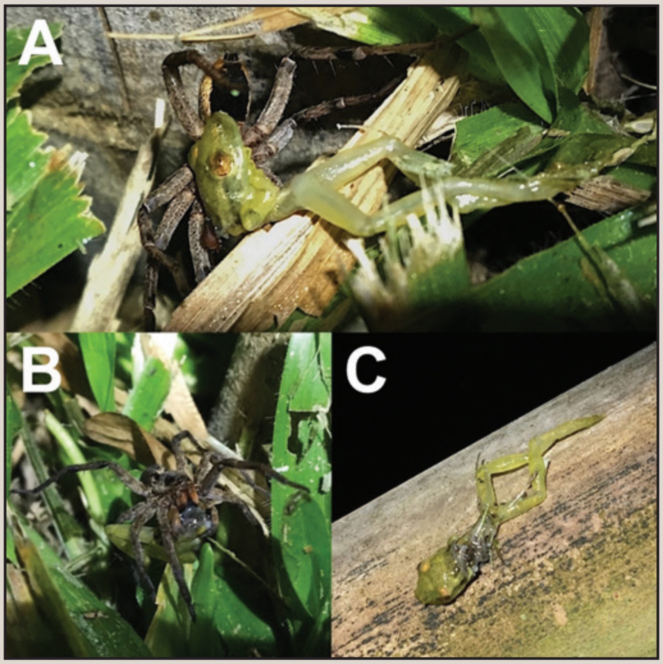

Fig. 1. A, B) Juvenile *Scinax imbegue* preyed upon by *Lycosa erythrognatha*; C) the same individual partially digested after the predation encounter at Parque Estadual Fontes do Ipiranga, Municipality of São Paulo, Brazil.

To the best of our knowledge, this represents only the second report of a spider feeding upon *S. imbegue* (Zornosa-Torres et al. 2019, *op. cit.*) and the first report for a lycosid spider. Records of spider predation for the genus *Lycosa* have been previously documented for other species of anurans, such as *Pseudopaludicola* cf. *mystacalis* (Moraes and Pertel 2011. Herpetol. Rev. 42:414), *Boana pulchella* ((Villanova et al. 2015. Herpetol. Rev. 46:412), and *Rhinella ornata* (Almeida et al. 2010. Herpetol. Notes. 3:173–174). Throughout the *Scinax alter* species complex, there has only been one report of predation on *S. alter* by spiders (*Ancylometes rufus;* Prado and Borgo 2003. Herpetol. Rev. 34:238–239). Further research is needed to determine the extent to which *S. imbegue* is preyed upon by spiders and the impact this predator has on the population size of *S. imbegue*.

We are grateful to R. Bertani from the Instituto Butantan for the identification of the spider. We also thank the Parque Estadual Fontes do Ipiranga for logistical support and RAN/ ICMBIO for the collecting permit (SISBIO No 63597/4). Funding was provided by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001.

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***THOROPA MILIARIS* (Military River Frog). PREDATION.** Spiders from the genus *Trechalea* are normally found associated with water bodies (Carico 1993. J. Arachnol. 21:226–257). Besides preying on invertebrates, they may also prey on vertebrates, such as fishes (Nyffeler and Pusey 2014. PLoS ONE 9:e99459) and anurans (Menin et al. 2005. Phyllomedusa 4:39–47; Moura and Azevedo 2011. Biota Neotr. 11:1–3). The genus *Thoropa* includes six species distributed in eastern Brazil (Frost 2019. Amphibian Species of the World: an Online Reference. Version 6.0; https://amphibiansoftheworld.amnh.org; 11 Nov 2019). All species are known to live in rocky environments and have semiterrestrial tadpoles, which inhabit shallow, slow-flowing water on rock surfaces (Bokermann 1965. An. Acad. Bras. Ciênc. 37:525–537; Sabbag et al. 2018. Mol. Phylogenet. Evol. 122:142–156.). Among these species, *Thoropa miliaris* has the widest distribution (Cocroft and Heyer 1988. Proc. Biol. Soc. Wash. 101:209–220) being found mostly in Brazil (Sabbag et al.

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Fig. 1. *Thoropa miliairis* tadpole being preyed upon by *Trechalea* sp. in the Municipality of Cataguases, Minas Gerais, Brazil.

2018, *op. cit.*). Here, we report a predation event by *Trechalea* sp. on a tadpole of *T. miliaris*.

At 1550 h on 29 December 2013, we found a *Trechalea* sp. feeding on a *T. miliaris* tadpole (Fig. 1) in a permanent stream bordered with gallery forests in the Atlantic Forest biome in the Municipality of Cataguases, Minas Gerais, Brazil (21.24337°S, 42.72452°W; WGS 84). At the time of the observation, the air temperature was 24°C. The spider was found with the *T. miliaris* along the stream margin on a stony substrate. To the best of our knowledge, this is the first report of predation on *T. miliaris* by *Trechalea* sp., thus expanding the spectrum of predator-prey interactions among spiders and amphibians under natural conditions (Menin et al. 2005, *op. cit.*; Moura and Azevedo 2011, *op. cit.*). After this observation, the spider was collected and sent for identification to the Arachnological Collection of Butantan Institute, São Paulo, Brazil.

We thank A. D. Brescovit for helping with the identification of the spider species.

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***TRIPRION PETASATUS* (Yucatan Casquehead Treefrog). DIET.** *Triprion petasatus* is a medium-sized hylid frog that occurs in seasonally dry forests and savannas on the Yucatán Peninsula, Mexico. *Smilisca baudinii* (Mexican Treefrog) is a medium to large sized hylid, distributed from the southern USA to Panama. In both species, females deposit eggs in water, where they hatch into tadpoles and metamorphose into frogs (Lee 2000. A Field Guide to the Amphibians and Reptiles of the Maya World: the Lowlands of Mexico, Northern Guatemala, and Belize. Cornell University Press, Ithaca, New York. 416 pp.). There are little to no permanent waterbodies in the Calakmul Biosphere Reserve in the Yucatán Peninsula, and in recent years the temporary pools, or aguadas, have decreased in volume and frequency. Therefore, artificial water bodies such as water tanks are important reproduction and development sites for several anuran species, including *T. petasatus* and *S. baudinii* (Colston et al. 2015. Check List 11:1759). Diet is known to be a principle component in the length of larval periods and timing of metamorphosis; a high quality diet can greatly decrease the time spent in the larval stage, reducing the opportunity to be predated upon as well as providing the ability to forage within previously unused microhabitats (Kupferberg 1998. J. Herpetol. 32:84–92). This extremely important factor is largely understudied, and most diets, growth rates, and larval periods are unknown. One recent study found that when there was limited food availability, *T. petasatus* tadpoles would cannibalize conspecifics. However, that experiment isolated the subjects from the presence of other anuran species (Jacobson et al. 2019. Herpetol. Conserv. Bio. 14:308–324). Here we report the predation of *S. baudinii* metamorphs by *T. petasatus* tadpoles.

PHOTOS BY ART ADOJAAN

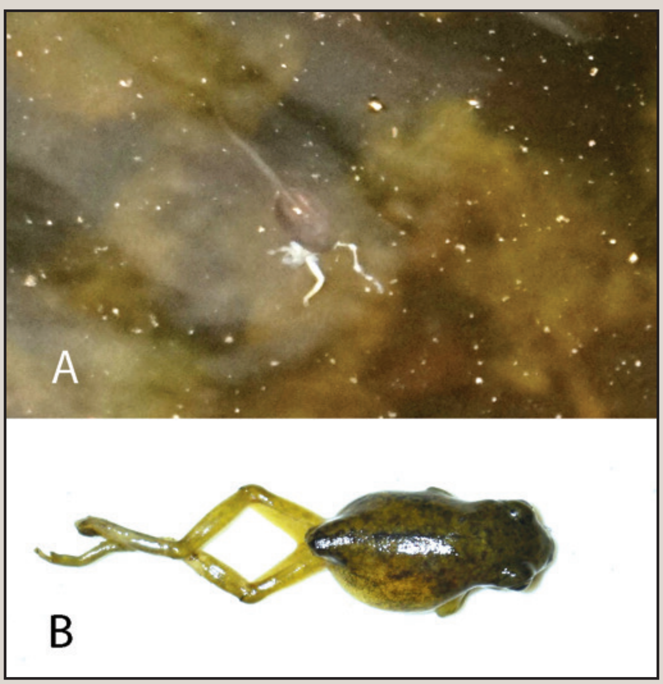

FIG. 1. A) *Triprion petasatus* tadpole with a *Smilisca baudinii* metamorph, seen mid-feeding with only half of prey item still intact. This photo was taken just before capture. B) *Smilisca baudinii* metamorph laid out for measurements.

On 23 June 2019, we observed a *T. petasatus* tadpole (1.6 cm SVL, 1.95 cm tail length, 1.6 g) grasping a dead *S. baudinii* metamorph (1.25 cm SVL, 0.9 cm tail length, 0.4 g) in its mouth and slowly feeding upon it (Fig. 1), in an artificial water tank at the KM20 research site in the Calakmul Biosphere Reserve, Campeche, Mexico (18.36487°N, 89.89254°W; WGS 84; 275 m elev.). After multiple attempts a second *T. petasatus* individual and its prey were caught (Fig. 2), measured and identified (Lee 2000, *op. cit.*), before being released. A total of six occurrences of this predation event were recorded on this day between 1540 h and 1930 h.

Tadpoles are known to have a wide array of dietary components, from algae and bacteria, to invertebrates, anuran eggs and other tadpoles. Dietary preference is suggested to change in response to environmental conditions and nutritional needs (Kloh et al. 2018. Amphibia-Reptilia 39:445–456). Limited food availability may cause them to feed upon conspecifics; however, this is suggested to only be the case when starvation is likely, and in fact, may even be detrimental to tadpole growth (Jefferson et al. 2014. Naturwissenschaften 101:291–303). Furthermore, *S. baudinii* is known to sympatrically and synchronously breed with *T. petasatus* (Duellman and Klaas 1964. Copeia 1964:308–321). Therefore, our observations could be the result of limited prey availability and the nutritional benefits of predating upon another anuran species instead of conspecifics, to accelerate metamorphosis.

Neotropical amphibians have experienced large declines and observations such as these provide useful insights for species conservation and natural history. As far as we know, this is the first record of a tadpole killing and feeding upon the metamorph of another anuran species. Studies usually show that diet is based on what is available and not necessarily what would be eaten when other choices are present. Our observation highlights this point and how interspecific competition is a major factor impacting anuran reproductive potential in regions with limited availability of reproductive sites.

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FIG. 1. *Corythornis cristatus* (Malachite Kingfisher) catching a tadpole of *Xenopus victorianus* (Lake Victoria Clawed Frog) in Akagera National Park, Rwanda.

***XENOPUS VICTORIANUS* (Lake Victoria Clawed Frog). LARVAL PREDATION.** *Xenopus victorianus* is widely distributed in the river valleys of the northern Great Lakes region around Lakes Victoria and Kivu in the Central African Albertine Rift (Channing and Howell 2006. Amphibians of East Africa. Cornell University Press, Ithaca, New York. 418 pp.). Although common and locally abundant, not much is known about its natural history. Tadpoles of this species are fairly large (up to 80 mm) and typically assume a head-down position in midwater, often forming schools. On 26 December 2016 at 1431 h, I observed and photographed a *Corythornis cristatus* (Malachite Kingfisher) catching a tadpole of *Xenopus victorianus* (Fig. 1) from a small pond at the edge of a vast wetland formed by the Akagera River in the northern outstretches of Akagera National Park, Rwanda (1.35996°S, 30.59406°E; WGS 84; 1290 m elev.). *Corythornis cristatus* is known to feed on fish and small arthropods, especially spiders (Vande Weghe and Vande Weghe 2011. Birds in Rwanda. An Atlas and Handbook. Rwanda Development Board, Kigali, Rwanda. 336 pp.). This represents the first documentation of predation on tadpoles of *X. victorianus* by a kingfisher and the first report of tadpole hunting in *C. cristatus.*

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TESTUDINES — TURTLES

***ACTINEMYS MARMORATA* (Western Pond Turtle). INVASIVE SPECIES VECTOR.** Managing nonnative aquatic species may be difficult or impossible following introductions to riparian systems, particularly when an invasion involves multiple vectors. We observed *Potamopyrgus antipodarum* (New Zealand Mud Snail) attached to the carapace of *A. marmorata* while repeating a mark-recapture study originally conducted from 2010–2014 in the lower Pajaro River, Santa Cruz County, California, USA.

On 25 and 28 June 2019, we captured an adult *A. marmorata* (#1) in a hoop trap (0.762 × 1.83 m) along the lower Pajaro River (36.8844°N, 121.7709°W; WGS 84). The individual was examined to determine if it was previously marked by scute-notch, weighed, measured, and photographed. It was inspected for health and although no evidence of infestation was observed during the initial capture or in a subsequent review of our photographs, when it was recaptured 3 d later, no less than five adult *P. antipodarum* were present (Fig. 1). Subsequent visual inspections of 38 *A. marmorata* (16 new captures) between 22–26 July 2019, revealed one additional male (#2; located at 36.90275°N, 121.68228°W; WGS 84) with >10 adult *P. antipodarum* in green algae (*Chlorophyta*) growing on its carapace. We reviewed the photographs of all *A. marmorata* handled in 2019 (91 captures), and no other individuals appeared to be infected. The Pajaro River study area, which is constrained by levees (averaging ca. 90 m in width [range: 70–195 m]), extended from Murphy's Crossing, 14 river km downstream to the Thurwacher Bridge, excluding the City of Watsonville due to extensive human disturbance within the riparian corridor. The lower reach from approximately State Hwy 1 to Thurwacher Bridge was tidally influenced and the entire surrounding uplands converted to agriculture and urbanization.

FIG. 1. *Actinemys marmorata* with *Potamopyrgus antipodarum* on carapace, Pajaro River, California, USA.

In 2010, *A. marmorata* #1 was captured 6.8 river km upstream, subsequently recaptured in 2011 ca. 9.8 river km upstream, and not observed again until 2019. *Actinemys marmorata* #2 was originally captured 10.7 river km upstream in 2010 and recaptured in 2014 ca. 6.8 river km upstream. Although presumably constrained to the riparian corridor due to habitat conversion outside the levees, given that the study area is an open system, *A. marmorata* may act as a vector for invasive *P. antipodarum* to spread upstream. The Pajaro River drains a 3367 km^2 watershed throughout four counties in central California.

Potamopyrgus antipodarum was first identified in the western United States in 1987 in the Middle Snake River, Idaho, apparently associated with transplanted trout eggs or live fish, and was found in the Owens River in California in 2000 (Alonso and Castro-Díez 2008. Hydrobiol. 614:107–116; http://nas.er.usgs.gov; 16 Nov 2019). It is a clonal mollusk that can spread quickly in a riparian system simply by attaching to the surface tension of water and can also persist out of water for many hours embedded in moist mud or debris on equipment such as waders, nets, and boats (Levri et al. 2015. Biol. Inv. 17:497–506). It was first discovered in the lower San Lorenzo River, Santa Cruz County in 2007 but not detected in the Pajaro River until October 2018, when CS observed extraordinarily high numbers near Thurwacher Bridge during annual fish sampling within and upstream of the lagoon. No eradication methods are currently available for riverine systems.

Whereas animals and humans may unwittingly spread *P. antipodarum* between watersheds, once established other vectors include fish that may consume *P. antipodarum*, but which then pass thru their digestive system alive (Vinson et al. 2008. N. Amer. J. Fish. Mgmt. 28:701–709). *Actinemys marmorata* may also act as a vector within a riparian system that could theoretically spread *P. antipodarum* upstream and downstream, or to an off-channel pond, lake, or reservoir, if infected individuals travel overland and the snail survives. For many years in California, fisherman, boaters, and aquatic biologists have been urged to clean and dry their gear for a minimum of 48 h, freeze for 6 h, or disinfect equipment with chemicals to slow the spread of this highly invasive mollusk (http://ucanr.edu; 16 November 2019).

This research was conducted under the authority of our California Department of Fish and Wildlife (CDFW) scientific collecting permits and associated memorandum of understandings. We are grateful for funding provided by the County of Santa Cruz Department of Public Works/Zone 7 Flood Control District. *Potamopyrgus antipodarum* specimen identification was confirmed by D. Post, CDFW Office of Spill Prevention and Response Aquatic Bioassessment Laboratory, Rancho Cordova, California.

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***APALONE FEROX* (Florida Softshell). PREDATION.** *Apalone ferox* is a highly aquatic species of softshell turtle distributed from South Carolina southward throughout Florida and west to Mobile County, Alabama, USA (Ernst and Lovich 2009. Turtles of the United States and Canada. Smithsonian Institution Press, Washington, D.C. 827 pp.). *Apalone ferox* is the largest of the native North American softshell turtles, rendering adults immune to predation from all sources except for large American Alligators (*Alligator mississippiensis*). However, nests and hatchlings are subject to a wide variety of predators including multiple species of predatory mammals and birds (Ernst and Lovich 2009, *op. cit.*). Throughout the Everglades ecosystem, seasonal pulses in hydrology concentrate prey resources into areas of low elevation that retain water throughout the dry season. Huge influxes of wading birds occupy the Everglades during these seasonal dry downs to take advantage of the increased prey densities that occur during this period (Cook et al. 2014. Freshwater Biol. 59:1608–1621). While other studies have described the increase in prey densities of fish and invertebrates, highly aquatic chelonian species like *A. ferox* are also likely concentrated during these periods and may provide another source of energy for some of the large wading birds capable of consuming them. At 1805 h on 23 February 2020, I observed an adult Great Egret (*Ardea alba*) consuming a juvenile *A. ferox* (Fig. 1) within a deep slough section of the Loxahatchee National Wildlife Refuge, Palm Beach County, Florida, USA (26.49157°N, 80.21838°W; WGS 84). The *A. alba* struggled to consume the *A. ferox* for over 30 min before finally swallowing the prey whole. The *A. alba* appeared to have killed the *A. ferox* by breaking its neck, instead of through its usual method of hunting that relies on using its prodigious beak to spear prey items. It is possible that the influx of high trophic level wading birds during the dry season may substantially increase predation on juvenile and hatchling turtle species across the Everglades ecosystem.

Fig. 1. Predation of a juvenile *Apalone ferox* by *Ardea alba* within a deep slough of the Everglades, Florida, USA.

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***CHELONIA MYDAS* (Green Sea Turtle). PREDATION.** Aside from *Homo sapiens*, sharks of the orders Carcharhiniformes and Lamniformes are the primary predators of Cheloniidae (Marquez 1990. FAO Fisheries Synopsis 125:1–81). *Carcharodon carcharias*, *C. leucas*, and *Galeocerdo cuvier* are known to prey upon *Dermochelys coriacea*, *Caretta caretta*, and *Chelonia mydas* at sea (Fergusson et al. 2000. Env. Biol. Fishes 58:447–453; Heithaus et al. 2002. Mar. Biol. 140:229–236; Cliff and Dudley 2008 J. Exp. Mar. Biol. Ecol. 356:43–51). Injuries characteristic of shark predation have been documented in Cheloniidae stranded along the western Gulf of Mexico (GoM) in Texas, USA (Shaver 1995. Mar. Turt. Newsl. 70:2–4). Herein, we describe four reports of *C. mydas* removed from shark stomachs, two of which were identified to species, and report injuries consistent with shark interactions in 45 additional *C. mydas* found stranded in south Texas during 2019.

On 22 April 2019, personnel conducting surveys for nesting and stranded sea turtles on Boca Chica Beach, Cameron County, Texas, USA found the decomposed head and nearby complete stomach of a shark. The stomach contained an intact juvenile *C. mydas* (Fig. 1A) that measured 25.8 cm straight carapace length (SCL) and 21.3 cm straight carapace width (SCW). The *C. mydas* had injuries indicative of shark predation, including crescent-shaped bite wounds characterized by sharply incised tooth marks with scoring of bone on the carapace and plastron, and a similar wound on the right front flipper. The shark was identified as *Carcharodon leucas* based on the morphology of the head and teeth and partial sequencing of the mitochondrial cytochrome oxidase I gene.

On 28 April 2019, a recreational fisherman removed two juvenile *C. mydas* (Fig. 1B) from the stomach of an unidentified shark on Boca Chica Beach, 1.6 km north of the Rio Grande River. Both had bite wounds on the plastron and flippers. The *C. mydas* were identified to species based on photographs, as they were not retrieved for examination. The shark was not photographed and no samples were available for identification of species.

Fig. 1. A) *Chelonia mydas* carcass encased (with rear flipper protruding) in a *Carcharhinus leucas* stomach found on Boca Chica Beach, Texas on 22 April 2019; B) *C. mydas* carcasses removed from a Chondrichthyes stomach washed ashore on Boca Chica Beach on 28 April 2019; C) possible *C. mydas* carcass encased in a Chondrichthyes stomach observed on Boca Chica Beach on 29 April 2019; D) *C. mydas* carcass removed from a *Galeocerdo cuvier* stomach at Padre Island National Seashore, Texas on 29 June 2019.

On 29 April 2019, personnel conducting surveys for nesting and stranded sea turtles photographed an unidentified shark stomach washed ashore on Boca Chica Beach that appeared to contain a juvenile *C. mydas* (Fig. 1C). However, neither the species of shark nor the consumed *Cheloniidae* could be identified because both were moved or washed away before they could be examined.

On 29 June 2019, a juvenile *C. mydas* was found in the stomach of a 246.4 cm (total length) *G. cuvier* captured on hook-and-line near the Padre Island National Seashore (PAIS) 27.4 km marker (Fig. 1D). The anglers took the shark home but provided the *C. mydas* to PAIS biologists. The *C. mydas* was partially digested and three flippers and the head were missing. The detached distal half of the right front flipper also was found within the stomach. The *C. mydas* measured 32.1 cm curved carapace length (estimated) and 26.9 cm curved carapace width (estimated). The shark was identified as *G. cuvier* based on photographs.

Forty-five additional juvenile *C. mydas* (29.1 cm mean SCL; range: 22.2–58.8 cm) exhibiting injuries consistent with shark interaction stranded in south Texas in 2019. Forty-three were found on the GoM-facing coast, one was caught within a bay, and another was found within a coastal inlet. Twenty-seven of the stranded juvenile *C. mydas* were alive upon discovery. Of those found dead, the injuries consistent with shark interactions were either attributed to predation or post-mortem scavenging of turtles that had died from other causes.

These observations indicate that juvenile *C. mydas* are being targeted as prey by *C. leucas* and *G. cuvier* in the western GoM. The number of juvenile *C. mydas* in south Texas waters has notably increased in recent years (Shaver et al. 2017. PLoS ONE 12:e0173920); an effect credited to international conservation efforts. Greater numbers of *C. mydas* recruiting into foraging habitat undoubtedly has increased their availability as prey. Continued documentation of shark interactions is of interest to both study of the recovering *C. mydas* population as well as its potential ecological implications.

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***CHELONIA MYDAS* (Green Sea Turtle). TWINNING.** Embryological twinning in turtles is rare, but occasionally reported. Twins have been recorded in several species of sea turtles, such as the Olive Ridley Sea Turtle (Sreeram et al. 2016. Indian Ocean Turtle News. 24:8–9), Leatherback Sea Turtle (Eckert 1990. J. Herpetol. 24:317–320), and Green Sea Turtle (Kaska and Downie 1999. Zool. Middle East 19:55–69). Here, we report a case of twinning in *Chelonia mydas* based on observations made in March 2017 in Atol das Rocas (3.86388°S, 33.81111°W; WGS 84), an important nesting area for this species in Brazil.

Atol das Rocas is located 260 km east of the state capital of Rio Grande do Norte, northeastern Brazil. On 24 January 2017 a female Green Sea Turtle laid her eggs and the location of the nest was marked with a numbered PVC stake. The hatchlings emerged on 26 March 2017; the nest was opened and stillborn turtles were removed. Nineteen of 109 eggs failed to hatch and one pair of twins was found among the stillborn (Fig. 1). Twin sea turtles have been found alive (Sreeram et al. 2016, *op. cit.*). Additionally, it was reported that the same female Leatherback Sea Turtle had twins in different years, and even for the same species, the occurrence of twins may be rare in some nesting areas and common in others (Eckert 1990, *op. cit.*). Twins may or may not differ in size, and they can have malformations of the shell or exhibit albinism (Kaska and Downie 1999, *op. cit.*). In the occurrence presented here, we were not able to perform further morphological or DNA analysis to determine the cause of twinning. This is apparently the first reported case of marine turtle twinning for Atol das Rocas, Brazil.

PHOTO BY MAURIZÉLIA BRITO

Fig. 1. Twins found inside a Green Sea Turtle nest from Brazil. In this image, it is possible to see the same yolk shared by the hatchlings.

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***CHELONOIDIS DENTICULATUS* (Yellow-footed Tortoise). DIET.** On 2 November 2019, at 0840 h, along the trails of the Pantiacolla Lodge, next to the banks of the Alto Madre de Dios River, in Manu National Park, Peru, a large but drying temporary pond was discovered. Within the drying pond, a large *Chelonoidis denticulatus* (Yellow-footed Tortoise) was observed sitting in the mud. Upon closer inspection, the tortoise was scavenging on a rotting *Hoplias malabaricus* (Wolf Fish) that had become trapped (Fig. 1). A number of other large fish carcasses were present, and it seems possible that the *C. denticulatus* had been attracted by the smell. Despite extensive searches, no other tortoises were seen in the area. As soon as we approached the *C. denticulatus*, it stopped eating and remained next to the remains the fish. A similar behaviour has been recorded in the closely related *C. carbonaria* (Mourthe and Castro 2017. Herpetol. Rev. 48:422–423), but we believe this is the first record of fish scavenging in *C. denticulatus*, especially within Manu National Park. Pantiacolla Lodge is in a zone generally described as Premontane Rainforest, in the High Amazon basin. The site is dominated by lowland Amazonian rainforest that is characterized by floodplain (várzea) and terra firme habitats. The property ranges from 400–900 m above sea level, with a monthly average temperature of 23.1°C, a rainy season ranging between November and April and a dry season from May to August (Loaiza-Muñoz et al. 2017. Wilson J. Ornithol. 129:813–819).

Fig. 1. Yellow-footed Tortoise (*Chelonoidis denticulatus*) in front of a *Hoplias malabaricus* carcass on which it was observed feeding in Peru.

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***GRAPTEMYS PSEUDOGEOGRAPHICA* (False Map Turtle). INTERSPECIFIC BASKING.** *Graptemys pseudogeographica* is native to the central USA but has been introduced in many places outside its native range, primarily via the pet trade (Kraus 2009. Alien Reptiles and Amphibians: a Scientific Compendium and Analysis. Springer Science + Business Media B.V., Dordrecht, Netherlands. 564 pp.). Interspecific basking has been observed in a number of North American turtle species and communities (e.g., Weber and Layzer 2014. Herpetol. Rev. 45:117; Jones and Cochran 2014. Herpetol. Rev. 45:311–312; Hartzell and Hartzell 2016. Herpetol. Rev. 47:453). On 3 November 2018, in the lagoon within a park in Buenos Aires, Argentina (34.55794°S, 58.43319°W; WGS 84), we observed a small *G. pseudogeographica* basking with an adult *Phrynops hilarii* that remained partly submerged (Fig. 1A). At 1439 h on 28 April 2019, in the same location, we observed interspecific basking of two *G. pseudogeographica* and a *P. hilarii* although at a greater distance (Fig. 1B). On another occasion, at 1227 h on 9 November 2019 in the same lagoon as the previous observations, we observed an adult *G. pseudogeographica* basking with an adult *Trachemys dorbigni*; these turtles were less than 0.1 m apart (Fig. 1C). *Trachemys dorbigni* and *P. hilarii* are native species in Buenos Aires (Cei 1993. Museo Regionale di Scienze Naturali Monografie, Turin 14:1–949) but *G. pseudogeographica* is exotic. However, in our observations the three species appeared to be neutral to the presence of the other, without aggressive behavior or other interactions. The specimens were photographed, but not collected. To our knowledge, this is the first report of *G. pseudogeographica* in Argentina and the first report of interaction with *P. hilarii* and *T. dorbigni*.

Fig. 1. *Graptemys pseudogeographica* basking with a *Phrynops hilarii* (A), two *G. pseudogeographica* baking with a *P. hilarii* (B), and a *G. pseudogeographica* basking with *Trachemys dorbigni* (C).

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***KINIXYS ZOMBENSIS* (Southeastern Hinge-back Tortoise). AGGRESSION.** *Kinixys zombensis* was elevated to full species level (Kindler et al. 2012. J. Zool. Syst. Evol. Res. 50:192–201) after it was initially described as a subspecies of *K. belliana* (Hewitt 1931. Ann. Natal Mus. 6:461–506). However, *K. zombensis* had been treated as a synonym of *K. belliana* for many years and as

PHOTO BY J. MALAN

Fig. 1. Injury to hind foot of female *Kinixys zombensis* after being bitten by a courting male.

PHOTO BY J. MALAN

Fig. 2. Healed injury of female *Kinixys zombensis* depicted in Fig. 1, showing the missing toenails.

such, very little is known about the habits and behavior of true *K. zombensis* as most articles do not state specific localities that the specimens originated from. It is relatively well known that most southern African tortoises display aggressive behaviour during the mating season. This can be in the form of male combat as well as attacks on females during courtship. (Boycott and Bourquin 2000. The Southern African Tortoise Book. A Guide to Southern African Tortoises, Terrapins and Turtles. O. Bourquin, Hilton. 228 pp.). *Kinixys zombensis* is the second largest tortoise species occurring in southern Africa and both sexes grow to the same size. We have observed male aggression towards females on multiple occasions and here present pertinent observations, witnessed in South Africa.

Typically, if a female does not respond favorably to the advances of the male during the breeding season, the latter will start to circle around the female and ram into her. This can occur throughout the day and even persist into the early evening. The male will often bite at any exposed part of the female's body, such as the head, neck, and legs. Each event may last anywhere from 10–45 min. Figure 1 shows the injury caused to a female's left rear foot after being bitten by a male during this process. The injury did not result in limb loss, however she did lose two of her four nails on the specific foot (Fig. 2). These injuries can at times result in blood being drawn and may even lead to limbs being lost. When encountering *K. zombensis* in the wild, adult females frequently have injuries to their heads, necks, and legs, most likely caused by aggressive courtship interactions with males. However, we have never found any of these injury types on subadult females or on any male specimens, indicating that this only happens to sexually mature females.

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***LEPIDOCHELYS OLIVACEA* (Olive Ridley Sea Turtle). PREDATION.** Mortality of marine turtle eggs and juveniles is high as compared with adult individuals, with estimated rates of survival of one in a thousand eggs (Frazer 1986. Herpetologica 42:47–55; Peters et al. 1994. Herpetologica 50:369–373). This low survival rate could be caused by infertile eggs, low success emerging from the sand, and predation (Burger and Gochfeld 2014. Copeia 2014:109–122). Sea turtle predators include a wide variety of taxonomic groups, including terrestrial and aquatic vertebrates and invertebrates (Fowler 1979. Ecology 60:946–955; Witherington and Salmon 1992. J. Herpet. 26:226–228; Engeman et al. 2003. Biol. Conserv. 113:171–178; Santidrian et al. 2010. Chelon. Conserv. Biol. 9:18–25). However, the list of predators varies according to the life stage. For example, hatchlings are eaten by animals ranging from crabs, fishes, reptiles, birds, to mammals, including wild and domestic species (Fowler 1979, *op. cit.*; Witherington and Salmon 1992, *op. cit.*; Engeman et al. 2003, *op. cit.*; Santidrian et al. 2010, *op. cit.*). Some of these predators arrive at the beaches during the emergence of the turtles to take advantage of the large availability of prey (Ims 1990. Am. Nat. 136:485–498; Eckrich and Owens 1995. Herpetology 51:349–354) and this accumulation of predators could either attract or deter other predators (Burger and Gochfeld 2014, *op. cit.*). As adults, the main predators of sea turtles are sharks in the sea and (in the neotropics) jaguars on land when females are nesting (Brito et al. 2018. Chelon. Conserv. Biol. 17:280–283). Here we report, to our knowledge, the first predation event of *Lepidochelys olivacea* hatchlings by a Common Black Hawk, *Buteogallus anthracinus* (Aves: Accipitridae).

We observed a juvenile Common Black Hawk (*B. anthracinus*) preying on hatchling Olive Ridley Sea Turtles at Playa Avellanas, Guanacaste Province, Costa Rica (10.2300°N, 85.8378°W; WGS 84; 5 m elev.) a half-hour after sunrise on 30 January 2018. When we arrived on the beach, the tide was low and there were three dozen hatchling turtle tracks across at least 75 m of sand to the sea, indicating that the hatch had recently occurred. Two hatchlings were still on the sand midway to the water. When first observed, the hawk was quietly perched on a tree branch 3 m above the ground and was actively eating a hatchling (Fig. 1). The tree was growing at the back beach-land interface and its branches extended over a small bluff (ca. 1 m) covered in grasses and other terrestrial vegetation at the start of a public access path. The turtle nest was evidently at the back of the beach, based upon the tracks in the dry sand. Over the course of an hour, the hawk was observed to drop down into the grass above the beach several times and reemerge with another live hatchling. Although aware of our presence, the hawk continued to retrieve, perch and feed in the same tree. This behavior and the location directly above the beach and fresh tracks led us to believe that the bird had caught turtles as they were hatching and cached them in this area.

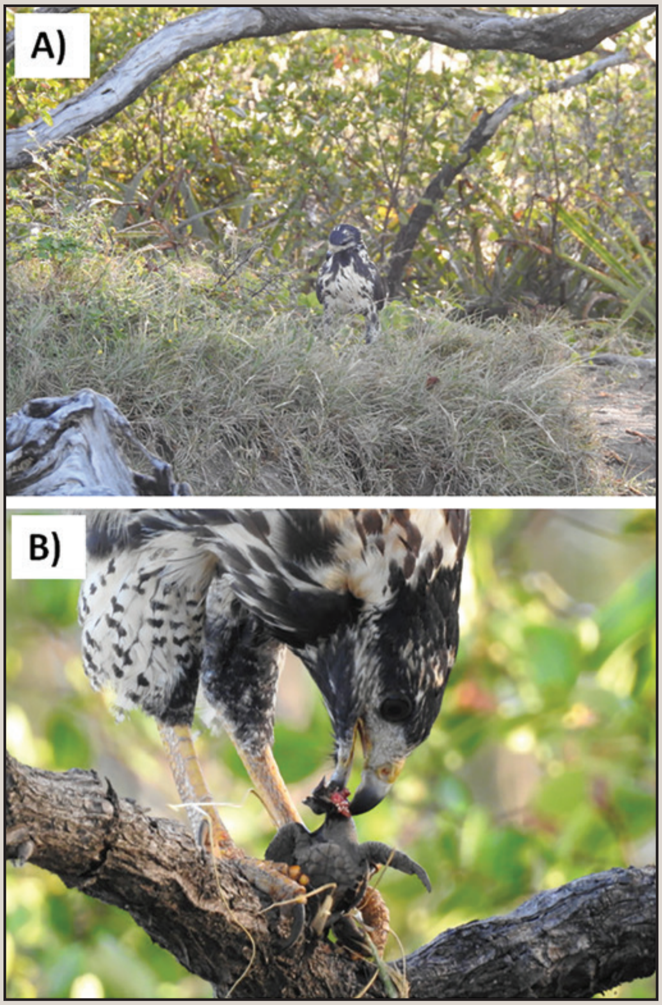

Fig. 1. Common Black Hawk juvenile consuming a hatchling of *Lepidochelys olivacea* at Playa Avellanas, Guanacaste Province, Costa Rica. A) Common Black Hawk hunting the turtle in the grass; B) Common Black Hawk eating the turtle; note the strands of grass around the turtle.

It is possible that the relatively small number (dozens rather than hundreds or thousands) of hatchlings from an individual solitary turtle nest can attract opportunistic local predators by chance, such as the Common Black Hawk in this report. From our observation of tracks, thirty-three hatchlings had reached the water by dawn with two lone individuals still partway to the water. This hatching event was located along a stretch of coast known for solitary nests, but within 50 km of massive reoccurring arribadas such as at Ostional Nacional Wildlife Refuge, 35 km south of Playa Avellanas. We encourage all sea turtle investigators to look for, annotate, and photo document opportunistic predation on sea turtle eggs and hatchlings, to increase our knowledge about the topic.

LS thanks Vicerrectoría de Investigación of Universidad de Costa Rica for support under the project number B9123 and Escuela de Biología for half-time support.

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***LISSEMYS PUNCTATA ANDERSONI* (Indian Flap Shell Turtle). INCUBATION.** On 4 January 2018 at 1940 h at Khooni khan Lake at Kamla Nehru Biodiversity Park, New Delhi, India (28.680785°N, 77.216796°E; Fig. 1A), a female *Lissemys punctata* under observation (Fig. 1B) laid a clutch of seven eggs. The spherical eggs ranged from 25.2–29.1 mm (mean: 25.8 mm) in diameter and weighed from 9.7–13.3 g (mean: 10.9 g). To avoid predation of the turtle's eggs by stray dogs in the park, the eggs were collected and retained for artificial incubation. They were placed in a plastic container (Fig. 1C) with autoclaved Yamuna River sand as substrate (mixed with water at a 1:1 ratio by weight). The eggs were incubated within a temperature range of 27–36; a 100-watt incandescent bulb was used as a heating source. They were monitored regularly during the incubation period.

Five eggs were discarded after 28 d as they were found to be rotten and non-viable. On 16 July 2018, the remaining two eggs hatched successfully (Fig. 1D). The total incubation period was 193 d, which expands the known incubation range for *L. punctata*, previously documented to be between 270 and 398 d (Bhupathy et al. 2014. *In* Rhodin et al. [eds.], Conservation Biology of Freshwater Turtles and Tortoises: A Compilation Project of the IUCN SSC Tortoise and Freshwater Turtle Specialist Group, pp. 076.1–076.12). The hatchlings weighed 5.6 g and 6.2 g, carapace length was 34.4 and 36.7 mm, and carapace width was 26.2 and 27 mm (respectively). After two weeks, the two hatchling turtles were released into the lake near to where the eggs were collected.

We thank H. Singh and B. Chopra (Kamla Nehru Biodiversity Park) for their support and cooperation.

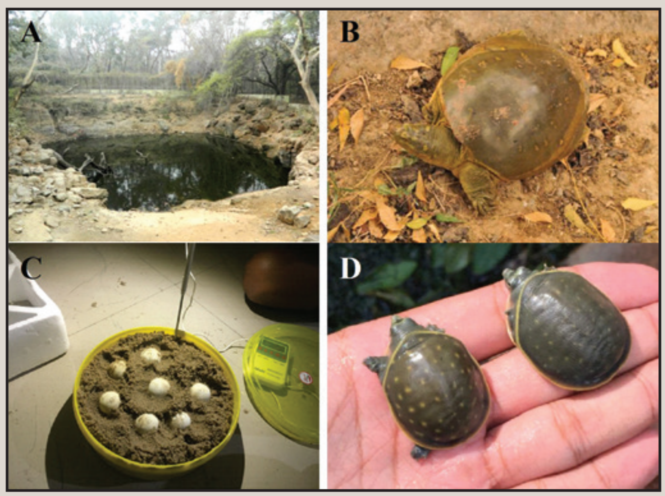

Fig. 1. A) Khooni khan Lake in Kamla Nehru Biodiversity Park; B) female *Lissemys punctata* recorded near Khooni khan Lake; C) Eggs kept for artificial incubation; D) emerged hatchlings from the eggs.

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***MACROCHELYS TEMMINCKII* (Alligator Snapping Turtle). CAUDAL PREHENSILITY.** *Macrochelys temminckii* possesses a long tail such that two young specimens weighing 1.8 and 3.6 kg were able to grasp a stick or broom handle with their tails when tapped on the posterior part of the plastron with a pencil. Their grip was enough to allow them to be raised off the ground by elevating the stick or broom handle for intervals of a few seconds to several minutes (Brode 1958. Copeia 1958:48). Herein, we describe an account of an adult demonstrating prehensile ability with its tail. On 17 July 2019, from 1922–1935 h, at the Retreat at Artesian Lakes, Liberty County, Texas, USA, video footage was taken (using a QYSEA-V6FIFISH underwater drone ROV camera) of an adult male *M. temminckii* as it was vertically oriented and holding onto an observation deck support pole measuring 23.2 cm in diameter. The turtle supported itself using its claws as well as its tail, which was wrapped around half of the pole. The specimen had a midline carapace length of 58.9 cm, maximum carapace length of 63.1 cm, maximum carapace width of 49.7 cm, maximum shell height of 25 cm, mass of 44.9 kg, precloacal tail length of 22.8 cm and post-cloacal tail length of 36.2 cm. The turtle was hand-captured, measured, weighed, marked with a Biomark brand passive integrated transponder (#3061059801B42), and released at its location of capture.

We thank staff at the Retreat at Artesian Lakes, A. M. Brinker, and T. Underwood for use of the image. The Texas Parks and Wildlife Department issued collecting permit (SPR-1017-201).

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MYUCHELYS BELLII **(Bell's Turtle). UNEXPECTED DIETARY CONTENTS.** Freshwater turtles are typically omnivores and dietary generalists and fill important niches as aquatic grazers and scavengers. Some species prefer plant material over animal, or vice versa, but in general, freshwater turtle species will take advantage of all available food sources. The natural diets of a species can be dcoumented by directly observing feeding, examining feces, and by flushing the stomachs of captured individuals. Stomach flushing provides more intact samples than feces, and is logistically more feasible than observing foraging behavior, but is also more invasive than these other methods (Legler 1977. Herpetologica 33:281–284).

Previous work on *Myuchelys bellii* posits a typical omnivorous diet, with a bias toward plant matter; these inferences were based on microscope analysis of fecal samples (Fielder et al. 2015. *In* Rhodin et al. [eds.], Conservation Biology of Freshwater Turtles and Tortoises: A Compilation Project of the IUCN SSC Tortoise and Freshwater Turtle Specialist Group, pp. 088.1–088.7). Plant material found in the fecal matter included the fruits of an invasive *Rubus* sp. (blackberry), and unspecified aquatic weeds and filamentous green algae. Animal matter included freshwater sponges, crayfish of the genera *Eustacus* and *Cherax*, and various unspecified insects and carrion. Evidence of smaller invertebrates was not noted in these studies, though they may have been fully digested, such that a microscopic analysis did not identify them.

Snorkeling surveys for *M. bellii* were conducted on 27 October 2019 in the MacDonald River, south of Walcha, New South Wales, Australia (31.114°S, 151.450°E). Local climatic conditions were dominated by a severe two-year drought, and the river was not flowing; surveys took place in a large remnant pool that was ca. 4 m deep at its maximum, and ca. 250 m long by 25 m wide. Water was ca. 20°C at the surface and turbid (< 1 m visibility); weather was clear with a slight breeze. Two female *M. bellii* were captured by hand in the late morning; they were underwater but close to shore and attempted to flee into deeper water. The smaller female (#5011) had a carapace length of 23.7 cm and a mass of 1528 g. The larger female (#5012) had a carapace length of 27.1 cm and a mass of 2695 g. Females at these sizes are considered adults, and #5012 was in the 90% percentile for carapace length and mass for all capture records of female *M. bellii* (B. Chessman et al., unpubl.). While turtle #5011 was seemingly healthy, turtle #5012 had cataracts in both eyes, a condition that afflicts ca. 10% of adult *M. bellii* in the MacDonald River catchment (Fielder et al. 2015, *op. cit.*).

Both turtles were brought to the Armidale Campus of the University of New England (UNE) and subjected to stomach flushing within 2 h of capture, using the methodology outlined in Chessman (1986. Wildl. Res. 13:65–69). Immediate visual assessment showed a considerable amount of yellow-brown matter in the collected contents, although detail was not distinguishable to the naked eye. Samples were collected, preserved in 70% ethanol, and refrigerated for storage. The turtles were held at UNE for 14 d as part of a separate behavioral study and were released at the site of capture on 9 November 2019.

Stomach contents were later examined under a dissecting microscope, revealing that the yellow-brown matter was *Daphnia* spp. No other animal or plant material was found in the samples. The samples were filtered and dried in a drying oven at 60°C for 24 h to obtain dry mass. The sample drawn from #5011 contained 0.080 g, and the sample from #5012 was 0.027 g of dry organic matter. Based on estimated dry mass for an individual *Daphnia* from these samples (ca. 25 µg), these dry masses translate to ca. 3200 *Daphnia* for turtle #5011 and ca. 1080 *Daphnia* for turtle #5012. Notably, the turtle with healthy eyes (#5011) had considerably more prey in her stomach than the much larger turtle afflicted with cataracts (#5012).

To our knowledge, this is the first recorded instance of such large freshwater turtles consuming mass quantities of small, free-swimming invertebrates. Another side-necked turtle, *Podocnemis unifilis* (Yellow-spotted River Turtle), has been observed skimming the surface of the water for food (Belkin and Gans 1968. Ecology 49:768–769), but its diet appears to be almost exclusively herbivorous (Balensiefer and Vogt 2006. Chelon. Conserv. Biol. 5:312–317). All *M. bellii* subsequently sampled in this study (N = 5) had empty stomachs, except for a small male that had a single larval Trichoptera (caddisfly).

This presents a number of possible trophic relationships between *M. bellii* and *Daphnia*. *Daphnia* may represent a regular part of the species' diet, and turtles without this prey item in their gut had simply not foraged successfully prior to capture. *Daphnia* may be a seasonal part of the species' diet, representing a major food source only in spring. Alternatively, consumption of *Daphnia* may have been a "starvation diet" food item, forced by the severe drought. The diet for these endangered turtles should be explored in depth to further elucidate their relationship with *Daphnia*. Further, the method of prey capture employed by large turtles to capture *Daphnia* may be an interesting line of future study, particularly given one of these turtles presumably had impaired vision. Perhaps *M. bellii* employs a filter feeding strategy, as reported in other species of freshwater turtles.

We thank the NSW Environmental Land Trust for funding this project through the Saving Our Species initiative, and the Holsworth Wildlife Research Endowment for their generous funding as well. We also thank the volunteers that made capturing and sampling these turtles possible. All work was conducted in accordance with UNE Animal Ethics protocol AEC18-113 and National Parks and Wildlife permit SL102192.

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***NILSSONIA GANGETICA* (Ganges Softshell Turtle). PREDATION.** *Nilssonia gangetica* is a large trionychid up to 90 cm in carapace length, and is distributed across north and northeast India and adjacent countries (Das 1995. Turtles and Tortoises of India. Oxford University Press, Bombay, India. 179 pp.). Predation on adults has not been reported before, and in this note we report an observation of predation by an Indian (Bengal) Tiger (*Panthera tigris tigris*) from Ranthambore National Park, Rajasthan State, India. Tigers prefer medium to large prey, like ungulates, but are known to opportunistically take birds, monitor lizards, and fish (Schaller 1967. The Deer and the Tiger. University of Chicago Press, Chicago, Illinois. 370 pp.). The diet of tigers in the Sundarbans mangrove forests is comprised of ca. 20% aquatic resources, including fish, crabs, and turtles (Mukherjee and Sarkar 2013. J. Ecosyst. 2013:1–7).

On 5 March 2016 at 1728 h, at Ranthambore National Park (Zone 3; 26.0113°N, 76.5047°E), a male tiger was observed sitting along the bank of a wetland with thick grass on the far side of the waterbody. The tiger was then observed to walk into the waterbody and wait in a crouching position before it caught a large (ca. 60 cm) adult *N. gangetica* that was not visible earlier to us at a distance of ca. 500 m. The tiger grabbed the turtle with its jaws and front claws, and held onto it underwater for a few minutes, after which he walked off into the grass out of sight carrying the turtle in its jaws (Fig. 1). As prey are usually killed and dragged off to a secluded spot to be consumed by tigers, it is unknown if the softshell turtle survived this attack.

We thank I. Das for identification of the turtle.

Fig. 1. Male Bengal Tiger (*Panthera tigris tigris*) attacking an adult Ganges Softshell Turtle (*Nilssonia gangetica*) in Ranthambore National Park, Rajasthan, India.

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***PLATEMYS PLATYCEPHALA* (Twist-necked Turtle). ECTOPARASITES.** *Platemys platycephala* a small freshwater chelid turtle inhabiting rain-filled pools in the Amazon rainforest (Vogt 2008. Tartarugas da Amazônia. Wust Ediciones, Lima, Peru. 104 pp.), where it largely feeds on tadpoles and fish (e.g., *Rivulus* spp.). At 1630 h 13 March 2018, we captured a male *P. platycephala* (Fig. 1A; 149.6 mm CL, 95.3 mm CW, 138.2 mm PL, 89.9 mm PW) in a small forest pool in Três Bocas Community, Municipality of Juruti, Pará, Brazil (2.27607°S, 56.17181°W; WGS 84; 70 m elev.). It was found to be infested with 29 leeches in the inguinal region of both hind limbs. This appears to be the first record of *Placobdella*

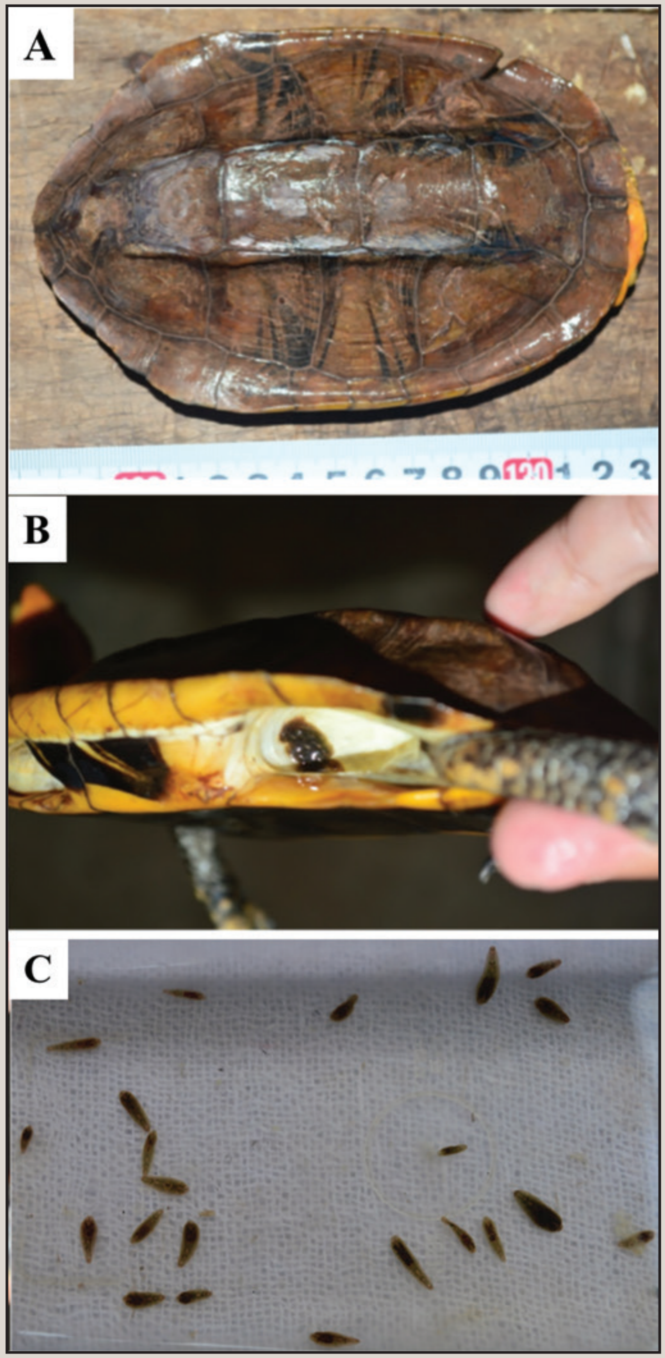

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Fig. 1. A) Individual *Platemys platycephala* male; B) *Placobdella parasitica* in the right inguinal region of *P. platycephala*; C) *Placobdella parasitica* removed from the turtle, in Juruti, Pará, Brazil.

parasitica (Rhynchobdellida: Glossiphoniidae; Fig. 1B, C) on this species. Other individuals of *P. platycephala* from nearby pools were observed to have leeches as well. This is the first time we have noted leech infestation in >30 individuals of *P. platycephala* collected over the last three years.

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***PODOCNEMIS EXPANSA* (Giant South American River Turtle) and *PODOCNEMIS UNIFILIS* (Yellow-spotted River Turtle). ECTOPIA CORDIS.** Congenital deformities are structural or functional anomalies present at birth or hatching (Madhavi and Rajasree 2012. Int. J. Biomed. Res. 3:69–73). The causes of these occurrences are consequences of genetic, environmental, or interaction factors, acting in one or more stages of individual development (Schild et al. 2003. Mr. Pesq. Vet. Bras. 23:13–16). Ectopia cordis or ectopic heart is the abnormal congenital development of the heart outside the thoracic cavity, and depending on the volume of the organ, it maybe total or partial (Madhavi and Rajasree 2012, *op. cit.*); it is a rare condition often associated with other heart defects and results in high mortality (Shirian et al. 2010. Open Anat. J. 2:34–36).

Podocnemis expansa and *P. unifilis* are two pleurodiran (Podocnemididae) species that range widely in the Amazon Basin (Pritchard and Trebbau 1984. The Turtles of Venezuela. SSAR Contrib. Herpetol. 2:1–403). Cases of embryonic malformations in turtles are rarely recorded, and cases of malformations in Amazonian species have not yet been reported. Here, we describe two cases of ectopia cordis in embryos of *P. expansa* and *P. unifilis*. A study to describe the embryonic development of *P. expansa* in natural nests was conducted between September and December 2014, on a beach of the Center for Research and Preservation of Aquatic Chelonians, Uatumã River, Balbina, Amazonas (SISBIO/IBAMA 39472-4; CEUA/INPA 025/2013). The incubation period lasted between 58 and 64 days, with a mean incubation temperature of 30.3°C. Between October and December 2018, we incubated 100 eggs of *P. unifilis* in the laboratory at a temperature of 31.8°C, for 60 d (SISBIO nº 39472-9; CEUA/INPA nº 050/2018). In an embryo of *P. unifilis* on the 14th day of incubation (Fig. 1) and in an embryo of *P. expansa* on the 33rd day of incubation (Fig. 2), the heart was found to have developed externally to the plastron, a condition similar to the ectopia cordis described in mammals. Ectopia cordis in turtles is not commonly described; there is one record of a hatchling Australian Red-bellied Side-necked Turtle (*Emydura subglobosa*) hatching with ectopia cordis (https://people.com/pets/baby-albino-turtle-born-heart-outside-body/; 20 Mar 2020). In the two cases found in our studies we observed the same malformation condition in living embryos developing in the egg, but under different incubation conditions. This type of malformation has not been described previously in these species. Turtles are good models for research on embryonic development because malformations are easily recognized.

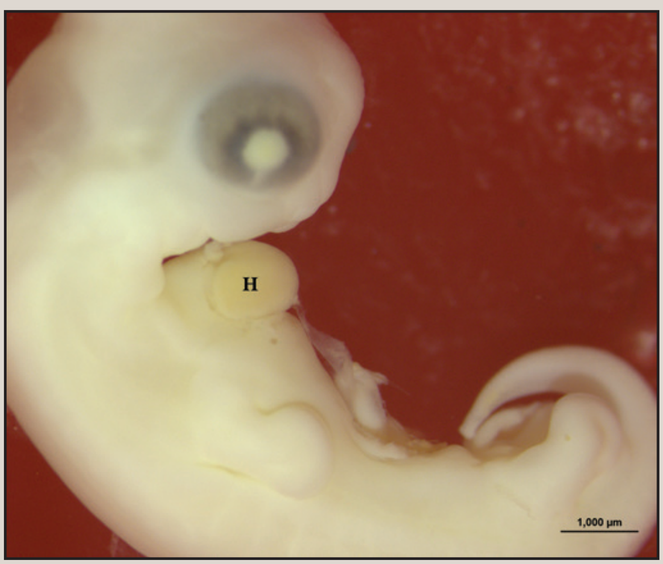

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Fig. 1. Ectopia cordis in *Podocnemis unifilis* embryo after 14 d of incubation. H = heart.

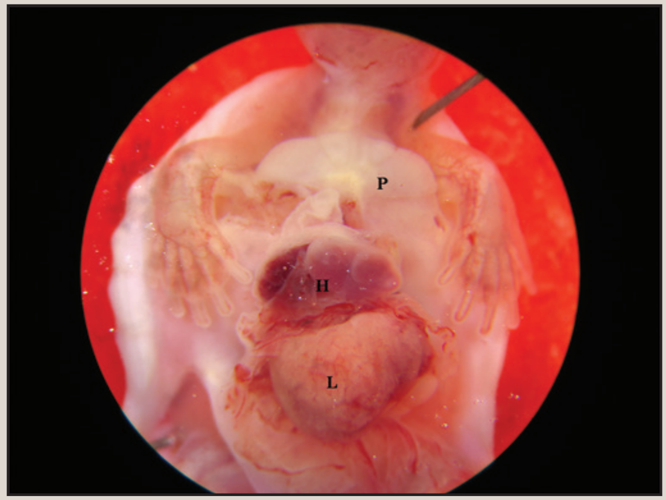

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Fig. 2. Ectopia cordis in *Podocnemis expansa* embryo after 33 d of incubation. P = plastron; H = heart; L = liver.

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***PODOCNEMIS UNIFILIS* (Yellow-Spotted Amazon River Turtle). FLAVISM.** Color variations deviating from normal pigmentation have been reported in different species of freshwater and sea turtles (e.g., *Trachemys dorbignyi*: Bager 2010. Herpetol. Bull. 113:34; *Eretmochelys imbricata*: Hitchins and Bourquin 2005. Phelsuma 14:103–104). Usually, these aberrant color variations are reported in low frequency in monitored populations (Kaska and Downie 1999. Zool. Middle East 19:55–56). Leucism (reduction in melanin and some other integumentary pigments) was recently reported in *Podocnemis unifilis* (Erickson and Kaefer 2014. Salamandra 51:273–276). Here, we note two unusual hatchling *P. unifilis* observed among normal colored hatchlings

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Fig. 1. Hatchling *Podocnemis unifilis* with normal coloration (right) and hatchling showing flavism (left) from Juruti, Pará, Brazil.

in the nursery of Juruti-Miri Community, included in the Municipal Program of Management of Chelonians, in Juruti, Pará, Brazil (2.23421°S, 56.13351°W; WGS 84). In total, the community produced 2967 hatchlings, and only two hatchlings presented with the variation in coloration called flavism, where melanin is largely suppressed and a yellowish coloration dominates (Fig. 1). Aberrant color variations (e.g., albinism), can be caused by a genetically induced enzyme deficiency that affects the metabolism of melanin during the life of an organism, leading to the partial or complete absence of dark pigmentation (Veena et al. 2011. Indian J. Fish. 58:109–112). To our knowledge this is the first report of flavism for *P. unifilis*.

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***PODOCNEMIS UNIFILIS* (Yellow-spotted Amazon River Turtle). SHELL ABNORMALITY.** *Podocnemis unfilis* is one of the four species of this genus in the Brazilian Amazon (Vogt 2008. Tartarugas da Amazônia. Wust Ediciions, Lima, Peru. 104 pp.). Recently, a structural anomaly was reported for *P. sextuberculata* (Six-tubercled Amazon River Turtle; Perrone et al. 2016. Herpetol. Rev. 47:287). Here, we describe what appears to be the first report of extra-marginal scutes on the carapace of *P. unifilis* hatchlings. At 0936 h on 5 February 2019, in Juruti-Miri Community, in the Municipal Program of Management of Freshwater Turtles, in Juruti, Pará, Brazil (2.23421°S, 56.13351°W; WGS 84) we noted three hatchlings that differed in scute pattern from the others (Fig. 1). The normal number of marginal scutes is 12 per side (Fig. 1A). One hatchling had 13 marginal scutes on each side (Fig. 1B) and another had 11 marginal scutes on each side (Fig. 1C). The latter hatchling also had five pleural (= costal) scutes per side (normal number is four), due to a presumed split in each fourth pleural. We have observed 30,884 *P. unifilis* hatchlings in this region and only these two turtles had marginal scute anomalies.

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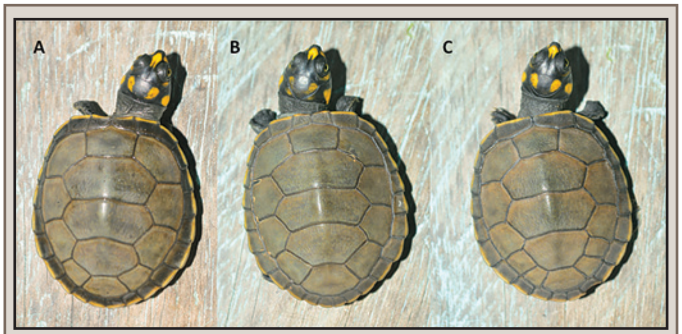

Fig. 1. A) *Podocnemis unifilis* hatchling with the normal number of marginal scutes (12); B) hatchling *P. unifilis* with 13 marginal scutes; C) hatchling *P. unifilis* with 11 marginal scutes, all from Juruti, Pará state, northern Brazil.

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***PSEUDEMYS CONCINNA* (River Cooter). WOUNDING, CONSPECIFIC AGGRESSION, and REPRODUCTIVE BEHAVIOR.** Elongate foreclaws and/or precopulatory foreclaw display (titillation) are widespread among males of the subfamily Deirochelyinae (Emydidae). This courtship behavior is hypothesized to have evolved to act in species recognition (reproductive isolation), supersede biting as an ancestral reproductive behavior, promote female acquiescence for mating, and/or serve as the basis for female mate choice (Jackson and Davis 1972. Herpetologica 28:58–64; Liu et al. 2013. Chelon. Conserv. Biol. 12:84–100). Male foreclaw display and female-biased body size are universal traits among *Pseudemys* species suggesting a female mate choice mating system (Berry and Shine 1980. Oecologica 44:185–191; Liu et al. 2013, *op. cit.*). However, increasing evidence from other members of the Deirochelyinae (e.g., *Trachemys* and *Chrysemys*) suggests that the mating system of this group has been oversimplified.

On 4 March 2020, while snorkeling Poe Spring, Alachua County, Florida, USA (29.82579°N, 82.64872°W; WGS 84), I observed an adult male *P. concinna* with scarring on the nape (Fig. 1). This scarring was consistent in form and severity with conspecific bite wounds observed on *Chrysemys picta*, a species in which unexpected sexual weaponry and coercive reproductive tactics have recently been described (Hawkshaw et al. 2019. Evol. Ecol. 33:889–900; Moldowan et al. 2020. Can. J. Zool. 98:269–278). The paired nape wounds closely resemble those inflicted by the tomiodonts and/or tomium of the turtle beak (although it is worth noting that *P. concinna* lacks bicuspid tomiodonts as found in some other *Pseudemys*; Moldowan et al. 2016. Zoomorphology 135:499–510). Aggressive behavior such as biting, either from a conspecific male or female, is a probable explanation for the observed wounds and are inconsistent with those caused by predators or ectoparasites such as leeches.

The few observations on reproductive behavior in *P. nelsoni* suggest that males direct aggressive behaviors, such as biting and shell clattering, toward females during reproduction (Kramer 1984. Herpetol. Rev. 15:113–114; Kramer 1986. *In* Drickamer [ed.], Behavioral Ecology and Population Biology, Readings from the 19th International Ethological Conference, pp. 29–34. Privat, Toulouse). The presence, frequency, and demographics of injuries can be used to assess cryptic behavior, such as male-male competition and sexual coercion, of freshwater turtles (Keevil et al. 2017. Can. J. Zool. 95:393–403; Moldowan et al. 2020, *op. cit.*). Although females are disproportionately subject to aggression

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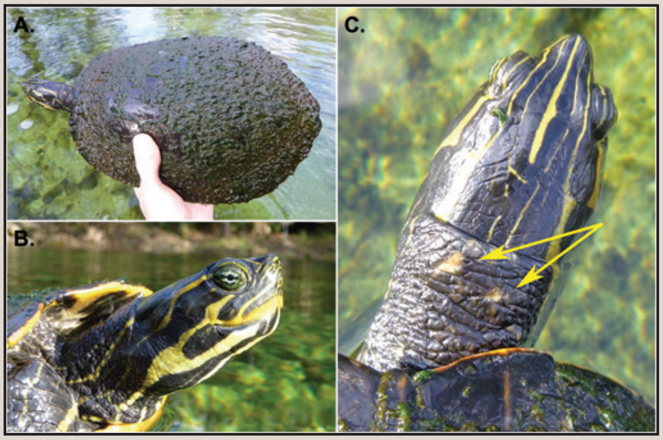

Fig. 1. Adult male *Pseudemys concinna*: A) dorsal body view; B) lateral right head view; C) dorsal neck view demonstrating two parallel gashes consistent with those inflicted from bites of the turtle beak.

and the resulting injuries in *Chrysemys*, injuries are still present on males and cryptic male-male aggression seemingly occurs in the species (Moldowan et al. 2020, *op. cit.*). Reports of male aggression and ontogenetic shifts in reproductive tactics from courtship to coercion in *P. nelsoni* (Kramer 1984, *op. cit.*; Kramer 1986, *op. cit.*), *T. scripta* (Davis and Jackson 1973. Herpetologica 29:62–64; Thomas 2002. Copeia 2002:456–461), and *C. picta* (Hawkshaw et al. 2019, *op. cit.*; Moldowan et al. 2020, *op. cit.*) hint that reproductive behaviors and social organization of these animals are more complex than currently appreciated. Future research should document sex- and size-specific patterns in soft tissue wounding (secundum Keevil et al. 2019, *op. cit.*; Moldowan et al. 2020, *op. cit.*) and perform studies of reproductive behavior in natural settings to better understand the reproductive biology of the Deirochelyinae.

Thanks to J. Gray, E. Munscher, and J. Johnston for discussion of *Pseudemys* biology. To G. Salazar and R. C. Stanley I am grateful for their friendship as well as facilitation and support of this work.

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***PSEUDEMYS PENINSULARIS* (Peninsula Cooter). INTERSPECIFIC MUTALISM.** Chelonians of many species in multiple habitats often show algae growth on the carapace. Other species in both marine and freshwater ecosystems are known to use epibiotic algae and similar organisms on turtle's shells as a food source (Meshaka 1988. Herpetol. Rev. 19:88; Krawchuk et al. 1997. Can. Field-Nat. 111:315–317; Meshaka and Deyrup 1999. Herpetol. Rev. 30:95), with fishes often being reported (Smith 1988. Herpetol. Rev 19:55; Losey et al. 1994. Copeia 1994:684–690; Grossman et al. 2006. Chelon. Conserv. Biol. 5:284–288). These interactions are often interpreted as mutualistic, as epibiont loads of algae may potentially have detrimental effects on the carrier in some cases (Neil and Allen 1954. Ecology 35:581–584; Garner et al. 1997. J. Wildl. Dis. 33:78–86). Here, we describe an observation of a potentially invasive freshwater fish performing mutualistic algae cleaning behavior on *Pseudemys peninsularis*.

At 1554 h on 5 February 2020 an adult female *P. peninsularis* was observed swimming and foraging in a man-made wetland at Freedom Park in Naples, Florida, USA (26.16478°N, 81.78136°W) with two large (ca. 30 cm) armored catfish (*Pterygoplichthys* sp.) attached to and feeding on the filamentous algae on its carapace (Fig. 1.). Approximately 3 min later one of the catfish disengaged, leaving the other fish to continue its foraging for several minutes until the turtle left our view. During this process, the turtle continued to swim and forage, apparently unhindered by the large fish attached to its carapace. The armored catfish has similarly been observed feeding on algae growing on Manatees in northern Florida springs (Nico et al. 2009. Aquat. Invasions 4:511–519) and observed feeding on non-native *Trachemys scripta* in Pinellas County, Florida (A. Orfinger, pers. comm.). However, to our knowledge this interaction has not been seen in the wild between *P. peninsularis* and nonnative *Pterygoplichthys* sp. It is possible that *Pterygoplichthys* sp. exhibit similar behaviors in other portions of their introduced range, and within their native home range where they are able to interact with species that grow algae on their shells, however to our knowledge this has not been documented. With the distribution and invasion of nonnative fish in the Loricariidae family continuing throughout Florida (Orfinger and Gooding 2018. Zool. Stud. 57:1–16), documenting interactions like these are important and perhaps alert us to future impacts that nonnative fauna may have on native assemblages.

Fig. 1. *Pterygoplichthys* sp. feeding on algae on the carapace of a *Pseudemys peninsularis* in Florida, USA.

We thank J. Armbruster and A. Orfinger for help with fish identification and personal accounts with these species in Florida, and S. Doody for insight and review of this note.

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***TERRAPENE ORNATA ORNATA* (Ornate Box Turtle). DIET.** *Terrapene o. ornata* has a mostly carnivorous diet and has been characterized as opportunistic and indiscriminate with regard to what it eats (Legler 1960. Univ. Kansas Publ. Mus. Nat. Hist. 11:527–669). Insects make up a large proportion of the diet, though several other groups, including some vertebrates, have been documented as prey (Ernst and Lovich 2009. Turtles of the United States and Canada. Second edition. John Hopkins University Press, Baltimore, Maryland. 827 pp.). Many *T. o. ornata* prey items are toxic or unpalatable to other predators, including millipedes, fireflies (Lampyridae), and even toad carrion (*Anaxyrus cognatus*; Hill and Wilcoxen 2005. Herpetol. Rev. 36:443),

Fig. 1. Adult *Terrapene ornata ornata* with froth and two visible cercopoid nymphs (white arrows) on its beak from Oklahoma, USA.

suggesting that this species has a broad tolerance to unsavory chemical compounds.

On 2 May 2020 at 1230 h in Red Rock Canyon Adventure Park, Caddo County, Oklahoma, USA (35.43755°N, 98.35339°W; WGS 84), we observed an adult *T. o. ornata* adjacent to a hiking trail, where it appeared to be feeding on spittlebug nymphs (superfamily Cercopoidea, order Hemiptera) encased in froth (Fig. 1). From a series of photos, we counted three separate nymphs in froth on the beak of the turtle. It is unclear whether the individual was intentionally consuming the froth, nymphs, or both. Cercopoid nymphs exude froth while feeding on the xylem of host plants. The froth contains chemicals that act as irritants to certain predators and prevent nymphs from desiccating (del Campo et al. 2011. Chemoecology 21:1–8). Although the moisture content of cercopoid froth may be small, we suggest that it could be an important source of hydration for *T. o. ornata* during times of drought, though confirmation would require further investigation. Our observation appears to be the first documentation of *T. o. ornata* consuming the froth and nymphs of insects in the superfamily Cercopoidea. Their tolerance of the chemical compounds in cercopoid froth further support the undiscerning nature of the *T. o. ornata* diet.

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***TESTUDO GRAECA* (Mediterranean Spur-thighed Tortoise). CARAPACE ANOMALY.** Collecting data for a study concerning the carapacial laminae of *T. graeca* necessitated examining 25 specimens in the National Collection of Amphibians and Reptiles at the Hebrew University of Jerusalem (HUJ-R). Specimen HUJ-R 940 had an abnormal number of laminae along each of the rows, with an added lamina in each (Fig. 1). The added lamina seems to have deformed and altered the growth (and shape) of the laminae along the central line of the carapace. I had previously assigned an ID number to each lamina of the carapace of the tortoises (Fig. 2). This was for personal use and ease of work, and herein, I use this standard terminology of the carapace's laminae. Most notably, among the central laminae, the added lamina seems to have pushed C3 and C4 apart to allow it to grow between them. The same can be said for CL2 and CL3, as well as CR2 and CR3, where an added lamina seems to have pushed them apart.

Hypothetically, this strange phenomenon could have originated from a skeletal deformity of an additional rib, affecting the overlapping and usually alternately matching keratinous layers of the carapace (Werner 2016. Reptile Life in the Land of Israel. Edition Chimaira, Frankfurt AM, Germany. 494 pp.) resulting in added laminae. To test this hypothesis, the specimen was submitted, with a similarly sized "normal" specimen, to Itamar Tsur for radiography, to compare and test for irregularities. Analysis of these images showed no skeletal malformation. Indeed, there is some indication that the array of the laminae is not guided by the underlying bony carapace. In a

Fig. 1. Specimen of *Testudo graeca* (HUJ-R 940) with six large central laminae instead of the normal five (C2–C6, in Fig. 2).

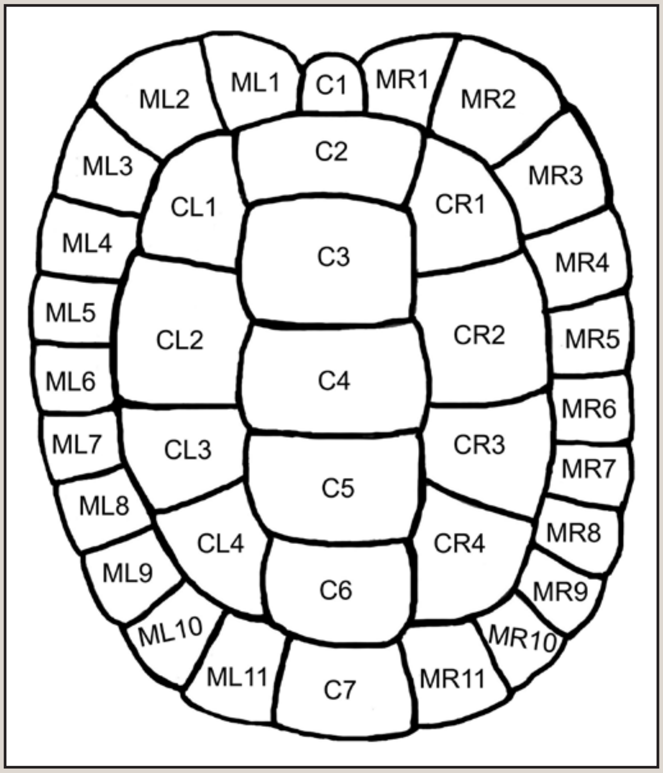

Fig. 2. Sketch of carapacial laminae identification. C = central laminae; CL/CR = costal laminae left/right; ML/MR = marginal laminae left/right.

traumatized (presumably fire-damaged) *T. graeca* carapace, the regenerating laminae were numerous and small (Werner 2016, *op. cit.*).

I thank B. Shacham and Y. L. Werner for their hospitality and guidance at the Hebrew University of Jerusalem.

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***TESTUDO GRAECA* (Mediterranean Spur-thighed Tortoise). EMBRYOLOGICAL TWINNING.** In Dagestan, *Testudo graeca* is distributed on the Primorsky lowland and in the foothills up to 700 m elev. (Mazanaeva and Gichikhanova 2018. Curr. Stud. Herpetol. 18:135–145). *Testudo graeca* is included in the Red Book of the Russian Federation and the Republic of Dagestan as a species with steadily decreasing numbers and range, with some populations on the verge of extinction (Darevsky 2001. The Red Data Book of the Russian Federation. Animals. M., AST-Astrel, Russian Federation, Moscow. 862 pp.; Mazanaeva 2009. The Red Data Book of the Republic of Dagestan. Makhachkala, Republican Newspaper and Magazine Printing House, Republic of Dagestan, Makhachkala. 552 pp.). Here we report on embryological twinning with fusion in *T. graeca* from Dagestan. Twinning and bicephalic (two-headed) animals are the result of abnormal embryo development. This phenomenon is rare but has been reported in wild and captive chelonians; individuals with significant anomalies in nature presumably do not survive, but under captive care some anomalous individuals can live for a long time.

On 25 June 2018, we observed the nesting of a wild *T. graeca* in the foothills of Dagestan; this tortoise produced seven eggs, which were collected and incubated under laboratory conditions in an Exo-Terra® incubator. At the end of September, a two-headed tortoise with a double shell and 3 pairs of limbs hatched from one of the eggs (Fig. 1). The two heads and partial bodies were fused posteriorly, and the heads were thus turned in opposite directions (Fig. 1). The tortoise(s) died 4 d after hatching.

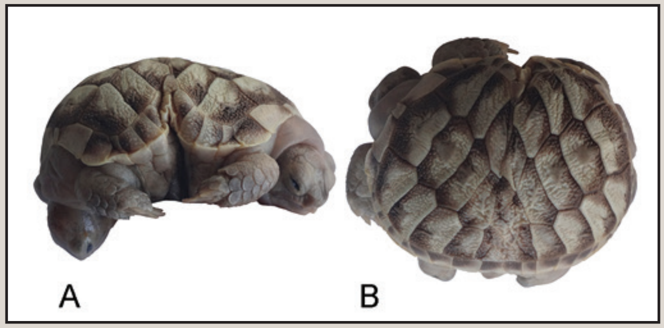

Fig. 1. Newborn two-headed *Testudo graeca*. A) Lateral view; B) dorsal view.

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***TRACHEMYS SCRIPTA ELEGANS* (Red-eared Slider). DISEASE.** Emerging diseases are one of the major threats to global herpetofauna and reporting locales at which these diseases occur is vital to conversation efforts. Shell disease in turtles has been documented in a variety of captive and wild species beginning in the latter half of the 20th century, and can affect a substantial percentage of a population reaching as high as 74% in a *Pseudemys concinna* (River Cooter) population from Georgia (Lovich et al. 1996 J. Wildl. Dis. 32:259–265). Clinical signs of the disease predominantly include the presence of lesions or ulcers on the carapace and/or plastron that damage and degrade the epidermis with more severe cases afflicting the bone (Hernandez-Divers et al. 2009. J. Wildl. Dis. 45:637–652). Although the causative agent remains unknown, researchers have provided evidence for a fungal origin (Woodburn et al. 2019. J. Clin. Microbiol. 57:e00628–18).

An adult female *Trachemys scripta elegans* was located on the shore of a lake on the Southern Illinois University Carbondale campus, Jackson County, Illinois, USA (37.713°N, 89.228°W; WGS 84) at 1535 h on 16 April 2020. It did not exhibit a flight response upon approach and was hand captured. Estimated body measurements of the turtle were ca. 220 mm carapace length, ca. 199 mm plastron length, and ca. 164 mm carapace width. Presence of eggs was not assessed. Initial observations revealed that multiple lesions were present on the plastron (Fig. 1) and their appearance was similar to those described in published reports on ulcerative turtle shell disease. Lesions varied both in size and disease stage; those deemed to be in an "early" stage appeared as minor pits in the scutes while those at a "later" stage had the scutes entirely worn away resulting in the underlying bone being exposed. Lesions were absent on the carapace. The findings seem to follow the patterns observed in other cases with more pronounced lesions present on the plastron and then progressing to the point at which scutes would slough off leading to extensive bone damage and secondary infection.

No other visible maladies or ectoparasites were found and the turtle was released at the site of capture after 5 min of handling. Injury through a predation attempt does not seem a likely cause for the lesions, and direct harm to this turtle as a

PHOTO BY JASON W. DALLAS

Fig. 1. A female *Trachemys scripta elegans* exhibiting signs of ulcerative shell disease on its plastron from Illinois, USA.

cause for these lesions cannot be ruled out from consideration. However, from the symptoms described, this turtle appears to be the first example of turtle shell disease at this location and the first published report of it in southern Illinois. The lake is home to a large number of *T. s. elegans*, and other turtle species, and monitoring the assemblage could provide answers to questions regarding derivation and prevalence of this shell disease.

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***TRACHEMYS SCRIPTA SCRIPTA* (Yellow-bellied Slider). EPIBIONTS.** *Trachemys scripta scripta* is a subspecies of Pond Slider native to the southeastern USA (Conant 1975. A Field Guide to Reptiles and Amphibians of Eastern and Central North America. Houghton Mifflin, Boston, Massachusetts. 429 pp.). Sliders are considered freshwater turtles, but occasionally enter brackish or saltwater. Mitchell (1994. The Reptile of Virginia. Smithsonian Institution Press, Washington, D.C. 341 pp.) noted that several *T. s. scripta* from Virginia had barnacles on their shells. Here, we document additional records of extensive barnacle attachment to *T. s. scripta.*

On 21 February 2020 at 0750 h, we observed an adult female *T. s. scripta* (21 cm carapace length, 2.1 kg) in Lake Osceola in the middle of the University of Miami Campus, Miami, Florida, USA (25.7186°N, 80.2792°W; WGS 84) with ca. 80 barnacles on its carapace (Fig. 1A) This individual was found in a D-trap three meters away from the shore, set for a mark-recapture turtle study. Most of the barnacles appeared to be alive. We also observed two small crabs moving between those barnacles (Fig. 1B). About 20 min later, we observed another adult female *T. s. scripta* (22.8 cm carapace length, 2.1 kg) in the same lake in another trap ca. 50 m from the previous trap with ca. 30 barnacles on its carapace. These observations are particularly interesting because of the extent of colonization, which might be suspected to inhibit the movement of the turtles. We note that Lake Osceola is connected to the ocean, via Biscayne Bay, by canals, and the water is brackish (salinity of the lake averaged 3.66 psu with a YSI device). We did not identify which species of barnacles were on the turtles; future work with appropriate permits could enable the collection and identification of epibiont barnacles on *T. s. scripta* at this locality.

PHOTOS BY LEYNA R. STEMLE

Fig. 1. A) Adult female *Trachemys scripta scripta* found with barnacles on its carapace; B) same individual with a small crab visible (circled in white).

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CROCODYLIA — CROCODILIANS

***ALLIGATOR MISSISSIPPIENSIS* (American Alligator). DIET.** American Alligators are generally aquatic, and typically inhabit lakes, swamps, and marshes (Elsey and Woodward 2010. *In* Manolis and Stevenson [eds.], Crocodiles. Status Survey and Conservation Action Plan. Third edition, pp. 1–4. Crocodile Specialist Group, Darwin, Australia). Alligators are opportunistic predators (Wolfe et al. 1987. NE Gulf Sci. 9:1–8; Elsey et al. 1992. Proc. Annu. Conf. SE Assoc. Fish Wildl. Agencies 46:57–66) and take a wide variety of aquatic vertebrate prey or vertebrates that are active along the shoreline (Neill 1971. The Last of the Ruling Reptiles. Alligators, Crocodiles, and Their Kin. Columbia University Press, New York, New York, 486 pp.). At least 40 bird species have been described in the diet of alligators, including waterfowl, wading birds, passerines, and birds of prey/raptors (Gabrey and Elsey 2017. J. Louisiana Ornithol. 10:1–10; Rainwater et al. 2018. J. Raptor Res. 52:516–518). However, birds appear to be an uncommon component of the diet of the alligator (Delany and Abercrombie 1986. J. Wildl. Manage. 50:348–353; Gabrey and Elsey 2017, *op. cit.*) and thus typically do not appear in large numbers, unless the alligator might be associated with a bird rookery. We herein report an exceptionally large number of Blue-winged Teal (*Spatula* [formerly *Anas*] *discors*) from the stomach of a single *Alligator mississippiensis.*

On 18 September 2018, during the annual autumn wild alligator harvest in Louisiana, USA, we recovered the carcasses of eight *S. discors* (Fig. 1) from the stomach of a large (presumably adult) alligator. We also recovered catfish remains (probably *Ictalurus* sp.) and a crab claw (likely *Callinectes sapidus*) from the partial stomach contents. We suspect the alligator was harvested and processed a day or two before we examined it, thus the total length and sex of the alligator are unknown. The wild-caught alligator was processed (hide with identifying CITES tag removed and separated from the carcass prior to deboning for meat processing), after which we could access the viscera and stomach contents.

Fig. 1. Eight *Spatula discors* remains found in the stomach of a presumptive adult *Alligator mississippiensis* collected in September 2018 in Louisiana, USA.

Spatula discors predation by *A. mississippiensis* was recently reported for the first time and included a single bird (Gabrey and Elsey 2017, *op. cit.*). Of the North American waterfowl species, *S. discors* is one of the smaller ducks (adult females average 376.5 g, adult males average 462.7 g; Bellrose 1980. Ducks, Geese, and Swans of North America. Stackpole Books, Harrisburg, Pennsylvania. 540 pp.). The finding of eight flight-capable *S. discors* in one stomach is unusual and constitutes a substantially large volume of prey ingested.

This observation is noteworthy as *S. discors* can breed in Louisiana (Bellrose 1980, *op. cit.*) and flightless ducklings might be easy prey for alligators, but the eight birds in the stomach contents of the alligator all appear to have been capable of flight, and not local birds (hatched in the current season and flightless, brood stage birds). Also, by mid-September it is unlikely that the *S. discors* would have been molting (and thus flightless) as molt occurs earlier in northern regions for this species (Bellrose 1980, *op. cit.*). Thus, it would be unlikely alligators would commonly encounter and catch so many flight-capable ducks as potential live prey items; presumably taken in a brief period of time, as the carcasses were in relatively similar states of decomposition (Fig. 1). This raises the question of how this alligator found and consumed these ducks.

The early teal hunting season opened in Louisiana on 15 September 2018, and we speculate some or all eight teal may have been hunter-harvested and subsequently scavenged by the alligator. Many duck hunters remove the breast meat from harvested ducks and discard the remainder of the carcasses at or near boat docks in close proximity to waterfowl hunting camps or houseboat mooring areas, where alligators can feed opportunistically (Elsey et al. 2018. Herpetol. Rev. 49:737–738). Some of the duck carcasses recovered appear to have been "breasted out" (Fig. 1) and thus may have been scavenged by the alligator; this is a common mode of foraging in crocodilians (Platt et al. 2014. Herpetol. Rev. 45:488–489; Elsey et al. 2018, *op. cit.*). Alternatively, some carcasses may have been ducks shot by hunters but not recovered before being ingested by alligators (e.g., Gabrey and Elsey 2017, *op. cit.*; Elsey et al. 2018, *op. cit.*), but we can't rule out some may have been taken as live prey.

To our knowledge this quantity of waterfowl has not previously been identified in a single alligator stomach, however in some cases alligators have been reported to consume large quantities of birds. For example, a study at a Louisiana refuge area with extensive rookeries documented 136 herons removed from 24 alligator stomachs for an average of 5.67 herons/stomach; range: 1–11 herons/stomach (McIlhenny 1934. Copeia 1934:80–88). A recent study suggested mutualism between herons and alligators, with herons attracted to nest near alligators that might deter mammalian predators, and alligators receiving nontrivial food benefits (chicks or dropped food) from nesting birds (Burtner 2011. M.S. Thesis, University of Florida, Gainesville, Florida. 67 pp.). The ability of alligators to ingest such a wide variety of organisms and adapt to novel prey items may be a factor influencing their long-term success over a diverse range of habitats.

We acknowledge the assistance of A. Duplechin, L. LeDoux, and M. Miller with observations reported in this note.

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***CROCODYLUS MORELETII* (Morelet's Crocodile). ADULT MORTALITY.** Collisions with aquatic vessels (e.g., boats, jet skis, and their propulsion systems) are a significant threat to freshwater and marine vertebrates, causing injuries and mortality in a range of species (Lightsey et al. 2006. J. Zoo Wildl. Med. 37:262–275; Work et al. 2010. J. Exp. Mar. Biol. Ecol. 393:168–175; Hollender et al. 2018. Chel. Conserv. Biol. 17:298–302). While impacts of vessel strikes on aquatic mammals and turtles are well-documented, few reports exist regarding vessel impacts on crocodilians (Grant and Lewis 2010. Herpetol. Conserv. Biol. 5:456–460; Brien et al. 2008. Florida Field Nat. 36:55–59). Here, we report the mortality of an adult *Crocodylus moreletii* as the result of a probable vessel strike in Belize.

On 10 May 2019, during a nocturnal spotlight survey of *C. moreletii* in the New River (Orange Walk District; 17.78837°N, 88.63577°E; WGS 84; 8.0 m elev.), we encountered a dead crocodile floating on its back among aquatic vegetation, ca. 3 meters from the shore. We moved the animal from the water to the shoreline for a gross dissection and determination of death. The crocodile was an adult male (total length [TL] = 255.5 cm, head length [HL] = 37 cm, tail girth [TG] = 57 cm) that had been previously captured and marked five years earlier on 6 February 2014 (TL = 185 cm, HL = 27 cm, TG = 40.5 cm; growth rate (TL) = 1.1 cm/month). The overall body of the animal was intact, with mild color degradation, and obvious postmortem bloating indicated by a prolapsed penis and coelomic distention. The dorsal skull had a laceration that measured 2 cm wide at maximum width and 22 cm long that spanned 10 cm rostral to the left eye, crossing the left globe, and extending caudo-medially to the parietal skull plate (Fig. 1A). This linear cutting and pulverizing wound caused the left eye to prolapse and exposed skull sinuses (Fig. 1A). The left lacrimal, prefrontal, frontal, and parietal cranial plates were all damaged. The margins of the wound were sharp and

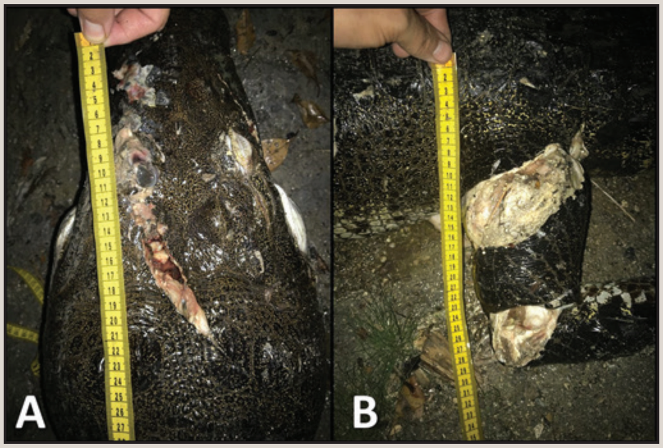

Fig. 1. Adult *Crocodylus moreletii* killed by a vessel strike in the New River, northern Belize. A) Dorsal skull with 2 × 22 cm laceration extending rostral to the left eye, crossing the left globe, and extending caudo-medially to the parietal skull plate (note prolapsed left eye and exposed skull sinus), suggestive of an outboard skeg strike; B) left rear limb with two circumferential, dorsal, and parallel slashing wounds consistent with a propeller strike. The proximal laceration (below hip) cut through the skin to expose underlying muscle, while the distal laceration cut the left dorsal aspects of the knee joint exposing muscle, tendons and ligaments.

deep and consistent with an outboard skeg (lowest extension of the motor, for steering and propeller protection) strike at significant speed (> 10 mph). In addition, the left rear limb had two partially circumferential, dorsal, and parallel (6 cm apart) chopping/slicing wounds measuring 15 cm proximally and 12 cm distally in length (Fig. 1B). The proximal laceration was several centimeters distal to the left coxofemoral (hip) joint and exposed the underlying muscle (Fig. 1B). Postmortem bloating appears to have distorted the wound's width which was 6.5 cm at its apex. The distal wound cut the left dorsal aspects of the left stifle (knee) joint exposing muscle, tendons and ligaments (Fig. 1B). This wound's dimensions also appeared distorted from the effects of heat, water, and necrosis with a maximum width of 6 cm (Fig. 1B).

The injuries we report were consistent with vessel strikes observed in West Indian Manatees (*Trichechus manatus*) and marine turtles (Lightsey et al. 2016, *op. cit.*; Work et al. 2010, *op. cit.*), and we concluded the crocodile's most probable cause of death was watercraft impact trauma (vessel strike). The wounds we found in the *C. moreletii* can be caused by other edged instruments (e.g., axes, machetes; DiMaio and Di Maio 2001. Forensic Pathology. CRC Press, New York, New York. 592 pp.; Handlos et al. 2019. Forensic Sci. Med. Pathol. 15:516–518), and we considered this possibility. However, we concluded a vessel strike was more likely for multiple reasons. First, while vessel strikes on sea turtles and manatees are most often characterized by a continuous linear cut (skeg) perpendicular to several parallel chopping/slicing wounds (propeller), in some instances only the former occurs (Lightsey et al. 2016, *op. cit.*; Work et al. 2010, *op. cit.*), as observed in the *C. moreletii* described here. Second, the few documented cases of machete attacks on wildlife and humans indicate multiple, multi-directional strikes to the head (DiMaio and Di Maio 2001, *op. cit.*; B. Stacy, pers. comm.), unlike the single strike (presumed skeg wound) we observed in the *C. moreletii*. Third, due the thick bony skull of adult crocodiles, which can often withstand gunshots and powerful bites from conspecifics (Webb and Messel 1977. Aust. Wildl. Res. 4:311–319; Erickson et al. 2014. J. Zool. 292:48–55; Butfiloski 2019. South Carolina Alligator Hunting Guide. 2019. South Carolina Department of Natural Resources, Columbia, South Carolina. 26 pp.), we find it unlikely a human could, in a single blow, generate the force necessary to drive a machete into a crocodile's skull to produce the long, deep wound observed. Instead, the pattern of injuries we observed suggest the crocodile was first struck in the head by the outboard motor skeg, was instantly turned, and was then struck on the left hind limb by the propeller.

Increased and unregulated boat traffic on the New River due to burgeoning tourism and an expanding human population has likely increased the vulnerability of *C. moreletii* and other aquatic vertebrates to vessel-related injuries and mortalities in Belize. Grant and Lewis (2010, *op. cit.*) found that enforced speed zones in Costa Rican waterways were positively associated with lower rates of boat collisions and associated injuries and mortalities in *Caiman crocodilus fuscus* (Spectacled Caiman), with slower boat speeds presumably providing caiman sufficient time to avoid oncoming vessels. Imposing similar speed limits on Belizean rivers may be an effective measure to reduce vessel strikes on crocodiles and other aquatic wildlife there, but effective enforcement of speed limits in Belize, particularly remote areas where crocodiles are more abundant, may not be realistic.

We thank George Reyes and Lamanai Outpost Lodge for logistical support in Belize. This paper is Technical Contribution Number 6845 of the Clemson University Experiment Station.

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***CROCODYLUS SIAMENSIS* (Siamese Crocodile). NESTING and NEST ATTENDANCE.** Nest attendance is probably universal among the order Crocodylia (Grigg and Kirshner 2015. Biology and Evolution of Crocodylians. Cornell University Press, Ithaca, New York. 649 pp.) and components of this behavior include nest guarding, aggressive nest defense directed at potential predators (including humans), opening the nest to liberate hatchlings, and transporting hatchlings to water (Lang 1987. *In* Webb et al. [eds.], Wildlife Management: Crocodiles and Alligators, pp. 273–294. Surrey Beatty and Sons, Ltd., Sydney, Australia). Nest attendance is generally carried out by female crocodilians, but on occasion by males (Grigg and Kirshner 2015, *op. cit.*).

Crocodylus siamensis is one of the most critically endangered crocodilians in the world and occurs (or formerly occurred) throughout much of mainland southeast Asia, Java, and Borneo (Simpson and Bezuijen 2010. *In* Manolis and Stevenson [eds.], Crocodiles: Status Survey and Action Plan, pp. 120–126. IUCN/SSC Crocodile Specialist Group, Darwin, Australia). Fewer than 1000 adult *C. siamensis* are thought to survive in the wild and most populations are small, fragmented, and of questionable viability (Simpson and Bezuijen 2010, *op. cit.*). Unsurprisingly in light of its rarity, the biology of *C. siamensis* remains poorly studied in the wild. We here report field observations of nesting, aggressive nest defense, and prolonged nest attendance by *C. siamensis* in Savannakhet Province, Laos.

Our observations were made in wetlands adjacent to Noa Neua Village (Xaibouli District) during a community-based conservation program that aims to recover populations of *C. siamensis* in Savannakhet Province (Platt et al. 2014. Croc. Spec. Group Newsletter 33[2]:22–27). As part of this program, eggs collected from the wild are artificially incubated, and the offspring reared in captivity (i.e., "head-started") until attaining a total length (TL) of 75–100 cm, and then repatriated into community-managed wetlands (Platt et al. 2014, *op. cit.*). The wetlands near Noa Neua Village are shallow, non-alluvial depressions characterized by open water interspersed with dense stands of aquatic vegetation (*Eleocharis*, *Nymphaea*, and *Nelumbo*), surrounded by patches of scrub forest and extensive seasonal rice fields (Platt et al. 2018a. Nat. Hist. Bullet. Siam Soc. 62:195–198) and managed by villagers as a "sacred zone" where wildlife (including crocodiles) is protected from hunting (Platt et al. 2018. Croc. Spec. Group Newsletter 37[4]:6–12).

We first visited Noa Neua on 12 July 2011 to collect eggs from a crocodile nest found about one month earlier by participants in the community conservation program. The nest (16.98350°N, 104.91036°E; WGS 84; 148 m elev.) was located in a dense patch of low-lying scrub forest ca. 100 m from the wetland and bordered by rice fields (Fig. 1). We approached the nest along an unused water buffalo trail and encountered a large crocodile (ca. 3.0 m TL)—presumed to be the nesting female—concealed in dense understory vegetation, lying about 1.0 m from the nest beside a water-filled wallow (Fig. 2). Each time we attempted to reach the nest, the female lunged forward and upwards, lifting her forelegs and head off the ground, and loudly snapping her jaws. This aggressive behavior was triggered when we approached to within about 10 m of the nest, but the female made no attempt to pursue us beyond this distance. After several aggressive displays by the female, the villagers became concerned that our actions would "anger the spirits" and asked that we withdraw from the area. We complied with their wishes and immediately departed without opening the nest.

Accompanied by the village team, we returned to the site on 15 November 2011 to determine the fate of the clutch. As before, we encountered the female lying concealed in vegetation near the nest and she reacted aggressively to our presence (129 s; https://www.youtube.com/watch?v=jmwCzh4q_vU&feature=youtu.be), preventing us from closely inspecting the nest mound. Given that *C. siamensis* eggs typically hatch from mid-August through mid-September in Laos (Platt et al., unpubl. data), the female was defending the nest at least two months beyond the normal hatching date. Our final visit occurred on 12 July 2012 by which time the female had deserted the nest. We closely examined the site and found the nest mound was positioned at the base of a tree, about 0.3 m from the wallow (ca. 2 × 2 m) in a small opening amidst a dense thicket of saplings interwoven with vines. We estimated canopy closure directly above the nest mound at 20%. The mound consisted of soil and decomposed herbaceous vegetation, and contained 12 intact, but non-viable eggs; four additional eggshells were found beside the mound. The mean (± 1 SD) length and width of the 12 intact eggs was 48.1 ± 1.5 mm (range: 46.1–50.6 mm) and 92.2 ± 3.1 mm (range: 88.2–101.0 mm), respectively. Members of the community conservation team opened the nest about two months prior to our visit (late April or early May 2012) and reported the mound contained a clutch of 35 eggs. We inspected 10 additional active *C. siamensis* nests at other wetlands in Savannakhet Province (seven nests during 2011–2013 and three nests in 2019) and collected eggs from nine, and the above incident was the only instance of aggressive nest defense by an attending female crocodile directed at us.

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Fig. 1. *Crocodylus siamensis* nesting habitat near Noa Neua Village in Savannakhet Province, Laos. Nest is located in the dense, low-lying patch of scrub forest to the left of photograph. Note extensive rice fields with wetland in distance.

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Fig. 2. Female *Crocodylus siamensis* lying partially concealed in dense ground vegetation beside a nest mound (not visible in photograph).

Our observations of *C. siamensis* nesting and attendance behavior are noteworthy for several reasons. First, our observations are one of the few reports on reproductive ecology and clutch attributes for wild *C. siamensis* (see also Simpson and Han 2004. *In* Proc. 17th Working Meeting IUCN-SSC Crocodile Specialist Group, pp. 110–120. IUCN Publ., Gland; Platt et al. 2006. Herpetol. Nat. Hist. 9:183–188; Kanwatanakid-Savini et al. 2012. Herpetol. Conserv. Bio. 7:157–168; Bezuijen et al. 2013. J. Herpetol. 47:41–65; Sam et al. 2015. Cambodian J. Nat. Hist. 2015:153–164), and one of only three reports (Platt et al. 2006, *op. cit.*; Kanwatanakid-Savini et al. 2012, *op. cit.*; Bezuijen et al. 2013, *op. cit.*) that describe micro-sites used for nesting. Second, we are aware of only two other first-hand accounts of nest attendance by wild *C. siamensis*. Kanwatanakid-Savini et al. (2012, *op. cit.*) found a female concealed in dense grass beside a nest in Kaeng Krachan National Park, Thailand that fled from researchers, and Bezuijen et al. (2013, *op. cit.*) stated that a nest in Laos was "guarded fiercely by a female of TL 2.8–2.9 m". Third, although female crocodilians are known to attend nests after the clutch has been removed (Grigg and Kirshner 2015, *op. cit.*), our observation appears to be the only reported instance of a female crocodilian actively defending a nest well beyond the date when the clutch should have hatched. Our observation thus raises interesting questions regarding the cues responsible for terminating nest attendance by female crocodilians.

Our counterparts at the Provincial and District Offices of Forestry and Agriculture are thanked for facilitating fieldwork in Savannakhet Province. Funding for this project was provided by MMG, Critical Ecosystem Partnership Fund, Virginia Zoo, Detroit Zoo, and St. Augustine Alligator Farm. Troy Hansel, Santi Saypanya, and Christopher Holmes provided critical administrative oversight and logistic support through the Wildlife Conservation Society Lao Program. Deb Levinson and Ruth Elsey are thanked for providing literature, and insightful comments by Lewis Medlock improved an early draft of this manuscript. Finally, the Community Conservation Cadres in Noa Neua deserve special mention for their enthusiasm and field assistance, sharing their traditional beliefs, and continuing dedication to crocodile conservation in Laos. This paper represents technical contribution number 6826 of the Clemson University Experimental Station.

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***PALEOSUCHUS TRIGONATUS* (Smooth-fronted Caiman). PREDATION**. *Paleosuchus trigonatus* is a small caiman present in French Guiana where it occupies rainforest and wetlands habitats. With a primarily nocturnal lifestyle, as well as a preference for burrows and caves for shelter, daytime observations of their behavior are rare (Magnusson and Lima 1991. J. Herpetol. 25:41–48; Lemaire et al. 2018. Crocodile Specialist Group Newsl. 37:18–21). *Paleosuchus trigonatus* has a diverse diet that includes a variety of arboreal and terrestrial species such as monkeys, porcupines, agoutis, armadillos, fish, lizards, and snakes, but there is little information on the snake species consumed (Magnusson et al. 1987. J. Herpetol. 21:85–95; Moldowan et al. 2016. S. Am. J. Herpetol. 11:176–182). Here, we report an adult *P. trigonatus* feeding on an adult *Corallus caninus* (Emerald Tree Boa).

On 21 April 2014 at 1145 h, we observed a *P. trigonatus* at the edge of the Arataye River, close to Nouragues Ecological Research Station in the Nature Reserve Les Nouragues, French Guiana (4.04°N, 52.67°W; WGS 84; 30 m elev.). Initially submerged under water on a shallow sandy bank of a small river island, the caiman emerged on the bank with an adult individual of *C. caninus* in its jaws (Fig. 1) that appeared freshly killed or possibly still alive. After a few minutes, the caiman retreated back into the river and disappeared under water with the prey. *Corallus caninus* is primarily an arboreal boid snake (Henderson et al. 2013. Biol.


PHOTO BY ANDRIUS PASUKONIS

Fig. 1. A large *Paleosuchus trigonatus* feeding on a large *Corallus caninus* in the Nature Reserve Les Nouragues, French Guiana.

J. Linn. Soc. 109:466–475), that is occasionally found on the ground. Both *P. trigonatus* and *C. caninus* are regularly observed in this area, and to our knowledge this is the first observation of *P. trigonatus* preying on *C. caninus*.

We thank the Nouragues Ecological Research Station (managed by CNRS) which benefits from "Investissement d'Avenir" grants managed by Agence Nationale de la Recherche (AnaEE France ANR-11-INBS-0001; Labex CEBA ANR-10-LABX-25-01).

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SQUAMATA — AMPHISBAENIANS

***AMPHISBAENA VERMICULARIS* (Wagler's Worm Lizard). PREDATION.** *Amphisbaena vermicularis* is a small (up to 325 mm total length) fossorial amphisbaenid that is rarely observed above ground with a distribution from northeastern Brazil to Bolivia (Gans 2005. Bull. Am. Mus. Nat. Hist. 289:1–130). The Burrowing Owl, *Athene cunicularia*, ranges from western North America to Tierra del Fuego in South America (Weick 2006. Owls [Strigiformes] Annotated and Illustrated Checklist. Springer-Verlag, Berlin. 384 pp.) and are well-known reptile predators. For example, *A. cunicularia* feed on colubrid and blind snakes (Herse 2016. Southwest. Nat. 61:341–348; Claúdio et al. 2017. Herpetol. Notes. 10:429–431) and lizards of many different families from temperate arid and desert habitats (Carevic et al. 2012. J. Arid. Environ. 97:237–241; Herse 2016, *op. cit.*) to dry tropical regions (Vieira and Teixeira 2008. Bol. Mus. Biol. Mello Leitão 23:5–14; Cadena-Ortíz et al. 2016. Rev. Bras. Ornitol. 24:122–128). Until now, there was no record of *A. cunicularia* predation on an amphisbaenid.

At 1020 h on 10 June 2013, at the Universidade Estadual de Feira de Santana, Feira de Santana, Bahia, Brazil (12.26666°S, 38.96666°W; WGS 84; 223 m elev.), we observed an adult *A. cunicularia* perched in a tree ca. 5 m above ground with an *A. vermicularis* in its talons. The *A. vermicularis*, which appeared to be an adult, was writhing as it tried to escape from the owl.

FIG. 1. A) *Athene cunicularia* with an *Amphisbaena vermicularis* in its talons, being chased by a Great Kiskadee (*Pitangus sulphuratus*) in Bahia, Brazil; B) view of the *A. cunicularia* with *A. vermicularis* showing the lizard's length after the owl fled to another part of the tree.

After a few seconds, a second bird, a Great Kiskadee (*Pitangus sulphuratus*) approached the owl and chased it from its initial perch to another perch in the same tree (Fig. 1A). The owl sat on this new perch for a few seconds, still holding the *A. cunicularia* in its talons (Fig. 1B), before flying out of view with the lizard, preventing us from observing the owl consuming the worm lizard. To our knowledge, this is the first record of an *A. cunicularia* feeding on a species of Amphisbaenidae.

We thank the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), Universidade Estadual de Feira de Santana (UEFS), and Instituto Nacional de Pesquisas da Amazônia for research support. We thank the Capes-INPA research grant to A. M. Silva-Neto (Process: 88887.312051/ 2018-00) and the CNPq research grant to D.M.D.M. Mendes (Process: 141878/2018-5).

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SQUAMATA — LIZARDS

***AMEIVA AMEIVA* (Giant Ameiva). PREDATION.** *Ameiva ameiva* is native to central and South America but was introduced to Florida in the 1950s (Duellman and Schwartz 1958. Bull. Florida State Mus. 3:286–287) and is now an established non-native component for the state's lizard fauna (Meshaka 2011. Herpetol. Conserv. Biol. 6:69–70). In its native range, *A. ameiva* is preyed upon by a number of species, including snakes (Maffei et al. 2009. Herpetol. Notes 2:235–237; Ferreira Da Silva et al. 2016. Herpetol. Rev. 47:292), mammals (Leandro De Souza 2011. Herpetol. Rev. 42:426), raptors (Gaiotti et al. 2011. Herpetol. Rev. 42:426), and crabs (Lopes Segadilha et al. 2016. Herpetol. Rev. 47:292–293). However, little is known about the lizards' predators in its introduced range in Florida (Meshaka 2011, *op. cit.*). Here, we report an observation of predation of an adult *A. ameiva* by a Red-shouldered Hawk (*Buteo lineatus*).

On 11 July 2020, at ca. 1245 h we observed an immature Red-shouldered Hawk with a lizard in its talons, fly in front of our vehicle in Naples, Florida, USA (26.21339°N, 81.75010°W; WGS 84; 5 m elev.). The hawk appeared to briefly struggle with flight while carrying the large prey item which allowed us to confirm the lizard it as an adult *A. ameiva.* After a couple seconds the hawk left our field of vision and entered into a nearby Pine Flatwoods. To our knowledge this is the first record of the non-native *A. ameiva* being predated by a native raptor in Florida, and the second case of predation by a hawk anywhere in the lizard's range. The only other report we are aware of was a *A. ameiva* removed from the stomach of a Gray Hawk (*Buteo nitidus*) in its native range in Brazil (Gaiotti et al. 2011, *op. cit.*).

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***ASPIDOSCELIS SACKII GIGAS* (Sack's Reticulated Whiptail). COLOR PATTERN VARIATION.** *Cnemidophorus sacki* (= *C. sackii* *gigas* sensu Duellman and Zweifel 1962. Bull. Am. Mus. Nat. Hist. 123:155–210; *Aspidoscelis sacki* = *sackii gigas* sensu Reeder et al. 2002. Am. Mus. Novit. 3365:1–61) was described from the state of Morelos, Mexico, as *C. gigas* by Davis and Smith (1952. Herpetologica 8:97–100) based on a distinctive color pattern and later was relegated to a subspecies of Sack's Spotted Whiptail by Duellman and Zweifel (1962, *op. cit.*). *Aspidoscelis sackii gigas* is one of the largest forms of *Aspidoscelis*, reported to grow to 140 mm SVL (Duellman and Zweifel 1962, *op. cit.*) and males of *A. sackii sackii* grow to 153 mm SVL (Walker 1981a. J. Herpetol. 15:321–328). Published references to *A. sackii gigas* are few and mainly include general statements on color patterns, meristic variation, scutellation characters, and/or locality records typically based on specimens from the south-central Mexican states of Guerrero, Morelos, and Puebla (e.g., Duellman and Zweifel 1962, *op. cit.*). The only exceptions known to us pertaining to the biology of the subspecies is a note on reproduction in *A. sackii gigas* (as *A. sacki*, by Hernández-Gallegos et al. 2011. Herpetol. Rev. 42:428) and a brief reference to its evolutionary history (as *A. sackii*, by Barley et al. 2019. Mol. Phylogenet. Evol. 132:284–295).

We undertook this study based on observations made in the summer of 2012 on live adults of *A. sackii gigas* (Fig. 1–3) from El Transformador, Municipality of Pilcaya, Guerrero, Mexico (18.665°N, 99.4808°W; WGS 84; 1117 m elev.) and from nearby Tonatico, Municipality of Tonatico, México (18.75044°N, 99.62025°W; WGS 84; 1597 m elev.). The objectives were to describe ontogenetically derived adult dorsal and ventral color patterns and to interpret the adaptive significance thereof. We used established terminology (see Walker 1981b. Copeia 1981:826–849; Walker 1981c. Copeia 1981:850–868) in describing the dorsal pattern posterior to the forelimbs in the three adults of *A. sackii gigas*.

Juveniles of *A. sackii gigas* have a pattern of cream to cream-yellow longitudinal stripes separated by longitudinal fields of brown-black to black ground color (Duellman and Zweifel 1962, *op. cit.*). Variations on this theme characterize members of the *C. sexlineatus* (= *A. sexlineatus* sensu Lowe et al. 1970. Syst. Zool. 19:128–141) species group (sensu Reeder et al. 2002, *op. cit.*). The ventral pattern of juveniles of *A. sackii gigas* consists of either unmarked cream-white or off-white hues. Complex ontogenetic changes, which result in dramatic changes in the dorsal and ventral patterns of many members of the *A. sexlineatus* species group, are well underway in lizards of both sexes of *A. sackii gigas* of ca. 90–100 mm SVL (Duellman and Zweifel 1962, *op. cit.*). However, these authors presented only brief remarks pertaining to the dorsal pattern of *A. sackii gigas*: "Adults with a tan or greenish tan dorsum, with dark brown or black reticulations and irregular spots, not forming distinct cross bars." We describe the adult dorsal pattern of the subspecies in life in greater detail. Adults from El Transformador, Guerrero, retained only vague indications of the former positions of the alternating longitudinal pale-hued stripes and dark-hued fields, and they were only detectable by an experienced observer (Fig. 1A–C). In these individuals the pattern on the neck and body from the occipital scales to the forelimbs ranged from a complex mixture of dark brown ground color and lichenoid to lineate green-gold markings (Fig. 1A) to a more uniformly brown-tan hue which obscured the original dark ground color (Fig. 1B–C). Each of the three adults also had an irregular darker band of ground color along the sides, interrupted by either gray-tan to tan reticulations or vertical bars. This band on each side of adults was represented in juveniles by the upper lateral field bordered below and above

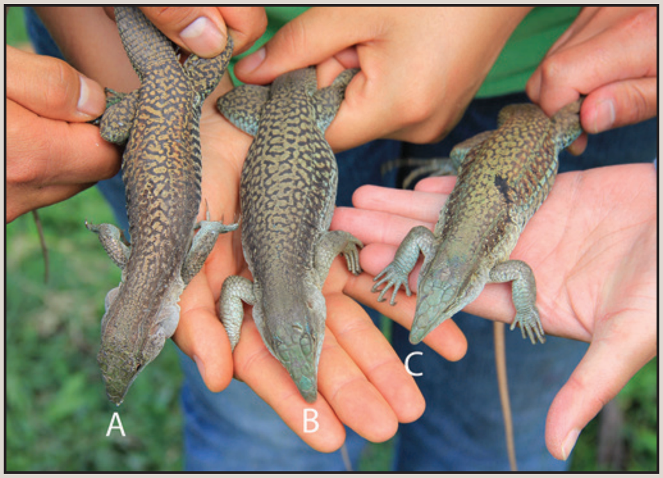

Fig. 1. Variation in dorsal patterns in *Aspidoscelis sackii gigas* obtained in July 2012 at Transformador, Municipality of Pilcaya, Guerrero (note reduced to obscured contrast between pattern elements and black ground color especially from forelimbs anteriorly to occipital scales): A) mature male; B) mature female; C) smaller adult male.

Fig. 2. Variation in ventral patterns in *Aspidoscelis sackii gigas* obtained in July 2012 at Transformador, Guerrero: A) mature male; B) mature female; C) smaller adult male.

by the lateral and dorsolateral stripes, respectively. Remnants of these pattern components are only vaguely and variously discernable in adults (Fig. 1A–C). The dorsal pattern consists of brown to black areas of ground color (i.e., modifications of the juvenile pattern of dark-hued fields between the pale-hued stripes), appropriately referred to as reticulations by Duellman and Zweifel (1962, *op. cit.*), surrounding tan to green-gold-tan reticulations, inappropriately referred to as dorsum rather than pale dorsal pattern components by Duellman and Zweifel (1962, *op. cit.*). However, the tan to green-tan reticulations are never coalesced into distinct series of cross bars as characterizes *A. sackii sackii* to the east of the distribution of *A. sackii gigas* (Duellman and Zweifel 1962, *op. cit.*). As indicated in Fig. 3, there was sharper contrast between the pale and dark dorsal pattern components in individuals of *A. sackii gigas* from Tonatico than from those from El Transformador.

No terminology better describes the visual illusion of the dorsal pattern of *A. sackii gigas* than to regard it as a perfect camouflage configuration. Walker (1981a, *op. cit.*) reported that *A. sackii* (= subspecies *sackii*) preferred microhabitats

Fig. 3. Dorsal pattern in a mature male of *Aspidoscelis sackii gigas* obtained in July 2012 at Tonatico, México (note sharp contrast between dorsal pattern elements and black ground color).

with shrubs and trees in the remote Tomellin Canyon of the southeastern Mexican state of Puebla and the north-central Mexican state of Oaxaca, whereas its much smaller syntopic congener *A. parvisocius* (Mexican Pygmy Whiptail) preferred more open-structured microhabitats. Although we observed tropical deciduous forest interspersed with agricultural crops at Tonatico, compared with more open tropical deciduous forest interspersed with agricultural crops and grassland at El Transformador, additional study will be required to determine either how or whether giant-sized *A. sackii gigas* and moderately large *A. costatus costatus* partition microhabitats at the two sites. Based on the findings in Asplund (1974. Copeia 1974:695–703) that large-bodied species of whiptail lizards typically inhabit shrubby habitats, it is likely that the dorsal pattern of adult *A. sackii gigas* is an adaptation that results in blending into the dappled sunlight of shrubby vegetation, with *A. costatus costatus* using more open-structured microhabitats.

Ventrally, the color pattern of *A. sackii gigas* is among the most stunningly colorful that we have observed in the genus (Fig. 2A–C), though it was mundanely described as follows by Duellman and Zweifel (1962, *op. cit.*): "Bluish white bellies of many adult males heavily mottled with black posteriorly; chin pale pink." We provide a more detailed description of the adult ventral pattern of the subspecies using lizards from El Transformador. The throat region and part of the gular fold of the largest adult males becomes orange-red (much more subdued in adult females and smaller adult males which remain unmarked by dark-hued spots or markings; Fig. 2A–C). The scales posterior to the gular fold and thoracic region are mostly orange-red with off-white posterior edges; some lateral thoracic scales also have a touch of gray-blue. An abrupt change occurs in the colors of the scales in the abdominal region; they are predominantly dark gray-blue to gray-black with some scales having pale blue. From a ventral perspective the median aspect of the tail is off-white and the more lateral aspects are gray-blue.

We can provide insight into how strong sexual dimorphism in the ventral color pattern, as noted in *A. sackii gigas*, can simultaneously function as an attractant in intraspecific mating and deterrent to interspecific mating when it appears to be hidden beneath the lizard. Based on research on the sexually dimorphic *A. gularis* (Texas Spotted Whiptail) in Bentsen-Rio Grande Valley State Park, Hidalgo County, Texas, USA (JEC, unpubl. data), it has been observed that male *A. gularis* displayed both the throat and thoracic regions by raising the body with the forelimbs during courtship with conspecific females, as well as during encounters with diploid parthenogenetic *A. laredoensis* (Laredo Striped Whiptail) with which it occasionally hybridizes (Cole et al. 2020. Am. Mus. Novit. 3947:1–13). We suggest that males of *A. sackii gigas* will be found to offer similar displays in potential intraspecific mating sequences, as well as in interspecific encounters with *A. costatus costatus* at Tonatico, Mexico, and El Transformador, Guerrero.

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***ASPIDOSCELIS TIGRIS SEPTENTRIONALIS* (Plateau Tiger Whiptail). AVERAGE SNOUT–VENT LENGTH.** *Aspidoscelis tigris septentrionalis* is distributed in the parts of Arizona, Colorado, New Mexico, and Utah that constitute the Colorado Plateau (Dessauer et al. 2000. Bull. Am. Mus. Nat. Hist. 246:1–148). This whiptail lizard has been intensively studied with reference to reproductive biology (McCoy and Hoddenbach 1966. Science 154:1671–1672; Taylor et al. 1992. J. Herpetol. 26:443–447) and variation in snout–vent length (SVL), meristic variables, and color pattern (Taylor and Buschman 1993. Herpetologica 49:4251; Dessauer et al. 2000, *op. cit.*; Walker et al. 2015. Herpetol. Conserv. and Biol. 10:935–947).

A report by Heyborne et al. (2019. Herpetol. Rev. 50:569–570) of a supernumerary caudal anomaly, based on an image of an uncaptured individual of *A. t. septentrionalis* from the parking area of lower Calf Creek Falls, Grand Staircase-Escalante National Monument, Utah, USA (37.79372°N, 111.41494°W; WGS 84; 1600 m elev.), incidentally indicated that the average SVL of the subspecies is 105 mm referenced as based on Heyborne et al. (unpubl. data). This size for the average SVL of Plateau Tiger Whiptails (i.e., average of measurements of adults ventrally from tip of snout to transverse cloacal slit) is significantly larger than previously found in 11 samples of *A. t. septentrionalis* (sexes pooled) comprising 335 specimens of 79 mm SVL or larger from three sites in Arizona, three in Colorado, one in New Mexico, and four in Utah. Mean SVL as indicated by individual samples ranged from 85.7–95.2 mm (Taylor 1983. Ph.D. Dissertation, University of Colorado, Boulder, Colorado, table 4), and locations of sampling sites are shown in Taylor et al. (1992. *op. cit.*, fig. 1) and Taylor and Buschman (1993, *op. cit.*, fig. 1). Several specimens (Taylor et al. 1992, *op. cit.*, fig. 2) are larger than the maximum SVL of 96 mm for specimens of the subspecies reported by Walker et al. (2015. Herpetol. Conserv. Biol. 10:935–947).

Clarification of the average SVL of adults in *A. t. septentrionalis* is important: for example, assessment of the role of character displacement in body size of sympatric congeners is often based on published average values for whiptail lizards. Moreover, divergence in body size is an important subject for ecologists addressing questions on the diversity of species in communities, effects on population size and habitat use, similarity between potentially competing species (e.g., Brown and Wilson 1956.

Syst. Zool. 5:49–64; Hutchinson 1959. Am. Nat. 93:145–159; Asplund 1974. Copeia 1974:695–703), and reproductive potential (Taylor et al. 1992, *op. cit.*). The objective here is to provide a correction for the erroneous average SVL of 105 mm for *A. t. septentrionalis* reported by Heyborne et al. (2019, *op. cit.*) which was said to be based on lizards captured during an inventory of the herpetofauna of Grand Staircase-Escalante National Monument located in Kane and Garfield counties in southern Utah. Specimens referenced in Taylor (1983, *op. cit.*), Taylor et al. (1992, *op. cit.*), and Taylor and Buschman (1993, *op. cit.*) are deposited in the University of Colorado Museum of Natural History; those referenced in Walker et al. (2015, *op. cit.*) are deposited in the University of Arkansas Department of Zoology and BKS collections.

The only congener of *A. t. septentrionalis* in this national monument and elsewhere in Utah is triploid parthenogenetic *A. velox* (Plateau Striped Whiptail) based on Cole et al. (2019. Am. Mus. Novitat. 3936:1–8). W. H. Heyborne (pers. comm.) recently provided these data on the average SVL of the two whiptail lizard species he obtained from Grand Staircase-Escalante National Monument, Utah: *A. t. septentrionalis* (83.5 mm) and *A. velox* (76.4 mm). He also explained the basis for the erroneous report of average SVL in *A. t. septentrionalis* which we will not repeat. Extensive data on average SVL and clutch size of reproductive females of this subspecies are included in Taylor et al. (1992, *op. cit.*).

We thank H. L. Taylor and W. H. Heyborne for generously answering questions pertaining to their respective studies of *A. t. septentrionalis* in the southwestern United States. The former authority also critiqued the manuscript and offered numerous edits. Voucher specimens of this subspecies collected for this report were made under provisions of credentials from appropriate agencies in Arizona, New Mexico, and Utah made available to various coauthors of this report.

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***ASPRONEMA DORSIVITTATUM* (Paraguay Mabuya). MELANISM.** Melanism is a chromatic anomaly derived from excessive melanin concentration in the skin of a number of animal lineages (Kettlewell 1973. The Evolution of Melanism. Clarendon Press, Oxford, UK. 442 pp.). In the case of reptiles, melanism may have direct influence in several behavior aspects of these animals such as thermoregulation and camouflage (Trullas et al. 2007. J. Therm. Biol. 32:235–245). *Aspronema dorsivittatum* is a small lizard widely distributed through forest edges, shrublands and grasslands of Brazil, Uruguay, Argentina, Paraguay, and Bolivia (Hedges and Conn 2012. Zootaxa 3288:1–244). Typical coloration of this species is brownish to golden dorsum, dark and pale dorsolateral stripes and whitish belly (Hedges and Conn 2012, *op. cit.*). Herein, we report the first record of melanism in the lizard *A. dorsivittatum* (Mabuyidae), from the Brazilian Atlantic Forest.

On 9 December 2019, during faunal monitoring at Salto Pilão Hydreletric Usine, Municipality of Apiúna, Santa Catarina, southern Brazil (27.09512°S, 49.47766°W; WGS 84; 435 m elev.), DB observed and photographed a completely melanistic *A. dorsivittatum* foraging in a shrubland (Fig. 1). *Aspronema dorsivittatum* is the only Mabuyidae species found in this region and seven photos were reviewed to verify the species identification. Melanism is a quite common condition in some lineages of Squamate reptiles, but to our knowledge this is the first record of a melanistic individual in the genus *Aspronema*.

A) PHOTO BY DIEGO BORTOLOZZO; B) PHOTO BY ISMAEL FRANZ

Fig. 1. A) Melanistic individual of *Aspronema dorsivittatum* from the Municipality Apiúna, Santa Catarina, Brazil; B) normal colored *A. dorsivittatum* from Municipality of Lages, Santa Catarina, Brazil.

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***BASILISCUS BASILISCUS.* (Common Basilisk). BEHAVIOR.** *Basiliscus basiliscus* is a semi-aquatic lizard occurring from Nicaragua south to northwestern Colombia (Savage 2002. The Amphibians and Reptiles of Costa Rica: a Herpetofauna between Two Continents, Between Two Seas. University of Chicago Press, Chicago, Illinois, 934 pp.). Its aquatic behavior includes running over the water, and diving into water to escape predators and to pursue invertebrate and small vertebrate prey along streams and rivers (Savage 2002, *op. cit.*). At night this species sleeps within a few meters of the water, perched on vegetation, boulders, and juveniles may sleep directly on the ground among rocks (Van Devender 1982. Herpetologica 38:189–208; CLB, pers. obs.). Herein, I report three instances of a novel subaquatic sleeping behavior in *B. basiliscus* from Costa Rica.

PHOTO BY CÉSAR BARRIO-AMORÓS

Fig. 1. Adult male *Basiliscus basiliscus* sleeping underwater.

On 21 March 2020 around 1930 h, a colleague and I observed a subadult female *B. basiliscus* sleeping among rocks 30 cm underwater, motionless and with its eyes closed. This observation was made along the Baru River near the Nauyaca waterfalls between Dominical and Platanillo de Barú, Puntarenas Province, Costa Rica (9.2685°N, 83.8094°W; WGS 84; 108 m elev.). I remained for ca. 10 min snorkeling, waiting for any possible reaction, but the lizard did not move and stayed completely still. The second observation occurred on 31 March 2020 during a nocturnal survey, at 2000 h, along an unnamed creek in San Josecito, Uvita, Puntarenas Province, Costa Rica (9.2284°N, 83.7360°W; 340 m elev.). I observed an adult male *B. basiliscus* submerged in a pool at an approximate depth of 60 cm underwater, apparently sleeping (Fig. 1). I approached the lizard to a distance of 1.5 m to film and photograph it; by the lack of movement and its posture the animal appeared to be sleeping, comparable to the first observation at Barú. However, in this case, the whole animal was visible. I returned 1 h later to find this *B. basiliscus* had moved. The third observation occurred on 3 April 2020 at 1953 h in the same pool as the 31 March 2020 observation. On this night we saw a subadult female resting among rocks on the bottom of the pool at an approximate depth of 70 cm underwater. We observed this *B. basiliscus* underwater for 42 min until it moved. The female's initial movements were very slow and its eyes were closed. After a couple minutes it appeared to detect our flashlight beams and then moved to the surface to breathe and escaped.

At both sites sleeping *B. basiliscus* of all age classes were abundant on the vegetation and many exhibited escape behaviors consistent with nocturnal disturbances, e.g. by jumping into and swimming to the river bottom (Van Devender 1982, *op. cit.*). I infer these lizards were sleeping underwater because of their resting or placid behavior; however, it is unclear how long the *B. basiliscus* were submerged and if they fled to the water after a disturbance. I found this species can remain submerged for at least 42 min in a state of apparent sleep, and to my knowledge such a duration and behavior has not been reported in a Neotropical lizard. The longest underwater duration registered for a Neotropical lizard is ca. 16 min in *Norops aquaticus*, which utilized air bubbles, trapped around their head to breathe (Swierk 2019. Herpetol. Rev. 50:134–135). More research is needed to determine how often this behavior occurs and how much time are these basilisks capable to sleep underwater.

I thank Harold Mena, Brona Gabrysova and Humberto Nuñez for advising and field company.

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***BASILISCUS VITTATUS* (Brown Basilisk). HABITAT USE and TAIL BIFURCATION.** *Basiliscus vittatus* (Corytophanidae) is a medium-sized lizard (140 mm SVL) inhabiting low and moderate elevations from Mexico, to Central America and north of South America. In the Yucatán Peninsula, this species inhabits all types of vegetation (Lee 2000. A Field Guide to the Amphibians and Reptiles of the Mayan World. Cornell University Press, Ithaca, New York. 402 pp.) and has been also reported in karst formations (Nahuat-Cervera and Barrientos-Medina 2018. Mundos Subterráneos UMAE 28–29:1–13). On 17 March 2018 at 2232 h, we found two individuals of *B. vittatus* sleeping on the rocky wall ca. 2 m above the floor, ca. 15 m inside the cave "Aktún Beh" near Mérida-Campeche highway, Municipality of Maxcanú, Yucatán, Mexico (20.5637°N, 89.9797°W; WGS 84; Fig. 1). The cave was surrounded by deciduous forest and is used as a clandestine dump. One of the individuals, an adult male (14 cm SVL), had a bifid tail (Fig. 2). The bifurcation point was at the tip of the tail, with the longer arm measuring 43 mm, and the other 33 mm. Based on the color pattern, the longer arm seemed to be the regenerated

Fig. 1. Adult male *Basiliscus vittatus* on the rocky wall in Aktún Beh Cave, Maxcanú, Yucatán, Mexico.

Fig. 2. Adult male *Basiliscus vittatus* with a bifurcated tail from Aktún Beh Cave, Maxcanú, Yucatán, Mexico.

part. Caudal autotomy is a defensive mechanism widely used by lizards, which responds to predator attacks. Tail abnormalities such as bifurcation are common in the regeneration process and are known from several lizard families (Passos et al. 2016. Phyllomedusa 15:79–83). To our knowledge, this observation represents the first record of tail bifurcation of *B. vittatus* and with the family Corytophanidae, and the first report of the cave habitat use for this lizard species.

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***CTENOTUS ROBUSTUS* (Eastern Striped Skink). NOCTURNAL FORAGING.** The effect of artificial night lighting in attracting invertebrates and creating novel foraging opportunities has been well documented in nocturnal lizards (Perry et al. 2008. Urban Herpetol. 3:239–256). While less documented, artificial light can also cause diurnal lizards to modify their activity to include nocturnal foraging proximal to artificial lighting (Perry et al. 2008, *op. cit.*) by exploiting the "night-light niche" (Garber 1978. Trans. Kansas Acad. Sci. 81:79–80). Herein, we document the possible first recorded observation of nocturnal foraging under artificial light by the diurnal skink *Ctenotus robustus.*

Between 2030 and 2130 h on 6 and 8 February 2018, at the Sandy Hollow Tourist Hotel, Sandy Hollow, NSW, Australia (32.33514°S, 150.56709°E; WGS 84) we observed an individual *C. robustus* (ca. 100 mm SVL) actively foraging for insects under artificial light. This nocturnal behavior was observed on two separate nights by presumably the same individual. The individual emerged from a loading grate located outside the hotel ca. 35 min after sunset, during which the area was illuminated by artificial lights, which were attracting insects. The lizard primarily fed on crickets (Gryllidae). The air temperature at the time of the observation was ca. 28°C; however, the concrete floor the *C. robustus* was foraging on would have been warmer.

Ctenotus robustus belongs to one of the most speciose genera of Australian lizards with more than 100 recognized species, all of which are considered to be exclusively diurnal (Wilson and Swan 2013. A Complete Guide to Reptiles of Australia. Reed New Holland, Sydney, Australia. 196 pp.). This observation compliments the growing body of evidence of diurnal reptiles occupying the "night-light niche" (see review by Perry et al. 2008, *op. cit.*) to extend their activity and/or shift to more suitable weather conditions.

We thank J. Valdez for his thoughtful commentary on this manuscript.

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***CYRTODACTYLUS CONSOBRINUS* (Thin-banded Forest Gecko). DIET.** Little is known about the diets of geckos of genus *Cyrtodactylus*, but they have been reported to prey on insects, gastropods, and malacostracans, the latter not identified to species level (Valakos and Vlachopanos 1989. Biol. Gallo-Hellenica 15:179–184; Bauer et al. 2009. Zootaxa 2124:51–62; Gaulke 2011. The Herpetofauna of Panay Island, Philippines: An Illustrated Field Guide. Edition Chimaira, Frankfurt am Main, Hesse. 390 pp.). *Cyrtodactylus consobrinus* is common and widely distributed from southern Thailand through Peninsular Malaysia, Singapore, Sumatra, and Borneo (Grismer 2011. Lizards of Peninsular Malaysia, Singapore and Their Adjacent Archipelagos. Edition Chimaira, Frankfurt am Main, Hesse. 728 pp.), and although common, virtually nothing is known about feeding habits in the wild. Herein, we report on the first instance of *C. consobrinus* feeding on a terrestrial snail.

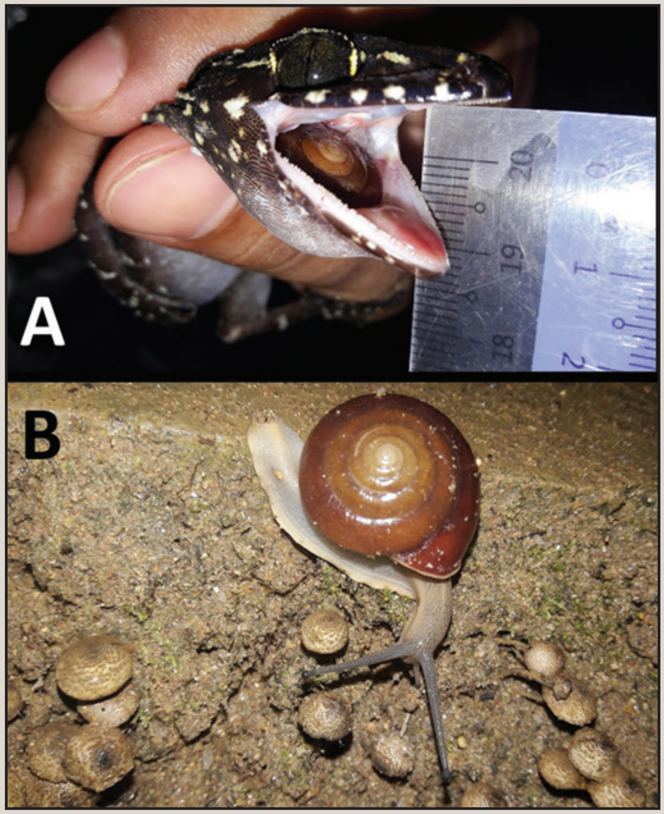

PHOTO BY BAIZUL HAFSYAM BADLI-SHAM

FIG. 1. A) Captured *Cyrtodactylus consobrinus* with the *Quantula striata* inside its mouth; B) a reference example of *Q. striata* (2.3 cm shell diameter) found in the same habitat.

Our observation was made on the night of 22 December 2019 during a herpetological survey in a Sekayu lowland forest, Hulu Terengganu District, Malaysia (4.96444°N, 102.9538°E; WGS 84; 75 m elev.). We collected an adult *C. consobrinus* (11.7 cm SVL, 14.1 cm total length) from a bark crevice on a tree trunk. Upon capture we placed the lizard in a zip-lock plastic bag, without bark or debris from the tree, for 3 h until the survey ended. After the survey, we examined the bag and noticed the *C. consobrinus* with a snail in its mouth and we surmise the lizard regurgitated the snail while in the bag. After photographing the lizard with the snail in its mouth (Fig. 1A), we placed both back in the bag. The following morning, 23 December 2019, the snail had been ingested by the gecko. Based on morphological characteristics (Fig. 1B), we identified the snail as *Quantula striata* (Tan et al. 2015. Nature in Singapore 8:25–30), the only known bioluminescent terrestrial snail in the world (Haneda 1946. Seibutsu 1:294–298). It is unclear if bioluminescence is for interspecific communication (Deheyn and Wilson 2011. Proc. Royal Soc. B 278:2112–2121) or is a form of predator deterrence or protection (Deheyn et al. 2000. J. Mar. Biol. Assoc. UK 80:179–180; Deheyn and Wilson 2011, *op. cit.*). There is evidence that *Q. striata* is distasteful to rodents and invertebrates, which did not feed on *Q. striata* in laboratory trials (Liat 1966. J. Zool. 148:554–560). This is the first observation of *C. consobrinus* feeding on a land snail that belongs to a species that is potentially distasteful.

We thank the Department of Forestry Malaysia (JPSM) for issuing permits to conduct herpetofaunal study at the Sekayu lowland forest and Forestry Department Terengganu for logistical support. We thank M. Effendi bin Marzuki for identifying the snail and C. Kin Onn for reviewing and providing comments on early drafts of this note. Finally, we thank Universiti Malaysia Terengganu for providing research equipment for our work.

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ELGARIA MULTICARINATA MULTICARINATA **(Forest Alligator Lizard). MAXIMUM SIZE.** Fitch (1938. Amer. Midl. Nat. 20:381–424) reported the largest *Elgaria multicarinata* from the state of Oregon, from a subspecies known from northern California, Oregon, and Washington he assigned as *E. m. scincicauda*, a taxon not currently recognized (Crother [ed.] 2017. SSAR Herpetol. Circ. 43:1–103.). This animal was collected on 7 August 1932, 3.2 km east of Dark Hollow (Jackson County) and measured 141 mm SVL (Museum of Vertebrate Zoology, University of California, Berkeley [MVZ] 15130).

During a study of the Denman Wildlife Area, Jackson County, Oregon, USA at 0936 h on 17 May 2019, I detected a large *E. multicarinata* foraging in a patch of Mule's Ears (*Wyethia* sp.) on a sloping Oregon White Oak (*Quercus garryana*)-dominated woodland (42.46028°N, 122.88278°W; WGS 84; 381 m elev.). This lizard was a 148.0 mm SVL, 43.6 g, male (hemipenes everted), *E. multicarinata*, with a 92.5 mm tail (46.0 mm regenerated). I took dorsal and ventral photographs to verify its individual identification if recaptured (Fig. 1) and released it at the capture location.

Regionally, I have examined 157 *E. multicarinata*, of which 17 (including this animal) are in the largest length class (≥ 130.0 mm SVL). Excluding this animal, the remaining 16 individuals in this length class averaged 132.3 ± 2.0 mm (SD) SVL and 30.6 ± 4.5 g (SD) in mass. This makes the record 148.0 mm SVL animal over seven standard deviations greater than the mean length of the remaining individuals examined from Rogue-south Umpqua region of southwestern Oregon in this length class.

Uncertainty in *E. multicarinata* systematics in context of this record merits brief comment to avoid confusion with Fitch's (1938, *op. cit.*) subspecies *E. m. scincicauda*. The name Forest Alligator Lizard for *E. m. multicarinata* was applied due to lack of support for the taxon *E. m. scincicauda* and asymmetry among datasets for *E. multicarinata* populations (Crother et al. 2017, *op. cit.*; Leavitt 2017. Mol. Phylo. Evol. 110:104–121). Yet, within *E. multicarinata*, Leavitt's analyses (2017, *op. cit.*), which resolve much of the dataset asymmetry, unambiguously identify northern and southern taxa. Further, Leavitt (2017, *op. cit.*) assigned *E. multicarinata* from Benton County (Oregon) and much of northern California, which geographically brackets the location of this animal, to the northern taxon. I also recognize that several individuals of *E. multicarinata* up to 175 mm SVL exist (Van Denburgh 1922. Occ. Pap. Cal. Acad. Sci. 10:457; Fitch 1938, *op. cit.*; Mitchell 1961. Herpetologica 17:210–211), however, Leavitt's (2017, *op. cit.*) analyses place all these animals in the southern taxon. Hence, though populations within *E. multicarinata* lack formal recognition, I am confident the animal discussed here is a size record for both Leavitt's northern taxon and the state of Oregon.

Fig. 1. Dorsal (above) and ventral (below) views of a record-sized *Elgaria m. multicarinata* from Jackson County, Oregon, USA.

I thank C. Rombough for reviewing this note and the Oregon Department of Fish and Wildlife (ODFW) for supporting the citizen science-based field effort during which this work was done. The author is a subpermittee on ODFW Scientific Handling Permit #074-19.

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GEKKO JAPONICUS **(Schlegel's Japanese Gecko). DIET.** *Gekko japonicus* is a small-bodied, nocturnal lizard distributed in eastern China, South Korea, and Japan (Zhou et al. 1982. Acta Zootax. Sin. 7:438–446; Ota et al. 1989. J. Herpetol. 23:76–78). The food habits of *G. japonicus* are not well known but recorded prey includes small terrestrial invertebrates such as insects, spiders, and crustaceans (Ota and Tanaka 1996. The Encyclopedia of Animals in Japan 5, Amphibians, Reptiles, Chondrichthyes. Heibonsha, Tokyo, Japan. 69 pp.), as well as tree sap (Murai et al. 2013. Herpetol. Rev. 44:323–324). Terrestrial or freshwater snails are known dietary items of lizards including geckos (DeBoer et al. 2018. Caribb. Herpetol. 62:1–8), but to our knowledge, marine, intertidal snails have not been a widely reported lizard food item (Bauer and DeVaney 1987. Amphibia-Reptilia 8:349–364). Herein, we report a novel marine snail as a prey item in the diet of *G. japonicus*.

On 3 June 2018 at 1308 h, we collected a female *G. japonicus* (71.1 mm SVL, 38.0 mm tail length; retaining two eggs) from a rift of bedrock on the coast of Misaki-cho, Sennan-gun, Osaka Prefecture, Japan (34.3219°N, 135.1113°E; WGS 84; 0 m elev.). We placed the lizard in a plastic cage (11 × 10 × 15 cm) at the Osaka City Research Center of Environmental Science for a food preference experiment. In preparation for the experiment, the lizard was not fed for 2 d. On 8 June 2018, at 1500 h, we observed the lizard vigorously shaking its head from side to side and it expelled a

PHOTOS BY KOHSUKE AKITA

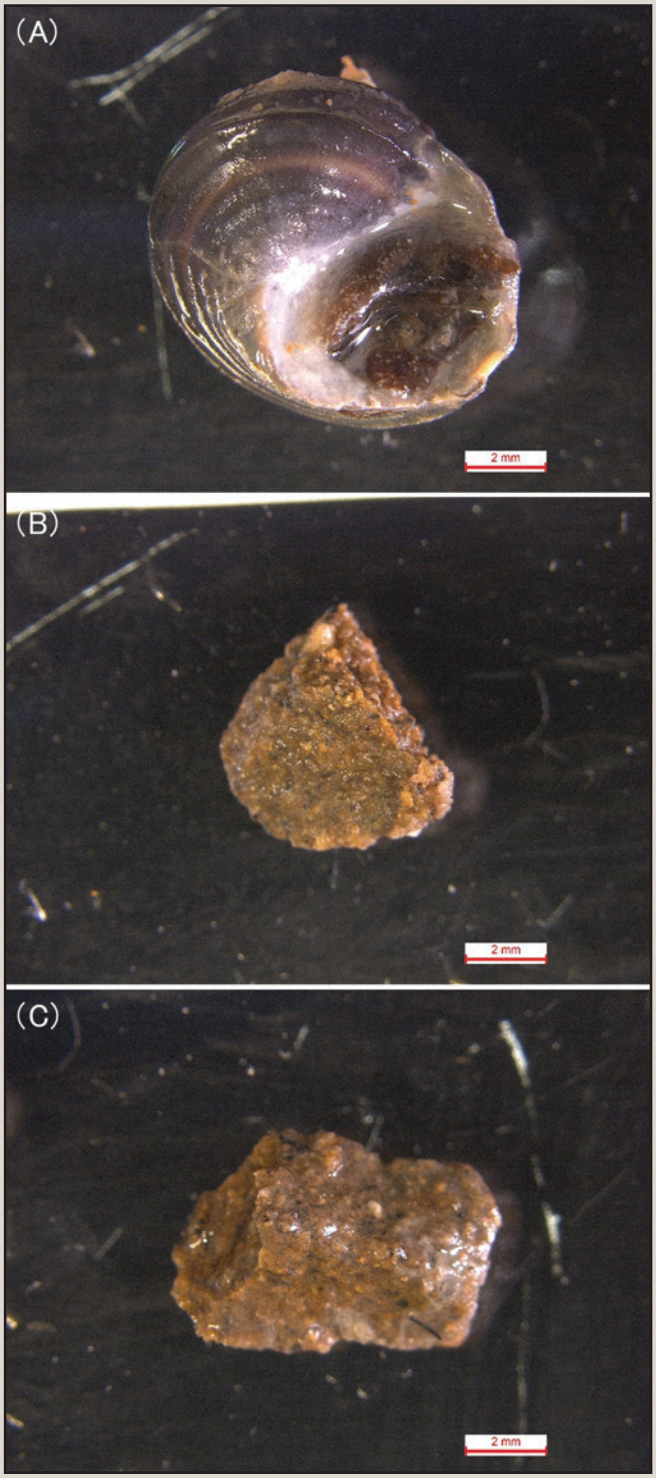

Fig. 1. *Littorina brevicula* (A) and pebbles (B, C) expelled by *Gekko japonicus.*

partially digested periwinkle, *Littorina brevicula* (6.8 mm shell height, 8.3 mm shell width; Fig. 1A), along with two pebbles (6.1 × 5.9 mm and 7.2 × 4.7 mm, respectively; Fig. 1B, C). The expelled pebbles seemed to be too large to ingest accidentally. The shell of the periwinkle was intact, but the operculum had been broken and the body of the marine mollusk had been partially digested.

To our knowledge, this is the first record of marine gastropod in the diet of a gecko and we report the first instance of geophagy, possibly to facilitate digestion of a hard-bodied prey item in *G. japonicus.* Coastal marine gastropods such as *L. brevicula* have thicker and more crack-resistant shells compared to freshwater and terrestrial snails (Vermeij 2015. Vita. Malacol. 13:1–25). The presence of the pebbles in *G. japonicus* may be functional instead of accidental. Lizard geophagy to aid digestion by macerating hard arthropod exoskeletons or plant matter has been documented in other lizards (Sokol 1971. J. Herpetol. 51:69–71; Sylber 1988. J. Herpetol. 22:413–424) but has not been reported in *G. japonicus.* We hypothesize that *G. japonicus* ingested the small pebbles to facilitate digestion including breakdown of the hard operculum of the *L. brevicula.* It is unclear how often *G. japonicus* feeds on *L. brevicula*, one of the most common gastropods in the supralittoral zone around Japan (Azuma and Chiba 2016. J. Moll. Stud. 82:259–267), and further work is needed to determine the frequency of this hard-bodied snail in its diet.

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GYMNOPHTHALMUS UNDERWOODI **(Underwood's Spectacled Tegu). PREDATION.** *Gymnophthalmus underwoodi* is a nonnative species first recorded in the Dominican Republic in 2010 in the Municipality of Higüey, La Altagracia (Scantlebury et al. 2010. IRCF Rept. Amphib. 17:180–181). Within its native range in South America, and on other Lesser Antillean Islands where it has spread, birds such as *Buteo magnirostris* (Voous 1969. Ardea 57:117–148), and other wild birds and chickens in Guadeloupe have been reported as predators (Breuil 2002. Histoire Naturelle des Amphibiens et Reptiles Terrestres de l'archipel Guadeloupéen. Patrimoines Naturels 54, Paris. 348 pp.). Here, I report on a predation event of an adult *G. underwoodi* by an adult *Mimus polyglottos* (Northern Mockingbird).

While birdwatching on 29 February 2020, at 1129 h, I observed an adult *M. polyglottos* in the Parque Mirador del Sur (18.43644°N, 69.97486°W; WGS 84) perched on the branch of a *Delonix regia* tree. Seconds later, the bird flew to the ground and gave chase to, and caught, a small shiny lizard. With the prey secure in its bill, the bird flew back to the tree, proceeded to smash it on the branch five or six times, and then swallowed the lizard. Once the lizard was consumed, the bird rubbed its beak on the branch and then flew to a nearby tree. While watching this entire event through my binoculars I was able to identify the lizard as a *G. underwoodi.* The whole sequence lasted for ca. 3 min.

Northern Mockingbirds have been reported to feed on small anoles (Farnsworth et al. 2020. *In* Poole [ed.], Birds of the World. Cornell Lab of Ornithology, Ithaca, New York), juvenile *Leiocephalus carinatus armouri* in Florida (Smith et al. 2006. Herpetol. Rev. 37:224) and other reptiles. While other bird species are known to prey on *G. underwoodi*, to my knowledge this is the first songbird reported to predate on it.

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HEMIDACTYLUS FRENATUS **(Common House Gecko). DIET.** Although *Hemidactylus frenatus* is native to Asia, it is widely introduced in southeast Asia, northern Australia, Madagascar, Mexico, Florida (USA), Central America, northern South

America, the Caribbean, and many Pacific islands (Kraus 2009. Alien Reptiles and Amphibians: A Scientific Compendium and Analysis. Springer Science and Business Media B.V., Dordrecht, Netherlands. 563 pp.). In Mexico, *H. frenatus* has become widespread and well established both natural and urban habitats (Valdez-Villavicencio and Peralta-García 2008. Acta Zool. Mex. 24:229–230; Farr 2011. Southwest. Nat. 56:265–273; Ramírez-Reyes et al. 2015. Rev. Mex. Biodivers. 86:541–545). *Hemidactylus frenatus* is a dietary generalist that feeds on invertebrates from at least 16 orders (Tyler 1961. Trans. Roy. Soc. S. Aust. 84:45–49; Brown et al. 2017. Herpetol. Rev. 48:645–646), and small vertebrates (Galina-Tessaro et al. 1999. Rev. Biol. Trop. 47:237–238; Díaz-Pérez et al. 2012. Acta Zool. Mex. 8:613–616). Despite their diverse diets, there are no records of *H. frenatus* feeding on centipedes (Scolopendridae), and herein we report the first observation of *H. frenatus* preying on a centipede from an urban area in Mexico.

On 8 February 2020, we captured and photographed an adult *H. frenatus* preying on a live Minor Blue Leg Centipede, *Rhysida longipes* (adult, not sexed; Fig. 1) in the garage of an author's house in Puerto Vallarta, Jalisco, Mexico (20.67656°N, 105.22476°W; WGS 84; 4 m elev.). We watched this predation event for 3 min and during this time the centipede writhed and wiggled, apparently trying to escape, but never appeared to try and bite the gecko. The gecko was not observed to swallow the centipede because the gecko moved somewhere else.

Centipedes are generally venomous (Lewis 1981. The Biology of Centipedes. Cambridge University Press, Cambridge, Massachusetts. 476 pp.) and can be a dangerous prey item for lizards, especially small ones (McCormick and Polis 1982. Biol. Rev. 57:29–58; Charles and Smith 2009. J. Trinidad Field Nat. Club 2009:42–43). *Rhysida longipes* is a widespread tropical species that can reach a length of 8 cm and probably has a neurotoxic venom that can inflict a painful bite to humans (Attems 1930. Das Tierreich 54:1–308; Undheim and King 2011. Toxicon 57:512–524; Kronmüller and Lewis. 2015. ZooKeys 510:269–278; Undheim et al. 2015. Toxins 7:679–704). There are few records of lizards preying on *R. longipes*, but we found one example from Florida, USA, by *Anolis sagrei* (Thawley 2017. Anole Annals. www.anoleannals.org/2017/12/09/when-a-meal-can-bite-back/; 9 April 2020).

PHOTOS BY ISMAEL E. HUERTA-DE LA BARRERA

Fig. 1. *Hemidactylus frenatus* preying on *Rhysida longipes* in Puerto Vallarta, Jalisco, Mexico.

We thank Marco A. López-Luna (DACBiol, Universidad Juárez Autónoma de Tabasco, México), and Tonatiuh Ramírez-Reyes (Facultad de Ciencias, Universidad Nacional Autónoma de México) for identifying the lizard.

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***HEMIDACTYLUS GIGANTEUS* (Giant Leaf-toed Gecko). SAUROPHAGY.** *Hemidactylus giganteus* is a large-bodied, uncommon gecko found throughout peninsular India (Giri et al. 2003. Hamadryad 27:217–221). Despite being widespread, only one prey taxon, winged termites, have been recorded in the diet of *H. giganteus* (Giri et al. 2003, *op. cit.*). However, Giri et al. (2003, *op. cit.*) remark that the diet of *H. giganteus* is probably fairly catholic in nature. Herein, we report an observation of *H. giganteus* feeding on a Common House Gecko (*Hemidactylus* cf. *frenatus*) in Karnataka, India.

At 1844 h on 1 March 2020, we observed an adult *H. giganteus* catch an adult *H.* cf. *frenatus* (Fig. 1) on the outer wall of the guard outpost building at the Namada Chilume Deer Park within the Devarayanadurga State Forest in Karnataka, India (13.36834°N, 77.19165°E; WGS 84; 867 m elev.). The *H. giganteus* held the midbody of the *H.* cf. *frenatus* in its mouth while the prey attempted to defend itself by biting at the mouth of the *H. giganteus*. Then the *H. giganteus* started vigorously shaking its head and thrashing its prey against the wall. After a few minutes, the *H.* cf. *frenatus* appeared to have been subdued and the *H. giganteus* began to ingest the lizard head-first. After 3 min, the *H. giganteus* moved into a small gap between the roof and the wall, with the posterior half of the prey still sticking out of its mouth, where it presumably finished swallowing the *H.* cf. *frenatus*. There are four *Hemidactylus* species in this area and we identified the prey species as *H.* cf. *frenatus* by its smooth dorsum, tubercled tail, and body coloration (Smith 1935. The Fauna of British India, including Ceylon and Burma. Reptilia and Amphibia. Vol. II-Sauria. Taylor and Francis, London, England. 440 pp.; Giri and Bauer 2008. Zootaxa 1700:21–34.). Saurophagy, and even cannibalism,

Fig. 1. *Hemidactylus giganteus* preying on *Hemidactylus* cf. *frenatus* in Karnataka, India.

has been well documented in *Hemidactylus* (Zamprogno and Teixeira 1998. Herpetol. Rev. 29:41–42; Pombal and Pombal 2010. Herpetol. Rev. 41:223–224), and to our knowledge this is the first report of saurophagy in *H. giganteus*.

We thank Varad B. Giri for confirming the identification of the geckos, and Somappa Vittal Ingu (Forest Guard, Karnataka Forest Department) for assisting us with the documentation of this observation.

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***HEMIPHYLLODACTYLUS TITIWANGSAENSIS* (Titiwangsa Slender Gecko). ENDOPARASITES.** *Hemiphyllodactylus titiwangsaensis* is restricted to the Malaysian state of Pahang where it is an upland, nocturnal, scansorial species (Grismer 2011. Lizards of Peninsular Malaysia, Singapore and their Adjacent Archipelagos. Edition Chimaira, Frankfurt am Main. 728 pp.). We know of no reports of helminths from *H. titiwangsaensis* and herein identify the first helminth for this lizard species.

Seven *H. titiwangsaensis* (mean SVL = 49.9 mm ± 4.3 SD; range: 43–55 mm) were collected in west Malaysia, Pahang State, Cameron Highlands (4.4721°N, 101.3801°E; WGS 84; 1114 m elev.), during 2005, 2011, 2012 and deposited in the herpetology collection of La Sierra University (LSUHC), Riverside, California, USA (LSUHC 7208, 7212, 7213, 9162, 10717, 10721, 10273). We examined this specimen series for helminths by removing the digestive tract through a mid-ventral incision and the contents of the esophagus, stomach, small and large intestines were searched for helminths utilizing a dissecting microscope. We found only female nematodes, nine in total, and only in the large intestines of two of the seven lizards (1 in LSUHC 10717, 8 in LSUHC 7212). Each nematode specimen was cleared in a drop of lactophenol on a glass microscope slide, a cover slip was added, then studied under a compound microscope for identification. We identified the helminths as *Pharyngodon oceanicus* after comparisons with the species description (Bursey and Goldberg 1999. J. Helm. Soc. Wash. 66:37–40). The voucher helminths were deposited in the Harold W. Manter Parasite Laboratory (HWML), University of Nebraska, Lincoln, USA as (HWML 111580).

Pharyngodon oceanicus has been found in *Gehyra oceanica* from Rarotonga, Cook Islands, Tahiti and Moorea, Society Islands, French Polynesia (Bursey and Goldberg 1999, *op. cit.*), Papua New Guinea (Goldberg et al. 2010. Pacific Sci. 64:131–139), *Eutropis* (as *Mabuya*) *cumingi* from the Philippines (Goldberg et al. 2005. Comp. Parasitol. 72:88–101), and in *Hemidactylus depressus* from Sri Lanka (Goldberg et al. 2011. Comp. Parasitol. 78:359–366). Here, we identified *H. titiwangsaensis* as a new lizard host for *P. oceanicus* and expanded the range of this helminth to West Malaysia.

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***IGUANA IGUANA* (Green Iguana). DIET and SCAVENGING.** It is known that wild *Iguana iguana* are mainly herbivorous (Van Devender 1982. *In* Burghardt and Rand [eds.], Iguanas of the World, pp. 162–163. Noyes Publishing, Park Ridge, New Jersey). However, there are records of occasional reports of iguanas consuming of insects (Savage 2002. The Amphibians and Reptiles of Costa Rica. University of Chicago Press, Chicago, Illinois, USA. 934 pp.), snails (Towsend et al. 2005. Southwest. Nat. 4:361–364), bird eggs (Schwartz and Henderson 1991. Amphibians and Reptiles of the West Indies: Descriptions, Distributions, and Natural History. University of Florida Press, Gainesville, Florida. 720 pp.), and mammal carrion (Loftin and Tyson 1965. Copeia 1965:515). Here we report on Green Iguana's feeding on bird carcasses at a Cattle Egret (*Bubulcus ibis*) rookery during the nesting season.

On 11 August 2018 we observed two adult female *I. iguana* approaching a communal egret nesting site within the Wildlife Conservation Management Unit (UMA-CICEA) of the Universidad Juárez Autónoma de Tabasco, in the city of Villahermosa, Tabasco, Mexico (17.99056°N, 92.97111°W; WGS 84; 15 m elev.). The rookery consisted of at least 12 visible egret nests, and one Green Heron (*Butorides virescens*) nest, but there were more we could not see. The visible nests had many chicks and fledglings and we observed numerous live and dead chick carcasses and remains on the ground. At 1120 h we observed the two *I. iguana* scavenging and consuming remains of Cattle Egret fledglings on the ground (Fig. 1). The two lizards were observed near each other, ca. 1 m apart, scavenging on separate carcasses and no agonistic interaction was observed. We observed the first iguana scavenge the leg, part of the breast, and a feathered wing of a fledging that for ca. 11 min. The iguana bit the carcass midbody and near the head and jerked the carcass side-to-side until one small pieces of flesh were removed. Once the piece of flesh was cut the carcass fell to the ground. This biting and jerking feeding behavior was repeated five times with breaks over several seconds. We observed the second iguana scavenge what appeared to be a femur and part of the breast for ca. 8 min in the same manner described above. After feeding on their respective carcasses each *I. iguana* left the area.

It is well known that many egret and heron chicks and fledglings fall from the nests at communal rookery sites, either accidentally or due to sibling rivalry (Mock 1987. Behav. Ecol. Sociobiol. 20:247–256). This phenomenon is known to attract opportunistic reptile scavengers such as *Alligator mississippiensis* (American Alligator; Gabel et al. 2019. Nature Sci. Rep. 9:14512)

Fig. 1. Adult *Iguana iguana* feeding on a fledging Cattle Egret (*Bubulcus ibis*) carcass at a rookery in Tabasco, Mexico.

and *Agkistrodon piscivorus* (Cottonmouth; Lillywhite et al. 2002. Herpetol. Rev. 33:259–261). To our knowledge this is the first report of opportunistic scavenging at a wading bird rookery by *I. iguana* and warrants further investigation to determine if this behavior is a more common occurrence.

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LEIOCEPHALUS CARINATUS **(Northern Curly-tailed Lizard). DIET.** *Leiocephalus carinatus* is an established exotic species in Florida, USA (Krysko et al. 2019. Amphibians and Reptiles of Florida. University Press of Florida, Gainesville, Florida. 728 pp.) and are opportunistic omnivores consuming flowers, seeds, fruits (Schwartz and Henderson 1991. Amphibians and Reptiles of the West Indies. University Press of Florida, Gainesville, Florida. 720 pp.) with a large portion of their diet consisting of arthropods (Schoener et al. 1982. Oecologia 53:160–169). They are also known to occasionally prey on lizards such as *Anolis sagrei* (Schoener et al. 2002. Ecol. Monogr. 72:383–407), *Agama picticauda* (Blais et al. 2019. Herpetol. Rev. 50:374), and smaller conspecifics (Dean et al. 2005. Herpetol. Rev. 36:451). Here, I present the first apparent record of *L. carinatus* preying on a snake in Florida.

On 7 July 2019, three citizen scientists (Kim Coates, Roger Griffin, Ramona Griffin), observed an adult *L. carinatus* consuming a young *Coluber constrictor* (North American Racer) in Palm Beach County, Florida, USA (26.46145°N, 80.05821°W; WSG 84; 4 m elev.). Their observation was made under a beach pavilion and it was unclear if the young snake was deceased and scavenged prior to consumption, or if the *L. carinatus* actively preyed upon the snake. *Leiocephalus carinatus* is an ambush-foraging predator (Cooper et al. 2005. Herpetologica 61:250–259), and to my knowledge scavenging has not been reported in this species. Therefore, this snake may have been actively hunted, and thus represents the first report of the non-native *L. carinatus* preying on a native snake in Florida. Photo vouchers of this event was submitted to the Florida Museum of Natural History (UF 190174, 190175).

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PHOTO BY RAMONA GRIFFIN

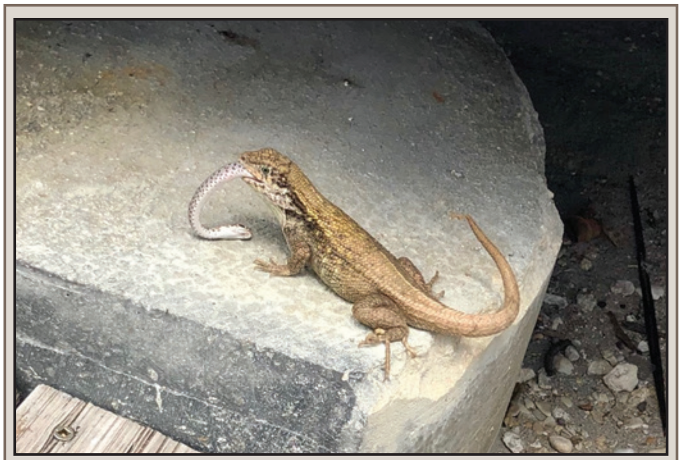

Fig. 1. *Leiocephalus carinatus* consuming a *Coluber constrictor* in Palm Beach County, Florida, USA.

LIOPHOLIS WHITII **(White's Skink). DIET.** *Liopholis whitii* is a medium-sized viviparous lizard that occurs in a wide range of habitat types in south-eastern Australia (Cogger 2014. Reptiles and Amphibians of Australia. 7th edition. CSIRO publishing, Collingwood, Victoria. 642 pp.). Skinks in the genus *Liopholis* are considered dietary generalists feeding mainly on invertebrates (Chapple 2003. Herpetol. Monogr. 17:145–180) and rarely on vertebrates (Brown 1991. Austr. J. Zool. 39:9–29). More speficially, *L. whitii* are considered insectivorous and feed on a large proportion of ants (Brown 1991, *op. cit.*). Here, we present a record of *L. whitii* preying on *Bassiana duperreyi* (Eastern Three-lined Skink).

On 24 December 2018, at 1545 h, we observed an adult *L. whitii* preying on sub-adult *B. duperreyi* on a rocky outcrop near to Cooma (36.44972°S, 149.18583°E; WGS 84; 960 m elev.), New South Wales, Australia. When first observed, the *L. whitii* grabbed and held on to the *B. duperreyi* near its vent for a few seconds. The *B. duperreyi* was then released and quickly grasped again, this time near to the neck, and the *L. whitii* entered a small hollow beneath rocky outcrop and was lost from view. To my knowledge this is the first record of usually insectivorous *L. whitii* predating a lizard.

Fig. 1. *Liopholis whitii* feeding on a sub-adult Eastern Three-lined Skink, *Bassiana duperreyi*, from New South Wales, Australia.

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LOXOPHOLIS SOUTHI **(Northern Rugose Lizard). PREDATION.** *Loxopholis southi* is a small (maximum total length of 103 mm) diurnal, leaf litter lizard ranging from up to 703 m elevation in eastern and southwestern Costa Rica to western Colombia (Savage 2002. The Amphibians and Reptiles of Costa Rica: a Herpetofauna between Two Continents, Between Two Seas. University of Chicago Press, Chicago, Illinois. 934 pp.). While a common species, little is known about their predators. Herein, I report on the predation of a *L. southi* by a spider in Costa Rica.

On 10 January 2019, at 2151 h, I observed a spider preying on a *L. southi* in the leaf litter on a trail in a private forest reserve in Tinamaste, San José, Costa Rica (9.29542°N, 83.77436°W; WGS 84; 673 m elev.). At the time of the observation the lizard was immobile and the spider's right fang penetrated the top of the lizard's skull behind the right eye, with a second puncture wound above same eye, indicting two bites (Fig. 1, 2). I observed this predation event for 10 min before moving on. Neither the spider

PHOTO BY ROEL DE PLECKER

Fig. 1. A wandering spider, *Kiekie curvipes*, predating on *Loxopholis southi* from San José, Costa Rica.

PHOTO BY ROEL DE PLECKER

Fig. 2. *Kiekie curvipes* predating on *Loxopholis southi*. The spider's right fang penetrates the lizard's skull behind the right eye, with a second puncture wound above the same eye.

nor lizard were collected as vouchers but both were identified from the photos. *Loxopholis southi* is the only lizard in the region with heavily keeled ventral scales (Fig. 1) and the spider was identified as *Kiekie curvipes* (Ctenidae), formerly of the genus *Ctenus* (Polotow and Brescovit 2018. Zootaxa. 4531:353–373). This spider species is an active hunter in the leaf litter, and like other ctenid spiders are well-known predators of small frogs and lizards (Folt and Lapinski 2017. Phyllomedusa 16:269–277; Maffei et al. 2010. Herpetol. Notes 3:167–170). To my knowledge this is the first report of predation of a spider on *L. southi*.

I thank Nicolas Hazzi for identifying the spider to the species level.

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***OPHISAURUS VENTRALIS* (Eastern Glass Lizard). HABITAT USE.** Burrowing crayfish and their burrows are common throughout the southeastern USA in intermittently wet habitats and terrestrial habitats with shallow water tables (Welch et al. 2008. Am. Midl. Nat. 159:378–384), and various invertebrates and vertebrates are known to use these burrows. For example, *Lithobates areolatus* (Crawfish Frog) exhibit nearly obligate use of crayfish burrows (Heemeyer et al. 2012. J. Wildl. Manage. 76:1081–1091), and some snakes use them as refuge from predators (e.g., *Nerodia rhombifera* [Diamond-backed Watersnake]; Kofron 1978. J. Herpetol. 12:543–554) or as hibernacula (e.g., *N. erythrogaster neglecta* [Copperbelly Watersnake]; Kingsbury and Coppola 2000. J. Herpetol. 34:294–298); however, we found no documentation of lizards using crayfish burrows. Herein, we report the first instance of the lizard *Ophisaurus ventralis* using crayfish burrows.

In January 2020, during intensive sampling designed to clarify several systematic questions about burrowing crayfish in the genera *Lacunicambarus* and *Creaserinus*, we sampled hundreds of crayfish burrows from western Florida to southeastern Louisiana, USA. We sampled burrows along stream banks, in wet forests, and in open environments, including mowed roadside swales and ditches, utility right-of-ways, prairies, pine savannas, and pitcher plant bogs. On 13 January 2020, we encountered an *O. ventralis* inside of a crayfish burrow in a mowed roadside ditch with a shallow water table in southeast Mississippi near the Alabama state line (30.4760°N, 88.4152°W; WGS 84; ca. 4.5 m elev.). No crayfish was found in the burrow containing the lizard, but we did not excavate the burrow further after the lizard emerged. The burrow entrance was open, with an estimated diameter of 3.0 cm, and had an old chimney that had been eroded by rain. After we excavated the burrow to ca. 10 cm deep, the lizard, which appeared to be a juvenile or small adult, emerged completely, and moved around in an agitated manner. After several seconds, the lizard put its head back into the burrow and became still, with much of his body remaining outside of the burrow, allowing us to easily capture it. We took photographs (https://www.inaturalist.org/observations/37929127; 13 Feb 2020) but did not measure the lizard.

To our knowledge this is the first documentation of a lizard species using crayfish burrows but considering the density of these burrows in the southeastern USA (Welch et al. 2008, *op cit.*), such behavior may be more widespread. Collections of burrowing crayfishes are sparser than those of surface-dwelling crayfishes. Because biologists excavate relatively few crayfish burrows, we have likely only scratched the surface of understanding the breadth of species using the burrows, whether opportunistically or consistently. Such understanding is useful in assessing the ecosystem services provided by burrowing crayfish and the potential importance of their burrows to herpetofaunal species.

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***SALVATOR MERIANAE* (Argentine Giant Tegu). DIET.** The teiid lizard *Salvator merianae* is widely distributed throughout South America occurring throughout much of Bolivia, Uruguay, Paraguay and northern Argentina, and almost all of Brazil. The species typically occupies open areas, but also forest fragments and altered vegetation near urban areas (Ávila-Pires 1995. Zool. Verh. 299:1–706). Its diet consists of a wide array of prey items including eggs of a variety of species, carrion, fish, amphibians, reptiles, birds and small rodents, as well as invertebrates and plant material of all kinds (Sazima and D'Angelo 2013. Herpetol. Notes 6:427–430). Here, we report field evidence of *S. merianae* feeding on *Ameiva ameiva* (Giant Ameiva).

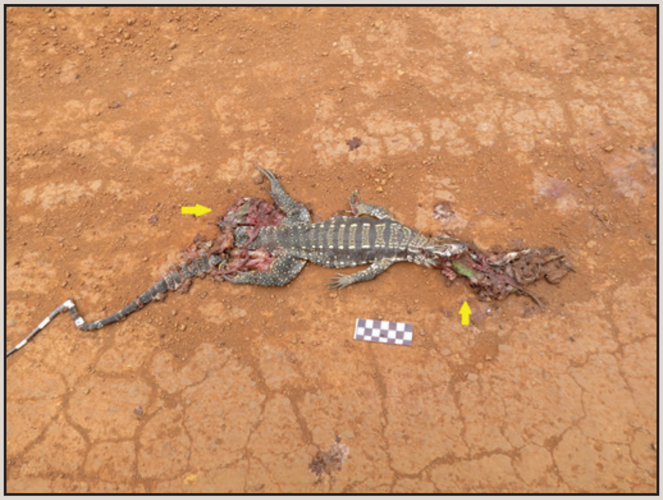

Fig. 1. Road killed *Salvator merianae* with expelled viscera, from Minas Gerais, Brazil. Yellow arrows point to the two *Ameiva ameiva* that had been recently consumed.

At 1328 h on 17 October 2018 we found a carcass of *S. merianae* in the middle of a dirt road in the District of Cocais, Barão de Cocais, Minas Gerais, Brazil (19.84005°N, 43.42445°W; WGS 84; 743 m elev.). It was apparent the carcass had been hit mid-body by a vehicle because its organs and stomach contents were expelled from the mouth and vent (Fig. 1). We found two adult *A. ameiva* in the expelled viscera and judging by their condition they had preyed upon recently. *Salvator meriane* is known to prey on lizards such as *Tropidurus hispidus* (Silva et al. 2013. Herpetol. Notes 6:51–53) and *T. torquatus* (Arruda et al. 2007. Ann. Com. Ecol. Bras. 8:1–2), and to our knowledge, this is first record of *S. merianae* preying on *A. ameiva*.

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***SCELOPORUS GRAMMICUS* (Mesquite Lizard). UNUSUAL GROUPING and MORTALITY.** On 16 October 2018, at least seven adult individuals (identified by counting skulls) of *Sceloporus grammicus* were found deceased within a rock crevice at 4160 m elev. in La Malinche National Park, Mexico (19.23711°N, 98.03408°W; WGS 84; Fig 1A). The rock crevice (Fig. 1B), which was 80 cm from the ground and on the west-facing slope, was 39 cm long, 1 cm wide, and ca. 19 cm deep (estimated volume of 768 cm^3). All dead individuals were found in the same rock crevice with their bodies in contact, along with four live individuals (three adult females and one adult male). The extraction of the bodies revealed an advanced state of decomposition, making it impossible to identify the sex of individuals; nevertheless, we identified them as adults by their snout–vent length. All dead lizards were removed. Two months later (11 December 2018), we found the dead body of an adult, along with five living individuals (three adult females and two adult males). The crevice was surrounded by volcanic rocky outcrops with a wide availability of potential shelters, none of which were occupied by individuals. Our first hypothesis was death by crushing, caused by a slight displacement of the rocks, however, we ruled out that possibility due to the repetitive death of individuals in the same place. Therefore, the most plausible hypothesis is death by freezing. At 4160 m elev. the environmental conditions (e.g., temperature, humidity, wind speed, solar radiation) are extremely hostile to these organisms. This observation is consistent with reports on aggregations of different species of *Sceloporus* in periods of cool temperatures (Weintraub 1968. Copeia 1968:708–712; Ruby 1977. Herpetologica 33:322–333). Grouping has been considered a strategy to reduce cooling rates (Myres and Eells 1968. Herpetologica 24:61–66; Aleksiuk 1977. Herpetologica 33:98–101; Rabosky et al. 2012. PLoS ONE 7:e40866). Therefore, it is likely that the grouping behavior, and the group death, observed in *S. grammicus* is influenced by cool temperatures and the extreme environment experienced at 4160 m elev.

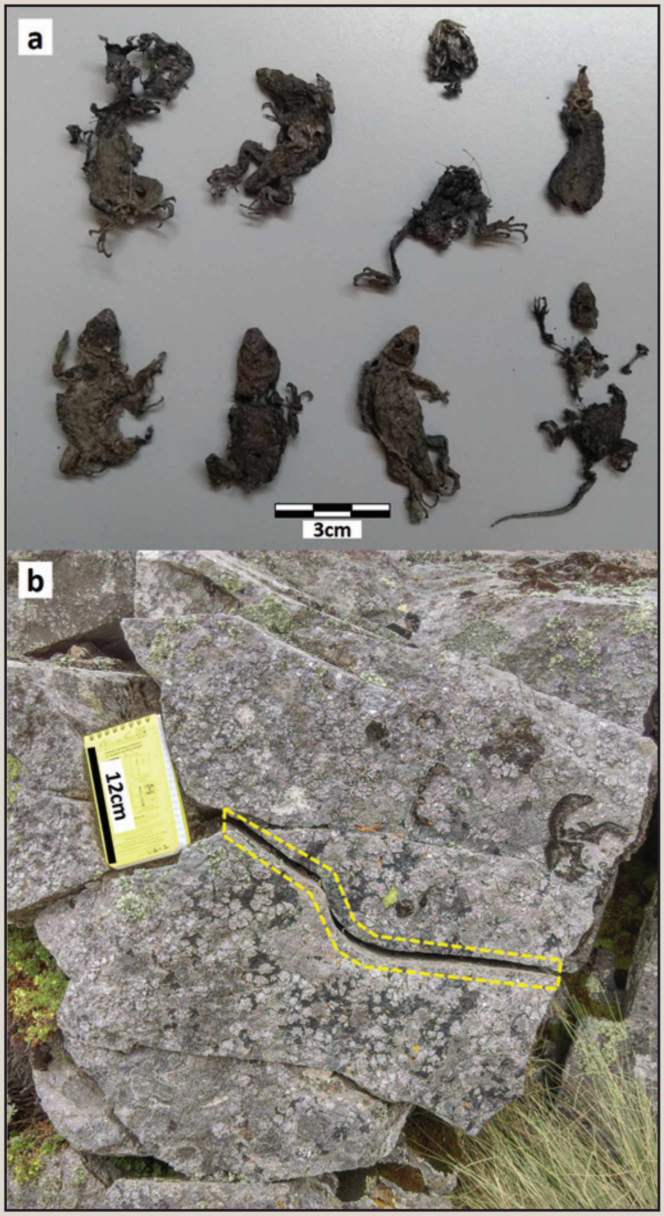

Fig. 1. A) Dead individuals of *Sceloporus grammicus* extracted from a crevice at 4160 m elev. in La Malinche National Park, Mexico; B) crevasse of volcanic rock.

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***SCINCOPUS FASCIATUS.* (Banded Skink). MATING BEHAVIOR.** The skink *Scincopus fasciatus* has a large geographical distribution across much of the African Sahel region from Mauritania to Sudan (Schleich et al. 1996. Amphibians and Reptiles of North Africa. Koeltz Scientific Publishers, Koenigstein, Germany. 627 pp.; Trape et al. 2012. Lézards, crocodiles et tortues d'Afrique occidentale et du Sahara. IRD Editions, Marseille. 503 pp.), with isolated populations in the northern Sahara Desert. The populations in Tunisia represent the species northern limit with only three known locations: the El Arad plain (south of Gabès; Olivier 1896. Rev. Sci. Bourb. Centre Fr. 15 août: 117–133), Tozeur (Schleich et al. 1996, *op cit.*), and the Hazoua oasis (Lanza and Corsi 1981. Monit. Zool. Ital. 14:17–29) and Souk Djedid (Nouira et al. 1999. Bull. Soc. Sci. Nat. Tunisie 27:121–130). *Scincopus fasciatus* is nocturnal and restricted to sandy soils covered with either shrubby natural vegetation (e.g., *Retama raetam*, *Ziziphus lotus*) or at the edges of cultivated areas in the hyperarid Saharan region. Because of its rarity and secretive nature little is known about the species' distribution, behavior, and reproductive biology (Schleich et al. 1996, *op. cit.*; Sindaco 1995. Boll. Mus. Reg. Sci. Nat. Torino 13:117–122). Herein, I report the first observations on the mating behavior of *S. fasciatus* from Bou Hedma National Park in southern Tunisia (34.47536°N, 9.64893°E; WGS 84; 105 m elev.) and note a new population.

On 8 May 2017 at 0030 h, I was accompanied by a night park ranger in search of nocturnal reptiles in Bou Hedma National Park where we observed a pair of adult *S. fasciatus* presumptively exhibiting copulation behavior on a sandy trail (Fig. 1). The surrounding habitat consisted of a loamy flat plain sparsely covered with low widely dispersed shrubs (*Rhanterium suaveolens*, *Haloxylon schmittianum*, and *Haloxylon scoparium*) interspersed with dry annual vegetation, about 15 m away from a dense stand of *Acacia tortilis*. We observed the two lizards biting each other near the neck and moving in a circle (Fig. 1), but we did not see vent-to-vent contact. Our observation lasted more than 3 min, but we do not know how long the lizards were engaged in this interaction. We photographed the pair at a distance of ca. 3 m, and after 3 min they separated and slowly moved away from each other to a distance of ca. 3 m apart on the sand to an open area on the sand, and did not retreat to the cover of nearby shrubs. The lizards did not seem affected by our presence because of how slowly they moved away and then rested in the open. It was after this that we stopped our observation. We infer this was a mating interaction and not agonistic behavior because we did not observe chasing or fighting—behaviors that are common in skinks (Cooper and Vitt 1987. Herpetologica 43:7–14). The type of neck biting we observed has been reported as a mating behavior in skinks of the genera *Plestiodon* (Pyron and Camp 2007. Amphibia-Reptilia 28:263–268) and *Sphenomorphus* (Done and Heatwole 1977. Copeia 1977:419–430), and we may not have observed the two *S. fasciatus* long enough to observe copulation (e.g., Goin 1957. Herpetologica 13:155–156).

This observation is important for three reasons. First, to my knowledge this is the first information on the mating behaviour of the *S. fasciatus* in its natural habitat and provides insights on their breeding phenology. The observation took place in late

Fig. 1. Putative courtship behavior between a pair of *Scincopus fasciatus* in Bou Hedma National Park, Tunisia.

spring, following the rainy winter season, suggesting breeding the species breeds just before the dry season, a pattern noted in other arid-adapted skinks (James and Shine 1985. Oecologia 67:464–474). Second, this is the first record of this rare species in Bou Hedma National Park increasing the total number of sites in Tunisia to four. Finally, to my knowledge, all previous observations of this secretive species have been of solitary individuals and this is the first observation of a pair interacting at the same time.

I thank all the people who accompanied me on nocturnal fieldtrips and park curators Lazhar Hamdi and Abdellatif Ben Ali for permitting me work in the park, as well as an anonymous referee who helped critically improve this paper.

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***THECADACTYLUS RAPICAUDA* (Turnip-tailed Gecko). DIET.** *Thecadactylus rapicauda* (Squamata: Gekkonidae) is a large Neotropical gecko distributed from southern Mexico to the northern Brazilian Amazon and found mostly in rainforest and forested areas in trees or on the forest floor (Ávila-Pires 1995. Zool. Verh. 299:1–706). The diet of *T. rapicauda* includes relatively large arthtopod prey (up to 42 mm) such as orthopterans, mantids, beetles, isopods, diplopods, and spiders (Vitt and Zani 1997. Herpetologica 53:165–179; Acosta-Chaves et al. 2015. Mesoam. Herpetol. 2:197–199). The ctenid spider *Phoneutria boliviensis* is a large bodied species found in similar habitats as *T. rapicauda* in Central and South America (Simó and Brescovit 2001. Bull. Br. Arachnol. Soc. 12:67–82; Hazzi 2014. J. Arachnol. 42:303–310). Here, we report predation by *T. rapicauda* upon *P. boliviensis*.

On 23 November 2019, at 2039 h, we observed an adult *T. rapicauda* ingesting a *P. boliviensis* in the Centro Rústico de Vivência, Tumucumaque Mountains National Park, Amapá, Brazil (1.1873°N, 52.3708°W; WGS 84; 99 m elev.). The lizard was already preying on the spider when we made our observation and do not know where the spider was captured. The gecko began to swallow the spider and held the head and thorax in its mouth for ca. 30 min. Spiders are known from the diet of *T. rapicauda*, but to our knowledge there is no information on species consumed (Vitt and Zani 1997, *op. cit.*), and this is the first recorded observation of *T. rapicauda* preying on *P. boliviensis*.

Fig. 1. *Thecadactylus rapicauda* preying upon *Phoneutria boliviensis* in the Centro Rústico de Vivência, Tumucumaque Mountains National Park, Amapá, Brazil.

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***TRACHYLEPIS ATLANTICA* (Noronha Skink). NECTIVORY and POLLINATION.** There are an increasing number of observations of lizard species visiting flowers and acting as pollinators, and this phenomenon seems to be most common on islands (Pérez-Mellado et al. 1997. Copeia. 3:593–595; Olesen and Valido 2003. Trends Ecol. Evol. 18:177–181). The skink *Trachylepis atlantica* is endemic and the most abundant lizard to the Fernando de Noronha Archipelago, located about 350 km from the northeastern Brazilian coast, and has previously been observed feeding and pollinating the leguminous Mulungu Tree (*Erythrina velutina*) on the main island of Fernando de Noronha (Sazima et al. 2005. Biota Neotrop. 5:185–192). Here, we report on *T. atlantica* visiting flowers of the Maniçoba Tree (*Manihot carthaginensis*: Euphorbiaceae) on Fernando de Noronha.

At 0702 h on 30 January 2020, we observed an adult *T. atlantica* feeding on flower nectar of *M. carthaginensis*, on a trail of near Sancho's Beach, Fernando de Noronha Archipelago, Brazil (3.85464°S, 32.44119°W; WGS 84). The Maniçoba Tree was introduced to the island from the mainland where it is native and widespread (Bachman et al. 2011. ZooKeys 150:117–126, Silva et al. 2011. Pesq. Agropec. Bras. 46:1082–1088). The lizard was observed on the apex of a branch, near some inflorescences, ca. 6 m above the ground (Fig. 1A). We watched the lizard approach one of the open flowers and put the head inside it, beginning the movement of deglutition of nectar. The feeding took almost 30 s (Fig. 1B). After feeding on the open flower, the lizard examined other flowers on the same branch, but these were not open yet. The lizard then climbed to higher flowering branches and this was when we lost sight of the lizard. Our entire observation lasted ca. 5 min. To the best of our knowledge, this is the first record of *T. atlantica* utilizing the nectar, and likely pollinating, the introduced *M. carthaginensis*. Rocha et al. (2009. J. Herpetol. 43:450–459) demonstrated *T. atlantica* is omnivorous, and feeds more on plant material than invertebrates, including nectar (Sazima et al. 2005, *op. cit.*). Nectar is easily digestible, and our observation showing *T. atlantica* feeding on the non-native

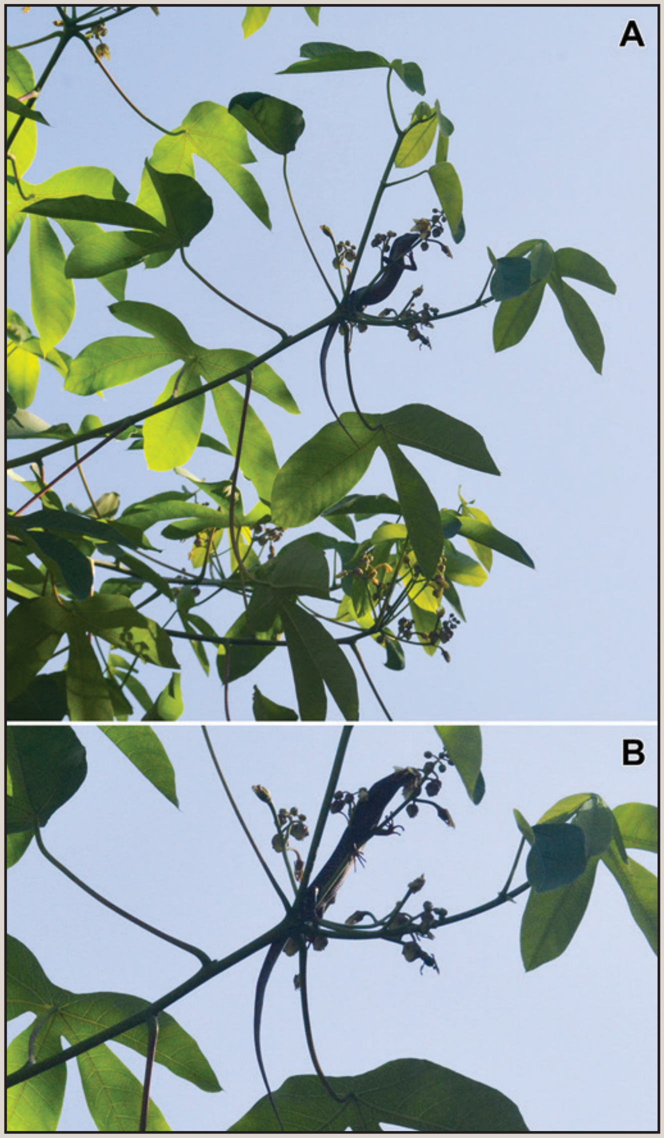

Fig. 1. A) *Trachylepis atlantica* visiting flower of *Manihot carthaginensis* in the Fernando de Noronha Archipelago, Brazil; B) zoomed image of the *T. atlantica* feeding on nectar of *M. carthaginensis*.

Maniçoba Tree suggests a generalized adaptation in the digestive tract of this lizard (Cooper and Vitt 2009. J. Zool. 257:487–517). The aforementioned information might explain why the endemic *T. atlantica* ingests nectar, and incidentally pollinate, an alien plant species.

We thank the project Diversidade de insetos com ênfase à região amazônica (FAPEAM/Protax. Process: 062.00645/2017) for research support; the ATDFN for authorization and the ICMBio for the logistical support. We thank the Capes-INPA research grant to A. M.S. Neto (Process: 88887.312051/ 2018-00), the CNPq research grant to DMDMM (Process: 141878/2018-5) and JAR (Process: 300.997/2016-7), and the FAPEAM for the Ph.D scholarship to JCO (002/2016 – POSGRAD 2017).

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***TROPIDURUS CATALANENSIS* (Calango; Collared Lizard). BONE DEFORMITY.** Lizards have different types of bone deformities (Gehring et al. 2010. Herpetol. Notes 3:321327; Banzato et al. 2013. Veterin. Rec. 173:4349; Mans and Braun 2014. Veterin. Clin. N. Am.: Exot. Anim. Pract. 17:369–395). On 12 March 2018 at 1205 h, we captured a *Tropidurus catalanensis* with severe abnormalities (Fig. 1) in the municipality of Osasco, São Paulo, Brazil (23.5423°S, 46.7602°W). The lizard had snout–vent length (SVL) of 69.22 mm and a body mass of 16.25 g. The SVL and the body mass were respectively smaller and greater than the averages for normal individuals in the population, and both were within the observed ranges. The head seemed to be abnormally sunken into the body, entering into the shoulders; the vertebral column was highly deformed from thorax to tail with lateral and vertical distortions of the spine, the trunk and the tail were undulated; limbs, fingers, and toes were kinked abnormally. Deformities of lizards may be genetic, congenital, hormonal, caused by unappropriated nutrition and/or exposure to inadequate environmental conditions (Billy 1986. Can. J. Zool. 64:2418–2424; Barten 1993. Veterin. Clin. N. Am.: Sm. Anim. Pract. 23:1213–1249; Mans and Braun 2014, *op. cit.*). Considering the level of the abnormalities, they seemed not induced by accidents or attacks. Osteological disorders affect locomotion (Barten 1996, *op. cit.*; Mendyk 2008. Biawak 2:72–79; Vega and Wefer 2016. Biawak 10:51–53), but the particular *T. catalanensis* observed was capable of moving well on horizontal and near horizontal surfaces. Reports of bone deformities in lizards of the genus *Tropidurus* include cases of tail bifurcation in *T. torquatus* (Martinelli and Bogan 2013. Hist. Nat. 3:93–97), *T.* gr. *torquatus* (Martins et al. 2013. Herpetol. Notes 6:369–371), and *T. semitaeniatus* (Passos et al. 2014. Herpetol. Rev. 45:138), but there has been no description of such significant bone malformations as reported here for *T. catalanensis*.

Fig. 1. Doral (A) and lateral (B) views of a *Tropidurus catalanensis* captured in São Paulo, Brazil with significant bone deformities.

We are grateful to the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) and the Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP; São Paulo Research Foundation) for grant to TMC and for financing the development of the research (process n° 2016/23599-3).

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***TROPIDURUS CATALANENSIS* (Calango; Collared lizard). CAUDAL AUTOPHAGY.** Caudal autotomy in lizards has costs resulting from loss of fat reserves for organismal functions and allocation of resources to regrow tails (Clause and Capaldi 2006. J. Exp. Zool. 305A:965–973; Bateman and Fleming 2009. J. Zool. 277:1–14; Higham et al. 2013. Physiol. Biochem. Zool. 86:603–610). To compensate for energetic and nutritional resources losses due caudal release and regeneration, lizards sometimes eat their detached tails in a demonstration of autophagy (consumption of own body parts; Judd 1955. Copeia 2:135–136; Bateman and Fleming 2009, *op. cit.*; Iglesias-Carrasco and Cabido 2016. Salamandra 52:215–216). We observed this behavior in a captive *Tropidurus catalanensis* (86.78 mm SVL, 19.5 g) in the Municipality of Osasco (23.5423°S, 46.7602°W), São Paulo, Brazil. On 5 February 2018, we noted the individual had dropped the distal portion of the tail. The lizard was housed alone apart from the crickets and beetle larvae provided as food and was not handled. Therefore, there was no obvious threat to its safety and no stimuli to caudal autotomy. On 7 February 2018, we noted that the lizard ate part of its detached tail and had completely eaten it by 9 February. Autophagy of released tails, a form of self-cannibalism, is documented for several species of lizards (Judd 1955, *op. cit.*; Bateman and Fleming 2009, *op. cit.*; Iglesias-Carrasco and Cabido 2016, *op. cit.*), but as far as we know, this is the first report for a *Tropidurus* species. However, the *T. catalanensis* did not eat satisfactorily despite being fed regularly, and lost weight in captivity (18.5 g on 12 February 2018). The lizard was found dead on 25 February 2018.

We are grateful to the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) and the Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP; São Paulo Research Foundation) for grant to TMC and for financing the research (process n° 2016/23599-3).

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***TROPIDURUS CATALANENSIS* (Calango; Collared Lizard). CLUTCH and EGG SIZE.** Females of *Tropidurus* lizards reproduce during different seasons in the year and have clutch sizes of 1–14 eggs (Ortiz et al. 2014. Can. J. Zool. 92:643–655). On 10 January 2018, we collected two *T. catalanensis* in the Municipality of Osasco, São Paulo, Brazil (23.5423°S, 46.7602°W), and maintained them in captivity inside individual plastic containers

Table 1. Length (mm), width (mm), and volume (mm^3) of each of nine eggs laid by two captive *Tropidurus catalanensis*. Individual refers to Lizard I or Lizard II (see text for explanation).

Individual	Length	Width	Volume
I	18.19	7.12	482.83
	17.32	7.48	507.40
	16.69	8.39	615.15
	18.88	8.18	661.47
	18.17	8.42	674.49
II	17.97	7.95	594.68
	19.78	7.54	588.80
	17.07	8.53	650.32
	17.69	8.20	622.81

within a climatic chamber programed with a photoperiod of 12 h dark at 17°C, 12 h light at 27°C, and a relative humidity of 70%. One lizard had snout–vent length (SVL) of 94.47 mm and body mass (BM) of 23.25 g (hereafter, Lizard I), and the another had SVL of 87.30 mm and BM of 19.50 g (hereafter, Lizard II). The SVL, BM, and clutch sizes of the two *T. catalanensis* were within ranges reported for reproductive females of the species (Arruda et al. 2019. South Am. J. Herpetol. 14:103–115). On 5 March 2018, we observed five eggs inside a hide within the container of Lizard I. On 3 April 2018, we noted four eggs on the bottom of the container of Lizard II. The eggs of both individuals had an ovoid-spheroid shape. Those of Lizard I were laid in a line, one after the other, and remained attached to the surface by the viscous substance. The eggs of the Lizard II seemed positioned randomly, perhaps because have been moved by the lizard after laid. Collectively, the eggs averaged 17.97 ± 0.95 mm length (range: 16.69–19.78; N = 9), 7.98 ± 0.49 mm width (range: 7.12–8.53; N = 9), and had a volume of 599.77 ± 66.21 mm^3 (range: 482.83–674.49; N = 9; Table 1). Unfortunately, none of the eggs hatched in captivity.

We are grateful to the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) and the Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP; São Paulo Research Foundation) for grant to TMC and for financing the development of the research (process n° 2016/23599-3).

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***TROPIDURUS JAGUARIBANUS* (Neotropical Lava Lizard). ENDOPARASITES.** *Tropidurus jaguaribanus* is an endemic lizard of northeast Brazil (Passos et al. 2011. Zootaxa 2930:60–68; Roberto et al. 2013. Herpetol. Rev. 44:627) and five species of endoparasites are known to parasitize this species: one species of cestoda (*Oochoristica travassosi*) and four species of nematode (*Parapharyngodon alvarengai*, *Physaloptera* sp., *Spauligodon* sp., and *Strongyluris oscari*; Alcantara et al. 2018. Phyllomedusa 17:195–210). Here, we present infection of a sixth species of endoparasite in *T. jaguaribanus*.

On 26 May 2014 we collected an adult male *T. jaguaribanus* (6.2 cm SVL) at the Estação Ecológica Aíuaba (ESEC Aíuaba) in the Municipality from Aíuaba, Ceará, northeastern Brazil (6.57361°S, 40.12361°W; WGS 84; 466 m elev.). The gastrointestinal tract was removed for desiccation and analysis of endoparasites using a stereomicroscope. The specimens of endoparasites found were counted and placed in glass flasks containing 70% alcohol. We found three individual nematodes identified as *Physaloptera lutzi* (Universidade Regional do Cariri [URCA] E1417) in the stomach of this lizard. We determined that the nematodes were male *P. lutzi* by the uneven chitinized spikes in shape and size, the longest being straight and the smallest slightly curved (Ramallo and Díaz 1998. Bol. Chil. Parasitol. 53:19–22). In the definitive host, nematodes in the genus *Physaloptera* are usually found strongly attached to the stomach lining and are sometimes attached to the mucous lining of the intestines of definitive hosts, and feed on blood (Ávila and Silva 2010. J. Venom. Anim. Toxins Trop. Dis. 16:543–572; Pereira et al. 2012. J. Parasitol. 98:6–10; Pereira et al. 2014. J. Parasitol. 100:221–227). *Physaloptera lutzi* has been found in 15 species of lizards, including four species of *Tropidurus* (Ávila and Silva 2010, *op. cit.*; Araujo Filho et al. 2017. J. Helminthol. 91:312–319; Lima et al. 2017. Biota Neotrop. 17:1–7; Teixeira et al. 2017. Brazil. J. Biol. 77. 312–317; Teixeira et al. 2018. Herpetol. Notes 11:799–804), and this is the first record of the nematode *P. lutzi* parasitizing *T. jaguaribanus*.

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SQUAMATA — SNAKES

***AGKISTRODON CONANTI* (Florida Cottonmouth). BURROW/HABITAT USE.** *Agkistrodon conanti* is a semi-aquatic venomous snake found throughout Florida and southern Alabama and Georgia, USA and often considered conspecific with *A. piscivorus*, which is found throughout the rest of the southeastern United States (Burbrink and Guiher 2015. Zool. J. Linn. Soc. 173:505–526). They inhabit semi-aquatic environments, although they willingly enter a variety of terrestrial habitats. Cottonmouths may be active throughout the day at any time of year but seek microhabitats the provide them with opportunities to regulate their body temperature. Hein et al. (2009. J. Alabama Acad. Sci. 80:35–44) documented *A. piscivorus* using the burrows of other animals to aid in thermoregulation and wintering, and they are known to use the burrows of crayfish, rodents, and Gopher Tortoises (*Gopherus polyphemus*; Gloyd and Conant 1990. Snakes of the *Agkistrodon* Complex: a Monographic Review. Society for the Study of Amphibians and Reptiles, Oxford, Ohio. 614 pp.). Here, we describe the observation of *A. conanti* using a *Dasypus novemcinctus* (Nine-banded Armadillo) burrow, which to our knowledge has not been previously documented in any literature.

At 1828 h on 8 May 2019, an adult *A. conanti* was documented emerging from an armadillo burrow via remote infrared camera (Bushnell®, Overland Park, Kansas, USA) on Little St. Simon's Island, Georgia, USA (Fig. 1). Cameras were positioned to capture photos and video of the commensal use

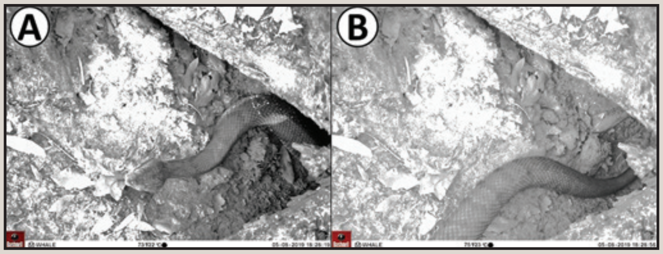

Fig. 1. An adult *Agkistrodon conanti* exiting an armadillo burrow on Little St. Simons Island Georgia, USA on 8 May 2019: A) *A. conanti* beginning to exit burrow at 1828 h; B) *A. conanti* finishing exiting the burrow with only tail visible.

of *D. novemcinctus* burrows by other taxa. The burrow occupied by the *A. conanti* was located in the maritime forest on the northwest end of the island (31.27522°N, 81.29669°W; WGS 84; 3.75 m elev.) and was ca. 94 m from the nearest aquatic habitat (tidal marsh). The burrow was 91 cm in length, 20 cm in width, and 20 cm in height, and was facing the northwest. When the *A. conanti* exited the burrow, the ambient temperature recorded by the camera was 22°C. The camera recorded four pictures and two 10-sec videos of the *A. conanti* emerging from the burrow, resulting in a total of 49 sec of documentation.

This observation is the first direct record of *A. conanti* using an armadillo burrow as a refugium. That the *A. conanti* was not recorded entering the burrow may have been due to a low body temperature that was insufficient to trigger the infrared camera (Welbourne et al. 2017 Remote Sensing in Ecol. Conserv. 3:133–145), which may have increased while inside the burrow. Armadillo burrows are used as refugia by other snake species, including *Crotalus adamanteus* (Eastern Diamond-backed Rattlesnakes; Means 2017. Diamonds in the Rough: Natural History of the Eastern Diamondback Rattlesnake. Tall Timber Press, Tallahassee, Florida. 390 pp.) and *Lampropeltis getula* (Eastern Kingsnakes; Steen et al. 2010. Copeia 2010:227–231). Armadillo burrows may function as important refugia for various snake species, especially on barrier islands where no other medium-sized burrowing animals are present.

We thank Little St. Simons Island for granting us permission to conduct research on the island. Support for this research was provided by the John Spencer Fellowship from the River Basin Center at the University of Georgia, American Wildlife Conservation Foundation, The Explorers Club Exploration Fund Grant, Theodore Roosevelt Memorial Fund of the American Museum of Natural History, and the American Society of Mammologists' Grant-in-Aid of Research.

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AMBLYODIPSAS CONCOLOR **(KwaZulu-Natal; Purple-glossed Snake). DEFENSIVE BEHAVIOR/DEATH-FEIGNING.** *Amblyodipsas concolor* is a little known and secretive snake, belonging to the subfamily Atractaspidinae. On 19 February 2019, an adult female *A. concolor* was found crossing a tar road just outside Pilgrim's Rest, Mpumalanga Province, South Africa (24.87983°S, 30.72923°E; WGS 84; 1402 m elev.), late in the evening. The snake was moved to the side of the road using a long pair of forceps and photographed. On initial contact, the snake released a very pungent smell from the cloaca which lasted for several minutes and it thrashed around vigorously, trying to get away. This behaviour had previously been documented (Boycott 2009. African Herp News 48:20–21). While the specimen was being photographed, it suddenly rolled over completely, lying motionless on its back for several minutes before starting to move again. During the entire photography session, this behaviour was observed numerous times. The snake was identified based on the following characteristics, which fits the description of *A. concolor* (Broadley 1990. FitzSimons' Snakes of Southern Africa. Jonathan Ball and AD Donker Publishers, Parklands, South Africa. 387 pp.): total length 508 (444 + 64) mm; preoculars 0; postoculars 1; temporals 0 + 1 + 1; upper labials 7, the 3rd and 4th entering the orbit; lower labials 7, the first 4 in contact with the anterior chin shields; dorsal scales in 17 rows at midbody; 153 ventrals; anal divided; 31 subcaudals which are paired.

This behavior is the first of its kind recorded in any species of *Amblyodipsas*. Death-feigning behavior, or thanatosis, more recently defined as tonic immobility (Humphreys and Ruxton 2018. Behav. Ecol. Sociobiol. 72:22), is thought to be an anti-predator strategy to inhibit further attack by a predator. Prior to this observation, 13 species of snakes occurring in southern and eastern Africa had been known to feign death (Bates and Nutall 2013. African Herp News 60:5–9; Bates and Boshoff 2018. African Herp News 67:19).

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BOA IMPERATOR **(Central American Boa). DIET and MORTALITY.** *Boa imperator* is a large boid (total length to 340 cm) that occurs from southern Mexico through Central America and into northwestern Colombia (Suárez-Atilano et al. 2014. J. Biogeogr. 41:2371–2384; Card et al. 2016. Mol. Phylogenet. Evol. 102:104–116). The diet of this species is composed of small and medium-sized vertebrates, including iguanas and other lizards, birds, and mammals such as rats, opossums, agoutis, coatis, ocelots, and young deer (Heimes 2016. Herpetofauna Mexicana Vol. I. Snakes of Mexico. Edition Chimaira. Frankfurt am Main. 572 pp.).

At 0830 h on 22 October 2019, we found a juvenile *B. imperator* (23.8 cm SVL, mass without prey = 42 g) dead in the community of Centenario, Municipality of Escarcega, Campeche, Mexico (18.64668°N, 90.29197°W; WGS 84). The snake did not have any external wounds that would indicate a cause of death and had an obvious (bulging) large prey item in its stomach. We conducted an autopsy, which revealed that the prey was an adult Baltimore Oriole (*Icterus galbula*; 35 g; Fig. 1). The body mass of the prey was equivalent to the 83.3% of the body mass of the snake. The size of the prey may have caused an obstruction of the stomach, and evident perforations in the stomach wall may have been caused by the bill of the bird. Because the dead specimen was found early in the morning, is possible that the *B. imperator* captured the bird while it was sleeping.

Snake mortality while consuming prey can result from the ingestion of toxins (Rhind and Steer 2016. Herpetol. Rev. 47:308–309; Kojima 2017. Herpetol. Rev. 48:211), asphyxiation (De Sousa Germano and Franca 2017. Herpetol. Rev. 48:452; Patel et al. 2017. Herpetol. Rev. 48:869; Adams and Childress 2018. Herpetol. Rev. 49:765) from attempting to eat too large a meal (Christman et al. 2016. Herpetol. Rev. 47:477; Domínguez-Godoy et al. 2017. Mesoam. Herpetol. 4:426–428), or due to a decrease in locomotion ability (Madrid and Cifuentes 2012. Bol. Asoc.

Fig. 1. The result of the necropsy of the juvenile *Boa imperator* from Campeche, Mexico, showing an *Icterus galbula* weighing 83% the mass of the snake in the stomach.

Herpetol. Esp. 23:34–36). It has been reported that young snakes sometimes catch and eat prey much larger than the maximum size they can safely ingest, perhaps due to their lack of experience (Sazima and Martins 1990. Mem. Inst. Butantan 52:73–79). We suggest that this may have been the case in our observation. To our knowledge, this is the first record of *I. galbula* in the diet of *B. imperator*, and the first report of incidental mortality from ingesting large prey for this snake species.

We thank E. Acosta for his help in identifying the bird.

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***BOTHROPS JARARACUSSU* (Jararacussu; Jararacuçu). DIET.** *Bothrops jararacussu* is distributed along the Brazilian states of Bahia and Rio Grande do Sul (Freitas 2003. Serpentes Brasileiras. Malha-de-Sapo-Publicações, Lauro de Freitas, Bahia, Brazil. 160 pp.; Bernarde 2014. Serpentes Peçonhentas e Acidentes Ofídicos no Brasil. Anolis Books Editora, Curitiba, Brazil. 223 pp.). These snakes prey mainly on mammals, snakes, lizards, and anurans (e.g., Marques et al. 2004. Herpetol. Rev. 35:58; Marques and Sazima 2004. *In* Marques and Duleba [eds.], História Natural dos Répteis da Estação Ecológica Juréia-Itatins, pp. 257277. Estação Ecológica Juréia-Itatins. Ambiente físico, flora e fauna. Holos editora; Hartmann et al. 2009. Pap. Avul. Zool. 49:343360). *Crossodactylus gaudichaudii* is a species distributed in the Brazilian states of São Paulo and Rio de Janeiro (Heyer et al. 1990. Arq. Zool. 31:231410; Rocha et al. 2004. Pub. Avul. Mus. Nac. 104:323). Tadpoles of these anurans are eaten by freshwater crabs *Trichodactylus petropolitanus* (Motta-Tavares et al. 2015. Herpetol. Rev. 46:7374) and adults are preyed upon by snakes *Thamnodynastes* cf. *nattereri* (Dorigo et al. 2014. Herpetol. Notes 7:261264). Here, we report a predator-prey relationship involving *C. gaudichaudii* and *B. jararacussu*.

On 13 November 2013, TAD and LS captured an adult *C. gaudichaudii* in the Parque Nacional da Floresta da Tijuca, Municipality of Rio de Janeiro, Rio de Janeiro, Brazil (22.946°S, 43.275°W; ca. 600 m elev.). At 1545 h, next to a stream, they released the individual on the leaf litter of the forest floor. Shortly after liberation, the *C. gaudichaudii* was attacked by a juvenile *B. jararacussu* that was hidden in a burrow nearby (Fig. 1). The frog was not intentionally offered to the snake; in fact, the snake was only noted after the attack. The snake bit and held the frog in its mouth and after ca. 30 min completely ingested it head-first. Adult *B. jararacussu* have a diet comprised mainly of mammals, whereas, as supported by our find, juveniles eat predominantly ectotherms (Marques et al. 2004, *op. cit.*; Marques and Sazima 2004, *op. cit.*; Hartmann et al. 2009, *op. cit.*).

Fig. 1. *Bothrops jararacussu* preying upon a *Crossodactylus gaudichaudii* in Rio de Janeiro, Brazil.

We are grateful to the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) for grants to CFDR (processes nº 304791/2010-5 and nº 472287/2012-5), to the Fundação Carlos Chagas Filho de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ) for support to CFDR through Programa Cientistas do Nosso Estado (process nº E-26/102.765/2012) and to the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) and FAPERJ (Process nº E-26/100.524/2014) for grants to TMC.

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***BOTHROPS LEUCURUS* (Whitetail Lancehead). DIET.** *Bothrops leucurus* is terrestrial, crepuscular viperid found in the Caatinga and Atlantic Forest in eastern Brazil, from Ceará in the north to Espírito Santo in the south (http://www.reptiledatabase.org; 1 Feb 2020). Like most vipers, this species undergoes a striking ontogenetic shift in diet, with juveniles feeding predominantly on ectothermic animals (including amphibians and reptiles, as well as occasionally fish; Freitas and Loebmann 2010. Herpetol. Rev. 41:34), and adults feeding largely on endotherms, such as primates and rodents, but also other snakes (Bernarde 2012. Anfíbios e Répteis: introdução ao estudo da herpetofauna brasileira. Anolis Books, Curitiba, Brazil. 320 pp.; Castro and Oliveira 2017. Herpetol. Rev. 48:445–446; Silva et al. 2015. Herpetol. Rev. 46:637). *Leptodactylus troglodytes* (Brazilian Sibilator Frog) is restricted the Caatinga and Atlantic Forest of northeastern Brazil, north of Minas Gerais (http://research.amnh.org; 1 Feb 2020). They are

Fig. 1. *Bothrops leucurus* with a freshly ingested *Leptodactylus troglodytes* in the stomach (MUFAL 15963): A) prey partially in the stomach; B, C) *B. leucurus* and *L. troglodytes* in dorsal view, respectively. Scale bar = 1 cm.

normally found on the ground in areas with herbaceous vegetation and flooded natural and urbanized areas (Kokubum et al. 2009. Herpetol. J. 19:119–126). Here, we describe the first record of *B. leucurus* preying upon *L. troglodytes*.

At 0600 h on 32 August 2019, we captured a subadult *B. leucurus* (MUFAL 15963: 300.05 mm SVL, 13.27 mm head width; Fig. 1A, B) on the ground at the margins of a forest remnant between the edge of the forest and a monoculture of Sugar Cane (*Saccharum officinarum*) in Cariri da Prensa Farm, Municipality of Boca da Mata, Alagoas, Brazil (9.69051°S, 36.20070°W; WGS 84; 94 m elev.; SISBio/ICMBIO 54413-4). After collection, the specimen was euthanized with 2% lidocaine, fixed in 10% formalin, and preserved in 70% ethanol. We dissected the specimen and found a well-preserved adult female *L. troglodytes* (MUFAL 15963 [stomach contents]: 51.38 mm SVL; 16.38 mm head width; Fig. 1A, C), which was later incorporated into the Coleção Herpetológica do Museu de História Natural da Universidade Federal de Alagoas (MUFAL). This observation corroborates the batracophagous habits of juvenile vipers (Bernarde 2012, *op. cit.*) and the high SVL (1/6) and HW (0.8/1) ratio underscores the large size of prey that are sometimes consumed.

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***BUNGARUS CAERULEUS* (Common Krait). LEUCISM.** *Bungarus caeruleus* is a nocturnal venomous snake that feeds mainly on other snakes and is known to be cannibalistic (Parmar and Tank 2019. Rept. Amphib. 26:21–34). The body is glossy black or bluish or brownish black above with paired white cross bands, which are usually absent on fore body or are substituted by white vertebral spots, the ventral scales are white in color and the vertebral scales are hexagonal (Smith 1943. The Fauna of British India, Including Ceylon and Burma. Reptilia and Amphibia. Vol III-Serpentes. Taylor and Francis, London, England. 526 pp.; Das 2003. J. Bombay Nat. Hist. Soc. 100:446–501). Herein, we reported first record of leucism in *B. caerulesus* from Goa, India.

Fig. 1. Leucistic *Bungarus caeruleus* from Goa, India.

Recently, we came across a dead leucistic specimen of *B. cearuleus* (Fig. 1). The individual (Bombay Natural History Society Museum [BNHS] 3576: 129.7 cm total length; 115.2 cm SVL, 340 g) was white with black eyes and lacked any other pigmentation on the body. The individual was encountered on 9 December 2018 at ca. 2030 h at Porvorim, Goa, India (15.4903°N, 73.8108°E; WGS 84). The snake was identified as *B. ceareleus* with the help of keys (Daniel 1983. The Book of Indian Reptiles. Oxford University Press, Bombay, India. 141 pp.; Whitaker and Captain 2008. Snakes of India, The Field Guide. Draco Books, Chennai, India. 469 pp.). Specifically, the specimen exhibited dorsal scales 15:15:15; preoculars 1; postoculars 2; temporals 1 + 2; supralabials 7; 3rd and 4th supralabials in contact with eye; loreal absent; anal plate undivided; subcaudals entire; ventrals 213; subcaudals 41. The individual encountered had normal black eyes and a blackish top of the snout and head.

A complete albino *B. caeruleus* was rescued on 8 October 2009 by Sandesh Amonkar, a member Animal Rescue Squad at Ponda (15.4909°N, 73.8278°E; WGS 84), Goa, India. The individual rescued from Ponda lacked any pigment and had red eyes), while the individual described in the present study is leucistic (lacking body pigment but with black or blue eyes). Leucism in snakes is uncommon, but may be more commonly recorded in nocturnal, crepuscular, or burrowing species that are less vulnerable to visual predators.

We thank A. Captian, V. Giri, T. Jhadav, A. Singh, G. Tambre and V. Patel for their logistic support.

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***CHILABOTHRUS CHRYSOGASTER CHRYSOGASTER* (Turks Island Boa). DIET.** *Chilabothrus chrysogaster chrysogaster* consumes a variety of small- to medium-sized endothermic and ectothermic prey (Reynolds and Gerber 2012. J. Herpetol. 46:578–586). On small islands, adults and juveniles are largely saurophagous (Reynolds and Niemiller 2011. Herpetol. Rev. 42:290) and are known to prey on four of the six native lizard species found on the Caicos Bank, plus the introduced *Hemidactylus*

PHOTO BY GIULIANO COLOSIMO

FIG. 1. Food bolus from *Chilabothrus chrysogaster chrysogaster* containing an adult *Hemidactlyus maboiua*, an introduced species, and an adult *Sphaerodactylus caicosensis*, a native species, on the right beneath the tail of the *Hemidactylus*.

maboiua (Reynolds et al. 2017. Herpetol. Rev. 48:857). We have observed direct predation on the following native lizard species: *Leiocephalus psammodromus*, *Cyclura carinata*, *Anolis scriptus*, and *Aristelliger hechti*. We have yet to document *C. chrysogaster* using the skink *Spondylurus caicosensis* or the dwarf gecko *Sphaerodactylus caicosensis* as prey. The skink is cryptic and exists at low-density throughout its range, while the dwarf gecko is locally abundant and widespread and thus would seem to represent a profitable food source for smaller boas.

At 1918 h on 8 March 2020 we captured a young adult female *C. c. chrysogaster* (512 mm SVL; 26 g). The animal subsequently regurgitated a food bolus containing two nearly-intact gecko carcasses (Fig. 1). One was an introduced *H. maboiua* (ca. 40–45 mm SVL), previously reported as a novel food item for this species (Reynolds et al. 2017, *op. cit.*), the other was an adult female *Sphaerodactylus caicosensis* (30 mm SVL), a species not previously documented as a prey item. *Sphaeroactylus caicosensis* are common on the island and found among the many rock piles that *C. chrysogaster* occupies, hence it is likely (and was long suspected) that this species serves as an important food resource for younger *C. chrysogaste*r.

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***CLONOPHIS KIRTLANDII* (Kirtland's Snake). ACTIVITY.** *Clonophis kirtlandii* is a small, semi-aquatic, fossorial natricine snake found in the midwestern United States. Little is known about its natural history due to its cryptic habits. *Clonophis kirtlandii* inhabits grassy areas adjacent to ponds, creeks, and ditches (Bavetz 1994. Trans. Illinois State Acad. Sci. 87:151–163). Its diet consists mostly of soft-bodied invertebrates (Minton 2001. Amphibians and Reptiles of Indiana. Indiana University Press, Indianapolis, Indiana. 404 pp.). *Clonophis kirtlandii* are known to hibernate in crayfish burrows from October to late March (Felbaum et al. 1995. Endangered and Threatened Species of Pennsylvania. Wild Resource Conservation Fund, Harrisburg, Pennsylvania. 80 pp.). In some states they have been observed in all months but are most active in March–April and October (Minton 2001, *op. cit.*). Conant (1943. Am. Midl. Nat. 29:313–341) stated that "specimens have been collected in every month except December" but that they are "apt to be found on mild days, even in midwinter… coated with mud and still sluggish from the cold." Two specimens (National Museum of Natural History, Smithsonian Institution [USNM] 33845, 33846) were collected 19 December 1902 in Grant County, Indiana, USA and one (Illinois Natural History Survey [INHS] 10609) was collected 19 December 1978 in Fulton County, Illinois, USA.

At 1300 h on 26 December 2019, near the Killdeer Plains Wildlife area, in Harpster, Ohio, USA (40.71737°N, 83.35512°W; WGS 84), MA observed a juvenile *C. kirtlandii* on the edge of a recently disturbed field adjacent to a cleared pathway where the vegetation was cleared down to the substrate. It appeared that the snake had dried substrate on its body from the moist ground, which created a contrast against the vegetation, making the snake easier to spot. Upon approach the snake remained still, which allowed for some images to be taken, before it moved off into denser vegetation. The observation was made under a mostly overcast sky with a temperature of 15°C (60°F). No morphometric data were collected. This is an unusual time of year to observe this species in Ohio.

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***CORALLUS HORTULANA* (Suaçuboia). MALE COMBAT.** In some snake lineages, confrontations between conspecific males at certain times of the year can result in physical fights, termed male combat, for priority-of-access to females or other resources (Shine 1978. Oecologia 33:269–278; Shine et al. 2000. Anim. Behav. 59:4–11). In general, these behaviors begin with intimidating postures, such as arching the body, which can accompany physical combat. Males of some species assume subtle aggressive behaviors, in which individuals keep part of their bodies intertwined in a horizontal position; most of the time they push the adversary in an attempt to take down the opponent when they are in a vertical position (Carpenter et al. 1978. Herpetologica 34:207–212). Combat in nonvenomous species, including pythonids, can include biting (Shine 1994. Copeia 1994:326–346). Larger males are often successful in combat events (Andren 1986. Amphibia-Reptilia 7:353–383) and may gain priority access to females (Madsen and Shine 1993. Am. Nat. 141:167–171).

Corallus hortulana is a species of arboreal boid that is widely distributed in northern South America. It is slender, laterally-flattened, and exhibits great variation in coloration, including shades of orange, red, yellow, beige, gray and brown. On average, females are larger than males (Castro et al. 2016. Répteis da Restinga do Parque Estadual Paula César Vinha. First edition. Centro Universitário São Camilo, Guarapari, Brazil. 95 pp.). Here, we report an instance of apparent male combat in *C. hortulana*.

On 25 October 2019, at 0630 h, in the Parque Estadual de Dois Irmãos, Recife, Pernambuco, Brazil (8.125°S, 34.875°W; WGS 84; 28 m elev.), two adult male *C. hortulana* were found in combat. The individuals were intertwined and perched in a tree ca. 180 cm above the ground. Approximately 10 min later, they fell from the branch to the ground, but remained entwined until 1520 h (Fig. 1A); immediately after separating, they were captured. Male 1 (163.6 cm SVL, 32.5 cm tail length, 820 g) was likely a resident; it had been captured and recaptured three times in the same

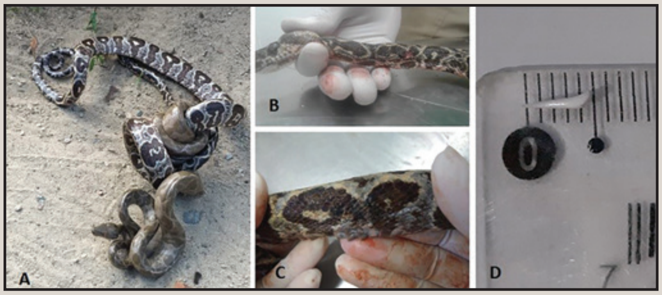

PHOTO BY LABORATÓRIO INTERDISCIPLINAR DE ANFÍBIOS E RÉPTEIS/UFRPE

Fig. 1. Apparent male combat in *Corallus hortulana* (A), evidence of injuries caused during combat (B, C), and teeth removed from the body of one of the males (D).

area, marked by scale clipping and microchipping. Male 2 (157.7 cm SVL, 33.0 cm tail length, 470 g) bit Male 1, which attempted to escape unsuccessfully, however Male 1 was still able to expel Male 2. During handling, we noticed that there was a tooth (0.53 cm) embedded between the ventral scales 42 and 43 of Male 1. The animal also had callus in the dorsal region on the right side close to scales 42 and 43 and scratches (Fig. 1 B–D), probably inflicted in other combats.

The animals presented a combat pattern similar to other arboreal boids (Carpenter et al. 1978. Herpetologica 34:207–212; Osborne 1984. Herpetol. Rev. 15:50), with the posterior region of the body intertwined. The behavior of biting the rival in male combat has also been described in boids (Shine 1994. Copeia 1994:326–346). Although male-male aggression has been observed in other *Corallus* species under captive conditions (*C. caninus*; Obsorne 1984. Herpetol. Rev. 15:50), to our knowledge biting in combat rituals is unprecedented in the natural history of *C. hortulana*. Male combat is seldom observed in nature and further natural history studies are needed to fully understand male combat behaviors and their roles in the biology of *Corallus*.

We are grateful to CNPq for funding, the management of the Parque Estadual de Dois Irmãos for the authorization granted, to the Programa de Pesquisa em Biodiversidade - Mata Atlântica (PPBio- Mata Atlântica) and to Sisbio for license no. 11218-1.

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***CORONELLA AUSTRIACA* (Smooth Snake). DIET/CANNIBALISM.** *Coronella austriaca* is known to exhibit cannibalism, but cases reported in the literature pertained adult specimens preying upon juveniles (e.g., Drobenkov 2000. Russ. J. Herpetol. 7:135–138) rather than juveniles preying upon juveniles. The lack of such cannibalistic behavior records among juveniles can be related to small size differences between young snakes, that would not allow one to ingest another.

On 27 August 2014, cannibalistic behavior between two juvenile *C. austriaca* was observed (both with ca. 20–25 cm SVL); one specimen bit another one and did not release it (Fig. 1A). Snakes were found beneath two flat rocks located several meters apart. Both individuals were collected and the behavior was initiated by one individual after snakes were placed close to each other during routine field procedures (measurements, sampling). For the purpose of the ongoing study of the population, the snakes were then captured and separated, so

PHOTO BY ALEKSANDRA KOLANEK

Fig. 1. A) Cannibalistic behavior of *Coronella austriaca* juveniles; B) juveniles basking together before first shed.

we cannot determine if the event would have concluded in ingestion. The observed behavior took place in late summer shortly after snakes were born and after their first shed. Earlier (14 August 2014), newborn individuals were observed basking in the group of five individuals, interestingly, without intraspecific aggression (Fig. 1B). Our observation may indicate that first shed affects the intraspecific behavior of juvenile snakes. This in turn corroborates previous findings on chemoreception and kin discrimination in juvenile *C. austriaca* (Pernetta et al. 2009. Anim. Behav. 77:363–368).

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***CROTALUS HORRIDUS* (Timber Rattlesnake). ARBOREAL BEHAVIOR.** Early reports of arboreal behavior in *Crotalus horridus*, a predominantly terrestrial snake, can be found in Klauber (1956. Rattlesnakes: Their Habits, Life Histories, and Influence on Mankind, Volume 1. University of California Press, Berkeley, California. 740 pp.). More recently researchers reporting observations of arboreality in *C. horridus* have hypothesized that foraging, thermoregulation, predator avoidance, and/or courtship may explain arboreal behavior with this behavior being more common in females ≤ 90 cm (Coupe 2001. Herpetol. Rev. 32:83–85; Rudolph et al 2004. Texas. J. Sci. 56:395–404).

At 1330 h on 7 July 2019, at Land Between the Lakes National Recreation Area, Lyon County, Kentucky, USA (36.99135°N, 88.07271°W; WGS 84; 60 m elev.), a radio-tagged female *C. horridus* (109.7 cm SVL, 650 g) was found at a height of ca. 9.1 m in a Scarlet Oak tree (*Quercus coccinea*; diameter at breast height [DBH] = 10.5 cm; Fig. 1) following a rain shower. The individual remained in the tree for ca. 5 days and was observed in a coiled position on the ground nearby prior to climbing. During the observation, cloud cover was nearly zero and the ambient temperature was ca. 31°C, with a relative humidity of 84% and barometric pressure of 29.41 mm Hg. The site is a sub-xeric oak hickory forest with no recent history of prescribed fire. There was an absence of conspicuous prey items (e.g., squirrel or bird nests) and the position of the body was not indicative of an ambush posture that would be used to secure small rodent or bird prey. One month later, on 10 August 2019, the same individual climbed another Scarlet Oak (DBH = 23.5 cm) located ca. 75 m away to a height of ca. 8 m. The *C. horridus* remained in the tree for > 2 weeks and underwent ecdysis on a branch (Fig. 2). The individual returned to the ground following ecdysis. The individual had undergone ecdysis ca. two weeks prior to this observation. Our observations indicate that adult specimens larger than 90 cm exhibit arboreal behavior. Additionally, the female *C. horridus* in our study has a history of lesions consistent with Snake Fungal Disease (SFD) and tested positive for the presence of *Ophidiomyces ophiodiicola*, the fungus associated with this disease.

Fig. 1. *Crotalus horridus* exhibiting arboreal behavior in Kentucky, USA.

Fig. 2. *Crotalus horridus* shed skin ca. 8 m off the ground in Kentucky, USA.

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***CROTALUS HORRIDUS* (Timber Rattlesnake). DICEPHALY.** On 25 August 2019, DS and DB visited a known *Crotalus horridus* rookery in the Pine Barrens of Burlington County, New Jersey, USA, where they found an adult female *C. horridus* with several neonates along the edge of a wetland. The neonate snakes were basking near the female. DB noticed that one of the neonates was dicephalic (Fig. 1), but all the snakes retreated down a hole. When they returned 1 h later they were able to safely capture the dicephalic individual (26.4 cm SVL, 30 cm total length, 27.4 g). Since *C. horridus* are legally protected in New Jersey, RZ contacted the New Jersey Department of Environmental Protection's (NJDEP) Endangered and Nongame Species Program (ENSP) to report the finding of the two-headed rattlesnake. The NJDEP allowed RZ to keep the dicephalic *C. horridus* in captivity under existing permits (NJDEP permit numbers: ES 2019001 and SH 2019004), because it was unlikely that the snake could survive in the wild.

On 3 September 2019, with some help, the dicephalic neonate shed its skin. It took its first meal of a small fuzzy mouse on 13 September and has subsequently eaten several more fuzzy mice using either head and has gained weight (to 33.1 g on 5 Nov 2019). Both heads have been observed drinking water simultaneously. Although the right head appears dominant in determining movement and travel direction, both heads exhibit typical tongue-flicking. The dicephalic snake consumes small mice using either head (Fig. 2).

Fig. 1. Dicephalic neonate *Crotalus horridus* from the Pine Barrens of Burlington County, New Jersey, USA.

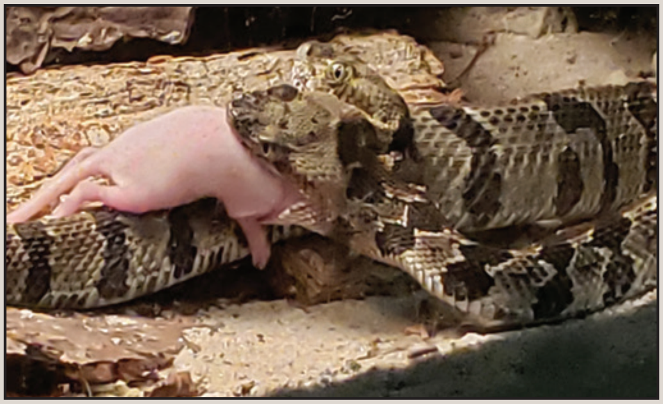

Fig. 2. Dicephalic *Crotalus horridus* feeding.

Currently, approximately 1287 verified cases of dicephaly have been reported for 190 snake species of 102 genera (Albuquerque et al. 2013. Herpetol. Notes 6:85–87). With respect to *Crotalus*, there are 33 dicephalic rattlesnakes reported in the literature. Of these records, 23 were wild caught individuals and 10 were from captive-bred specimens (McAllister and Wallach 2006. J. Arkansas Acad. Sci. 60:67–73).

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DENDRELAPHIS TRISTIS **(Common Bronzeback Treesnake). REPRODUCTION.** *Dendrelaphis tristis* is a medium-sized diurnal colubrid found throughout peninsular India, as well as in Sri Lanka, extreme southeastern Pakistan, western Bangladesh, and at lower elevations in Nepal and Bhutan, with isolated records in north-central Pakistan (Masroor 2011. Pakistan J. Zool. 43:1215–1218) and Myanmar (Wallach et al. 2014. Snakes of the World: A Catalogue of Living and Extinct Species. CRC Press, Boca Raton, Florida. 1227 pp.); the northern boundaries of the range are poorly known (Joshi et al. 2019. Herpetol. Notes 12:305–308). Gravid females are known "almost throughout the year" (Schleich and Kästle 2002. The Amphibians and Reptiles of Nepal. Költz Scientific Books, Königstein, Germany. 1200 pp.) with reports from September to February (Daniel 1983. The Book of Indian Reptiles. Oxford University Press, Bombay, India. 141 pp.), April (Whitaker and Captain 2008. Snakes of India, The Field Guide. Draco Books, Chennai, India. 469 pp.; Khaire 2006. A Guide to Snakes of Maharashtra, Goa and Karnataka. United Multicolour Printers, Pune, India. 129 pp.), and August (Daniel 1983, *op. cit.*; Aengals 2004. Cobra 56:10–11; Vyas et al. 2013. Sauria 35:51–53). Published reports of clutch size include five to six (in Gujarat; Vyas et al. 2013, *op. cit.*), six to seven (Whitaker 1978. Common Indian Snakes: A Field Guide. MacMillan, Madras, India. 154 pp.; Daniel 1983, *op. cit.*; Schleich and Kästle 2002, *op. cit.*) and six to eight (Khaire 2006, *op. cit.*; Whitaker and Captain 2008, *op. cit.*; Aengals 2004, *op. cit.*). Eggs are reported to be "long and thin" (Whitaker and Captain 2008, *op. cit.*) or "oblong" (Aengals 2004, *op. cit.*), with published measurements of 29–39 × 10–12 mm (Daniel 1983, *op. cit.*; Schleich and Kästle 2002, *op. cit.*), 35 × 10 mm (Khaire 2006, *op. cit.*), 34–36 × 23–25 mm and 4.5–5 g (Aengals 2004, *op. cit.*), and 31.4–45.7 × 11.8–12.2 mm (in Gujarat; Vyas et al. 2013, *op. cit.*). Herein, we report a maximum clutch size of 10 eggs measuring 26–36 × 10.5–15 mm, and other novel information on reproduction of *D. tristis*.

At 1630 h in 1 August 2019, a gravid female *D. tristis* (896 mm SVL, 447 mm tail length, mass at capture = 121 g, mass at parity = 98 g, girth at capture = 50 mm, girth at parity = 34 mm; dorsal scales in 15-15-11 rows, 195 ventrals, and 152 subcaudals with divided anal plate) was rescued by Vasudev P. Limbachiya at Ongc Nagar, Magdalla, Surat, Gujarat, India (21.14184°N, 72.750232°E; WGS 84). The *D. tristis* was housed in a 3 × 2 ft transparent plastic container lined with newspaper, where it laid 10 pale yellowish to creamy-white adherent eggs overnight on 12 August 2019 (Fig. 1). The *D. tristis* was fed four *Fejervarya* frogs. After parturition, no signs of parental care were noted, so the *D. tristis* was released on 19 August 2019.

Adherent eggs were separated (by gently brushing them with water) and wrapped in pieces of a woolen cloth mat. Eggs were marked from A to J using a red pen and housed in a plastic jar for incubation, during which time they were moistened every 7 d. Mean temperature was 29.8°C and mean humidity was 81.9%. Eggs hatched during the day between 8 and 12 October after an incubation period of 57–60 d. Detailed measurements of eggs and hatchlings were taken (Table 1). Out of 10 eggs, one was normal-sized but infertile (D), and four became infected with fungus (F, H, I, J); the remaining five hatched. During candling, we found embryos located at different sites within the eggs. Four of the

Table 1. Detailed morphometrics of eggs and hatchlings of *Dendrelaphis tristis*, along with position of embryos developed in eggs observed while candling. * = infertile eggs, † = eggs that became infected and did not hatch.

Egg	Size of eggs (mm)	Initial mass of eggs (g)	Mass of eggs on 5th day (g)	Location of embryo in eggs	SVL + tail length (mm)	Midbody girth (mm)	Body mass of hatchling (g)	Sex
A	29 x 14	3.55	3.78	bottom	195+80	15	2.48	M
B	36 x 13	4.06	4.14	top	211+90	16.5	2.82	F
C	34.5 × 13	3.23	4.60	top	205+83	17	2.99	M
D	26 x 14	3.29	3.20	Not developed	*	*	*	*
E	29 x 15	3.83	4.00	top	212+92	16	2.87	F
F	27 x 15	3.78	4.04	side	†	†	†	†
G	30.5 x 14.5	3.65	3.85	top	211+99	15	2.78	F
H	27 x 15	3.75	3.91	bottom	†	†	†	†
I	29 x 15	4.06	4.36	bottom	†	†	†	†
J	26 x 10.5	2.03	2.06	top	†	†	†	†

PHOTO BY DIKANSH S. PARMAR

Fig. 1. *Dendrelaphis tristis* with clutch of ten eggs.

five eggs where the embryos were at the top of the egg hatched, whereas only one of the three eggs where the embryos were at the bottom of the egg did so. Further study of this phenomenon is required.

Schleich and Kästle (2002, *op. cit.*) reported the incubation period as 28–42 d; Aengals (2004, *op. cit.*) as 44 d; others (Whitaker 1978, *op. cit.*; Daniel 1983, *op. cit.*; Vyas et al. 2013, *op. cit.*; Parmar 2017. Sauria 39:31–36) have reported incubation durations of 55–60 d. Whitaker (1978, *op. cit.*) and Whitaker and Captain (2008, *op. cit.*) reported the size of hatchlings at birth as 150 mm; Aengals (2004, *op. cit.*) as 220–250 mm. We report SVL of hatchlings at birth ranging from 195 to 212 mm. One hatchling (from egg C) was born with a kinked tail (Vyas et al. 2013, *op. cit.*; Parmar 2017, *op. cit.*). They were released in their natural habitat.

Finally, nesting sites of *D. tristis* are reported to include tree holes, rotten vegetation (Whitaker and Captain 2008, *op. cit.*), hollow trees, and deserted birds' nests (Schleich and Kästle 2002, *op. cit.*). We have found eggs of a different *D. tristis* in a hole in the wall of house, surrounded by trees, ca. 8 m above the ground.

We thank Vasudev P. Limbachiya for helping in rescue operation and logistic support.

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DIADOPHIS PUNCTATUS **(Ringneck Snake). REPRODUCTION.** *Diadophis punctatus* is distributed from the Atlantic to Pacific coasts and south to central Mexico. Details of its life history, however, have been documented at only two areas within this extensive range: Florida (Myers 1965. Bull. Florida State Mus. 10:43–90) and Kansas, USA (Fitch 1975. Univ. Kansas Mus. Nat. Hist. Misc. Publ. 62. 53 pp.). Little information is available concerning reproduction in Pacific Coast populations. Reports of egg counts in California snakes include Hanley (1943. Copeia 1943:145–147), Stebbins (1954. Amphibians and Reptiles of Western North America. McGraw-Hill Book Co., New York. 536 pp.), and Cunningham (1959. Herpetologica 15:17–20). Communal nesting was reported in Oregon (Brodie et al. 1969. Herpetologica 25:223–227). A lab-incubated clutch in southern California hatched in 48 days (Perkins 1952. Herpetologica 8:79). Here I report data on four clutches from southern California.

On 1 April 2017, I collected a large adult female *D. punctatus* (533 mm total length [TL]) in the Laguna Mountains (1860 m elev.), San Diego County, California, USA. On 9 June (69 days post-collection) she laid three elongated eggs, the two largest of which measured 9.5 × 47 mm and 9 × 38 mm; egg surfaces were smooth and yellowish (Fig. 1). These were incubated on slightly moistened vermiculite at room temperature (25–27°C). Over the course of incubation, eggshell color changed to off-white. Approximately 24 h before the first egg pipped (day 47 of incubation), eggshells became semi-transparent—more of a membrane than a shell—such that the developing snake was clearly visible (Fig. 2). Hatching occurred 26–29 July (48–51 days incubation). Hatchlings measured 165, 180, and 191 mm TL. Given that mating occurred prior to collection on 1 April, the interval from breeding to hatching was ≥ 118 days. The pronounced eggshell thinning immediately prior to hatching has not been documented for western populations of *D. punctatus*. Eggshell thinning presumably facilitates pipping and might also function to release calcium for absorption by hatchlings.

On 15 March 1987, a large adult female *D. punctatus* was collected in the Santa Ana Mountains (elev. 355 m), Orange County, California. The snake was held in captivity and on 19 July laid a single large egg (44 mm long; B. Thomason, pers. comm.). There is no record as to whether the egg hatched. The interval from field collection to oviposition was 127 days, exceeding the Laguna Mountains female reported above by 58 days. Blanchard (1942. Bull. Chicago Acad. Sci. 7:1–144) suggested that captivity might prolong egg retention, and that possibility should be taken into account in assessing the significance of these observations.

I provide unpublished data on two additional clutches of *D. punctatus* from southern California: 1) an exceptionally large female (ca. 610 mm TL) collected in Orange County, California, on 10 March 2002 laid four eggs in captivity in early April (B. Hinds, pers. comm.); 2) A female from Riverside County laid three eggs in captivity (T. Derbyshire, pers. comm.). Taken together with published egg counts for California populations of *D. punctatus* (Hanley 1943, *op. cit.*; Stebbins 1954, *op. cit.*) but excluding an anomalous clutch of 9 eggs reported by Cunningham (1959, *op. cit.*), mean clutch size is 2.57 (range: 1–4; N = 7). The snake obtained by Hinds—likely approaching record size for southern California individuals of this species and yet producing only 4 eggs—further calls into question the clutch size report of Cunningham (1959, *op. cit.*).

Collection was made under California Department of Fish and Wildlife scientific collecting permit 013377 issued to the Museum of Vertebrate Zoology. I thank Gordon Schuett for

Fig. 1. Two of three freshly laid eggs of *Diadophis punctatus* from San Diego County, California, USA. Note the extreme elongation and yellowish coloration.

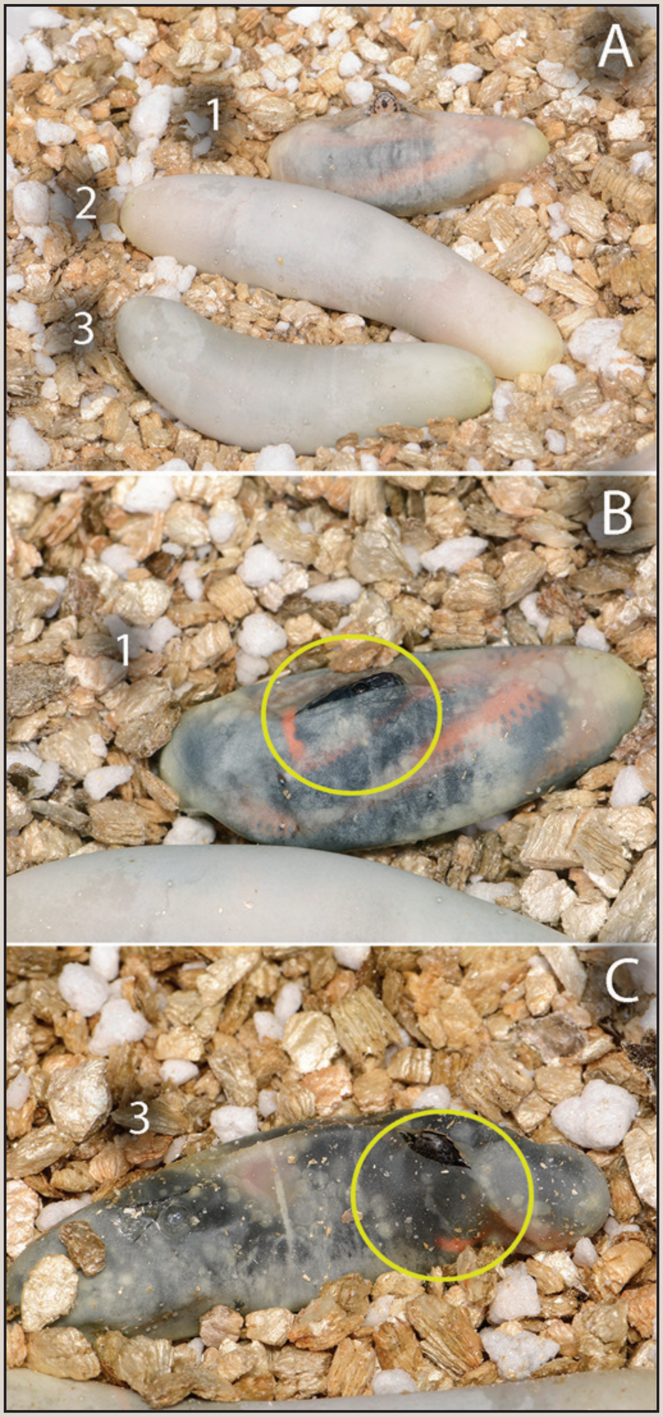

Fig. 2. Clutch of *Diadophis punctatus* eggs about to hatch. A) Clutch as first egg is pipping. Note that the eggshell of egg no. 1 has become semi-transparent; B) closeup of egg no. 1, circle indicating position of hatchling's head; C) egg no. 3, photo taken 24 h after top photo, illustrating pronounced transformation of the egg covering. Circle indicates position of hatchling's head, with orange neck ring visible.

reviewing a draft of this note, and Toby Derbyshire, Brian Hinds, and Blake Thomason for sharing observations reported here.

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DIADOPHIS PUNCTATUS REGALIS **(Regal Ringneck Snake) and *SALVADORA GRAHAMIAE GRAHAMIAE* (Mountain Patch-nosed Snake). DIET and PREDATION.** *Diadophis punctatus* is widely distributed in North America and exhibits considerable variation in feeding habits, often based on geography, ranging from earthworm-dominated diets (e.g., Fitch 1975. Univ. Kansas Mus. Nat. Hist. Misc. Publ. No. 62. 53 pp.) to predation on other reptiles (e.g., Gehlbach 1974. Herpetologica 30:140–148). The subspecies *D. p. regalis* of the southwestern United States feeds largely on snakes and lizards (see Hibbitts and Hibbitts [in press] *In* A. T. Holycross and J. C. Mitchell [eds.], Snakes of Arizona. ECO Herpetological Publishing, Rodeo, New Mexico, for a recent review).

At ca. 0900 h on 9 August 2014 on the southern flank of the Huachuca Mountains, Cochise County, Arizona, USA (31.4155°N, 110.4288°W; WGS 84; 1730 m elev.), we observed a large (ca. 875 mm total length) *D. p. regalis* just coming onto the road. As we stopped to photograph the snake, it began to regurgitate a recent meal—a partly digested *Salvadora g. grahamiae* that was slightly longer than itself (Fig. 1). To our knowledge, this is the first documentation of any species of *Salvadora* in the diet of *D. punctatus.*

PHOTO BY RICHARD CAZARES

Fig. 1. *Diadophis punctatus regalis* regurgitating an adult *Salvadora grahamiae* in Cochise County, Arizona, USA.

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DIADOPHIS PUNCTATUS REGALIS **(Regal Ring-necked Snake) and *TANTILLA HOBARTSMITHI* (Smith's Black-headed Snake). DIET and PREDATION.** *Diadophis punctatus regalis* inhabits much of the American Southwest, including the Pinyon-Juniper forests of Utah's Great Basin Desert (Stebbins 2003. A Field Guide to Western Reptiles and Amphibians. Third edition. Houghton-Mifflin Company, Boston, Massachusetts. 560 pp.). Although it has been established that *Diadophis* prey on other snakes (Blanchard 1942. Bull. Chicago Acad. Sci. 7:1–144), few observations have been recorded regarding the diet of *D. p. regalis* in southern Utah. Here we report an instance of *Tantilla hobartsmithi* being consumed by *D. p. regalis.*

At 1548 h on 15 May 2019 (mostly cloudy skies following a minor rain event), along Hwy 91 within the Beaver Dam Mountains, Washington County, Utah, USA (37.08067°N,

Fig. 1. *Diadophis punctatus regalis* with previously consumed *Tantilla hobartsmithi* protruding from wounds sustained from a vehicle in Washington County, Utah, USA.

113.86084°W; WGS 84; 1265 m elev.), PRM and NDK found a road-killed adult *D. p. regalis* (38.5 cm SVL; 8 cm tail length) with a *T. hobartsmithi* protruding from its body (Fig. 1). Both animals seemed to have been killed within hours. Both specimens were preserved at the Monte L. Bean Museum at Brigham Young University (BYU 53596). To our knowledge, this is the first record of *T. hobartsmithi* in the diet of *D. punctatus*.

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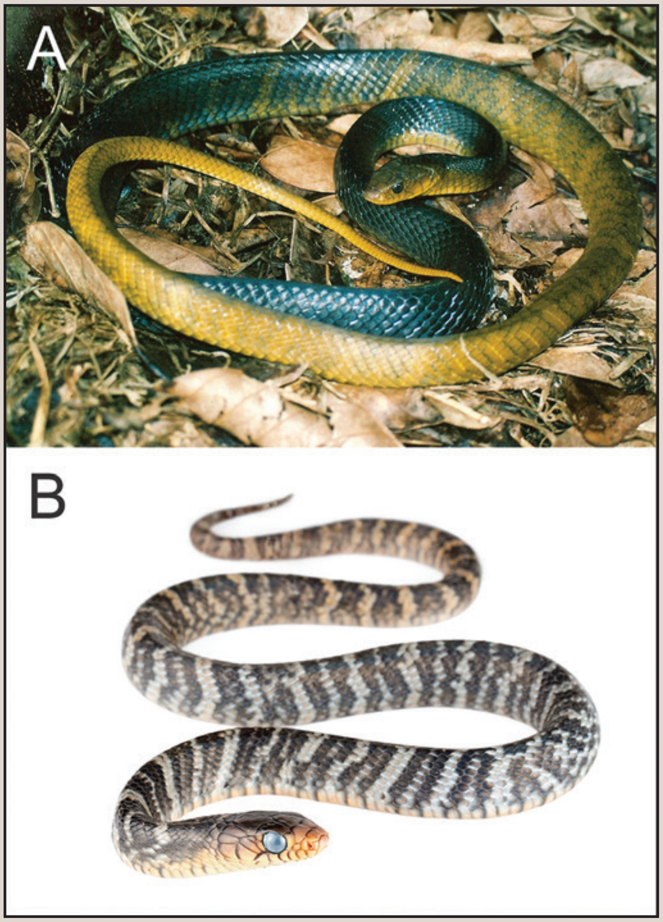
DRYMARCHON CORAIS **(South American Indigo Snake). COLORATION.** *Drymarchon corais* is a large, terrestrial, diurnal colubrid snake that reaches up to 3 m in total length. It can be easily diagnosed by its dorsal coloration (Fig. 1), which is anteriorly dark brown and posteriorly and ventrally bright yellow in adults. Juveniles possess dark brown transverse bars (Freitas 2003. Serpentes Brasileiras. Malha-de-Sapo-Publicações, Lauro de Freitas, Bahia, Brazil. 160 pp.). Here, we present a report of an unusually colored specimen of *D. corais*.

While conducting fieldwork at Fredberg Ecolodge, Fredberg, Suriname (4.6519°S, 55.4955°W; WGS 84; 0 m elev.), at 0930 h on 2 July 2019, DCL came across an aberrant adult specimen of *D. corais* (Fig. 2; ca. 180 cm total length) consuming an adult *Helicops angulatus*. Upon closer examination, it was observed that the *D. corais* possessed a light grey background coloration, with discrete transverse black bars, a cream-colored venter, brown eyes, and white skin. The specimen was released after being photographed. The pattern of this individual is remarkably similar to the normal juvenile pattern of *D. corais*, with transverse dark bars over a grey background coloration. However, hatchlings and juveniles normally have yellow coloration, notably on the venter, dorsum of the tail, and head. The total absence of yellow pigment on the aberrant individual suggests that it probably represents an axanthic mutation.

It has been postulated that chromatic aberrations should be more common in crepuscular, nocturnal, cryptozoic or fossorial species, because these should be less likely to influence predation risk from visually oriented predators (Sazima and Di-Bernardo 1991. Mem. Inst. But. 53:167–173). This is not the case for *D. corais*, given its large size, terrestrial and diurnal habits. Because the aberrant individual was an apparently healthy adult, it seems that the anomaly did not significantly impair its survival in nature. These questions remain open, while this finding highlights the need for further research into the ecological outcomes of chromatic anomalies.



1A: PHOTO BY MARCO ANTONIO DE FREITAS; 1B: PHOTO BY ALEJANDRO ARTEAGA

Fig. 1. Individuals of *Drymarchon corais*: A) adult specimen from Monte Negro, Rondônia, Brazil; B) newborn specimen from Ecuador.

Fig. 2. Aberrant individual of *Drymarchon corais*: A) individual being handled by the senior author; B) individual in situ on the forest floor; C) dorsal view of the individual.

We would like to thank Alejandro Arteaga (Tropical Herping, AMNH) and Marco Antonio de Freitas (UFPE), for kindly sending us photographs of *D. corais* specimens; OME-N was funded by CNPq with a PIBIC Grant (136628/2016-8).

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***ELAPHE CARINATA* (King Ratsnake). DIET.** While *Bungarus multicinctus* (Many-banded Krait) is renowned for preying on other species of snake, it is also eaten by other snakes, including conspecifics (Slowinski 1994. Herpetol. Rev. 25:51–53). *Elaphe carinata* is a large colubrid found in northern Vietnam and east-central China, as well as on Taiwan and some of the Ryukyu Islands of Japan (Schulz 1996. A Monograph of the Colubrid Snakes of the Genus *Elaphe* Fitzinger. Havlickuv Brod, Czech Republic, Költz Scientific Books. 439 pp.). The diet of *E. carinata* includes small mammals, birds and bird eggs, lizards, reptile eggs, and amphibians, but they are most well-known for eating other snakes, including *Sinonatrix percarinatus*, *Boiga kraepelini*, *Ptyas dhumnades*, *Ptyas mucosa*, *Lycodon rufozonatus*, *Deinagkistrodon acutus*, and conspecifics (Pope 1935. The Reptiles of China. American Museum of Natural History New York, New York, New York. 604 pp.; Mori and Moriguchi 1988. Snake 20:98–113; Lee and Lue 1996. Biol. Bull. National Taiwan Normal University. 31:119–124; Mao et al. 2007. Herpetol. Rev. 38:206).

At ca. 2035 h on 22 July 2019, while searching a mountain road for snakes in Fuxing Township, Taoyuan County, Taiwan, (24.67525°N, 121.40555°W; WGS 84). I peered into a drainage culvert and spotted an *E. carinata* swallowing a large *B. multicinctus*. The *E. carinata* immediately recoiled from my light into the culvert's outlet pipe and disappeared. Returning down the road at ca. 2240 h, I found the *E. carinata* lying bloated in the culvert, having fully swallowed the *B. multicinctus*, and began taking photos of it. After a few shots, my lights and flash disturbed it and led to it to rapidly disgorge the *B. multicinctus*, which it had swallowed head-first (Fig. 1) and flee again into the outlet pipe.

Fig. 1. *Elaphe carinata* regurgitating *Bungarus multicinctus* near Fuxing Township, Taoyuan County, Taiwan.

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***FARANCIA ERYTROGRAMMA* (Rainbow Snake). TERRESTRIAL OVERWINTERING/ECDYSIS.** *Farancia erytrogramma* is a rare semi-aquatic snake found from Maryland to Louisiana, USA, usually in or near coastal plain waterways surrounded by sandy soil (Ernst and Ernst 2003. Snakes of the United States and Canada. Smithsonian Institution Press, Washington, D.C. 668 pp.). Both species in the genus *Farancia* are known to make terrestrial movements and *Farancia abacura* (Mud Snake) sometimes spend time on land, hundreds of meters from water (Steen et al. 2013. Herpetol. Rev. 44:208–213), including forays to lay eggs and guard their nests (Meade 1940. Herpetologica 2:15–20). Terrestrial activity in *F. erytrogramma* is less well-documented (Steen et al. 2013, *op. cit.*) and the causes are largely unknown. Gibbons et al. (1977. Herpetologica 33:276–281) suggested that *F. erytrogramma*, which hatch in the fall, must spend the winter on land and migrate to wetlands the following spring. Nest attendance has not been reported in *F. erytrogramma*, and terrestrial movements of adult individuals are assumed to represent dispersal between wetlands in response to changing water levels (Willson et al. 2006. Wetlands 26:1071–1078) or to terrestrial overwintering sites (Steen et al. 2013, *op. cit.*). Richmond (1945. Copeia 1945:28–30) reported that *F. erytrogramma* were abundant in dry, sandy fields adjacent to marshes in Virginia, "as many as twenty having been plowed out of a ten-acre field in one day." Neill (1964. Am. Midl. Nat. 71:257–295) thought that the apparent tendency of *F. erytrogramma* to overwinter on land in the northern part of its range might reflect thermoregulatory basking where streams remain relatively cold, although *F. erytrogramma* can be relatively active throughout the winter (Garst and Willson 2016. Herpetol. Rev. 47:682–683). Aside from the mention of shed skins from hatchlings left in nests (Richmond 1945, *op. cit.*; Neill 1964, *op. cit.*), nothing is known of patterns of ecdysis.

At ca. 1230 h on 19 November 2019, one of us (AL) found a sub-adult *F. erytrogramma* (ca. 500 mm SVL) partially buried in mulch in a suburban neighborhood in Myrtle Beach, Horry County, South Carolina, USA (33.74139°N, 78.82778°E; WGS 84; 2 m elev.). The *F. erytrogramma* appeared almost completely white, with clouded eye caps and the color barely visible (Fig. 1A), indicating that it would soon undergo ecdysis. The location is ca. 20 m from the nearest body of water, one of a series of small freshwater marshes located about 900 m upstream of the mouth of a tidal creek known as Canepatch Swatch and dominated by Alligatorweed (*Alternanthera philoxeroides*), water pennywort (*Hydrocotyle* spp.), White Marsh (*Zizaniopsis miliacea*) and sedges (*Carex* spp.). Water quality sampling at the mouth of the creek (National Water Quality Monitoring Council; https://www.waterqualitydata.us/portal/#siteid=21SCBCH-WAC-016A&mimeType=csv) reveals that the average salinity there is 30.8 ppt, but can fall to 0 during precipitation events.

The *F. erytrogramma* was observed again at 1300 h on 20 November (still pre-shed), at 1500 h on 6 December (post-shed; Fig. 1B), at 1730 h on 25 December, and at ca. 1030 h on 27 December, despite being handled a number of times (including once on 25 December to remove the snake from the road, where it was in danger of being run over). It was found dead of unknown causes in a neighbor's yard on 18 February 2020. Potential use of terrestrial sites for overwintering and ecdysis in *F. erytrogramma* remains to be clarified, although the infrequency with which this species is encountered in nature will make any such investigation extremely challenging.

We thank members and admins of the Facebook Snake Identification group for quickly confirming the identity of this snake, A. Tweel and T. Arrington (South Carolina Department of Natural Resources) for guidance on accessing water quality survey data for the region, and N. Shea (South Carolina Department of Natural Resources) for aid in plant identification.

Fig. 1. A) Pre-molt *Farancia erytrogramma* partially buried in mulch; B) post-molt at the same location 16 days later, where it apparently remained for at least 21 more days (total of 37 days between initial and final observation).

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***FICIMIA PUBLIA* (Blotched Hooknose Snake). DIET.** *Ficimia publia* occurs in the Mexican states of Veracruz, Puebla, and Guerrero (Torres-Pérez-Coeto et al. 2016. Acta Zool. Mex. 32:123–124), and then south into Guatemala, Belize, and northeastern Honduras (Wilson and Johnson 2010. Conservation of Mesoamerican Amphibians and Reptiles. Eagle Mountains Publishing, Eagle Mountain, Utah. 812 pp.). This snake occurs in a variety of habitats ranging from tropical wet forests to subtropical dry forests and has been recorded in degraded forest and secondary vegetation (Wilson 2017. Mesoam. Herpetol. 4:791–884). *Ficimia publia* is known to consume centipedes (Ariano-Sánchez and Lee 2013. The IUCN Red List of Threatened Species. https://www.iucnredlist.org; accessed 5 April 2020), spiders (Lee 1996. The Amphibians and Reptiles of the Yucatan Peninsula. Cornell University Press, Ithaca, New York. 500 pp.), orthopterans, beetle larvae (Holm 2008. PhD Thesis, The University of Arizona, Tucson, Arizona. 242 pp.), and a scorpion was found in the stomach of a specimen from Oaxaca, Mexico (Canseco-Márquez and Gutiérrez-Mayen 2010. Anfibios y reptiles del Valle de Tehuacán-Cuicatlán. CONABIO. 216 pp.).

PHOTO ALDO CARMONA

Fig. 1. *Ficimia publia* swallowing an scorpion in Vercruz, Mexico.

On 4 April 2020 we found an adult *F. publia* (ca. 30 cm total length) that had captured a scorpion and which it was holding in its jaws. The snake was observed on a road in the village of Dos Amates (18.43306°N, 95.12007°W; WGS 84; 326 m elev.) in the Municipality of Catemaco, Veracruz, Mexico. We watched the snake consume the scorpion by the posterior middle part of the body, leaving the stinger and pincers aside. These were consumed last (Fig. 1). Total consumption of the prey took no more than 3 min. After consuming the scorpion, the snake moved away from the site, hiding among the secondary vegetation. To our knowledge this is the second report of scorpion feeding by *F. publia*.

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***HYPSIGLENA CHLOROPHAEA* (Desert Nightsnake). DIET.** *Hypsiglena chlorophaea* is a small colubrid snake that occurs in southwestern deserts and parts of the Intermountain West in the United States, south-central British Columbia, and northwestern Mexico (Weaver 2010. J. Herpetol. 44:148–152; Mulcahy 2007. Mol. Phylogenet. Evol. 46:1095–1115). This nocturnal, rear-fanged, mildly venomous snake primarily feeds on lizards and squamate eggs, but its diet is also known to include snakes, anurans, insects, amphisbaenians, mammals, and occasionally carrion (Rodriguez-Robles et al. 1999. Copeia 1999:93–100; Brennan 2004. Sonoran Herpetol. 17:30; Setser and Goode 2004. Herpetol. Rev. 35:177; Weaver 2010, *op. cit.*). Although *H. chlorophaea* is known to prey on snakes, most observations have been documented in adults. Diet observations for *H. chlorophaea* suggest that younger, smaller snakes primarily feed on lizards, squamate eggs, and insects. We report separate observations of *Chilomeniscus stramineus* (Variable Sandsnake) as prey of a neonate and an adult *H. chlorophaea*.

On 21 August 2019, at 2000 h, JB and DH captured a female neonate *H. chlorophaea* (164 mm SVL, 31 mm tail length, 2.9 g) on a golf cart path at Stone Canyon (32.46635°N, 110.98126°W; WGS 84; ca. 924 m elev.), a residential development in the foothills of the Tortolita Mountains, near Oro Valley, Arizona, USA. We collected the snake and transported it to our lab. The

PHOTO BY ALEXUS CAZARES

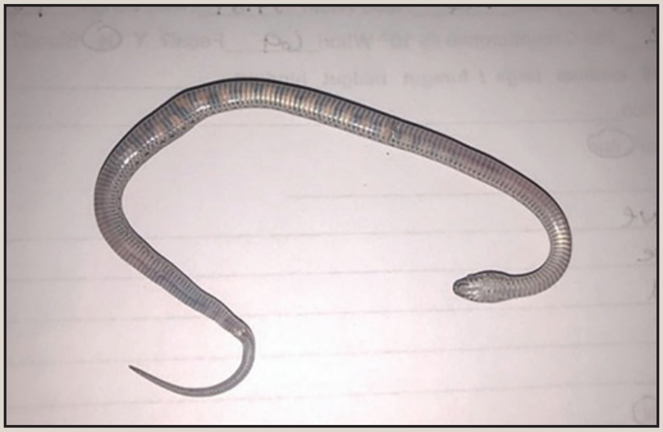

Fig. 1. Neonate *Hypsiglena chlorophaea* with visible *Chilomeniscus stramineus* in gut from Arizona, USA.

PHOTO BY MATT GOODE

Fig. 2. *Hypsiglena chlorophaea* constricting *Chilomeniscus stramineus* in Arizona, USA.

following day, we anesthetized the snake to obtain demographic data and observed a recently ingested *C. stramineus* (ca. 59 mm total length), readily visible through the ventral scales of the *H. chlorophaea* (Fig. 1). We often encounter *C. stramineus*, a known prey item of adult *H. chlorophaea*, at our study site (Tuijl-Goode 2008. Sonoran Herpetol. 26:66).

At 1944 h on 26 August 2007, MG and RTG observed an adult *H. chlorophaea* constricting and envenomating a *Chilomeniscus stramineus* (Fig. 2), also on the golf cart path at Stone Canyon. As the *H. chlorophaea* was constricting, the *C. stramineus* bit and wounded the mouth of the *H. chlorophaea*. Once the *H. chlorophaea* killed its prey, it carried the *C. stramineus* to a height of ca. 30–40 cm up and into a bush, where it finished consuming the prey item. This entire interaction lasted 1.5 h, ending at 2114 h. In both observations, the head and upper neck of the *C. stramineus* were doubled back on the body when swallowed.

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IMANTODES CENCHOA **(Blunt-headed Treesnake). DIET.** *Imantodes cenchoa* is a widespread Neotropical snake distributed from the east coast of Mexico to Argentina (Souza et al. 2014. Zoologia 31:8–19). It is primarily arboreal, and nocturnal or crepuscular in habitat, capturing prey that are asleep on the vegetation (Eversole et al. 2018. Herpetol. Rev. 49:343; Clause and Clause 2016. Herpetol. Rev. 47:312–313). The preferred prey items are lizards of the genera *Norops* and *Dactyloa*, but they are known to feed on other lizards, reptile eggs, and amphibian species as well (Ávila-Pires 1995. Zool. Verh. 299:1–706; Souza et al. 2014, *op. cit.*; Clause and Clause 2016, *op. cit.*). Within these preferred genera, twelve species have been recorded from the diet of *I. cenchoa*: *Norops capito*, *N. chrysolepis*, *N. fuscoauratus*, *N. lemurinus*, *N. mariarum*, *N. ortonii*, *N. petersii*, *N. rodriguezii*, *N. uniformis*, *N. barkeri*, *Dactyloa punctata*, and *D. frenatus* (Campbell 1998. Amphibians and Reptiles of Northern Guatemala, the Yucatán, and Belize. University of Oklahoma Press, Norman, Oklahoma. 400 pp.; Gutierrez-C. and Arredondo-S. 2005. Herpetol. Rev. 36:324; García-Padilla and Luna-Alcántara 2011. Herpetol. Rev. 42:99–100; Ray et al. 2011. Herpetol. Rev. 42:100; de Sousa et al. 2014. Zoologia 31:8–19; Clause and Clause 2016, *op. cit.*). Here, we report the thirteenth species of *Norops* from the diet of *I. cenchoa*.

At 1940 h on 8 January 2020, during a herpetofaunal survey at the Rio Negro Sustainable Development Reserve (RNSDR), located in the state of Amazonas, within the municipalities of Manacapuru, Iranduba and Novo Airão, Brazil (3.050°S, 60.753°W; WGS 84; 55 m elev.), we found an adult female *I. cenchoa* (102 cm total length, 72.4 cm SVL; Fig. 1A) active at a height of 3.5 m in forest vegetation. The snake was subsequently captured for deposition into the herpetology collection of the Laboratório

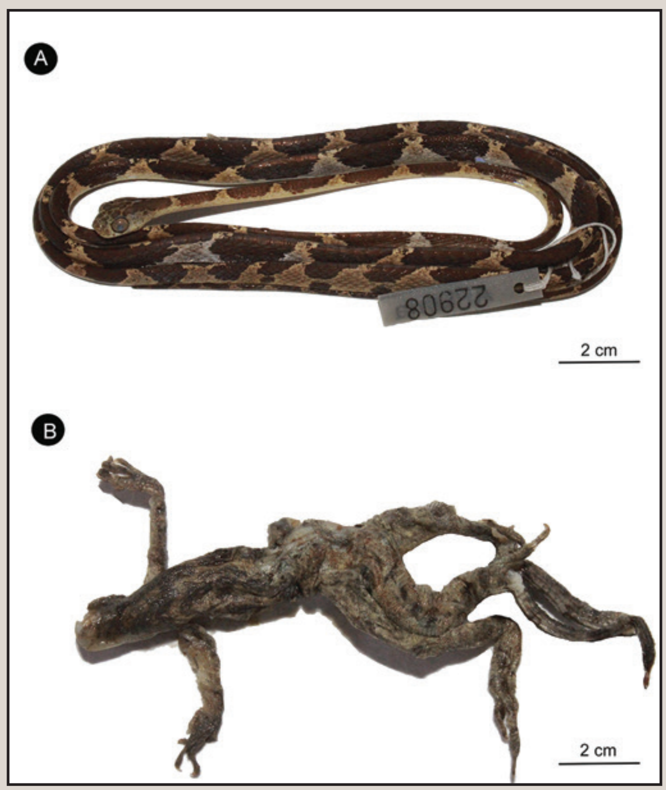

Fig. 1. A) Adult female *Imantodes cenchoa* (APL 22908); B) with partially digested *Norops tandai* prey item from RNSDR, Amazonas, Brazil.

de Ecologia de Populações, National Institute of Amazonian Research (APL; Amazonas, Brazil). During preservation, we opened the stomach and found a partially digested *Norops tandai* (Fig. 1B). This is the first documented instance of *I. cenchoa* preying on *Norops tandai*.

We thank Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) for scholarship to ASF (proc. 300440/2020-0), to RCSP (proc. 062.01903/2015), to JSD (proc. 140929/2019-3); Centro de Estudos Integrados da Biodiversidade Amazônica (CENBAM) and National Institute of Amazonian Research for logistical support. We also thank "Janinho" for assistance with fieldwork. This work was conducted under collection and ethics permits from IBAMA/SISBIO (Ministry of Environment, Government of Brazil) No. 72434-1.

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LATICAUDA LATICAUDATA **(Blue-lipped Sea Krait). PREDATION**. *Laticauda* spp. often return to land to mate, lay eggs, or rest. The main predators of *Laticauda* are marine animals such as crabs, sharks, moray eels, groupers, sweetlips, and other fishes (Voris and Jefferies 1995. J. Trop. Ecol. 11:569–576). Although there have also been some reports of sea snakes being eaten by animals that spend some of their time on land (e.g., Sea Eagles, Saltwater Crocodiles, and Leopard Seals; Heatwole 1999. Sea Snakes. Krieger Publishing Company, Malabar, Florida. 148 pp.), these attacks occurred in the sea. Thus, there are no reports of sea snakes being eaten by predators on land. Here, we report an observation of predation of a *L. laticaudata* by a terrestrial snake, *Lycodon rufozonatus walli* (Red-banded Snake; formerly known as *Dinodon rufozonatum walli*; Guo et al. 2013. Mol. Phylogenet. Evol. 68:144–149; Siler et al. 2013. Zool. Scr. 42:262–277).

At 0437 h on 8 September 2016, we discovered a *L. r. walli* (SVL = 826 mm, tail length = 214 mm) swallowing a female *L. laticaudata* (765 mm SVL, 110 mm tail length) in the coastal area of Ishigaki Island, Okinawa Prefecture, Japan (24.4494°N, 124.0797°E; WGS 84; Fig. 1). At the time of discovery, it was still dark with no sunlight. At first, the predator and prey were positioned in a tight slit of limestone rock and the upper half of the sea snake had been engulfed. The *L. r. walli* tried to swallow the prey completely, but at 0600 h the *L. r. walli* gave up and regurgitated the *L. laticaudata*. By that time, the regurgitated *L. laticaudata* was already dead. Both individuals were collected and measured. The body of the *L. laticaudata* exhibited many bite wounds and the eyes were cloudy (Fig. 2). The specimen of *L. laticaudata* was deposited in the Museum of Kyoto University (KZ 73067).

The terrestrial snake *L. r. walli* is a common subspecies endemic to the Miyako and Yaeyama Islands, Japan, where it is found from forests to coastal areas. This nocturnal species is a generalist predator that preys on fishes, mammals, birds, amphibians, and reptiles, including snakes (Mori and Moriguchi 1988. The Snake 20:98–113). *Laticauda laticaudata* is a common species in the Ryukyu Islands, and often comes onto land at night. Therefore, these two species may come into contact regularly during the night. Sea kraits, especially female *L. laticaudata*, are relatively weak and slow when they are on land (Shine and Shetty 2001. J. Evol. Biol. 14:338–346; Bonnet et al. 2005. Biol. J. Linn. Soc. 85:433–441), especially if they are gravid or have fed recently (Brischoux

Fig. 1. *Lycodon rufozonatus walli* swallowing a *Laticauda laticaudata* headfirst in Ishigaki, Japan.

Fig. 2. The body of *Lycodon laticaudata* with numerous bite wounds and cloudy eyes.

et al. 2007. Mar. Ecol. Prog. Ser. 350:145–151). However, as in the current reported case, various species of sea snakes, including *L. laticaudata*, have a body size that is too large for swallowing and consumption by land snakes like *L. r. walli*. It seems that *L. r. walli* do not frequently feed on sea snakes.

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LEPTODEIRA MACULATA **(Southwestern Cat-eyed Snake). DIET/OPHIOPHAGY.** The semi-arboreal snakes of the genus *Leptodeira* are widespread in tropical America, where they mostly prey on amphibian eggs, frogs, and lizards (Köhler 2008. The Reptiles of Central America. Second edition. Offenbach, Herpeton Verlag. 400 pp.; McCranie 2011. The Snakes of Honduras: Systematics, Distribution, and Conservation. Society for the Study of Amphibians and Reptiles, Ithaca, New York. 714 pp.). Ophiophagy has rarely been documented in the genus. Cantor and Pizzato (2008. Herpetol. Rev. 39:470–471) reported that *Leptodeira annulata* (Banded Cat-eyed Snake) feeds on *Atractus zebrinus* and *Oxyrophus guibei* after a revision of museum specimens collected from Brazil; however, the latter prey item might have been consumed in captive conditions during transportation. McKelvy et al. (2013. Herpetol. Notes 6:177–178) reported

PHOTO BY BRUNO CORTÉS-ORTÍZ

Fig. 1. Adult female *Leptodeira maculata* (MZFC 34867, left), and its regurgitated prey, a juvenile *Salvadora mexicana* (MZFC 34843, right), from Guerrero, Mexico.

that a *Leptodeira septentrionalis* (Northern Cat-eyed Snake) regurgitated a *Ninia sebae* in Costa Rica.

On 7 October 2018, at 0010 h, we collected an adult female *Leptodeira maculata* (MZFC 34867, 30.71 cm SVL, 8.45 cm tail length, 173 ventral scales, 68 subcaudal scales) active on the ground at the base of a tree near the Río La Salitrera river at Puente La Salitrera, Municipality of Zihuatanejo de Azueta, Guerrero, Mexico (17.72394°N, 101.60107°W; WGS84; 16 m elev.). Upon examination, a bulge was felt in the stomach, which we forced the snake to regurgitate. The food item was a juvenile *Salvadora mexicana* (Mexican Patch-nosed Snake; MZFC 34843) partially digested and broken into three segments (Fig. 1). The *S. mexicana* was expelled tail first, suggesting that it was consumed headfirst. Also, a small lizard tail was obtained, most likely of a juvenile *Sceloporus pyrocephalus* (Boulder Spiny Lizard), given that it was common near the collection site. Both snakes were deposited in the herpetological collection of the Museo de Zoología "Alfonso L. Herrera," Facultad de Ciencias, UNAM (MZFC). This is the first record of ophiophagy in *L. maculata* and for a Mexican species of the genus.

Collection was conducted under the collecting permit FAUT-0015 issued to Oscar Flores-Villela by SEMARNAT with an extension to Ricardo Palacios-Aguilar. We thank Proyecto PAPIIT IN 216218 for funding.

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***LIMAFORMOSA CROSSI* (Crosse's File Snake) and *MEHELYA POENSIS* (Western Forest File Snake). COLORATION/BIOFLUORESCENCE.** Recently biofluorescence has been reported in a number of amphibians and reptiles (e.g., Taboada et al. 2017. Proc. Nat. Acad. Sci. USA 114:3672–3677; Prötzel et al. 2018. Sci. Rep. 8:698; Lamb and Davis 2020. Sci. Rep. 10:2821), and many more than previously expected possibly have the ability to emit fluorescence. In many cases, biofluorescent pattern and color pattern under natural light are correlated, and the fluorescence emitted in response to blue excitation light are generally within the spectrum of green light (e.g, Seiko and Terai 2019. Galaxea 21:7–8). Until now the functional role of biofluorescence in amphibians and reptiles is largely unclear, so documenting individual cases is helpful for future study.

Here, I report a unique red fluorescence emission in two African file snakes, *Limaformosa crossi* and *Mehelya poensis* (family Lamprophiidae). We examined one living male *L. crossi* in captivity and its fresh shed skins, and one frozen dead body of *M. poensis* stored in the Kitakyushu Museum of Natural & Human History, provided by the pet trade. In addition, one living female *Elaphe climacophora* (Japanese Ratsnake: Colubridae) captured on 8 August 2019 around Kawachi lake of Kitakyushu City, Japan, and its fresh shed skin were also examined as a control. Ultraviolet LED light (UV-A, peak at 360–390 nm) without a filter was used for excitation. Strong red fluorescence was recognized on the ventral surface of *L. crossi* and *M. poensis* (Fig. 1A, B), whereas no obvious fluorescence was recognized on the dorsal area of the two file snakes and the entire body surface of *E. climacophora*. The area emitting red fluorescence in both file snakes almost perfectly coincided with the ventral and subcaudal scales. The same area of the

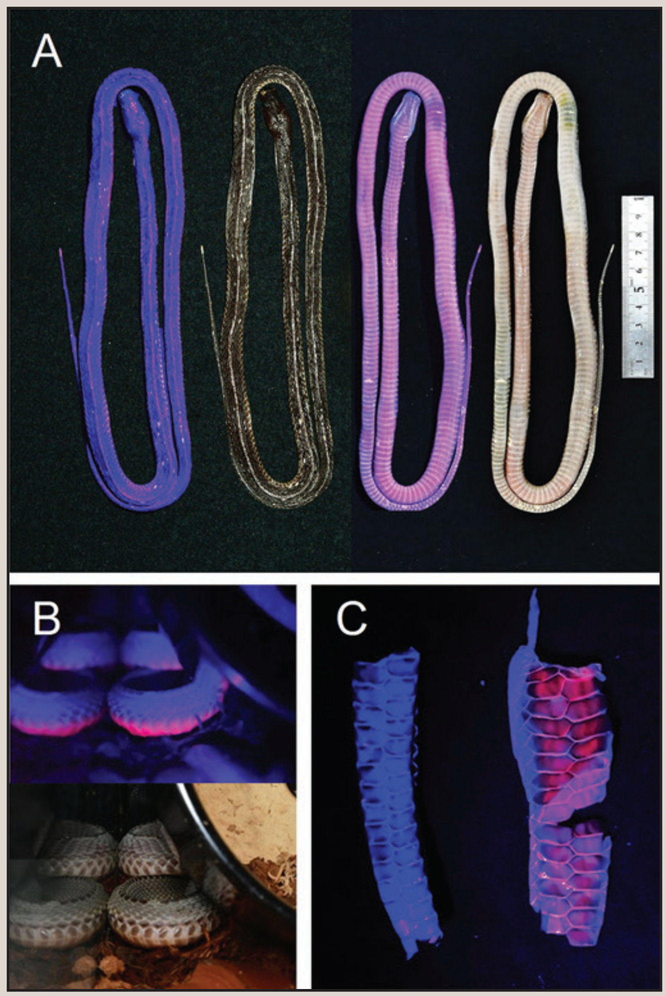

Fig. 1. A) Left to right: *Mehelya poensis* in dorsal view under UV-A, under natural light (NL), and in ventral view under UV-A, and under NL. Scale bar = 10 cm; B) top to bottom: live *Limaformosa crossi* under UV-A and NL; C) left to right: shed skins of tails of *L. crossi* and *Elaphe climacophora* (control) under UV-A. The blue color recognized in each photo is spillover from UV-A.

shed skins also emitted red fluorescence in *L. crossi*, whereas no excitation was recognized in the shed skin of the control snake (Fig. 1C). The shed skin fluorescence in *L. crossi* was observed after several ecdysis cycles, and the fluorescence ability of shed skin was sustained at least 30 d after molting. I also exposed shed skins of *Python regius* (in captivity), *Pantherophis guttatus* (in captivity), and *Elaphe quadrivirgata* (in the wild) to UV-A, but no red fluorescence was visible in shed skins of these snakes (data/photos not shown).

African file snakes occur in savanna and forest habitats in sub-Saharan Africa and are nocturnal predators that feed on terrestrial vertebrates. Although no specific hypotheses about the function of ventral fluorescence in these snakes exist at present, the two genera examined in this study are phylogenetically distant (Broadley et al. 2018. Afr. J. Herpetol. 67:43–60), suggesting that biofluorescence may be widespread across the former members of the genus *Gonionotophis* (including *Gracililima* as well as the two aforementioned genera). To our knowledge, this is the first report of red fluorescence emission in snakes or their shed skins.

This study was supported by JSPS Grant-in-Aid for Scientific Research (B) (No. 17H02028), and I appreciate Y. Asakawa's assistance with the museum work.

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***MASTICOPHIS LATERALIS* (Striped Racer). DIET/CANNIBALISM.** On 22 October 2019, I encountered a road-killed *Masticophis lateralis* (ca. 80 cm total length [TL]) in Monrovia Canyon, San Gabriel Mountains, Los Angeles County, California, USA. A tail was protruding from the dead snake's mouth. Dissection revealed a young-of-year conspecific (ca. 38 cm TL; Fig. 1). Published diet records indicate that *M. lateralis* feeds primarily on lizards (Fitch 1935. Trans. Acad. Sci. St. Louis 29:1–38; Fitch 1949. Amer. Midl. Nat. 41:513–579; Cunningham 1959. Herpetologica 15:17–20; Cornett 1982. Herpetol. Rev. 13:96; Clark 2014. Son. Herpetol. 27:79), but also birds (Grinnell and Storer 1924. Animal Life in the Yosemite. University of California Press, Berkeley, California. 752 pp.; Cunningham 1959, *op. cit.*; Shafer and Hein 2005. Herpetol. Rev. 36:195; Dunn and Herr 2017. Herpetol. Rev. 48:858), mammals (Fitch 1949, *op. cit.*), and other snakes (e.g., *Salvadora hexalepis*, *Crotalus oreganus*; Van Denburgh 1922. The Reptiles of Western North America, 2 volumes. Spec. Publ. California Acad. Sci. 1028 pp.; iNaturalist 15581171; www.inaturalist.org/observations/15581171). To my knowledge, this is the first report of cannibalism in this species.

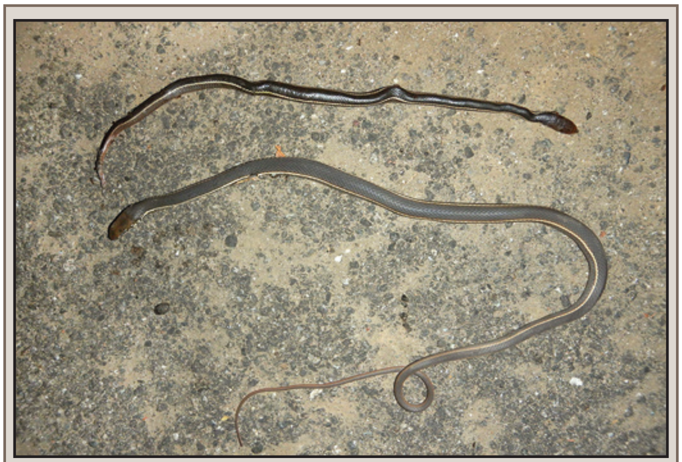

Fig. 1. Road-killed adult *Masticophis lateralis* (lower) and juvenile conspecific (upper) removed from its stomach from California, USA.

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***NOTECHIS SCUTATUS OCCIDENTALIS* (Western Tiger Snake). DEFENSIVE BEHAVIOR.** *Notechis scutatus occidentalis* is a large, polymorphic elapid found in a variety of habitats across southwestern Australia, but it is particularly abundant in wetlands (Mirtschin et al. 2017. Australia's Dangeous Snakes: Identification, Biology and Envenoming. CSIRO Publishing, Clayton, Australia. 100 pp.) due to its preference for feeding on frogs (Aubret et al. 2006. Behav. Ecol. 17:716–725; Lettoof et al. 2020. IJP:PAW 11:32–39). Although *N. s. occidentalis* is mainly terrestrial, individuals are known to occasionally forage in the aquatic environment (Aubret and Shine 2008. Am. Nat. 171:524–531). Across their range *N. scutatus* have also been observed fleeing into the water (Mirtschin and Bailey 1990. SA Nat. 64:53–61) and swimming underwater has been recognized as a behavior to escape predation (Aubret 2004. Aust. J. Zool. 52:357–368). Aubret (2004, *op. cit.*) reported that under laboratory conditions, *N. s. occidentalis* from the urban wetland Herdsman Lake, Western Australia, Australia, can hold their breath for over 20 min and suggested this could be advantageous to escape predation.

At 1249 h on 23 September 2019, at Herdsman Lake (31.92023°S, 115.80448°E; WGS 84), we released a small (72.3 cm SVL) adult *N. s. occidentalis* after recording morphometric data, and observed it fleeing into the water. We have released hundreds of *N. s. occidentalis* and the usual response is to hide in vegetation, but occasionally some will choose the water and swim away. This individual swam straight down to the bottom of the water (ca. 50 cm deep) and proceeded to hide under debris. We remained quiet and motionless while recording the time the snake spent under the debris. After a total of 18 min 36 s the snake surfaced and took its first breath of air (Fig. 1). This is not incorporating a ca. 2 min delay before we initiated the recording. This is not the longest

PHOTO BY JARI CORNELIS

Fig. 1. *Notechis scutatus occidentalis* surfacing to breathe with the rest of the body still hidden under debris.

apnoea record for the species (Aubret 2004, *op. cit.*), but to our knowledge it is the first known *in situ* record of apnoea, as well as the first record of a wild *N. s. occidentalis* selecting to hide beneath submerged debris for an extended period of time as opposed to swimming away and resurfacing, as an antipredator behavior.

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***OPHIOPHAGUS HANNAH* (King Cobra). NESTING and BEHAVIOR.** *Ophiophagus hannah* is the only snake in the world known to construct an aboveground nest. The nest usually consists of a mound of leaf litter (ca. 1–3 feet high), built by the female, within which she lays her eggs (Leakey 1969. J. National Research Council, Thailand 5:1–80). Female *O. hannah* are known to guard their nest (for several weeks to two months), presumably to deter potential egg-predators (Whitaker 1978. Common Indian Snakes: A Field Guide. MacMillan, Madras, India. 154 pp.). On 26 June 2019, we located two nests (29.3222°N, 79.6562°E; WGS 84; 1241 m elev.) in the Nainital Forest Division of Uttarakhand, northern India, based on information provided by a local villager. The distance between these “twin” nests was found to be only 6.6 m, and two adult *O. hannah* were also observed, one lying coiled on top of each nest. Both nests were primarily composed of pine (*Pinus roxburghii*) needles, one of two common nesting materials (the other being an Oak sp. [*Quercus leucotrichophora*]) used by *O. hannah* in this part of its range (Dolia 2018. Herpetol. Notes. 11:217–222). Nest dimensions were as follows: Nest 1 (N1): diameter (east-west direction 168 cm; north-south direction 157 cm), circumference 380 cm; height 43 cm; Nest 2 (N2): diameter (east-west direction 175 cm; north-south direction 190 cm); circumference 375 cm; height ca. 45 cm. N1 contained 18 eggs, 17 of which hatched during the first week of September, while N2 contained 19 eggs, 17 of which hatched about a week later. We are only aware of one similar observation of two adjacent *O. hannah* nests. The two nests, each with an attending female, were found to be only ca. 38 cm apart within the same clump of bamboo, in southern Thailand (Nakhon Si Thammarat Province; Leakey 1969. J. Nat. Res. Council Thailand. 5:1–20). Such unusual observations call for future investigations into the approximate territory sizes of female *O. hannah*, especially during nesting.

PHOTO BY JIGNASU DOLIA

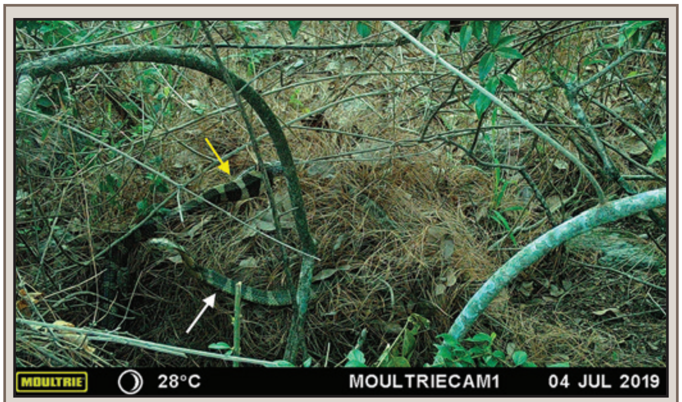

Fig. 1. Camera trap image of two *Ophiophagus hannah* seen together on a nest. The white arrow points to F1 (the female *O. hannah* who built the nest of pine needles), while the yellow arrow points to the visiting *O. hannah* (unknown sex) that briefly interacted with F1 on 4 July 2019 in Nainital, Uttarakhand, India.

In an effort to remotely monitor one of these twin nests, we deployed a camera trap (Moultrieâ M-50i trail camera; Birmingham, Alabama, USA; model # MCG-13270) overnight to monitor activity at N1. The camera was programmed to operate in time-lapse mode, taking one image every 30 s. On 4 July 2019, ca. 20 min after we left the nest site, another *O. hannah* visited N1 at 1903 h, while the first female (F1) was on top of her nest (Fig. 1; Lee Kong Chian Natural History Museum, National University of Singapore [ZRC(IMG)] 2.458). Although we are unsure of the sex of this visiting *O. hannah*, it seems to have a larger body size and head-width than that of F1. Due to logistical constraints, we were unable to set up an identical camera trap at N2, thus making it hard to determine whether the visiting *O. hannah* was in fact the nearby nesting female (F2) or a third, possibly male individual. However, there seems to have been a definite interaction, lasting about 4 min in total, between the two snakes. From the series of 14 successive 30-s snapshots of this brief event, we interpret their interaction as follows: at 1902 h, F1 raises her head (about 30 cm from the nest) and seems to be sensing another animal’s presence. At 1903 h, for the first time, the visiting cobra’s head and forebody, which is held upright for ca. 1 min, is clearly seen at the lower left side of the nest. At 1904 h, the visiting cobra joins F1 on top of her nest. In Fig. 1, we can see that both *O. hannah* are on top of N1, their heads off the ground, seemingly in alert positions. The visiting *O. hannah*’s hood seems to be slightly flattened in this image, clearly showing its first V-shaped neck band. The series of images between 1904 h and 1906 h are rather indistinct, and one can only make out an overlap of serpent coils. Finally, at 1907 h, the visiting *O. hannah* seems to leave N1 and F1, ending this interesting and possibly rare interaction. This is probably the first photographic evidence of two adult *O. hannah* seen together on one nest.

The primary author (JD) would like to thank the Uttarakhand State Forest Department for granting him permission to carry out fieldwork and to The Rufford Foundation, UK, for providing funding during 2018, with which the camera trap was purchased.

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***OVOPHIS OKINAVENSIS* (Hime Habu). *LEUCISM*.** *Ovophis okinavensis* is a medium-sized terrestrial pit viper found in the Okinawa and Amami Islands in the Ryukyu Archipelago, Japan (Takara 1962. Sci. Bull. Division Agr. Home Econ. Engineering, Univ.

Fig. 1. Leucistic *Ovophis okinavensis* observed on Amami Island, Japan.

Ryukyu 9:1–202). The typical coloration for the species is brownish gray or yellowish brown, with darker cross-bands or large blotches on the dorsum (Maki 1931. A Monograph of the Snakes of Japan. Daiichishobo, Tokyo, Japan. Vii + 240 pp.). Here, I report unusual coloration observed in *O. okinavensis*.

At 0119 h on 20 March 2017, a leucistic juvenile *O. okinavensis* (169 mm SVL, 29 mm tail length; Kyoto University, Graduate School of Human and Environmental Studies [KUHE] 61971; Fig. 1) was found on a forestry road in Amami-Oshima Island, Kagoshima Prefecture, Japan (28.42641°N, 129.57841°E; WGS84; 283 m elev.). Its coloration was yellowish pink with yellow blotches on the dorsum. The pupils were black, and the irises were grayish white. Albinism has been reported previously in *O. okinavensis* (Takada and Ohtani 2011. Keys to the Illustrated Manual of Japanese Reptiles and Amphibians in Natural Color. Hokuryukan, Tokyo. 296 pp.), however, to my knowledge this is the first report of leucism in *O. okinavensis*.

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***OXYBELIS FULGIDUS* (Green Vine Snake). DIET.** *Oxybelis fulgidus* is a large (to 230 cm total length [TL]), slender, arboreal colubrid that occurs at low and moderate elevations of Veracruz and southeastern Oaxaca, in México, through Central and South America, to northern Bolivia and Argentina (Heimes 2016. Herpetofauna Mexicana Vol. I. Snakes of Mexico. Edition Chimaira. Frankfurt am Main, Germany. 572 pp.). In the Yucatán Peninsula, this species inhabits all vegetation types, being most common in secondary vegetation and forest edges (Lee 2000. A Field Guide to the Amphibians and Reptiles of the Mayan World. Cornell University Press, Ithaca, New York. 402 pp.). The diet of *O. fulgidus* is mostly composed of lizards, although they also prey on birds (Henderson 1982. Amphibia-Reptilia 3:71–80). This species has been reported prey on birds from 17 families (Cherry et al. 2017. Mesoam. Herpetol. 4:650–652), and in 106 *O. fulgidus* analyzed in the northern region of Brazil, 46.3% of the prey were birds, especially Passeriformes (Scartozzoni et al. 2009. S. Am. J. Herpetol. 4:81–89).

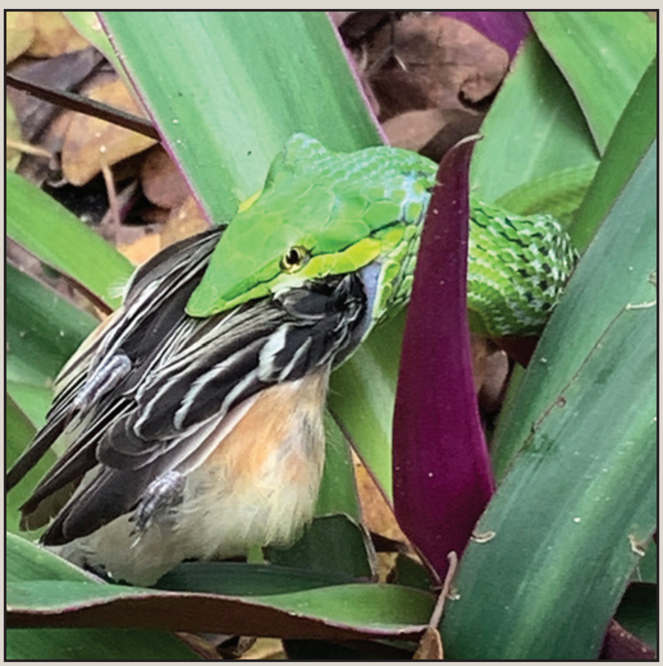

Fig. 1. An adult *Oxybelis fulgidus* consuming a *Tyrannus forficatus* in an urban zone in Cancún, Benito Juárez, Quintana Roo, Mexico.

At 1205 h on 24 October 2019, we found an adult *O. fulgidus* (ca. 165 cm TL) on the ground in an urban zone in the city of Cancún, Municipality of Benito Juárez, Quintana Roo, México (21.19735°N, 86.85940°W; WGS 84). The snake had caught an adult *Tyrannus forficatus* (Scissor-tailed Flycatcher; Fig. 1). At the time of the first observation, the *T. forficatus* was dead and the *O. fulgidus* was in the process of eating it. After ca. 15 min, the *O. fulgidus* finished eating the *T. forficatus* and, noticing our presence, moved to a small tree (ca. 4 m high), where it coiled up.

Among the species of the family Tyrannidae reported in the diet of *O. fulgidus* are *Elaenia* sp. (Rodrigues et al. 2005. Herpetol. Rev. 36:325–326), *Pitangus sulphuratus* (Viana et al. 2014. Herpetol. Rev. 45:518–519) and *Tyrannus melancholicus chloronotus* (Hayes 2002. J. Trinidad & Tobago Field Nat. Club. 2002:59–61). This represents the first time that *T. forficatus* has been reported in the diet of *O. fulgidus*.

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***PITUOPHIS RUTHVENI* (Louisiana Pinesnake). REPRODUCTION IN REPATRIATED POPULATION.** Threatened with extinction, the survival of *Pituophis ruthveni* is reliant on the fire-maintained, Longleaf Pine (*Pinus palustris*) ecosystem, which has been drastically reduced by ongoing and historical land use changes. On 19 July 2010, three captive-bred individuals were released onto restored habitat within the Kisatchie National Forest in Louisiana, USA, marking a major milestone in a cooperative effort between the U.S. Forest Service, U.S. Fish and Wildlife Service, Louisiana Department of Wildlife and Fisheries, and the Association of Zoos and Aquariums' Louisiana Pinesnake Species Survival Plan. The release site is positioned within *P. ruthveni*'s historic range, where the taxon is thought to be extirpated, as no snakes had been reported after 3749 trap-days of trapping during 2004–2009 (unpubl. data). A total of 178 captive-bred *P. ruthveni* have been repatriated to this site since 2010, all of which were tagged with passive integrated transponder (PIT) tags. Monitoring via automated PIT readers and funnel traps indicate that a significant portion of the released snakes have survived, grown, and acclimated to the natural environment (unpubl. data). Here, we report the first instance of reproduction within the repatriated population of *P. ruthveni*.

On 21 June 2016, a non-tagged individual with an SVL of 116.3 cm (Snake X; Fig. 1) was caught via funnel trap within the Catahoula Ranger District release site (Grant Parish, Louisiana). A genetic repository of skin sheds from all released snakes was used to perform parentage analyses on the repatriated population. Specifically, DNA was extracted from sheds of all individuals released before the discovery of "Snake X" (N = 75) following methods described by Fetzner (1999. BioTechniques 26:1052–1054). Individuals were genotyped for 14 previously developed microsatellite loci (Kwiatkowski et al. 2010. Conserv. Genet. Resour. 2:163–166) via PCR. The resulting PCR products were genotyped

Fig. 1. Untagged *Pituophis ruthveni* collected in Grant Parish, Louisiana, USA.

using an ABI 3100 Genetic Analyzer. Program Cervus v3.0.7 was used to perform both a parent-pair analysis with known sexes and an identity analysis. Identity analyses ruled out the possibility of a released snake losing its PIT tag, and parent-pair analyses confirmed a female hatched in 2010 and released in 2011 as the most likely mother, with 99% statistical confidence. No father was confidently assigned. This significant discovery is a highpoint in the repatriation efforts of this species and indicates that captive-bred, released Louisiana Pinesnakes are able to survive and reproduce in the wild.

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PSEUDASPIS CANA **(Mole Snake). DIET and HABITAT USE.** *Pseudaspis cana* is a robust (ca. 200 cm total length) species of non-venomous lamphrophiid snake inhabiting the southern and eastern parts of Africa. It has a pointed snout with an enlarged rostral scale which aids in breaking into rodent burrows (Alexander and Marais 2007. A Guide to the Reptiles of Southern Africa. Struik, Cape Town. 408 pp.) and specially designed teeth to aid in prey handling in confined spaces (Evans et al. 2019. PeerJ 7:e6943). The tendency for *P. cana* to prey upon fossorial and subterranean mammals as well as occupy uninhabited rodent burrows is well described in field guides (Fitzsimons 1970. A Field Guide to the Snakes of Southern Africa. Collins, London. 221 pp.; Alexander and Marais 2007, *op. cit.*). However, the peer reviewed literature lacks observation notes regarding diet or behavior. Here we report the first documented occurrences of *P. cana* breaking into, occupying, and likely predating upon mole-rats (family Bathyergidae) in southern Africa.

We have been researching *Fukomys damarensis* (Damaraland Mole-rat) in the Kalahari region of southern Africa as well as both *Georychus capensis* (Cape Mole-rat) and *Bathyergus suillus* (Cape Dune Mole-rat) in the Western Cape of South Africa for a number of years. Mole-rats are subterranean dwelling rodents native to Africa which live in extensive burrows completely sealed from the surface as a predator avoidance tactic (Begall et al. 2007. Subterranean Rodents—News from Underground. Springer, Berlin. 388 pp.). Mole-rats occupy the same burrow for life (Bennett and Jarvis 2004. Mamm. Species 756:1–5) and will aggressively defend it against any invaders including conspecifics (Cooney 2002. Proc. R. Soc. Lond. B Biol. Sci. 267:801–806). After sufficient rainfall has softened the soil, they create new tunnels and excess sand is extruded into mounds on the surface (Lovegrove and Painting 1987. Koedoe 30:149–163). They are at risk from predation by snakes (primarily *P. cana* and *Naja nivea* [Cape Cobra]) which may enter mole-rat burrows through these fresh mounds by pushing into the soft soil with their snout (Bennett and Jarvis 2004, *op. cit.*). To enter a mole-rat burrow, a snake would have to force their way through the mound and a 10–20 cm soil plug until it reaches the tunnel (Bennett and Jarvis 2004, *op. cit.*). During the dry season the mounds harden so that it would be almost impossible for a snake to break into a mole-rat burrow (KF, CV, DWH, pers. obs.). Since mole-rats occupy the same burrow for life they can be frequently recaptured by placing live traps at the tunnel under mounds. If there are fresh mounds then it means a mole-rat is present in that burrow and often mole-rats are still present if no fresh mounds are visible (KF, CV, DWH, pers. obs.). If several days of trapping pass without capture or activity (mole-rats respond to disturbances by blocking the offending tunnel or trap with sand) we assume the burrow is empty.

On 15 October 2018 at the Kalahari Research Centre in the Northern Cape Province of South Africa (26.97859°S, 21.83227°E; WGS 84; 1480 m elev.) we placed traps at tunnel entrances to a *F. damarensis* burrow ca. 30 cm deep within 10 m of each other and checked them every couple of hours. This group consisted of a reproductive male and female and their three adult offspring (174 g, 143 g, 130 g, 87 g, 79 g, respectively). We had successfully captured part of the colony, and JJ continued checking traps as normal throughout the day. It was discovered that a tunnel had been blocked by sand in the manner typical of a mole-rat response to disturbance. The sand that blocked the tunnel was only a few

Fig. 1. Two *Pseudaspis cana* at a *Georychus capensis* burrow. One of the snakes was inside the burrow with just its tail visible (top middle).

centimeters deep, so the blockage was easily cleared by hand. Immediately after breaking through the blockage, something bit JJ's finger and upon withdrawing his hand, about 20 cm of the body of *P. cana* followed. It released its grip shortly after being pulled from the tunnel, stayed protruded for a few seconds, and then retreated back into the tunnel. Due to the quick retreat of the snake we were unable capture it for measurement or photographs. As it only came out of the tunnel about 20 cm, we can only speculate that the total length was at least 60 cm. We suspect this snake had been resting in the section of tunnel after the mole-rats had blocked access to the trap we placed. The aggressive response immediately upon breaking through the blockage in the tunnel suggests that the snake was actively attempting predation at that location.

At another long-term study site in Dordabis, Namibia (22.96667°S, 17.68333°E; WGS 84; ca. 2100 m elev.), Bennett (pers. comm.) encountered a grey *P. cana* (ca. 100 cm total length) inside a *F. damarensis* burrow. As with JJ, Bennett placed his hand inside the burrow and the snake wrapped itself around the hand of Bennett who pulled the snake out of the burrow. The *P. cana* did not bite Bennett, once it was grasped around the head it uncoiled itself and was released far from the study site. This snake had two bulges at mid-body from recently consumed prey which were assumed to be mole-rats.

At Waylands Farm southwest of Darling, Western Cape, South Africa (33.41044°S, 18.42861°E; WGS 84; 146 m elev.) both *B. suillus* and *G. capensis* occur in sympatry where they have been long studied by the Mammal Research Institute at the University of Pretoria. In January 2018 DWH and BvJ encountered a black *P. cana* (ca. 150 cm total length) in the vicinity of *B. suillus* burrows. The snake was observed on the surface using its head as a digging tool to break into a newly created mound which had been formed the previous night. The snake moved its head side to side while pushing into the sand and thus opened a hole big enough for its head. It continued in this manner until it broke into the tunnel and entered the burrow. After a few days, the snake was sighted on the surface near the same burrow with a noticeable lump in its belly. The snake was chased away from the immediate trapping area by BvJ. Traps were placed at the burrow the snake left in an attempt to capture the mole-rat. After 5 d of no activity in the traps, the burrow was excavated. No mole-rats were found inside so it can only be assumed that the burrow occupant was predated upon by the snake since a fresh mound the day previous meant a *B. suillus* was present in the burrow prior to the snake entering the burrow.

During September 2019, CV captured and marked 30 *G. capensis* at the study site in Darling. During this month no *P. cana* were observed. When CV returned to Darling in November, she started recapturing these marked *G. capensis* and found 12 burrows were empty after several days of trapping without activity. We believe it very likely that these missing mole-rats had been predated upon (most likely by snakes) as most of these female *G. capensis* were pregnant in September and therefore unlikely to have left their burrows. At 1130 h on 11 November 2019 CV observed a black *P. cana* at the same study site in Darling in the vicinity of a *G. capensis* burrow. The next day at 1230 h two black *P. cana* were seen at another nearby *G. capensis* burrow which CV was actively trying to capture the mole-rat (Figure 1). The snakes made no move to flee when approached and remained even when CV started digging nearby. On another occasion during November 2019, after a few days of trapping without activity, a trap was removed from a *G. capensis* burrow and a *P. cana* was found inside the burrow at the tunnel entrance. On 7 December 2019 a greenish-brown *P. cana* was observed digging into a *G. capensis* burrow through a mound. After few minutes of digging the snake entered a tunnel and disappeared inside. About 10 min later it came up again through the same small opening and moved away. Previous trapping efforts at that burrow had already confirmed that the burrow was empty.

While we did not actually witness a snake capturing and consuming a mole-rat, we believe the evidence for predation on mole-rats by *P. cana* is strong. *Pseudaspis cana* is well equipped to break into sealed mole-rat burrows and may spend a few days or possibly a few months inside the burrows.

We thank Nigel Bennett (Department of Zoology and Entomology, Mammal Research Institute, University of Pretoria, Pretoria 0028, Gauteng, South Africa) for sharing his observation from Namibia. We thank Tim Clutton-Brock, Marta Manser, David Gaynor, Markus Zöttl, and the Kalahari Research Trust for financial and logistical support during work at the Kalahari Research Centre. We thank Graham Alexander and Bryan Maritz for helpful comments.

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***RHABDOPHIS CONSPICILLATUS* (Red-bellied Keelback). ANTIPREDATOR BEHAVIOR.** Many squamate reptiles demonstrate tail-breakage, or urotomy as an antipredator strategy. Urotomy is dichotomized into autotomy and pseudautotomy, where the former is characterized by voluntary intravertebral breakage and regeneration, whereas the latter involves intervertebral breakage without regeneration (Savage and Slowinski 1996. Biol. J. Linn. Soc. 57:129–194). Autotomy has evolved in several lineages of lizards, as well as *Sphenodon*, and pseudautotomy is found in some other lizards and a few snake species. Here we report a case of pseudautotomy in a small terrestrial natricine snake, *Rhabdophis conspicillatus*, which is distributed throughout the Sunda region in southeast Asia.

At 2146 h on 25 August 2018, one of the authors (KF) captured a male *R. conspicillatus* (320 mm SVL, 72 mm complete tail length, 9.2 g) on a trail surrounded by lowland dipterocarp forest in Kubah National Park, Sarawak, Malaysia (1.60774°N, 110.19329°E; WGS 84; 249 m elev.). The snake was fleeing into the leaf litter on the side of the trail when spotted by the observer. As KF grabbed the snake by the tip of its tail, it immediately performed rapid undulation and lateral rotation of the body, causing part of the tail to break off. The dropped tail (41 mm long) kept wriggling for over 30 sec, but the exact duration of the movement was not recorded. Air temperature and cloacal body temperature measured immediately after capture were 24.8°C and 25.6°C, respectively. Both the snake and the detached tail were collected for further inspection. A radiograph revealed that the tail was broken intervertebrally

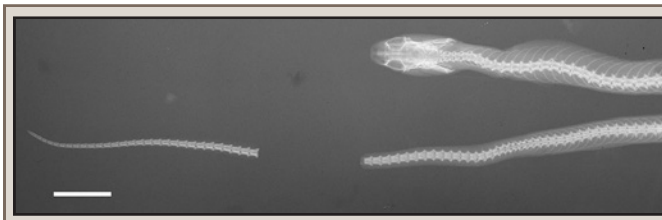

Fig. 1. A radiograph of *Rhabdophis conspicillatus* (SRC 00771) which performed pseudautotomy. Scale bar = 10 mm.

between the 21st and 22nd vertebrae (Fig. 1). The specimen was deposited in the collection of the Research, Development and Innovation Division, Sarawak Forest Department (SRC 00771).

This is the first case of pseudautotomy in the genus *Rhabdophis*, although the same behavior has been observed in other related natricine snakes, such as *Xenochrophis piscator* (Ananjeva and Orlov 1994. Russ. J. Herpetol. 1:169–171), *Natriciteres* spp. (Broadly 1987. Afr. J. Herpetol. 33:18–19), *Amphiesma stolatum* (Sharma 1980. Snake. 12:60), and *Nerodia sipedon* (Bowen 2004. Can. Field. Nat. 118:435–437). The trait may be more common in this subfamily than other snake taxa, which calls for further phylogenetic and ecological exploration.

We collected the specimen under the permission of the State Government of Sarawak (Research Permit No. [133]JHS/NCCD/600-7/2/107 and Park Permit No.WL72/2018).

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***SCOLECOPHIS ATROCINCTUS* (Black-banded Snake). REPRODUCTION/COMBAT BEHAVIOR.** *Scolecophis atrocinctus* is a slender-bodied colubrine that is found between 40 and 1600 m along the Pacific versant from southeastern Guatemala to northwestern Costa Rica, and along the Atlantic versant in southwestern Honduras and western Nicaragua (Wilson and Williams 2002. *Scolecophis*, *S. atrocinctus*. Cat. Amer. Amph. Rept. 758:1–4). Very little is known about its natural history.

At 1543 h on 3 January 2020, one of us (EC) spotted a pair of adult *Scolecophis atrocinctus* along the edge of a trail in Parque Nacional Rincón de la Vieja (Guanacaste, Costa Rica). The two snakes were found active, stretched out, and intertwined on the forest floor. For several minutes they twisted and rolled around each other, simultaneously attempting to lift their heads and necks over top of one another (Fig. 1A). One bit the other posterior to the head at least once (Fig. 1B). The snakes remained entwined and continued the rolling/head-lifting behavior before eventually disappearing into the leaf litter, still wrapped around each other (Fig. 1C, D). A video of this observation can be viewed at: https://vimeo.com/386567377.

As the snakes were not collected and sexed—and no descriptions of reproductive or combat behavior in *S. atrocinctus* have been published—we cannot say with certainty whether this was an instance male-male combat, intersexual combat, or pre-coital reproductive behavior. We note that the observation (including intertwining bodies, rolling over several times, and biting) corresponds well with reports of male-male combat in another small, ground-dwelling sonorine snake, *Sonora semiannulata* (Kroll 1971. Texas J. Sci. 23:300; Broussard et al. 2020. Herpetol. Rev. 51:359–360) and is similar to instances of male-male combat described in the elapids *Micrurus altirostris* (Almeida-Santos et al. 1998. Herpetol. Rev. 29:242–243) and *M. lemniscatus carvalhoi* (Missassi et al. 2018. Herpetol. Rev. 48:214–215). Intraspecific combat behavior in New World colubrids is more commonly reported in larger-bodied species and appears to be exceedingly rare in smaller taxa (Shine 1994. Copeia 1994:326–346; Senter et al. 2014. PLoS ONE 9:e107528; and references therein). To the best of our knowledge, our record is the first of combat behavior in *Scolecophis atrocinctus,* and only the third report of such behavior among any species of the colubrid tribe Sonorini (Kroll 1971, *op. cit.*; Broussard et al. 2020, *op. cit.*; Montingelli et al. 2019. J. Zool. Syst. Evol. Res. 57:205–239). Whether the paucity of similar records reflects a truly rare behavior among small snakes or a bias in our understanding due to the cryptic nature of these species requires more thorough investigations of their natural history. This observation was originally submitted to iNaturalist (https://www.inaturalist.org/observations/37250618), and we encourage the use of this and other citizen science platforms for documenting natural

Fig. 1. Combat behavior between two *Scolecophis atrocinctus* from Guanacaste, Costa Rica: A) individuals intertwined and rolling; B) one individual biting the other; C, D) snakes intertwined, alternating head and neck movements.

history observations. We thank Rhett M. Rautsaw for assistance with video editing.

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TANTILLA CUNICULATOR **(Yucatán Centipede Snake). ARBOREAL BEHAVIOR.** *Tantilla cuniculator* is a small colubrid (ca. 250 mm total length [TL]) endemic to the Yucatán Peninsula (Campbell 1998. Amphibians and Reptiles of Northern Guatemala, the Yucatán and Belize. University of Oklahoma Press, Norman, Oklahoma. 380 pp.), which encompasses southern Mexico, Northern Guatemala, and Belize (Heimes 2016. Herpetofauna Mexicana Vol. I. Snakes of Mexico. Edition Chimaira. Frankfurt am Main, Germany. 572 pp.). This snake species is relatively uncommon to encounter and our knowledge about its diet and reproduction is limited (Lee 2000. A Field Guide to the Amphibians and Reptiles of the Maya World. Cornell University Press, Ithaca, New York. 402 pp.). It generally inhabits tropical thorn forest, tropical deciduous forest, and evergreen seasonal forests, is considered to have predominantly terrestrial and fossorial habits, and it is most commonly found within or beneath the upper layer of leaf-litter (Heimes 2016, *op. cit.*).

At 1036 h on 21 July 2019 an adult *T. cuniculator* (ca. 210 mm TL) was observed on the trunk of a *Haematoxylum campechianum* tree (ca. 6 m tall), at ca. 70 cm from the ground (Fig. 1) at our Hormiguero research camp site (18.40308°N, 89.48712°W; WGS 84) inside Calakmul Biosphere Reserve, Campeche, Mexico. The snake was facing downward and slowly heading towards the forest floor, using the tree's natural crevices to manoeuvre around. Arboreal behavior has been recorded in other species of the genus *Tantilla*. For example, in Costa Rica, two individuals of *T. schistosa* were observed in a palm tree at a height of 5 m (Solórzano 2004. Serpientes de Costa Rica. Universidad de Costa Rica. San José, Costa Rica. 792 pp.). *Tantilla cuniculator* is described as terrestrial (Lee 2000, *op. cit.*; Heimes 2016, *op. cit.*) and, to our knowledge, this observation represents the first record of arboreal behaviour in this species.


PHOTO BY AMY ELIZABETH ROSS

Fig. 1. Arboreal behavior in *Tantilla cuniculator* from Campeche, Mexico.

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TANTILLITA CANULA **(Yucatecan Dwarf Short-tail Snake). PREDATION.** *Tantillita canula* is a diminutive colubrine (ca. 180 mm total length) that occurs in the Central Petén region in northeastern El Salvador, Guatemala, central Belize, and the Yucatán Peninsula in Mexico (Heimes 2016. Herpetofauna Mexicana Vol. I. Snakes of Mexico. Edition Chimaira. Frankfurt am Main, Germany. 572 pp.). This snake is considered a nocturnal terrestrial species, and it has been recorded in different vegetation types, including thorn forest and tropical evergreen forest (Lee 2000. A Field Guide to the Amphibians and Reptiles of the Maya World. Cornell University Press, Ithaca, New York. 402 pp.). The biology and ecology of this species are poorly known, and no predators or predation events on this snake have been recorded. Here, we report a predation event upon *T. canula* by a bird.

At 1104 h on 6 December 2016, in the Campus de Ciencias Biológicas y Agropecuarias of the Universidad Autónoma de Yucatán, Mérida, Yucatán, Mexico (20.86853°N, 89.61865°W; WSG 84), PNC and FPR observed an adult *Momotus lessonii* (Lesson's Motmot) perched on a 2 m high branch of a tree. Immediately, the bird flew to the ground and caught an adult *T. canula* (ca. 150 mm total length) with its beak (Fig. 1). The event occurred in a location surrounded by secondary vegetation and deciduous forest. The bird held the snake and repeatedly hit it against rocks on the ground. Meanwhile the snake thrashed about, trying to free itself from the

Fig. 1. Adult *Tantillita canula* being preyed on by *Momotus lessonii* in Mérida, Yucatán, Mexico.

bird's beak. A few minutes later, the bird finished eating the snake and flew away from the site.

Members of the family Momotidae feed on insects and small vertebrates (Lovette and Fitzpatrick 2016. Handbook of Bird Biology. Third edition. John Wiley & Sons, Chichister, West Sussex. 736 pp.). Some species have been recorded preying on herpetofauna, such as *Baryphthengus martii* (Master 1999. Wilson Bull. 111:439–440) and *Eumomota superciliosa* (Ortiz-Lachica et al. 2017. Mesoam. Herpetol. 4:630–631). To our best knowledge, this observation represents the first record of predation on *T. canula*.

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***THAMNOPHIS ELEGANS TERRESTRIS* (Coast Gartersnake). TETRODOTOXIN POISONING.** The interaction between toxic Pacific newts (*Taricha* spp.) and predatory gartersnakes (*Thamnophis* spp.) has become a model system for addressing questions of arms-race coevolution (e.g., Brodie and Brodie 1999. Bioscience 49:557–568; Thompson 2005. The Geographic Mosaic of Coevolution. University of Chicago Press, Chicago, Illinois. 443 pp.), the adaptive process (Feldman et al. 2009. Proc. Nat. Acad. Sci. USA 106:13415–13420; McGlothlin et al. 2016. Curr. Biol. 26:1616–1621), and even convergent molecular evolution (Feldman et al 2012. Proc. Nat. Acad. Sci. USA 109:4556–4561; Brodie and Brodie 2015. Brain Behav. Evol. 86:48–57; Hague et al. 2017. Evolution 71:1504–1518). Newts contain tetrodotoxin (TTX; Mosher et al. 1964 Science 144:1100–1110; Wakely et al. 1966. Toxicon 3:195–203), a powerful neurotoxin that disrupts nerve transmissions and muscle activity (Hille 2001. Ion Channels of Excitable Membranes. Third edition. Sinauer Associates, Sunderland, Massachusetts. 812 pp.), leading to paralysis or even death in nearly all predators (Brodie 1968. Copeia 1968:307–313). TTX levels vary across species of *Taricha* as well as geographically within species (Hanifin et al. 1999. J. Chem. Ecol. 25:2161–2175; Hanifin et al. 2008. PLoS Biol. 6:e60), with some populations containing newts with almost no TTX (Brodie and Brodie 1991. Evolution 45:221–224; Hague et al. 2016 Ecol. Evol. 2016. 6:2714–2724), whereas other populations contain newts so deadly that a single individual could kill >30 people (Stokes et al. 2015. Northwest. Nat. 96:13–21). Despite the potent effects of TTX, three gartersnake species have evolved varying degrees of resistance to TTX in western North America (Feldman et al. 2009, *op. cit.*). To date, nearly all observations of *Thamnophis* preying on transformed newts in the wild include only those three coevolved gartersnakes species: *T. sirtalis* (Brodie 1968, *op. cit.*; Brodie and Brodie 1990. Evolution 44:651–659; Brodie et al. 2002. Evolution 56:2067–2082), *T. couchii* (Brodie et al. 2005. J. Chem. Ecol. 31:343–356; Pool and Wiseman 2007. Herpetol. Rev. 38:344–345), and *T. atratus* (Fox 1951. Univ. California Publ. Zool. 50:485–530; Greene and Feldman 2009. Herpetol. Rev. 40:103–104). Here, we report a novel predator-prey interaction between a *Thamnophis* species not previously known to prey on toxic *Taricha*.

At 1400 h on 1 March 2020 under cool, cloudy skies, RWH and RS encountered an adult female *Thamnophis elegans terrestris* (ca. 70 cm TL) in the process of ingesting an adult California Newt (*Taricha torosa*; Fig. 1) along San Carpoforo Creek in San Luis Obispo County, California, USA. Under normal conditions, the snake would have fled as we approached, but in this case she remained motionless. After a short period of observation, we moved on but marked the location for later examination. We returned to the spot ca. 30 min later and observed that the snake had not moved. Suspecting TTX-induced impairment given that the snake's body showed no signs of injury, we touched the snake's tail to check for paralysis. The snake responded by slowly moving its tail but was unable to crawl or otherwise move its body. We then noticed a food bolus that most likely was another adult newt ingested earlier (Fig. 2).

Fig. 1. Adult female *Thamnophis elegans terrestris* as first encountered, ingesting an adult *Taricha torosa* in San Luis Obispo County, California, USA.

Given that the snake was a full-grown adult living in an area with an abundant newt population, it seems likely that newts have been part of this snake's diet. Newts from this area contain 0.1–0.3 mg of TTX (mean = 0.13 mg of TTX; Hanifin et al. 2008, *op. cit.*), only enough to reduce the sprint speed of a sympatric *T. sirtalis* to 85% of its baseline speed (Brodie et al. 2002, *op. cit.*), but enough to reduce the crawl speed of a sympatric *T. elegans* to 50% or more of its normal ability (Feldman et al. 2009, *op. cit.*). Based on this, we

Fig. 2. Photo taken ca. 30 min after first encounter (Fig. 1), showing little or no progress in completing ingestion of the newt. Arrow denotes a food bolus that presumably represents another adult newt. The snake was unable to flee, disgorge newt, defend itself, or otherwise move its body—physical impairments consistent with TTX poisoning.

suggest that the snake observed here was experiencing the sublethal effects of TTX and that the impairment eventually subsided, and the snake fully recovered. We cannot speculate on the duration of the snake's immobility and thus exposure to predators (or the elements), but lab studies show that recovery in *T. sirtalis* generally occurs within 1 to 3 h (Williams et al. 2003. Herpetologica 59:155–163), though some snakes remain impaired for over 7 h (Brodie and Brodie 1990, *op. cit.*). This observation is noteworthy because it is the first to document predation by *T. elegans* on metamorphosed *Taricha* in the wild and suggests yet a fourth snake species may be engaged in the complex arms-race with newts.

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VIPERA ASPIS HUGYI **(Southern Italian Asp). COLORATION.** *Vipera aspis* is a polytypic species for which four subspecies are currently recognized: *V. a. aspis*, *V. a. francisciredi*, *V. a. hugyi*, and *V. a. zinnikeri* (Golay et al. 2008. Amphibia-Reptilia 29:71–83; Di Nicola et al. 2019. Anfibi & Rettili d'Italia. Edizioni Belvedere, Latina, Italy. 568 pp.). The polymorphism level is high in all subspecies, with dorsal ground hues usually varying from light grey to brown or reddish. The most common dorsal pattern is the blotched morph and varies in the different subspecies with more or less separated blotches of variable size (*V. a. aspis* and *V. a. francisciredi*), variably thick zig-zag band (*V. a. aspis* and *V. a. zinnikeri*) or elliptical, roundish or quadrangular shapes (*V. a. hugyi*; Zwahlen et al. 2012. 7th World Congress of Herpetology, Vancouver, Canada. 739 pp.; Di Nicola et al. 2019, *op. cit.*). Melanistic individuals are known for all *V. aspis* subspecies (Bruno 1976. Atti Soc. Ital. nat. Museo civ. Stor. nat. Milano. 117:165–194; Bruno 1985. Le vipere d'Italia e d'Europa. Edagricole, Milan, Italy. 278 pp.; Brodmann 1986. Die giftschlanger Europas und die gattung Vipera in Afrika und Asien. Kümmerly + Frey, Bern, Switzerland. 148 pp.), even though they are only rarely reported for *V. a. hugyi* (Di Nicola and Meier 2013. Herpetol. Rev. 44:698). A rarer condition is the patternless or concolor morph (showing no or greatly reduced dorsal pattern), which is well known for the nominate subspecies (Mebert et al. 2011. Elaphe 1:9–13; Tessa 2016. Atti XI Congresso Nazionale della Societas Herpetologica Italica, Trento 2016) and poorly reported for *V. a. zinnikeri* (De Smedt 2006. The Vipers of Europe. – Eigenverlag, Halblech, Germany. 340 pp.; K. Mebert, pers. comm.). This color morph was also observed on a putative hybrid between the latter subspecies and *V. latastei* (Zuazo et al. 2019. Bol. Asoc. Herpetol. Esp. 30:35–41) and was reported in a generic way for *V. a. francisciredi* (De Smedt. 2006, *op. cit.*). The adaptive function of the concolor morph still requires further investigation (Zwahlen et al. 2012, *op. cit.*; Tessa 2016, *op. cit.*) although several hypotheses have already been proposed (see Dubey et al. 2015. BMC Evol Biol 15:99).

Vipera aspis hugyi is endemic to southern Italy, being distributed in central and southern Campania, Apulia and Basilicata (excluding the northernmost portions), Calabria, Sicily and on Montecristo Island (where it was introduced in historical times; Masseti and Zuffi 2011. Br. Herpetol. Bull. 117:1–9; Di Nicola et al. 2019, *op. cit.*). On 29 May 2019, at 1129 h, an adult patternless *V. a. hugyi* was observed in the territory of Noto, Province of Siracusa, Sicily, Italy (36.96°N, 14.93°E; 520 m asl), by some forest workers who photographed (Fig. 1), filmed, and then let the snake go. The individual had a totally uniform light brown dorsal color; unfortunately, no detailed images of the head and belly are available. The snake was found moving in a small grassy clearing, located on the edge between a pine reforestation and a garrigue with scattered bushes and rocky outcrops. The authors did not have the opportunity to personally examine the snake, but the morphological evaluation of the animal habitus and the finding point leave no doubts about the reliability of the observation and the subspecific identity of the individual. This report constitutes the first observation of patternless morph in *V. a. hugyi*. Further field investigation will be useful to check if it is an isolated case or if this morph can be locally widespread, as happens in other asp populations (Mebert et al. 2011, *op. cit.*)

PHOTO BY VINCENZO LOMBARDO

Fig. 1. Adult patternless *Vipera aspis hugyi* individual from Noto territory, Siracusa, Sicily.

We are gratefull to Nunzia Bennardo and Vincenzo Lombardo for providing us photographs and information about the viper observation, Sebastian Colnaghi for putting us in contact with the forest workers, and Salvatore Russotto for his communications.

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XENOCHROPHIS TRIANGULIGERUS **(Triangle Keelback). DIET and FEEDING BEHAVIOR.** The diet of *Xenochrophis trianguligerus*, a widespread aquatic natricine, has been reported to include frogs, including frogspawn and tadpoles (e.g., Stuebing and Inger 1999. A Field Guide to the Snakes of Borneo. Natural History Publications (Borneo), Kota Kinabalu, Malaysia. 262 pp.), and fish (Das 2010. A Field Guide to the Reptiles of South-East Asia. New

FIG. 1. *Xenochrophis trianguligerus* consuming a fanged frog (*Limnonectes* sp.) in Lambusango Forest Reserve, Buton Island, southeast Sulawesi, Indonesia.

Holland Publishers, London, UK. 376 pp.). However, the diet of *X. trianguligerus* east of Wallace's Line, in Sulawesi and the Moluccas, remains poorly documented (de Lang and Vogel 2005. The Snakes of Sulawesi. Edition Chimaira Publishing, Frankfurt, Germany. 312 pp.). Here, we report observations of this species predating and consuming fanged frogs (*Limnonectes* sp.) in Sulawesi.

One observation was made on 4 July 2008 within Lambusango Forest Reserve, Buton Island, southeast Sulawesi, Indonesia (5.35187°S, 122.90182°E; WGS 84). Both the snake and frog were observed on sandy soil ca. 10 m from the bank of a small river, between the buttresses of a small tree. The snake initially seized the frog by its left rear leg and then maneuvered itself into a position where it could consume it, rear first (Fig. 1). A similar observation was made by one of the authors (GG) in Bako National Park, North Sulawesi, in August 2013. These observations demonstrate that components of the diet of *X. trianguligerus* in Sulawesi is similar to that of the species elsewhere in Southeast Asia, and also highlights this snake as a predator of poorly-known *Limnonectes* frogs. Images of this predation event have been deposited in the National Museum of Natural History, Smithsonian Institution, Herpetological Image Collection (USNM Herp Image 2901, 2902).

The fieldwork which documented this observation was covered by RISTEK permit 1261/FRP/SM/VI/08.

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XENOPELTIS UNICOLOR **(Sunbeam Snake). PARASITES.** *Xenopeltis unicolor* is known from southeast Asia and the East Indies (Wallach et al. 2014. Snakes of the World A Catalogue of Living and Extinct Species. CRC Press, Boca Raton, Florida. 1201 pp.). There are two published records of helminths from *X. unicolor*: the cestode *Macrobothriotaenia ficta* (Scholz et al. 2013. Zootaxa 3640:485–499) and the nematode *Meteterakis longispiculata*

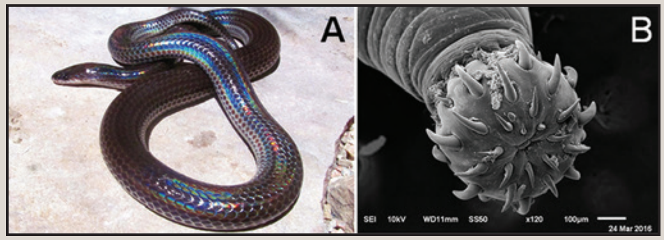

FIG. 1. A) *Xenopeltis unicolor* from Sumatra, Indonesia; B) SEM image of the anterior end of the acanthocephalan parasite, *Sphaerechinorhynchus serpenticola* removed from the intestine of *X. unicolor*.

(Schmidt and Kuntz 1972. Trans. Amer. Micros. Soc. 91:63–66). In this note we add to the helminth list of *X. unicolor*.

One adult female *X. unicolor* (540 mm SVL, 60 mm tail length) collected in 2014 from Sumatra, Indonesia (0.5897°S, 101.3431°E; WGS 84), was obtained from Bushmaster Reptiles, Boulder, Colorado, USA. It was deposited in the University of Northern Colorado Museum of Natural History Herpetology Collection (UNC-MNH 6074), sacrificed, and the body cavity was opened and searched for helminths utilizing a dissecting microscope. The small intestines contained an assortment of helminths. They were cleared in a drop of lactophenol, examined under a compound microscope and identified as two Cestoda (*Macrobothriotaenia ficta*), five Nematoda (*Meteterakis longispiculata*), and 30 Acanthocephala (*Sphaerechinorhynchus serpenticola*). We identified *M. ficta* by comparison to Scholz et al. (2013, *op. cit.*) and *M. longispiculata* from the key provided by Zhang and Zhang (2011. Zootaxa 2869:63–88). *Sphaerechinorhynchus serpenticola* (Fig. 1) was identified by comparison to the original description (Schmidt and Kuntz 1966. J. Parasitol. 52:913–916). *Sphaerechinorhynchus serpenticola* is previously known from *Naja naja* from Borneo (Schmidt and Kuntz 1966, *op. cit.*) and *Ophiophagus hannah* from Thailand (Kiel and Schmidt 1984. Avian/Exotic Practice 1:26–30). A list of species of *Meteterakis* and their helminths was provided by Junker et al. (2015. Syst. Parasitol. 92:131–139) and *X. unicolor* is the only known host of *Macrobothriotaenia ficta* (Scholz et al. 2013, *op. cit.*). Voucher helminths were deposited in the Harold W. Manter Parasitology Laboratory (HWML), The University of Nebraska, Lincoln, Nebraska, USA as *Macrobothriotaenia ficta* (HWML 111563), *Meteterakis longispiculata* (HWML 111564), *Sphaerechinorhynchus serpenticola* (HWML 111565). *Sphaerechinorhynchus serpenticola* in *X. unicolor* is a new host record.

We thank Kamuran Tepetelan (Bushmaster Reptiles) for the donation of *X. unicolor* and Chad Wangeline (UNC) for assistance with SEM preparation.

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