

NATURAL HISTORY NOTES

CAUDATA — SALAMANDERS

AMBYSTOMA MACULATUM (Spotted Salamander) and **AMBYSTOMA JEFFERSONIANUM** (Jefferson's Salamander). **CUTANEOUS BACTERIA.** The importance of the cutaneous microbiome in amphibians is becoming increasingly apparent (Culp et al. 2007. *Herpetologica* 63:66–71; Muletz-Wolz et al. 2017. *Appl. Environ. Microbiol.* 83:e00186-17). Dermal bacteria can inhibit the growth of pathogenic organisms such as the chytrid fungi *Batrachochytrium dendrobatidis* and *B. salamandrivorans* (Muletz-Wolz et al. 2017. *Front. Microbiol.* 8:1551). The preponderance of studies on vertebrate dermal bacteria have been done on mammals (Colston and Jackson 2016. *Mol. Ecol.* 25:3776–3800). Studies on salamanders have tended to focus on plethodontid salamanders (Lauer et al. 2007. *Copeia* 2007:630–640; Fitzpatrick and Allison 2014. *FEMS Microb. Ecol.* 88:482–494; Muletz-Wolz et al. 2017, *op. cit.*). To our knowledge, there have been no studies that have focused on the cutaneous microbiome of ambystomatid salamanders.

On 7 March and 28 March 2017 12 *Ambystoma maculatum* (seven females, five males) and three *A. jeffersonianum* (all females; whether these were pure Jefferson's or unisexual hybrids with *A. laterale* was unknown) were captured by hand as they migrated toward breeding pools at Mendon Ponds Park, Monroe County, New York, USA (43.02472°N, 77.57277°W; WGS 84; 171 m elev.). Salamanders were rinsed three times with distilled water to remove environmental bacteria and debris (Lauer et al. 2007, *op. cit.*). Swabs were taken from the dorsal and ventral surface of each salamander, and swabs were streaked onto tryptic soy agar (TSA) plates and incubated at room temperature. Salamanders were released immediately after samples were obtained. Common bacteria from each plate were subcultured to obtain pure colonies and subsequently gram stained and analyzed with BioMerieux API 20E kits to identify bacterial species. These kits use twenty biochemical tests to identify bacteria to the genus or species level.

The number of bacterial colonies found per animal ranged from 2–577 and the number of bacterial species per salamander ranged from 1–6 and averaged 3.08 in *A. maculatum* and 1.5 in *A. jeffersonianum*. More colonies were found on both surfaces of male *A. maculatum* than females (Mann-Whitney U-test, $P < 0.05$). No statistical difference was found between number of colonies found on ventral versus dorsal surfaces for either sex in *A. maculatum*.

TSA plates in both species contained prominent mucoid colonies. We chose to focus on a species identified as *Pseudomonas aeruginosa*. Several species of *Pseudomonas* have been found among the cutaneous bacterial communities of plethodontid salamanders (Woodhams et al. 2015. *Ecology* 96:595; Muletz-Wolz et al. 2017, *op. cit.*) but only one study identified *P. aeruginosa* specifically (Lauer et al. 2008. *ISME Journal* 2:145–157). *Pseudomonas aeruginosa* has been shown to

have antifungal properties (Lauer et al. 2007, *op. cit.*) and other *Pseudomonas* have strong antifungal abilities that may play a role in prevention of both *B. dendrobatidis* and *B. salamandrivorans* (Lauer et al. 2007, *op. cit.*). *Pseudomonas aeruginosa* is the first component of the microbiome of ambystomid salamanders to be identified, but more work is needed to help understand the components and significance of cutaneous bacterial communities in these species.

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AMPHIUMA MEANS (Two-toed Amphiuma). **DIET.** Amphiumas are among the largest amphibians in North America and are considered to be powerful predators. *Amphiuma means* has been reported consuming a wide variety of both vertebrate and invertebrate prey items (Petranka 1998. *Salamanders of the United States and Canada*. Smithsonian Institution Press, Washington, DC. 587 pp.). Smaller animals like crayfish, macroinvertebrates, fish, frogs, and even other salamanders are all important components of their diet. However, dietary records show that they also occasionally take much larger prey items, including full-grown sunfish, turtles, and water snakes (Petranka 1998, *op. cit.*).

On 2 February 2019, we collected an adult *A. means* (43.2 cm SVL, 58.5 cm total length, 201 g) using a collapsible mesh minnow trap within a shallow slough section of the Loxahatchee National Wildlife Refuge, Palm Beach County, Florida, USA (26.49156°N, 80.21838°W; WGS 84). The *A. means* was brought back to the field station and placed in a solution of 0.5 g tricaine methanesulfate (MS-222) per liter of water, used to anesthetize salamanders prior to injection with a 1 cm passive integrated transponder (PIT) tag (Biomark, Boise, Idaho, USA). The *A. means* was kept overnight in a separate bucket of water to allow adequate recovery time. Prior to its release on 3 February 2019, a regurgitated segment (86.6 mm long × 9.6 mm wide) of a *Nerodia fasciata* (Banded Watersnake) was found in the bucket with the *A. means*. While the *A. means* obviously consumed this portion of the snake, it is unclear if the *A. means* predated the *N. fasciata* or simply scavenged the remains.

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EURYCEA CIRRIGERA (Southern Two-lined Salamander). COMMUNAL NESTING. On 3 February 2019, we flipped a large rock to reveal at least nine separate *Eurycea cirrigera* nests in a small stream in Athens-Clarke County, Georgia, USA (33.92800°N, 83.37500°W; WGS 84). At least two female *E. cirrigera* were present with the nests, but we did not thoroughly search the excavation underneath. We quickly photographed the rock, and we used this photograph to count the number of eggs in seven of the nests (Fig. 1). These nests ranged in size from 35 to 83 eggs (mean = 48.1, SD = 16.8), and varied in development from recently deposited to near hatching. Communal nesting has been detailed for several members of the *Eurycea bislineata* species complex, but primarily for species with “guarding” male reproductive tactics, including populations from the Ohio River Valley currently assigned to the paraphyletic *E. cirrigera* sensu lato (e.g., Jakubanis et al. 2008. *Northeast. Nat.* 15:131–140; summarized in Pierson et al. 2019. *Am. Nat.* 193:608–618.). Males of these species have hypertrophied jaw musculature and exhibit mate-guarding behavior at nesting sites. In contrast, males of *E. cirrigera* (sensu stricto)—which occurs throughout much of the Gulf and Atlantic Coastal Plains and Piedmont—appear to exhibit only “searching” tactics. These males lack hypertrophied jaw musculature but have elongate cirri that are presumably used to locate females in terrestrial habitats (Pierson et al. 2019, *op. cit.*). Although it has been mentioned in previous literature accounts of the species (Jensen et al. 2008. *Amphibians and Reptiles of Georgia*. University of Georgia Press, Athens, Georgia. 575 pp.), our observation represents the most thorough description of communal nesting in *E. cirrigera* (sensu stricto) and includes a particularly large number of females nesting under a single rock. This stream was heavily sedimented, and as a result, suitable nesting sites appeared limited, which may in part explain this concentration of nests under a single rock. Further study of the relationships between reproductive tactics, nesting, and parental care in this group is warranted.



FIG. 1. Nine communal nests of *Eurycea cirrigera*, found in Athens-Clarke County, Georgia, USA.

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EURYCEA SPELAEA (Grotto Salamander). POLYMELIA. Abnormalities in digits and limbs of amphibians have been reported in many species of amphibians (Sessions and Ruth 1990. *J. Exp. Zool.* 254:38–47; Hinckley et al. 2015. *Herpetol. Bull.* 133:36–37). Causes of deformities include inbreeding (Williams et al. 2008. *Biol. Lett.* 4:549–552), parasitic (trematode) infections, exposure to environmental pollutants (Blaustein and Johnson 2003. *Front. Ecol. Environ.* 1:87–94; Taylor et al. 2005. *Env. Health Pers.* 113:1497–1501), and bite injury (Thompson et al. 2014. *Regeneration* 1:27–32). One of the earliest reports of polymelia (an extra limb) in Caudata occurred in 1901 in *Notophthalmus viridescens* (Williamson 1901. *Ohio J. Sci.* 2:2) with additional reports occurring in *Salamandra infraimmaculata* (Hinkley et al. 2015. *Herpetol. Bull.* 133:36–37), *Ambystoma macrodactylum* (Sessions and Ruth 1990, *op. cit.*), *A. talpoideum* (Davis 2010. *Herpetol. Rev.* 41:327–328) and *Pseudotriton ruber ruber* (Cecala et al. 2007. *Herpetol. Rev.* 38:434), to name a few. Fossil evidence also supports the existence of polydactyly and polymelia in Jurassic salamanders (Wang et al. 2016. *Paleobio. Palaeoenv.* 96:49–59). Abnormalities caused by parasitic infections of trematodes have been reported in *Eurycea spelaea* (Fenolio et al. 2013. *Speleobiol. Notes* 5:34–37), however, this is the first known report of limb deformity in this species.

On 22 September 2018, while surveying a cave in Barry County, Missouri, USA (precise location withheld due to conservation concerns), we found a Grotto Salamander with a second foot on the anterior portion of its left rear thigh (Fig. 1). This extra foot was smaller in size compared to its other feet and had only four developed digits. During movement, the accessory foot protruded from the thigh forward creating a waving motion. When the rear left leg was extended forward, the extra foot contacted the midrib of the salamander. This appeared to slightly restrict its range of motion, but the overall movement of the individual was not hindered, and the pace of movement was normal. The individual may have in fact benefited from the added ground contact the extra foot provided on steep surfaces.



FIG. 1. Dorsal view of *Eurycea spelaea* with an extra foot growing out of the left rear limb. The abnormal additional foot is indicated by the arrow.

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EURYCEA SUBFLUVICOLA (Ouachita Streambed Salamander). **DIET.** *Eurycea subfluvicola* is the first paedomorphic spelepine salamander to be reported from the Ouachita Mountains, Interior Highlands of North America (Steffen et al. 2014. *Zootaxa* 3786:423–442). It is known only from the type locality headwater stream basin in Hot Spring County, Arkansas (precise locality withheld due to conservation concerns) and is a protected species as listed in Arkansas Game and Fish Commission regulations. Since its description, nothing has been published regarding the ecology of the Ouachita Streambed Salamander. Determining the ecology and life history of *E. subfluvicola* is challenging, given that access to salamanders is limited to periods of stable stream flows in spring and fall. During summer and fall/winter months, those segments within the stream basin where salamanders have been found can be completely dry for periods of several months (4–8 mo depending upon annual climate regime). When surface waters recede, salamanders must retreat with the falling water table via the interstitial spaces into the gravel streambed substrate. When conditions are favorable for surface activity *E. subfluvicola* hide under stones, in leaf litter, or in subterranean passages by day, and come out to forage after dark.

On the evening of 20 November 2015, we used aquarium dipnets to capture and temporarily hold several individuals of *E. subfluvicola* for photographic purposes. When placed in a photographic V-tank aquarium, an adult individual regurgitated a clump of small (< 12 mm), tubular-shaped organisms. These were collected and later identified as three aquatic oligochaete worms (Oligochaeta).

As part of a photographic identification project we captured 42 adult salamanders from the same pool on the evening of 15 April 2016. As salamanders were captured they were placed in a plastic holding tub and were handled as gently as possible at all times with the use of small aquarium dipnets. While in the temporary holding container, several individuals regurgitated stomach contents. These food items were collected and later identified as 11 isopods (Asellidae, *Lirceus* sp.), with an average length of 5 mm (range 4–7 mm), and one aphid (Aphididae).

These observations support the idea that *E. subfluvicola* is an opportunistic feeder, consuming any available appropriately-sized prey. This is similar to the diets as reported for the larvae and paedomorphic species of other Interior Highland *Eurycea* (Rudolph 1978. *Amer. Midl. Nat.* 100:141–159; Tumlison et al. 1990. *J. Herpetol.* 24:222–225). We have observed Amphipoda, Decapoda, Ephemeroptera, Plecoptera, and Trichoptera within the stream segments where the salamander occurs, but our qualitative observations are that the isopod (*Lirceus* sp.) is the most abundant potential prey source at known salamander sites. *Eurycea subfluvicola* has been observed at eight discrete sites, and *Lirceus* is almost always present, but neither isopods nor salamanders are found uniformly throughout the stream segments with discontinuous surface flow. We suggest that isopods constitute the predominant food of *E. subfluvicola* when salamanders are foraging on the surface of the streambed. Further research is needed to determine the aquatic macroinvertebrate faunal composition and density within the stream system as a whole and compared with specific *E. subfluvicola* localities. Additional research is also needed to determine the diet of the

syntopic, metamorphic *Eurycea multiplicata* (Many-ribbed Salamander).

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ANURA — FROGS

AGALYCHNIS CALLIDRYAS (Red-eyed Tree Frog) and TRACHYCEPHALUS TYPHONIUS (Veined Treefrog). **REPRODUCTIVE BEHAVIOR.** *Agalychnis callidryas* occurs in the lowlands of central Veracruz in Mexico, southward to Panamá (Köhler 2011. *The Amphibians of Central America*. Herpeton Verlag, Offenbach. 400 pp.). *Trachycephalus typhonius* ranges from Tamaulipas and Sinaloa in Mexico to Argentina and Brazil in South America (Calderón-Mandujano et al. 2008. *Amphibians and Reptiles of the Sian Ka'an Biosphere Reserve and surrounding areas*. COMPACT, ECOSUR, CONABIO, SHM A.C. México. 111 pp.). At 2201 h on 14 September 2018, we found an adult male *A. callidryas* (47 mm SVL) in interspecific amplexus with an individual of *T. typhonius* (53 mm SVL; unknown sex; Fig. 1). The frogs were found on the handrail of the stairs of a viewpoint, at the height of 1.60 m, surrounded by semi-deciduous forest at Área de Protección de Flora y Fauna Otoch Ma'ax Yeetel Kooch in the Mayan community of Punta Laguna, Solidaridad, Quintana Roo, Mexico (20.64710°N, 87.63400°W; WSG 84). Previous intergeneric amplexus involving *A. callidryas* was observed between a male of this species and a male *Cruziohyla calcarifer* (Marchant et al. 2015. *Herpetol. Rev.* 46:229). To our knowledge, this is the first observation documenting the amplexus between *A. callidryas* and *T. typhonius*, two anuran species found in sympatry in México and Central America.



FIG. 1. Heterospecific amplexus between *Agalychnis callidryas* (top) and *Trachycephalus typhonius* (bottom) at Punta Laguna, Solidaridad, Quintana Roo, Mexico.

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ALYTES OBSTETRICANS (Common Midwife Toad). CANNIBALISM. Cannibalism has been observed in *Alytes muletensis* (Tonge 1989. Int. Zoo Yearb. 28:45–53). However, to the best of our knowledge, we provide here the first report of this behavior in *Alytes obstetricans*. At 1319 h on 3 August 2016, we observed several tadpoles at an advanced stage of development (approximately Gosner Stage 30 [Gosner 1960. Herpetologica 16:183–190]) attacking and eating a group of eggs of the same species in a small pond in Aragón, Spain (42.63000°N, 0.55000°E; WGS 84). Once they finished, we realized that only two eggs remained intact. The area included the confluence of multiple streams, but at this time of year sections of the streams become dry and isolated. This might produce a reduction in food availability or/and an accumulation of tadpoles at small water points, which might have influenced this case of cannibalism.

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LEPTODACTYLUS GRACILIS (Dumeril's Striped Frog). PREDATION. *Leptodactylus gracilis* is a medium-sized anuran species, distributed in Bolivia, Brazil, Paraguay, and Uruguay (de Sá 2014. S. Am. J. Herpetol. 9:S1–S100). This species occurs in open environments, where the males vocalize from burrows and nests are built (Haddad et al. 2013. Guia dos anfíbios da Mata Atlântica: Diversidade e Biologia, Anolis Books, São Paulo, Brazil. 544 pp.). Few predation records of *L. gracilis* are reported in literature (Zilio 2006. Rev. Bras. Ornitol. 14:379–392). Herein, we report predation by *Athene cunicularia* (Burrowing Owl). On 20 September 2018 in the municipality of Criciúma, Santa Catarina, southern Brazil (28.43560°S, 49.24160°W; WGS 84; 26 m elev.), a dead individual of *Leptodactylus gracilis* was found at the entrance of the owl shelter

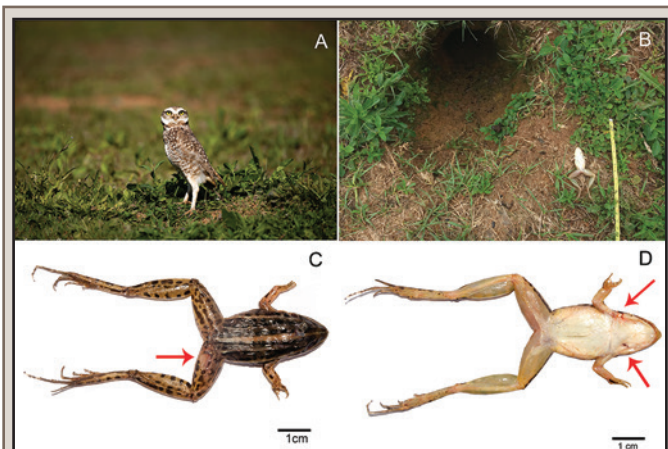


FIG. 1. A) An individual *Athene cunicularia* at the entrance of the monitored shelter; B) an individual *Leptodactylus gracilis* found in the shelter; C) dorsal view of *L. gracilis* with arrow demonstrating injuries in the hind limb; D) ventral view of *L. gracilis* with arrow demonstrating wounds in the jaw.

studied (Fig. 1). The specimen had wounds in the mandible and in the hind limbs, probably marks of talons, suggesting predation by the owl upon the anuran. Several species of the genus *Leptodactylus* are consumed by vertebrates, including *Athene cunicularia*, which has already been observed, for example, consuming *L. latrans* (Vieira and Teixeira 2008. Bol. Mus. Biol. Mello Leitão 23:5–14) and *L. fuscus* (Lanschi and Martinelli 2012. Herpetol. Rev. 43:322–323). To our knowledge this is the first report of *A. cunicularia* preying upon *L. gracilis*.

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LITHOBATES CATESBEIANUS (American Bullfrog). DIET. *Lithobates catesbeianus* is a temperate-zone North American ranid that has been widely introduced outside of its native range. It is famous for its dining habits, which are perhaps the best known of any anuran (Bury and Whelan 1984. Ecology and Management of the Bullfrog. USFWS Resource Publication No. 155; Casper and Hendricks 2005. In M. Lannoo [ed.], Amphibian Declines: The Conservation Status of United States Species, pp. 540–546. University of California Press, Berkeley, California). Vertebrate items consumed by American Bullfrogs are numerous (Batista 2002. Herpetol. Rev. 33:131; Carpenter et al. 2002. Herpetol. Rev. 33:130; Cross and Gerstenberger 2002. Herpetol. Rev. 33:129–130; King et al. 2002. Herpetol. Rev. 33:130–131; Dodd 2013. Frogs of the United States and Canada. The John Hopkins University Press, Baltimore, Maryland. 982 pp). Here, we report the consumption of a previously unreported prey taxon for American Bullfrogs.

On 14 June 2018, we collected an adult female *L. catesbeianus* (167 mm SVL, 471 g) from a permanent pond adjacent to the Little Deschutes River in Deschutes County, Oregon, USA (43.82020°N, 121.45330°W; WGS 84; 1291 m elev.). It was dissected and found to contain a partially digested *Thomomys talpoides* (Northern Pocket Gopher). Prior to this observation, we had found another *T. talpoides* in the stomach of an adult bullfrog from Deschutes County, Oregon, USA (43.88000°N, 121.43300°W; WGS 84; 1269 m elev.). To the best of our knowledge, this is the first published record of *L. catesbeianus* predation on *T. talpoides* (Dodd 2013, *op. cit.*).

Bullfrogs were collected under a Scientific Taking Permit from the Oregon Department of Fish and Wildlife, who require said permit for the collection of a state-designated invasive species.

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LITHOBATES CATESBEIANUS (American Bullfrog). PREDATION. At 1112 h on 23 December 2018, we observed a *Lithobates catesbeianus* being attacked by three *Cairina moschata* (Muscovy Duck; two males and one female) at the edge of a lake near a residential neighborhood in Lake County, Florida, USA (28.82496°N 81.64665°W; WGS 84). The encounter began with the larger of the two male *C. moschata* grabbing the *L. catesbeianus* from shallow water, taking it onto shore, and vigorously shaking the frog, resulting in partial loss of its right rear leg (Fig. 1). The male *C. moschata* then consumed a small amount of the frog's flesh from the damaged appendage. All *C. moschata* interacted aggressively with the frog for several minutes (Fig. 1), consuming small portions of its exposed flesh. The birds then foraged on plant material in shallow water at the edge of the lake, straying no more than 1.5 m from the *L. catesbeianus*. The *L. catesbeianus* attempted escape numerous times throughout the encounter, but the *C. moschata* grabbed the frog and shook it any time it moved. However, the birds did not consume any more of it. The *L. catesbeianus* then took refuge under a Sabal Palm (*Sabal palmetto*). A *C. moschata* not part of the group approached the area of the encounter at 1128 h, and the two males chased the intruder to open water. The main group of *C. moschata* then swam to another area of the lake at 1129 h. A portion of the encounter can be viewed at <https://youtu.be/9Xjru7l8Ags>. *Cairina moschata* is omnivorous, consuming a variety of plant and animal material (www.allaboutbirds.org/guide/Muscovy_Duck/lifehistory; 24 Dec 2018). It is an invasive species in Florida, and it is unknown whether they represent an important predator of *L. catesbeianus* or if this was simply an opportunistic predation attempt.



FIG. 1. A) *Lithobates catesbeianus* (American Bullfrog) being attacked by a group of adult *Cairina moschata* (Muscovy Duck) in Lake County, Florida, USA. The arm of the *L. catesbeianus* can be seen in the mouth of a male *C. moschata*; B) partial loss of the right leg of the *L. catesbeianus* as a result of being shaken by a male *C. moschata*.

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NYCTIMYSTES INTERCASTELLUS. ENDOPARASITES. *Nyctimystes intercastellus* is an endemic microhylid frog from Papua New Guinea, and is known from the Fergusson, Goodenough, and Normanby islands of the D'Entrecasteaux Archipelago (Kraus 2012. Zootaxa 3493:1–26). There are no reports of helminths from *N. intercastellus*, in part because of its recent identification as a distinct species. In this note we establish an initial helminth list for *N. intercastellus*.

We examined 15 *N. intercastellus* (mean SVL = 41.4 mm \pm 2.1 SD, range = 38–45 mm) deposited in University of Michigan Museum of Zoology (UMMZ) that were collected during September 2013 on Normanby Island, Milne Bay Province, Papua New Guinea (10.06000°S, 151.07520°E, WGS 84; 490 m elev.: UMMZ 242372, 242373, 242381–242390, 242394; 10.0589°S, 151.0717°E; WGS 84; 500 m elev.: UMMZ 242995, 242396). We fixed the frogs in neutral-buffered formalin and stored them in 70% ethanol. We opened the body cavity with a longitudinal incision and removed and opened the digestive tract. We examined the esophagus, stomach and small and large intestines for helminths under a dissecting microscope. We placed nematodes on a glass slide in a drop of lactophenol, added a cover slip and identified specimens using Anderson et al. (2009. Keys to the Nematode Parasites of Vertebrates, Archival Volume. CAB International, Wallingford, Oxfordshire, UK. 463 pp.) and Gibbons (2010. Keys to the Nematode Parasites of Vertebrates, Supplementary Volume. CAB International, Wallingford, Oxfordshire, UK. 416 pp.).

We found one female and one larval Nematoda assignable to different genera: *Cosmocerca* and *Abbreviata*. We have assigned the female to *Cosmocerca novaeguineae* (prevalence = number infected/number examined = 6.6%; large intestine of UMMZ 242387) based upon comparison with the measurements of the allotype presented by Moravec and Sey (1990. Acta. Soc. Zool. Bohem. 54:268–286). The larva cannot be assigned to species (*Abbreviata* sp.; prevalence = 6.6%; larva in stomach cyst of UMMZ 242396).

Cosmocerca novaeguineae was described by Moravec and Sey (1990, *op. cit.*) from *Cornufer papuensis* (as *Platymantis papuensis*; Ceratobranchidae) collected in West Sepik Province, Papua New Guinea. *Cosmocerca novaeguineae* has a monoxenous life cycle, is widespread in frogs in Papua New Guinea and has been reported in members of the Ceratobranchidae, Hylidae, Limnodynastidae, Microhylidae, and Ranidae (Goldberg et al. 2009. J. Nat. Hist. 43:1987–2007). The distribution of *Abbreviata* is worldwide (Bain et al. 2015. Zootaxa 3918:151–193). Members are heteroxenous and encysted larvae are widespread in New Guinean herptiles, having been reported in members of the Ceratobranchidae, Hylidae, Limnodynastidae, Microhylidae, Ranidae (Goldberg et al. 2009, *op. cit.*) as well as scincid lizards (Goldberg et al. 2008. J. Nat. Hist. 42:1923–1935).

Voucher helminths were deposited in the Harold W. Manter Parasitology Laboratory (HWML), The University of Nebraska, Lincoln, Nebraska, USA as *Cosmocerca novaeguineae* (HWML 110450) and *Abbreviata* sp. (larva; HWML 110451). *Nyctimystes intercastellus* represents a new host record for *Cosmocerca novaeguineae* and *Abbreviata* sp. larva.

We thank Greg Schneider (UMMZ) for permission to examine *N. intercastellus*.

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OSTEOCEPHALUS CABRERAI (Spiny-backed Treefrog) and **LEPTODACTYLUS MYSTACEUS** (Amazonian White-lipped Frog). **INTERSPECIFIC AMPLEXUS**. The hylid *Osteocephalus cabrerai* occurs mainly on edges of streams, and is distributed in Amazonian Colombia and Peru, the Guiana Shield, the Orinoco Delta in Venezuela, and Brazilian central Amazon (Jungfer et al. 2010. *Zootaxa* 2407:28–50). Despite this wide distribution, there is little information on the reproductive biology and natural history of this species (Lima et al. 2011. *Phyllomedusa* 10:137–142). The leptodactylid *Leptodactylus mystaceus* is an abundant species occurring from Venezuela to southern Brazil (Affonso et al. 2011. Check List 7:198–199) and it was reported previously in a case of interspecific amplexus with the hylid *Boana multifasciatus* (Avelar et al. 2018. *Herpetol. Rev.* 49:299–300). At ca. 2200 h on 24 April 2012 on Highway AM-240, Community São Francisco, Presidente Figueiredo, Amazonas, Brazil (2.01277°S, 59.82115°W; WGS 84), we observed interspecific amplexus between a male *O. cabrerai* and female *L. mystaceus*. This behavior was observed on the edge of a small stream within an upland forest. The two specimens were in axillary amplexus on the ground and maintained their position during ca. 15 min. of observation. At the same place, there were other specimens of *O. cabrerai* on small bushes vocalizing, but none of them were observed in amplexus. To our knowledge, this is the first report of interspecific amplexus between *O. cabrerai* and *L. mystaceus*.

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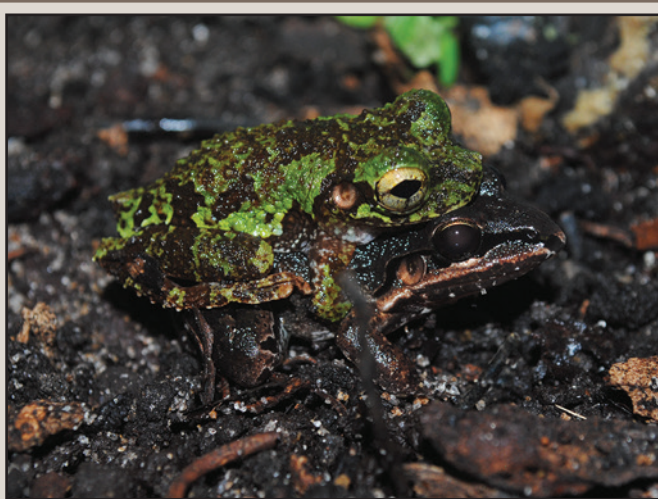


FIG. 1. Male *Osteocephalus cabrerai* amplexing a female *Leptodactylus mystaceus* in Presidente Figueiredo, Amazonas, Brazil.

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PELOPHYLAX KURTMUELLERI (Balkan Water Frog) and **PELOPHYLAX EPEIROTICUS** (Epirus Water Frog). **DEFENSIVE BEHAVIOR**. Specific antipredatory postures are known for many species of the family Ranidae (Toledo et al. 2011. *Ethol. Ecol. Evol.* 23:1–25). Here, we provide the first observations of defense posture in two species of *Pelophylax* (Ranidae) that inhabit wetlands of the southwestern Balkans from lowlands to hilly areas (Speybroeck et al. 2016. *Field Guide to the Amphibians and Reptiles of Britain and Europe*. Bloomsbury Publishing, London. 432 pp.).

The first observation (adult male *P. kurtmuelleri*; Fig. 1A) was observed at 2348 h on 12 October 2014 near Doxa Lake, Peloponnese, Greece (37.93100°N, 22.28300°E; WGS 84; 875 m elev.). The second observation (adult female *P. kurtmuelleri*; Fig. 1B) was observed at 1300 h on 24 September 2015 near Osum River, Uznovë, Albania (40.685°N, 20.011°E; WGS 84; 66 m elev.). The third observation (subadult *P. epeiroticus*; Fig. 1C) was observed at 0914 h on 31 October 2018 in Kaifa Lake, Peloponnese, Greece (37.51700°N, 21.59700°E; WGS 84). In all cases we observed defensive posture known as partial body-raising (Toledo et al. 2011, *op. cit.*). All these frogs were captured from the water surface and after a few minutes of ex-situ photography presented the defense behavior. The frogs remained in typical posture from 3–10 min without stretched legs. The body-raising concluded for a few seconds, then resumed for the same time interval when the photographer got up. All the individuals kept this posture when the photographer raised quickly from the height of their eyes. The individuals retained their eyes open throughout the duration of defense, and the back legs were vertically stretched.

Similar types of defensive behaviors have been reported in other species of frogs (*Bufo bufo*, *Bufo viridis*, *Hyla arborea*, and *P. esculentus*; Hinsche 1928. *Biologisches Zentralblatt*. 46:296–305). Interestingly, the body-raising defense behavior



FIG. 1. Adult male of *P. kurtmuelleri* from Lake Doxa, Greece (A), adult female of *P. kurtmuelleri* from Uznovë, Albania (B), and subadult individual of *P. epeiroticus* from Kaifa Lake, Greece (C) displaying body-raising defense posture.

has never been observed in the closely related but terrestrial genus *Rana*, where current members of mainly aquatic or semi-aquatic frogs (*Pelophylax*) were historically classified. The most common defense behavior of *Rana* is immobility posture known as “eye-protection” (see e.g., Haberl and Wilkinson 1997. Brit. Herpetol. Soc. Bull. 61:16–20; Jablonski et al. 2019. Herpetol. Bull. 147:19–20), which is not reported for the genus *Pelophylax*. This difference may be explained by differences in predation pressure experienced by the two groups.

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PSEUDACRIS ORNATA (Ornate Chorus Frog). ALBINISM. Albinism has been recorded in Bufonidae, Hylidae, Ranidae, and Scaphiropodidae (Jameson and Myers 1957. Herpetologica 1:74; Dyrkacz 1981. SSAR Herpetol. Circ. 11. 31 pp.). Within Hylidae, true albinism has been noted for *Trachycephalus mesophaeus*, *T. venulosa*, *Hypsiboas albomarginatus* (White-edged Treefrog), and *Pseudacris [Hyla] regilla* (Pacific Treefrog; Jameson and Myers 1957, *op. cit.*; Sazima 1974. J. Herpetol. 8:264–265; Motte and Cacciali 2009. Bol. Asoc. Herpetol. Esp. 20:65–67, de Oliveira et al. 2013. Herpetol. Notes 6:577–578). Dyrkacz (1981, *op. cit.*) also reported partial albinism in one specimen of *Hyla arenicolor* (Canyon Treefrog), unconfirmed abnormal coloration in *P. regilla*, and one leucistic *Pseudacris triseriata* (Western Chorus Frog). Additionally, hypomelanism has been reported within the Hylidae (Turner 2017. Od. Nat. 55:22–28).

Albinistic individuals lack all coloration; the individuals described in this note lacked all melanin including in the skin, mucosa, and eyes, and are therefore classified as true albinos (Bechtel 1995. Reptile and Amphibian Variants: Colors, Patterns, and Scales. Krieger Publishing Company, Malabar, Florida. 206 pp.). Here, we report the second confirmed case of albinism in the genus *Pseudacris*.

On 9 February 2018, multiple egg masses were collected from Alapaha River Wildlife Management Area, Irwin County, Georgia, USA (31.51819°N, 83.34823°W; WGS 84) and held under refrigeration ca. 4.5°C for 11 d before being transferred to aquaria at room temperature. Hatching began on 12 February 2018 and was completed by 25 February 2018. Tadpoles with abnormal coloration were evident 9 d later. Four individuals were transferred to a plastic cup with Maidencane (*Panicum hemitomon*) and a bubbler and were fed rabbit chow ad libitum. Of the four tadpoles, one died on 5 March 2018. One albino tadpole grew extremely slowly and died 25 May 2018. The remaining two tadpoles were transferred to a larger container with *P. hemitomon* and a bubbler on 13 May 2018. The container was exposed to indirect sunlight and the tadpoles appeared to be growing and developing limb buds. One tadpole died following a water change on 1 June 2018 and was submitted to the Georgia Museum of Natural History (GMNH 51918). This individual had been growing and undergoing development, and other than pigmentation, was normally developed (Fig. 1). We expect it would have completed metamorphosis without the stress of a water change. The remaining albino tadpole completed

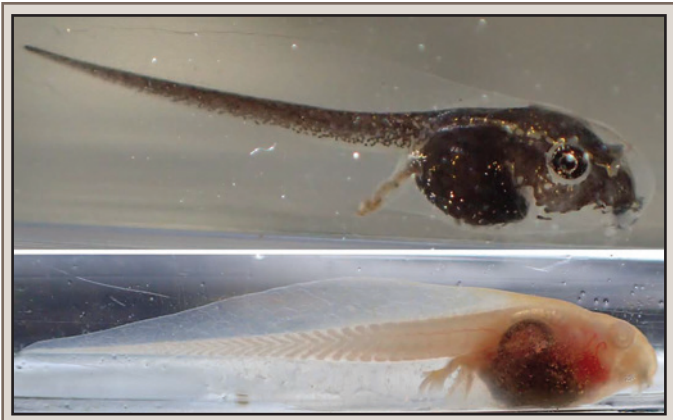


FIG. 1. Wild-type *Pseudacris ornata* (top) and albino *P. ornata* tadpole (bottom).



FIG. 2. Albino *Pseudacris ornata* metamorph with US dime for size comparison (left) and wild-type *P. ornata* (right).

metamorphosis on 27 June 2018 (Fig. 2). The metamorphic individual lacked any pigmentation including within and around the eye. The animal exhibited normal behavior with the exception of an apparent visual impairment. The metamorph hopped and burrowed normally and responded to shadows, but it appeared to only feed on fruit flies using tactile cues. The individual died on 11 September 2018 and was preserved in 10% formalin and stored in 70% ethanol (GMNH 51919).

While there are many causes of albinism, spontaneous mutations in the TYR gene, which is responsible for coding the tyrosinase enzyme, have resulted in amphibian albinism (Miura et al. 2017. Genes Genet. Syst. 92:189–196). Tyrosinase catalyzes the production of tyrosine, which is necessary for the production of melanin and is converted to the thyroid hormones thyroxine (T4) and triiodothyronine (T3). T4 and T3 regulate cell growth and differentiation and are essential to successful metamorphosis. The developmentally normal albinistic metamorph is significant because it is generally assumed that selective pressures (Pash et al. 2007. Herpetol. Bull. 100:8; Marinuzzi et al. 2016. Cuad. Herpetol. 30:69–73) and disruption of these metabolic pathways limit the occurrence of albinism in nature. However, normal metamorphosis is possible and the presence of genetically albino individuals within populations may signal high genetic diversity, and is therefore, worthy of further inquiry.

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RANA PRETIOSA (Oregon Spotted Frog). CANNIBALISM. Cannibalism is frequently reported in ranid frogs, although most accounts involve postmetamorphic life stages (Wells 2007. Ecology and Behavior of Amphibians. University Chicago Press, Chicago, Illinois. 1148 pp.). A previous note described cannibalism of hatching embryos by postmetamorphic Columbia Spotted Frogs (*Rana luteiventris*; Rombough 2016. Herpetol. Rev. 47:118–119), although the behavior is exhibited by both species of spotted frogs. Here, I describe a series of analogous cannibalism events by postmetamorphic *Rana pretiosa*.

Between 21 April and 6 May 2018, the following observations were made at a series of freshwater marshes in central Oregon (Deschutes County, Oregon, USA; 43.88500°N, 121.44719°W; WGS 84; 1269 m elev.). Seven frogs (three juveniles [ca. 45 mm SVL] and four adults [51–64 mm SVL]) at four separate breeding sites were observed eating newly emerged embryos (Gosner Stage 20–24; Gosner 1960. Herpetologica 16:183–190). In three of these observations, frogs (two juveniles, one adult) sat next to egg masses and ate embryos as they wiggled free of the jelly and/or aggregated on top of the masses. In the rest of the cases, the frogs (one juvenile, three adults) sat where egg masses had recently hatched eating newly emerged embryos wriggling at the surface of shallow (< 1 cm deep) water (Fig. 1). I watched one or two frogs eating embryos per breeding site. At one breeding site, I saw a juvenile frog cannibalizing newly emerged embryos during three separate visits over a 15-d period (Fig. 2).



FIG. 1. Adult *Rana pretiosa* feeding at an aggregation of embryos in shallow water (< 1 cm) where egg masses have recently hatched.



FIG. 2. Juvenile *Rana pretiosa* (white arrow) catching recently hatched embryos. Inset: Close-up of embryos (most at Gosner Stage 22–23) aggregating atop a hatched egg mass.

Like *R. luteiventris*, *R. pretiosa* is an explosive breeding, communal spawner that deposits multiple egg masses in shallow water over a short period of time, often one or two days (Licht 1969. Can. J. Zool. 47:1287–1299). As embryos emerge from the egg jelly, they often aggregate in large groups atop the masses, where their motion may attract predators. Although little attention has been given to this part of the spotted frogs' life cycle, these observations suggest that it is a period in which both spotted frog species can incur considerable mortality.

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RHINELLA MARINA (Cane Toad). DIET. *Rhinella marina* (Bufonidae) is an invasive, exotic species in Florida, USA. A study examining the diet of *R. marina* in Florida (Meshaka and Powell 2010. Florida Sci. 73:175–179) found that it largely consisted of invertebrates such as beetles, termites, ants, and flies. This is generally consistent with what has been found as the primary diet of *R. marina* in Australia (Shine 2010. Q. Rev. Biol. 85:253–291). However, the diet of *R. marina* also includes vertebrates such as blind snakes (Pizzatto et al. 2012. Herpetol. Rev. 43:469–471; Kelehear 2014. Herpetol. Rev. 45:339), nestling *Passer domesticus* (House Sparrow; Beckmann and Pizzatto 2011. Herpetol. Rev. 42:592), and unidentified rodent and anole species (Meshaka and Powell 2010, *op. cit.*), among others. Vegetation and stationary items such as vegetables, and pet food (Alexander 1965. Herpetologica 20:255–259) are also possible food sources. Herein, we report a hatchling *Apalone ferox* (Florida Softshell Turtle) in the diet of *R. marina* in Florida. *Apalone ferox* is a native freshwater turtle species in Florida. This species has a nesting season that lasts from March to August (Iverson and Moler 1997. J. Herpetol. 31:399–409) and an incubation period between 56 and 86 days, with neonates averaging 9.4 g and carapace length ranging from about 3.60–4.43 cm (Ernst and Lovich 2009. Turtles of the United States and Canada. 2nd Edition. Johns Hopkins University Press, Baltimore, Maryland. 827 pp.).

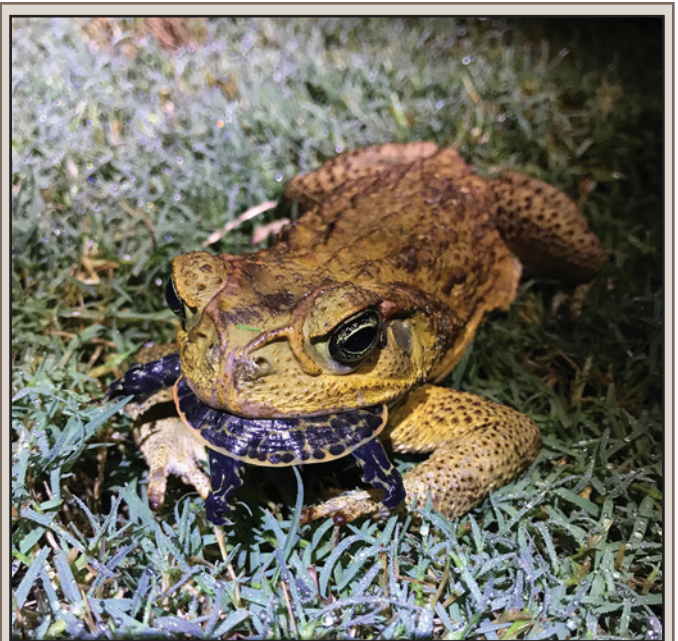


FIG. 1. *Rhinella marina* preying on *Apalone ferox*.

Between 0300 h and 0500 h on 6 July 2018 ca. 200 *R. marina* were caught by hand and removed from a residential golf course community located near an artificial lake on private property in Collier County, Florida, USA (26.18711°N, 81.75009°W; WGS 84). One toad was identified and photographed with a hatchling *A. ferox* in its mouth prior to being removed (Fig. 1). No other *A. ferox* were located in the area. To our knowledge this is the first record of *R. marina* preying on this turtle species. There has been a report of a hatchling *Trachemys scripta elegans* (Red-eared Slider) in a *R. marina* stomach in Bermuda (Kelehear 2016. Herpetol. Rev. 47:129–130) and a report of the remains of two hatchling *Emydura victoriana* (Northern Red-faced Turtles) in a *R. marina* stomach in Australia (Groffen 2018. Herpetol. Rev. 49:310). It is assumed by both Kelehear (2016, *op. cit.*) and Groffen (2018, *op. cit.*) that this trophic interaction is most likely rare. Further, anurans are gape-limited predators, therefore without additional observations it is unknown if this *R. marina* could have successfully swallowed this *A. ferox*. As *R. marina* continues to expand its range through Florida, these types of interactions may become more prevalent.

We thank Lindsey and Dan Floyd for sharing their observations and photo.

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RHINELLA MARINA (Cane Toad) and RHINELLA MERIANAE (Common Lesser Toad). INTERSPECIFIC AMPLEXUS. A number of studies have shown that male bufonids have only a limited capacity for the recognition of conspecific females or even to distinguish between males and females (Marco et al. 2002. Ethol. Ecol. Evol. 14:1–8; Yu et al. 2010. Ital. J. Zool. 77:476–480). Males of the genus *Rhinella* are not very selective, moving toward and forming amplexus with anything that moves nearby (Pombal et al. 2005. Pap. Avul. Zool. 45:201–213). Instances of interspecific amplexus have been previously reported for species of *Rhinella*, for example, between *Rhaebo guttatus* and *Rhinella marina* (Machado et al. 2011. Herpetol. Notes 4:167–169); between *Lepidactylus macrosternum* and *Rhinella* cf. *granulosa* (Sodré et al. 2014. Herpetol. Notes 7:287–288); and between *Rhinella major* and *R. marina* (Costa et al. 2016. Acta. Zool. Mex. 32:385–386).

The *Rhinella granulosa* group consists of 13 described species with distribution from Panamá to Argentina; in the Brazilian Amazon there are three species: *R. major*, *R. merianae*, and *R. mirandaribeiroi* (Narvaes et al. 2009. Arq. Zool. 40:1–73; Silva 2017. Zootaxa 4294:145–150). *Rhinella merianae* is distributed in Venezuela, Guiana, Suriname, French Guiana, and Brazil, north of the Amazon River, at the Solimões, Negro, and Branco rivers (Narvaes et al. 2009. Arq. Zool. 40:1–73). The native range of *R. marina* extends from east of the Andes to Central Amazonia and is widely invasive in Australia, Japan, Philippines, Papua New Guinea, and numerous islands across the Caribbean and the Pacific (Lever 2001. The Cane Toad. The History and Ecology of a Successful Colonist. Westbury Academic and Scientific Publishing, West Yorkshire, 230 pp.; Acevedo et al. 2016. Zootaxa 4103:574–586).

Here, we report interspecific amplexus by adult *R. merianae* on adult *R. marina*. The observation was made at ca. 1900 h on 29 December 2012 in a temporary puddle of rainwater at the Experimental Farm of the Federal University of Amazonas, Manaus, Amazonas, Brazil (2.64978°S, 60.05376°W; WGS 84). Due to the rain, there was a great activity of anurans on the banks

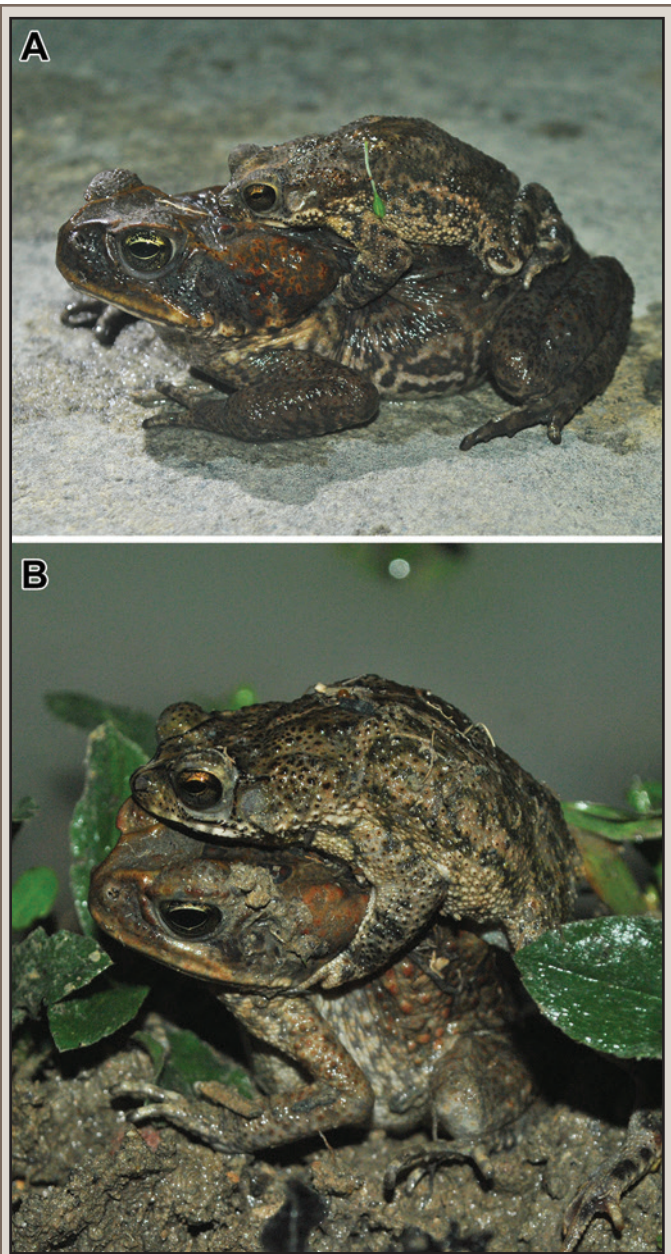


FIG. 1. A) Male *Rhinella merianae* amplexing a large female *R. marina*; B) Male *Rhinella merianae* amplexing a small female *R. marina*.

of the puddle. We found two male *R. merianae* in amplexus with two female *R. marina* (Fig. 1A, B). Although cases of interspecific amplexus in *Rhinella* are common, in this note, we report interspecific amplexus between *R. merianae* and *R. marina* for the first time.

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SCINAX IMBEGUE. PREDATION. Anurans are preyed upon by various predators, including vertebrates and invertebrates (Toledo et al. 2007. *J. Zool.* 271:170–177). Arachnids are the most common anuran invertebrate predators (Toledo 2005. *Herpetol. Rev.* 36:395–400). Here we report a predation event of a *Scinax imbegue* male by a *Phoneutria keyserlingi* (Wandering Spider). At 2056 h on 7 April 2017, in a swamp at the Reserva Betary, municipality of Iporanga, São Paulo, Brazil (24.58920°S, 48.628442°W; WGS 84), we observed an adult male *S. imbegue* being preyed upon by the ctenid spider *P. keyserlingi* (Fig. 1). Similar reports were published for the sister species, *Scinax alter*, which was preyed upon by spiders from the family Psauridae (Marra et al. 2003. *Herpetol. Rev.* 34:55; Prado and Borgo 2003. *Herpetol. Rev.* 34:238–239; Pinto-Silva 2018. *Herpetol. Rev.* 49:100–101). Predation of other *Scinax* species by ctenid spiders is well documented (e.g., Cicchi 2010. *Herpetol. Rev.* 41:207; Melo-Sampaio et al. 2012. *Herpetol. Rev.* 43: 636–637; Bovo 2013. *Herpetol. Rev.* 44:300; Fonte 2013. *Herpetol. Rev.* 44:300), indicating that arachnids may be common predators of this group of frogs.

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FIG. 1. *Scinax imbegue* being preyed upon by a wandering spider (*Phoneutria keyserlingi*) in Iporanga, Brazil.

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TESTUDINES — TURTLES

ACANTHOCHELYS RADIOLATA (Brazilian Radiolated Swamp Turtle). ECTOPARASITES. Brazil has high turtle species diversity, but to date there have been few studies on native chelonian ectoparasites. Parasitism is one of the many possible causes for declines in turtle populations (Gibbons et al. 2000. *BioScience* 50:653–666). Turtles serve as hosts to a variety of ticks (Acari; Garcés-Restrepo et al. 2013. *Biota Neotrop.* 13:74–79), and the first step in monitoring the potential threats of ectoparasite associations with a host species is to identify the parasite species involved. Here, we report the first record of ectoparasitism of *Acanthochelys radiolata* by the tick *Amblyomma rotundatum*.

Acanthochelys radiolata is a chelid turtle endemic to the Atlantic Forest region of Brazil. At 2100 h on 17 December 2018, CZZ captured a male *A. radiolata* (16.4 cm SCL) during fieldwork in Queixadinha district in the municipality of Baixo Guandu (19.55927°S, 40.92386°W; WGS 84), Espírito Santo, Brazil. During visual screening in the field, we found 18 ticks adhering to the internal parts of the turtle's limbs and neck (Fig. 1). Three ticks had adhered to the right hind limb, five adhered to the right front limb, and 10 adhered to the left front limb. These ticks, identified as *Amblyomma rotundatum*, have been previously reported on *Hieremys annandalii*, *Rhinoclemmys areolata*, *R. punctularia*, *Kinosternon scorpioides*, *Chelonoidis carbonaria*, *C. chilensis*, *C. denticulata*, *Gopherus polyphemus*, and *Testudo graeca* (Guglielmone and Nava 2010. *Zootaxa* 2541:27–49). We add *Acanthochelys radiolata* as a host of *Am. rotundatum*. Ticks are vectors of hemogregarine infections, which could reduce host hemoglobin concentrations (BurrIDGE and Simmons 2003. *Vet. Parasitol.* 113:289–320). *Amblyomma rotundatum* has been identified as the vector of the hemogregarine *Hemolivia stellata* in giant toads (Petit et al. 1990. *Ann. Parasitol. Hum. Comp.* 65:3–15). In addition, lesions created by ticks may serve as sites of pathogen entry and infection (Ernst and Ernst 1977. *Biotropica* 9:139–142). The collected ticks were deposited in the tick collection of Coleção Nacional de Carrapatos (CNC-3934), Faculdade de Medicina Veterinária, Universidade de São Paulo, São Paulo, Brazil.

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FIG. 1. Ticks (*Amblyomma rotundatum*) attached to *Acanthochelys radiolata*.

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ACTINEMYS MARMORATA (Northern Pond Turtle). DIET. *Actinemys marmorata* has been described as a dietary generalist, exploiting a broad food niche that is primarily aquatic, but sometimes includes terrestrial foods (Bury 1986. J. Herpetol. 20:515–521). Much of the diet of adults is plant-based, the bulk of which is filamentous algae. Stomach contents analyses have revealed that these turtles are also opportunistic predators of live fish and larval and adult anurans (Bury 1986, *op. cit.*), although predation events are rarely witnessed in the wild (Major 1991. Auk 108:190–195; Van Vuren 2001. Am. Midl. Nat. 145:94–100). However, a seasonal abundance of protein-rich prey appears each spring in the form of amphibian eggs (and unhatched larvae). Biphasic amphibians whose life history includes aquatic larvae must use aquatic habitats to reproduce, and the egg-laying of aquatic amphibians is often concentrated within rather short time periods and offers immobile, easily-obtained food for an opportunistic predator. Here, I report on a direct observation of an *A. marmorata* feeding on amphibian eggs.

My observation occurred in a small, narrow pool in an intermittent stream in Sonoma County, California, USA, on the afternoon of 18 May 2018. Copeland Creek originates on the Mitsui Ranch, at the top of Sonoma Mountain, and meanders through a riparian strip comprised primarily of California Bay-laurel (*Umbellularia californica*), Oregon Oak (*Quercus garryana*), Coast Live Oak (*Quercus agrifolia*), and willows (*Salix* spp.), surrounded by open grasslands. While surveying for native amphibians in an open-canopy stretch of the creek, I noticed a small area of Quaking Grass (*Glyceria leptostachya*) and sedges (*Carex* spp.) in the water near the shear bank that edges a small pool. Nothing was visible on the surface, so I stepped cautiously forward to the edge to get a closer look. Half a meter below my feet, the bank was slightly undercut and I could see the head of a Northern Pond Turtle moving just under the surface. The turtle's head was repeatedly lunging forward toward some vegetation, but it wasn't coming away with any pieces; the vegetation kept springing back each time the turtle pulled away. When I raised my 8 × 42 binoculars, I could see that the turtle was biting off portions of a gelatinous mass that was attached the grass stem. After a moment, I recognized the curved arc of a developing amphibian embryo at the approximate developmental stage of 20–25 (Gosner 1962. Herpetologica 16:183–190), but there was not enough of the embryo mass remaining to visually determine the species. However, as I watched the turtle (a male, ca. 140 mm carapace length) over the next 4 min, it fully consumed three embryo masses of the Pacific Chorus Frog (*Hyla regilla*). The turtle never surfaced while I watched, and though there were many embryo masses in the pool, each at various stages of development, the turtle moved past the less developed ones and appeared to target those in the latter stages. Two of the masses it consumed were attached obliquely to grass stems and the turtle consumed these quickly, but a third mass was wrapped around

a grass stem, and the turtle required more time and effort with that one. After consuming this difficult mass, the turtle surfaced. It spotted me and immediately dove under a rock in the deepest part of the pool, ending my observation.

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BATAGUR TRIVITTATA (Burmese Roofed Turtle). SEXUAL SIZE DIMORPHISM. *Batagur trivittata* is a critically endangered, highly aquatic turtle endemic to the large rivers of Myanmar (Ernst and Barbour. 1989. Turtles of the World. Smithsonian Institution Press, Washington, D.C. 313 pp.; Stanford et al. 2018. Turtles in Trouble: The World's 25+ Most Endangered Tortoises and Freshwater Turtles - 2018. IUCN Tortoise and Freshwater Turtle Specialist Group, Ojai, California. 79 pp.). *Batagur trivittata* was feared extinct (Bhupathy et al. 2000. Chelon. Res. Monogr. 2:156–164) until it was “rediscovered” in the early 2000s (Platt et al. 2005. Chelon. Conserv. Biol. 4:942–948; Kuchling et al. 2006. Oryx 40:176–182), and intense *in-* and *ex-situ* conservation efforts are now focused on population recovery (Platt and Platt 2018. Turtle Survival 2018:41–48). Although fewer than 10 reproductive females survive in the wild (Çilingir et al. 2018. Conserv. Biol. 31:1469–1476), the captive population is approaching 900 and thus, *B. trivittata* is no longer in eminent danger of biological extinction. Conservation efforts notwithstanding, basic natural history information on *B. trivittata* remains sparse. Smith (1931. The Fauna of British India, including Ceylon and Burma. Vol. 1. Loricata and Testudines. Taylor and Francis, London, UK. 185 pp.) stated that female *B. trivittata* (carapace length [CL] to 580 mm) are considerably larger than males (CL to 460 mm), but otherwise little is known about sexual size dimorphism in this species. We here quantify sexual size dimorphism in a large series (N = 179) of *B. trivittata* and comment on the adaptive significance of our findings.

Our sample of turtles was sourced from captive-breeding colonies at Htamanthi Wildlife Sanctuary (N = 70), Lawkanandar Wildlife Sanctuary (N = 20), Wildlife Reserves Singapore (N = 22), Yadanabon Zoological Gardens (N = 41), and Yangon Zoological Gardens (N = 20). Five turtles held at Yadanabon Zoological Gardens were obtained as adults from pagoda ponds or confiscated from traders and fishermen; the remaining turtles in our sample were reared in captivity after being hatched from eggs deposited by captive females or collected from nests along the Chindwin River. All turtles used in our study were ≥ 10 years-old, and breeding coloration was evident in males during the reproductive season. We determined the sex of each turtle based on dimorphic shell coloration and tail morphology (Platt et al. 2017. Herpetol. Rev. 48:616–618), and measured (to nearest 1.0 mm) the mid-line CL (Method D; Iverson and Lewis 2018. Herpetol. Rev. 49:453–460) using tree calipers. In addition to captive turtles, we also included measurements of six intact shells of adult female *B. trivittata* examined at villages along the Dokhtawady and Chindwin rivers (Platt et al. 2005, *op. cit.*; Platt et al. 2018. Nat. Hist. Bull. Siam Soc. 63:67–114) in our analysis.

We used a Student's t-test to test the one-tailed hypothesis that CL of adult female *B. trivittata* was significantly greater than that of adult males (e.g., Platt et al. 2008. Chelon. Conserv. Biol. 7:195–204). We then quantified the degree of size dimorphism (defined as a statistically significant difference in mean length or mass of organisms from the same population) between the sexes with a compressed sexual size dimorphism index (SDI;

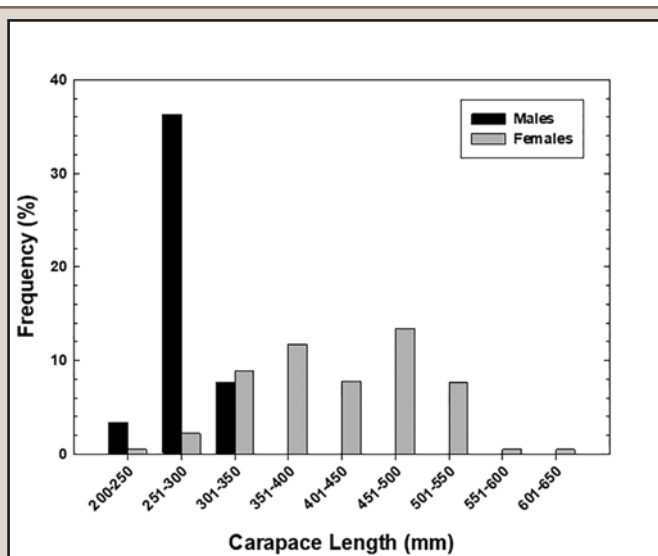


FIG. 1. Size-class distribution of male (N = 84) and female (N = 95) *Batagur trivittata* from captive-breeding colonies in Myanmar and Singapore. Also included in this data set are measurements of six female *Batagur trivittata* shells examined at villages along the Dokhtawady and Chindwin rivers in Myanmar.



FIG. 2. Similar-aged female (above) and male (below) *Batagur trivittata* at captive-breeding center in Htamanthi Wildlife Sanctuary, Myanmar. Tree calipers for scale.

Lovich and Gibbons 1992. Growth Develop. Aging 56:269–281). SDI is a dimensionless number calculated by dividing the mean size of the larger sex by the mean size of the smaller sex and then adding or subtracting one from this value depending on whether males or females, respectively, are the larger sex (Lovich and Gibbons 1992, *op. cit.*). Although SDI can be based on mass or some measure of body length, we selected CL as the appropriate variable because body mass often exhibits considerable variation among animals of similar body length owing to the presence of eggs in gravid females, recent ingestion of large meals, and overall body condition (Lovich and Gibbons 1992, *op. cit.*).

Our sample of *B. trivittata* consisted of 95 females and 84 males with a mean (± 1 SD) CL of 417 ± 76 mm (range: 234–620 mm) and 280 ± 21 mm (range: 224–331 mm), respectively (Fig. 1). The mean CL of females was significantly greater than that of males (one-tailed t-test with unequal variances; $t = 16.8$, DF

= 110, $P < 0.0001$). The CL of the largest female in our sample exceeded the previously reported maximum CL for *B. trivittata* (Smith 1931, *op. cit.*) by 40 mm. The SDI calculated from our sample was 0.48, indicating that *B. trivittata* is strongly sexually dimorphic with females being almost 50% larger than males (Fig. 2). In contrast, Lovich et al. (2014. Biol. J. Linn. Soc. 112:142–149) found that *Batagur affinis* was only weakly dimorphic (SDI = 0.11). To our knowledge, comparable sexual size dimorphism indices are unavailable for other species of *Batagur*; however, casual observations suggest the degree of dimorphism varies widely within the genus, with riverine species (e.g., *B. trivittata*) exhibiting pronounced dimorphism while those inhabiting coastal estuaries (e.g., *B. affinis*) are weakly dimorphic.

Sexual size dimorphism is common among turtles (Gosnell et al. 2009. Herpetologica 65:70–81), and while it has long been recognized that females are the larger sex in *B. trivittata* (Theobald 1868. J. Linn. Soc. Zool. 10:4–67; Smith 1931, *op. cit.*), our study is the first to quantify this size differential. Although numerous adaptive theories have been proposed, the mechanism and evolution of sexual size dimorphism remain controversial (Lovich et al. 2014, *op. cit.*). Among swimming (as opposed to bottom-walking) species of aquatic turtles, Berry and Shine (1980. Oecologia 44:185–191) suggest that females will be the larger sex when elaborate pre-coital displays and nuptial structures are important in courtship, and mating is based on female choice rather than forced insemination by males. According to Moll and Moll (2000. In Klemens [ed.], Turtle Conservation, pp. 126–155. Smithsonian Institution Press, Washington, D.C.), selection in river turtles favors larger body size in females to increase fecundity and make them less vulnerable to predators at the nest site, while smaller body size is favored in males to enhance mobility and hasten their reproductive contribution through early maturation.

Although virtually nothing is known regarding courtship and mating among *B. trivittata*, the brilliant yellow-green head coloration of males, which becomes prominent in the months leading up to the nesting season (December through March) strongly suggests the existence of an elaborate courtship display in *B. trivittata*. Moreover, the diminutive males hardly seem capable of physically subduing the gargantuan females, and hence forcible insemination seems highly unlikely in *B. trivittata*. Of course, with so little known concerning the natural history of *B. trivittata*, we cannot rule out the possibility that ecological differences are driving the observed patterns of sexual size dimorphism. Differences in body size can allow males and females to exploit different dietary and spatial resources, thereby avoiding potential intraspecific competition (Slatkin 1984. Evolution 38:622–630; but see also Shine 1989. Quart. Rev. Biol. 64:419–461). That said, we have observed nothing among captive *B. trivittata* to indicate significant ecological differences exist between the sexes.

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CHELONIA MYDAS (Green Sea Turtle). NESTING BEHAVIOR. In the United States, *Chelonia mydas* has been documented nesting on the East Coast (predominantly the Atlantic Coast of Florida), and along the Eastern and Western Gulf of Mexico in Florida and Texas (Seminoff et al. 2015. NOAA Tech. Mem. 571 pp.). Upon reaching maturity, *C. mydas* return to their natal beaches to nest, usually with high fidelity (Limpus 1992. Wildl. Res. 19:347–358). At 2340 h on 15 June 2011, staff from the Riverhead Foundation for Marine Research and Preservation responded to a report of an adult female *C. mydas* near Main Pavilion Dune Road on Ponquogue Beach in Hampton Bays, New York, USA. The turtle was observed returning to the water without nesting at 0044 h on 16 June 2011. The turtle measured 111.7 cm straight carapace length. An Inconel metal flipper tag was present in the front left flipper, which was matched to her original tag application during a non-nesting emergence on 27 June 2006, at 1835 h, at Padre Island National Seashore (PAIS), in Kleberg County, Texas, USA, when the turtle measured 115.2 cm curved carapace length. The same PAIS biologist that observed the non-nesting emergence also observed this female nesting on 28 June 2006, at 0715 h, at PAIS, 12.0 km north of the non-nesting emergence location. From 177 eggs laid at that event, 67 eggs hatched (37.9%) and 67 hatchlings emerged and were released on the beach at PAIS and entered the Gulf of Mexico.

In 2011, this female was documented nesting in Delaware where she laid 194 eggs. A Cape Henlopen State Park Ranger discovered the nesting turtle around 0300 h on 18 August 2011. Although tags were not recorded at the Delaware nesting event, this turtle was identified as the same individual based on DNA analysis and photos taken at those events using the facial scale pattern unique to the individual (Fig. 1; Carpentier et al. 2016. J. Exp. Mar. Biol. Ecol. 476:15–21). Parentage analysis using eight microsatellite loci (CcP1B03, CcP1F04, CcP1G02, CcP2H12, CcP5F01, CcP5H07, CcP7B07, CcP7E11; Shamblin et al. 2007. Mol. Ecol. Notes 7:784–787) and mitogenomic sequencing (Shamblin et al. 2012. Mol. Ecol. 21:2330–2340) with a combined first-parent exclusion probability of 0.9998, confirmed a mother-offspring relationship between a maternal skin sample collected from the nesting female at PAIS in 2006 and a dead embryo collected from the Delaware nest. This female was excluded as laying any of the nine North Carolina clutches sampled for genetics in 2011 (Shamblin et al. 2018. Chelon. Conserv. Biol. 17:314–319). The Marine Education, Research and Rehabilitation Institute partnered with the University of Delaware College of Marine Studies and the Delaware Department of Natural Resources and Environmental Control to protect the clutch in Delaware through the incubation period. Eight hatchlings emerged 4–7 December 2011 and were taken to the North

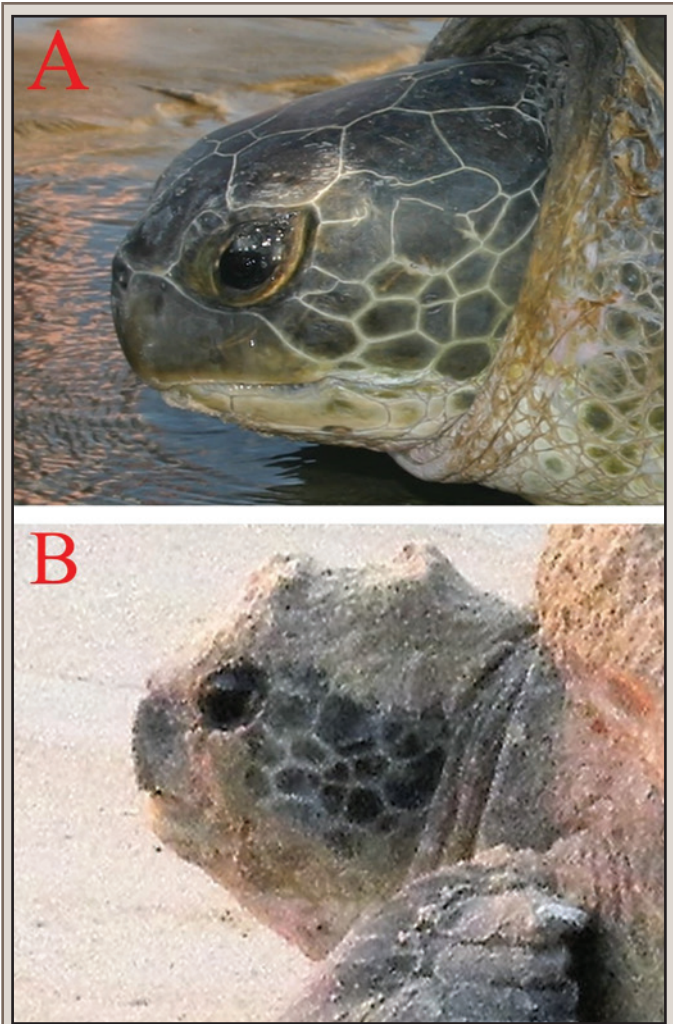


FIG. 1. The unique facial scale pattern used to identify the *Chelonia mydas* (Green Sea Turtle) individual observed nesting in Texas (A) and Delaware (B).

Carolina Aquarium at Pine Knoll Shores for care, where seven survived. The remaining unhatched eggs were transferred to the North Carolina State University Center for Marine Sciences and Technology for additional incubation; seven additional hatchlings emerged from these eggs, but only one survived. The eight hatchlings that survived from this clutch were released into the Gulf Stream. This is the first *C. mydas* confirmed to have nested both on the Texas Gulf Coast and the North Atlantic Coast of the United States. This is also the first record of *C. mydas* nesting in Delaware and the second *C. mydas* observed attempting to nest in New York. The first was a female observed during a non-nesting emergence in 1998; based on examination of facial scale patterns, this was not the same individual as was observed in 2011.

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CHELYDRA SERPENTINA (Snapping Turtle). MORTALITY. Entanglement or entrapment by anthropogenic debris may be an occasional source of turtle mortality (Plotkin and Amos 1988. *In* Schroeder [ed.], Proceedings of the Eighth Annual Workshop on Sea Turtle Biology and Conservation, pp 79–82. NOAA Technical Memorandum NMFS-SEFC-214, Forth Fisher, South Carolina; Triessnig et al. 2012. *Chelon. Conserv. Biol.* 11:68–77). This has been well-documented in sea turtles (e.g., Plotkin and Amos 1988, *op. cit.*; Triessnig et al. 2012, *op. cit.*), but may also occasionally cause mortality of freshwater turtles. Herein, I report a novel observation of an adult *Chelydra serpentina* which appeared to have become entrapped and died within a partially submerged, discarded rubber tire. On 3 July 2019 at 1048 h, I observed a deceased *C. serpentina*, ca. 30 cm straight-line carapace length, within a small cove of Lake Chillisquaque, Montour County, Pennsylvania, USA (41.10707°N, 76.66468°W; WGS 84). The turtle's carapace was stuck within the opening of a partially submerged tire, ca. 10 m from the lake's shoreline (Fig. 1). Presumably, the turtle ascended the tire to bask, subsequently became entrapped within the tire opening, and eventually expired. Because the turtle's carapace was roughly the same diameter of the tire opening, turtles of larger or smaller sizes may not have become entrapped as easily. However, this observation appears to be unique and may suggest entrapment within discarded tires could be a minor source of mortality within some turtle populations.



FIG. 1. Deceased *Chelydra serpentina* within a discarded tire.

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CHRYSSEMYIS PICTA (Painted Turtle). MORTALITY. On 10 June 2019 at 1450 h, I observed a deceased adult female *Chrysemys picta* within gravel substrate ca. 4 m from the shoreline of an unnamed pond within Scott Township, Columbia County, Pennsylvania, USA (41.00918°N, 76.41994°W; WGS 84). The deceased turtle was observed oriented in a unique and atypical position, with its anterior end positioned vertically upright and its right hind limb and



FIG. 1. Deceased *Chrysemys picta* as found in an unusual orientation.

right lower quarter of its shell entrapped within a small hole (Fig. 1). The turtle appeared to be desiccated and its limbs and head were retracted into its shell.

Although the turtle's cause of death is unknown, several potential scenarios may be plausible in which this deceased turtle may have arrived at this atypical position. Turtles are subject to a wide-variety of potential hazards, such as predation, disease, road mortality, collection for food or other means, entrapment by anthropogenic structures or debris, and even by natural sources of entrapment (Gibbs and Shriver 2002. *Conserv. Biol.* 16:1647–1652; Kornilev et al. 2006. *Herpetol. Rev.* 37:145–148; Ernst and Lovich 2009. *Turtles of the United States and Canada*. Second edition. Johns Hopkins University Press, Baltimore, Maryland. 840 pp.; Nickerson and Pitt 2012. *Bull. Florida Mus. Nat. Hist.* 51:257–267; Triessnig et al. 2012. *Chelon. Cons. Biol.* 11:68–77; Franklin 2015. *Herpetol. Rev.* 46:246; Currylow et al. 2015. *Herpetol. Notes* 8:485–487). One possibility is that the turtle may have succumbed to natural entrapment by means of becoming stuck within the small hole in which it protruded from (Fig. 1). Turtles can occasionally become entrapped within natural structures such as crevices and may eventually expire from dehydration/heat stress (Wilson and Topham 2009. *Herpetol. Rev.* 40:335–336; Currylow et al. 2015, *op. cit.*). After observing the dead turtle in its original position, I removed it from the small hole and observed that it was slightly “secured” by dried substrate within the hole. However, this substrate may have dried following the death of the turtle, and the possibility that the turtle would not have been able to free itself if trapped while alive appears to be unlikely due to the orientation in which the turtle was found (Fig. 1).

An alternative possibility is that this turtle may have died prior to arriving at the unusual orientation and was moved into this position by another organism. Due to the fact that no obvious signs of predation (e.g., gnaw marks or injuries) were observed on the dead turtle, it is unlikely to have succumbed to predation. However, it plausibly could have become entrapped between the rails of an adjacent railroad track and expired (e.g., Kornilev et al. 2006, *op. cit.*; Heske 2015. *Urban Nat.* 4:1–13), which has been observed in *C. picta* and other turtle species at this location (SMH, pers. obs.). A scavenger such as a North American Raccoon (*Procyon lotor*) may have then moved the turtle into this unusual orientation while attempting to obtain the soft parts the carcass (i.e., limbs, head) that were retracted into the shell.

Regardless of the cause of death or by what means the turtle became oriented in the position in which it was found, this observation appears to be unique and the hardened substrate supporting the carcass may suggest the turtle had remained in this position for a prolonged period of time (e.g., hours or days) until it was observed.

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GRAPTEMYS GIBBONSI (Pascagoula Map Turtle). REPRODUCTION. We studied *Graptemys gibbonsi* in the Chickasawhey River, at Leakesville, Green County, Mississippi, USA (31.15233°N, 88.55350°W; NAD 83), a tributary of the Pascagoula River, from 1978–1979 to determine the status of the *Graptemys* in this river. Since that time, we have dissected and analyzed the turtles we preserved and deposited in Carnegie Museum of Natural History (CM). Here, we report the data of the size and age at female sexual maturity in this population, largest immature female, smallest mature female, eggs per clutch, egg size, and the number of growth rings in immature and mature females (Table 1). Females were considered mature if they had enlarged follicles or corpora lutea in the ovaries or shelled eggs in the oviducts; number of clutches per reproductive season was estimated by counting size groups of ovarian follicles, and diameters of corpora lutea (Moll and Legler 1971. Bull. Los Angeles Co. Mus. Nat. Hist. 11:1–102).

Lindeman (Lindeman 2013. The Map Turtle and Sawback Atlas: Ecology, Evolution, Distribution, and Conservation. University of Oklahoma Press, Norman, Oklahoma. 460 pp.) summarized the reproductive data available for all *Graptemys* species and data available for *G. gibbonsi* are weak at best. He reported our unpublished data on *G. gibbonsi*: the mean clutch size was 7.5 on the lower Chickasawhey River (Lovich et al. 2009. 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. 029.1–029.8. Chelonian Research Monograph 5). Here, we would like to report a more complete data set on this population. During our study we found five immature females: 1) 148 mm CL, 8 growth rings; 2) 168 mm CL, 10 growth rings; 3) 194 mm CL, 9 growth rings; 4) 198 mm CL, 9 growth rings, and 5) 214 mm CL, 9 growth rings. The smallest mature female was 192 mm CL; a mature female of 232 mm CL had 11 growth rings, suggesting that maturity in females is reached in about 11 years at 192 mm CL. Large females produce three clutches annually. On 29 June 1979 a fresh clutch of 6 eggs (mean size: 39 × 27 mm, clutch mass 94 g) was collected from an unknown female on a beach 4 km downstream from the Leakesville Bridge on the Chickasawhey River, Leakesville, Greene County, Mississippi, USA. The clutch was deposited in fine grained white sand on a sloping beach, 6 m from the river margin.

We thank the U.S. Fish and Wildlife Service for funding our research. Field assistance was appreciated from Cupcake, C. Sue, and A. Cornejo. Fieldwork was completed under the auspices of permits to RCV from Mississippi Heritage Program. Animals collected were treated following the guidelines for the use of live amphibians and reptiles in field and laboratory research published by the American Society of Ichthyologists and Herpetologists (2004). RCV conducted this research under the auspices of a Richard A. Mellon Postdoctoral Fellowship in the Section of Amphibians and Reptiles of the Carnegie Museum of Natural History. Specimens examined at Carnegie Museum: CM 94948, 94949, 95559, 95361, 94966, 94967, 94977–94979, 95770, and 95879.

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GRAPTEMYS PEARLENSIS (Pearl River Map Turtle). REPRODUCTION. We studied *Graptemys pearlensis* in the Pearl River at Georgetown Water Park, 2 km above and 2 km below the mouth of the Stong River, Copiah County, Mississippi, USA (31.89000°N, 90.28639°W; NAD 83) from 1978–1979. Since that time, we have dissected and analyzed the turtles we preserved and deposited in the Carnegie Museum of Natural History (CM). Here we report data regarding the size and age at female sexual maturity in this population, largest immature female, smallest mature female, eggs per clutch, egg size, and the number of growth rings in immature and mature females (Table 1 and below). Females were considered mature if they had enlarged follicles or corpora lutea in the ovaries or shelled eggs in the oviducts; number of clutches per reproductive season was estimated by counting size groups of ovarian follicles, and diameters of corpora lutea. Lindeman (2013. The Map Turtle and Sawback Atlas: Ecology, Evolution, Distribution, and Conservation. University of Oklahoma Press, Norman, Oklahoma. 460 pp.) summarized the reproductive data available for all *Graptemys* species, but data specific to *G. pearlensis* are limited. Cagle (1952. Copeia 1952:223–234) reported a clutch size of three eggs, with enlarged follicles suggesting two more clutches of three eggs.

We caught 44 adult males, 63 adult females, and 18 juveniles in 20 days of trapping (2–9 July 1979 and 2–13 August 1979). The smallest gravid female was 205 mm CL, a mass of 1063 g, eight distinct growth rings (annuli), and had a clutch of three eggs (egg mean 38 × 25 mm, 13 g). This suggests that females may mature at a minimum of 8 years of age. However, the largest immature female had nine annuli and was 224 mm CL, suggesting that both size and age at reproductive maturity varies in this species. Females produce two to three clutches annually. On 1 August 1978 we found a nest 25 m from the water on a fine-grained white sand beach; the nest at its greatest depth was 170 mm and contained nine eggs.

TABLE 1. Reproductive parameters of female *Graptemys gibbonsi* from the Chickasawhey River at Leakesville, Mississippi, USA, 1978–1979. RCM = relative clutch mass (clutch mass/mass of spent female) EMI = Egg Mass Index (mass of the egg/mass of spent female × 100).

Clutch size	Egg length (mm)	Egg width (mm)	Egg mass (g)	Mean clutch mass (g)	Mean female mass (g)	Mean RCM	Mean EMI
5–14	33–44	23–29	7–16.5	85	2085	0.04	0.67
mean = 7.5	mean = 38.3	mean = 26	mean = 13.9	N = 14	N = 5		
N = 14	N = 43	N = 43	N = 38				

TABLE 1. Reproductive parameters of female *Graptemys pearlensis*. RCM=relative clutch mass (clutch mass/mass of spent female) EMI = Egg Mass Index (mass of the egg/mass of spent female x 100).

Clutch size	Egg length (mm)	Egg width (mm)	Egg mass (g)	Mean clutch mass (g)	Mean female mass (g)	Mean RCM	Mean EMI
3–9	27–43	23–27	12.4–19	95.1	1731	0.06	0.89
mean = 6.4	mean = 38.4	mean = 25.9	mean = 15.4	N = 19	N = 19		
N = 22	N = 125	N = 125	N = 133				

Specimen numbers of turtles examined at the Carnegie Museum of Natural History: CM 67481, 94906, 94935, 95050, 95055, 95057, 95632, and 95593.

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KINOSTERNON INTEGRUM (Mexican Mud Turtle). ECTOPARASITES. *Kinosternon integrum* is one of the most widely distributed kinosternid turtles in Mexico, occurring from sea level to 2545 m in western, central and southern parts of the country (Legler and Vogt 2013. The Turtles of Mexico: Land and Freshwater Forms. University of California Press, Berkeley, California. 402 pp.). In Mexico, seven tick species (Acari: Ixodidae) of the genus *Amblyomma* (*A. dissimile*, *A. sabanerae*, *A. elephense*, *A. rotundatum*, *A. scutatum*, *A. auricularium*, and *A. mixtum* [= *A. cajennense*]) have been recorded parasitizing amphibians and reptiles (Guzmán-Cornejo et al. 2011. Zootaxa 2998:16–38; Charruau et al. 2016. Dis. Aquat. Organ. 121:167–171), and there is one record of a tick parasitizing the White-lipped Mud Turtle, *Kinosternon leucostomum* (Pearse 1936. Publ. Carnegie Instit. Wash. 457:45–59; Paredes-León et al. 2008. Zootaxa 1904:1–166). Herein, we present the first report of the bot tick, *Amblyomma* sp., as an ectoparasite of *Kinosternon integrum*.

On 9 May 2012, near Puerto Vallarta, Jalisco, México (20.6666°N, 105.2666°W; WGS 84; 7 m elev.), we observed an adult male *K. integrum* (ca. 13 cm carapace length) infested by ca. 300 individuals of *Amblyomma* sp., based on a photograph taken by F. McCann. The great majority of exemplars were nymphs, attached around the head (tympanum and chin), on the skin area between the front legs and neck, and on the external side of the turtle's front legs; a few nymphs and female *Amblyomma* sp.

were observed on the upper carapace and beneath the anterior marginals (Fig. 1). In addition, there were ticks attached on the posterior side of the body (hind legs, tail, and around the cloaca), but these were not photographed. The presence of ectoparasites on turtles is common; however, some studies have shown that heavy infestations could produce anemia and significantly reduce host health and viability (Garcés-Restrepo et al. 2013. Biota Neotrop. 13:74–79). Further studies on the relationships between tick load and haematological parameters and body condition need to be conducted to estimate the effect on the general health of turtle populations.

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KINOSTERNON VOGTI (Vallarta Mud Turtle). DIET. *Kinosternon vogti* is one of the most narrowly distributed kinosternid turtles in Mexico; it is restricted to small streams and ponds in the urban area of Puerto Vallarta, Jalisco (López-Luna et al. 2018. Chelon. Conserv. Biol. 17:2–13). Unfortunately, this habitat has been fragmented and damaged by urban growth and little is known about the biology of this recently described and threatened turtle species. Information on its distribution and ecology is desperately needed (López-Luna et al. 2018, *op. cit.*). Here, we report the first observations regarding the diet of *K. vogti*.

From August to November 2017, we captured *Kinosternon vogti*, *K. integrum*, *K. chimalhuaca*, and *Trachemys ornata* using fyke net traps in a stream on the campus of the Universidad de Guadalajara in Puerto Vallarta, Jalisco, Mexico (20.7018°N, 105.2244°W; WGS 84; < 5 m elev.). Five individuals of *K. vogti* were captured (Fig. 1A). We measured maximum carapace length (CL), and body mass (BM). All measurements were taken with a digital caliper (scale 150 mm, precision 0.1 mm) and electronic balance (scale 50 kg, precision 0.1 g). We also collected the stomach contents from each individual using the flushing technique described by Legler (1977. Herpetologica 33:281–284). The stomach contents were preserved in 70% ethanol for laboratory analysis in the Centro Universitario de la Costa of the Universidad de Guadalajara. Within 24 h after sampling and data collection, turtles were returned to the site of capture.

The carapace length (mean ± SD) of males measured during the study was 91.3 ± 11.8 mm and body mass (mean ± SD) was 108.3 ± 10.4 g. The carapace length (mean ± SD) of females was 90.9 ± 2.8 mm and body mass (mean ± SD) was 145.2 ± 21.4 g. All stomachs contained unidentified plants. A juvenile Common Pill-bug (*Armadillidium vulgare*; Fig. 1B) was identified in a male



FIG. 1. *Kinosternon integrum* parasitized by *Amblyomma* sp. in Puerto Vallarta, Jalisco, Mexico.

PHOTO BY FRANK MCCANN



FIG. 1. A) Adult male *Kinosternon vogti* specimen (83.3 mm CL); B) *Armadillidium vulgare* (Isopoda: Oniscidae) in the stomach contents of an adult male *K. vogti*; C) *Aeneolamia albofasciata* (Hemiptera: Cercopidae) in the stomach contents of an adult female *K. vogti*. Scale bar 1 mm.

turtle (83.3 mm CL, 120 g), and four adult spittlebugs (*Aeneolamia albofasciata*) were recovered from a female turtle (88.9 mm CL, 130 g; Fig. 1C). The common pill-bug was identified based on Schmalzfuss (2006. Stuttg. Beitr. Naturkd., A. 693:1–102), and the spittlebugs were identified according to Clark et al. (1976. Folia Entomol. Mex. 34:13–24). The non-native common pill-bug is often a pest in gardens and greenhouses around the world (Robinson 2005. Handbook of Urban Insects and Arachnids: A Handbook of Urban Entomology. Cambridge University Press, Cambridge, UK. 472 pp.), and the native spittlebug is the most economically important insect pest of buffelgrass pastures in Mexico and Latin America (Martin et al. 1995. Ann. Entomol. Soc. Am. 88:471–478; Cuarán et al. 2012. Rev. Colomb. Entomol. 38:171–176).

Our observations suggest that *K. vogti* could be classified as an omnivore, like other kinosternid turtles (see Macip-Ríos et al. 2010. Chelon. Conserv. Biol. 9:90–97). However, our data are insufficient to determine whether there is variation between sexes or size classes, as occurs in other mud turtle species (Aguirre-León and Aquino-Cruz 2004. Acta Zool. Mex. [n.s.] 20:83–98). The presence of native and non-native arthropods and plant matter in the stomach contents may be more related to opportunistic omnivore behavior more than to prey preferences (Ernst and Lovich 2009. Turtles of the United States and Canada. Johns Hopkins University Press, Baltimore, Maryland. 827 pp.; Legler and Vogt 2013. The Turtles of Mexico: Land and Freshwater Forms. University of California Press, Berkeley, California. 402 pp.). Further studies of additional specimens will be needed to better understand the trophic ecology of *K. vogti*.

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MACROCHELYS TEMMINCKII (Alligator Snapping Turtle). KYPHOSCOLIOSIS. Kyphosis commonly refers to a hump-back appearance caused by a dorsally convex curvature of the spine in



FIG. 1. The protrusion from the kyphoscoliosis is present on the right side (left in picture) of the subadult male *Macrochelys temminckii*. The protrusion is present on the posterior 2nd vertebral, anterior 3rd vertebral, and dorsal section of the 2nd right costal.



FIG. 2. Five costal scutes on the right side of the subadult male *Macrochelys temminckii*. The kyphotic protrusion can be seen between the central keel and the right second costal keel.

the sagittal plane, while scoliosis is the lateral curvature of the spine, either to the left or right of midline within the frontal plane (Rhodin et al. 1984. Brit. J. Herpetol. 6:369–373). Spinal deformities, including kyphosis and scoliosis, have been observed in at least seven families, 23 genera, and 27 species of turtles (Rothschild et al. 2012. Herpetological Osteopathology: Annotated Bibliography of Amphibians and Reptiles. Springer-Verlag, New York, New York. xi + 450 pp.), and these conditions likely occur in most chelonian species. The exact cause of these spinal deformities in chelonians is unknown, but there are a few plausible explanations: excessive pressure on incubating eggs, insufficient oxygen levels or moisture within the nest, late retraction of the yolk, low ambient temperatures during critical stages of egg development, and premature fusion between costal plates and ribs followed by their differential growth rates (Plymale et al. 1978. Southwest. Nat. 23:457–462).

In turtle populations, the reported frequency of kyphosis ranges from 0.06% (*Trachemys scripta*: Tucker et al. 2007. Herpetol. Rev. 38:337–338) to 2.1% (*Trachemys g. gaigeae*; Stuart and Painter,



FIG. 3. Dorsal x-ray of the subadult male *Macrochelys temminckii* showing the right lateral curvature of the spine.

2008. *Herpetol. Rev.* 39:218–219), while scoliosis seems to occur much less frequently (0.03–0.11%), perhaps due to its subtleness of expression in turtles. The effects of these spinal deformities on life history characteristics vary. One juvenile female *Graptemys oculifera* (kyphotic) grew 3.7 cm in plastron length in five years, while two kyphotic adult females had marginal growth over an 8- to 12-yr period, with one female's growth rate falling within the expected range of normal *G. oculifera* and the other lower than expected (Selman and Jones 2012. *Chelon. Conserv. Biol.* 11:259–261). A kyphotic Wood Turtle (*Glyptemys insculpta*) was also smaller than expected for its age class (Harding and Bloomer 1979. *Bull. New York Herpetol. Soc.* 15:9–26), while a kyphotic juvenile *Chelydra serpentina* gained body mass faster per month than a developmentally-normal clutch mate (Wilhoft 1980. *Bull. New York Herpetol. Soc.* 15:15–26). The growth, body size, age at sexual maturity, and reproduction of a female kyphotic *Chrysemys picta marginata* was comparable to developmentally normal females within the same population (Moldowan et al. 2015. *Chelon. Conserv. Biol.* 14:157–160).

On 23 March 2018, a subadult male *Macrochelys temminckii* was captured in a baited hoop net on the Leaf River (Pascagoula River drainage), 10 km S of Hattiesburg, Mississippi. The male measured 35.6 cm straight-line carapace length, 28.1 cm straight-line plastron length, 15.9 cm carapace height, and weighed 12.91 kg. The presence of a protrusion on the posterior 2nd vertebral, anterior 3rd vertebral, and the dorsal section of the 2nd right costal suggests kyphoscoliosis (Fig. 1). Also, as normally occurs in chelonians with kyphosis and/or scoliosis, other shell abnormalities were observed. There was an extra right costal scute (totaling five), including a keel on the fifth right costal (Fig. 2), as well as a lateral curvature of the central keel towards

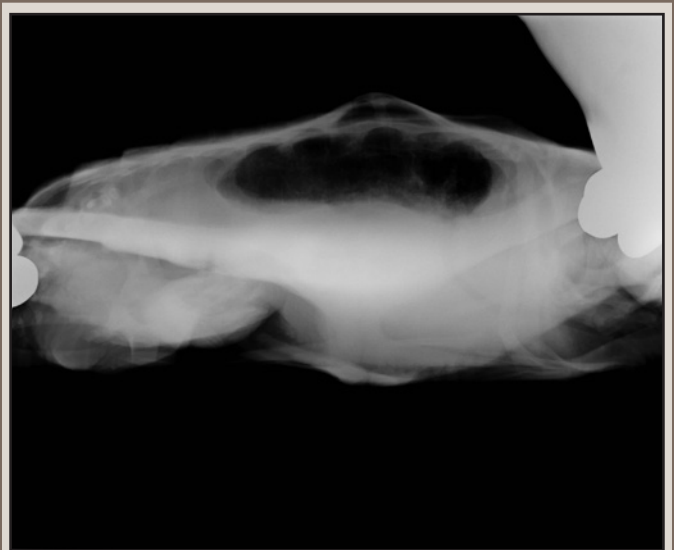


FIG. 4. Lateral x-ray view of the kyphotic protrusion on the subadult male *Macrochelys temminckii*. The protrusion does not seem to contain internal organs and sits directly above the lungs.

the right side of the body at the 3rd vertebral scute. Beginning at the 2nd costal scutes, the carapace flares slightly outwards, more so than observed in normal *M. temminckii*. An x-ray of the turtle confirms the suspected kyphoscoliosis by depicting a dorsally convex curvature of the spine in the sagittal plane, as well as slight scoliosis of the spine towards the right of midline (Fig. 3). Based on the x-ray, there does not seem to be any internal organs occupying the kyphotic protrusion which sits directly above the lungs (Fig. 4).

Kyphosis has been observed and reported in the closely-related *C. serpentina*, and there was a brief mention of a kyphotic *M. temminckii* hatched at the Tishomingo National Fish Hatchery in Oklahoma, which was subsequently used in a study of gonad and genital morphology (Ligon et al. 2014. *Herpetol. Conserv. Biol.* 9:146–155). However, to our knowledge, there have been no reported observations of spinal deformities in a wild *M. temminckii*, leading us to conclude that this is the first reported case of a wild *M. temminckii* with kyphoscoliosis. Based on the number of *M. temminckii* captured within the Pascagoula River drainage, kyphosis/kyphoscoliosis occurs in 0.52% of the population (1 of 193); however, if compared to all *M. temminckii* captured in Mississippi by the authors, the occurrence of kyphosis/kyphoscoliosis decreases to 0.28% (1 of 360). The turtle was captured and handled under Mississippi Department of Wildlife, Fisheries, and Parks scientific collection permit #0421171.

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MALACLEMYS TERRAPIN TERRAPIN (Northern Diamond-backed Terrapin). **EPIBIONT.** *Crassostrea virginica* (Eastern Oyster) inhabits estuarine waters from the Canadian Maritimes to the Gulf of Mexico and have also been reported as far south as Argentina and Brazil. Larval *C. virginica* are planktonic



FIG. 1. Female *Malaclemys terrapin terrapin* with two *Crassostrea virginica* attached to its carapace.

phytoplankton consumers during several weeks of growth and development. They require solid substrates on which to attach as sessile juveniles at metamorphosis. Typical benthic and intertidal oyster settlement substrates include the shells of live and dead oysters, shell fragments, rocks, and both natural and manufactured structures of concrete, wood, and other materials. Here we report attachment and growth of *C. virginica* upon the carapace of a *Malaclemys terrapin terrapin*.

The range of *M. t. terrapin* extends from Cape Cod, Massachusetts to Cape Hatteras, North Carolina, USA (Ernst and Lovich 2009. *Turtles of the United States and Canada*. Second Edition. Johns Hopkins University Press, Baltimore, Maryland. 344 pp.) and is completely overlapped by the range of *C. virginica*. On 10 July 2018, we captured an eight-yr-old female *M. t. terrapin* in a bank trap (Webb and Piavis 1998. *An Investigation of Crab Bank Trap Use in the Annessex River, Maryland*. Maryland Department of Natural Resources Fisheries Service, Annapolis, Maryland. 3 pp.) on Mine Creek in Frenchtown, Maryland, USA. Two *C. virginica* oysters and multiple *Balanus* sp. (barnacles) were attached to the carapace (Fig. 1). A similar epibiotic commensalism has been previously documented for oysters colonizing a more southern terrapin subspecies, *Malaclemys terrapin macrospilota* (Ornate Diamond-backed Terrapin; Jackson and Ross 1971. *Herpetologica* 27:341–344). The *M. t. terrapin* that carried epibiont *C. virginica* had a carapace length of 190 mm (Fig. 1). The maximum length (shell height) of the *C. virginica* growing on the carapace of that *M. t. terrapin* were estimated from images at 60–75 mm, indicating their ages to be ca. 2 yrs (Southworth et al 2010. *J. Shellfish Res.* 29:271–290).

Those *C. virginica* are projected to have attached to the *M. t. terrapin* carapace at their metamorphoses during the summer of 2015 or 2016.

A *C. virginica* growing attached to the carapace of a *M. t. terrapin* might benefit from enhanced feeding opportunities from passive transport through productive shallow waters in conjunction with terrapin surveillance and feeding activities. Since terrapins rarely leave estuarine waters otherwise, an oyster living on a terrapin carapace would be forced to seal its valves against desiccation only during brief, seasonal, terrestrial egg laying excursions by reproductive females. The unusually smooth surfaces of the valves of the epibiont *C. virginica* on the *M. t. terrapin* that we encountered, suggest regular, minor abrasions during terrapin travels and activities that may have included active efforts to dislodge the oysters.

Epibiont oysters might be more likely to occur on adult terrapins due to growth slowing to only 3% per year as mature adults (Ernst and Lovich 2009, *op. cit.*). Liabilities of epibiont oysters on host terrapins include modified shell hydrodynamics with possible losses in swimming efficiency and navigation. Potential benefits include possible camouflage of terrapins from prey and strengthening of the colonized terrapin carapace.

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PHRYNOPS HILARII (Hilaire's Side-necked Turtle). PREDATION. *Phrynops hilarii* has a natural distribution that includes southeastern Brazil and Paraguay, eastern and northeastern Argentina, and the whole of Uruguay (Cabrera 1998. *Las Tortugas Continentales de Sudamérica, Austral*. Ed. Independent. Córdoba, Argentina. 108 pp.). This freshwater turtle inhabits lagoons and marshes with floating vegetation, or slow streams (Ceï 1993. *Museo Regionale di Scienze Naturali Monografie [Turin]* 14:1–949).



FIG. 1. *Tigrisoma lineatum* preying on juvenile *Phrynops hilarii*.

PHOTO BY GRACIELA NEIRA

At 1449 h on 23 March 2019, on the edge of a lagoon in the Costanera Sur Ecological Reserve, an urban reserve in Buenos Aires City, Argentina (34.60738°S, 58.35880°W; WGS 84), we observed an adult Rufescent Tiger Heron (*Tigrisoma lineatum*) preying on a juvenile *Phrynosoma hilarii* (Fig. 1). The animals were photographed but not collected. This note adds an additional species to the list of animals known to prey on *P. hilarii* and also expands the list of food items known for the natural diet of *T. lineatum*. I thank G. Neira for the photo.

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PODOCNEMIS ERYTHROCEPHALA (Red-headed River Turtle).
UNUSUAL NESTS. *Podocnemis erythrocephala* is the smallest species of its genus, with a geographic distribution restricted mainly to blackwater ecosystems (and, less commonly, to clearwater systems) in the Amazon. Like all *Podocnemis* species, *P. erythrocephala* nests in the receding water season, and hatchling emergence occurs at the beginning of the rising water season. Females frequently nest in open forested areas with a sandy substrate, locally called *campina* or *campinarana*. Nests are shallow with number of eggs varying from 2 to 18 (Ferrara et al. 2016. *In* Balestra et al. [orgs.], Manejo Conservacionista e Monitoramento Populacional dos Quelônios Amazônicos, pp. 15–28. IBAMA, Brasília, DF).

In the Trombetas River, a population of *P. erythrocephala* is protected by the conservation program *Pé-de-Pincha* at Boa Nova community (1.8182°S, 56.28030°W), in which the data here described were collected. During the 2018 reproductive monitoring period, we recorded seven nests laid in an uncommon environmental situation for *Podocnemis* spp., a saturated sandy microhabitat in the campinarana. The surface layer was dry, but a few inches below, where the eggs were, the soil was saturated (Fig. 1). Nesting began on 12 September, and soaked nests were found from 15 September to 2 October, which is generally the beginning of the nesting season. Nests were, on average, 13.7 m distant from the water, but only 24.9 cm above the water level (Table 1). To avoid human predation, nests were transferred from the natural habitat to a semi-natural condition near a local cooperators house as part of the conservation program. Under controlled conditions (dry sandy soil, partially covered with palm leaves), the eggs from one nest did not hatch, but the hatching rate varied from 62–79% in the remaining nests (Table 1).

Nesting information in the Brazilian Amazon is available for the Negro (Batistella and Vogt 2008. *Chelon. Conserv. Biol.* 7:12–20), Tapajos (Carvalho et al. 2011. *Chelon. Conserv. Biol.* 10:146–148), and for the Nhamundá, Andirá, Mamuru-Uaicurapá,

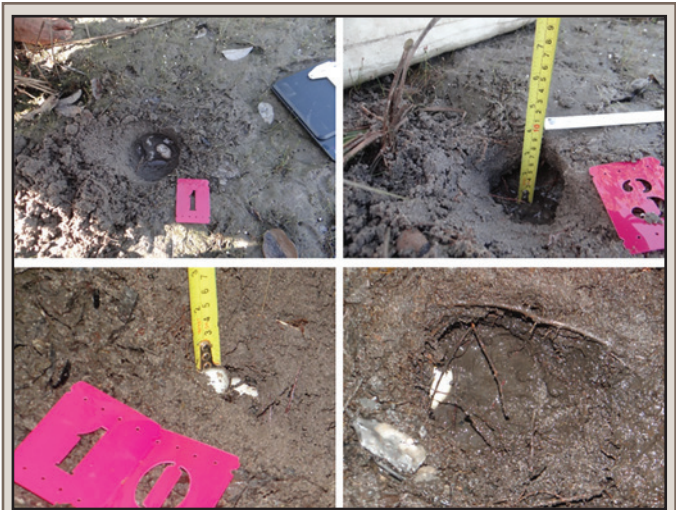


FIG. 1. Nests of *Podocnemis erythrocephala* laid in saturated sandy soil in the 2018 reproductive period at Boa Nova community, Sapucuá Lake, Oriximiná, Brazil.

Maués-Urupadi, Jamary, Matupiri, and Uatumã rivers and Juruti Lake (Andrade 2015. *Manejo Comunitário de Quelônios - Projeto Pé-de-Pincha*. UFAM, Manaus, Amazonas. 325 pp.), and no nests deposited under the unusual conditions here described were reported for these other areas. Since eggs were moved, we were not able to evaluate if the eggs would have hatched under these unique conditions. Nesting in saturated soil has been reported for *Podocnemis unifilis*, *P. expansa*, and *P. sextuberculata* in 2005 and 2009 in the middle Amazon (Rodrigues et al. 2012. *In* Andrade [org.], *Manejo Comunitário de Quelônios no Médio Amazonas e Juruá - Projeto Pé-de-Pincha*, pp. 534–565. UFAM, Manaus, Amazonas). It is possible that a delay in the retreat of high water might have caused the turtles to nest in an environment that was not ideal, but we do not have enough data for a conclusive analysis. Recording these events may be useful in understanding the potential effects of changing climatic conditions on Amazon turtle reproduction.

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TABLE 1. Dates and ecological information for nests of *Podocnemis erythrocephala* laid in saturated soil during 2018 reproductive period in Boa Nova community, Sapucuá Lake, Oriximiná, Brazil.

Nest	Date	Distance from water (m)	Height from water level (cm)	Initial depth (cm)	Final depth (cm)	Number of eggs
1	15 Sep 2018	6.8	17.0	5.0	10.0	6
2	15 Sep 2018	6.7	13.0	4.5	10.0	9
3	24 Sep 2018	3.7	19.0	3.0	7.0	7
4	28 Sep 2018	8.4	30.0	6.0	10.0	9
5	1 Oct 2018	7.7	13.0	4.0	8.0	7
6	1 Oct 2018	4.7	20.0	4.0	9.0	10
7	2 Oct 2018	7.4	24.0	4.0	8.0	10

RHINOCEMYS PUNCTULARIA (Spotted-legged Turtle).

REPRODUCTION. The reproductive biology of *Rhinoclemmys punctularia* is not well known (Ferrara et al. 2017. *Quelônios Amazônicos: Guia de Identificação e Distribuição*. Wildlife Conservation Society. Manaus, Amazonas, Brazil. 182 pp.), though some aspects of its reproduction have been reported (Cunha and Vogt 2018. *Herpetol. Rev.* 49:488). Four gravid females were collected from forest streams, in the municipality of Juruti, Pará, Brazil (2.23035°S, 56.06009°W; WGS 84; 74 m elev.) from September–December 2018. Turtles were collected in 1-m diameter baited fyke-nets (Vogt 1980. *Copeia* 1980:368–371). The females had a mean mass of 1467 g (1292–1643 g). Palpation of the inguinal cavity to detect presence of hard-shelled eggs was used to determine if a turtle was gravid. Eggs were obtained by induction of oviposition (Ewert and Legler 1978. *Herpetologica* 34:314–318) and involved injecting 10 units of oxytocin per kg of total mass of the gravid turtle into the inguinal cavity. Eggs were incubated in damp fine grain vermiculite (proportion 1:1 vermiculite-water) in plastic bowls within clear thin plastic bags at ambient temperatures (27–29°C). Eggs were laid on 22 September, 23 September, and 5 December 2018. Three turtles laid clutches of two eggs and one produced three eggs.

One egg hatched 4 December 2018 after 72 d of incubation and another egg hatched 11 December 2018, after 80 d of incubation. A third egg hatched on 1 March 2019, after 86 d incubating. The incubation period for these three eggs had a mean of 79 d (range: 72–86 d) at ambient temperature. The nine eggs had a mean length of 62.7 mm (range: 57.2–70.4 mm), mean width of 31.4 mm (range: 28.5–34.3 mm) and a mean mass 43 g (range: 36–52 g). One egg began hatching at 1400 h with full emergence at 2100 h. The hatchling had a soft cylindrical shell, and CW was 68.2% of CL at hatching; the following day the height of the carapace was reduced and the total carapace length was longer. By the 8th day the CW/CL was 83.9%. Plastron scute lengths were measured on the 8th day: Gular scute 11.3 mm; humeral scute 6.4 mm; pectoral scute 12.5 mm; abdominal scute 13.2 mm; femoral scute 10.3 mm, and anal scute 11.5 mm; thus abdominal>pectoral>anal>

ular>femoral>humeral (absolute values). The umbilical scar was 14.1 mm in length. Mean measurements of the hatchlings were: 53.7 mm CL; 43.3 mm CW; 53.6 mm PL; 36.0 mm PW, 22.2 mm carapace height and 26.6 g mass.

The hatchlings are similar in color pattern to the adults. The carapace is oval, and the mean CL of the hatchlings, 53.7 mm, is 27% of the mean CL of the adult females (N = 7; mean = 196.4 mm CL). The carapace is moss green with small orange dots. The plastron is black with burnt-yellow coloration along the edges. The ventral aspect of the marginal scutes has small black speckles. The posterior border of the carapace is serrate. The head is relatively small, with bright red dorsolateral stripes, and ventrally the gular is light yellow (Fig. 1).

Rhinoclemmys punctularia has a long intermittent nesting period in different months: March and April (Vogt 2008. *Tartarugas da Amazônia*. Gráfica Biblos. Lima, Peru. 108 pp.), July (Soares et al. 2017. *Herpetol. Rev.* 48:85–86), July and August (Vogt 2008, *op. cit.*) and September and December (Cunha and Vogt 2018, *op. cit.*). Other species in the genus have similar or smaller clutch sizes: *R. annulata* (1–2 eggs; Rueda-Almonacid et al. 2007. *Las Tortugas y los Crocodylia de los Países Andinos del Trópico*. Conservation International, Bogotá, Colombia. 537 pp.), *R. nasuta* (1 egg; Garcés-Restrepo 2017. *Amphibia-Reptilia* 38:351–361), *R. diademata* (1–3 eggs, Armesto et al. 2014. *Catálogo de Anfibios y Reptiles de Colombia* 2:47–52). *Rhinoclemmys* can produce several clutches throughout the year (Merchan and Fournier 2007. *Herpetol. Rev.* 38:72; Páez et al. [eds.]. 2012. *Biología y Conservación de las Tortugas Continentales de Colombia*. Instituto de Investigación de Recursos Biológicos Alexander von Humboldt, Bogotá, Colombia. 528 pp.).

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FIG. 1. Carapace and plastron view of three representative hatchling *Rhinoclemmys punctularia* hatched in this study. Black bar = 1 cm.

TRACHEMYS ADIUTRIX (Maranhão Slider). AESTIVATION and HABITAT USE. *Trachemys adiutrix* is a small freshwater emydid turtle, locally known as “Pininga” or “Jurará” (Vanzolini 1995. Rev. Brasil. Biol. 55:111–125; Fig. 1). The species was described from a population at Santo Amaro, in Lençóis Maranhenses National Park; their range is restricted to vegetated areas within the sand dunes, with or without permanent bodies of water, on the coast of Maranhão and Piauí states. *Trachemys adiutrix* is listed as Near Threatened (Rhodin et al. 2018. Chel. Conserv. Biol. 17:135–161) because of the fragile nature and restricted range of the habitat in which they live.

Our study area of 130 ha is in the region of Barro Vermelho, Municipality of Paulino Neves, Maranhão, Brazil (2.65000°S, 42.61667°W). The region has two distinct climatic seasons: the rainy season and the dry season. The rainy season extends from the end of January through July, concentrating 88% of the annual rainfall in 6 months and is characterized by lower temperatures, thundershowers, and winds of low velocity. The dry season, from August to January, has higher temperatures and stronger winds. The climate has been described as “semi-arid hot tropical equatorial” with a mean annual temperature of 26°C (Nimer 1979. Climatologia no Brasil. Instituto Brasileiro de Geografia e Estatística, Rio de Janeiro, Brazil. 421 pp). The region is characterized by sand dunes (formed by windblown fine sand) up to 50 m in height between the small lakes. The rains in the early part of the year fill shallow lakes that vary from 200–500 m in diameter and have small patches of submerged and emergent aquatic vegetation. During the dry season, most of these lakes are completely dry; only a few of the larger lakes and small rivers maintain water throughout the year. The islands of vegetation between the dunes and the lakes are formed by trees less than 3 m high and smaller shrubs. The most common trees are Murici (*Byrsonima* sp., Malpighiaceae), Creolí (*Mourir* sp., Melastomataceae) and the palm Carnaúba (*Copernicia cerifera*, Arecaceae).

Turtles were captured in two low-transparency permanent lakes: Curral Lake, 572 m in diameter and a maximum of 74 cm deep, covered by the aquatic plant “junco” (reed) and Lagoa dos Altos, 141 m in diameter, with a maximum depth of 2.12 m, with floating macrophytes. The measurements of the lakes were recorded in July during the rainy season. We sampled turtle movements monthly from June 2006 through January 2007; in June and July we used five fyke nets with 50-cm hoops and 20-m leads to capture the turtles. Each turtle captured was individually

marked with a numbered yellow Floy Cinch-up Tag (Floy Tag & Mfg., Inc., Seattle, Washington) threaded through holes drilled in the 8th and 9th left marginal scutes. In addition to these field numbers each turtle was noted by the individual frequency of the transmitter attached to it. Males were identified using external characteristics (long pre-cloacal tail length extending beyond the carapace, females had shorter tails). Turtles smaller than 13 cm were classified as juveniles. We attached 165 MHz radio transmitters with an epoxy base glue to the highest part of the carapace of eight adult females and two adult males (AVM™ Model LA12-Q). We used an AVM™ receiver and Yagi antenna to find the turtles with transmitters.

We released the turtles at their points of capture after attaching transmitters. We were able to locate the turtles precisely by sight with the radio telemetry system. The monitoring of activity of the turtles was made by walking along the borders of the lakes during the rainy season and in the dune areas during the dry season. The home range area and the distances moved by each turtle were obtained from the GPS localities recorded. These data were plotted with programs Arcview GIS v3.2 (ESRI, Redlands, California) and Carta Linx v1.2 (Clark Labs, Worcester, Massachusetts). Movements to aestivation sites were calculated by measuring the minimum linear distance moved from the activity area (border of the lake) to the depression that the turtles dug in the soil or beneath a grass hummock to aestivate. Turtles were localized directly 88 times during the eight months of the study. Mean carapace length (CL) for 10 turtles was 17 cm (range: 16–19 cm); there was no significant difference in the mean CL of males and females (17.2 and 17.0 cm, respectively). The mass of females ranged from 610–1180 g (mean = 821 g) while males were more uniform in size 700–890 g (mean = 795 g).

Mean home range area was 4.56 ha, (range: 0.02–16.15 ha; SD = 5.2 ha). The mean area occupied by females was 4.85 ha, which was greater than that of males (mean = 3.43 ha) though this difference was not significant (Mann-Whitney U: $p = 0.602$). There was no correlation between the home range area and the size of the turtle (Pearson correlation: $r = 0.259$, $p > 0.05$; Spearman correlation: $r = 0.512$, $p > 0.05$). The movements from the lakes to aestivation sites ranged from 105–809 m (mean = 270 m). Turtles entered aestivation sites in August and September. The mean number of days aestivating ranged from 132–164 d (mean = 152 d). During the dry season, fields of plants with affinities for salt and sand dominate



FIG. 1. Adult female *Trachemys adiutrix* from Barro Vermelho, Municipality of Paulino Neves, Maranhão State, Brazil.



FIG. 2. Removing a female *Trachemys adiutrix* (#3490) from her aestivation site in the sand from Pequenos Lençóis Maranhenses Maranhão State, Brazil. This individual did not dig into the sand but was covered by 18 cm of windblown sand.



FIG. 3. *Trachemys adiutrix* aestivating in a clump of vegetation in the region of Pequenos Lençóis Maranhenses, Maranhão State, Brazil.

the landscape (Sampaio 1934. *Phytogeografia do Brasil*. Editora Nacional, São Paulo, Brazil. 284 pp.). The turtles usually aestivate solitarily (Fig. 2, 3), but on one occasion three turtles were found aestivating in the same grass tussock. While aestivating, the turtles usually do not move, and once the turtle has selected its aestivation site it will remain there throughout the dry season.

The high wind velocity during the dry season influences the transport of sand along the coast and the interior part of the dunes. One turtle that was aestivating in a form near the surface during November 2006 was recaptured in the same locality in January 2007, 18 cm below the surface of the windblown sand (Fig. 2). At that depth the sand temperature was 31.4°C, while the sand at the surface was 41.3°C. The air temperature in the shade at 6 cm above the sand at the same time, at 1030 h, was 32.8°C. This turtle was initially disturbed in the process of locating it; when released, it made a new form within 19 m of the old one. Within two months, the windblown sand completely covered the site where the turtle was aestivating. Upon examination the turtle appeared normal in regard to eye moisture, mobility, and body color, and there was no obvious evidence of dehydration. The grass tussocks play a crucial role in the survivorship of *T. adiutrix* (Fig. 3). Humidity at the aestivation site, independent of temperature, is the principal variant in the selection of the aestivation microhabitat, though the selection of the aestivation site can be influenced by a combination of temperature, humidity, and herbaceous cover (Morales-Verdeja and Vogt 1997. *Copeia* 1997:123–130).

All the transmitters were removed from the turtles in January 2007; the mass of each turtle was taken and compared to their original mass in June. Three turtles lost little weight during aestivation, though the largest turtle lost 190 g. Mean weight loss of the turtles after aestivation was 8.4% of their original mass. Aestivation behavior occurs annually and has allowed these turtles to survive in this restricted and challenging habitat. This adaptation presumably developed over a long period of time, perhaps countering the idea that this population is merely a subpopulation of *Trachemys dorbignii* separated by a few thousand km.

Both the lakes and the terrestrial areas adjacent to the lakes are critical habitat for *T. adiutrix*. The results of our study demonstrate the need for designation and protection of the habitat surrounding the temporary lakes where this species aestivates and nests. These turtles are vulnerable to the modifications of the habitat made by humans and their livestock. We suggest that the Brazilian governmental agency having authority for the protection of threatened and endangered reptiles and amphibians,

(RAN/ICMBIO) designate critical habitat for this species; intensive use of this habitat for growing crops or grazing livestock must be discouraged in order to ensure the survivorship of this species. Fortunately, our study area is included in Lençóis Maranhenses National Park and is protected by federal legislation, though the area is threatened by the intrusion of human activities and their livestock. Without a designated active management plan and habitat protection scheme, this species could decline or disappear altogether because of its restricted range and fragile habitat.

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CROCODYLIA — CROCODILIANS

MELANOSUCHUS NIGER (Black Caiman). DIET. Crocodylians are generalist and opportunistic apex predators, feeding on a large variety of prey. In general, smaller individuals consume principally invertebrates (e.g., crustaceans, insects, spiders) while most of the diet of adults consists of fish, especially during the dry season. Non-aquatic tetrapods, such as birds and mammals, have been reported, but in very low frequencies (Magnusson et al. 1987. *J. Herpetol.* 2:85–95; Barão-Nóbrega et al. 2016. *Herpetol. J.* 26:65–71). Black Caiman are the biggest of the four Amazonian caiman species, with some adult males reaching 4–5 m in length and weighing > 300 kg (Thorbjarnarson 2010. *In* Manolis and Stevenson [eds.], *Crocodyles: Status Survey and Conservation Action Plan*, pp. 29–39. Crocodile Specialist Group, Darwin, Australia). Larger individuals of this species can feed on heavily armored species, such as turtles (De La Ossa et al. 2010. *Rev. Col. Ciec. Anim.* 2:244–253), but we have found only one record of this species preying on mammals (rodents: Da Silveira and Magnusson 1999. *J. Herpetol.* 33:181–192), and we have found no records of arboreal prey, such as monkeys.

Alouatta has the broadest distribution of Neotropical primate genera, occupying tropical forests from southern Mexico to northern Argentina (Cortés-Ortiz et al. 2003. *Mol. Phylogenet. Evol.* 26:64–81). The 12 recognized species of the genus have been documented to interact with 22 mammalian species (27% of them identified as predators), 19 species of birds (63% being raptors), and only three species of reptiles (Cristóbal-Azkarate et al. 2015. *In* Kowalewski [ed.], *Howler Monkeys, Developments in Primatology: Progress and Prospects*, pp. 141–164. Springer Science + Business Media, New York, New York). *Alouatta puruensis* (Red Howler Monkey) occurs along the Purus River basin and adjacent parts of the upper Madeira River (Gregorin 2006. *Rev. Brasil. Zool.* 23:64–144). Natural history and ecological aspects of this Amazonian species are poorly known and no long-term studies exist. Nonetheless, *A. puruensis* has been preyed on by *Boa constrictor* (Quintino and Bicca-Marques 2013. *Primates*



FIG. 1. Hindleg of *Alouatta puruensis* (Red Howler Monkey) found in the stomach contents of a *Melanosuchus niger*.

54:325–330) and *Harpia harpyja* (Harpy Eagle; Peres 1990. Wilson Bull. 102:560–561; Sherman 1991. Folia Primatol. 56:53–56). We have not found literature records of *A. puruensis* being preyed on by non-arboreal species.

In July 2008, we analyzed crocodilian stomach contents from the Piagaçu-Purus Sustainable Development Reserve located in the lower Purus River (4.0833°S, 61.7333°W; WGS 84), ca. 350 km SW of Manaus, Brazil. In the 33 crocodilian stomachs we analyzed, we found only one new food type for *M. niger*. This individual was a sub-adult male (82.0 cm SVL, 171.3 cm total length, 14.2 kg) and had a leg in its stomach. The hind limb was well preserved with lot of hair still present but no muscle (Fig. 1). It was identified as *A. puruensis* by comparison with material from the mammal collection of the Instituto Nacional de Pesquisa da Amazônia, in Manaus. *Alouatta puruensis* often swims in the flooded forest (Kulaif-Terra, pers. comm.) and the abundance of *M. niger* in this habitat could explain our record (Da Silveira 2002. In Larriera and Verdade [eds.], Conservación y el Manejo de Caimanes e Cocodrilos de América Latina, pp. 61–78. C.N. Editoria, Piracicaba, Sao Paulo, Brazil). Nevertheless, we do not have information on how this predation event occurred, and it might have been a case of scavenging a dead individual. Predation episodes like this are rarely witnessed due to their uncommonness, short duration, and the tendency of predators to avoid humans (Isbell 1994. Evol. Anthropol. 3:61–71; Urbani 2005. J. Anthropol. Sci. 83:89–109). We assume that our finding reflects the opportunistic foraging behavior of *M. niger*, is the first record of a *M. niger* feeding on a monkey species, and the second observation in central Amazonia of such interaction between caimans and primates (Barão-Nóbrega et al. 2016, *op. cit.*).

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SQUAMATA — LIZARDS

ALOPOGLOSSUS ANGULATUS (Northern Teiid). PREDATION.

The lizard species *Alopoglossus angulatus* is distributed across Brazil, French Guiana, Suriname, Guyana, Colombia, Ecuador, and Peru, in regions ranging from 100–760 m above sea level (Köhler et al. 2012. Herpetol. Monogr. 26:173–188). This species is found among leaf litter and is usually found in habitats associated with water (Vitt et al. 2007. Phyllomedusa 6:11–21). At 0810 h



FIG. 1. A) Adult *Turdus leucomelas* offering an individual *Alopoglossus angulatus* to a youngling in its nest; B) a *T. leucomelas* youngling starts to swallow *A. angulatus*; C) the *T. leucomelas* youngling swallows the *A. angulatus*.

PHOTOS BY DIOGO LAGROTTERIA

on 23 August 2012 we observed an adult *Turdus leucomelas* (Pale-breasted Thrush) using its beak to hold a dead adult *A. angulatus* (ca. 6.2 cm SVL) and offering it to two *T. leucomelas* younglings living in its nest (Fig. 1A). The nest was located under the eaves of a residential house within the Acariquara Environmental Protection Area (APA UFAM-Acariquara), an urban terra firme forest fragment of ca. 776 ha in Manaus, Amazonas, Brazil (3.08355°S, 59.96294°W; WGS 84). The observation started while the adult *T. leucomelas* was flying towards the nest carrying the *A. angulatus*. When it landed, both younglings on the nest immediately reacted by widely opening their beaks and moving their wings. One of the younglings received the lizard and started to swallow the whole body. The swallowing process started by the lizard's head (Fig. 1B) and lasted for ca. 50 s (Fig. 1C). The youngling seemed to struggle while swallowing. The lizard's head was already severely damaged when first brought to the nest, as well as its tail, which seemed to be autotomized, indicating a possible fight between the animals. The only other observation of predation on *A. angulatus* is by the frog *Leptodactylus pentadactylus* (Couto et al. 2014. Herpetol. Notes 7:37–39; Couto et al. 2018. Herpetol. Notes 11:519–525), thus making this observation the first record of this lizard species being preyed upon by a bird.

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AMBLYRHYNCHUS CRISTATUS (Marine Iguana). TAIL REGENERATION AND BIFURCATION. Caudal autotomy is a widespread anti-predator strategy in lizards (Bateman and Fleming 2009. J. Zool. 277:1–14). Lizard taxa capable of caudal autotomy have a series of vertebrae in their tails with pre-formed breakage planes (Etheridge 1967. Copeia 1967:699–721). Such planes exist in most members of the Iguanidae but not in *Amblyrhynchus*, nor in *Brachylophus*, *Conolophus*, and *Iguana delicatissima* (Pregill and Worthy 2003. Herpetologica 59:57–67). The ability to autotomize is likely to be ancestral to all modern squamates and subsequent loss of autotomy planes and the ability to shed the tail by lizards may, for some species, be associated with specializations of the tail that makes autotomy too costly (Fleming et al. 2013. Phys. Biochem. Zool. 86:645–658).

In March 2019, an adult *Amblyrhynchus cristatus* was photographed (Fig. 1A) on Isla Fernandina in the Galápagos Islands (0.2638°S, 91.4458°W). The tail of this individual appeared to be intact apart from an indentation on its dorsal surface, perhaps from a predatory attack or some sort of crush injury. Immediately adjacent to this indentation and growing from the right side of the tail was a “regenerated” tail fragment, ca. 3 cm long, and appearing to be much like many of the other bifurcations in regenerated tails recorded across lizard taxa, including iguanids (Koleska et al. 2017. Herpetol. Notes. 10:363–364; Koleska and Jablonski 2018. Phyllomedusa 17:157–159). In May 2019, a second individual was photographed (Fig. 1B) on Isla Santa Cruz (0.7641°S, 90.3394°W) demonstrating a similar regenerated tail fragment on the left side of its tail, and an amorphous regenerated mass at the tip of the tail. *Amblyrhynchus cristatus* is famously a marine forager, and its laterally flattened tail, while not unlike that of terrestrial relatives, is vital for swimming capability (Dawson et al. 1977. Evolution 31:891–897). As such, it is not surprising that it has lost the ability to autotomize its tail. Our observation, however, indicates



FIG. 1. A) Tail of adult *Amblyrhynchus cristatus* with wound/indentation and adjacent supernumerary regeneration of tail material. Intact tail of a second individual on the left; B) Tail of adult *A. cristatus* with supernumerary regeneration of tail material and regeneration at tip of tail.

that loss of autotomy does not necessarily entail loss of regenerative ability, as demonstrated by this supernumerary tail that has presumably grown from the damaged ependyma lining the spinal cord (Gilbert et al. 2013. Phys. Biochem. Zool. 86:631–644). *Amblyrhynchus cristatus* has few natural terrestrial predators once adult (Berger et al. 2007. Horm. Behav. 52:653–663), but it is susceptible to attacks by feral dogs (Kruuk and Snell 1981. J. Appl. Ecol. 18:197–204), and bite marks from dogs have been recorded on the tails of *A. cristatus*, although without causing tail loss, or, apparently, any extraneous regeneration (Berger 2006. Ph.D. Dissertation, Universität Ulm). As far as we can tell, although regeneration of extra tail material resulting in bifurcation is relatively common in lizards, this is the first record of tail material regenerating in a species that does not have caudal breakage planes and does not autotomize its tail, indicating that regeneration and autotomy are not necessarily linked.

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ASPIDOSCELIS GULARIS (Common Spotted Whiptail). **PRE-DATION.** *Aspidoscelis gularis* is a common lizard inhabiting southern Oklahoma, southeastern New Mexico, the majority of Texas, and northern Veracruz. The Great-tailed Grackle, *Quiscalis mexicanus*, is a common bird species, whose large native range overlaps the entirety of that of *A. gularis*. The diet of *Q. mexicanus* usually consists of arthropods, small vertebrates, and plant matter (Grabrucker et al. 2010. Open Ornithol. J. 3:101–104) including one record of a predation event on *Aspidoscelis sonora* (Jennings 1984. Southwest. Nat. 29:514). Both species are commonly observed in the same habitat on or near roadways, especially when a fence line is present. While conducting internal road surveys at 1520 h on 3 July 2017 at Laughlin Air Force Base, Val Verde County, Texas, USA (29.3676°N, 100.7779°W; WGS 84), a male *Q. mexicanus* was observed perched on a fence consuming an *A. gularis* (Fig. 1). The prey capture was not witnessed; however, due to the lack of human activity on this road it is highly unlikely the lizard was killed by a vehicle. As observers approached to identify the lizard, the grackle took flight several times moving ca. 500 m down the fence line. The bird resumed picking apart and shaking the lizard each time he landed. Although the frequency of predation by *Q. mexicanus* on *A. gularis* is unknown, it is likely an opportunistic occurrence.



FIG. 1. *Quiscalis mexicanus* perched on top of a fence post consuming an *Aspidoscelis gularis*.

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ASPIDOSCELIS GUTTATUS (Mexican Racerunner) and SCELOPORUS SINIFERUS (Long-tailed Spiny Lizard). **OPPORTUNISTIC FORAGING.** *Aspidoscelis guttatus* (Teiidae), a ubiquitous, diurnal, and large-bodied lizard species, is distributed in parts of several states in southern Mexico (Duellman and Wellman 1960. Misc. Publ. Mus. Zool. Univ. Michigan 111:1–81), including Oaxaca (Mata-Silva et al. 2015. Mesoam. Herpetol. 2:1–62; Mata-González et al. 2016. Mesoam. Herpetol. 3:483–484). It is one of seven species of *Aspidoscelis* in the state (Mata-Silva et al. 2015, *op. cit.*). *Sceloporus siniferus* (Phrynosomatidae), a commonly encountered, diurnal, small-bodied, and long-tailed lizard species (Lemos-Espinal et al. 2001. West. N. Am. Nat. 68:498–500; Lemos-Espinal, pers. comm.), is distributed in Guatemala and



FIG. 1. Individuals of *Aspidoscelis guttatus* and *Sceloporus siniferus*, the former with a winged termite in its mouth, in close proximity as they consume termites emerging from a ground nest cavity in Oaxaca, Mexico.

several Mexican states, including Oaxaca (Mata-Silva et al. 2015, *op. cit.*). It is one of 26 species of *Sceloporus* in the state (Mata-Silva et al. 2015, *op. cit.*). Here, we report an observation on feeding habits of two young adult *A. guttatus* and an adult *S. siniferus* at Paja Blanca, Municipality of San Pedro Huamelula, Oaxaca, Mexico. The *A. guttatus* were two of many individuals observed in an area located ca. 2.6 km from the Pacific Ocean with secondary hardwood growth, scattered cacti, and rock outcrops (15.92384°N, 95.73852°W; WGS 84; ca. 20 m elev.). The *S. siniferus* shown in Fig. 1 was one among several congeners observed in the area and was only identified with assistance of the acknowledged authorities.

On 15 May 2015 at ca. 1000 h, a warm day after the first heavy downpour of the rainy season at Paja Blanca, we recorded this sequence of events over a period of ca. 20 min. Numerous termite alates were observed emerging from a hole leading from a nest cavity in the moist, porous, debris-strewn soil. Present at this foraging event were two young adult *A. guttatus* as well as an individual *S. siniferus*. The prey was identified as a winged termite, characterized by a banded pattern on the abdomen and general body configuration of a termite, including bilateral pairs of wings of the same length (Fig. 1). The *S. siniferus* also consumed termite alates from the nest cavity. During the duration of this observation, individuals of both species of lizards consumed 5–10 alates shortly after their emergence. Most strikingly, the individuals of the two species were tolerant of each other such was their attention to the abundance of winged insects. Availability of this particular prey item is seasonal and the opportunity to harvest the winged insects as they emerged and before they had taken flight obviously facilitated consumption. This observation emphasized the opportunistic feeding strategies of each of these species. The abundance of prey in the moment precluded this observation being offered as an example of interspecific competition.

We are grateful to Adrián Nieto Montes de Oca, Universidad Nacional Autónoma de México, for assistance in identifying the prey items, the species of *Sceloporus*, and the young adult ontogenetic stage of *A. guttatus*. J. A. Lemos-Espinal kindly provided a second opinion on the identity of *Sceloporus* and commentary on the manuscript.

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ASPIDOSCELIS TESSELATUS (Checkered Whiptail). DIET and SCAVENGING. Whiptail lizards of the genus *Aspidoscelis* primarily consume live invertebrates, but there are a few accounts of whiptails consuming vertebrates (e.g., Babb and Brennan 2013. *Herpetol. Rev.* 44:507; Chávez-Martínez and Ramírez-Bautista 1998. *Herpetol. Rev.* 29:99–100). Opportunistic scavenging of dead prey has been reported for *A. gularis* (Ferrer and Lazcano 2016. *Herpetol. Rev.* 47:666). Here, we present an account of scavenging behavior on a novel vertebrate prey item for *A. tessellatus*, a common whiptail lizard species in the American southwest.

At ca. 0915 h on 25 June 2018 on Santa Elena Canyon Trail by the Rio Grande in Big Bend National Park, Texas, USA (29.165°N, 103.612°W; WGS 84), we observed an adult *A. tessellatus* carrying a small brown bat with black wings (likely *Myotis* sp.). On close inspection, the bat carcass appeared to be dried out, and, during continued observation of about 10 min, the lizard shook it and slapped it against the ground repeatedly, likely in an attempt to break off a piece small enough for consumption (Fig. 1). We continued down the trail, and both the bat and lizard were gone when we returned ca. 15 min later. To our knowledge, this observation represents both a novel food item (*Myotis* sp.) and a first report of attempted scavenging for this species. Our observation lends support to the idea that although whiptails primarily eat arthropods, they will opportunistically feed on vertebrates.



FIG. 1. Adult *Aspidoscelis tessellatus* carrying around a small dead bat.

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ASPIDOSCELIS TIGRIS SEPTENTRIONALIS (Plateau Tiger Whiptail). SUPERNUMERARY CAUDAL ANOMALY. *Aspidoscelis tigris* is a common lizard throughout much of the desert western United States. Having been variously divided into

subspecies, several distinct populations are noted. The subspecies *A. t. septentrionalis* is found across most of the Colorado Plateau and portions of adjacent warm deserts. Like all forms of the species, the Plateau Tiger Whiptail has a distinctly long tail. The average SVL for the subspecies is ca. 105 mm (Heyborne et al., unpubl. data), while the maximal tail length is nearly twice that. The long tail presumably evolved to increase locomotor ability, perhaps facilitating balance during bipedal bouts, and tail loss has been correlated with reduced locomotor performance (Ballinger et al. 1979. *Herpetologica* 35:114–116). Despite the increased fitness conveyed by intact tails, tail autotomy is relatively common in this species as an antipredator strategy.

At 1300 h on 1 August 2017, a *A. t. septentrionalis* was observed darting in and out from under concrete parking blocks in 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.). Closer inspection showed the specimen to have a supernumerary tail anomaly. As has been reported for other species with supernumerary tails (Koleska and Jablonski 2018. *Phyllomedusa* 17:157–159), the tail appeared to have been broken at one point but not completely severed. The left fork was apparently the original tail, with a length and scalation typical for the species. The two secondary tails were both thicker and shorter than the original. The right secondary tail was ca. one quarter the length of the left fork (original tail) and ended in a broad blunt end. The left secondary tail was little more than a tip just beginning to form in between the original tail and the right secondary tail. The fork itself was excessive in size and curved slightly toward the animal's right side, where the secondary tails branched. The supernumerary condition coupled with the increased girth of the fork resulted in a tail that seemed unusually heavy for a lizard of this size. The increased mass appeared to impede the locomotory ability of the lizard as it was not as quick or as agile as a typical member of this species. Despite its decreased ability to locomote, attempts to capture the animal for closer examination were unsuccessful.



FIG. 1. *Aspidoscelis tigris septentrionalis* with supernumerary tails.

Supernumerary and bifid tails have been reported in a number of species from this genus, including *Aspidoscelis sexlineata* (supernumerary; Trauth et al. 2014. Herpetol. Rev. 45:492–493), *A. velox* (bifid; Cordes and Walker 2013. Herpetol. Rev. 44:319), *A. exanguis* (bifid), *A. neomexicana* (bifid), and *A. uniparens* (bifid; Bateman and Chung-MacCoubrey 2013. Herpetol. Rev. 44:663). However, we believe this to be the first report of a bifid or supernumerary tail from *A. tigris*. As was noted above, the supernumerary condition of this specimen seemed to be a detriment to locomotion and, has been previously noted in the literature, is likely an example of an adaptive response to caudal autotomy becoming non-adaptive due to incomplete loss or tail injury (Trauth et al. 2014, *op. cit.*).

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BACHIA TRINITATIS (Trinidad Hex-scaled Bachia). DEFENSIVE BEHAVIOR. *Bachia trinitatis* is a small fossorial gymnophthalmid lizard (6.4 cm SVL) that is distributed across Trinidad and Tobago (Murphy et al. 2018. A Field Guide to the Amphibians and Reptiles of Trinidad and Tobago. Trinidad and Tobago Field Naturalists' Club, Port-of-Spain, Trinidad. 336 pp.). On 16 June 2016, an individual was collected in leaf litter at Pigeon Peak Trail, Tobago, Trinidad and Tobago (11.3171°N, 60.5431°W; WGS 84) and taken back to the lab for closer inspection. The lizard was placed in a container with leaf litter. Upon trying to photograph the specimen alive, it rolled over to its side and laid in that position with its legs stretched out for 2 min (Fig. 1), before readjusting itself back. The specimen was later deposited at The University of the West Indies Zoology Museum in Trinidad (UWIZM.2016.22.26). Although death-feigning is apparent in many species of lizards, documentation of it in gymnophthalmids is limited (Mesquita et al. 2018. Herpetol. Notes. 11:1065–1067) and this could be the first documentation of it in this species.



FIG. 1. *Bachia trinitatis* death-feigning while being photographed.

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BRADYPODION SETAROII (Setaro's Dwarf Chameleon). REPRODUCTION. *Bradypodion setaroi*, one of the smallest species of the genus, was described in 1976 (Raw 1976. Durban Mus. Novit. 11:139–161). It inhabits coastal dune forest patches

between Richards Bay, KwaZulu Natal province, South Africa and the southernmost part of Maputo province of Mozambique. Parturition has previously been recorded during the month of February (Reissig 2013. African Herp News. 59:42–44). Maximum clutch size records are reported as 11 from a wild caught specimen (Tilbury 2018. Chameleons of Africa – An Atlas. Including the Chameleons of Europe, the Middle East and Asia. Edition Chimaira. Frankfurt, Germany. 643 pp.) and 12 from a captive specimen (Masurat and Masurat 1995. Sauria 17:3–9). The latter record is from a captive female that unfortunately died prior to giving birth.

On 10 February 2019 at 1732 h, an adult female *B. setaroi* with a total length of 126 mm (66 mm SVL; 60 mm tail length) was observed giving birth to 12 neonates in St. Lucia, South Africa (28.38510°S, 32.41375°E; WGS 84). This observation took place in a natural forest area, just outside of the town. After the female had finished giving birth, she weighed 4.2 g. Measurements (to nearest mm) were obtained of offspring as follows: mean SVL = 21.3 mm (range: 21–22 mm, SD: 0.492), mean tail length = 22.2 mm (range: 21–23 mm; SD: 1.193). Their combined mass was 2.5 g.

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CARLIA BICARINATA (Rainbow-skink). ENDOPARASITE. *Carlia bicarinata* is known from the Central Province and the National Capital District, Papua New Guinea (Uetz et al. [eds.] 2019. The Reptile Database. <http://www.reptile-database.org>; accessed 7 Mar 2019). We know of no published records of endoparasites from *C. bicarinata* and establish the helminth list for this species in our note.

One adult *C. bicarinata* (82 mm SVL, 85 mm tail length, 3.1 g) was collected by hand in September 2010 in Papua New Guinea, National Capital District (9.4438°S, 147.1803°E; WGS 84) and was deposited in the Bernice P. Bishop Museum (BPBM) in Honolulu, Hawaii, USA (BPBM 37425). The *C. bicarinata* was preserved in 10% neutral buffered formalin and stored 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 parasites utilizing a dissecting microscope. One female nematode was found in the small intestine. It was placed on a glass slide in a drop of lactophenol, a cover slip was added, and identification was made from this temporary wet mount. Identification as *Maxvachonia adamsoni* was made utilizing Anderson et al. (2009. Keys to the Nematode Parasites of Vertebrates, Archival Volume, CAB International, Wallingford, Oxfordshire. 463 pp) and by comparison to the original description (Moravec and Sey 1990. Acta Soc Zool. Bohem. 54:268–286). *Maxvachonia adamsoni* is a common nematode in geckos and skinks from Papua New Guinea. A host list is in Goldberg et al. (2010. Pac. Sci. 64:131–139). It also has been reported from the hylid frog, *Litoria infrafrenata* (Goldberg et al. 2013. J. Nat. Hist. 47:1891–1910). The individual *M. adamsoni* was deposited in the Harold W. Manter Parasitology Laboratory (HWML), The University of Nebraska, Lincoln, Nebraska, USA (HWML 110860). *Maxvachonia adamsoni* in *C. bicarinata* is a new host record.

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COLOBOSAUIROIDES CEARENSIS (Litter Lizard). DIET. *Colobosauroides cearensis* is a fossorial or semi-fossorial lizard species of the family Gymnophthalmidae and is distributed in mainland and island localities from México to Argentina (Colli et al. 1998. *Herpetologica* 54:169–174; Pellegrino et al. 2001. *Biol. J. Linn. Soc.* 74:315–338). *C. cearensis*, as well as its congener, *C. carvalhoi*, is distributed in northeastern Brazil and is associated with relict forest environments of the Caatinga Domain (Soares and Caramaschi 1998. *Bol. Mus. Nac. Sér. Zool.* 388:1–8). *Coleodactylus meridionalis* is a lizard species of family Sphaerodactylidae (Gamble et al. 2011. *Zool. J. Linn. Soc.* 163:1244–1266) and occurs in tropical forest leaf litter (Freire 1999. *Bol. Mus. Nac.* 399:1–14) of the Atlantic Forest (Freire 1999, *op. cit.*), Caatinga (Vanzolini et al. 1980. *Répteis da Caatinga*. Academia Brasileira de Ciências, Rio de Janeiro. 161 pp.), and Cerrado biomes (Colli et al. 2002. *In* Oliveira and Marquis [eds.], *The Cerrados of Brazil: Ecology and Natural History of a Neotropical Savanna*, pp. 223–241, Columbia University Press, New York, New York). Herein, we present the first information about the diet of *Colobosauroides cearensis*, as well as the first case of saurophagy in the family Gymnophthalmidae.

We examined the stomach contents of *C. cearensis* collected from 2012–2013 in the Serra de Santa Catarina, a Caatinga area in Paraíba, Brazil (7.00322°S, 38.22456°W; WSG 84; 700 m elev.). In the stomach of a male *C. cearensis* (Federal University of Campina Grande [LHUF CG] 566: 49.4 mm SVL, 52 mm tail length, 2.0 g; Fig. 1A) we found an adult *Coleodactylus meridionalis* (LHUF CG 2284: 26.0 mm CRC, 0.222 g; Fig. 1B), without tail and part of hindlimbs. Large prey items, such as lizards, can provide high

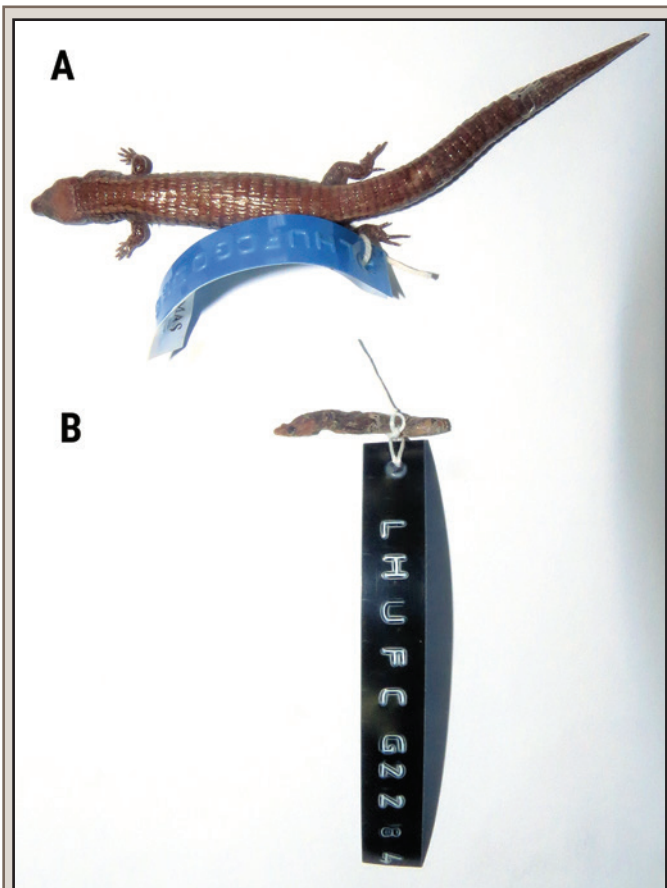


FIG 1. Adult male *Colobosauroides cearensis* (A) that had consumed an adult *Coleodactylus meridionalis* (B).

energetic value (Vitt 2000. *Herpetol. Monogr.* 14:388–400), and thus, some lizard predators will opportunistically consume some vertebrate prey. Although uncommon in the literature, there are reports of saurophagy for some families such as Teiidae (Sales and Freire 2010. *Herpetol. Rev.* 41:217–218; Tavares et al. 2017. *Herpetol. Rev.* 48:36–37), Gekkonidae (Bonfiglio et al. 2006. *Bio-ciências* 14:107–111), and Tropicuridae (Passos et al. 2016. *Biota Neotrop.* 16:1–5). However, no cases have been reported for the family Gymnophthalmidae. Furthermore, there are no ecological studies of *C. cearensis*. It is also important to note that there are records of *Colobosauroides meridionalis* being preyed upon by spiders (Oliveira et al. 2017. *Herpetol. Notes* 10:221–223) and lizards, including *Tropidurus hygomi* and *Brasiliscincus heathi* (Vargens et al. 2005. *Herpetol. Rev.* 36:173–174; Alcantara et al. 2015. *Herpetol. Rev.* 4:630).

Specimen collected under license (#25267-1) of the System Authorization and Information on Biodiversity (SISBIO-IC-MBio).

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CTENOSAURA SIMILIS (Black Iguana). DIET. *Ctenosaura similis* is a large lizard (ca. 490 mm SVL) that occurs from the Isthmus of Tehuantepec, including the Yucatan Peninsula, Mexico, to Panama in Central America (Köhler 2008. *Reptiles of Central America*. Herpeton Verlag, Offenbach. 367 pp.). The diet of this species changes with age, as juveniles consume animal prey such as insects, and adults are predominantly herbivorous. However, occasionally adult individuals feed on animal prey (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. 402 pp.).

Among the prey of adult *C. similis* are arachnids (*Aphonopelma crinirufum*; Dion and Porras 2014. *Mesoam. Herpetol.* 1:157–158), reptiles (*C. similis*, *Basiliscus vittatus*; Mora et al. 2015. *Mesoam. Herpetol.* 2:107–109; Cedeño-Vázquez and Beutelspacher-García 2016. *Herpetol. Rev.* 47:297), birds (Fitch and Hackforth-Jones 1983. *In* Janzen [ed.], *Costa Rican Natural History*, pp. 394–396. University of Chicago Press, Chicago, Illinois), small terrestrial mammals (*Oryzomys*, *Scotinomys*, and *Sigmodon*; Campbell 1998. *Amphibians and Reptiles of Northern Guatemala, the Yucatán and Belize*. University of Oklahoma Press, Norman, Oklahoma. 400 pp.), and bats (*Eumops*; Fitch et al. 1971. *Southwest. Nat.* 15:398–399). Here we report observations of *C. similis* feeding on a Tropical Mockingbird (*Mimus gilvus*) and a Mexican Red-rump Tarantula (*Brachypelma vagans*) in the Yucatán Peninsula, Mexico.

At 1033 h on 15 September 2018 in Puerto Aventuras, Municipality of Solidaridad, Quintana Roo (20.49725°N, 87.23837°W; WGS 84), an adult male *C. similis* (ca. 90 cm total length) was observed feeding on a still alive adult *M. gilvus* (Fig. 1) in the ground of the forest, next to the base of a tree in a semi-deciduous medium forest, near a housing complex.

In Rancho La Pimienta, Municipality of Carmen, Campeche (18.07034°N, 91.69846°W; WGS 84) at 1509 h on 11 January 2019, an adult female *C. similis* (ca. 73 cm total length) was found preying on an adult *B. vagans* (Fig. 2). The event occurred in metal tubes used as a bridge by local residents, surrounded



FIG. 1. An adult male *Ctenosaura similis* eating an adult *Mimus gilvus* in Solidaridad, Quintana Roo, Mexico.



FIG. 2. An adult female *Ctenosaura similis* preying on an adult *Brachypelma vagans* in Carmen, Campeche, Mexico.

by semi-deciduous medium forest and induced pasture. To our knowledge these are the first documentary observations of *C. similis* preying upon *M. gilvus* and *B. vagans*. We thank Y. Hénaut for helping to verify the identification of the tarantula.

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CYCLURA CYCLURA INORNATA (Allen Cays Rock Iguana). INJURY FROM TOURISTS. Supplemental feeding of *Cyclura cyclura inornata* by tourists has become a daily activity on Leaf Cay and U Cay in the Allen Cays, northern Exumas, Bahamas (Smith and Iverson 2016. *Herpetol. Conserv. Biol.*

11:214–221). It is well documented that supplemental feeding of wild iguana populations can cause alterations in population structure (Iverson et al. 2006. *Biol. Conserv.* 132:300–310), behavior (Hines 2011. *Herpetol. Conserv. Biol.* 6:250–259), and physiology (Knapp et al. 2013. *Conserv. Physiol.* 10.1093/conphys/cot032). Tourists often throw provisions on the beach near iguanas, which the iguanas then eat, ingesting substantial amounts of sand, and produce dense, cement-like fecal pellets that can be fatal (Hines et al. 2010. *Herpetol. Rev.* 41:77–78). To reduce sand consumption caused by supplemental feeding, we urged tourism companies to modify their food delivery system. At least one company now encourages tourists to feed grapes impaled on the ends of sticks (Knapp et al. 2013, *op. cit.*), including wooden kebab skewers. Although this delivery system generally reduces the ingestion of sand, tourists nervous about a large, hungry, charging, open-mouthed iguana, often drop the skewers before or after the bait is removed by the iguana. On occasion this apparently results in the ingestion of the skewer as well as the food.

On 19 May 2016 on the primary tourist feeding beach of Leaf Cay, we captured a male iguana (40.1 cm SVL, 2530 g, ca. 20.7 yrs of age; first marked in 2002) with an 8-cm bamboo skewer perforating the abdominal wall (Fig. 1). The condition of the skewer indicated relatively recent ingestion. The iguana appeared to be in good condition and was behaving normally

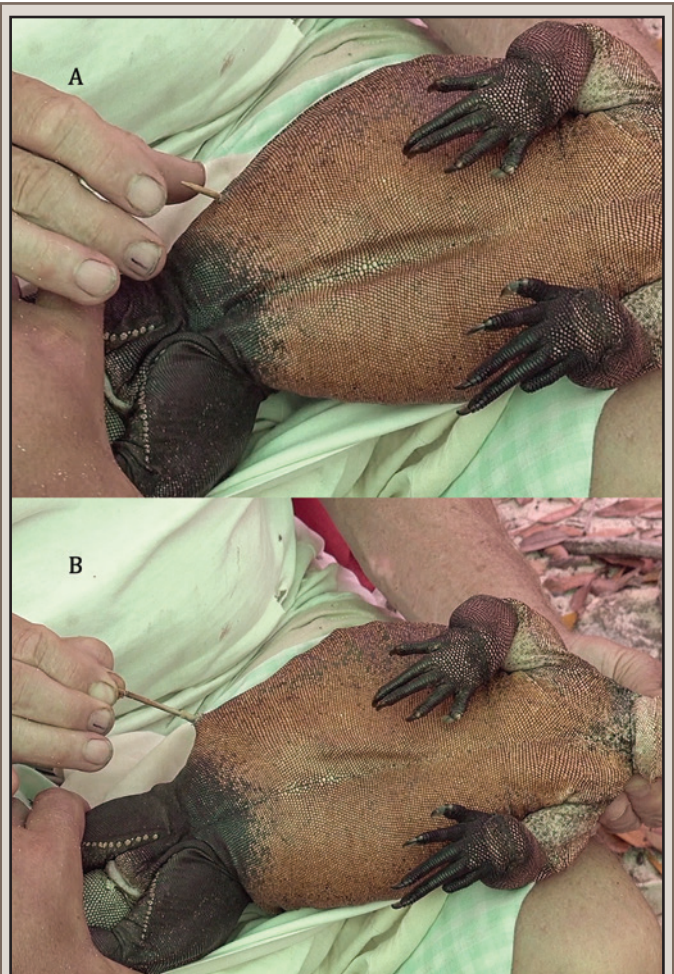


FIG. 1. A) Kebab skewer perforating abdomen of *Cyclura cyclura inornata*; B) Removal of skewer.

when captured, so the skewer was carefully removed and the exit wound treated with antibiotics. The extent of internal tissue damage could not be determined. We were not able to recapture this iguana or locate its carcass during fieldwork in 2017–2019, and we presume it did not survive.

This is not the first evidence of the danger of these skewers to lizards. Kebab sticks have been previously implicated in the death of a monitor lizard (*Varanus* sp.) at a barbecue site in the Northern Territory of Australia (Trembath and Freier 2005. *Herpetofauna* 35:48–49). Although the use of kebab skewers for feeding iguanas in the Exumas was done with good intentions, their small size, sharp end, and tendency to be dropped by some tourists has introduced just one more threat to the survival of this and other endangered species.

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ELGARIA MULTICARINATA (Southern Alligator Lizard). PREDATION. *Elgaria multicarinata* is a medium-sized anguillid lizard of western North America (Stebbins 2003. *Western Reptiles and Amphibians*. 3rd Edition. Houghton Mifflin Company, New York, New York. 533 pp.). The species occupies a variety of habitats, but is generally found in or near moist areas, often around human habitations (Cowles 1937. *Science* 85:99–100; Fitch 1938. *Am. Midl. Nat.* 20:381–424; Stebbins 2003, *op. cit.*). As with other members of the genus, *E. multicarinata* feeds on a wide variety of insect prey, even taking small vertebrates and occasionally bird eggs (Fitch 1938, *op. cit.*; Cunningham 1956. *Herpetologica* 12:225–230; Nussbaum et al. 1983. *Amphibians and Reptiles of the Pacific Northwest*. University of Idaho Press, Moscow, Idaho. 332 pp.; Stebbins 2003, *op. cit.*). The species is even known to feed on highly venomous *Latrodectus hesperus* (Western Black Widow Spider) and their egg sacs (Cowles 1937, *op. cit.*; Cunningham 1956, *op. cit.*). At one point, it was even suggested that *E. multicarinata* could serve as a biological control for urban/suburban populations of *L. hesperus* in Southern California (Cowles 1937, *op. cit.*), although the importance of *L. hesperus* in their diet is still unknown.



FIG. 1. Young-of-year *Elgaria multicarinata* (Southern Alligator Lizard) ensnared in the web of an adult *Latrodectus hesperus* (Western Black Widow Spider) at a suburban residence in Yolo County, California, USA.

Latrodectus hesperus is a nearly ubiquitous, web-building, venomous, polyphagous spider found from Mexico to southern Canada, including the western United States (Salomon 2011. *J. Arachnol.* 39:154–160; Bradley 2012. *Common Spiders of North America*. University of California Press, Berkeley, California. 282 pp.). Although *Latrodectus* species have been shown to successfully capture and consume small vertebrates, the majority of their prey consists of insects (Salomon 2011, *op. cit.*; Bradley 2012, *op. cit.*). The vertebrates that have been reported as *Latrodectus* prey include *Christinus marmoratus* (Marbled Southern Gecko), *Uta stansburiana* (Common Side-blotched Lizard), and *Contia tenuis* (Common Sharp-tailed Snake; König 1987. *Herpetofauna* 9:6–8; Wilson 1991. *Ecol. Monogr.* 61:393–414; Beaman and Tucker 2014. *Herpetol. Rev.* 45:514), among others. Here, we document the novel predation of a small *E. multicarinata* by *L. hesperus*. This observation is noteworthy because it shows that the relationship between predator and prey in this system may be complex, warranting further investigation.

On 26 December 2018, at the entrance of a garage of a residence in West Sacramento, Yolo County, California, USA (38.55333°N, 121.52275°W; WGS 84; 9 m elev.), we discovered a young-of-year *E. multicarinata* (Museum of Natural History, University of Reno [UNR] 9867 [CRF 3374], 40 mm SVL) entrapped in the web of an adult female *L. hesperus* (Fig. 1). The rear of the lizard was encased in webbing ca. 30 cm off the ground, situated near several desiccated arthropods, and was in a state of desiccation that made it clear the *L. hesperus* had fed on the lizard. It is unknown whether this predation event by *L. hesperus* was active or opportunistic (i.e., whether the spider killed the lizard with venom, or simply waited for the lizard to perish in its web), though the location of the lizard, which was suspended in the web well off the ground, makes it unlikely that the lizard was accidentally entangled. Though *Latrodectus* venom possesses compounds that act specifically on vertebrate tissues and physiological systems (Grishin 1998. *Toxicon* 36:1693–1701), we know of only one confirmed case where *L. hesperus* actively captured and envenomated a small vertebrate (*U. stansburiana*; Wilson 1991, *op. cit.*). Regardless, these spiders may be more important predators of small vertebrates than is generally appreciated, and further investigation into the predator-prey interactions between *E. multicarinata* and *L. hesperus* is needed.

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EUTROPIS BIBRONII (Seashore Skink). TAIL BIFURCATION. *Eutropis bibronii* is distributed in the coastal belt and further inland of eastern India in Tamil Nadu and Southern Kerala provinces as well as in parts of coastal Sri Lanka (Uetz et al. [eds.] 2019. *The Reptile Database*. <http://www.reptile-database.org>; accessed 31 Mar 2019; De Silva et al. 2017. *Zootaxa* 4329:175–182; Chandramouli et al. 2012. *Salamandra* 48:241–242). Bifid tails are an abnormality resulting from incomplete caudectomy when the tail is partially broken and does not separate completely from the body, but enough damage has been caused such that a new tail growth begins (Gandla and Srinivasulu 2015. *Taprobanica* 7:263–265). Among Indian scincids, bifid tails have been documented in *E. carinata* and *E. allapalensis* (Brindley 1898. *J. Bombay Nat. Hist. Soc.* 11:680–689; Vyas 2016. *IRCF Reptiles & Amphibians* 23:108–109). On 2 February 2019, we came across

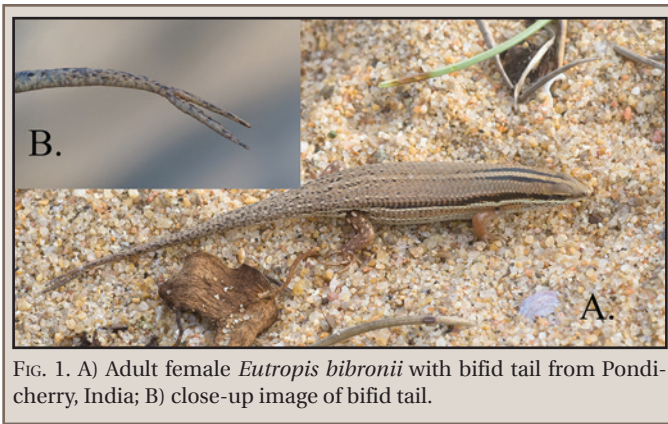


FIG. 1. A) Adult female *Eutropis bibronii* with bifid tail from Pondicherry, India; B) close-up image of bifid tail.

an adult female *E. bibronii* (47.7 mm SVL) having a bifid tail at the Pondicherry University beach (12.01351°N, 79.86072°E; WGS 84), Pondicherry, India. The bifurcation started 45.16 mm posterior of the cloaca in the vertical plane, with the top part of the bifurcated tail measuring 8.15 mm and the bottom part measuring 8.95 mm. To our knowledge this is the only case of tail bifurcation documented in *E. bibronii*.

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GEHYRA DUBIA (Dubious Dtella). VOCAL DYADIC INTERACTIONS. Acoustic signals are important methods of communication required for social interactions in many animal taxa. *Gehyra dubia* is an arboreal and rock-dwelling species that is found on the northeast coast of Australia (Doughty 1996. *J. Zool. [Lond.]* 240:703–715). In a previous study of *G. dubia* vocalization of individuals held in captivity, either alone, or in same- and different-sex pairs in neutral arenas (Phogkansananan et al. 2014. *Herpetol. Conserv. Biol.* 9:285–296), five different call types were reported. The contexts in which they occurred were: “single chirp calls” produced by both males and females when alone and in conspecific pairs of either sex, “double chirp calls” produced by males and females in aggressive conspecific encounters, “multiple single chirp (MSC) calls” produced by males, “multiple double chirp (MDC) calls” produced by males and females during aggressive encounters, and “triple chirp calls” produced by females and males during both same- and opposite-sex conspecific encounters.

The functions and specific contexts of these calls were only studied in neutral arenas. We examined the use of calls by female *G. dubia* in resident-intruder dyadic encounters. Eleven *G. dubia* (three males, eight females) were detected using lights and then hand captured from sclerophyll bushland in Townsville, Queensland, Australia (19.3314°S, 146.7564°E), at night between 1700 h and 2200 h, between May and July 2014. Gecko vocalizations were recorded in three different social treatments: 1) one female intruder placed in the home cage of one female resident (N = 7 replicates), 2) one male intruder placed in the home cage of one female resident (N = 3 replicates), and 3) one female intruder placed in the home cage of one male resident (N = 3 replicates). The intruding gecko (marked with white paint) was placed into the resident gecko’s cage and was left to habituate for 5 min before recording for 60 min. A shotgun microphone (NTG3 Microphone, RØDE™) was placed inside the cage attached to the underside of the lid and connected to a sound recorder (PMD661 Portable Solid-State Recorder, Marantz™) to record

all vocalizations. In addition, a video camera (HDR-SR7E Handycam, SONY™) was placed 0.3 m from the cage, and recorded simultaneously to identify which gecko was vocalizing and to record behavior. At the end of each trial the intruding gecko was returned to its cage. Call types were identified by uploading the audio files into Avisoft-SAS Lab Lite v5.2.07 (Avisoft Bioacoustics, Germany) and were categorized based on the call characteristics described by Phongkansananan et al. (2014, *op. cit.*). Vocalizations (squeaks) that did not have a structured profile were excluded. Call characteristics were identified by using a high-pass filter ($f_c = 1.0$ kHz) with a resolution of 0.183 Hz. Individual calls were matched to behavioral contexts by examining the corresponding video from one minute prior to the call to one minute after the call.

This study provides the first evidence that female *G. dubia* use MSC calls, as well as identifying two new call types: a quartet and a distress call (Fig. 1). The quartet was a short duration call (mean: 0.23 s, range: 0.167–0.285 s) made up of four chirps of on average 0.02 s each in length (range: 0.008–0.048 s; Fig. 1A). The quartet had an average minimum frequency of 999.5 Hz (range: 937–1,687 Hz), average maximum frequency of 6,271.6 Hz (range: 4,312–10,875 Hz), and an average fundamental frequency

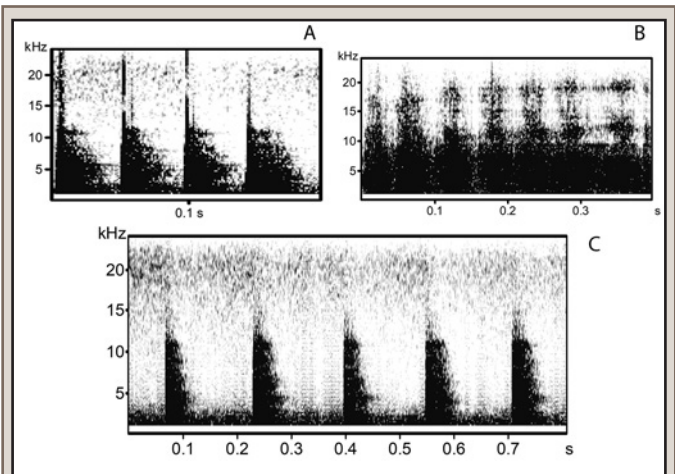


FIG. 1. Spectrograms of three new call types produced by female *Gehyra dubia* and a behavioral interaction following a quartet call. Spectrogram panels shows a quartet call with four chirps in the call sequence (A), a distress call with eight chirps in the call sequence (B), and part of a multiple single chirp call sequence (C). The x-axis displays time in seconds and the y-axis displays the frequency in kHz.



FIG. 2. Female (left) and male (right) *Gehyra dubia* interaction immediately after the female produced a quartet call and prior to the male biting the female.

of 2,743.9 Hz (range: 730–3,580 Hz). Intruding females in the male-female treatment were the only ones to make this call type. The quartet was emitted by females in a non-aggressive manner when in the presence of a male (Fig. 2). The males responded by body bending (body slightly raised and arched sideways with head and tail pointing towards the opponent) and tail wagging (consistent undulating movements of the tail), behaviors usually displayed during defense or submission in male-male and female-female interactions. However, because females did not approach males aggressively, nor did they try to resist (when the male bit or touched the female) or chase away the male, it is unlikely the males were displaying defensive behavior. Therefore, the quartet call is possibly used by females to instigate an interaction (sexual or social) with a male.

The distress call is comprised of 5–9 short (mean chirp duration: 0.025 s, range: 0.002–0.098 s), fast (mean chirp interval: 0.04 s, range: 0.009–0.109 s) chirps that appear blurred (Fig. 1B). These distress calls have an average minimum frequency of 1,101.8 Hz (range: 937–2,437 Hz), average maximum frequency of 7,669.2 Hz (range: 3,000–23,437 Hz), and an average fundamental frequency of 2,798.9 Hz (range: 675–8,677 Hz). Distress calls were produced primarily by females just after being bitten or lunged at, or while being chased. Distress calls differ from the “squeak” which is usually emitted when geckos are handled or bitten. The distress call is structured into multiple, very fast chirps which can be distinguished on the spectrogram (Fig. 1B). This call also sounds more like a rattle compared to a “squeak” which has little structure and is more of a long, single chirp. The distress call appears to be a defensive call used to communicate retreat and submissiveness, whereas the “squeak” is used when in physical distress (e.g., being bitten or handled).

MSC calls were produced primarily by resident females in the presence of an intruding male. These calls included an average of 12 (range: 3–23) short, fast chirps (mean: 0.023 s, range: 0.011–0.037 s) and lasted an average of 2.3 seconds (range: 0.4–4.0 s; Fig. 1C). The MSC call had an average minimum frequency of 872.5 Hz (range: 716–1,094 Hz), average maximum frequency of 7450.9 Hz (range: 4,999–10,613 Hz), and an average fundamental frequency of 1464.1 Hz (range: 1,044–2,089 Hz). MSC calls produced by *G. dubia* females occurred before and after chasing away the intruding gecko. This suggests that the MSC call is an aggressive call possibly warning of aggressive intent, to communicate intention to defend one’s site, and perhaps showing dominance. Female *G. variegata* (Tree Dtella), a sibling species of *G. dubia*, regulate the number of females occupying a territory via dominant females evicting newer or smaller females (Bustard 1970. Ecology 51:724–728). Similar behavior was observed in this study, with female residents producing the MSC call after being challenged by the intruder or when the intruder was close to the resident.

This study recorded three firsts in female *G. dubia* vocalization: female *G. dubia* producing MSC calls, description of the quartet call, and description of the distress call. This research was conducted under James Cook University Animal Ethics Approval No. A2051.

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GERRHONOTUS OPHIURUS (Smooth-headed Alligator Lizard). **MICROHABITAT.** *Gerrhonotus ophiurus* is a Mexican endemic semi-arboreal anguillid lizard, restricted to the Sierra Madre



FIG. 1. A general view of a *Neotoma angustopalata* nest in Llera de Canales, Tamaulipas, Mexico.

Oriental and the Tamaulipas-Tabasco Atlantic Lowland physiographic regions (Johnson et al. 2017. Mesoamer. Herpetol. 4:543–620). This species occurs in pine-oak and cloud forests, at elevations between 130 and 2800 m (Lemos-Espinal and Dixon 2013. Amphibians and Reptiles of San Luis Potosí. Eagle Mountain Publishing, Eagle Mountain, Utah. 300 pp.; Ramírez-Bautista et al. 2014. Anfíbios y Reptiles de Hidalgo, México: Diversidad, Biogeografía y Conservación. Sociedad Herpetológica Mexicana, A.C., México. 387 pp.). The lizard has been encountered in brush piles along logging roads (Lemos-Espinal and Dixon 2013, *op. cit.*). Otherwise, the nature of terrestrial refuges used by this species has not been reported.

From 27 July to 14 August 2018, at Mesa La Paz in the municipality of Llera de Canales, Tamaulipas, Mexico (23.32098°N, 98.84295°W; WGS 84; 417–429 m elev.), we found six individuals of *G. ophiurus*. All were observed between 1007 h and 1454 h. Two were active in scrub vegetation and four were observed using the abandoned nests of the rodent *Neotoma angustopalata* as a refuge (Fig. 1). The latter observations were made by people cleaning up the landscape to develop a wind energy project. As the rodent nests were lifted, the lizards were observed within them. The habitat where the specimens were found is typical piedmont scrubland, with dominant plant elements such as *Randia* sp., *Croton* sp., *Heliopsis parvifolia*, *Cordia boissieri*, and *Yucca treculeana*. This is the first report of the use of *Neotoma angustopalata* nests as shelter by *G. ophiurus*. Another important observation is that in the area where the animals were observed, there were no other potential ground shelters, such as rocks or plant debris, only piedmont scrub.

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GONOCEPHALUS BORNENSIS (Borneo Anglehead Lizard). **REPRODUCTION.** *Gonocephalus bornensis* is an agamid lizard endemic to Borneo. This species is arboreal and reported to lay four eggs per clutch (Malkmus et al. 2002. Amphibians and Reptiles of

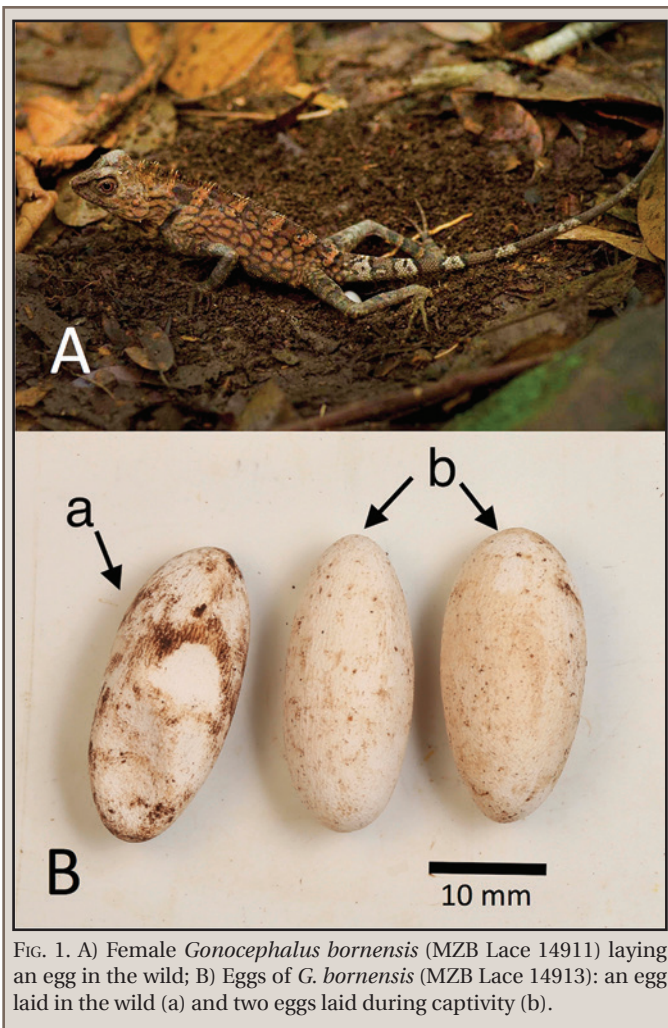


FIG. 1. A) Female *Gonocephalus bornensis* (MZB Lace 14911) laying an egg in the wild; B) Eggs of *G. bornensis* (MZB Lace 14913): an egg laid in the wild (a) and two eggs laid during captivity (b).

Mount Kinabalu. A. R. G Gantner Verlag, Königstein, Germany. 424 pp.), but there is no detailed information on its reproductive habits in the wild. On 13 March 2019, at 1000 h, we found a female *G. bornensis* (Museum Zoologicum Bogoriense [MZB] Lace 14911: 101 mm SVL; 239 mm tail length; Fig. 1A) laying eggs on a trail surrounded by primary forest in the foot of Mt. Halau-halau, Batang Alai Timur, Kabupaten Hulu Sungai Tengah, Kalimantan Selatan, Indonesia (2.6762°S, 115.6127°E; WGS 84; 700 m elev.). The air temperature at the site was 22.3°C and the ground temperature was 21.3°C. When we found the lizard, she was sitting on a hole (minor axis 35.5 mm, major axis 42.2 mm, 51.5 mm depth, bottom diameter 22.0 mm) dug at the center of the trail, where a single egg had been laid (MZB Lace 14913: 11.1 × 25.7 mm; Fig. 1B). The forest floor around the site was covered by dense leaf litter except for the trail surface. It is possible that the lizard chose the trail selectively to dig the hole for oviposition. The lizard paused for about 5 min until it quickly retreated. We captured the lizard and collected the egg. We then kept these in a plastic bag for 3 d for observation. The lizard laid two more eggs (MZB Lace 14913: 11.7 × 24.8 mm, 10.8 × 25.0 mm; Fig. 1B) during captivity. No more eggs were found from the body when we made the individual as voucher specimen, indicating the clutch size was three eggs.

Specimen and eggs collected under an approved permit (#79/E5/E5.4/SIP/2019) from the Indonesian government.

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GYMNODACTYLUS GECKOIDES. EGGS and HATCHLINGS.

Gymnodactylus geckoides is Caatinga endemic found in northeastern Brazil (Vanzolini 2004. An. Acad. Bras. Ciênc. 76:663–698). Here, we provide preliminary data on nest site, eggs, and hatchlings for this species. On 28 September 2018, during herpetological surveys in the Catimbau National Park, in the municipalities of Buíque, Ibimirim, Sertânia, and Tupanatinga in Pernambuco, northeastern Brazil (8.51583°S, 37.34972°W), we found three eggs deposited under different macambiras (bromeliads), which were glued to the rock without litter or vegetation. The eggs were collected and placed in glass containers with sand and litter and kept in the laboratory at room temperature and humidity until hatching. The average temperature was $26.8 \pm 7.77^\circ\text{C}$. The three eggs ranged from 9.49–10.17 mm in length and from 8.12–8.50 mm in width. By using the formula of volume for an ellipsoid, the eggs showed a mean volume of $287.85 \pm 92.38 \text{ mm}^3$ (range: 157.22–355.42 mm^3). Based on the months of collection, the gravid females collected were found with only one egg per female, corresponding to most phyllodactylids (e.g., Colli et al. 2003. J. Herpetol. 37:694–706).



FIG. 1. *Gymnodactylus geckoides* egg and hatchling born in captivity.

Of the three eggs, only one hatched, on 14 November 2018 (16 days after collection) (Fig. 1). Measurements of this juvenile were: 19.8 mm SVL, 26.4 mm TL, 3.8 mm body width, 2.6 mm body height, 4.1 mm head width, 6.8 mm head length, 3.5 mm head height, 7.4 mm forearm length, and 7.2 mm hind limb length. Dorsal coloration was dark brown, with black rings and yellow spots along the medial region from head to snout, while the tail region showed alternating white and black rings. Ventral coloration was light white. The hatchling *G. geckoides* was taken back to the capture site and released. To the best of our knowledge, this is the first record of *G. geckoides* hatching under laboratory conditions, with notes on hatchling morphometry, egg volume, clutch size, and minimum time of incubation.

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HEMIDACTYLUS MABOUIA (Tropical House Gecko). PREDATION. *Hemidactylus mabouia* is an exotic species introduced to many parts of the Americas, including Brazil, and is currently well established in anthropic and perianthropic environments. It is a nocturnal and arboreal species. The primary predators of this gecko in its introduced range are larger vertebrates such as birds, mammals, snakes, and other lizards (Nogueira et al. 2013. *Herpetol. Notes* 6:39–43). In Brazil, *H. mabouia* is sympatric with large arboreal tarantulas of the family Theraphosidae, among which *Avicularia variegata* (Grizzled Pinktoe) is restricted to Brazil and Venezuela (Fukushima et al. 2017. *ZooKeys* 659:1–185).

On 11 May 2014, we observed an adult *A. variegata* (ca. 12 cm total length) preying on an adult *H. mabouia* (ca. 5 cm SVL; Fig.



FIG. 1. *Avicularia variegata* preying on *Hemidactylus mabouia* in Rio Preto da Eva, Amazonas, Brazil.

1) on a trunk of Dwarf Coconut Tree in the Jabuti Farm, Rio Preto da Eva, Amazonas, Brazil (2.72058°S, 59.51086°W; WGS 84). The predation occurred at night (1935 h), 1.6 m above the ground on the tree trunk. The gecko was restrained with a dense web layer. The spider was on top of the gecko when we first observed it and commenced ingestion of the gecko head-first (Fig. 1). The spider did not move until the gecko was completely ingested. Spiders of the family Ctenidae are known to prey on *H. mabouia* (Lanschi et al. 2012. *Herpetol. Rev.* 43:133–134), but to our knowledge, this is the first record of this gecko species preyed by the theraphosid species *A. variegata*.

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IBEROLACERTA CYRENI (Carpetan Rock Lizard). REPRODUCTION. *Iberolacerta cyreni* is a small diurnal species mainly associated with rocky environments in high mountain areas of central Spain (Elvira and Vigal 1985. *Amphibia-Reptilia* 6:173–179). This species is usually active from late April to early October, mating in May–June and egg-laying in July (Elvira and Vigal 1985, *op. cit.*), even though its reproductive cycle is thought to occur later in Sierra de Gredos (Elvira and Vigal 1985, *op. cit.*). Herein, we describe a copulatory event of *I. cyreni*.

The copulatory interaction was observed on 1 July 2014, during a field trip to Sierra de Gredos at San Juan de Gredos, Ávila, Spain (40.27223°N, 5.235094°W; WGS 84; 2350 m elev.). The female (ca. 60 mm SVL) was first seen at 1059 h atop a sunlit rock, likely thermoregulating. Subsequently, the male (ca. 70 mm SVL) approached from behind, tongue-flicking, and moved slowly across the female's body. The male lunged at the female and bit her mid-ventrally while attempting to copulate. The female struggled and the pair moved around on top of the rock, with the male occasionally biting down on the female (Fig. 1). The interaction lasted 2 min, with the pair seemingly undisturbed by the observer's close presence (ca. 2 m) and camera flashes. This species is usually shy, fleeing as soon as potential threats (e.g., humans) approach



FIG. 1. Copulating *Iberolacerta cyreni* from Sierra de Gredos, Spain.

(Cooper et al. 2012. Behav. Ecol. 23:790–797). However, this pair was in copulating behavior a few meters from a frequently used mountain path, with several people walking past. Our observations seem to corroborate that the reproductive cycle of *I. cyreni* from the Sierra de Gredos population indeed takes place later than previously reported for this species elsewhere.

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KENTROPYX STRIATA (Striped Whiptail Lizard). PREDATION. Studies suggest that predation by spiders may be an important force in regulating the life history of neotropical herpetofauna, but detailed descriptions of predator-prey relationships are scarce (Martins 1993. Herpetol. Rev. 24:83–84; Folt and Lapinski 2017. J. Herpetol. 16:269–277). *Kentropyx striata* is a small teiid lizard (males: ca. 125 mm SVL; females: ca. 85 mm SVL) and inhabits areas of open formations (savanna formations) in a large part of cis-Andean South America, north of the Amazon



FIG. 1. *Theraphosa* cf. *blondi* holding *Kentropyx striata* in the jaws, at the Municipality of Oriximiná, Pará State, northern Brazil.



FIG. 2. Dorsal view of *Theraphosa* cf. *blondi* holding *Kentropyx striata* in the jaws, at the Municipality of Oriximiná, Pará State, northern Brazil.

River (Colombia, Venezuela, Guyana, Suriname, Brazil [Amapá, Pará, Roraima], and also Trinidad), as well as on the southern margin of the Amazon at its lower course (Ávila-Pires et al. 2017. South Am. J. Herpetol. 12:224–235). At 0930 h, on 7 March 2011 in the Municipality of Oriximiná, Pará State, Brazil (1.64614°S, 55.90683°W; WGS 84; 25 m elev.), we observed a *Theraphosa* cf. *blondi* (Goliath Bird Eater; Theraphosidae) capturing an individual of *K. striata* (Fig. 1). The predator struck the lizard and kept the prey fixed to the jaw for ca. 20 mins. The lizard died but the spider did not continue feeding, possibly due to our presence. The specimens were not collected (Fig. 2). To our knowledge, this is the first report of *K. striata* being preyed upon by *T. cf. blondi*.

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LIOLAEMUS FITZGERALDI (Fitzgerald's Tree Iguana). ENDO-PARASITES. A total of 158 species of the genus *Liolaemus* occur in Argentina (Abdala and Quinteros 2014. Cuad. Herpetol. 28:55–82). *Liolaemus fitzgeraldi* is distributed in Argentina and Chile (Acosta et al. 2017. Los Reptiles de San Juan. Editorial Brujas, Córdoba. 130 pp.). In Argentina, *L. fitzgeraldi* is distributed in San Juan and Mendoza provinces (Abdala et al. 2012. Cuad. Herpetol. 26:215–248). This small species is predominantly omnivorous and has a unimodal activity pattern (Acosta et al. 2017. *op. cit.*). According to the latest categorization of lizards of Argentina, it holds a status of insufficiently known (Abdala et al. 2012. *op. cit.*). The purpose of our note is to provide, for the first time, a record of *Parapharyngodon* sp. in *L. fitzgeraldi*.

Fourteen specimens of *L. fitzgeraldi* (seven juveniles: mean SVL = 24.1 ± 0.6 mm, range: 23–25 mm; seven adults: mean SVL = 51.7 ± 4 mm, range: 45–56 mm) were collected (by noosing) in January 2015 from Los Azules, Calingasta Department, Provinces of San Juan, Argentina. For each specimen, the body cavity was opened with a mid-ventral incision, the digestive tract was removed, and its contents examined for helminthes using a dissecting microscope. The nematodes found were stored in 70% ethanol. Nematode observation and identification was done using the diaphanization by lactophenol technique. Seven nematodes (6 females, 1 male) were isolated from the stomachs and identified as *Parapharyngodon* sp. The specimens were deposited in the parasitological collection of the Department of Biology, National University of San Juan (UNSPar253).

Infection prevalence was 14% with a mean intensity of 3.5 ± 0.7 (range: 3–4). Parasitic nematodes of the genus *Parapharyngodon* have a direct life cycle, where moisture plays an important role (Castillo et al. 2018. Ann. Parasitol. 64:83–88). Pharyngodonidae includes intestinal parasites of reptiles herbivorous and omnivorous (Anderson 2000. Nematode Parasites of Vertebrates: Their Development and Transmission. CABI Publishing, Oxon, U.K. 650 pp.). Previous reports of *Parapharyngodon* from Argentina have been documented. In Argentina, *Parapharyngodon* are parasites of lizards of the families Liolaemidae and Tropiduridae: *Phymaturus punae* (Ramallo et al. 2002. J. Parasitol. 88:979–982; Ramallo et al. 2016. Acta Parasitol. 61:461–465), *P. palluma* and *Liolaemus buergeri* (Goldberg et al. 2004. Comp. Parasitol. 71:208–204), *P. antofagastensis*, *P. zapalensis*, *L. rothi*, *L. boulengeri*, and *L.*

umbrifer (O'Grady and Dearing 2006. *Oecologia* 150:355–361), *P. williamsi* (Ramallo et al. 2016. *Acta Parasitol.* 61:461–465), *P. extrilidus* (Ramallo et al. 2017. *Herpetol. Rev.* 48:198; Castillo et al. 2018. *Ann. Parasitol.* 64:83–88), *L. ruibali* (Castillo et al. 2017. *Herpetol. Rev.* 48:651–652), *Tropidurus torquatus* (Lamas and Zaracho 2006. *Herpetol. Rev.* 37:4), and *T. etheridgei* (Cruz et al. 1998. *Herpetol. Nat. Hist.* 6:23–21).

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LIOLAEMUS GROSSEORUM. DIET. *Liolaemus grosseorum* is a member of the *boulengeri* group of *Liolaemus* and is an oviparous and insectivorous mid-sized lizard (max SVL = 55 mm; Etheridge 2001. *Cuad. Herpetol.* 15:3–15). It is distributed in four of Argentina's provinces: Mendoza, La Pampa, Neuquén, and Río Negro (Pérez et al. 2018. *Cuad. Herpetol.* 32:141–143). There are few studies on the ecology and natural history of this species, including its diet. Here we report *L. grosseorum* preying upon a scorpion, *Timogenes mapuche*. At 0900 h on 27 January 2019, during a sampling campaign in the Bajo de Añelo, Neuquén Province, Argentina (38.3481°S, 69.1031°W, WGS 84; 344 m elev.), we found an adult male *L. grosseorum* preying on a scorpion (52 mm long) for ca. 5 min, until he ate it completely (Fig. 1). Scorpions are usually nocturnal animals in the Monte landscapes and *L. grosseorum* is a diurnal, mostly sit and wait predator, therefore it is likely these encounters are rare.

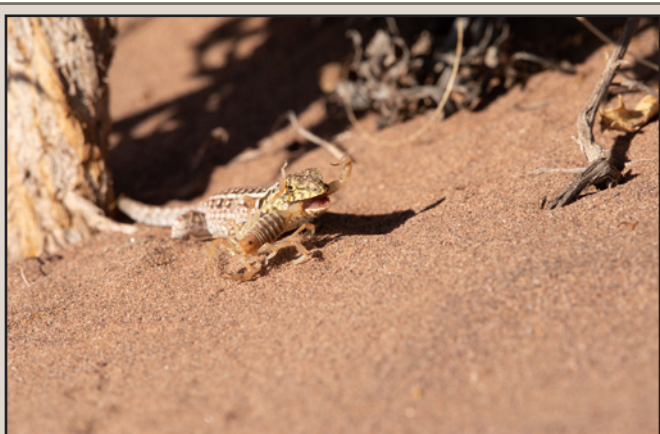


FIG. 1. *Liolaemus grosseorum* consuming *Timogenes mapuche* in Neuquén Province, Argentina.

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LIOLAEMUS OLONGASTA (Chelco Lizard). ENDOPARASITES. A total of 158 species of the genus *Liolaemus* occur in Argentina (Abdala and Quinteros 2014. *Cuad. Herpetol.* 28:55–82). In Argentina, *L. olongasta* is distributed in San Juan, Mendoza, and Ríoja

provinces (Abdala et al. 2012. *Cuad. Herpetol.* 26:215–248). It is mainly insectivorous and has a unimodal activity pattern (Acosta et al. 2017. *Los Reptiles de San Juan*. Editorial Brujas, Córdoba. 130 pp.). It is currently categorized as a non-threatened species (Abdala et al. 2012. *Cuad. Herpetol.* 26:215–248). Here, we report on the helminth endoparasites in the gastrointestinal tracts of *L. olongasta* in Matagusanos, San Juan Province, Argentina.

In February 2017, three specimens of *L. olongasta* (adult males; mean SVL = 5.9 ± 0.17 cm, range: 5.7–6 mm; weight = 7.4 ± 0.37 g, range (7–7.7 g) were collected at Matagusanos, San Juan Province (31.24638°S, 68.62916°W; 910 m elev.). Phytogeographically, the area is included in the Monte. The stomach and intestines were longitudinally slit, and their contents were examined using a microscope. The dissection revealed one type of prey item and nematodes. The nematodes found were stored in 70% ethanol. Nematode observation and identification was done using the diaphanization by lactophenol technique. The specimens were deposited in the parasitological collection of the Department of Biology, National University of San Juan (UNSPar254). A dissection of the animal revealed recent ingesta that included one scorpion.

A total of two nematodes larvae of the genus *Physaloptera* were isolated from the stomachs of one adult specimen (infection prevalence = 33.3%, with a mean intensity of 2 and mean abundance of 0.66). Species of the genus *Physaloptera* occur in the stomach of a variety of terrestrial vertebrates (Goldberg and Bursley 1989. *J. Wildl. Dis.* 25:425–429). Larvae are common in amphibians and lizards (Anderson 2000. *Nematode Parasites of Vertebrates: Their Development and Transmission*. CABI Publishing, Oxon, U.K. 650 pp.). Currently, there are 100 *Physaloptera* described, including valid and inquirendae species, nine of these were described from reptiles (Pereira et al. 2012. *J. Parasitol.* 98: 1227–1235). In Argentina, *Physaloptera* has been reported the following reptiles: *Liolaemus quilmes*, *Liolaemus ornatus*, *Liolaemus alticolor* (Ramallo and Díaz 1998. *Bol. Chil. Parasitol.* 53:19–22), *Tropidurus etheridgei* (Cruz et al. 1998. *Herpetol. Nat. Hist.* 6:23–21), *Leiosaurus catamarcensis*, *Leiosaurus belli*, *Liolaemus neuquensis* (Goldberg et al. 2004. *Comp. Parasitol.* 71:208–214), *Liolaemus koslowskyi*, *Liolaemus darwini* (O'Grady and Dearing 2006. *Oecologia* 150:355–361), and *Xenodon merremi* (Lamas et al. 2016. *Facena* 32:59–67). *Physaloptera* sp. in *Liolaemus olongasta* is a new host record from Argentina.

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LYGISAURUS CURTUS. ENDOPARASITES. *Lygisaurus curtus* occurs throughout the Papuan Peninsula where it appears to frequent disturbed areas in rainforests from sea level to 1540 m in elevation (Kraus 2007. *J. Herpetol.* 41:410–423). There are, to our knowledge, no reports of helminths for *L. curtus*. In this note we establish the initial helminth list for this species.

Three adult *L. curtus* (mean SVL = 38.3 mm ± 1.5 SD, range: 37–40 mm) were collected by hand from Papua New Guinea, Northern Province, near Mt. Victory (9.22909°S, 149.13546°E; WGS 84; 229 m elev.) on 29 September 2010. They were deposited

in the Bernice P. Bishop Museum (BPBM) in Honolulu, Hawaii, USA (BPBM 37441–37443). The *L. curtus* were fixed in neutral buffered 10% formalin and stored 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 under a dissecting microscope. Helminths were placed on a glass slide in a drop of lactophenol, a cover slip was added, and identification was made from these temporary wet mounts. Identification was made utilizing the illustrations and descriptions in Anderson (2000. Nematode Parasites of Vertebrates, Their Development and Transmission, 2nd ed. CABI Publishing, Oxfordshire, UK. 650 pp.). The large oral opening and thickened buccal cavity wall as well as esophageal morphology, anterior muscular part shorter than posterior glandular part and absent bulb, are the main criteria for assigning these specimens to Rictulariidae.

We found 4, 1, and 10 rictulariid larvae in cysts from the stomachs of BPBM 37441–37443, respectively. Voucher helminths were deposited in the Harold W. Manter Parasitology Laboratory (HWML), The University of Nebraska, Lincoln, Nebraska, USA as rictulariid larva (HWML 110829). Adults of Rictulariidae are found in mammals, and insects serve as intermediate hosts (Anderson 2000, *op. cit.*). Since development beyond larvae is not known to occur in reptiles, they are best considered as paratenic (= transport) hosts. Rictulariid larvae in *L. curtus* is a new host record.

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MEROLES ANCHIETAE (Anchieta's Shovel-snouted Lizard). CANNIBALISM. *Meroles anchietae* is an omnivorous species with a diet primarily consisting of immature seeds and small arthropods (e.g., ants and beetles). Seeds are comparable to insects in their energy content and require less time and energy for foraging and harvesting (Robinson and Cunningham 1978. Madoqua 11:41–53; Murray and Schramm 1987. Madoqua 15:55–61; Nagy and Shemanski 2009. Afr. J. Herpetol. 58:39–43). In contrast, the co-occurring congener *M. cuneirostris* is strictly carnivorous, almost exclusively consuming arthropods (Robinson and Cunningham 1978, *op. cit.*). A cannibalism event is also on record for *M. cuneirostris* (Childers and Eifler 2013. Herpetol. Rev. 44:675–676). Despite overlapping ranges, the two species differ in their habitat preferences—*M. anchietae* occupies dune slipfaces while *M. cuneirostris* occupies dune bases—which might account for their dietary differences (Murray and Schramm 1987, *op. cit.*).

On 13 January 2019, during a study on the movement ecology of *M. anchietae* on the dunes south of the Gobabeb Research and Training Centre, Erongo, Namibia (23.56199°S, 15.04162°E, WGS 84; 408 m elev.), we observed an adult male *M. anchietae* consume a conspecific juvenile. At 0938 h, an adult male chased a juvenile down a dune slipface and after a ca. 30 s tumbling struggle captured the juvenile in his mouth and began biting the juvenile's body, while the juvenile continued to move and resist the male. In response, the male thrashed the juvenile against the ground and then began moving up the slipface toward the crest while carrying the juvenile in his mouth. A few meters upslope, another adult appeared and began to chase the male holding the juvenile but stopped after 10 s and left the vicinity. Later, the adult thrashed

the juvenile against the ground twice, while releasing it in between onto the sand, where the seemingly-still-alive juvenile made small twitching movements. Once movement ceased, the adult carried the juvenile under the vegetation and released it onto the sand. He then positioned his own body so that the snout of the juvenile was facing his mouth and proceeded to swallow the juvenile headfirst. After about 1 min (ca. 6 min since the start of the encounter), the entire juvenile was consumed. The male remained under the vegetation for another 5 min after eating the juvenile, at which point we captured the male and then measured him (51 mm SVL, 4.5 g).

Based on the 53 juveniles and 25 adult males we captured and measured for our study (juvenile mean mass = 0.749 g, range = 0.5–1 g; adult male mean mass = 4.178 g, range = 3.4–5.5 g), and assuming the juvenile was of average size, we estimate that the cannibalistic male weighed ca. 3.75 g before consuming the juvenile, and that the consumed juvenile (mass ca. 0.75 g) could have been as much as 20% of his original body mass. Our observation represents the first detailed account of an *M. anchietae* cannibalism event; one other cannibalistic observation for this species has been noted (Robinson and Cunningham 1978, *op. cit.*), but with no further descriptions.

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PHYMATURUS EXTRILIDUS. PREDATION. Although it is known that avian scavengers will consume lizards (Jiménez 1995. Hornero 14:1–9), here we report the first record of an avian scavenger consuming *Phymaturus extrilidus*. This is only the second record of a confirmed predator of *P. extrilidus* (Lobo et al. 2012. Copeia 2012:12–22). At 1350 h on 26 November 2013, we observed an adult Andean Matamico (*Phalcooboenus megalopterus*) flying with a dead specimen in its beak over the canyon Aguada de la Home in the Reserva Natural de Uso Múltiple Don Carmelo, Ullum Department, San Juan Province, Argentina (30.94871°S, 69.08233°W, WGS 84; 3122 m elev.).

We thank R. E. Beninato for confirming the identification of this lizard.

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SALVATOR MERIANAE (Common Tegu). FEEDING. *Salvator merianae* is a diurnal and terrestrial large teiid with a wide regional distribution in Brazil, Argentina, Paraguay, and Uruguay. It is an actively foraging omnivore, and feeds on fruits, and a wide range of invertebrates and vertebrates, including eggs (Carreira et al. 2005. Reptiles de Uruguay. DIRAC. Fac. Ciencias. 639 pp.; Ceï 1993. Mon. Mus. Reg. Sci. Nat. Torino 14:1–949). At the



FIG. 1. A young *Salvator merianae* climbing a Mburucuyá (*Passiflora caerulea*) on a Coronilla Tree (*Scutia buxifolia*) to eat wasps.

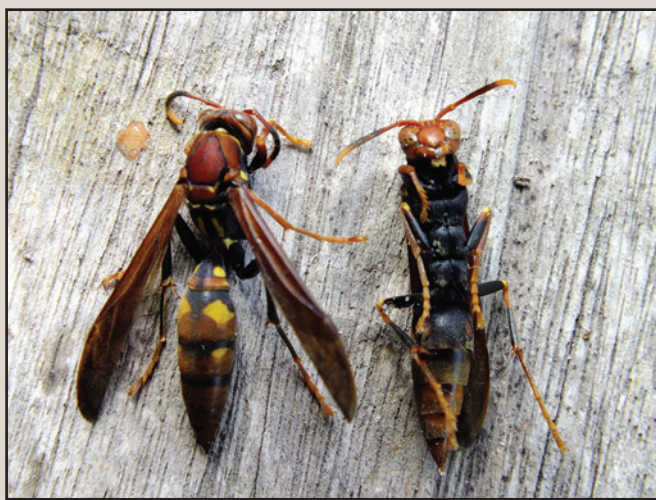


FIG. 2. Wasps of the species *Polistes versicolor* eaten by young *Salvator merianae*.

Refugio de Fauna Laguna de Castillos, Rocha Department, Uruguay (34.36396°S, 53.85814°W; WGS 84), park staff has regularly observed that during the warm months when the species is more active, individuals often climb trees up to 3 m in height (Fig. 1), attacking nests of the paper wasp *Polistes versicolor* (Fig. 2). Observations were made between 1991 and 2018 and the individuals are largely juveniles (ca. 1 yr old). Once fed, they dropped to the ground. Due to their larger size and low weight they do not seem to suffer damage. This feeding behavior together with the use of vertical space had not been reported so far for this species. This ability to adapt is one of the aspects that make *S. merianae* a successful species that occupies different environments, including urbanized areas.

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SCELOPORUS OLIVACEUS (Texas Spiny Lizard). UNNATURAL MORTALITY. Plastic waste is a significant source of animal mortality, especially in marine ecosystems (Gregory 2009. *Phil. Trans.*



FIG. 1. Two individuals of *Sceloporus olivaceus* killed after becoming ensnared in plastic waste in Eastland County, Texas, USA.

R. Soc. B 364:2013–2025), and increasingly, information is available on mortality caused by plastic products, netting, and meshes in terrestrial reptiles (Iverson and Durso 2018. *Herpetol. Rev.* 49:754; Montez and Saenz 2018. *Herpetol. Rev.* 49:750–751). Here we further document the potential hazards of plastic waste products on native herpetofauna. On 6 April 2018, one of us (LAW) found two adult individuals of *Sceloporus olivaceus* dead in a plastic keyboard lining in a residential area in Eastland, Eastland County, Texas, USA (32.3983°N, 98.8405°W; WGS 84; Fig. 1). Both lizards were in similar states of decomposition and appeared to have suffocated after becoming ensnared in openings for keyboard keys. Specimens were deposited at the Amphibian and Reptile Diversity Research Center, University of Texas at Arlington in the condition found (UTA R-65252 [female], UTA R-65253 [male]). Our observation is noteworthy in that one individual was a male and the other a female captured in a single perforated plastic sheet, which might have resulted from courtship after the first individual was ensnared. Such social interactions could potentially lead to higher mortality from perforated plastic waste products.

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TROPIDURUS HISPIDUS (Peters' Lava Lizard). PREY-PREDATOR INTERACTION. The lizard genus *Tropidurus* (Tropiduridae) is highly diverse, comprising 30 species distributed in the Neotropical region (Carvalho 2016. *Am. Mus. Novit.* 3853:1–44). In this group, the largest species, *Tropidurus hispidus*, is widely distributed in open landscapes, ranging from northeastern Brazil to Venezuela (Rodrigues 1987. *Arq. Zool.* 31:105–230). *Tropidurus hispidus* has been reported as prey of the snake *Philodryas nattereri* (Mesquita et al. 2010. *Herpetol. Notes* 41:96), even causing the snake's death upon ingestion (Menezes et al. 2013. *Herpetol. Notes* 6:55–57). Herein we report an unsuccessful predation attempt on this lizard by a snake in a patch of Atlantic Forest in northeastern Brazil.

On 29 September 2018, at 1030 h at Santuário Ecológico de Pipa, Tibau do Sul, Rio Grande do Norte, Brazil (6.2244°S, 35.0662°W, WGS 84; 62 m elev.), we observed a juvenile *T. hispidus* (ca. 150 mm SVL) exposed to direct sunlight (probably thermoregulating) at the base of a tree. Suddenly we noticed a colubrid snake, *Taeniophallus occipitalis* (ca. 400 mm SVL), quickly



FIG. 1. *Tropidurus hispidus* (up the tree, position indicated by black arrow) after unsuccessful predation attempt by *Taeniophallus occipitalis* (base of the tree, indicated by white arrow).

emerging from under the leaf litter and lunging toward the lizard. The lizard quickly moved up the tree (ca. 1.5 m) and stayed motionless but alert, observing the snake (Fig. 1). The snake kept tongue-flicking and attempted to move farther up the tree. Unable to do so, it retreated to the leaf litter, whereupon the lizard jumped to the ground and disappeared under the leaf litter upon seeing the approaching human observers.

Other than *P. nattereri* (Mesquita et al. 2010, *op. cit.*; Menezes et al. 2013, *op. cit.*), and *Drymarchon corais* (Prudente et al. 2014, *Herpetol. Notes* 7:99–108), snake predators of *T. hispidus* are poorly known. Our observation is the first report of attempted predation, albeit unsuccessful, on *T. hispidus* by *Taeniophallus occipitalis*. We suggest that because similar-sized *T. torquatus* has been reported in the diet of *T. occipitalis* (Gomes 2000, M.Sc. Thesis, UNESP – São José do Rio Preto), it is likely that this snake is also a predator of *T. hispidus*. We acknowledge funding from the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001.

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***UROSTROPHUS VAUTIERI* (Brazilian Steppe Iguana). DEFENSIVE BEHAVIOR, PREDATION, and REPRODUCTION.** Lizards and snakes are particularly good subjects to explore specific and general questions in vertebrate behavioral biology. Defensive strategies used by Neotropical lizards and snakes are poorly known for many species (Martins 1996. *In* Del Claro [ed.], *Anais do XIV Encontro Anual de Etologia*, pp. 185–199. Sociedade Brasileira de Etologia, Universidade Federal de Uberlândia, Brazil). *Urostrophus vautieri* is an oviparous and arboreal iguanian lizard with prehensile tail belonging to the family Leiosauridae (Enyaliinae) and is restricted to southern and southeastern regions of Brazil (Uetz et al. [eds.] 2019. *The Reptile Database*. <http://www.reptile-database.org>; accessed 18 Feb 2019). Defensive behaviors of *U. vautieri* remain largely unknown.

Here we report the defensive behaviors of six individual *U. vautieri* captured alive between 2014 and 2018 in the National Forest of Ritópolis (21.05587°S, 44.27165°W; WGS 84; 896 m elev.), a small protected area (89.5 ha) in Municipality of Ritópolis, Minas Gerais, southeastern Brazil. The lizards were captured in riparian forest (N = 5) and in seasonal semi-deciduous forest (N = 1). Measurements (mean, range) were: total length = 13.2 cm (11.3–16.3 cm), tail length = 8.1 cm (6.9–10.5 cm), mass = 4.4 g (1–10 g). Individuals were caught by pitfall trap (N = 2) and funnel trap (N = 1) associated with a guide fence or captured by hand (N = 3). The following defensive behaviors were recorded at the moment the lizards were captured or removed from the trap. Two defensive behaviors were exhibited by all lizards: open mouth display (Fig. 1A) and bite (Fig. 1B). Two specimens hissed, one presented thanatosis (Fig. 1C), and one other displayed gular inflation. The open mouth display revealed a blue coloring on the inner corners and in the upper palate (Fig. 1D); this was always the first defensive behavior presented by each lizard.

Chironius exoletus (Linnaeus' Sipo) is a colubrid snake with an extensive range from Costa Rica to Argentina (Uetz et al. [eds.] 2019, *op. cit.*). This species is terrestrial and arboreal, diurnal,

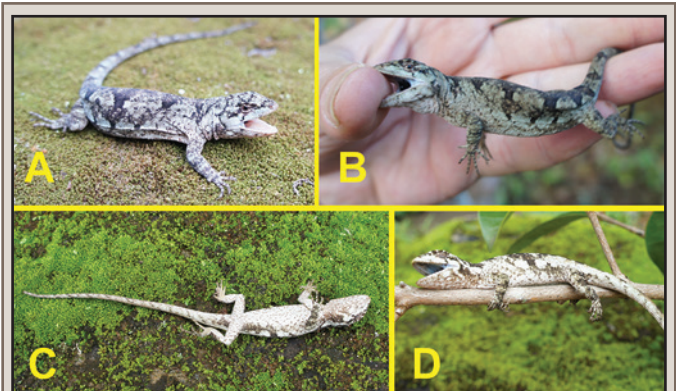


FIG. 1. Defensive behaviors exhibited by *Urostrophus vautieri* in Ritópolis National Forest: A) open mouth display; B) bite; C) thanatosis; D) open mouth display showing blue coloration on the inner corners and in the upper palate.



FIG. 2. *Chironius exoletus* captured in Ritópolis National Forest and *Urostrophus vautieri* prey.

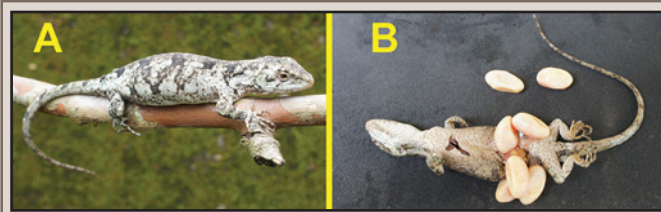


FIG. 3. A) Gravid female *Urostrophus vautieri* from Ritópolis National Forest; B) same specimen dissected with seven well-developed oviductal eggs.

and eats amphibians (Marques et al. 2017. *Serpentes da Caatinga*. Ponto A Editora, Cotia. 240 pp.). On 24 February 2014, a female *C. exoletus* (Universidade Federal de Juiz de Fora [CHUFJF] 1786: total length = 129.5 cm, tail length = 46.6 cm, mass = 142 g) captured in a funnel trap in riparian forest in the Ritópolis National Forest was dissected and the stomach contained a *U. vautieri* (CHUFJF 1637: total length = 12.0 cm, tail length = 8.4 cm, mass = 5 g) that had been ingested headfirst (Fig. 2). We are unable to determine if predation of the lizard occurred before the snake entered the trap, or if the lizard entered the trap first and then attracted the snake.

On 12 January 2016, a gravid female *U. vautieri* (CHUFJF 1634: total length = 15.4 cm, tail length = 9.0 cm, mass = 8 g) was captured alive (Fig. 3A) in riparian forest in the Ritópolis National Forest. The specimen was dissected and seven well-developed oviductal eggs were found (Fig. 3B). Measurements were: average length = 12.97 mm (12.30–13.49 mm), width = 7.02 mm (6.70–7.78 mm), volume = 594.73 mm³ (563.67–718.57 mm³).

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SQUAMATA — SNAKES

AGKISTRODON PISCIVORUS (Cottonmouth). PREY SIZE. *Agkistrodon piscivorus* is a common pit viper species with a relatively wide distribution across the southeastern United States, from central Texas eastward through the gulf coast states to the southern coast of Virginia and northward into southern Illinois. *Agkistrodon*



FIG. 1. Post-mortem and post-dissection photo of *Agkistrodon piscivorus* and prey item (*Pantherophis obsoletus*).

piscivorus is characteristic of wetland and riparian environments that commonly occur throughout this area and many of its life history characteristics reflect the species' association with this habitat type. This species is considered a highly generalized opportunistic predator that has a wide dietary niche known to consist of invertebrates, fish, mammals, and other herpetofauna (Campbell and Lamar 2004. *The Venomous Reptiles of the Western Hemisphere*. Cornell University Press, Ithaca, New York. 976 pp.; Herr and Graham 2014. *Herpetol. Rev.* 45:511).

On 23 April 2010, at ca. 1638 h, an adult female *A. piscivorus* was found dead as a result of a fatal encounter with rice farming equipment in Fort Bend County, Texas, USA (29.46720°N, 95.67983°W; WGS 84; Fig. 1). This individual measured 80.32 cm total length (TL). After further investigation it was discovered that the individual had ingested a male *Pantherophis obsoletus* (Western Ratsnake) that measured 103.5 cm TL. The prey item was easily identifiable, and ingestion had presumably occurred recently. Based on the position of the prey item, the individual *A. piscivorus* presumably forced the vertebral column of the *E. obsoletus* to bend into waves which resulted of the ability of this individual consume a diet item that exceeded its own length (Jackson et al. 2004. *Zoology* 107:191–200). There were no signs that this was a result of scavenging behavior (e.g., physical damage to prey item, advanced decomposition, etc.), therefore making direct predation a more likely explanation. Although not confirmed, it is likely that the size of the diet item had resulted in immobility of the individual *A. piscivorus* and subsequent inability to escape the farm equipment encounter. Ingestion of prey often compromises locomotor performance in snakes, particularly in endurance capacities required for escape from predators or external dangers (Garland and Arnold 1983. *Copeia* 1983:1092–1096). This report provides insight into threshold levels of predator/prey size ratios and the dynamics of predator/prey relationships.

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BOA CONSTRICTOR (Boa Constrictor). DIET. *Boa constrictor* is a large snake with a wide distribution in Central and South America (Henderson et al. 1995. *Herpetol. Nat. Hist.* 3:15–27). It has a generalist diet, feeding on mammals, birds, and reptiles (Henderson et al. 1995, *op. cit.*; Martins and Oliveira 1998. *Herpetol. Nat. Hist.* 6:78–150; França et al. 2008. *Copeia* 2008:23–38; Pizzato et al. 2009. *Amphibia-Reptilia* 30:533–544). Here, we report a new avian prey item for *B. constrictor*.



FIG. 1. *Syrigma sibilatrix* regurgitated by a *Boa constrictor*.

On 13 November 2018, at Chapada dos Veadeiros, Alto Paraíso municipality, Goiás, Brazil (14.09948°S, 47.44896°W; WGS 84; 1013 m elev.), we found an adult female *B. constrictor* (1340 mm SVL; 145 mm tail length) basking in the sun, at 1136 h. When manipulated, it regurgitated a partially digested *Syrigma sibilatrix* (Whistling Heron; 260 mm wingspan; 95 mm tarsus; Fig. 1). *Syrigma sibilatrix* is a widespread ardeid throughout South America (Alfaro-Rodríguez and Venegas-Vargas 2016. Check List 12:1963). It inhabits open wetlands, preying upon worms, spiders, insects, and also snakes (Olguín et al. 2017. Cuad. Invest. UNED 9:91–96).

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BOA CONSTRICTOR CONSTRICTOR (Red-tailed Boa). DIET. Many neotropical snakes, including *Boa constrictor*, prey upon nestling birds, including nestlings of large birds such as parrots (Berkunsky et al. 2016. Ardea 104:143–151). Attempts to prey upon parrot nestlings are potentially risky, as snakes have been documented being attacked and injured by the adult parrots (Berkunsky et al. 2011. Ornitol. Neotrop. 22:459–464). Few successful predation attempts of adult Psittacidae have been documented, and with the exception of an adult *Ara severus* (Chestnut-fronted Macaw), all records of *Boa c. constrictor* predation of Psittacidae concern smaller species (*Myiopsitta monachus* [Monk Parakeet] and *Aratinga pertinax* [Brown-throated Parakeet]; Sironi et al. 2000. Amphibia-Reptilia 21:226–232; Quick et al. 2005. J. Herpetol. 39:304–307; Begotti and Filho 2012. Cotinga 34:172–173). The authors made the following observation at the La Selva Biostation Reserve in Heredia, Costa Rica (10.422°N, 84.015°W). On 2 July 2012, along the Reserve boundaries next to a shaded pasture, the authors encountered a flock of parrots in the high canopy making a series of alarm calls, and on the ground found a large (total



FIG. 1. *Boa constrictor constrictor* swallowing a *Pionus senilis* in Heredia, Costa Rica.

length ca. 2.5 m) *B. c. constrictor* completing the ingestion of a large parrot (Fig. 1). From the size, orange feet, short tail, and blue remiges (the only parts of the parrot observed), we identified the parrot as a male *Pionus senilis* (White-crowned Parrot), confirmed independently by T. Imfeld and S. Hejmadi. After ingestion, the *B. c. constrictor* moved into a hollow at the base of a nearby tree. Large parrots at La Selva do not normally descend to the ground, so it is likely the *B. c. constrictor* and *P. senilis* fell from the canopy, either during the capture process or due to the *B. c. constrictor* being harassed by the group mates of the victim. To our knowledge, this is the first observation of an adult *P. senilis* being subdued and eaten by a *B. c. constrictor*.

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BOAEDON CAPENSIS (African House Snake). REPRODUCTION and MATING. *Boaedon capensis* is a common lamprophiid found in southern and eastern Africa, where it is apparently parapatric with the similar tropical west and central African species *B. fuliginosus*; species boundaries within this genus remain unclear (Kelly et al. 2011. Mol. Phylogenet. Evol. 58:415–426; Greenbaum et al. 2015. Afr. J. Herpetol. 64:18–38). These snakes are common in the pet trade and a relatively large number of studies of the reproduction of *Boaedon* have taken place in captivity (many published under the name *Lamprophis fuliginosus*, which certainly represents several species, especially when breeding of captive animals of unknown provenance is taken into account; e.g. Boomker 1970. J. Herpetol. Assoc. Afr. 6:17–18; Walker and Ford 1996. J. Herpetol. 30:416–418; Aldridge et al. 2005. Amphibia-Reptilia 26:576–582). Little is known about the reproduction of *Boaedon* in the wild (Haagner 1987. J. Herpetol. Assoc. Afr. 33:9–12; Ford 2001. Afr. J. Herpetol. 50:31–34). Mating evidently takes place in spring (see below) and 5–18 eggs are laid in late spring or early summer (September–January in the southern hemisphere; Broadley 1983. Fitzsimons' Snakes of Southern Africa. Delta Books, Johannesburg, South Africa. 376 pp.; Haagner 1987, *op. cit.*). Notably, females can lay up to 6 clutches per year in captivity (Ford and Seigel 2006. J. Zool. 268:171–176), although there does not seem to be any indication that this happens in the wild (Branch 1984. Litteratura Serpentina 204:106–120).

At ca. 1700 h on 4 April 2018 at Marammana Estate, Bot River, Western Cape, South Africa (34.27221°S, 19.18622°E; WGS 84), one of us (EW) discovered a female *B. capensis* in the 1.5 cm exit to a drain coming from a roof gutter. The wall around

the drain was smeared with blood, and an attempt was made to free the *B. capensis*, which was assumed to be stuck. When the *B. capensis* came out of the hole, she was pulling behind her two male *B. capensis*, both of which were affixed to her cloaca by their own. The pair of males were dragged by the female into a corner of the veranda behind a door, then across the veranda and the lawn to a bush, a total distance of ca. 13 m over a period of ca. 20 min. The female made several stops, including 10 min behind the door. Videos are available at <https://doi.org/10.6084/m9.figshare.8217809.v1>.

Whether or not both males were simultaneously intromitting was difficult to determine, but the extended duration of contact suggests that copulation was either simultaneous or very proximate. Simultaneous multiple mating is rarely documented in wild snakes. Remarkably, Lee et al. (2010. IRCF Rept. Amphib. 17:14–15) documented two captive male *B. fuliginosus* simultaneously mating with a captive female during an experimental trial designed to study the biology of sex pheromones. Friesen et al. (2015. J. Exp. Biol. 218:1410–1418) published a photo of two copulatory plugs in the cloaca of a wild female *Thamnophis sirtalis parietalis* (Red-sided Gartersnake) from a Manitoba, Canada population known for its intense polygynandrous mating system characterized by scramble competition occurring at spring emergence from hibernation. Although *Boaedon* do produce copulatory plugs (Wisniewski 2007. The Role of the Copulatory Plug in *Lamprophis fuliginosus* and the Contribution of the SSK in *Nerodia sipedon*. M.S. Thesis, Saint Louis University, St. Louis, Missouri), little is known about their mating system in the wild and scramble competition does not seem likely, as communal hibernation is rare in *Boaedon* (Marais 2004. Afr. Herp News 37:24). Rather, Wilmes et al. (2011. Afr. J. Herpetol. 60:177–180) suggested that male *Boaedon* “likely copulate for an extended period of time to prevent rival males from mating with the same female, thus increasing the chance of paternity for the male” and Wisniewski and Aldridge (2007. In Joint Meeting of Ichthyologists and Herpetologists (JMIH). Saint Louis, Missouri 11–16 July 2007. Hosted by St. Louis University at the Hyatt Regency St. Louis, p. 134) confirmed that copulations in captivity lasted over 4.5 h and that the mated female was unattractive for 2–4 d following copulation. Ford and Seigel (2006, *op. cit.*) found that females in captivity normally re-mate 7–20 d after laying, and Hermann (1989. Sauria 11:3–8) reported that captive *Boaedon* are able to store sperm and produce viable young up to 2.75 years after breeding.

This observation highlights the need for comparative studies of mating systems and mating behavior in snakes (Senter et al. 2014. PLoS ONE 9:e107528), including the need for experiments investigating the exact function of hemipenes (Tokarz and Slowinski 1990. Anim. Behav. 40:374–379; Tokarz and Kirkpatrick 1991. Anim. Behav. 41:1039–1044; Shine et al. 2000. Behav. Ecol. 11:411–415).

Finally, the timing of mating in the wild may also be unusual (Aldridge et al. 2005, *op. cit.*). Most southern African snakes usually mate in early spring (August–October), but fall (March–May) mating is known in *Causus rhombeatus* and *Bitis arietans* (Branch 2007. Afr. Herp News 43:25). Hermann (1989, *op. cit.*) stated that “although spring is in the months of October to December for southern African animals, African House Snakes in captivity also mate in our spring from April to June [translated from German]” and reported that a captive pair of South African origin kept in a terrarium in Germany mated on 30 March and on 30 May, after which the female laid eggs on 8 June which hatched

on 14 August. Evidently, no exact reports of the timing of mating in wild *B. capensis* have been published. The mating season is temporally dissociated from the time of fertilization in the majority of northern hemisphere temperate zone snakes (Aldridge and Duvall 2002. Herpetol. Monogr. 16:1–25; Aldridge et al. 2009. Contemp. Herpetol. 2009:1–31), but whether this holds true for southern hemisphere temperate zone snakes is unclear.

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BOTHROPS ATROX (Common Lancehead). HABITAT USE. *Bothrops atrox* occurs from the eastern Andes to northern Bolivia. However, in Brazil its distribution is restricted to the Amazonian morphoclimatic domain (Campbell and Lamar 2004. The Venomous Reptiles of Latin America. Cornell University Press, Ithaca, New York. 425 pp.). Its habitat is typically areas of rainforest (Cole et al. 2013. Proc. Biol. Soc. Washington. 125:317–578). Here, we provide the first documentation of *B. atrox* in a naturally open area of Roraima, Brazil, the Lavrado (Vanzolini and Carvalho 1991. Pap. Av. Zool. 37:173–226).

We recorded four individuals, two live and two road-killed, on BR-401, Roraima, Brazil, at the following coordinates (WGS 84): 1) 2.5422°N, 60.2823°W; 2) 2.5755°N, 60.2710°W; 3) 3.1134°N, 60.1044°W; and 4) 3.1136°N, 60.1046°W. All locations are open areas in the Lavrado (Fig. 1). The animals were collected (permit #65637-1) and deposited in the herpetological collection of the National Institute of Amazonian Research – INPA (AER 01: INPA-H040105 and AER 02: INPA-H040106).

The physiographic unit where the specimens were collected is commonly called Lavrado, comprising an area of 230 km² in the northeast of Roraima State (Myers 1936. J. Ecol. 24:161–184; Pires and France 1985. In Prance and Lovejoy [eds.], Key Environments Amazonia, pp. 109–145. Pergamon Press, Oxford, UK). The vegetation of the Lavrado comprises three main strata. First, the grasses and ciperaceas, with predominance of the ciperaceas; second, bushes; and third, trees of medium size, forming islands of forest. The habitat is cut by dendritic forest networks, known as Buritizal paths, along water courses, often vegetated by *Mauritia flexuosa*. Also present are characteristic formation known as “canga,” comprised of fragmented quartz pebbles and granite extrusions, and vegetated with cacti. These

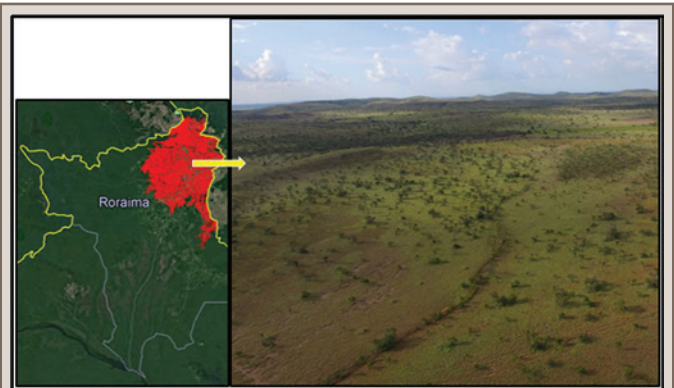


FIG. 1. Left: map showing the location of the Lavrado (red) in the Roraima political unit, Brazil; Right: image of this open habitat formation where *Bothrops atrox* were collected. Modified from MEPA (2018).



FIG. 2. Adult individual of *Bothrops atrox* collected in the Lavrado. Boxed, lateral details of the head.

are constant elements of the landscape, especially in the area of the Maú River, northeast of the drainage area. More detailed description can be found in Vanzolini and Carvalho (1991, *op. cit.*).

We suspect that *B. atrox* primarily occupies the gallery forest patches of the Lavrado, and that they only forage in the more open areas, returning to the closed canopy formations when they are not foraging. It is noteworthy that the specimens collected were always within sight of places with more dense vegetation, whether forest gallery or forest islands.

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BOTHROPS ATROX (Common Lancehead). PREDATION. *Bothrops atrox* is a pitviper native to tropical lowlands and rainforests throughout most of the northern South America. It is a terrestrial snake responsible for many snakebite accidents in Latin America (Calvete et al. 2011. *J. Proteomics*. 74: 510–527; Wustler et al. 1996. *Herpetologica* 52: 263–271). Here we report predation on *B. atrox* by a *Theraphosa* spider.

On 23 October 2017 an adult *Theraphosa stirmi* (Burgundy Goliath Birdeater; total length ca. 20 cm) was observed preying on a juvenile *B. atrox* (SVL ca. 30 cm) in a patch of Terra Firme upland forest near the margin of Acará water stream, within Adolpho Ducke Forest Reserve (Manaus, Amazonas, Brazil; 2.93851°S, 59.96878°W; WGS 84) (Fig. 1). Predation occurred at night (2000 h) on the ground, at ca. 30 cm from the entrance of spider's burrow. The *T. stirmi* first bit the *B. atrox* dorsally and then dragged it to the burrow. The pitviper initially squirmed and while inside the burrow bit the abdomen of *T. stirmi*. However, after 5 min, the *B. atrox* ceased movement and the *T. stirmi* commenced ingestion. The complete ingestion was not observed, but after 30 days, the same spider was observed normally in its burrow, apparently not damaged by the viper venom.



FIG. 1. *Theraphosa stirmi* preying on *Bothrops atrox* in Manaus, Amazonas, Brazil.

Theraphosa spiders are the largest in the world and belong to the family Theraphosidae, commonly known as tarantulas. *Theraphosa stirmi* has a distribution restricted to Brazil and Guyana (Rudloff et al. 2010. *Arth. Sci.* 1: 21–40; Almeida et al. 2018. *Check List*. 14: 647–650). There are previous records of frogs and caecilians being predated by other *Theraphosa* species (Menin et al. 2005. *Phyllomedusa* 4:39–47), but this is the first record of *B. atrox* preyed by one of these spiders.

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BOTHROPS FONSECAI (Fonseca's Lancehead). REPRODUCTION. *Bothrops fonsecai* is a medium-sized, terrestrial viperid snake in the *B. alternatus* group. Its distribution is restricted to southeastern Brazil, where it occurs associated with the remnants of Mixed Ombrophilous Forest of the Serras do Mar, Mantiqueira and Órgãos (Campbell and Lamar 1989. *The Venomous Reptiles of Latin America*. Cornell University Press, Ithaca, New York. 425 pp.; Muller 1971. *Salamandra* 7:9–30). Because it is endemic to high altitude areas, there is little information available in the literature about its life history. Reproductive data for this species are restricted to a female with 14 well-developed embryos in January (Sazima and Manzani 1998. *Herpetol. Rev.* 29:102–103) and three litters in March, with the birth of 8, 9, and 10 neonates (Duarte 2004. *Herpetol. Rev.* 35:175–176). However, little is known about the mating period and reproductive cycle of the species. Here we report a mating event of *B. fonsecai* in its natural habitat and comment on its reproductive cycle.

The copulation was observed at the Serra do Papagaio State Park (22.1478°S, 44.73047°W; WGS 84; 1730 m a.s.l.), on 30 March 2013, in the municipality of Baependi, Minas Gerais, Brazil. The snakes were seen during the day, on the roots of a fallen tree, at the edge of Mixed Ombrophilous Forest. Both snakes had their bodies stretched out in opposite directions, with only their tails intertwined (Fig. 1). As they noticed the researcher's approach,



FIG. 1. Male and female *Bothrops fonsecai* mating in Serra do Papagaio State Park, Minas Gerais, Brazil.

one of the snakes started vibrating its tail against the ground, and shortly thereafter, both started to move into the forest in opposite directions. In the same conservation unit (Serra do Papagaio State Park), we recorded two juveniles in February and March 2015, and an adult female (75 cm SVL, 10.5 cm tail length) with follicles in secondary vitellogenesis in November. Thus, females have embryos in January, parturition takes place in March (Sazima and Manzani 1998, *op. cit.*; Duarte 2004, *op. cit.*), and the encounter of juveniles in the wild in February and March (reported here) indicate that recruitment occurs between late summer and early fall. The presence of follicles in secondary vitellogenesis in late spring (December) and mating in early autumn (March and May) indicate that the reproductive cycle of *B. fonsecai* is biennial, as in other species of the genus *Bothrops* (Almeida-Santos and Salomão 2002. In Schutett et al. [eds.], *Biology of the Vipers*, pp. 445–462, Eagle Mountain Publishing, Eagle Mountain, Utah).

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BOTHROPS JARARACA (Jararaca). ANOMALOUS COLOR PATTERN. The most important group of venomous snakes in Brazil is the genus *Bothrops*, which cause a great number of snakebites (e.g., 20,000 cases in 2016 alone; <http://tabnet.datasus.gov.br>; 6 Feb 2019). The identification of these snakes is crucial for correct treatment and antivenom use (Warrell 2010. *The Lancet* 375:77–88). Herein, we report an anomalous color pattern of the species *Bothrops jararaca*.

On 20 September 2018, during a hike, an unusually-colored adult *B. jararaca* (Fig. 1A) was found in an Atlantic forest fragment in Cachoeiras de Macacu, Rio de Janeiro



Fig. 1A



Fig. 1B

FIG. 1. A) *Bothrops jararaca* from Rio de Janeiro state, Brazil, with anomalous pattern; B) *B. jararaca* from Rio de Janeiro state with typical color pattern.

state, Brazil (22.2225°S, 42.3357°E; WGS 84; 1054 m elev.). The dorsal blotches of the *B. jararaca* had coalesced into a stripe format along the body. Generally, *Bothrops jararaca* have dorsolateral blotches that are clearly separated (Fig. 1B). Color pattern is a relevant character for species identification on genus *Bothrops* (Campbell and Lamar 1989. *The Venomous Reptiles of Latin America*. Cornell University Press, Ithaca, New York. 425 pp.; Campbell and Lamar 2004. *The Venomous Reptiles of the Western Hemisphere*. Cornell University Press, Ithaca, New York. Vol. 1: xviii + 504 pp., Vol. 2: xiv + 422 pp.). Viperid snakes are known to occasionally have anomalous color patterns in nature (e.g., Vincent 1982. *Southwest. Nat.* 27: 263–272; Krecsák 2008. *Russ. J. Biol.* 15:97–102). However, this is the first record of a *Bothrops jararaca* from Atlantic forest, Rio de Janeiro state, Brazil with a striped pattern, without clearly defined dorsolateral blotches.

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BOTHROPS JARARACA (Jararaca). XANTHISM. Chromatic anomalies, such as albinism, are well known in several animal species, including snakes (McCardle 2012. *Albinism in Wild*



FIG 1. Xanthic juvenile female *Bothrops jararaca* at the Sorocaba Zoo.

Vertebrates. M.S. Thesis, Texas State University, San Marcos, Texas. 71 pp.). Albinism is a genetic disorder characterized by partial or complete lack of skin and eye pigmentation (Bechtel 1995. Reptile and Amphibian Variants: Colors, Patterns and Scales. Krieger Publishing, Malabar, Florida. 206 pp.). Xanthism is a type of albinism in which individuals produce predominantly yellow pigments and show lack of melanin (Stephenson and Drace 2014. Herpetol. Rev. 45:569–577). Few cases of xanthism have been reported for neotropical snake species (Sazima and Di-Bernardo 1991. Mem. Inst. Butantan 53:167–173; Travaglia-Cardoso and Parpinelli 2006. Herpetol. Bull. 97: 39–40).

On 1 November 2018, a juvenile female *Bothrops jararaca* (23.0 cm SVL; 3.3 cm tail length, 15 g; Fig. 1) was found in a swampy area near a road (Rodovia Bunjiro Nakao KM 62; 23.64695°S, 47.15909°W; WGS 84) in municipality of Ibiúna, São Paulo State, Brazil. The specimen was rescued by an employee of an environmental consulting company and was brought to Parque Zoológico Municipal Quinzinho de Barros (PZMQB; Sorocaba Zoo), at municipality of Sorocaba, São Paulo. The animal was dehydrated and exhibited motor incoordination and malformation of the occipital condyles. On 10 November 2018 the individual died, and the specimen was deposited in the Sorocaba Zoo collection. The dorsum and venter of the juvenile *B. jararaca* (Fig. 1) was yellow, and the dorsal markings were dark yellow. In contrast of another case of xanthism described in *B. jararaca* (Sueiro et al. 2010. Biotemas 23:155–160) in which the animals showed normal color pattern of the eyes and tongue, the specimen of this study had slightly reddish pupil and yellow iris, and pink tongue.

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COLUBER CONSTRICTOR PRIAPUS (Southern Black Racer).

DIET. *Coluber constrictor priapus* is a habitat generalist and diurnal snake species that is found throughout the eastern USA and is one of the most common snakes in Georgia (Jensen et al. 2008. Amphibians and Reptiles of Georgia. University of Georgia Press, Athens, Georgia. 575 pp.). It is an opportunistic predator that actively forages for its prey using visual detection (Ernst and Barbour 1989. Snakes of Eastern North America. George Mason University Press, Fairfax, Virginia. 282 pp.). The diet of *C. c. priapus* is broad, consisting of invertebrates, anurans, salamanders, lizards, snakes, turtles, mammals, and



FIG. 1. *Coluber constrictor priapus* ingesting a female or immature male *Setophaga ruticilla* (American Redstart) at the entrance of a *Dasyptes novemcinctus* burrow on Little St. Simons Island, Georgia, USA, on 30 October 2018.

birds, with the proportions and types of prey consumed varying across its range (Halstead et al. 2008. Copeia 2008:897–908). Here we describe the observation of *C. c. priapus* preying on a *Setophaga ruticilla* (American Redstart), which to our knowledge has not been previously documented in the literature.

On 30 October 2018, at 1512 h, an adult *C. c. priapus* preying upon a *S. ruticilla* was captured via a remote infrared camera (Bushnell®, Overland Park, Kansas, USA) on Little St. Simons Island, Georgia, USA (Fig. 1). Cameras are positioned to capture photos and video of the commensal use of nine-banded armadillo (*Dasyptes novemcinctus*) burrows by other taxa. The burrow where this predation occurred was located in the dune system on the northeast end of the island (31.27215°N, 81.27704°W; WGS 84, -0.87 m elev.). The camera recorded four pictures and two 10-second videos of the *C. c. priapus* capturing and carrying its prey in front of the burrow. This observation is the first direct record of *C. c. priapus* capturing and ingesting a *S. ruticilla* and suggests that migratory birds could be important prey items for racers on the island. Previous research has demonstrated the importance of migratory passerine birds for multiple other insular snake populations (Sun.1990. From Water onto Land. China Forestry Press, Beijing, pp.277–280, Boback 2005. Copeia 2005:880–885, Quick et al. 2005. J. Herpetol. 39:304–307, Marques et al. 2012. J. Nat. Hist. 46:885–895).

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CROTALUS HELLERI (Southern Pacific Rattlesnake).

DIET. The diet of juvenile *Crotalus helleri* is dominated by lizards and rodents (Mackessy 1988. Copeia 1988:92–101). On 3 March 2019 during daylight hours, SJ observed a juvenile *C. helleri* ingesting (tail first) an adult *Batrachoseps* (Plethodontidae) in the Santa Ana Mountains, Orange County, California, USA (33.70317°N,

PHOTOS BY SCOTT JAMES



FIG. 1. Yearling *Crotalus helleri* swallowing an adult *Batrachoseps* (slender salamander), Orange County, California.

117.63608°W; WGS 84; Fig. 1). Air temperature was 12°C under cloudy skies, and abundant rain had fallen over a period of several days prior to this observation. Both *Batrachoseps major* (Garden Slender Salamander) and *B. nigriventris* (Black-bellied Slender Salamander) are known from the area (Wake and Jockusch 2000. *In* Bruce et al. [eds.], *The Biology of Plethodontid Salamanders*, pp. 95–119. Kluwer Academic/Plenum Publishing, New York), but the limited view of the prey animal in photos precludes identification to species level. Predation by rattlesnakes on either *B. major* or *B. nigriventris* is unknown (Hansen and Wake 2005a. *In* M. Lannoo [ed.], *Amphibian Declines: The Conservation Status of United States Species*, pp. 680–682. University of California Press, Berkeley; Hansen and Wake 2005b, *ibid*, pp. 683–685), and to our knowledge this is the first report of rattlesnake predation on *Batrachoseps*. This is the second instance of *C. helleri* predation on plethodontid salamanders, as Mahrtdt and Banta (1997. *Herpetol. Rev.* 28:81) reported that a freshly collected *C. helleri* regurgitated an adult *Aneides lugubris* (Arboreal Salamander).

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CROTALUS HORRIDUS (Timber Rattlesnake). **DIET.** *Crotalus horridus* inhabits the deciduous forests of the Midwest and eastern United States from Oklahoma to Vermont extending south to Florida (Ernst and Ernst. 2003. *Snakes of the United States and*



FIG 1. *Crotalus horridus* consuming a *Baeolophus bicolor* (Tufted Titmouse).



FIG 2. *Crotalus horridus* as found at ambush site adjacent to a downed log.

Canada. Smithsonian Institution, Washington, D.C. ix + 668 pp.). There have been several studies investigating the diet of free-ranging *C. horridus* with mammals accounting for the majority (> 91%) of prey and birds accounting for < 8% (Clark 2002. *J. Herpetol.* 36:494–499; Reinert et al. 2011. *Copeia* 2011:430–442). *Crotalus horridus* has been documented as having consumed picids, phasianids, and passerellids.

At 0900 h, on 15 September 2018, at Land Between the Lakes National Recreation Area, Lyon County, Kentucky, USA (37.03961°N, 88.10444°W; WGS 84; 106 m elev.) we found one of the radio-transmitted *C. horridus* (109.7 cm SVL, 660 g) that is part of ongoing research with an adult *Baeolophus bicolor* (Tufted Titmouse) in its jaws (Fig. 1). The site was a xeric forest (oak, hickory, and cedar) and had been previously burned. Based on the position of the posterior two thirds of the body, the *C. horridus* appeared to have been coiled in an ambush position adjacent to a downed log, ca. 20 cm in diameter (Fig. 2), a behavior commonly used to secure rodent and small mammal prey (Reinert et al. 1984. *Copeia* 1984:976–981) and observed in this population of *C. horridus* during foraging, especially in late summer and fall.

We presume this was a predation event and not scavenging, since this involved an intact prey item as well as the presence of several drops of uncoagulated blood within 5 cm of the prey. When the *C. horridus* finished consuming the *B. bicolor*, the blood had coagulated completely. To our knowledge this is the first documented account of a *C. horridus* consuming *B. bicolor* or any member of the family Paridae.

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CROTALUS INTERMEDIUS (Mexican Small-headed Rattlesnake). REPRODUCTION. Published observations on the natural history of *Crotalus intermedius* are scant, and reports on litter size for each of the three subspecies are meagre. A litter size of five has been reported in *C. i. omiltemanus* (Armstrong and Murphy 1979. The Natural History of Mexican Rattlesnakes. Univ. Kansas Mus. Nat. Hist. Spec. Publ. 5:1–88) and six in *C. i. intermedius* (Canseco-Marquez and Gutierrez-Mayen 2010. Anfibios y Reptiles del Valle de Tehuacan-Cuicatlan. Mexico, D.F. 302 pp.). Herein, we report on three litter sizes obtained by dissecting specimens in the University of Illinois Museum of Natural History (UIMNH) Herpetology Collection.

A gravid *C. i. gloydii* (UIMNH 73614: 398 mm SVL, 429 mm total length) collected between July and December of 1965 on Cerro San Felipe, Oaxaca, Mexico contained five developing embryos; a gravid *C. i. intermedius* (UIMNH 48823: 302 mm SVL, 329 mm total length) collected on 21 March 1940 from “El Limon,” Puebla, Mexico contained two developing embryos and three unfertilized ova; and a gravid *C. i. omiltemanus* (UIMNH 35016: 453 mm SVL, 486 mm total length) collected on 1 January 1949 from Chilpancingo, Guerrero, Mexico contained five developing embryos.

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CROTALUS TRISERIATUS (Mexican Dusky Rattlesnake). DIET. *Crotalus triseriatus* is a small, stout rattlesnake, which occupies high elevation forests and grasslands in the eastern part of the Transverse Volcanic Cordillera within the Mexican states of Veracruz, Puebla, Tlaxcala, Mexico, Distrito Federal, Morelos, and Michoacan (Heimes 2016. Snakes of Mexico. Edition Chimaira, Frankfurt, Germany. 572 pp.; Bryson et al. 2014. Zootaxa. 3826:475–496). Its diet is primarily comprised of mammals and lizards (Heimes 2016, *op. cit.*; Mocino-Deloya et al. 2014. Rev. Mex. Biodivers. 85:1289–1291). Here we report the first instance of predation on the northern pygmy mouse (Rodentia: Cricetidae: *Baiomys taylori*) by *C. triseriatus*, which was discovered when examining the stomach contents of specimens in the University of Illinois Museum of Natural History (UIMNH) Herpetology Collection.

A single *Baiomys taylori* (56 mm SVL, 39 mm tail length, 13 mm hind foot) was discovered in the stomach of a male *C. triseriatus* (UIMNH 16852: 385 mm SVL, 423 mm total length, 23 mid-dorsal scale rows, 147 ventrals, 24 subcaudals, 51 dorsal blotches, and 7 tail bands) collected on 28 June 1949 from Lagunas de Zempoala National Park, Morelos, Mexico (19.0545°N, 99.315°W, WGS 84; ca. 2800 m elev.); it was ingested head-first (Fig. 1). The mammalian prey was identified based on the following characters: dorsal pelage brown, fifth digit shorter than



FIG 1. *Crotalus triseriatus* with *Baiomys taylori* prey.

second and fourth digits, hind foot greater than 8 mm, distribution, and elevational range (Ceballos 2014. Mammals of Mexico. Johns Hopkins University Press, Baltimore, Maryland. 957 pp.; Alvarez-Castaneda et al. 2017. Keys for Identifying Mexican Mammals: Revised and Updated Edition. Johns Hopkins University Press, Baltimore, Maryland. 522 pp.). Given that *C. triseriatus* has experienced numerous taxonomic splits in recent years, the recorded diet of the species is presently ambiguous and most published reports provide insufficient information to delimit between newly classified taxonomic entities.

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DENDRELAPHIS MARENÆ (Maren's Bronzeback). PREDATION BEHAVIOR. *Dendrelaphis marenæ* was recently recognized as a distinct species that had been hidden under the *D. pictus* species complex (Vogel and van Rooijen 2008. Herpetozoa 21:3–29). It can be separated from other Indo-Chinese, Sundaic and Mollucan *Dendrelaphis* species by having a fainter ventrolateral line, wider vertebral scales and a longer tail with more subcaudal scales than Indo-Chinese, Sundaic and Mollucan *Dendrelaphis* (Vogel and van Rooijen 2008. Amphibia-Reptilia 29:101–115). The divergence of *D. marenæ* on Sulawesi and the Philippines is likely due to isolation by oceanic barriers for prolonged time periods in geological history (How and Kitchener 1997. J. Biogeogr. 24:725–735; Inger and Voris 2001. J. Biogeogr. 28:863–891). Like other members of the genus *Dendrelaphis*, *D. marenæ* are mostly diurnal, found in pristine as well as cultivated habitats, and feed primarily on amphibians and small lizards (de Lang and Vogel 2005. The Snakes of Sulawesi. Edition Chimaira, Frankfurt, Germany. 117 pp.). Snakes of the genus *Dendrelaphis* are well-known to eat frogs in the genus *Polypedates* (Wells 2005. Malaysian Naturalist 58:38–39; Sudasinghe 2010. Sauria 32:75–78; Leong et al. 2009. Nature in Singapore. 2:361–364; Dela Cruz and Pradil 2018. Southeast Asia Vertebrate Records 34:82–83), but published observations of feeding behavior in the wild are uncommon.

At 1100 h on 10 July 2018, a *D. marenæ* was observed preying on a *Polypedates iskandari*, at the base of a tree close to a riverbank within secondary forest on Buton Island, Sulawesi (4.5946°S, 123.1567°E; WGS 84; 90 m elev.). When the snake became aware of our presence it slowly moved towards the center of a forest trail and suddenly lifted the anterior third of its

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FIG. 1. Screen shot from video footage of *Dendrelaphis marenae* rearing the anterior third of its body and holding the prey item above the ground while moving off of the main path, seemingly in response to our presence. The yellow line labels the snake's point of contact with the substrate.

PHOTO BY JOSH PHANGURHA



FIG. 2. Screen shot from video footage of *Dendrelaphis marenae* climbing with prey.

PHOTO BY JOSH PHANGURHA



FIG. 3. *Dendrelaphis marenae* consuming prey approximately 250 cm above the ground in vegetation.

body vertically above the ground, while still holding the prey in its mouth (Fig. 1). It then began to laterally undulate, using the posterior two thirds of its body in order to swiftly move across the path into denser vegetation on the other side of the trail. The snake stopped momentarily in the vegetation; it then proceeded to climb into the vegetation with the prey still secured in its mouth, reaching the top of a ca. 250 cm plant (Fig. 2). Here it proceeded to swallow the *P. iskandari* upside down, forcing the prey down its throat posterior end-first (Fig. 3). *Dendrelaphis marenae* has also been observed preying on *Hylarana mocquardi* and *Rhacophorus* cf. *edentulus* on Buton Island. These events

occurred during the middle of the day in low vegetation on stream banks. In both cases the snake was observed to carry the prey with approximately 30% of its body off the ground. Collectively these observations make a significant contribution to predation behavior and diet of *D. marenae*.

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DENDROPHIDION DENDROPHIS (Olive Forest Racer). DIET.

Dendrophidion dendrophis inhabits the northern Amazonian region from eastern Ecuador and Peru through northern Brazil to the Guianas (Lieb 1988. *Herpetologica* 44:162–175; Köhler 2008. *Reptiles of Central America*. Herpeton Press, Offenbach, Germany. 367 pp.). This species is terrestrial to semi-arboreal and inhabits primary and secondary growth forests (Cunha et al. 1993. *Bol. Mus. Para. Emilio Goeldi, Zool.* 9:1–191; Martins et al. 1998. *Herpetol. Nat. Hist.* 6:78–150).

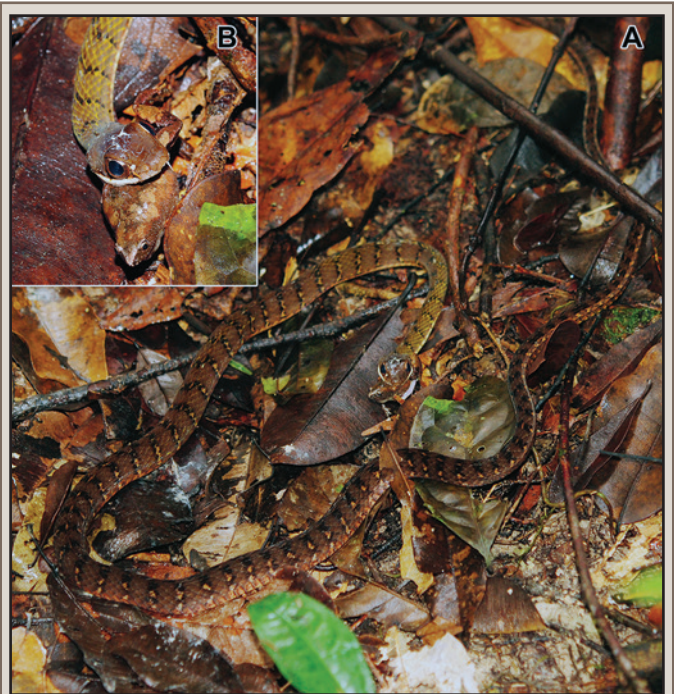


FIG. 1. A) *Dendrophidion dendrophis* preying on a *Chiasmocleis shudikarensis* in Manaus city, Amazonas, Brazil; B) snake swallowing the frog from behind.

At 1300 h on 14 March 2017 an adult *D. dendrophis* (ca. 80 cm total length) was observed preying on an adult *Chiasmocleis shudikarensis* (Anura: Microhylidae; ca. 2.5 cm body length) (Fig. 1A). The event took place on leaf litter in a patch of terra firme dense ombrophylous forest, in the Reserva Biológica do Cueiras-ZF02, city of Manaus, Amazonas, Brazil (2.58913°S, 60.11624°W; WGS 84). The snake began to ingest the frog from the rear, while it was still alive (Fig. 1B). The anuran did not perform agonistic vocal behavior. The prey was swallowed completely in 5 min.

The few records in the literature on the diet of *D. dendrophis* indicate that it is an anurophagous species, preying on terrestrial (*Adenomera*, *Anomaloglossus*, *Eleutherodactylus* and *Physalaemus*) and arboreal anurans (*Boana* and *Scinax*; Martins et al. 1998, *op. cit.*; Prudente et al. 2007. S. Am. J. Herpetol. 2:53–58). *Chiasmocleis shudikarensis* is a fossorial anuran species, restricted to the Guiana Shield in Guiana, Surinam, French Guiana and Brazil (north of Rio Amazonas; Peloso et al. 2014. Bull. Am. Mus. Nat. Hist. 386:1–112). Although *C. shudikarensis* live underground, during the reproductive period from March to May males can be found vocalizing on the ground, in puddles of water (Vitt et al. 2008. Guide to the Frogs of Reserva Adolpho Ducke, Central Amazonia. Áttema Design Editorial, Manaus. 176 pp.). This observation extends the diet breadth of *D. dendrophis* to fossorial anurans.

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EUNETES MURINUS (Green Anaconda). DIET. *Eunectes murinus* is an aquatic, nocturnal, and euryphagic snake species, feeding on several vertebrate taxa, both aquatic and terrestrial: fish (although little is known about the species of fish consumed), frogs, reptiles (*Kentropyx*, *Caiman*, *Paleosuchus*, snakes, and turtles), birds (jacana, jabiru, stork), and mammals (*Cuniculus*, *Dasyprocta*, *Hydrochoerus*, *Tayassu*, *Tapirus*, deer, and primates; Haddad Jr. et al. 2012. *Sucuris: Biology, Conservation, Reality and Myths of One of the Greatest Snakes in the World*. Technical Books Editora, Rio de Janeiro, Brazil. 82 pp.; Martins and Oliveira 1998. Herpetol. Nat. Hist. 6:78–150). On 9 November 2017, at 1000 h, we recorded of predation of a cichlid fish by an *E. murinus* caught at the municipality of Benevides, State of Pará, Brazil (1.32351°S, 48.24342°W, WGS 84; 28 m elev.). The adult *E. murinus* (170 cm total length, 4.700 kg) was collected accidentally in a gill net during fish sampling in the area of influence of Natura Ecoparque, municipality of Benevides, State of Pará, Brazil. The snake's stomach contained a fish (Fig. 1), which was identified as a cichlid, *Heros notatus* (Perciformes: Cichlidae). The *E. murinus* was collected and deposited in the Zoological Research Laboratory (ZRL) of the University of Amazonia (UNAMA) in municipality Santarém, State of Pará, Brazil. To our knowledge, *H. notatus* is a new record for the diet of *E. murinus*.



FIG. 1. Specimen of *Heros notatus* found in the stomach of a *Eunectes murinus*.

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IMANTODES CENCHOA (Blunt-headed Tree Snake). HABITAT USE. *Imantodes cenchoa* is a widespread species that occurs in forest environments in Central and South America (Cunha and Nascimento 1978. Publ. Avulsas Mus. Paraense Emilio Goeldi, 32:1–218). In Brazil, the species is found in Amazon, Atlantic Forest, and in gallery forests of Cerrado (França and Araújo 2007. Braz. J. Biol. 67:33–40). Its diet consists on lizards and anurans (Hartmann et al. 2009. Pap. Avulsos Zool. 49:343–360). It is active at night, preferentially foraging on vegetation, but may sporadically use the ground when changing sites (Henderson and Nickerson 1976. J. Herpetol. 10:205–210). *Imantodes cenchoa* can commonly be found coiled during the day (period of inactivity) in bromeliads (Henderson and Nickerson 1976, *op. cit.*).

Between June 2010 and October 2012, during research in the Reserva Biológica Guaribas (6.48144°S, 35.5353°W; WGS 84; 10 m elev.), Rio Tinto municipality, Northeast Brazil, we collected twelve individuals of *I. cenchoa* (Fig. 1A), and surprisingly, eleven of these individuals (N = 6 males, N = 5 females; average SVL = 65.3 cm; average tail length = 29.4 cm; average mass = 19.45 g) were resting during the day (between 0750 h and 1715 h) inside cavities in the trunk of *Campomanesia dichotoma* trees. This tree, that is endemic to the Atlantic Forest and occurs in the Northeast and Southeast Brazil (Sobral et al. 2009. In Stehmann et al. [eds.], *Plantas da Floresta Atlântica*, pp. 352–366, Jardim Botânico do Rio de Janeiro), presents a deeply fluted trunk (Fig. 1B). Ten of the individuals of *I. cenchoa* were found in the same tree, eight on different days, and two males were found at the same time in the same cavity. Another specimen was found in different *C. dichotoma*. All individuals were found coiled up inside of *C. dichotoma* cavities located from 1.0–1.6 m above the ground. Some of these individuals (N = 3 males, N = 1 female) were marked by scale-clipping and released, but none were recaptured. The



FIG. 1. *Imantodes cenchoa* (A) found inside a cavity of *Campomanesia dichotoma* tree in the Reserva Biológica Guaribas, Brazil (B).

others (N = 7) were fixed and deposited in the collection of the Universidade Federal da Paraíba (under ICMBio permit SISBIO 22940-1). We also found a juvenile *I. cenchoa* moving on bromeliad leaves at night (1800 h). These observations may indicate a specific species-microhabitat association, such as between *Imantodes* and bromeliads in Central America (Henderson and Nickerson 1976, *op. cit.*).

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LAMPROPELTIS CALIFORNIAE (California Kingsnake) and TRIMORPHODON LAMBDA (Sonoran Lyresnake). DIET and PREDATION. A recent comprehensive analysis of the diet of *Lampropeltis californiae* based upon the examination of museum specimens, unpublished field notes, unpublished observations, and an exhaustive review of the literature, included a list of all known snake prey of *L. californiae* (Wiseman et al. 2019. *Herpetol. Conserv. Biol.* 14:1–30). In that study, one *L. californiae* museum specimen (San Diego Museum of Natural History [SDMNH] 34291) contained a *Trimorphodon lyrophanes* (California Lyresnake) from San Diego

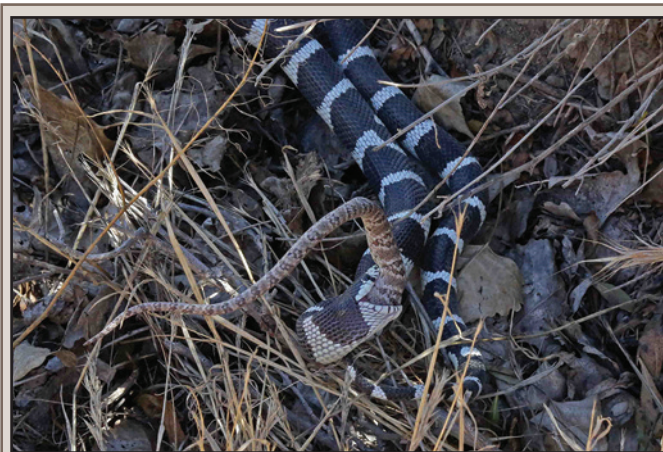


FIG. 1. *Lampropeltis californiae* feeding on *Trimorphodon lambda* in Grand Canyon, Arizona, USA.

County, California, USA, however, *T. lambda* was not listed as prey. On 4 September 2016, at 1313 h, one of us (CW) found an adult *L. californiae* (total length ca. 600–650 mm) in the act of swallowing an adult *T. lambda* head-first (Arizona State University [ASU] HP00385) on Bright Angel Trail between Indian Gardens and Three Mile Rest House in Grand Canyon, Coconino County, Arizona, USA. When found, the anterior two-fifths of the *T. lambda* had already been ingested; 5 min later the kingsnake had nearly reached the vent of the lyresnake (Fig. 1).

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LEPTOPHIS MEXICANUS (Mexican Parrot Snake). DIET. *Leptophis mexicanus* is a colubrid distributed from southern Mexico to northern Costa Rica, occurring over the lowlands of Guatemala. It is known to be an active forager that feeds mostly on hylid frogs (Oliver 1948. *Bull. Am. Mus. Nat. Hist.* 92:161–280). However, it has also been seen preying on lizards (Henderson 1982. *Amphibia-Reptilia* 3:71–80), salamanders, and bird eggs (Platt et al. 2016. *Mesoam. Herpetol.* 3:162–170). During a diurnal survey on 12 March 2018, at 1200 h, we observed a *L. mexicanus* feeding on a lizard at the Parque Nacional Laguna Lachuá (PNLL), Cobán, Alta Verapaz, Guatemala (15.95171°N, 90.67326°W; WGS 84; 194 m elev.), ca. 200 m from a highway, near main path of PNLL. The individual was observed at the base of a tree, between its roots, with the lizard partially consumed and only hind legs and tail observable (Fig. 1). Based on captures made during same fieldwork and the size, shape and coloration of tail and hind legs, we suggest the prey could be *Anolis capito*. Although consumption of lizards had already been described for *L. mexicana*, this is the first time *A. capito* is reported as their prey, which highlights the fact that they are not restricted to the consumption of frogs in rainforests of Guatemala.

We thank G. Ruano for his help with herpetofauna field identification, as well as R. Morales and S. González for their comments to discern the prey species. The fieldwork was carried out in the framework of the Ecology Field Workshop of the Escuela de Biología, in conjunction with the Programa de Investigación y Monitoreo de la Ecorregión Lachuá, for which we thank the coordinator professors.



FIG. 1. *Leptophis mexicanus* feeding on *Anolis capito* in Parque Nacional Laguna Lachuá, Cobán, Alta Verapaz, Guatemala.

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LIASIS FUSCUS (Water Python). REPRODUCTION. Mating aggregations, or mating balls, where multiple males simultaneously court a single female, have been documented in multiple snake species (Shine 2003. Proc. R. Soc. Lond. B 270:995–1004). Herein, we report the first known record of a mating ball in *Liasis fuscus*. This species is widespread throughout tropical portions of Australia. Although aspects of their ecology (Madsen and Shine 1999. Ecology 80:989–997) and reproductive biology (Stahlschmidt et al. 2012. Funct. Ecol. 26:812–821) have been extensively studied, little information is available concerning *L. fuscus* courtship in the wild.

On the morning of 21 August 2010, DFD discovered an entangled group of at least three *L. fuscus* tails at the entrance of a burrow that led under a large shed near Beatrice Hill, Northern Territory, Australia (12.6508°S, 131.3246°E; WGS 84; Fig. 1A). These animals were not disturbed, so no further details were collected. On 13 July 2016 at ca. 2130 h, GAB noticed what initially appeared to be a single snake in a small burrow near Harrison Dam, Northern Territory, Australia (12.3537°S, 131.2047°E; WGS 84). However, closer inspection revealed that multiple individuals were tightly interwoven into a mating ball (Fig. 1B). To detail the composition of this mating ball, the snakes were disturbed. Upon removal from the burrow, the snakes in the mating ball remained tightly interwoven. It was only after placing the mating ball into a pillowcase that the snakes disentangled. The mating ball contained one female (1755 g, 144.5 cm SVL) and six male *L. fuscus* (mass range: 715–1335 g; mean mass \pm SE: 1048 \pm 107 g; mean SVL \pm SE: 130.1 \pm 4.9 cm).

Although not common across snakes generally, mating ball formation has been documented in six families: Acrochordidae, Boidae, Colubridae, Elapidae, Pythonidae, and Viperidae. Across these families, mating balls have been documented primarily in aquatic and semi-aquatic species including *Acrochordus arafurae* (Shine 1986. Oecologia 69:260–267), *Agkistrodon piscivorus* (Shine 2003. Proc. R. Soc. Lond. B 270:995–1004), *Eunectes murinus* (Rivas and Burghardt 2001. Anim. Behav. 62:F1–F6), *Laticauda colubrina* (Shetty and Shine 2002. Herpetologica 58:170–180), *Natrix natrix* (Madsen and Shine 1993. Copeia 1993:561–564), *Nerodia sipedon* (Weatherhead et al. 1995. Behav. Ecol. Sociobiol. 36:301–311), *Thamnophis sirtalis* (Shine et al. 2000. Anim. Behav. 59:F4–F11), and now *L. fuscus*, but it has also been observed in species not regularly associated with water (e.g., *Morelia spilota* [Shine and Fitzgerald 1995. Oecologia 103: 490–498]; *Python molurus* [Bartoszek et al. 2018. Herpetol. Rev. 49:353–354]; *Boa imperator* [Schuett et al. 2019. Herpetol.

Rev. 50:383–385]). The apparent predominance of mating balls being in species associated with water could be explained by the buoyancy provided by water relieving weight on the female and the presence of a mating ball in water would provide resistance to assist in penetration of the successful male's hemipenis. However, most documented mating balls in aquatic and semi-aquatic species were on land, suggesting an alternative adaptive basis to this behavior that has led to its presence across a phylogenetically diverse group of aquatic or semi-aquatic species.

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LIODYTES ALLENI (Striped Crayfish Snake). PREDATION.

Liodytes alleni is a highly aquatic species of natricine snake distributed from extreme southern Georgia through the entire Florida peninsula (Ernst and Ernst 2003. Snakes of the United States and Canada. Smithsonian Institution Press, Washington, D.C. 668 pp.). There have been relatively few published observations of predators of *L. alleni* (Godwin 1992. Herpetol. Rev. 23:82; Szelistowski and Meylan 1996. Herpetol. Rev. 27:204–205; O'Brien 1998. Herpetol. Rev. 29:46–47; Gibbons and Dorcas 2004. North American Watersnakes: A Natural History. University of Oklahoma, Norman, Oklahoma. 438 pp.; Durso et al. 2017. Herpetol. Rev. 48:860–861). At 1013 h on 3 February 2019, we observed an adult *Egretta caerulea* (Little Blue Heron) consuming an *L. alleni* within a shallow slough section of the Loxahatchee National Wildlife Refuge, Palm Beach County, Florida, USA (26.49157°N, 80.21838°W; WGS 84). The *L. alleni* appeared to both bite the *E. caerulea* on the neck and perform mouth gaping behavior (Fig. 1), which others have suggested seeks to



FIG. 1. *Liasis fuscus* mating balls found on 21 August 2010 (A) and 13 July 2016 (B).



FIG. 1. *Egretta caerulea* preying upon *Liodytes alleni* (note the mouth gaping behavior).

mimic the mouth-gaping behavior of *Agkistrodon piscivorus* (Cottonmouth; Godley 1982. Florida Field Nat. 10:31–36). Within 10 min, the *L. allenii* had been almost completely consumed and the *E. caerulea* flew off.

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LYCODON ALCALAI (Alcala's Wolf Snake). DIET. *Lycodon alcalai* is a small, terrestrial snake endemic to the northern Philippines where it is known from the islands of Batan (70 km²), Sabtang (16 km²), and Calayan (196 km²; Ota and Ross 1994. Copeia 1994:159–174; Oliveros et al. 2011. Sci. Pap. Nat. Hist. Mus. Univ. Kans. 43:1–20). Although *L. alcalai* has been reported to prey upon Common Tree Frogs (*Polypedates leucomystax*) and unidentified, soft-shelled reptilian eggs (Ota and Ross 1994, *op. cit.*), little natural history information is available for this species. Here, we report on a new diet item for *L. alcalai*: an as of yet undescribed species of scaly-toed gecko (*Lepidodactylus*).

Our observation took place on 28 May 2018, in coastal, secondary growth forest of Barangay Magsidel, Municipality of Calayan, Calayan Island, Cagayan Province, Philippines (19.2748°N, 121.4470°W; WGS 84; 72 m elev.). Upon capture, an adult *Lycodon alcalai* (OMNH 46827; 435 mm SVL, 184 mm tail length, 18.8 g without prey) regurgitated a partially digested *Lepidodactylus*. The identification of this prey item to *Lepidodactylus* was based on digital morphology and the pattern on the remaining skin. This undescribed species of *Lepidodactylus* appears to be endemic to the Philippines and is the only member of the genus found on Calayan Island (Oliveros et al. 2011, *op. cit.*). During our May 2018 survey this gecko was commonly encountered at night on low vegetation or tree trunks in secondary forest and coconut plantations.

Members of the genus *Lycodon* typically exhibit strongly arched maxilla with three series of maxillary teeth, the largest of which being the anterior series (Leviton 1965. Philippine J. Sci. 94:117–140). Jackson and Fritts (2004. Amphibia-Reptilia 25:247–254) hypothesized that this dentition allows some species, such as *L. capucinus*, to manipulate and ingest hard-bodied skinks. In the case of *L. alcalai*, the largest maxillary teeth reside towards the medial and posterior portions of the maxilla (Ota and Ross 1994, *op. cit.*), which may allow the species to more easily open and ingest soft-shelled eggs (Ota and Ross 1994, *op. cit.*). With the addition of *Lepidodactylus* sp. to its known diet, this observation supports previous work suggesting that *L. alcalai* specializes on soft-bodied prey items (i.e. frogs, geckos, and soft eggs). Fieldwork supported by NSF DEB 1657648 to CDS, NSF DEB 1657662 to TG, and NSF DEB 1657527 to MH. Fieldwork was conducted under the Memorandum of Agreement with the BMB of the Philippines (2015–2020) and Gratuitous Permits to Collect No. 273.

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LYGOPHIS MERIDIONALIS. REPRODUCTION. The genus *Lygophis* comprises eight species widely distributed in moist environments in Central and South America (Dixon 1985. Copeia 1985:565–573; www.reptile-database.org, 20 Jan 2019). *Lygophis meridionalis* is a diurnal and terrestrial snake restricted to open areas in Argentina, Bolivia, Paraguay (Cacciali and Wüest 2009. Check List 5:383–385), and Brazil, including Amazonian (only savannas enclaves), Atlantic Forest, and Cerrado biomes (Castro and Oliveira 2017. Check List 13:2077). Although reproductive characteristics of other *Lygophis* species have been studied (e.g., Sivan et al. 2016. South Amer. J. Herpetol. 11:114–118), there is only one record of clutch size for *L. meridionalis* (Sawaya et al. 2008. Biota Neotrop. 8:127–149), which describes 7 eggs in oviduct. Herein, we provide the first record of eggs size for the species and the second report on its clutch size.

On 19 January of 2019, a female *L. meridionalis*, (565 mm SVL, 200 mm tail length), was found dead on road (Fig. 1) in Brazilian National Park, Federal District, Brazil (15.73917°S, 47.92611°W; WGS 84; 1093 m elev.). During examination of the specimen, we found 8 eggs in its oviduct (Fig. 1). The lengths of the eggs (in mm) were 22.73, 25.3, 28.35, 25.46, 23.55, 24.50, 25.22 and 24.91; widths (in mm) were 8.78, 9.28, 8.45, 9.07, 9.67, 9.56, 9.49 and 9.63.

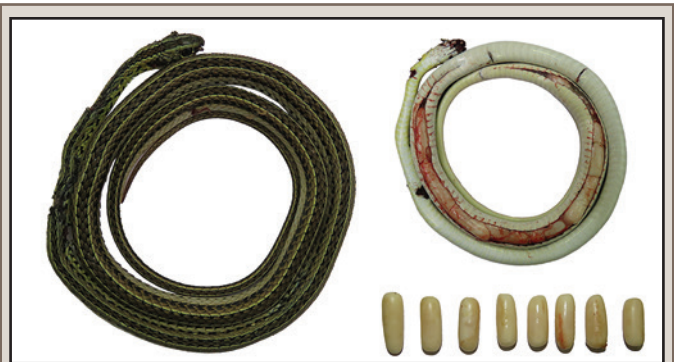


FIG. 1. Specimen of *Lygophis meridionalis* and its eggs from Federal District, Brazil.

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MASTICOPHIS SCHOTTI (Schott's Whipsnake). ENDOPARASITES. *Masticophis schotti* ranges from south Texas, USA into Mexico (Powell et al. 2016. Peterson Field Guide to Reptiles and Amphibians of Eastern and Central North America. Fourth Edition. Houghton Mifflin Harcourt, Boston, Massachusetts. 493 pp.). We know of no published reports of endoparasites in *M. schotti* and hereby establish the initial helminth list for this species.

A sample of 21 *M. schotti* from Texas that were deposited in the Biodiversity Research and Teaching Collections, Texas A&M University (TCWC) was utilized in an endoparasite examination. The lower part of the body cavity was opened and was visually examined for helminths. Six of the *M. schotti* (mean SVL \pm SD: 875.7 \pm 164.1 mm; range: 650–1040 mm) contained round bodies (ca. 2 mm in diameter) encysted in coelomic mesenteries or the inner body wall. Each was removed with jewelers forceps cleared

in a drop of lactophenol on a glass slide, a cover slip was added and the preparation was studied utilizing a compound microscope. The prevalence was 29%. Infected snakes were: TCWC 48657 (Zapata County), 84334 (Kinney County), 87861 (Val Verde County), 92963 (McMullen County), 97721 (Jim Hogg County), and 103170 (Jim Hogg County).

All were identified as oligacanthorhynchid cystacanths on the basis of descriptions and illustrations given in Petrochenko (1958. *Acanthocephala of Domestic and Wild Animals*, Vol. 2. Izdatel'stvo Akademii Nauk SSSR, Moskva. 478 pp.). All acanthocephalans require an intermediate host (Kennedy 2006. *Ecology of the Acanthocephala*. Cambridge University Press, Cambridge, UK. 249 pp.). Members of the Oligacanthorhynchidae utilize larvae of insects living in soil as intermediate hosts (Petrochenko 1958, *op. cit.*). *Masticophis schotti* becomes infected by eating a prey item that has eaten an infected insect intermediate host. The cystacanth remains dormant in the snake (unsuitable host) until it is eaten by a carnivore definitive host in which development to the adult occurs. Cystacanths have been reported in numerous snake species, both in North America (Goldberg and Bursey 2000. *Herpetol. Rev.* 31:104; Goldberg and Bursey 2004. *Herpetol. Rev.* 35:400) and Central America (Goldberg and Bursey 2004. *Carib. J. Sci.* 40:62–69; Goldberg and Bursey 2005. *Texas J. Sci.* 57:103–106; Goldberg and Bursey 2007. *Phyllomedusa* 6:69–72). Voucher cystacanths were deposited in the Harold W. Manter Parasitology Laboratory (HWML), The University of Nebraska, Lincoln, Nebraska, USA (as HWML 110821). *Masticophis schottii* represents a new host record for oligacanthorhynchid cystacanths.

We thank Toby J. Hibbitts (TCWC) for permission to examine *M. schotti*.

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MASTICOPHIS SCHOTTI (Schott's Whipsnake). REPRODUCTION. *Masticophis schotti* ranges from south Texas, USA into Mexico (Powell et al. 2016. *Peterson Field Guide to Reptiles and Amphibians of Eastern and Central North America*. Fourth Edition. Houghton Mifflin Harcourt, Boston, Massachusetts. 493 pp.). Little information is available on reproduction of *M. schotti*. Reproduction is reported to occur in May, clutches of 3–12 eggs are deposited in June or July, and hatching in south Texas takes place in August (Vermersch and Kuntz 1986. *Snakes of South-central Texas*. Eakin Press, Austin, Texas. 137 pp.). In this note I report information on timing of events in the *M. schotti* testis cycle from a histological examination of *M. schotti* from Texas.

A sample of eight adult male *M. schotti* collected in Texas from 1958–2016 (mean SVL \pm SD: 967.9 \pm 103.6 mm; range: 760–1093 mm) deposited in the Biodiversity Research and Teaching Collections, Texas A&M University (TCWC) was examined by county: DeWitt (TCWC 67244), Frio (TCWC 63774), Jim Hogg (TCWC 97721), Karnes (TCWC 75313), McMullen (TCWC 92963, 92964), Starr (TCWC 63112), and Webb (TCWC 42361). The lower part of the body cavity was opened and the left testis and a piece of the vas deferens was removed and embedded in paraffin. Histological sections were cut at 5 μ m and stained by Harris hematoxylin followed by eosin counterstain. Histology slides are deposited at TCWC.

TABLE 1. Monthly stages in the testis cycle of eight adult *Masticophis schotti* from Texas, USA.

Month	N	Regressed	Recrudescence	Spermiogenesis
February	2	2	0	0
March	1	1	0	0
April	1	1	0	0
May	2	0	1	1
September	2	0	0	2

Three stages were recorded in the testicular cycle (Table 1): (1) Regressed: germinal epithelium is reduced to 1–3 layers of spermatogonia and interspersed Sertoli cells; (2) Recrudescence: renewal of germinal epithelium occurs for the next period of spermiogenesis. As compared to regressed testes, there is an increase in cellularity, consisting of primary and secondary spermatocytes; and (3) Spermiogenesis: lumina of the seminiferous tubules are lined by sperm or clusters of metamorphosing spermatids. The smallest mature male (spermiogenesis) measured 760 mm SVL (398 mm tail length) and was collected in May (TCWC 97721). All examined vasa deferentia contained sperm.

The presence of sperm in vasa deferentia of all examined *M. schotti* (February, March, April, May, and September) indicate breeding may occur in winter, spring, and summer although breeding has only been reported to occur in spring (Vermersch and Kuntz 1986, *op. cit.*). Thus, it appears *M. schotti* has the capacity for spring breeding utilizing stored sperm produced the previous autumn (aestival spermatogenesis *sensu* St. Girons 1982. *Herpetologica* 38:5–16) or the current spring, based on the one male exhibiting spermiogenesis in May (TCWC 97721).

I thank Toby J. Hibbitts (TCWC) for permission to examine *M. schotti*.

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MASTIGODRYAS MELANOLOMUS (Salmon-bellied Racer). DIET. *Mastigodryas melanolomus* is a moderately large diurnal snake (total length [TL] up to 150 cm) that inhabits the lowlands and premontane slopes on the Atlantic versant from Tamaulipas, Mexico, and on the Pacific versant from southern Sinaloa, Mexico, southward through Central America to Panamá (Campbell 1998. *Amphibians and Reptiles of Northern Guatemala, the Yucatán, and Belize*. University of Oklahoma Press, Norman, Oklahoma. 380 pp.). *Mastigodryas melanolomus* consumes mostly lizards, but small snakes, reptile eggs, frogs, nestling birds, small mammals (rodents and shrews), and insects have been reported in its diet (Lee 2000. *A Field Guide to the Amphibians and Reptiles of the Mayan World. The Lowlands of Mexico, Northern Guatemala and Belize*. Cornell University Press, Ithaca, New York. 402 pp.; Heimes 2016, *op. cit.*, and references therein; Platt et al. 2016. *Mesoam. Herpetol.* 3:162–170).

At 1306 h on 7 September 2018, Fredy Omar Blanco Valades collected an adult male *M. melanolomus* (662 mm SVL), which was killed by local villagers in La Presumida, municipality of José María Morelos, Estado de Quintana Roo, Mexico (19.79978°N, 88.75304°W; WGS 84). After dissection in the laboratory to determine stomach contents, the specimen was deposited in the Herpetological Collection of Museo de Zoología de El Colegio de la Frontera Sur (ECO-CH-H 4500). We recovered an intact *Tantilla canula* (95 mm TL, 76 mm SVL, 0.5 g;



FIG. 1. Prey items recovered from the stomach of *Mastigodryas melanolomus* collected in La Presumida, Quintana Roo, Mexico.

ECO-CH-H 4501) from the stomach (Fig. 1). To our knowledge this finding represents the first record of *T. canula* in the diet of *M. melanolomus*. Additionally, we found four partially digested anoles (probably *Anolis sagrei* and *A. rodriguezii*; Fig. 1). Lizards previously reported as prey of *M. melanolomus* include *Ameiva undulata* (= *Holcosus undulatus*), *Anolis* (= *Norops*) *limifrons*, *Anolis* (= *Norops*) spp., *Cnemidophorus* (= *Aspidoscelis*) *angusticeps*, *Sceloporus chrysostictus*, *Sceloporus teapensis*, and *Sphenomorphus* (= *Scinella*) *incerta* (Lee 1996. The Amphibians and Reptiles of the Yucatán Peninsula. Cornell University Press, Ithaca, New York. 500 pp., and references therein; Platt et al. 2016, *op. cit.*, and references therein), which further indicate that lizards are a major component in the diet of *M. melanolomus*. Indeed, Stafford and Meyer (2000. A Guide to the Reptiles of Belize. Academic Press, San Diego, California. 356 pp.) suggested that *M. melanolomus* was largely saurophagous.

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MICRURUS ALLENI (Allen's Coralsnake). **DIET.** *Micrurus alleni* is a relatively uncommon, moderate-sized elapid snake that subdues its prey with neurotoxic venom. It is known to feed primarily on swamp eels, *Synbranchus marmoratus*, though it has also been noted to consume lizards and fossorial snakes (Roze 1996. Coral Snakes of the Americas: Biology, Identification, and Venoms. Krieger Publishing, Malabar, Florida. 328 pp.; Savage



FIG. 1. *Micrurus alleni* preying upon *Urotheca decipiens* at Finca Bellavista, Puntarenas Province, Piedras Blancas, Costa Rica.

2002. The Amphibians and Reptiles of Costa Rica: A Herpetofauna between Two Continents, between Two Seas. The University of Chicago Press, Chicago, Illinois. 934 pp.; Solórzano 2004. Serpientes de Costa Rica. Instituto Nacional de Biodiversidad, San José, Costa Rica. 791 pp.). *Urotheca decipiens* (Long-tailed Litter Snake) is a fairly common small snake, noted to be active during the day on the forest floor (Savage 2002, *op. cit.*).

On 19 September 2018 at Finca Bellavista, Puntarenas Province, Piedras Blancas, Costa Rica (8.76362°S, 83.19675°W, WGS 84; 160 m elev.), we observed an *M. alleni* preying upon a *U. decipiens* from 2230 h to 2310 h (Fig. 1). We estimate both snakes to be ca. 1 m total length, although the *U. decipiens* was broader than the *M. alleni*. Upon further inspection, we noticed that the *U. decipiens* had been badly injured and its internal organs were exposed near where the *M. alleni* was biting it. However, the *U. decipiens* remained alive and reactive throughout the observation. The *M. alleni* was attempting to drag the *U. decipiens*, and during the encounter, the pair moved ca. 10–15 m into the leaf litter in the tall secondary rainforest. The observation occurred near a small creek, but both snakes were on dry land. To our knowledge, both snakes remained alive at the conclusion of the observation. Photos of this event have been deposited at the University of Michigan Museum of Zoology (UMMZ 1299–1301).

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NERODIA FASCIATA (Southern Watersnake). **DEFENSIVE BEHAVIOR.** Tail autotomy is present throughout the Squamata and has likely evolved numerous times (Arnold 1984. J. Nat. Hist. 18:127–169). Though most commonly recognized in lizards, forms of tail breakage are also prevalent in snakes,



FIG. 1. Radiograph of the detached tail of *Nerodia fasciata*, displaying anterior breakage as a result of a writhing escape attempt.

with documented representatives from three families and over 30 genera (Crnobrnja-Isailovic et al. 2016. North-West J. Zool. 12:367–372). Here I report an observation of tail autotomy in the natricine snake *Nerodia fasciata*.

At ca. 1700 h on 28 February 2018, in Collier County, Florida, USA, I captured an adult *N. fasciata* (61.5 cm SVL) by hand at the caudal end of its body anterior to the cloaca. As I pulled the snake from its location, my grip slipped down to the distal end of the cloaca. Upon re-establishing my grip, the snake began writhing intensely as it was lifted. Almost immediately, the distal 13 cm of the snake's tail broke off and the snake fell the ground. The snake was immediately recaptured and showed a small amount of initial bleeding that clotted within ca. 5 min of the breakage. The broken tail continued moving for ca. 45 min. The snake was released after documenting photos, while the broken tail was frozen and taken in for radiographs. The radiographs indicated a vertebral breakage which may have been intervertebral in nature (Fig. 1), which is likely due to intense writhing/movement when attempting to escape my grip.

Similar observations of tail autotomy have been made in closely related species (*N. erythrogaster*; *N. sipedon*, *T. sirtalis*, *T. sauritus*; Fitch 2003. Herpetol Rev. 34: 212–213; Hampton 2007. Herpetol Rev. 38:91; Todd 2010. Amphibia-Reptilia 31:213–215; Lockhart and Amiel 2011. Herpetol Rev. 42:296–297). In other *Nerodia* species, the breakage was either hypothesized or confirmed to be an example of pseudoautotomy used presumably as anti-predator tactic, as has been documented in other studies (Placyk and Burghardt 2005. Amphibia-Reptilia 26:353–358; Santos et al. 2011. Amphibia-Reptilia 32:375–383). Lockhart and Amiel (2011, *op. cit.*) confirmed that *N. sipedon* separate from their tails intervertebrally, which is likely the case in *N. fasciata* as well. It is likely that other congeners perform similar behaviors when threatened with predation, however further testing of the mechanism across natricine snake taxa is warranted to determine the evolutionary relevance and mechanism of this behavior.

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NERODIA ERYTHROGASTER (Plain-bellied Watersnake) and NERODIA FASCIATA (Southern Watersnake). DEATH FEIGNING. The genus *Nerodia* consists of 10 species that range across eastern and central North America. Gibbons and Dorcas (2004. North American Watersnakes: A Natural History. University of Oklahoma Press, Norman, Oklahoma. 438 pp.) summarized defensive behaviors of watersnakes and listed escape, flattening the head or body, striking/biting, and spraying musk, and mentioned (p. 202) that basking *Nerodia taxispilota* in Virginia and South Carolina have been reported not to respond when



FIG. 1. *Nerodia erythrogaster* (A, B) and *Nerodia fasciata* (C, D) feigning death.

touched by human observers, which has been interpreted as a “playing dead” behavior, lack of alertness, or sleeping. Here we report the first case of death-feigning behavior in *N. erythrogaster* and *N. fasciata* in response to human handling.

At 1843 h on 15 September 2018, an adult *N. erythrogaster* was observed near a path in Kelley's Pond Campground in Montgomery, Texas, USA (30.51034°N, 95.66197°W; WGS 84). After the initial capture, the *N. erythrogaster* was placed on the ground for photographs, at which point the snake spontaneously flipped over to reveal its venter (Fig. 1). After being gently righted, it again flipped onto its back in a manner highly reminiscent of death feigning in *Heterodon*. After several iterations of this, the *N. erythrogaster* was moved ca. 50 m back to the water's edge and released, whereupon it righted itself and returned to the water.

The observation of apparent death feigning in *N. fasciata* occurred under somewhat less-natural conditions. The *N. fasciata* was captured during a “rescue” call-out at 1043 h on 23 September 2018 near Spring, Harris County, Texas, USA (30.08342°N, 95.41622°W; WGS 84). It was captured on a homeowner's property for relocation and placed in a five-gallon white paint bucket for transportation. During capture, the *N. fasciata* struck and musked copiously. However, after being placed in the bucket, the *N. fasciata* flipped over, ventral side up, in the same manner as the *N. erythrogaster* described above (Fig. 1). Only after being removed from the bucket to a neighboring bayou did the *N. fasciata* right itself and escape to the water's edge.

Death-feigning behaviors are widespread across non-avian reptiles and have been observed in nearly all major groups of snakes (Gehlbach 1970. Herpetologica 26:24–34). Many snake species that invert their bodies defensively expose brightly colored (as seen in *N. erythrogaster*) or highly-contrasting (as seen in *N. fasciata*) ventral patterns. However, to our knowledge, these are the first recorded observations of death feigning in the genus *Nerodia* in response to human handling.

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OVOPHIS MONTICOLA (Mountain Pit-Viper). REPRODUCTION.

Ovophis monticola is reported from India, Nepal, Bangladesh, Bhutan, southern China, and Southeast Asia (Das and Das 2017. A Naturalist's Guide to the Reptiles of India, Bangladesh, Bhutan, Nepal, Pakistan and Sri Lanka. Prakash Books India Pvt. Ltd., New Delhi, India. 176 pp.), where it is commonly found around human settlements. Although there have been some reports on the natural history of this species, no studies have specifically documented nesting ecology and hatchlings (Das 2012. A Naturalist's Guide to the Snakes of South-East Asia including Malaysia, Singapore, Thailand, Myanmar, Borneo, Sumatra, Java and Bali. John Beaufoy Publishing [UK] Ltd., Oxford, UK. 160 pp.). A detailed study of natural history of *Ovophis monticola* by Tillack et. al (2002. Sauria 25:29–46) suggested that this species is terrestrial and nocturnal, favoring moist conditions at moderate altitudes. Females lay 5–18 eggs and guard their clutch for around two months. Herein, we briefly describe a field observation of nesting ecology and hatchlings of this species from Mizoram, northeastern India.

On 16 July 2016, we received a report of an *O. monticola* female guarding a nest in secondary forest area near a small rural village, Bualpui NG, Lawngtlai District, located in the southern part of Mizoram, India. The site was visited on 18 August 2016 and we noted that the nest was inside the clump of *Bambusa tulda* (22.33167°N, 93.02133°E; WGS 84; 1529 m elev.) in a mound of bamboo leaves and other debris measuring 140 mm in diameter and 50 mm in height (Fig. 1). A total



FIG. 1. Female *Ovophis monticola* with a mound of bamboo leaves and other debris.



FIG. 2. Eggs guarded by female *Ovophis monticola*.



FIG. 3. Female *Ovophis monticola* with hatchlings.

number of 9 eggs were guarded by the female coiling over them (Fig. 2). As the local people threatened to kill the female and destroy the nest, all the nesting materials, along with female and eggs were relocated to a terrarium at the Developmental Biology and Herpetology Laboratory, Department of Zoology, Mizoram University, Aizawl, Mizoram. They were incubated under natural conditions with temperature and humidity fluctuating between 24–26°C and 82–86%. The snake measured 700 mm total length (630 mm SVL; 70 mm tail length). We were able to measure length and width of 5 eggs: mean length (range) = 40.7 mm (36.3–45.8 mm) and mean breadth (range) = 26.3 mm (25.5–27.1 mm).

On 4 September 2016, 8 juveniles hatched out from their eggs successfully (Fig. 3). The remaining egg may have been unfertilized or infected by fungus. Mean (range) measurements of hatchlings (N = 8) were: SVL = 217.25 mm (210–230 mm), tail length = 36.5 mm (32–42 mm). Total lengths were much larger than 180–200 mm reported by Whitaker and Captain (2008. Snakes of India: The Field Guide. Draco Books, Chennai, India. 385 pp.). On 5 September 2016, hatchlings were released near Mizoram University campus, while the female was euthanized, preserved, and catalogued in the Departmental Museum of Zoology (MZMU 1013), Mizoram University as a voucher specimen for further studies.

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OXYRHOPUS TRIGEMINUS (Brazilian False Coral Snake). ENDOPARASITES. *Oxyrhopus trigeminus* is widely distributed in South America, throughout parts of Bolivia, Peru, and Brazil (Costa and Bérnils 2015. Herpetol. Brasil. 4:75–93; Uetz et al. 2018. <http://www.reptile-database.org>. 21 Feb 2018). Snakes are hosts of a wide variety of endoparasites, including nematodes, trematodes, cestodes, and pentastomes (Silva et al. 2005. Arq.

Bras. Med. Vet. Zootec 57:1–2; Silva et al. 2008. J. Venom. Anim. Toxins. 14:161–165; Ávila et al. 2013. Brazil. J. Biol. 73:645–647; Mati et al. 2015. Helminthologia 52:159–166). Several studies have examined helminthofauna of snakes from northeastern Brazil (Almeida et al. 2008. Brazil. J. Biol. 68:193–197; Almeida et al. 2007. Brazil. J. Biol. 67:759–763; Almeida et al. 2006. Brazil. J. Biol. 66:559–564; Araujo Filho et al. 2013. Herpetol. Rev. 44:43–43; Oliveira et al. 2015. Herpetol. Rev. 46:444; Carvalho et al. 2018. Helminthologia 55:281–285).

In December 2015, a female *O. trigeminus* (514 mm SVL, 105 mm tail length, 37 g) was found dead on a road in the mountain range of the municipality of Exu (7.5119°W, 39.7241°S; WGS 84), Pernambuco, Brazil. The collected specimen was taken to the laboratory of Zoology of the Universidade Regional do Cariri-URCA, where it was measured and fixed in 10% formaldehyde, and preserved in 70% alcohol, then deposited in the herpetological collection of the Universidade Regional do Cariri (as URCA H13. 520). The larval stage of a parasite identified as *Physaloptera* sp. was found in the large intestine of the *O. trigeminus*. Nematodes are the major endoparasites of the digestive tract of snakes, and *Physaloptera* is the genus most commonly found in snakes (Barbosa et al. 2006. Rev. Biol. Ciênc. Terra 6:1–19; Oliveira et al. 2018. Herpetol. Rev. 49:551). Nematodes of the genus *Physaloptera* use insects (e.g. crickets, locusts, cockroaches, and beetles) as intermediate hosts (Gray and Anderson 1982. Can. J. Zool. 60:2134–2142). Insects are important prey of lizards and birds, which are preyed upon by *Oxyrhopus* (Alencar et al. 2012. J. Herpetol. 46:9–13; Coelho et al. 2019. Phyllomedusa 18:89–96). The present study establishes the first record of the nematode *Physaloptera* sp. parasitizing *O. trigeminus*.

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PHILODRYAS CHAMISSONIS (Chilean Green Racer). NOCTURNAL ACTIVITY. *Philodryas* is a genus of rear-fanged snakes widely distributed in South America, and comprises 22 oviparous species (Grazziotin et al. 2012. Cladistics 1:1–23; Zaher et al. 2014. Zootaxa 3785:469–480; Cacciali et al. 2016. Salamandra 52:293–305). Among them, *P. chamissonis* is endemic to Chile and inhabits areas close to human settlements (Sallaberry-Pincheira et al. 2011. Divers. Distrib. 17:152–162), but whose natural history is scarcely known (Donoso-Barros 1966. Reptiles de Chile. Ediciones de la Universidad de Chile. 458 pp.). It has been described as a diurnal generalist predator that includes in its diet frogs, lizards, small mammals, and birds (Greene and Jaksic 1992. Rev. Chil. Hist. Nat. 65:485–493; Escobar and Vukasonic 2003. Not. Men. Mus. Hist. Nat. 352:18–20; Skewes et al. 2013. Bol. Chil. Ornitol. 19:30–31; Torres 2017. Bol. Chil. Herpetol. 4:21; Reyes-Olivares et al. 2017. Herpetol. Rev. 48:865–866).

On 12 November 2012, during fieldwork at Cuesta Lo Prado (33.4778°S, 70.9383°W; WGS 84; 688 m elev.), Santiago, Metropolitan Region, Chile, at 2200 h, we observed an adult *P. chamissonis* at the edge of an unpaved road (Fig. 1). This snake had no evidence of injuries or trauma and when one of the authors



FIG. 1. Nocturnal observation of *Philodryas chamissonis* specimen in the locality of Cuesta Lo Prado, Santiago, Metropolitan Region, Chile.

approached to photograph it, the snake fled, crossing the road with great agility. The temperature recorded for that day was of 30°C, no registration of nocturnal temperature was possible. To our knowledge, this is the first report of nocturnal activity in *P. chamissonis*.

Although *Philodryas* have been considered diurnal (e.g., Hartmann and Marques 2005. Amphibia-Reptilia 26:25–31; Lopez and Giraud 2008. J. Herpetol. 42:474–480; de Mesquita et al. 2011. Herpetol. J. 21:193–198), recent reports have described nocturnal mating and hunting activities for *P. olfersii* and *P. viridissima*, respectively (de Mesquita et al. 2012. Herpetol. Brasil. 1:41–42; Chávez-Arribasplata et al. 2016. Phyllomedusa 15:195–197). Given the current lack of nocturnal records of activity for *P. chamissonis*, a case of *P. chamissonis* predation on the marsupial *Dromiciops gliroides*, which has arboreal and nocturnal habits (Godoy-Güinao et al. 2018. Ecosphere 9:e02424), was previously considered as an opportunistic event (Muñoz-Leal et al. 2013. Brazil. J. Biol. 73:1–3). Consequently, our observation highlights the need for further studies of the ecology of *P. chamissonis*.

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PHILODRYAS OLFERSII (Vinesnake). DIET. *Philodryas olfersii* is a diurnal, semi-arboreal species (Marques et al. 2001. Snakes of the Mata Atlantica: An Illustrated Guide to the Serra do Mar. Holos Publisher, Ribeirão Preto. 184 pp.) with a widespread distribution in South America, from northern Brazil to northern Argentina in both open and closed-canopy habitats (Peters and Orejas-Miranda 1970. Catalogue of the Neotropical Squamata: Part I. Snakes. Smithsonian Institution Press, Washington, D.C. 347 pp.). Its diet includes small vertebrates such as mammals, anurans, birds, and lizards (Sobral and Mendes 2017. Herpetol. Rev. 47:687). Here we report a novel prey item for *P. olfersii*.

On the 14 March 2019, at 1100 h, we found a *P. olfersii* preying on a *Tropidurus hispidus* at Boa Vista, Roraima, Brazil (2.85023°N, 60.67607°W; SIRGAS 2000). The snake was constricting the lizard (Fig. 1A–C), which had also been bitten, injecting venom through the longitudinally grooved opisthoglyphous teeth (Vanzolini et al. 1980. Répteis das Caatingas. Academia Brasileira de Ciências, Rio de Janeiro. 104 pp.). The snake was



FIG. 1. Constriction of *Tropidurus hispidus* by *Philodryas olfersii*. A) Biting and constriction; B) constriction; C) *T. hispidus* abandoned by the snake and detail of the opisthoglyph dentition of *P. olfersii*.

subsequently disturbed, and it fled without consuming the lizard. We left the lizard there hoping that the snake would return to finish its meal. *Tropidurus hispidus* has a wide distribution, from Venezuela to southern Minas Gerais, Brazil (Vitt et al. 1996. J. Trop. Ecol. 12:81–101). Sympatric with *P. olfersii* in much of its range, it is one of the most abundant lizards (González et al. 2011. ACTA Biol. Colombia 16:121–134).

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PHILODRYAS NATTERERI (Paraguay Green Racer). DIET. *Philodryas nattereri* is a diurnal dipsadine snake, widely distributed in open South American landscapes and one of the most common species in the Caatinga domain from northeastern Brazil. Its feeding habits are considered generalist, with a diet containing lizards (Vitt 1980. Pap. Avul. Zool. 34:87–98), anurans (Guedes et al. 2018. Herpetol. Notes 11:825–828), birds (Mesquita et al. 2011. Herpetol. J. 21:193–198) and mammals (Mesquita et al. 2010. Herpetol. Rev. 41:96). Until now, there are only two records of ophiophagy for *P. nattereri*, both assumed to be incidental (Mesquita and Borges-Nojosa 2009. Herpetol. Bull. 108:36–37; Guedes 2017. Herpetol. Rev. 48:679–680). Herein, we report an additional case of tentative predation of snakes by *P. nattereri*.

The present record was made at Floresta Nacional de Açú (5.58181°S, 36.94536°W; WGS 84; 92 m elev.), municipality of Assu, state of Rio Grande do Norte, northeastern Brazil. At 1046 h on 8 October 2015, an individual *P. nattereri* was found subjugating an adult *Oxyrhopus trigeminus* (False-Coral). The *O. trigeminus* presented a marked bolus in the stomach region, revealing that had recently eaten. The *P. nattereri* was biting the *O. trigeminus* in the first third of its body and constricting it in three coils around the



FIG. 1. *Philodryas nattereri* consuming an *Oxyrhopus trigeminus* in Assu municipality, northeastern Brazil. A) Predator biting and constricting the prey; B) prey attempting to escape with erratic movements.

prey's body (Fig. 1). The *O. trigeminus* only tried to disentangle from the predator and did not bite in defense. The predator–prey interaction was interrupted by external observers that touched the snakes with a stick, which triggered the escape of both. The *O. trigeminus* escaped, apparently without major injuries.

Oxyrhopus trigeminus is also a widely distributed snake in Brazil, being similarly common in Caatinga domain as *P. nattereri* (Mesquita et al. 2013. Pap. Avul. Zool. 53:99–113). It is considered primarily terrestrial and nocturnal (Lima-Verde 1976. Caatinga 1:21–56). Snakes of the genus *Oxyrhopus* are not aggressive and have been recorded as prey of other snakes (Pinto and Lema 2002. Iheringia 92:9–19). However, *O. trigeminus* has not been recorded as prey of other snakes in the Caatinga (Vitt and Vangilder 1983. Amphibia-Reptilia 4:273–296; Mesquita et al. 2013, *op. cit.*). Our observation constitutes the third record of ophiophagous behavior for *P. nattereri*, revealing that the consumption of snakes by *P. nattereri* may be more frequent than previously assumed.

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PYTHON MOLURUS BIVITTATUS (Burmese python). DIET. Both *Python molurus bivittatus* and *Iguana iguana* are introduced, invasive reptiles in Florida, USA. These species have been established in southern Florida since the latter years of the twentieth century (Krysko et al. 2011. Zootaxa 3028:1–64). We herein document the first recorded observation of *P. molurus bivittatus* preying upon *I. iguana*.

At 0110 h on 28 December 2018, MLK captured and euthanized a *P. molurus bivittatus* (251 cm total length) in Rocky Glades Public Small Game Hunting Area, Florida (25.5314°N, 80.5653°W; WGS 84) during python hunting activities. While harvesting the skin of the python, MLK noticed a mass in the gut of the snake.

PHOTO BY MICHAEL L. KIMMEL



FIG. 1. *Iguana iguana* discovered in gut of *Python molurus bivittatus* in Florida, USA.

Further examination revealed the partially digested carcass of an adult *I. iguana* (Fig. 1). This is noteworthy as it not only represents a newly documented diet record by *P. molurus bivittatus* in Florida, but also a newly documented predator of *I. iguana* in Florida. It also is significant as it represents one invasive reptile consuming another invasive reptile in Florida.

In Bharatpur, India, *P. molurus molurus* have been noted to prey upon *Varanus bengalensis* (Bengal Monitor), a monitor of similar stature to *I. iguana* (Bhupathy et al. 2014. Herpetol. J. 24:59–64). Additionally, *I. iguana* are known prey of other large invasive constrictor snakes, such as *Boa constrictor* in Aruba (Quick et al. 2005. J. Herpetol. 39:304–308). With these instances known, a record of *P. molurus bivittatus* consuming *I. iguana* is novel, though not necessarily unexpected.

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RHABDOPHIS SUBMINIATUS SUBMINIATUS (Red-necked Keelback Snake). **DIET.** *Rhabdophis subminiatus subminiatus* is a known predator of anurans, previously having been documented feeding on *Duttaphrynus melanostictus* (Mohammadi and Hill 2012. Trop. Nat. Hist. 12:123–125), *Uperodon globulosus* (Shihan and Kabir 2015. Zoos' Print 30:21), and *Fejervarya* sp. (Rahman et al. 2012. Herpetol. Rev. 43:350). Here we report the first documented predation of a *Polypedates leucomystax* (Four-lined Treefrog) by *R. s. subminiatus*.

The predation event occurred at 1010 h on 13 February 2018 within the Sakaerat Research Station, Nakhon Ratchasima Province, Thailand (14.5100°N, 101.9304°E; WGS 84). The adult *R. s. subminiatus* had already captured the adult *P. leucomystax*

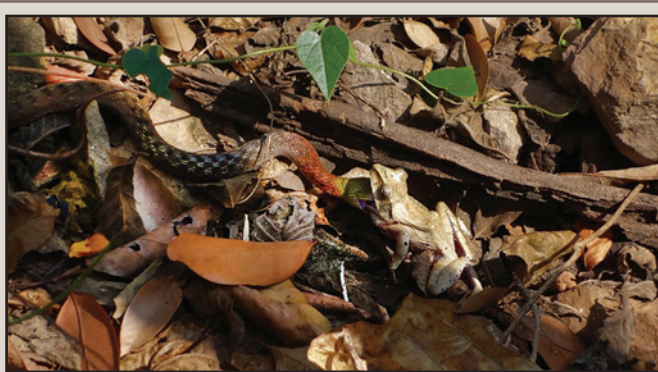


FIG. 1. *Rhabdophis subminiatus subminiatus* envenomating *Polypedates leucomystax*.

and was biting the frog's lower jaw to envenomate it (Fig. 1). The frog was observed vocalizing and kicking intermittently during this time. Seven minutes later the frog's movement ceased, and it appeared to be dead. The snake then repositioned its grip and consumed the frog headfirst over the following 4 min, finishing at 1024 h.

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SIAGONODON BORRICHIANUS (Degerbøl's Blindsnake). **PREDATION.** *Siagonodon borrichianus* (Leptotyphlopidae) occurs in the southern Monte Desert and northwestern Patagonian regions of Argentina (Ceï 1993. Reptiles del Centro, Centro Oeste y Sur de la Argentina. Herpetofauna de Zonas Áridas y Semiáridas. Monogr. IV Mus. Reg. Sci. Nat., Torino. 542 pp.; Fulvio-Pérez et al. 2010. Herpetol. Notes 3:65–67). Here we report a case of predation and the first record of *S. borrichianus* for Parque Provincial Ischigualasto, Departamento Valle Fértil, San Juan, Argentina (30.09779°S, 67.8336°W; SAD; 1331 m elev.). Two adult specimens of *S. borrichianus* were found in the fresh (<1 d old) regurgitate of a Pampas Fox (*Lycalopex gymnocercus*) along with two scorpions (*Timogenes* sp.), six cicadas (Cicadidae), bits of an unidentified lizard, numerous whole fruits/seeds of Chañar (*Geoffroea decorticans*), and blades of grass. Most of these food items had been chewed to varying degrees, but showed no obvious signs of chemical digestion, which facilitated their identification. Blindsnakes are infrequently encountered in nature because of their fossorial habits, but this species has also been reported in the diet other local vertebrates (e.g., toads; Quiroga et al. 2007. Herpetol. Rev. 38:208).

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THAMNOPHIS MARCIANUS (Checkered Gartersnake). **DIET.** *Thamnophis marcianus* feeds on a diverse group of prey, including earthworms, anurans, and fish (Ernst and Ernst 2003. Snakes of the United States and Canada. Smithsonian Institution, Washington, D.C. 668 pp.; Berkovitz and Shellis 2017. The Teeth of Non-Mammalian Vertebrates. Academic Press, London,



FIG. 1. *Thamnophis marcianus* ingesting a *Fundulus zebrinus* (Plains Killifish).

UK. 354 pp.). During a survey in the Natural Protected Area of Cañón de Santa Elena, on 14 October 2017, at the San Antonio Creek, Municipality of Manuel Benavides, Chihuahua, México (28.97561°N, 103.79011°W; WGS 84; 937 m elev.), at ca. 1000 h, a *T. marcinaus* (ca. 300 mm SVL) was found with a *Fundulus zebrius* (Plains Killifish) in its mouth (Fig. 1). The snake ingested the fish in ca. 5 min. *Fundulus zebrius* is considered an exotic and invasive species in México. It is now widespread and abundant in the Trans-Pecos region and may have impacts on native species that are yet to be seen (Miyazono and Taylor 2013. Southwest. Nat. 58:163–169). The role of *T. marcinaus* as a predator of *F. zebrius* warrants evaluation.

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THAMNOPHIS RADIX (Plains Gartersnake). SCAVENGING. *Thamnophis radix* exhibits a generalist feeding strategy and commonly preys upon amphibians and annelids, but occasionally also consumes fish, gastropods, small rodents, and carrion (Ernst and Ernst 2003. Snakes of the United States and Canada. Smithsonian Institution, Washington D.C. 668 pp.; Tuttle and Gregory 2009. J. Herpetol. 43:65–73). Anurans often are a major food source for *T. radix*, particularly in northern portions of its distribution (Tuttle and Gregory 2009, *op. cit.*). Herein, we describe the first observation of *T. radix* scavenging a road-killed anuran.

On 19 September 2017, we observed a *T. radix* scavenging a *Lithobates blairi* (Plains Leopard Frog) that had been killed by a motor vehicle on Highway 74 near Fairfield, Clay County, Nebraska, USA (Fig. 1; 40.4377°N, 98.1137°W; NAD83). The snake appeared injured as it thrashed around on the road, but we soon noticed it was attempting to dislodge a dead anuran adhered to the pavement. Previous observations of necrophagy by *T. radix* include accounts of unspecified carrion and consumption of a decomposed passerine (Platt et al. 2006. J. Kansas Herpetol. 20:10–19).

Snakes scavenging carrion from roadways has been documented fairly frequently (DeVault and Krochmal 2002. Herpetologica 58:429–436). Other observations of gartersnakes scavenging carrion from paved surfaces include a *T. proximus* (Western Ribbonsnake)

consuming an unidentifiable toad (Resetarits Jr. 1983. Herpetol. Rev. 14:75) and a *T. sirtalis* (Common Gartersnake) scavenging a passerine (Sajdak and Sajdak 1999. Herpetol. Rev. 30:229). Our observation further illustrates the generalist feeding strategy and versatility of *T. radix*, although the time and energy required to consume such food resources appears to be disadvantageous and may place the snake at risk of road mortality.

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THAMNOPHIS SIRTALIS (Common Garter Snake). REPRODUCTION. Many reports exist of mating behavior and strategies of *T. sirtalis* (Shine et al. 2005. Anim. Behav. 70:387–396), but fall mating has seldom been reported. On 4 October 2016, at ca. 1700 h, an aggregation of four Common Garter Snakes was observed in a large Burning Bush (*Euonymus alatus*) next to a small creek in Million Park off Tates Creek Rd in Richmond, Madison County, Kentucky, USA (37.74833°N, 84.30388°W; WGS 84). The cluster of snakes was 1.5–1.8 m off the ground and some individuals were exhibiting rhythmic body movements characteristic of mating behavior. Intertwining of the tails of a male and female was observed as the males were competing for the single female. One male positioned above the female was tongue flicking her on the back and appeared to have a hemipenis inserted (Fig. 1). Movements of observers caused the snakes to immediately begin disengaging from the mating ball. One male hanging down dropped directly into the small creek below (Fig. 1). The mating pair began to uncouple and the hemipenis became visible although the male continued to tongue flick the female and released a stream of saliva. Two of the snakes dropped to lower branches and then to the ground, while one snake remained in the tree for several minutes.

Arboreal mating balls in *T. sirtalis* may allow participants to more easily detect approaching predators as in this case. Most of the snakes dropped straight to the ground below allowing for a rapid escape from potential predators. This observation also confirms previous reports that this species may mate in late summer and early fall (Fitch 1980. Cat. Am. Amph. Rept. 270:1–4; Mitchell 1994. The Reptiles of Virginia. Smithsonian Institution Press, Washington, D.C. 352 pp.). Fall mating in this species may occur more often than realized as small groups of snakes gather prior to hibernation.

PHOTO BY KEITH GELUSO



FIG. 1. *Thamnophis radix* (Plains Gartersnake) scavenging remnants of a road-killed *Lithobates blairi* (Plains Leopard Frog) in Clay County, Nebraska, USA.

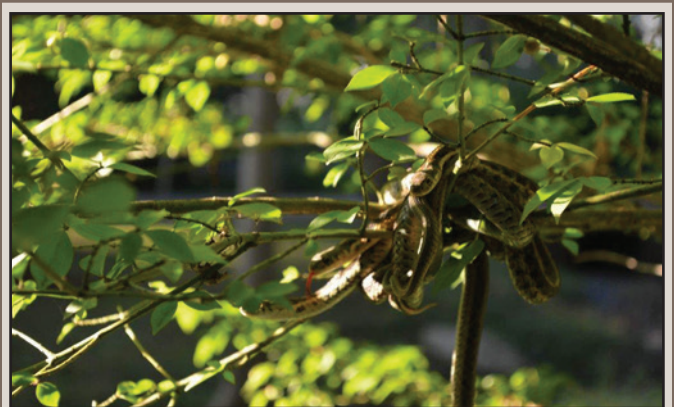


FIG. 1. Mating ball consisting of four *Thamnophis sirtalis*. Mating appears to be occurring due to rhythmic motions of snakes. The pair at the left of photo are mating. The male is above the female and tongue-flicking on her back. Posterior ends of two snakes are intertwined with hemipenis inserted.

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THAMNOPHIS SIRTALIS INFERNALIS (California Red-Sided Gartersnake). SCAVENGING. Despite the prevalence of the behavior in captive settings, natural observations of snakes consuming carrion are not commonly reported (DeVault and Krochmal 2002. *Herpetologica* 58:429–436). Observations of scavenging were initially assumed to be most common in pit vipers, although recent observations are challenging this assumption (Ayres 2012. *Acta Herpetol.* 7.1:171–174; Ucha and Santos 2017. *Herpetol. Notes* 10:439–441). It has been postulated that aquatic or semi-aquatic snakes may be the most likely to perform scavenging behavior, perhaps as a result of the increased frequency of encountering carrion (Sazima and Strüssman 1990. *Rev. Brasil. Biol.* 50:463–468). Here we present another instance of natural scavenging behavior, observed in a colubrid species often associated with water.

We encountered a neonate *Thamnophis sirtalis infernalis* as it began to eat a dead, newly metamorphosed *Rana boylei* (Foothill Yellow-legged Frog) on the banks of the Mad River in Humboldt County, California, USA (40.764°N, 123.88909°W; WGS 84) at 1540 h on 31 August 2017. The snake was initially observed just as it began to manipulate the shriveled frog into a favorable position in order to swallow the prey item, and we watched this process for about 20 min until the frog was nearly fully swallowed. The frog was visibly desiccated (Fig. 1) and the snake itself appeared to be dry, indicating that the *T. s. infernalis* had found the frog outside of water. To our knowledge, this is the first reported case of scavenging documented in this subspecies of *T. sirtalis*. The water levels in many of the locations where *R. boylei* (and other amphibians) breed in can be seasonally dynamic. Amphibian mortalities as a result of drying edgewater pools of rivers in the late summer and early fall may represent important opportunistic chances for young *Thamnophis* to feed prior to the winter.

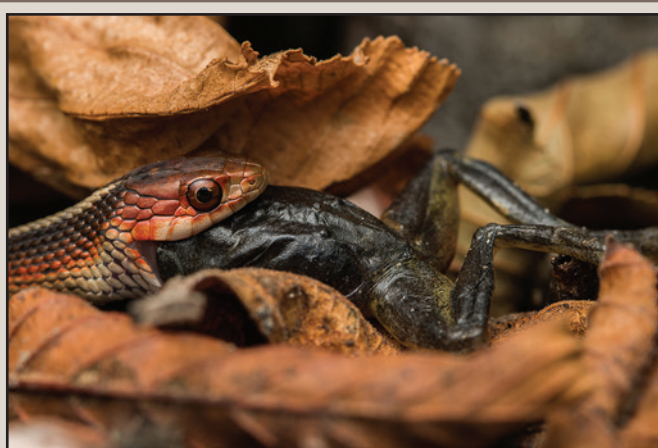


FIG. 1. *Thamnophis sirtalis infernalis* consuming dead *Rana boylei*.

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XENOCHROPHIS VITTATUS (Striped Keelback). DIET and DISTRIBUTION. *Xenochrophis vittatus* is native to Indonesia and was documented from northeastern Puerto Rico, USA, in 2011, which is the first record from the Western Hemisphere (Herrera-Montes et al. 2015. *Herpetol. Rev.* 46:64). At ca. 1600 h on 11 February 2017, we found two adult *X. vittatus* underneath a steel panel laying on the ground in a trail of a former blockhouse (18.431°N, 66.208°W; WGS 84) in the critical habitat (palustrine-herbaceous wetland) of the critically endangered *Eleutherodactylus juanariveroi* (Puerto Rican Plains Coquí) in Sabana Seca, Municipality of Toa Baja, Puerto Rico. One snake was collected (MZUPRRP-R-001508) and was in the process of ecdysis (285 mm SVL, 92 mm tail length, 9.4 mm head width).

On 24 February 2018, three adult individuals were found retreated under the same steel panel, and all three individuals were collected for examination of gut contents. One individual (a male in non-reproductive condition; 265 mm SVL, 95 mm tail length, 11 g) had the hind limbs of a different but undetermined *Eleutherodactylus* sp. in its stomach. A second individual (a male in reproductive condition, enlarged epididymis; 415 mm SVL, 35 mm tail length, 35 g) had the remains of the skin of an individual of the White-lipped Frog (*Leptodactylus albilabris*) in its intestinal tract. The third individual (a male in non-reproductive condition; 340 mm SVL, 120 mm tail length, 24 g) had empty stomach and intestines. On 8 October 2018, at ca. 1100 h, an adult individual (undetermined sex, not collected) was seen crossing the main road (Red Man Road; 18.433°N, 66.201°W; WGS 84) within this wetland. These observations indicate a first record and the establishment of *X. vittatus* in the critical habitat of *E. juanariveroi*, which also harbors populations of other species of amphibians (in decreasing order of relative abundance: *E. brittoni*, *E. coqui*, *E. cochranae*, *L. albilabris*, *Lithobates grylio*, *Osteopilus septentrionalis*, and *Lithobates catesbeianus*; *E. antillensis* [common] and *Rhinella marina* [rare] occur at the margins of this wetland).

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