NATURAL HISTORY NOTES

CAUDATA — SALAMANDERS

***AMBYSTOMA CALIFORNIENSE* (California Tiger Salamander). PREDATION.** There appears to be a scarcity of published information of predation on *Ambystoma californiense* (Petranka 1998. Salamanders of the United States and Canada, Smithsonian Institution Press, Washington, D.C. 587 pp.). Baldwin and Stanford (1987. Herpetol. Rev. 18:33) reported that a *Rana draytonii* (California Red-legged Frog) fed upon *A.californiense* larvae. More recently, Allaback et al. (2005. Herpetol. Rev. 36:50) noted an *A. californiense* larva consumed from a stock pond by *Sterna forsteri* (Forster's Tern). Allaback et al. (2005, *op. cit.*) also observed *A. californiense* consumed from a shallow seasonal pool by *Recuvirostra americana* (American Avocet). Although this salamander species is undoubtedly predated by other species of wildlife, the bulk of our understanding of such is based on speculation. We report here a new avian species preying upon *A. californiense* larvae.

While conducting dip-netting surveys as part of general amphibian surveys at the Carnegie State Vehicular Recreation Area, west of Tracy, California, USA, we commonly encountered *A. californiense* in silt-detention basins and cattle stock ponds. We surveyed Tyson Pond (37.63381°N, 121.55669°W; WGS 84), which is a constructed silt-detention basin upstream from Corral Hollow Creek. The pond's primary function is to catch sediment created by off-highway vehicle use before the silt can reach the creek. The pond is generally very to completely turbid, often exceeding 2000 NTU (Nephelometric Turbidity Units). At the time of our visit, silt loads were at least 1.5 m deep, leaving approximately 1 m of water in the basin. The pond was surrounded by *Artemisia californica* (California Sagebrush), *Lepidium latifolium* (Perennial Pepperweed), and a single mature *Populus fremontii* (Fremont Cottonwood). It featured a standpipe that can protrude 15–120 cm above the water line, depending on the season. On 4 May 2015, while approaching Tyson's Pond in a vehicle, we observed a *Ceryle alcyon* (Belted Kingfisher) alight on the standpipe, which at that time offered a perch ca. 1 m above the water surface. After perching in that position for about 5 sec, the bird flew swiftly (in less than 0.5 sec) down to the pond surface and seized a larval *A. californiense* that had surfaced to breathe. The kingfisher immediately returned to the standpipe, where it briefly adjusted its grasp on the salamander, then flew away from the pond with the prey item.

Our observation, although a single event, suggests that an additional avian predator, *C. alcyon*, will consume *A. californiense*, even within very turbid pools. We contend that the placement of standpipes, and other potential perches, in ponds that are known to have special-status amphibians should include some form of avian deterrent (Dura-Spike®, Bird-Flite®, or other metal-wire spike device) to discourage birds from alighting. This measure would reduce the effectiveness of the kingfisher's (or other perching predatory bird's) predation on surfacing larvae by increasing the distance from which it could attack.

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***DESMONATHUS MONTICOLA* (Seal Salamander). DIET.** On 9 June 2020 I encountered an adult *Desmognathus monticola* actively feeding on a living periodical cicada (*Magicicada* sp.) at 2358 h. This salamander was found on open rock next to Pipestem Creek in Summers County, West Virginia, USA (37.54788°N, 80.95960°W; WSG 84). I observed the salamander bite and shake the injured cicada before I disturbed the salamander, and it released the cicada. The documentation of periodical cicadas as a food source for many vertebrates is well known (Reid and Nichols 1970. Bull. Maryland Herpetol. Soc. 6:57) but not well documented in salamanders. The diet of *D. monticola* is known to include insects in the order Hemiptera, which includes cicadas, but it does not constitute a large percentage (Felix and Pauley 2006. Northeast Nat. 13:469–476). This observation has implications on the direct effect periodical cicada emergences have on salamander populations.

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ANURA — FROGS

***BOANA PUNCTATA* (Polka-Dot Treefrog). ANOPHTHALMIA.** Vision is important for anurans in detecting their environment, locating breeding sites, identifying mates and detecting prey (Duellman and Trueb 1994. Biology of Amphibians. John Hopkins University Press, Baltimore, Maryland. 670 pp.). Among the ocular anomalies that affect anurans, anophthalmia is characterized by the absence of one or both eyes (Henle et al. 2017. Mertensiella 25:9–48). This anomaly can impair reproductive activity, visual communication, foraging strategy, and consequently affect body condition (Tolledo and Toledo 2015. J. Zool. 296:167–176). In anurans, behavioral responses to predators are specializations of the left eye/right hemisphere system and the absence of part of this system can contribute to the inefficiency of these interactions (e.g., escape behavior; Robins 2006. *In* Malashichev and Deckel [eds.], Behavioral and Morphological Asymmetries in Vertebrates, pp. 86–106. Landes Bioscience, Georgetown, Texas).

On 16 October 2018 during an active search, a post-metamorphic juvenile *Boana punctata* (17 mm SVL) with anophthalmia in the left eye was found on a farm in the Municipality of Palotina, Paraná, southern Brazil (24.34778°S, 53.74694°W; WGS 84; 318 m elev.), where agricultural, livestock and aquacultural activities occur. The specimen was collected (ICMBio License no. 48465-3) and deposited in the herpetological collection of the Museum of Natural History of Capão da Imbuia (MHNCI-11018) (Fig. 1). This is the first report of an anomaly in

Fig. 1. *Boana punctata* with anophthalmia in the left eye from Paraná, Brazil.

B. punctata; however, ocular anomalies have been reported in other South American hylids, including unilateral anophthalmia in *Lysapsus bolivianus*, *Scinax fuscovarius* (Sousa and Costa-Campos 2017. Herpetol. Notes 10:413–415), and *Dendropsophus luddeckei* (Cortés-Suárez 2018. Rev. Latinoamericana Herpetol. 1:53–54) and bilateral anophthalmia in *Boana fasciatus*, *Osteocephalus leprieurii* (Ramalho et al. 2017. Herpetol. Bull. 139:43–44), and *Boana faber* (Brassaloti and Bertoluci 2018. Phyllomedusa 17:285–288).

Although the origin of anophthalmia in anurans is unknown, exposure to chemical pollutants, ranavirus infection, and hybridization are considered possible causes (see references in Mônico et al. 2019. Neotrop. Biol. Conserv. 14:213–220). Among the reports cited, anurans with anophthalmia were found in places with agricultural and livestock activities and in preserved and fragmented forests, which makes isolating causal factors difficult. We recommend the monitoring of anuran populations at different life stages and behavioral studies in order to assess the effects of anophthalmia in relation to normal conspecifics.

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***DENDROPSOPHUS MINUSCULUS* (Rivero's Tiny Treefrog). AGONISTIC INTERACTION.** Intraspecific interactions are frequently observed in frogs because males need to perform a variety of acoustic behaviors and visual displays to attract females and establish territories (Wells 2007. The Ecology and Behavior of Amphibians. University of Chicago Press, Chicago, Illinois. 1148 pp.; Brasileiro et al. 2020. Acta Ethol. 23:51–60). Territorial behaviors have been reported for some hylids, including *Dendropsophus* spp. (Miranda et al. 2008. Pap. Avul. Zool. 48:335–343; Brasileiro et al. 2020, *op. cit.*; Vaz-Silva et al. 2020. Guia de Identificação das Espécies de Anfíbios (Anura e Gymnophiona) do Estado de Goiás e do Distrito Federal, Brasil Central. Soc. Bras. Zoo. Curitiba, Brazil. 223 pp.). Nevertheless, we present the first record of an agonistic intrasexual interaction in *Dendropsophus minusculus*.

Fig. 1. Agonistic interaction in *Dendropsophus minusculus* in a restinga environment of the Environmental Protection Area Delta do Parnaíba, northeastern Brazil.

On 28 January 2016 around 2235 h we observed two *D. minusculus* (1.78 cm SVL, 0.2 g; second individual not collected) in a territorial fight in a restinga environment at Parnaíba River Delta, Ilha Grande Municipality, Piauí, northeastern Brazil (2.5419°S, 41.4827°W; WGS 84; 5 m elev.). We used the advertisement calls and morphology to identify the frogs as *D. minusculus* (Rivero 1971. Caribb. J. Sci. 11:1–9; Zina et al. 2014. J. Biol.74:146–153). A voucher specimen was deposited in The Zoological Collection of Universidade Federal do Piauí (CZDP [I1] 0472). The two *D. minusculus* males were calling from different branches emerging from the water; thereafter, they started to emit aggressive calls and visual signals culminating in a physical confrontation. The two *D. minusculus* tried to topple each other with kicking movements. Finally, the biggest treefrog ousted the smaller one, remaining in the area of dispute, and emitting post-fight vocalizations (Fig. 1). Although morphological parameters do not appear to influence success in physical disputes in some treefrogs (Brasileiro et al. 2020, *op. cit.*), detailed studies of the relationships between acoustic and morphological traits and fight success in anurans are needed.

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DENDROPSOPHUS RHODOPEPLUS **(Red-skirted Treefrog). CLOACAL PROLAPSE.** Although many studies have investigated cases of chytridiomycosis, mycobacteriosis, ranavirus, and trematodiasis in amphibians (Sallés et al. 2020. Clin. Vet. Peq. Anim. 40:15–27), other threats to the health of amphibians are scarcely documented. *Dendropsophus rhodopeplus* is a nocturnal and arboreal frog that dwells in vegetation under 2.5 m in height. It is found in swamps, and its distribution includes the southern Amazon region of Colombia, Ecuador, Peru, Brazil, and northern Bolivia (Valencia and Garzón 2011. Guía de Anfibios y Reptiles en Ambientes Cercanos a las Estaciones del OCP. Fundación Herpetológica Gustavo Orcés, Quito, Ecuador. 268 pp.). In this note we report a case of cloacal prolapse in *D. rhodopeplus*.

On 13 January 2018 at 1927 h, at Samona Yuturi Community, Capitán Augusto Rivadeneira Parish, Aguarico Canton, Orellana Province, Ecuador (0.66591°S, 81.96238°W; WGS 84; 216 m elev.), in a secondary swamp forest, we observed an adult *D. rhodopeplus* lying on a leaf (ca. 80 cm from the ground) (Fig. 1).

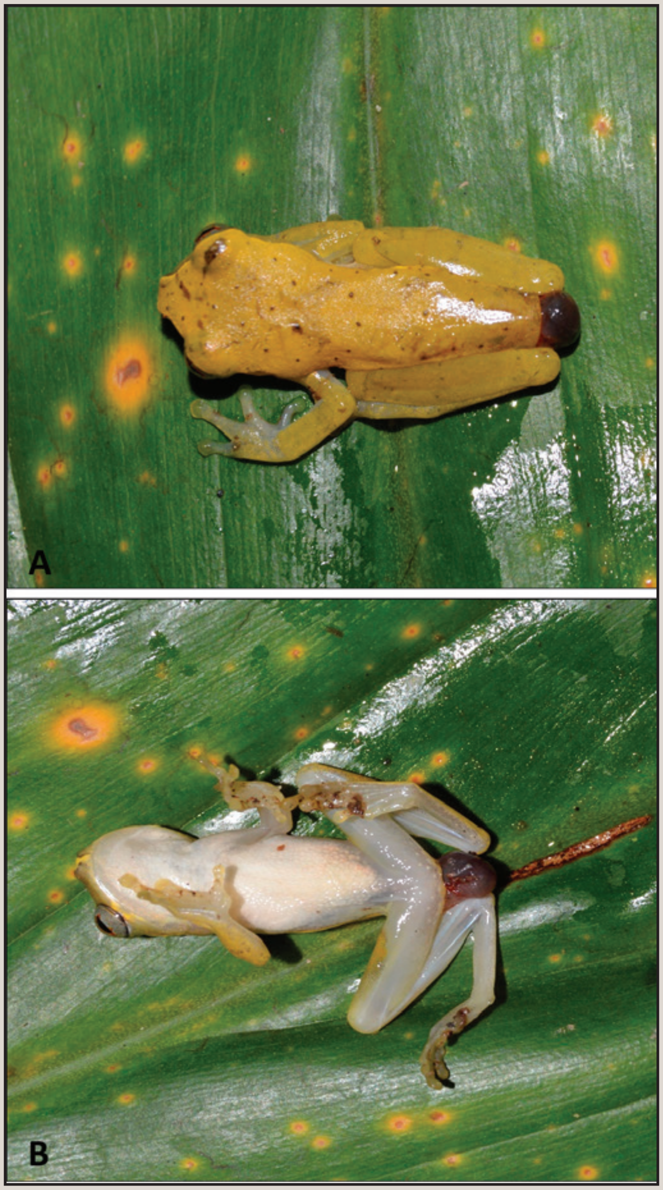

Fig. 1. Dorsal (A) and ventral (B) view of *Dendropsophus rhodopeplus* with cloacal prolapse.

This individual presented a conspicuous reddish abnormality on its cloaca, known as a prolapse. This condition is often present due to underlying pathologies such as gastroenteritis, peritonitis, neoplasia, parasitism, ingestion of foreign bodies, retained eggs, or gastrointestinal issues (Bertelsen and Crawshaw 2003. Exotic DVM. 5:23–26). Considering that cloacal prolapse is not an infrequent issue for amphibians (Poll 2009. J. Exot. Pet Med. 18:20–35), and that this condition could cause tissue edema and devitalization in affected individuals (Gibbons 2007. Proc. Assoc. Rept. Amphib. Vet. 69–86), reporting these observations is key to gaining knowledge about the occurrence of these types of events. Likewise, more detailed studies evaluating the impact of this condition at the population level could be important for conservation purposes.

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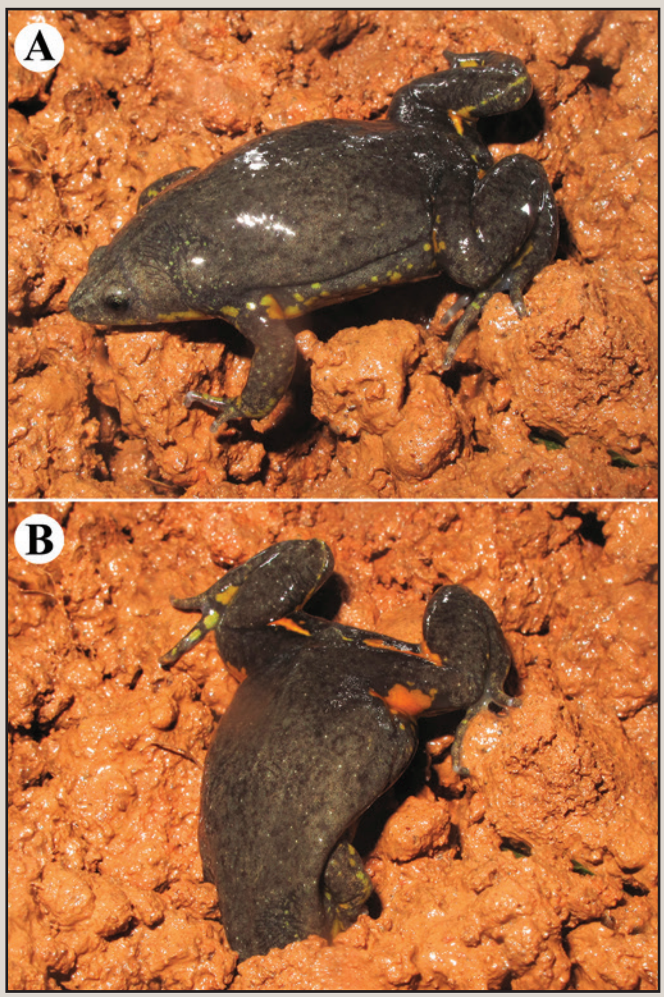
***ELACHISTOCLEIS CESARII*.** **BURROWING BEHAVIOR.** *Elachistocleis cesarii* is a species of South American narrow-mouthed frog (Microhylidae, Gastrophryninae) with fossorial habits. The



PHOTOS BY JOÃO F. R. TONINI

Fig. 1. A) *Elachistocleis cesarii* from Espírito Santo, Brazil; B) displaying snout-head-first burrowing behavior.

species ranges from southeastern to central Brazil (Toledo et al. 2010. Zootaxa 2418:50–60). On 4 June 2020, in the Municipality of São José do Calçado, Espírito Santo, Brazil (21.00074°S, 41.6457°W; WGS 84), we collected a juvenile *E. cesarii* during fieldwork. We placed the *E. cesarii* in a plastic container with soil obtained from the locality where it was found (Fig. 1A). The specimen was left undisturbed in the container and after a few seconds it exhibited snout-head-first burrowing behavior (Fig. 1B). The individual placed its head down into the soil, raised its body by stretching the rear limbs, and pushed its body downwards with help of the hind limbs until it was completely covered with soil. This is the second species in the genus known to perform this burrowing behavior, previously described only for *E. bicolor* (Nomura et al. 2009. J. Ethol. 27:195–201).

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ELEUTHERODACTYLUS NITIDUS **(Shiny Peeping Frog). HABITAT and NESTING.** *Eleutherodactylus nitidus* is a small frog endemic to Mexico. It ranges from Oaxaca to Sonora through the Sierra Madre Occidental and into the states of México, Puebla, Morelos, Tlaxcala, and Hidalgo in central Mexico (García-Vázquez and Trujano-Ortega 2012. Rev. Mex. Biodivers. 83:856–858; Lemos-Espinal and Dixon 2016. Amphibians and Reptiles of Hidalgo. CONABIO, Tlalpan, Ciudad de México. 80 pp.). According to vulnerability established through the Environmental Vulnerability Score (EVS), *E. nitidus* classifies as a species with medium vulnerability (Wilson et al. 2013. Amphib. Rept. Conserv. 7:97–127). The IUCN Red List, however, classifies this frog as a species of Least Concern. *Eleutherodactylus nitidus* has been observed inhabiting rock canyons, forest streams, coastal tropical scrub, under debris and other anthropogenic materials left within rural areas, and even next to a tollbooth in exurban habitats (García-Vázquez and Trujano-Ortega 2012, *op. cit.*; Bolaños-Gutiérrez 2013. Bachelor Thesis, Universidad Nacional Autónoma de México, Los Reyes Iztacala, Mexico. 85 pp.; Lemos-Espinal and Dixon 2016, *op. cit.*). Nevertheless, it has not been observed in habitats highly perturbed by humans.

We present, for the first time, an observation of *E. nitidus* in a city (population: 35,500) during the rainy season and an additional observation of *E. nitidus* within its natural habitat that includes the largest clutch size reported for this species. On 27 May 2016, we found a female (Fig. 1A) in Ixtapan de la Sal, Estado de México, Mexico, within a high-traffic urban landscape (18.84278°N, 99.68083°W; WGS 84; 1800 m elev.; Fig. 2). The urban yard was surrounded by houses with an asphalt road and was composed of grass, limestone bundles, and adorned with ornate shrubs and trees of the genera *Cupressus* and *Jacaranda*. This urban habitat presented several conditions that could affect amphibian survivorship, such as permanent human presence, domestic animals, impervious surfaces, and higher temperatures when compared to neighboring natural habitat. We observed no other species of amphibians in the area, however, other herpetofaunal

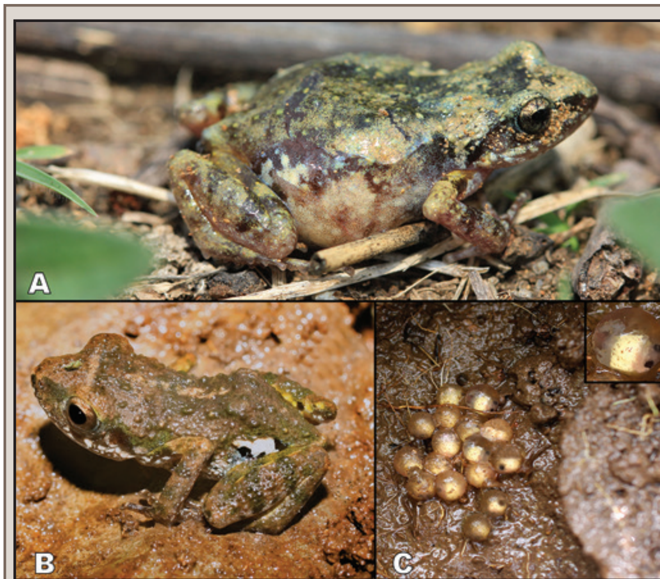

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FIG. 1. A) *Eleutherodactylus nitidus* female observed in an urban habitat in the State of México, Mexico. B) Male protecting a nest. Note that the mature male is smaller than the female; C) Nest with 16 eggs on a muddy surface. 1A)

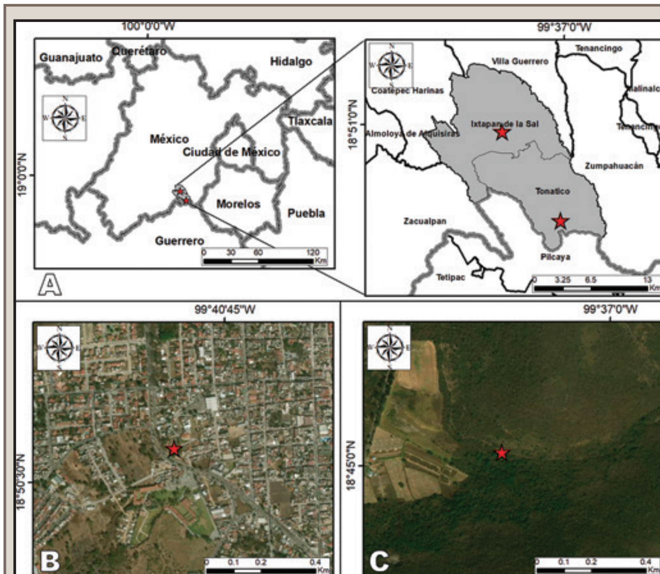

FIG. 2. A) Tonatico and Ixtapan de la Sal locations within the State of Mexico. B) Satellite image of the urban habitat in which a female was observed in Ixtapan de la Sal. C) Satellite image of the wild habitat in which a male and a nest were observed in Tonatico. Both satellite images were obtained from Esri, DigitalGlobe, Geoeye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS user community database from February 2017.

taxa were present (e. g., *Aspidoscelis*, *Sceloporus*, and *Urosaurus*). The behavior of *E. nitidus* within this urban setting was similar to that reported from natural habitats. *Eleutherodactylus nitidus* were located under rocks in both habitats, which is a common behavior for this frog in order to escape detection and avoid desiccation (Canseco-Márquez and Gutiérrez-Mayen 2010. Anfibios y Reptiles del Valle de Tehuacán-Cuicatlán. CONABIO, Tlalpan, Ciudad de México. 52 pp.). This finding suggests that *E. nitidus* can inhabit human settlements when cover is available, despite the general rule that urbanization promotes amphibian species decline due to habitat loss (McKinney 2002. Bioscience 52:883–890).

Within the more traditional natural setting, a male protecting a nest was observed beneath a rock (Fig. 1B, C) in a tropical deciduous rainforest at Tonatico, Estado de México, Mexico (18.75044°N, 99.62025°W; WGS 84; 1597 m elev.; Fig. 2A, C) on 22 August 2010. The nest contained 16 eggs (Fig. 1C), which to our knowledge is the largest clutch size reported for this species. The nest characteristics were similar to what has been described in the literature including the location beneath a rock, above wet soil, surrounded by vegetation, and protected by a male (Martín del Campo 1940. An. Inst. Biol. 11:745–746; Palacios-Aguilar 2018. Rev. Lat. Herpetol. 1:51–53). Finally, we note that in another nest nearby two frogs were observed facing each other with the eggs (N = 13) located between them. Unfortunately, the photograph (not included here) is of poor quality and the sexes of frogs could not be determined. However, we suspect they were males guarding the eggs as previously described by Palacios-Aguilar (2018, *op. cit.*) for *E. nitidus*.

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***EUPHLYCTIS CYANOPHLYCTIS* (Indian Skipping Frog). DIET.** *Euphlyctis cyanophlyctis* is nocturnal and diurnal with a distribution ranging throughout southern Asia. The diet of this species is described as consisting mostly of insects (Ahmed et al. 2009. Amphibians and Reptiles of Northeast India. A Photographic Guide. Aaranyak, Guwahati, India. 169 pp.). At 1630 h on 26 May 2020, in a paddy field utilized for agri-aquaculture in Zotlang, Champhai, Mizoram, India (23.45513°N, 93.33320°E; WGS 84; 1300 m elev.), an adult *E. cyanophlyctis* (42.67 mm SVL) was observed preying on a *Cyprinus carpio* (Common Carp) fingerling (ca. 32.48 mm total length). The frog ambushed the fingerling, bit it on the head (Fig. 1) and swallowed it in ca. 2 min. The frog was later dissected, and the gut contained three fresh *Cyprinus carpio* fingerlings. *Euphlyctis cyanophlyctis* is known to feed on other fishes such as *Danio aequipinnatus*, *Garra gotyla stenorhynchus*, *Telapia mossambica*, *Chela maubuka*, *Rasboria daniconius*, and *Amblyphrayngodon mola*. Their diet also includes juvenile anurans (*Duttaphrynus melanostictus* and *Euphlyctis* spp.; Hossain 2015. J. Asiat. Soc. Bangladesh Sci. 41:7–17). This is the first report of *E. cyanophlyctis* feeding on *Cyprinus carpio*.

Fig. 1. Adult *Euphlyctis cyanophlyctis* preying on a *Cyprinus carpio* fingerling in Mizoram, India.

This work was conducted under permission for herpetofaunal collection throughout Mizoram No. A.33011/2/99-CWLW/225 issued by the Chief Wildlife Warden, Environment, Forest and Climate Change Department, Government of Mizoram, India.

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***ISCHNOCNEMA ABDITA*. CLUTCH SIZE.** The Neotropical brachycephalid genus *Ischnocnema* of ground-dwelling and direct developing anurans is divided into five species series. The *Ischnocnema verrucosa* series is currently composed of eight species: *I. abdita*, *I. bolbodactyla*, *I. juipoca*, *I. karst*, *I. octavioi*, *I. penaxavantinho*, *I. surda*, and *I. verrucosa* (Canedo and Haddad 2012. Mol. Phylogenet. Evol. 65:610–620). There are few available studies providing information regarding clutch size and amplexus for the *I. verrucosa* species series (e.g., Lirio et al. 2018. Herpetol. Rev. 49:302–303). Herein, we provide information on the clutch and the amplexus of *I. abdita*, a leaf litter species that occurs in Espírito Santo and Minas Gerais, Brazil.

Two individuals were found in amplexus on the leaf litter during nocturnal visual encounter surveys in the Monumento Natural Serra das Torres, located in the Municipality of Mimoso do Sul, Espírito Santo, Brazil (21.03391°S, 41.26085°W; WGS 84;

Fig. 1. Female (left) and male (right) *Ischnocnema abdita* after amplexus from Espírito Santo, Brazil.

Fig. 2. Female *Ischnocnema abdita* and clutch of nine eggs.

760 m elev.). The encounter occurred at 1700 h on 10 February 2018, after a day of light rain and high humidity. We did not photograph the amplexus (Fig. 1), however, the male was on top of the female similar to that reported for *I. lactea* by Silva-Soares et al. (2018. Zootaxa 4444:137–153). The amplectant pair of *I. abdita* was collected and placed inside a plastic bag with moist leaf litter. The following morning, upon opening the bag, we noticed the female had deposited eggs. Nine ivory-white eggs were laid (Fig. 2), a number similar to what has been found in other species in this series (*I. verrucosa*: 10 eggs; Lirio et al. 2018, *op. cit.*; *I. juipoca*: 15 (SD = 4) eggs; Giaretta and Facure 2008. Contemp. Herpetol. 2008:1–4). The clutch structure was a clump made up of a mult-itiered stack of eggs, lacking a common surrounding matrix, with interstices between the eggs, and with distinct adherent adjacent jellies (Altig and McDiarmid 2007. Herpetol. Monogr. 21:1–32), as in other *Ischnocnema* (e.g., *I. verrucosa*, Lirio et al. 2018, *op. cit.*). Available information regarding the natural history of *I. abdita* is scarce, and this is the first report on the clutch and amplexus in this species.

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***ITAPOTIHYLA LANGSDORFFII* (Ocellated Treefrog). ANOPHTHALMIA.** Vision is an important sense used by anurans to detect prey and when absent can impair feeding behavior and visual communication (Nishikawa 2000. *In* Schwenk [ed.], Feeding: Form, Function, and Evolution in Tetrapod Vertebrates, pp. 117–144. Academic Press, San Diego, California; Toledo and Toledo 2015. J. Zool. 296:167–176). Impairments in these biological activities can affect anuran reproduction due to higher energy expenditure while attracting mates and defending territories (Toledo et al. 2007. Phyllomedusa 6:61–68).

Fig. 1. *Itapotihyla langsdorffii* with anophthalmia in right eye from Paraná, Brazil.

On 1 January 2020 we found a post-metamorphic juvenile *Itapotihyla langsdorffii* (30 mm SVL) with unilateral anophthalmia (Fig. 1), characterized by the absence of one or both eyes (Henle et al. 2017. Mertensiella 25:9–48). This record occurred in the Parque Nacional Superagui (25.45641°S, 48.24600°W; WGS 84; 20 m elev.), an island located in the Municipality of Guaraqueçaba, Paraná, Brazil. The individual was not collected.

Anophthalmia reports in anurans have been recorded on islands and in protected areas and encompass unilateral anophthalmia in a *Proceratophrys appendiculata* (Guenther's Horned Frog) tadpole, bilateral anophthalmia in a *Boana faber* (Blacksmith Treefrog) adult, and unilateral and bilateral anophthalmia in *Rhinella jimi* (Cururu Toad) adults (Toledo et al. 2007, *op. cit.*; Dias and Carvalho-e-Silva. 2012. Herpetol. Notes 5:197–199; Brassaloti and Bertoluci. 2018. Phyllomedusa 17:285–288). This note is the first report of anophthalmia in *I. langsdorffii*. Other abnormalities reported for this species include cephalic anomalies with absent and distorted mandibular bones (Mônico et al. 2016. Herpetol. Ver. 47:273–319).

The causes of anophthalmia in anurans are still poorly understood. Potential causal factors include natural mutation, exposure to chemical pollutants (Johnson et al. 2010. *In* Sparling et al. [eds.], Ecotoxicology of Amphibians and Reptiles, pp. 511–530. SETAC Press, Pensacola, Florida), infection by ranavirus (FV3; Burton et al. Vet. J. 177:442–444), and hybridization (Watson 1972. Aust. J. Zool. 20:423–433). Although the cause of anophthalmia in this report has not been investigated, some anomalies can be strongly associated with inbreeding, especially on islands (Williams et al. 2008. Biol. Lett. 4:549–552). We recommend the monitoring of anurans in Parque Nacional Superagui in order to evaluate the occurrence of different anomalies in different life stages and species.

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***LEPTODACTYLUS LATRANS* (Butter Frog). DEFENSIVE BEHAVIOR.** Amphibians exhibit a great number of defensive behaviors to avoid predation (e.g., unken reflex, thanatosis, stiff-legged posture, puffing up the body, mouth-gaping, biting, and body-raising; Toledo et al. 2011. Ethol. Ecol. Evol. 23:1–25). *Leptodactylus latrans* occurs throughout much of South America. Several defensive behaviors have been reported for *L. latrans* including parental distress calls (Sestito et al. 2016. Herpetol. Notes 9:221–225.), thanatosis, leaping, biting, head hitting, and squeaking (Rodrigues 2008. M.S. Thesis, Universidade Federal de Uberlândia, Minas Gerais, Brazil. 28 pp.). This variety of defensive behaviors makes this species a good model for behavioral studies.

Here, we report a new defensive behavior for *L. latrans*. The observation was made in a natural wetland at Taim Ecological Station (Estação Ecológica do Taim), a Ramsar site located in southern Brazil (32.83333°S, 52.43333°W; WGS 84). At 1920 h on 10 September 2014, as an adult male *L. latrans* was handled and gently touched by an observer it started to lower its snout until it touched the ground while raising its posterior end (Fig. 1). At the same time, it puffed up its body. This behavior was exhibited several times while the stimulus was repeated. The recorded video showing the described behavior is available at: http://dx.doi.org/10.26153/tsw/12522.

After ca. 1 min of no further stimulation the *L. latrans* returned to its natural posture. A similar behavior is seen in *Physalaemus biligonigerus* and *P. nattereri* and it is speculated that it enhances the display of the toxin-secreting inguinal glands (Maneyro et al. 2017. Amphibians of the Coastal Plains of Southern Brazil and Uruguay. Anolis Books, São Paulo, Brazil. 176 pp.). Although *L. latrans* does secrete toxins, it lacks inguinal glands, having widely distributed granular glands instead (Haddad et al. 2013. Atlantic Forest Amphibians Guide—Diversity and Biology. Anolis Books, São Paulo, Brazil. 544 pp.). Our hypothesis is that the observed elevation of the posterior region is a way of protecting the head and eyes. Camouflaging the eyes with disruptive coloring, such as stripes and masks, is widespread among birds, reptiles and amphibians. Although speculative, our hypothesis suggests a new form of anuran defensive behavior to protect the eyes.


PHOTO BY ALEXANDRO M. TOZETTI

Fig. 1. Defensive behavior of *Leptodactylus latrans* from Brazil in response to touching by an observer.

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***LITHOBATES BLAIRI* (Plains Leopard Frog). DEFENSIVE BEHAVIOR and INTERSPECIFIC HIBERNACULUM.** To escape predators, *Lithobates blairi* will generally leap away from the perceived predator into heavy vegetation rather than into water (Tipton et al. 2012. Texas Amphibians: A Field Guide. University of Texas Press, Austin, Texas. 309 pp.), but other defensive behaviors may also be utilized. For anurans, an array of defensive behaviors has been identified including counterattack, noxious secretions, vocalizations, death feigning, and a variety of non-typical body postures such as elevation, inflation, contraction, limbs interweaved, and various forms of unken reflex (Toledo et al. 2011. Ethol. Ecol. Evol. 23:1–25; Ferreira et al. 2019. Behav. Ecol. Sociobiol. 73:1–21). A defensive behavior considered rare for anurans is eye-protection (Toledo et al. 2011, *op. cit.*), a behavior placed within the defensive posture category unken reflex by Ferreira et al. (2019, *op. cit.*). The following describes *L. blairi* using eye-protection (unken reflex) in response to an anthropogenic threat. In addition, two *L. blairi* were observed using a hibernaculum with a *Peromyscus leucopus* (White-footed Mouse; Cricitedae).

On 9 April 2018 at 1120 h adjacent to Pond 11 of Lake Alan Henry Wildlife Mitigation Area, ca. 12 km S and 26 km W of Clairemont, Kent County, Texas, USA (33.06842°N, 101.01787°W; WGS 84), the polyester lid of an in-ground valve box for the adjacent water well was removed to expose two *L. blairi* and one gravid female *P. leucopus* hidden in a corner grass nest. The valve box (58 × 42 × 24 cm) only had one entrance, a ca. 5-cm diameter earthen burrow through the pipe opening end of the box. When initially reaching into the valve box for the larger *L. blairi* and slightly before making contact, the *L. blairi* placed its forefeet in front of its eyes in defense. The *L. blairi* (86 mm SVL) was removed and placed on nearby soil while rigid and still engaged in eye-protection. Its forefeet were held in front of its open eyes with the palms facing outward and its rear legs tucked close to the body (Fig. 1). There was no apparent arching or elevating of the body. After ca. 4 min the *L. blairi* relaxed its forefeet into a normal position with the rear legs splayed slightly. Subsequent placement of my hand close to its head again put the leopard frog back into the same rigid eye-protection posture. This process continued with similar results for two more series with the last series requiring actual touching before the *L. blairi* went into eye-protection posture. Each period of eye-protection became progressively shorter. The *L. blairi* did not attempt to leave the position where it was first placed, however it was cold (ca. 7°C) during these exercises. The second *L. blairi*, about two-thirds the size of the removed *L. blairi*, went into the burrow opening when originally disturbed. Because of the cold temperatures, the removed leopard frog and White-footed Mouse were replaced back into the valve box.

Eye-protection (Toledo et al. 2011, *op. cit.*) is generally defined as an anuran that covers its head, tympanum, and/or open or closed eyes with its forelimbs when threatened or predated. Unken reflex (Ferreira et al. 2019, *op. cit.*) is defined as the body convexly arched and palms lifted or twisted with bright coloration displayed on the venter or palm regions; eyes are open or closed and the rear legs may be raised. Since bright coloration cannot be displayed on venters or palms of *Lithobates* and the body was not arched, the defensive behavior for *L.*

Fig. 1. *Lithobates blairi* using the defensive behavior of eye-protection, or unken reflex, on 9 April 2018 at Lake Alan Henry Wildlife Mitigation Area, Kent County, Texas, USA.

blairi described herein is consistent with the category of eye-protection described by Toledo et al (2011, *op. cit.*).

Hypotheses of the adaptive function of eye-protection include changing the outline of the head to disorient a predator's search image (Channing and Howell 2003. Herpetol. Rev. 34:52); making an individual anuran appear larger or becoming motionless and inconspicuous as a variant of thanatosis (Brodie et al. 1998. J. Herpetol. 32:136–139); and being physically too large to swallow (Ferreira et al. 2019, *op. cit.*). Frogs from the Palearctic possibly use eye-protection during lower temperatures because hypothermic individuals have slower reactions and may be physically unable to escape (Harbel and Wilkinson 1997. Brit. Herpetol. Soc. Bull. 61:16–20; Jablonski et al. 2019. Herpetol. Bull. 147:19–20). For *L. blairi*, eye-protection may have resulted due to the cold temperatures inhibiting escape, however the second smaller *L. blairi* went through the burrow opening within 30 sec and did not use eye-protection. Another hypothesis may be that when my hand became close to the larger *L. blairi*, eye-protection posture was a conditioned response from repeated investigation or contact in the dark by the *P. leucopus* living in the same hibernaculum.

Lithobates blairi is the third known species of *Lithobates* and fourth known ranid from North America to use eye-protection as a defensive behavior. *Lithobates sylvaticus* (Wood Frog) from Arkansas (McCallum et al. 2003. Herpetol. Rev. 34:54–55), *L. capito* (Florida Gopher Frog) (Means 2004. Herpetol. Rev. 35:163–164), and *Rana draytonii* (California Red-legged Frog) (Wilkinson 2006. Herpetol. Rev. 37:207–208) are other North American ranids to use eye-protection. Some European ranid frogs include *R. temporaria* (European Common Frog) from Great Britain (Harbel and Wilkinson, *op. cit.*), *R. macrocnemis* (Iranian Long-legged Frog) from Armenia (Carretero et al. 2011. Herpetol. Notes 4:67–69), and *R. graeca* from the Balkan Peninsula of Greece (Jablonski et al., *op. cit.*).

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***LITHOBATES SYLVATICUS* (Wood Frog). HABITAT.** In the warmer portions of its range, *Lithobates sylvaticus* typically aestivate by seeking cool, moist microhabitats during periods of low humidity and/or high temperatures (Redmer and Trauth 2005. *In* Lannoo [ed], Amphibian Declines: The Conservation Status of United States Species, pp. 590–593. University of California Press, Berkeley, California). Aestivation microhabitats used by *L. sylvaticus* vary and examples include moist leaf litter (Heatwole 1961. Am. Midl. Nat. 66:301–313; Redmer 2002. Illinois Nat. Hist. Survey Bull. 36:163–194), caves, crevices, and moist ravines (Trauth et al. 1995. Bull. Chicago Herpetol. Soc. 30:46–51; Redmer 2002, *op. cit.*) and in tunnels along stream banks (Pitt et al. 2017. Herpetol. Conserv. Biol. 12:212–224). On 29 July 2019 at 1600 h, I found an adult *L. sylvaticus* of unknown sex within a small, grass covered depression in a residential lawn in the village of Mifflinville, Columbia County, Pennsylvania, USA (41.029°N, 76.303°W; WGS 84). Due to the fact that the frog was found in an inactive state under the patch of grass during a period of warm (ca. 26–32°C) and primarily dry weather, the *L. sylvaticus* was presumably utilizing this site for aestivation. However, it is unknown how long the frog occupied this microhabitat before it was discovered. To my knowledge, this aestivation microhabitat utilized by the frog has not previously been reported for *L. sylvaticus*. The general area in which the observation occurred consists primarily of residences and associated lawns, streets, and agricultural fields. A small, isolated wetland bordered by lawns and residences is located ca. 600 m from the site of my observation in which *L. sylvaticus* and other anuran species (*Anaxyrus americanus*, *Hyla versicolor*, *Lithobates catesbeianus*, *L. clamitans*, and *Pseudacris crucifer*) are known to breed. Therefore, this unusual aestivation microhabitat may have been facultatively used by the *L. sylvaticus* due to the absence of more typical summer habitat (i.e., woodlands; Redmer 2002, *op. cit.*) in the vicinity of the breeding wetland.

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***MELANOPHRYNISCUS STELZNERI* (Redbelly Toad) and *LEPTODACTYLUS MYSTACINUS* (Mustached Frog). INTERSPECIFIC AMPLEXUS.** Most anurans can be classified as either explosive or prolonged breeders, although these actually represent two ends of a continuum. In general, anurans that inhabit arid or semiarid regions have explosive breeding periods due to the use of ephemeral ponds for reproduction (Wells 2007. The Ecology and Behavior of Amphibians. University of Chicago Press, Chicago, Illinois. 1148 pp.). The genus *Melanophryniscus* is a putative monophyletic taxon currently represented by 20 species distributed in southern Brazil, southern Bolivia, Paraguay, Uruguay, and central and northern Argentina (Céspedes and Motte 2001. Bol. Asoc. Herpetol. Esp. 12:71–76; Baldo and Basso 2004. J. Herpetol. 38:393–403; Cairo et al. 2008. S. Am. J. Herpetol. 3:10–14). Within the genus, *M. stelzneri* is an endemic species of Sierras Pampeanas from central-western Argentina (Céspedes 2008. Facena 24:35–48; Lescano et al. 2015. Cuad. Herpetol. 29:103–115). Its reproduction is explosive and occurs in temporary ponds associated with heavy rains (Bustos Singer and Gutiérrez 1997. Cuad. Herpetol. 11:21–30). When heavy rains and high temperatures occur, most species of anurans in the Chaco Serrano show explosive reproduction (Cei et al. 2003. Facena 19:115–122). This type of reproductive strategy can lead to atypical amplectic behavior including multiple amplexus, same-sex amplexus, and interspecific amplexus (Gómez-Hoyos et al. 2012. Herpetol. Notes 5:497–498; Mudrek et al. 2017. Herpetol. Rev. 48:418; Heyborne et al. 2018. Herpetol. Rev. 49:102). In fact, within the genus *Melanophryniscus* some cases of atypical reproductive behavior are

Fig. 1. Atypical amplexus in *Melanophryniscus stelzneri*: A) interspecific amplexus between a male *Melanophryniscus stelzneri* and an adult *Leptodactylus mystacinus*, in San Luis, Argentina; B) intraspecific amplexus of two *Melanophryniscus stelzneri* males at La Florida dam, San Luis, Argentina.

known, such as interspecific amplexus between different *Melanophryniscus* species reported by Baldo and Basso (2004, *op. cit.*). Herein, we report two cases of atypical amplectic behavior in *M. stelzneri*: interspecific amplexus involving *M. stelzneri* and *Leptodactylus mystacinus*, and intraspecific amplexus between two male *M. stelzneri*.

We observed these atypical behaviors in November 2012 at the Wildlife Conservation Center La Florida (33.10195°S, 66.02796°W; WGS 84) located near La Florida Dam, La Florida, San Luis, Argentina, after heavy rains, with a mean air temperature of 27.2°C and 94% humidity. The interspecific amplexus between a male *M. stelzneri* and an adult *L. mystacinus*, was recorded at 0430 h on 4 November 2012 (Fig. 1A). The intraspecific amplexus between two male *M. stelzneri* occurred at 1930 h on 3 November 2012 (Fig. 1B). In addition, we observed other anuran species at the same temporary pond such as *Rhinella arenarum*, *L. bufonius*, *L. gracilis*, and *Odontophrynus occidentalis*. The specimens were not collected because the Wildlife Conservation Center La Florida is under protection and does not allow the removal of animals. Instead, we deposited photos to iNaturalist (www.inaturalist.org/photos/67531594, www.inaturalist.org/observations/42428798).

Intraspecific amplexus between males of *M. stelzneri* has been previously observed by Bustos Singer and Gutiérrez (1997, *op. cit.*). However, to the best of our knowledge, this report is the first record describing an amplectic pair of *M. stelzneri* and *L. mystacinus*. In fact, this is the first report of an interspecific amplexus between individuals of the genus *Melanophryniscus* and an individual from a different family (Leptodactylidae). Several authors have indicated by means of sound spectrograms that there are similarities in the nuptial vocalizations of *M. stelzneri* and *L. mystacinus* (Cei 1980. Amphibians of Argentina [Vol. 2]. Universitá Degli Studi di Firenze. 610 pp.; Bustos Singer and Gutiérrez 1997, *op. cit.*), which could indicate that this behavior is more common than we think. Finally, the explosive reproductive strategy of *M. stelzneri* coincides with other species of the Bufonidae, Odontophrynidae, and Leptodactylidae, which are frequent and abundant in Chaco Serrano environments (Cei et al. 2003, *op. cit.*). These facts could increase the possibility of interspecific interactions between these species.

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***ODORRANA HOSII* (Poisonous Rock Frog). DIET.** *Odorrana hosii* is widely distributed in primary and secondary forests in Peninsular Thailand, Peninsular Myanmar, Malaya, Sumatra, Borneo (Frost 2020. Amphibian Species of the World: An Online Reference. Version 6.1; https://amphibiansoftheworld.amnh.org; 1 July 2020), and Java (UA and GC, pers. obs.). However, very little is known about their natural history, including behavior. This medium–large frog species (males: 50–68 mm SVL; females: up to 100 mm SVL; Haas et al. 2020. Frogs of Borneo: An Online reference. http://frogsofborneo.org; 1 July 2020) is known to occupy torrential stream habitats and share similar resources with other cascade ranid species in the vicinity (UA and GC, pers. obs.). In Sumatra, *O. hosii* is often sympatric with *Sumaterana crassiovis* and *Huia sumatrana* (Arifin et al. 2018. Zoosyst. Evol. 94:165). These three species typically perch on various substrates (e.g., leaves, stems, logs, or rocks) along fast-flowing streams (UA and GC, pers. obs.), however, to date there are no available records on behavior or species interactions among *O. hosii, S. crassiovis,* and *H. sumatrana,*

During our fieldwork in Sumatra, we collected *O. hosii* (UA.2014.0437; deposited in the Biota Determination Laboratory, School of Life Sciences and Technology, Bandung Institute of Technology) at 2343 h on 22 March 2014 from a rock (100 cm diameter) 120 cm above water and about 400 cm away from a stream (ca. 4 m wide). The stream was located behind the field station of the Sumatran Elephant Conservation Response Unit of Fauna and Flora International (CRU-FFI) within the local protected forest in Aceh Province, Indonesia (4.90049°N, 96.12840°E; WGS 84; 700 m elev.). During preservation, we found a frog identified as *H. sumatrana* (27 mm SVL; Fig. 1) in addition to common prey items inside the gut (e.g., Orthoptera, Coleoptera; Cahyadi et al. 2015. Cambodian J. Nat. Hist. 2015:87–88) of the large female *O. hosii* (91.5 mm SVL, 71 g). The *H. sumatrana* was partially digested, with only bones and muscles of the dorsal surface and limbs remaining. Although both are commonly found in sympatry, this is the first record of

PHOTO BY GANJAR CAHYADI

Fig. 1. The remaining parts of *Huia sumatrana* after being consumed by *Odorrana hosii* in Sumatra.

an *O. hosii* preying upon a *H. sumatrana*. Judging from the size of both frogs, body size might play a role in this phenomenon. Our finding also sheds light on the possibility of complex interactions (e.g., competition, predator-prey) between cascade frog species.

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***ODORRANA HOSII* (Poisonous Rock Frog). INTERSPECIFIC AMPLEXUS.** Many observations of interspecific amplexus in anurans have been reported for species in the same family (e.g., Komine 2020. Herpetol. Rev. 51:100) and different families (e.g., Lyakurwa and Kachungwa 2020. Herpetol. Rev. 51:95; Bova and Heo 2020. Herpetol. Rev. 51:100). Despite being common and widely distributed in Peninsular Thailand, Peninsular Myanmar, Malaya, Sumatera, Borneo (Frost 2020. Amphibian Species of the World: An Online Reference. Version 6.1; https://amphibiansoftheworld.amnh.org; 8 July 2020), and Java (GC and UA, pers. obs.), reports on the natural history, including behavior, of *Odorrana hosii* are scarce. Here, we report the first record of interspecific amplexus between *O. hosii* and an unidentified species of *Limnonectes*. This is another example of interspecific amplexus between two different anuran families (Ranidae and Dicroglossidae).

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Fig. 1. Interspecific axillary amplexus between a male *Odorrana hosii* and a female *Limnonectes* sp. in Rimbo Panti Nature Reserve, West Sumatera province, Indonesia.

At 2138 h on 5 April 2014, we observed a male *Odorrana hosii* in axillary amplexus with a female *Limnonectes* sp. (Fig. 1) on a stream bank in Batu Hampar, Rimbo Panti Nature Reserve, West Sumatera province, Indonesia (0.35172°N, 100.04899°E; WGS 84; 460 m elev.). The pair was perched on the leaf litter under a big tree, about a meter away from the stream. The stream was rocky and clear with fast-flowing water. A high waterfall (ca. 15 m high) is located upstream, ca. 150 m from where the frogs were observed. The surrounding vegetation was mainly shrubs, ferns, and tree saplings. In the previous days, *O. hosii* had been observed breeding in another stream in the vicinity (GC and UA, pers. obs.). Several other anuran species were also observed in the region: *Chalcorana parvaccola*, *Leptobrachium* sp., *Leptophryne borbonica*, *Limnonectes* spp., *Megophrys nasuta*, *Phrynoidis asper*, and *Sumaterana crassiovis*.

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***PHYSALAEMUS BILIGONIGERUS* (Weeping Frog). PREDATION.** Hemipterans in the family Belostomatidae are important insect predators of aquatic vertebrates (Haddad et al. 2010. Wild. Environ. Med. 21:130–133). *Lethocerus* spp. produce strong toxins to subdue larger prey, toxins which also cause painful bites in humans (Picado-Twight 1936. Mem. Inst. Butantan 10:303–310; Menke 1963. Ann. Entomol. Soc. Am. 56:261–267; Haddad et al. 2010, *op. cit.*). *Lethocerus annulipes* occurs in Mexico, the West Indies, and Central and South America (Menke 1963, *op. cit.*; Ribeiro 2005. Arq. Mus. Nac. 63:247–262). Adult frogs can be common prey of *L. annulipes* (e.g., Nenda et al. 2008. Herpetol. Rev. 39:210; Zaracho 2012. Herpetol. Notes, 5:227–228; Taffarel et al. 2019. Curr. Herpetol. 38:110–113). *Physalaemus biligonigerus* (Leiuperidae) is a small frog widely distributed in South America (Kwet et al. 2010. The IUCN Red List of Threatened Species 2010:e.T57242A11607776).

Two previous reports recorded predation on *P. biligonigerus* by the giant aquatic bug *Lethocerus* sp. from Tintina and Río Hondo localities, Santiago del Estero Province, Argentina (Taffarel et al. 2019, *op. cit.*). Here, we report the predation of an adult *P. biligonigerus* by *L. annulipes*. On 8 February 2020 at 0050 h, in Miraflores, General Güemes Department, Chaco Province, Argentina (25.5830°S, 61.0163°W; WGS 84; 130 m elev.), we observed an adult male *L. annulipes* (59.7 mm total length, 21.6 mm body width) preying on an adult male *P. biligonigerus* (39 mm SVL). The observation occurred on the edge of a temporary pond (ca. 27 cm deep). The air and water temperatures, and the relative humidity at the moment of observation was 20.1°C, 30.2°C and 57% respectively. The insect was holding the frog with its raptorial forelimbs on the posterodorsal region of the body (Fig. 1). The *P. biligonigerus* and *L. annulipes* were deposited in the herpetological collection Blanca Beatriz Álvarez of Universidad Nacional del Nordeste Corrientes, Argentina (UNNEC 13600). During the observation a great number of males from other anuran species were calling: *Elachistocleis haroi*, *Phyllomedusa sauvagii*, *Rhinella major*, *Scinax nasicus*, and *Trachycephalus typhonius*. This is the third record of *P. biligonigerus* in the diet of *Lethocerus*, and the first record of *L. annulipes* predating on *P. biligonigerus*.

We are grateful to Bolívar Rafael Garcete-Barrett for her help with identification of the belostomatid. We thank the Secretaría General de Ciencia y Técnica of the Universidad Nacional del Nordeste (SGCYT-UNNE) for financial support (PI 16F012) and the Dirección de Recursos Naturales of the Chaco province for the collection permit.

Fig. 1. *Lethocerus annulipes* preying on a male *Physalaemus biligonigerus* in Chaco Province, Argentina.

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***PITHECOPUS GONZAGAI*. PREDATION.** Amphibians play a crucial role in trophic webs, both as predators and as prey of several animal taxa (Seale 1980. Ecology 61:1531–1550). A large variety of vertebrates, including fishes, amphibians, reptiles, birds and mammals, and invertebrates, such as ants, beetles, water bugs, spiders and crabs, are efficient predators of anurans (Toledo 2003. Phyllomedusa 2:105–108; Toledo et al. 2007. J. Zool. 271:170–177). *Pithecopus gonzagai* is distributed throughout northeastern Brazil, north of the São Francisco River (Andrade et al. 2020. Eur. J. Taxon. 723:108–134). Predation reports upon *P. gonzagai* are scarce in the literature. To date, only one report of predation of an adult *P. gonzagai* by *Leptodeira annulata* (Banded Cat-eyed Snake) is available in the literature (Falkenberg et al. 2014. Herpetol. Notes 6:97–98). Here, we report a case of predation upon an adult *P. gonzagai* by a bird in the Brazilian Caatinga.

Our observation occurred during fauna monitoring fieldwork on a wind farm in the Paranatama municipality, state of Pernambuco, northeastern Brazil (8.8959°S, 36.7356°W; WGS 84; 824 m elev.). At 1620 h on 3 December 2019, we observed an adult *Crotophaga ani* (Smooth-billed Ani) on the ground with a *P. gonzagai* in its beak (Fig. 1). After we approached to take photographs, the bird flew off with the frog in its beak and disappeared from view. The observation occurred on the side of an access road to the residents' houses, where herbaceous and shrubby vegetation impacted by cattle grazing predominate. The species identification of *P. gonzagai* was confirmed by observing the diagnostic characters visible in the photographs

Fig. 1. Predation of *Pithecopus gonzagai* by *Crotophaga ani* in Paranatama Municipality, Pernambuco, Brazil. Inset: close up of another photograph showing the dorsal color pattern and coloration of the limbs of *P. gonzagai*.

(Fig. 1), such as the green dorsal color pattern and the presence of vertical black stripes on an orange background on the flanks and limbs (Andrade et al. 2020, *op. cit.*). Moreover, *P. gonzagai* and *P. nordestinus* are phenotypically cryptic species isolated by a geographical barrier in northeastern Brazil (the São Francisco River; Andrade et al. 2020, *op. cit.*), thus the geographic location of our record (north of the São Francisco River) allowed us to confidently identify the specimen as *P. gonzagai.*

Crotophaga ani (Cuculidae) is a bird species with a wide geographic distribution in the Americas, from Florida in the USA to Argentina (Sick 2001. Ornitologia Brasileira. Nova Fronteira, Rio de Janeiro, Brazil. 862 pp.). Its diet is composed mainly of small invertebrates, such as beetles, hymenopterans, lepidopterans, orthopterans and spiders, but it also feeds on seeds and fruits, mainly during the dry season, when arthropod abundance decreases (Repenning et al. 2009. Zoologia 26:443–453). According to Toledo et al. (2007, *op. cit.*), vertebrate predators of anurans are classified in four categories: 1) opportunistic predators, 2) convenience predators, 3) temporary specialized, and 4) specialized predators. Based on this classification, *C. ani* can be classified as an opportunistic predator of anurans: a diet-generalist bird that can prey on anurans when it occasionally encounters them in nature. We suggest that encounters between *C. ani*, which is diurnal, and *P. gonzagai*, which is nocturnal, are rare. This predation event occurred during the peak of the dry season, when most anurans become inactive in the Caatinga (Jorge et al. 2015. Phyllomedusa 14:147–156), so it is highly probable that the *C. ani* picked up the *P. gonzagai* from its shelter. This is the first report of predation of *P. gonzagai* by a bird species.

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***PRISTIMANTIS MEDEMI*. PARENTAL CARE.** The genus *Pristimantis* includes a high diversity of terrestrial species. Direct development allows them to occupy a wide variety of habitats (Acevedo et al. 2014. Rev. Biol. Trop. 4:162–169; Acevedo et al. 2020. Zootaxa 4750:499–523). The genus is composed by 581 species (Frost 2020. Amphibian Species of the World: An Online Reference. Version 6.1; https://amphibiansoftheworld.amnh.org; 12 Jun 2020), with mainland distributions in northern Argentina, Bolivia, Brazil, Colombia, Ecuador, Guianas, Peru, Venezuela, and part of Central America. *Pristimantis* ranges between 0 and 4500 m elev. (Acevedo et al. 2020, *op. cit.*). There have been 223 species of *Pristimantis* recorded in Colombia (Acosta-Galvis 2019. List of Amphibians of Colombia: An Online Reference Version.09.2019; http://www.batrachia.com; 12 Jun 2020), but knowledge of the distribution patterns, natural history and ecology is limited for some species (Acevedo et al. 2014, op. cit.).

Pristimantis medemi is endemic to Colombia, it is distributed on the slopes and foothills of the Eastern Cordillera in the departments of Boyacá, Caquetá, Casanare, Cundinamarca, and Meta, between 450–2400 m elev. (Lynch 1994. Rev. Acad. Colomb. Cienc. Ex. Fis. Nat. 19:187–193; Acosta Galvis 2019, *op. cit.*). The species is in the category of least concern (LC) (IUCN SSC Amphibian Specialist Group 2018. *Pristimantis medemi*. The IUCN Red List of Threatened Species 2018:e.T56750A3048815; 17 June 2020), nonetheless, it may be threatened by habitat loss or degradation (Lynch 2006. Caldasia 28:135–155). *Pristimantis medemi* breeds in terrestrial habitats that are in proximity to bodies of water (Caceres-Andrade and Urbina-Cardona 2009. Caldasia 31:175–194).

Fig. 1. Egg attendance by a female *Pristimantis medemi* in Villavicencio, Colombia.

At 1917 h on 10 August 2019, during the rainy season (26°C air temperature) at La Arabia farm, Villavicencio, Colombia (4.171°N, 73.665°W; WGS 84; 910 m elev.), we found a female *P. medemi* in a hole (depth = 15 cm) protecting a clutch of eggs on the rocky edge of a steam, 140 cm above the stream (Fig. 1). There were 21 eggs in the clutch. When we approached the clutch, the *P. medemi* covered the eggs with her body and head. This type of parental care behavior has been reported in other *Pristimantis* species (Carrillo 2007. Herpetol. Rev. 38:183; Ryan et al. 2010. J. Herpetol. 44:193–200; Rojas-Rivera et al. 2011. Herpetol. Rev. 42:588–589; Martínez 2017. Herpetol. Rev. 48:415–416) where one of the parents protects the eggs by covering the clutch with its body.

Parental care is defined as any type of parental investment after laying eggs to increase the probability of offspring survival (McDiarmid 1978. *In* Burghardt and Bekoff [eds.], The Development of Behavior: Comparative and Evolutionary Aspects, pp. 127–147. Garland STPM Press, New York, New York; Wells, 2007. The Ecology and Behavior of Amphibians. University of Chicago Press, Chicago, Illinois. 1148 pp.). The behavior we observed in *P. medemi* is called investment in a fixed site, in a nest or burrow, with directly developing terrestrial eggs attended by the male or female (McDiarmid 1978, *op. cit.*). Available data suggest that in the genus *Pristimantis* it is the female that attends the nest (Myers 1969. Am. Mus. Novit. 2396:1–52; Lynch et al. 1996, Caldasia 18:329–342; Beck 1998. Anim. Behav. 55:439–449; Carrillo 2007 *op. cit.*; Wells 2007, *op. cit.*; Martínez 2017, *op. cit.*).

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***RANA ARVALIS* (Moor Frog). COLORATION.** *Rana arvalis* is a common anuran species of northern Eurasia. Its range stretches from northwestern France, east to Siberia and Transbaikalia, and from the Middle Danube Lowland in Hungary north to Scandinavia and southern Yakutia. *Rana arvalis* is also widely distributed in the northern half of Kazakhstan. Males typically acquire a blue color during the breeding season. In western and central Europe the mating color of males is bright blue, greyish-blue to purple or even ultramarine (Neas et al. 1997. Czech Recent and Fossil Amphibians and Reptiles. An Atlas and Field Guide. Edition Chimaira, Frankfurt am Main. 94 pp.; Glandt 2006. Der Moorfrosch. Einheit und Vielfalt einer Braunfroschart. Beiheft der Zeitschrift für Feldherpetologie 10. Laurenti Verlag, Bielefeld. 160 pp.; Ries et al. 2008. J. Zool. 276:229–236). Bright blue or pale blue mating coloration is typical for males from most of the European part of Russia (Fig. 1A; Dunaev and Orlova 2012. Amphibians and Reptiles of Russia. Atlas-Guide. Fiton Publishing House, Moscow, Russia. 320 pp.). In northeastern European Russia, in the northern Ural Mountains and West Siberia only some males are colored solid blue, while the remainder have a whitish blue throat and blue flanks and head, or different parts of the back and head are mottled (Fig. 1B; Anufriev and Bobretzov 1996. Amphibians and Reptiles. Fauna of the European North-east of Russia. Volume 4. Nauka, Saint-Petersburg, Russia. 130 pp.; Vershinin 2007. Amphibians and Reptiles of Ural. Ural Branch Russian Academy of Sciences, Yekaterinburg, Russia. 171 pp.). Under water, the color appears grayish (Fig. 2A).

Anecdotal information suggested that the typical blue color did not occur in breeding males of populations in Kazakhstan. On 19 April 2020, in a small pond south of Burabay Lake (53.053°N, 70.2703°E; WGS 84; 363 m elev.) in central Kazakhstan we observed a few male *R. arvalis* in amplexus without any trace of blue coloration. Even under water, at the time of spawning and fertilization, the background of their dorsum was dark sand, dark walnut, olive-gray or gray-brown (Fig. 2A, B). The dorsolateral dermal plicae (skin folds) were light terracotta or yellowish red. The females generally resembled the males, but their dorsum was characterized by more rusty shades. The coloration of the breeding individuals of both sexes was almost the same tone of brown as that of the males outside the breeding season. This phenomenon is interesting regarding possible geographic

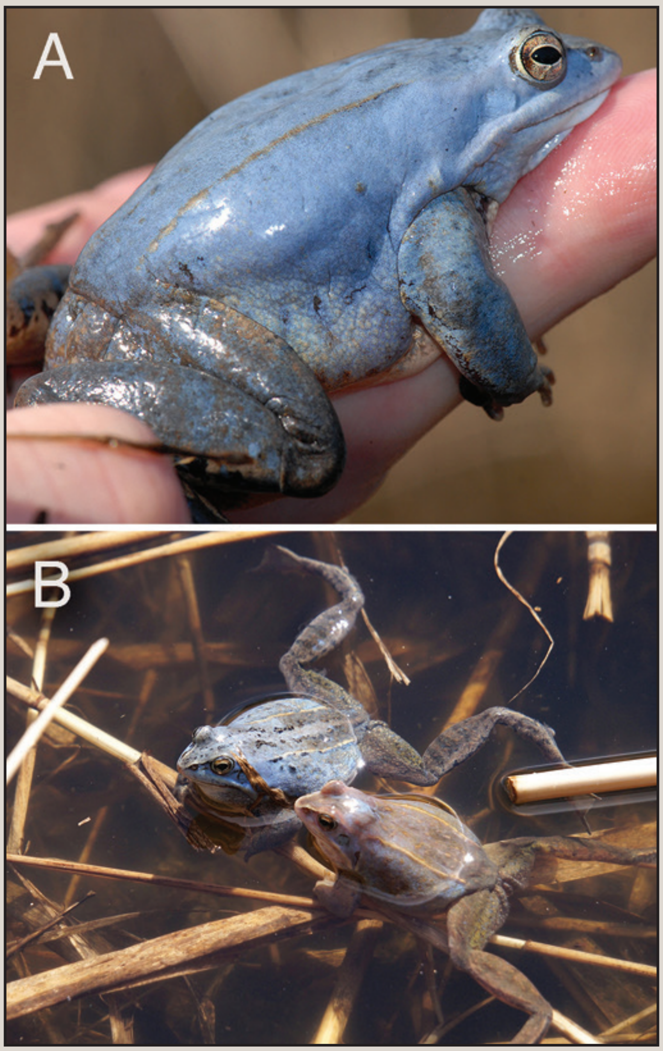

Fig. 1. A) Solid blue mating color of a male *Rana arvalis* from Bryansky Les Nature Reserve, Bryansk Region, European part of Russia; B) variations in blue mating color of *Rana arvalis* males from the vicinity of Novosibirsk City, West Siberia, Russia.

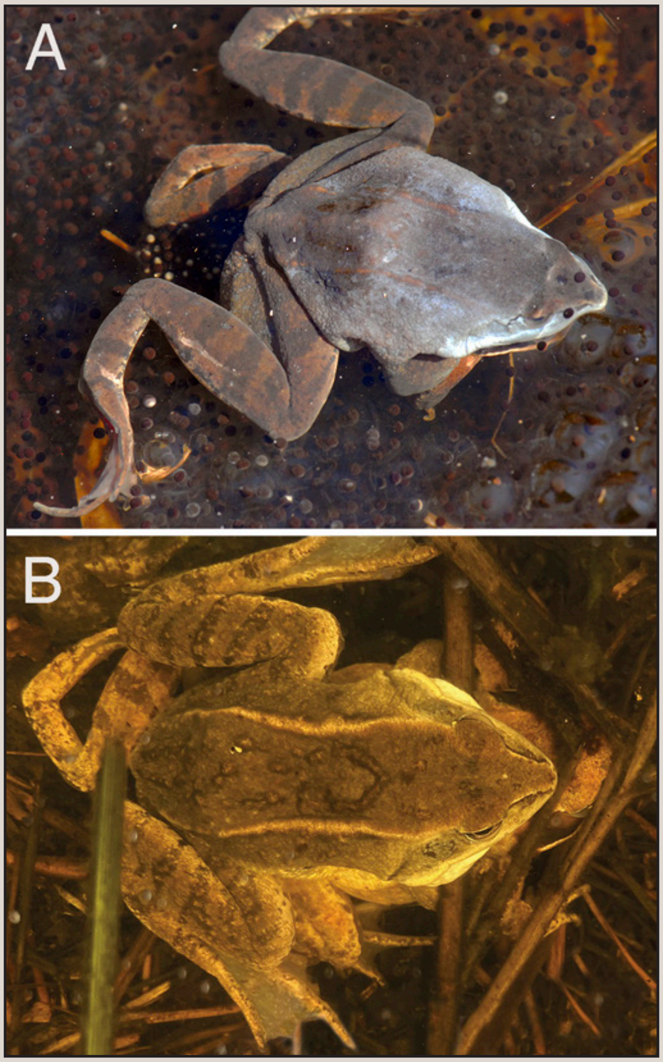

Fig. 2. A) Grayish mating color of a male *Rana arvalis* in amplexus under water, Bryansky Les Nature Reserve, Bryansk Region, European part of Russia; B) brown mating color of a male *Rana arvalis* in amplexus under water, Burabay Lake surroundings, central Kazakhstan.

variation of male mating coloration. The dependence of color manifestation on male age, breeding stage and/or certain physiological adaptations associated with the environment also needs to be clarified.

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RANA ITALICA **(Italian Stream Frog). PREDATION.** *Rana italica* is one of multiple epigean amphibians that can be found within subterranean environments (Lunghi et al. 2014. Acta Oecol. 55:29–35; Lunghi et al. 2018. Subterr. Biol. 25:49–60). These species not only find a suitable microclimate, but a safer environment with fewer predators compared to the surface (Bradley and Eason 2019. Behaviour 155:841–859; Culver and Pipan 2019. The Biology of Caves and Other Subterranean Habitats. Oxford University Press, New York, New York. 336 pp.). Indeed, most predators likely find these environments unsuitable because of both the general paucity of prey compared to the surface, and the difficulty of locating prey in total darkness (Culver and Pipan 2019, *op. cit.*). However, predators that rely on different cues (e.g., chemoreception) rather than sight alone to locate prey, are able to forage in subterranean environments. This is, for example, the case for *Natrix helvetica* (Barred Grass Snake; Schultze et al. 2020. Zool. Scr. 49:395–411). This snake is often found in subterranean environments (Lunghi et al. 2018. Spixiana 41:160; Mulargia et al. 2018. Russ. J. Herpetol. 25:172–176), where it likely pursues potential prey such as anurans and salamanders (Scali et al. 2011. *In* Corti et al. [eds.], Fauna d'Italia Reptilia, pp. 552–562. Edizioni Calderini de Il Sole 24 Ore, Bologna, Italia; Lanza et al. 2006. Atti Mus. Civ. Stor. Nat. Trieste 52:5–135).

During a survey in the province of Prato, Tuscany, Italy in June 2020, I observed a few juvenile *R. italica* being hunted by a young *N. helvetica* inside a cave more than 12 m from the cave entrance, in an area of complete darkness. This is a horizontal cave located in a forested area far from any water body. The *N. helvetica* was pursuing a *R. italica* but my presence disturbed the scene, and it fled deeper into the cave. This event shows that, although reduced, predation risk may still affect *R. italica* when it exploits subterranean environments (Lunghi et al. 2018, *op. cit.*). Furthermore, it will be interesting to understand whether predation risk for epigean amphibians in subterranean environments will increase in the future. More amphibian species will probably move to subterranean environments in response to climate change (Bellard et al. 2012. Ecol. Lett. 15:365–377), and their increased density could make it more profitable for potential predators to forage in these environments.

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RHINELLA **GR.** ***MARGARITIFERA*****. BREEDING SITE.** The *Rhinella margaritifera* species group represents a complex with several undescribed species distributed mainly throughout the Amazon Basin (Fouquet et al. 2007. Mol. Phylogen. Evol. 43:567–582; Lima et al. 2007. Zootaxa 1663:1–15). The majority of species in this species group breeds in permanent or temporary ponds nearby or connected to streams (Caramaschi and Pombal 2006. Pap. Avul. Zool. 46:251–259; Menin et al. 2006. Zootaxa 1258:47–56). Among the exceptions, *R. magnussoni* and *R. castaneotica* breed in small ponds formed in fallen tree trunks and in rain-filled fallen fruit capsules of *Bertholletia excelsa* (Brazil Nut Tree; Caldwell 1991. Pap. Avul. Zool. 37:389–400; Lima et al. 2007. *op. cit.*; Moraes et al. 2014. Herpetol. Rev. 45:683–684).

At 1620 h on 19 January 2018, an adult male and tadpoles of a small undescribed species (A. P. Lima, unpubl. data) of the *R. margaritifera* species group (38.23 mm SVL) were found in a rain-filled fruit capsule of *B. excelsa* (Fig. 1). They were found in a disturbed primary rainforest in the Municipality of Manacapurú, Amazonas, Brazil (3.20728°N, 60.44506°W; WGS 84; 60 m elev.). The fruit capsule contained 43 tadpoles in Gosner stages 30–34 (Gosner 1960. Herpetologica 16:183–190), ranging from 9.4–15.4 mm (mean = 13.3 mm ± 1.3 SD). The use of fallen fruit capsules of *B. excelsa* as larvae deposition sites has been documented not only for bufonids, but also for other frogs such as the hylid *Osteocephalus castaneicola* (Moravec et al. 2009. Zootaxa 2215:37–54) and the dendrobatids *Adelphobates castaneoticus* and *A. quinquevittatus* (Caldwell and Myers 1990. Am. Mus. Novit. 2899:1–21).

Fallen fruit capsules of *B. excelsa* appear to be an important habitat for larvae of some Amazonian anurans. This fruit capsule is typically gnawed open by *Dasyprocta* sp. (agoutis; Mori and Prance 1987. *In* Dickinson [ed.], The Geophysiology of Amazonia, pp. 69–89. Wiley, New York, New York) or cut by nut collectors and abandoned on the forest floor (Moravec et al. 2009. *op. cit.*). The empty capsule fills with rainwater and provide a transient microhabitat for tadpoles, mosquito larvae, and other small organisms. Breeding in phytotelmata can reduce both competition and predation (Krügel and Richter

FIG. 1. Male of the *Rhinella margaritifera* species group with tadpoles inside a fruit capsule of *Bertholletia excelsa* (Brazilian Nut Tree).

1995. Copeia 1995:955–963). Consequently, these fruit capsules may offer excellent shelter. Furthermore, water accumulated in these capsules remains for much longer than free water in small ponds on the forest floor (Moravec et al. 2009. *op. cit.*). Thus, these phytotelmata likely provide protection against predators as well as larval dehydration. The tadpoles of the *R. margaritifera* species group have robust beaks which may allow them to catch and consume mosquito larvae (an obvious and abundant food source), but this was not observed. We also have no evidence that females provide nutritive eggs to their tadpoles, although tadpoles of *R. magnussoni* were observed eating eggs in pools of water on fallen tree trunks (Lima et al. 2007, *op. cit.*). This needs to be investigated in future studies.

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***RHINELLA PROBOSCIDEA.* DEFENSIVE BEHAVIOR.** *Rhinella proboscidea* is a medium-sized terrestrial species that is active during the day in the forest leaf litter, and rests during the night on leaves of shrubs (Lima et al. 2012. Guide to the Frogs of Reserva Adolpho Ducke, Central Amazonia. Áttema Design Editorial, Manaus, Brazil. 187 pp.). Breeding occurs between March and May, when males and females aggregate in small bodies of water for egg deposition. On 22 May 2020 at 1541 h, in Reserva Florestal Adolpho Ducke Nature Reserve, Manaus, state of Amazonas, Brazil (3.00716°S, 59.93999°W; WGS 84), one individual *R. proboscidea* was found near a body of water. When captured for identification, it immediately exhibited two defensive behaviors (Fig. 1), which were classified according to Toledo et al. (2010. J. Nat. Hist. 44:1979–1988). In the first, the toad remained with the front and hind limbs pressed against the body, a behavior known as "shrinking" (Fig. 1A). Shortly afterwards, the animal switched to another defensive behavior, thanatosis, remaining immobile with the belly up, but with the limbs splayed away from the body, with the eyes open (Fig. 1B). Anurans have a wide variety of antipredator mechanisms. Ferreira et al. (2019. Behav. Ecol. Sociobiol. 73:1–21) compiled records for 462 Neotropical species, in which the Bufonidae had the second largest number of records, with 94 species. Thanatosis, has been reported for only eight of the 39 species of *Rhinella*. Recently, new defensive displays were described for *R. marina*, expanding knowledge of anuran defense mechanisms (Ferrante et al. 2020. Ethol. Ecol. Evol. 32:590–595). However, for *R. proboscidea*, this is the first report of defensive displays, even though some defensive behaviors have already been observed in the field, including postures involving belly inflation, leg stretching, and the use of a camouflage/immobility strategy, in which the animal remained immobile in the leaf litter (M. Menin and A. Ferreira, pers. comm.).

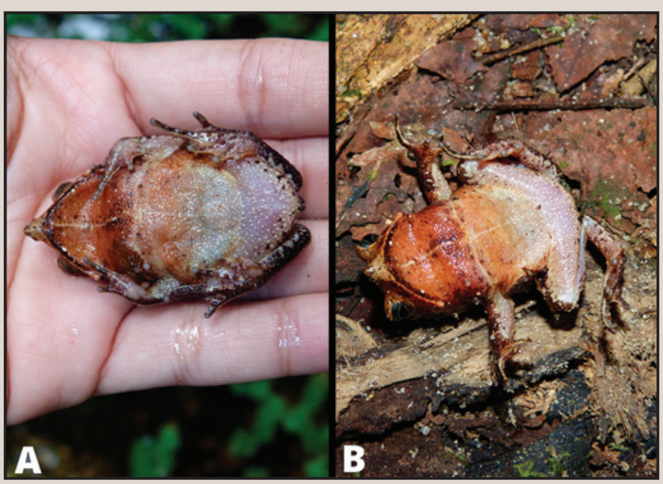

Fig. 1. Defensive behaviors in *Rhinella proboscídea* from Amazonas, Brazil: A) shrinking; B) thanatosis.

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***RUPIRANA CARDOSOI.* DEATH FEIGNING.** *Rupirana cardosoi* is an anuran (Leptodactylidae) endemic to the Chapada Diamantina region of Brazil (Camardelli and Napoli 2012. Herpetologica 68:31–47; Garda et al. 2017. *In* Silva et al [eds.], Biodiversity, Ecosystems Services and Sustainable Development in Caatinga: The Largest Tropical Dry Forest Region in South America, pp. 133–149. Springer-Verlag, Berlin). The species is classified as Near Threatened (Junca and Silvano 2004. *Rupirana cardosoi*. The IUCN Red List of Threatened Species 2004:e.T57322A11620407; 18 April 2020). *Rupirana cardosoi* has been documented in Morro do Chapéu, Palmeiras, Lençóis and Mucugê municipalities (Heyer 1999. Proc. Biol. Soc. Washington 112:19–39; Magalhães et al. 2015. Herpetol. Notes 8:243–261).

On 6 October 2019 during a herpetological expedition in the Mucugê City Park, Municipality of Mucugê, Bahia, Brazil (12.99240°S, 41.34088°W; WGS 84; 940 m elev.), a male *R. cardosoi* was found vocalizing in the water amid vegetation and rocks along a rocky field. When the individual was captured, it exhibited death feigning behavior (Fig. 1). Such behavior is thought to elicit disinterest from predators (Toledo et al. 2011. Ethol. Ecol. Evol. 23:1–25; Ferreira et al. 2019. Behav. Ecol. Sociobiol. 73:69). While death feigning the orange color of the thighs was exposed

PHOTO BY UBIRATÃ F. SOUZA

Fig. 1. Death feigning in an adult *Rupirana cardosoi*.

suggesting aposematism which is commonly associated with this behavior (Gomes et al. 2002. Copeia 2002:994–1005; Ferreira et al., *op. cit.*).

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***SCINAX IMBEGUE* (Snouted Treefrog). DEFENSIVE BEHAVIOR.** Anurans show several defensive strategies to avoid predation (Williams et al. 2000. J. Herpetol. 34:431–443; Toledo et al. 2007. J. Zool. 271:170–177). Predation can be divided into six phases: localization, identification, approach, subjugation, ingestion, and digestion, and anurans display various defensive strategies for each of these (Toledo et al. 2011. J. Ethol. Ecol. Evol. 23:1–25). The strategies to avoid subjugation may be passive (e.g., death feigning and body-raising) or active, such as displaying an aggressive response (e.g., jumping towards the predator with the mouth open, biting and/or kicking the predator; Hartmann et al. 2003. Herpetol. Rev. 34:50; Kok et al. 2007. Herpetol. Rev. 38:198; Figueiredo et al. 2017. Herpetol. Rev. 48:163). Herein, we present the defensive response of male (28.67 mm SVL) and female (29.63 mm SVL) *Scinax imbegue* against the ant *Pachycondyla* cf. *striata* (14.50 mm total length), recorded at 2050 h on 13 January 2020 (20.0°C air temperature, 86% relative humidity) in the Parque Estadual Fontes do Ipiranga, Municipality of São Paulo, São Paulo, Brazil (23.63889°S, 46.61972°W; WGS 84; 770 m elev.). We recorded one ant attacking a male and female *Scinax imbegue* during amplexus. First, the ant bit the leg close to the cloaca of the male. Both the male and female kicked the ant and removed it twice. However, the ant attacked the pair and bit again. The male released the female and kicked the ant to a distance of 13 cm. After this, the male clasped the female again, remaining in amplexus.

Less than 1% of anti-predation records in anurans are aggressive defensive responses (Toledo et al. 2011, *op. cit.*), as reported for the Brachycephalidae (*Ischnocnema henselii*), Bufonidae (*Anaxyrus americanus*), Cycloramphidae (*Cycloramphus boraceiensis*), Hemiphractidae (*Stefania woodleyi*), and Ranidae (*Rana aurora*; Hartmann et al. 2003, *op. cit.*; Wilkinson. 2006. Herpetol. Rev. 37:207; Kok et al. 2007, *op. cit.*; Hartzell. 2016. Herpetol. Rev. 47:102; Figueiredo et al. 2017, *op. cit.*). The behavior of kicking the predator was recorded only for *Anaxyrus americanus* (American Toad) kicking a snake (Hartzell 2016, *op. cit.*). Although kicking behavior has already been recorded for the genus *Scinax* (e.g., *S. cardosoi* and *S. eurydice*) in the reproductive context when resident males kick satellite males (Hartmann et al. 2005. J. Nat. Hist. 39:1675–1685; Moroti et al. 2017. Phyllomedusa 16:283–287), our observation represents the first report of aggressive defense behavior not only for *S. imbegue*, but also for the family Hylidae.

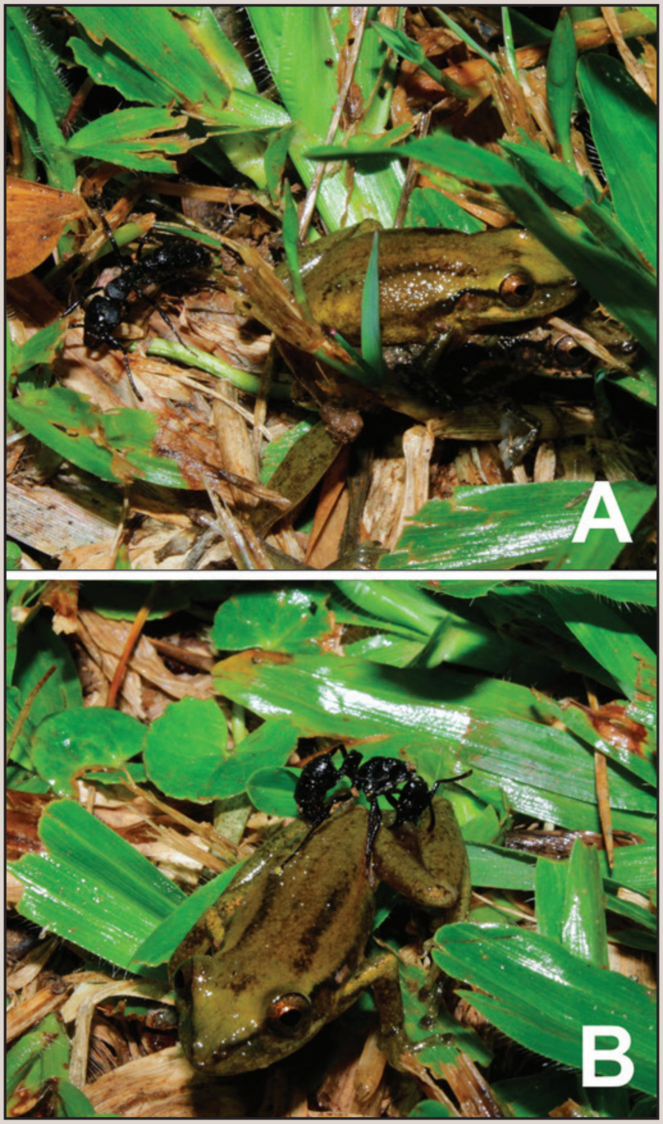

FIG. 1. A) A pair of *Scinax imbegue* in amplexus next to an ant *Pachycondyla* cf. *striata*. B) Ant biting a male *S. imbegue* in the Parque Estadual Fontes do Ipiranga, Municipality of São Paulo, Brazil.

We are grateful to Laura Leal for identification of the ant. We also thank the Parque Estadual Fontes do Ipiranga for logistical support and RAN/ ICMBIO for the collecting permit (SISBIO No 63597/4). WRP was funded by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001.

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SPHAENORHYNCHUS PLANICOLA **(Rio Lime Treefrog). ANTIPREDATOR MECHANISM.** Anurans have evolved a variety of defense mechanisms to avoid predation (Mailho-Fontana et al. 2013. J. Exp. Zool. 9999:1–13; Toledo et al. 2011. Ethol. Ecol. Evol. 23:1–25). Here, we report the first record of death feigning in *Sphaenorhynchus planicola*.

During a herpetological expedition in the flooded plains of a Restinga in the Reserva Particluar do Patrimônio Natural Fazenda Caruara (21.97556°S, 41.29306°W; WSG 84; sea level), two *S. planicola* were encountered. *Sphaenorhynchus planicola* is a hylid endemic to the coastal plains of the state of Rio de Janeiro, in southeastern Brazil (Frost 2020. Amphibian Species of the World: An Online Reference. Version 6.0; https://amphibiansoftheworld.amnh.org; 08 February 2020). Both individuals were in herbaceous vegetation within a swamp, vocalizing when captured. After capture the individuals were subjected to tests using fingers to simulate a predator, as demonstrated in Lourenço-de-Moraes et al. (2016. Herpetol. J. 26:237–244). The two individuals performed death feigning lasting 5 min 27 sec for the first individual (Fig. 1A) and 5 min 43 sec for the second individual (Fig. 1B). Death feigning is a mechanism that aims to provoke disinterest in the possible predator (Toledo et al. 2011, *op. cit.*; Ferreira et al. 2019. Behav. Ecol. Sociobiol. 73:69). Both individuals were deposited in the herpetological collection of the Universidade Estadual do Norte Fluminense (HNFC 878, 879).

PHOTOS BY UBIRATÃ SOUZA

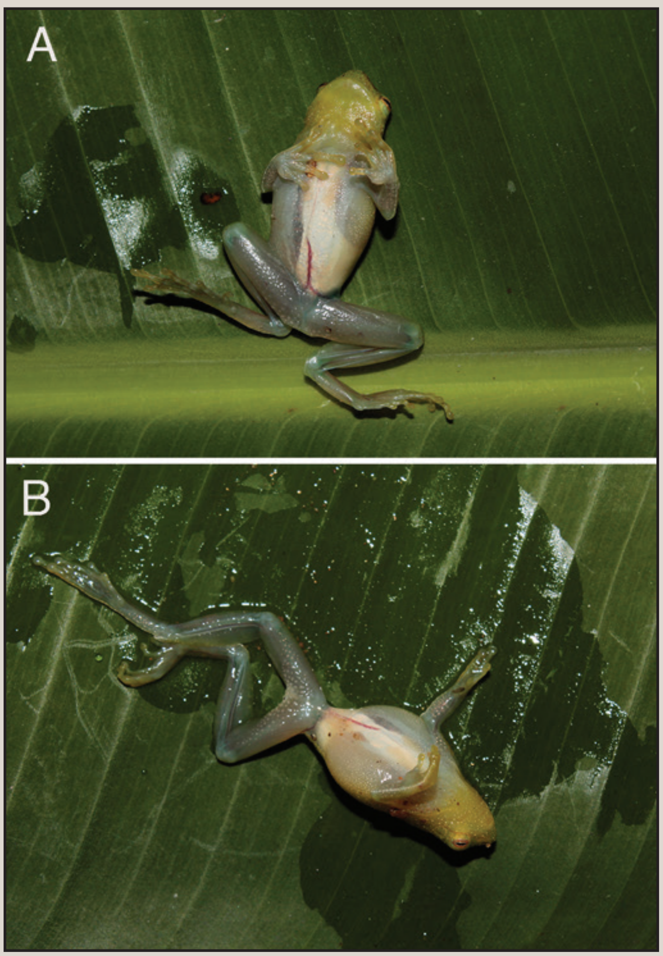

Fig. 1. A, B) Thanatosis or death feigning performed by two *Sphaenorhynchus planicola* in Brazil.

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TRACHYCEPHALUS TYPHONIUS **(Pepper Treefrog). DIET.** Amphibians are important components of food webs, consuming a wide variety of prey species and being preyed upon by a wide variety of predators (Wells 2007. The Ecology and Behavior of Amphibians. University Chicago Press, Chicago, Illinois. 1148 pp.; Maffei et al. 2014. Biol. Rev. 57:29–58). Most anurans are generalist and opportunistic predators (Santos and Vaz-Silva 2012. Herpetol. Brasileira 3:113–115). *Trachycephalus typhonius* (Hylidae) is distinguished by the presence of paired lateral vocal sacs, which protrude posteriorly to the angles of the jaws when inflated (Faivovich et al. 2005. Bull. Am. Mus. Nat. Hist. 294:1–240). *Trachycephalus typhonius* is considered a generalist predator of invertebrates and also some anurans, including *Scinax* spp. (Cintra et al. 2013 Herpetol. Rev. 44:500; Sugai et al. 2017. Herpetol. Rev. 48:613–614). Here, we present the first record of *T. typhonius* preying on *Scinax x-signatus*.

On 26 July 2019, at 2130 h, we recorded an adult male *T. typhonius* (34.0 g, 85.3 mm SVL; URCA-H 16040) preying upon a small hylid frog on the ground in Guaramiranga Municipality, Ceará, Brazil (4.27028°S, 38.93833°W; WGS 84; 912 m elev.). When we dissected the *T. typhonius* we found a well-preserved *Scinax x-signatus* individual (Fig. 1). Predation is considered one of the most important environmental pressures on anuran communities (Duellman and Trueb 1994. Biology of Amphibians. The Johns Hopkins University Press, New York, New York. 646 pp.), and it is important to report predatory interactions between tree frogs. Furthermore, we have observed *T. typhonius* climbing down from the trees when prey species are available on the ground.

We are grateful to ICMBio for the collection license (Permit: ICMBio 72384, process: 29613) and this study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES).

PHOTO BY KÁSSIO DE CASTRO ARAÚJO

Fig. 1. Specimens recorded of *Trachycephalus typhonius* (left) and *Scinax x-signatus* (right).

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TESTUDINES — TURTLES

***ACTINEMYS PALLIDA* (Southwestern Pond Turtle). NEST DESTRUCTION.** *Actinemys marmorata* is a species of special concern in California (Spinks et al. 2014. Mol. Ecol. 23:2228–2241; Thompson et al. 2016. California Amphibian and Reptile Species of Concern. University of California Press, Berkeley, California. xv + 390 pp.). Bury et al. (2012. Northwest Fauna 7:1–128) and Thompson et al. (2016, *op. cit.*) have suggested that declines in the species' range may be attributable to aspects of the nesting ecology (e.g., destruction or loss of nesting habitat, absence of protections for nesting sites, putative lack of information on nesting ecology). Herein, we report on the destruction of a nest of *A. pallida* during soil grading activity.

A long-term turtle nesting ecology study was conducted between 2013 and 2019 at Mt. View Sanitary District's Moorhen Marsh, Martinez, California, USA. Individual *A. pallida* were closely observed and tracked during their breeding season, and nest locations were located, marked, and protected from disturbance (Alvarez and Davidson 2018. Herpetol. Rev 49:101–103; Davidson and Alvarez 2020. West. Wildl. 7:42–49). Although data from this study suggested that an unknown proportion of nests remained undetected, the dominant site for nest construction was mapped and well known (Fig. 1).

Prior to the commencement of habitat restoration activities designed to benefit *A. pallida* at this site, pond levees were surveyed daily (i.e., 6 h/d for six weeks) for actively nesting turtles. Additionally, a turtle exclusion fence was installed to exclude turtles from the proposed construction area. On 20 August 2018, we received a report that a turtle was on a levee in an active construction portion of the restoration area. Upon our arrival to the reported area, a hatchling only partially free of its eggshell was found against the turtle exclusion fence, in an area that was freshly graded. The hatchling turtle had a small amount of fresh blood on its mouth and portions of its skin surface, and appeared to have been killed shortly before our observation. We searched for the presumed nest location and any other evidence of a nest, nestlings, or hatchlings, but no other signs were found. We concluded that an undetected nest was constructed within the restoration area, prior to the placement of the exclusion fence. During restoration activities, a small grader, which was removing the first 10 cm of surface soil, may have intersected a turtle nest that was actively hatching underground.

Fig. 1. Location of known primary nesting area (red box) for *Actinemys pallida*, and location of nestling (gold star) killed by ground disturbing activity. Photo modified from Google Earth Image 2020.

This observation indicates that females from even a very closely monitored population of *A. pallida*, for which typical nesting behavior is relatively well understood, can easily construct undetected nests. Further, it appears in this case that an undetected nest was made within an active construction area that, although thoroughly surveyed and closely monitored, was ironically destroyed by activities designed to enhance their habitat. Our long-term study suggested that the vast majority of known pond turtle nests were along the western boundary of the project area. Among 102 detected nests, only seven (6.8%), including the one reported here, were found in areas not within the typical known nesting area. Female pond turtles likely select nesting sites that meet the microhabitat requirements for nest placement and construction, however, some females will undoubtedly find suitable conditions in isolated locations in relatively cryptic habitat. This level of unpredictability (i.e., the expectation of outliers) in nest site location should be considered in mitigation measures and species management.

We are grateful to the Mt. View Sanitary District Board of Directors for long-term support to study these turtles. Work herein was conducted under a Lake and Streambank Alteration Agreement (1600-2016-0347-R3). We thank Kelly A. Davidson, Sarah M. Foster, and Karen James for assisting with nesting surveys.

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***APALONE FEROX* (Florida Softshell). PREDATION.** On 17 October 2008, while driving on the Tamiami Trail (Route 41), near Big Cypress National Preserve in Collier County, Florida, USA, we observed a Great Egret (*Ardea alba*) on the side of the road with something in its beak that did not appear to be a fish. The egret was standing ca. 1 m from the edge of a roadside canal on the north side of the road. We stopped the vehicle to get a closer look at what the egret was eating, and saw it was a juvenile *Apalone ferox*, which is a common species in south Florida (Conant and Collins 1998. A Field Guide to Reptiles and Amphibians of Eastern and Central North America. Third edition. Houghton Mifflin Co., Boston, Massachusetts. 450 pp.). The diet of Great Egrets typically consists of various fish, frogs and crayfish. They also are known to eat snakes, hatchling alligators, small birds and mammals, snails, and insects (Peterson 2012. Birds of Florida. Houghton, Mifflin, Harcourt Publishers, Boston, Massachusetts. 480 pp.). They usually hunt in shallow waters, either moving around slowly with the neck extended searching for prey or

FIG. 1. Great Egret (*Ardea alba*) from Florida, USA, with a juvenile Florida Softshell (*Apalone ferox*) in its beak.

standing motionless until the prey comes within striking distance at which time they will spear the prey with the long, sharp bill (Tekiela 2004. Birds of Florida Field Guide. Adventure Publications. Cambridge, Minnesota. 384 pp.). As we walked closer, we could see that the turtle was still alive because the front and rear limbs were moving aimlessly (Fig. 1). The egret was maneuvering the turtle in its beak but started walking away from us with the turtle still struggling. The egret then flipped the turtle around in its beak again, swallowed the turtle whole, and then flew away into the cypress swamp.

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***APALONE SPINIFERA GUADALUPENSIS* (Guadalupe Spiny Softshell). DIET and SCAVENGING.** Spiny Softshell are primarily benthic feeders and scavengers (Williams and Christiansen 1981. J. Herpetol. 15:303–308). On 27 June 2020, in Kerr County, Texas, USA (30.0456°N, 99.2491°W) at 1800 h, an adult female *A. spinifera guadalupensis* was observed eating exposed flesh from the hind quarters of a deceased White-tailed Deer (*Odocoileus virginianus*) that was floating in the creek. Photographs were taken and deposited in the Texas Turtles Digital Collection (TTDC 177, 178). This is apparently the first known documented observation of a Spiny Softshell eating a deer (Ernst and Lovich 2009. Turtles of the United States and Canada. Second edition. Johns Hopkins University Press, Baltimore, Maryland. 827 pp.).

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***APALONE SPINIFERA PALLIDA* (Pallid Spiny Softshell Turtle). BEHAVIOR.** Spiny Softshells are known to respond to handling with pugnacious bites and scratches (Ernst and Lovich 2009. Turtles of the United States and Canada. Second edition. Johns Hopkins University Press, Baltimore, Maryland. 827 pp.). Some individuals may even squirt blood from their eyes (Platt and Brantley 1991. Herpetol. Rev. 22:57). On 16 July 2019 at The Retreat at Artesian Lakes, Liberty County, Cleveland, Texas, USA (30.44023°N, 94.82373°W) at 0830 h, we were holding an adult female *A. spinifera pallida* for the purpose of macrophotography. While restrained in hand, she made several vigorous attempts to bite and scratch. During this time, a clear viscous fluid was released from her cloaca followed by a prolapse of her cloacal lining resulting in the subsequent exposure of the clitoris. Photographs were taken of this event (Fig. 1) and later deposited in the Texas Turtles Digital Collection (TTDC 170–172). The clitoris and cloacal lining was retracted after being exposed for less than 30 sec. The turtle was immediately released after the photographs were taken.

FIG. 1. Cloacal prolapse by *Apalone spinifera pallida* during handling.

The specimen was handled under the authorization of Texas Parks and Wildlife Scientific Research Permit SPR-1017-201.

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***CARETTA CARETTA* (Loggerhead Sea Turtle) × *LEPIDOCHELYS KEMPII* (Kemp's Ridley Sea Turtle). HYBRID REMIGRATION RECAPTURE.** During the Northwest Atlantic sea turtle nesting season (May–August) in 2020, a female turtle genetically confirmed to be a first-generation hybrid between a male Loggerhead Sea Turtle (*Caretta caretta*) and a female Kemp's Ridley Sea Turtle (*Lepidochelys kempii*) in 2018 (Pfaller et al. 2019. Herp. Rev. 50:347) was recaptured while nesting on Wassaw Island, Georgia, USA (31.9003°N, 80.9822°W) following a 2-year remigration interval. The turtle was identified by three individualized tags applied in 2018: two inconel metal tags attached externally to the posterior edge of each front flipper (left/right: KKD673/KKD657) and one passive integrated transponder tag embedded internally in the elbow region of the right front flipper (982000402272185). The turtle was measured for body and head size on three separate occasions by three separate researchers: mean curved carapace length notch-to-tip (± SD) = 87.2 (± 0.55) cm, mean curved carapace width (± SD) = 84.1 (± 1.2) cm, and mean head width (± SD) = 16.9 (± 0.31) cm. See Pfaller et al. (2019. Herp. Rev. 50:347) for morphological description of this hybrid turtle, as well as an explanation for the genetic analyses used to confirm its first-generation hybrid status.

The turtle deposited four clutches of eggs on Wassaw Island in 2020 separated by 14, 16, and 14 days: 1) 19 May, 2) 2 June, 3) 18 June, and 4) 2 July. The first three nests were deposited at night between 0100–0300 h, while the fourth nest was deposited during

PHOTO BY MONICA HARRIS

Fig. 1. *Caretta caretta* × *Lepidochelys kempii* hybrid recaptured nesting on Wassaw Island, Georgia USA.

the day (1400 h; Fig. 1). Daytime nesting is the predominant nesting behavior in *L. kempii* but is a rare behavior in *C. caretta* and other sea turtle species (Miller 1997. *In* Lutz and Musick [eds.], Biology of Sea Turtles, pp. 51–82. CRC Press, Boca Raton, Florida). Nest 1 contained 129 eggs that produced 88 hatchlings (hatching success [HS] = 73.6%) of which only seven emerged from the nest chamber (emergence success [ES] = 5.4%). The emergence date was unknown for nest 1 and ants were found inside the nest chamber, suggesting ant predation may have contributed to the low ES of this nest. Nest 2 was relocated away from the original nest site because it was at risk of tidal inundation. It contained 142 eggs that produced 111 hatchlings (HS = 78.2%) of which 108 emerged (ES = 76.1%) after 60 d. Nest 3 contained 98 eggs that produced 68 hatchlings (HS = 69.4%) of which 28 emerged (ES = 28.6%) after 51 d. Nest 4 contained 93 eggs that produced 85 hatchlings (HS = 91.4%) of which 84 emerged (ES = 90.3%) after 51 d and two tidal washes during Tropical Storm Isaias (3–4 August). Collectively, mean clutch size (± SD) was 115.5 (± 23.8) eggs, mean incubation duration (± SD) was 54.0 (± 5.2) d, mean hatching success was 78.1% (± 9.5), and mean emergence success was 50.1% (± 39.8).

Following hatchling emergence, tissue samples of large embryos and hatchlings found dead inside nests (2–4) were collected for genetic paternity analysis using nuclear DNA markers. We genotyped samples at 16 microsatellite loci, three of which are completely species diagnostic (CcP1H11, CcP7G11, and CcP7B07), with three additional loci possessing species-informative alleles (CcP1F01, CcP1G03, and CcP2H12; Shamblin et al. 2007. Mol. Ecol. Notes 7:784–787; Shamblin et al. 2009. Conserv. Genet. 10:577–580). In the former loci, the *L. kempii* alleles either fall between *C. caretta* bins or upstream or downstream of *C. caretta* microsatellite arrays. In latter loci, some alleles are shared between species, while others are present in only one species. Microsatellite genotyping reactions were carried out as described for loggerhead turtles (Shamblin et al. 2017. Mar. Biol. 164:138). Genetic analyses revealed that all sampled embryos and hatchlings were sired by a single male *C. caretta* and that this male was different than the male that sired hatchlings of this hybrid female in 2018 (i.e., the hybrid female mated with a different male *C. caretta* in each reproductive season).

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***CHELODINA WALLOYARRINA* (Kimberley Sandstone Longneck Turtle). BEHAVIOR.** A challenge for ecologists is to interpret behaviors exhibited by animals in response to humans within the context of more “natural” interactions (those not involving humans). For example, the Lace Monitor (*Varanus varius*) will usually regurgitate a recent meal upon capture, in at least some populations (e.g., Guarino 2001. Wildl. Res. 28:627–630). Has this behavior evolved to dissuade the predator, or to lighten the load to facilitate rapid escape, or is it simply a stress response with no adaptive anti-predator function? Herein we describe an unusual posturing behavior routinely exhibited by *Chelodina walloyarrina* when captured by us and discuss possible reasons for the behavior.

Chelodina walloyarrina occurs in rivers and streams in sandstone escarpments and in the areas that drain them, in the Kimberley region of northern Australia (Cann 2017. Freshwater Turtles of Australia. CSIRO Publishing, Clayton, Australia. 464 pp). During the dry seasons (April–August) from 2009–2019 our research group captured 90 individual *C. walloyarrina* from three sites at El Questro Wilderness Park, Western Australia (16.00858°S, 127.98102°W; WGS 84) as part of a project studying the impacts of invasive cane toads on native animal communities. The sites consist of shallow, rocky creeks within gorges (Emma Gorge, Amalia Gorge, and Moonshine Gorge). We conducted mark-recapture surveys involving capturing the turtles by hand through snorkeling and feeling under rocks for inactive turtles during the day or wading for active turtles with flashlights at night. During this time an undetermined, but large proportion, of the captured turtles displayed a unique posturing behavior when handled.

Upon lifting the turtles out of the water and holding them upside down, a common turtle handling method to reduce the probability of the handler being bitten or scratched, most individuals would completely extend all four legs. The legs were more or less in a plane parallel with the shell width, with the claws and webbing fully extended (Fig. 1). The head was withdrawn to the shell in most cases. The behavior could also be induced by turning the turtle upside down after initially having it right side up (e.g., during measurement taking). We can find no report of similar behavior in any other species of turtle. Between JSD and DV we have handled 28 chelid turtle species in South America and Australia, during which time we have not seen this posturing behavior in any other species. Moreover, we have not observed this in any turtle species. Indeed, most turtles retract their limbs to a varying extent when captured.

We can offer a few potentially adaptive reasons for the behavior. First, the posturing behavior makes the animal look larger than it is, and this could discourage predators during the prey capture or prey handling stage. For instance, extending the legs could make prey handling difficult for gape-limited predators. However, the behavior is counter to that exhibited by most turtles when captured, which generally draw the legs inwards towards the shell for protection when under threat (e.g., Dodd and Brodie 1975. Herpetologica 31:286–288). Predators have not been identified for this little-known species but would likely include White-bellied Sea Eagles (*Haliaeetus leucogaster*),

PHOTOGRAPH BY B. BARTEK

FIG. 1. Unique posturing behavior exhibited by *Chelodina walloyarrina* when captured and held upside down.

Dingos (*Canis lupus*), crocodiles (*Crocodylus johnstoni*, *C. porosus*), perhaps Rakali (*Hydromys chrysogaster*), feral cats (*Felis catus*) and Northern Quolls (*Dasyurus hallucatus*), and Aboriginal people. One of us (DR) observed a Freshwater Crocodile with an adult *C. walloyarrina* in its mouth at Windjana Gorge, Western Australia; the crocodile swam away with the turtle and the turtle's legs were not conspicuously extended. Of course, smaller individual *C. walloyarrina* could fall prey to a larger suite of predators (e.g., Barramundi, *Lates calcarifer*). It is difficult to imagine the posturing behavior being effective against these predators within the context of prey handling.

Another possibility is that the turtles equate the stimulus of being held upside down with falling. The species lives in creeks and other wetlands in often very rocky habitats, often traversing land between isolated pools (SD, pers. obs.). Perhaps they occasionally fall when climbing over boulders, during which time extending the legs could prevent them from rolling down boulders and/or finding themselves upside down. In this context, holding the turtles upside down could elicit the behavior.

Lastly, the posturing behavior may reflect the antipredator behavior of the turtle wedging itself into a crevice to prevent itself from being extracted by a predator. The species is usually found in crevices underwater when inactive and retreats to crevices when threatened while active (especially those formed between boulders and bedrock or the stream bottom). The turtles are often resistant to being easily removed from the crevices by researchers. In a similar example, the African Pancake Tortoise (*Malacochersus tornieri*) uses its forelimbs to wedge itself into rocky crevices in terrestrial situations (reviewed in Ireland and Gans 1972. Anim. Behav. 20:778–781). If this wedging behavior is an antipredator defense of *C. walloyarrina*, perhaps it continues the behavior in the hands of the researcher, much like an aquatic turtle paddling in air when lifted from the water.

It is of course possible that the behavior has some other adaptive or non-adaptive function. We did not have a chance to investigate further, but some simple handling experiments under different contexts should shed light on why this species exhibits this unique behavior when captured.

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***CHELONIA MYDAS* (Green Sea Turtle) and *CARETTA CARETTA* (Loggerhead Sea Turtle). TUNICATE EPIBIOTA.** Of thousands of marine turtles (*Caretta caretta*, *Chelonia mydas*, *Dermochelys coriacea*, *Eretmochelys imbricata*, and *Lepidochelys olivacea*) examined from three ocean basins (Atlantic, Indian, and Pacific), only two cases of epizoic tunicates (*Molgula* spp., on nesting *C. caretta*) were reported prior to 1985 (Frazier et al. 1991. Bull. Mar. Sci. 48:763–765). Additional observations of epizoic tunicates on nesting *C. caretta* have since been reported in Georgia, South Carolina, and Florida, USA (Caine 1986. J. Exp. Mar. Biol. Ecol. 95:15–26; Frick et al. 1998. Herpetol. Rev. 29:211–214; Frick et al. 2000. Mar. Turt. Newsl. 88:3–5; Frick et al. 2004. Southeast. Nat. 3:613–620; Pfaller et al. 2008. J. Nat. Hist. 42:1095–1102). Tunicates were also observed on non-nesting *E. imbricata* (20.0–85.0 cm SCL) in Puerto Rico, but SCL measurements were not specified for those turtles associated with tunicates (Schärer 2003. Rev. Biol. Trop. 51:87–90). To the authors' knowledge, reports of epizoic tunicates associated with *C. mydas* and sub-adult *C. caretta* have not been reported in literature. Herein, we describe the four observations of tunicate epibionts associated with stranded *C. mydas* (N = 3) and *C. caretta* (N = 1) since the establishment of the Texas Sea Turtle Stranding and Salvage Network (STSSN) in 1980.

On 25 July 2002, STSSN personnel documented a moderately decomposed sub-adult *C. caretta* stranded on Mustang Island, Nueces County, Texas, USA. The *C. caretta* measured 74.5 cm straight carapace length (SCL) and 59.0 cm straight carapace width (SCW). The turtle's carapace was partially covered with epibiota, including acorn barnacles, tunicates, skeleton shrimp, and bristle worms. On 21 March 2014, STSSN personnel recovered a live sub-adult *C. mydas* stranded on North Padre Island, Nueces County, Texas, USA (Fig. 1A). The *C. mydas*

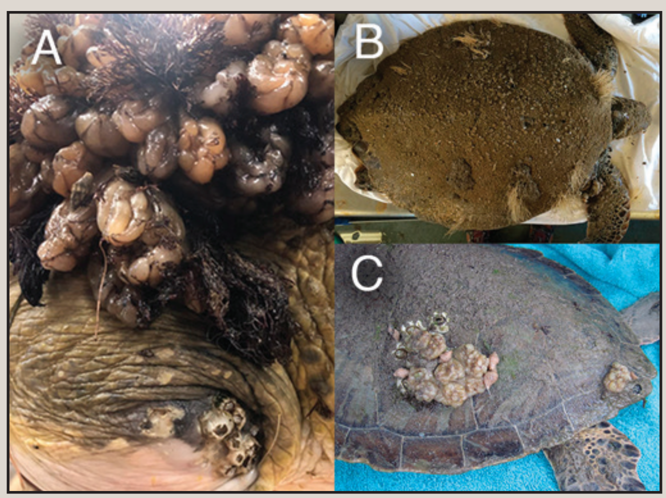

FIG. 1. A) Epizoic tunicates present on a *Chelonia mydas* found live stranded in a canal near North Padre Island, Texas, USA; B) epizoic tunicates documented on a *C. mydas* found live stranded on Mustang Island, Texas, USA; C) epizoic tunicates on a *C. mydas* found live stranded on North Padre Island.

measured 40.1 cm SCL and 32.4 cm SCW. The carapace was partially covered with epibiota, including green algae, barnacles, tunicates, and snails. On 13 February 2016, STSSN personnel recovered a live sub-adult *C. mydas* stranded on Mustang Island, Nueces County, Texas, USA (Fig. 1B). The *C. mydas* measured 57.2 cm SCL and 46.6 cm SCW. The neck and front left flipper were entangled in fishing line, and fibropapilloma tumors were documented in the eyes and under both front shoulders. Marine leeches were present on the left front shoulder, and hydroids and tunicates were present on the carapace. On 8 December 2020, a live sub-adult *C. mydas* was recovered from a canal in the Laguna Madre, near North Padre Island, Nueces County, Texas, USA (Fig. 1C). The *C. mydas* measured 66.2 cm SCL and 51.5 cm SCW. The *C. mydas* was found floating at the surface, with a healed front right flipper amputation. The carapace was 90% covered in epibiota, including tunicates, green algae, bryozoans, and barnacles. To our knowledge, this is the first published record of epizoic tunicates present on *C. mydas* and sub-adult *C. caretta*. Continued documentation of tunicate presence on marine turtles in Gulf of Mexico waters is of interest for the study of the local *C. mydas* population and for investigating the potential implications on sub-adult marine turtle health.

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***CHELYDRA SERPENTINA* (Snapping Turtle). ANTHROPOGENIC MORTALITY.** Many types of anthropogenic refuse are known to cause mortality of chelonians (Reding et al. 2020. Herpetol. Rev. 51:108; Yaghmour 2020. Mar. Pollut. Bull. 153:111031). Mortality of *Chelydra serpentina* (Snapping Turtle) is known to occur through a wide variety of natural (Ernst and Lovich 2009. Turtles of the United States and Canada. Second edition. The Johns Hopkins University Press, Baltimore, Maryland. 827 pp.) and anthropogenic (Hartzell 2015. Herpetol. Rev. 46:78; Piczak et al. 2019. Chelon. Conserv. Biol. 18:231–240) means. Here, I report a mortality event of an adult *C. serpentina* due to entrapment in anthropogenic refuse.

On 12 July 2020, I observed a deceased adult *C. serpentina* that was lodged inside a submerged vehicle tire (Fig. 1) in Kettle Creek Lake, within Kettle Creek State Park, Clinton County, Pennsylvania, USA (41.37840°N, 77.92716°W; WGS 84; ca. 256 m elev.). The individual was lodged in the opening of the tire, and likely drowned. I shifted the tire and deceased individual to obtain photographs. Decomposition of the individual had progressed to the point that the carapace consisted nearly entirely of bone and broke apart when I attempted to remove it from the tire, therefore, accurate measurements could not be obtained. The skull was found within the tire between the sidewalls and measured 88 mm at its widest point. According to tire specifications, the opening measured ca. 381 mm in diameter.

This type of mortality has been reported by Hartzell (2019. Herpetol. Rev. 50:556); however, in that case the tire was only partially submerged, and it was presumed that the individual had attempted to bask on the tire before becoming lodged. In this instance the tire was entirely submerged, and a possible scenario is that the individual became lodged while attempting to move through the tire while underwater and subsequently drowned as it could not reach the surface. An internet search revealed several accounts of deceased turtles lodged in tires. These observations

Fig. 1. The broken carapace of a deceased *Chelydra serpentina* found within a submerged tire.

highlight the importance of proper disposal of tires and other anthropogenic waste. Given the number of discarded tires throughout the landscape, the potential exists for this to be a form of indirect mortality for many species of chelonians around the world, and may often go unnoticed, especially when tires are submerged.

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***CHELYDRA SERPENTINA* (Snapping Turtle), *TRACHEMYS SCRIPTA* (Pond Slider), and *TERRAPENE CAROLINA* (Eastern Box Turtle). ANTICIPATORY BEHAVIOR.** While cognitive abilities are well-studied in mammals and birds, equivalent attention had not been directed toward non-avian reptiles prior to a review by Burghardt (1977. *In* Gans and Tinkle [eds.], The Biology of the Reptilia, Volume 7, pp. 555–681. Academic Press, New York, New York). Since that review, studies have found instances of play behavior, tool use, communication, learning, and short- and long-term memory in a number of species (Burghardt 2020. *In* Melfi et al. [eds.], Zoo Animal Learning and Training, pp. 227–230. Wiley-Blackwell, Hoboken, New Jersey). In testudines, several studies described the ability to learn in response to external stimuli, demonstrating both spatial cognition and long-term memory to complete a series of complicated learned tasks in lab environments (Wilkinson and Glass 2019. Encyl. Animal Cognit. Behav. doi.org/10.1007/978-3-319-47829-6_1430-1; Davis and Burghardt 2007. Behav. Process. 75:225–230). Here, we document what we interpret to be a newly recognized phenomenon in chelonian cognition in two aquatic species, *Chelydra serpentina* and *Trachemys scripta*, and possibly in the terrestrial *Terrapene carolina*.

For the last 10 years, as part of a wildlife rehabilitation program, one of us (MH) has been providing food (dead trout, mice, and/or chicks) for hand-reared and released *Lontra canadensis* (River Otters) at a site on the Yellow River, Rockdale County, Georgia, USA. Feedings occurred beginning in July and continued for five to six months as the otters adjusted to independent living. Each year, within three to four days of onset of the daily feeding events, the aforementioned species of turtle have been observed on game camera to emerge and wait at or on the shore at the appropriate spot, apparently in anticipation of receiving food.

Feeding events take place at 0700 h and 1900 h each day, and both *C. serpentina* and *T. scripta* seem to cue into the evening feeding time with more consistency than the morning feedings. Although typical sightings consist of a mix of four to five turtles of both *C. serpentina* and *T. scripta*, up to 15 turtles have been observed at one time. Although observed during feeding events, *T. carolina* was observed less frequently at the site, and also often viewed on game camera at other times of the day. The inconsistent presence of *T. carolina* may possibly be attributed to their opportunistic foraging strategy (Boyer and Boyer 2006. Rept. Med. Surg. 2:78–99). Occasionally the turtles do not appear at all, for unknown reasons.

Both species of aquatic turtles stop appearing at the shore within 3–4 d after the feeding events have stopped, indicating a rapid cessation of response with the absence of food. The turtles appear on camera, either congregated at the feeding site on shore, or in the water directly adjacent to the site. The congregations are observable on camera and commence prior to any auditory or visual cues from the arrival of the food provider, indicating that the turtles appear to be learning the time of feeding events, perhaps from sun position or other, unidentified, diel variation in the environment. The generally aquatic-feeding *Chelydra* and *Trachemys* often come ashore in anticipation of the food arrival, return to the water when the food provider arrives, but then re-emerge to take the food. We believe this demonstrates an example of anticipatory behavior or expectant memory (Torres and Papini 2017. *In* J. Vonk and T. Shackelford [eds.], Encyclopedia of Animal Cognition and Behavior. Springer, Cham. doi.org/10.1007/978-3-319-47829-6_1079-1), and to our knowledge, learned time-based anticipatory behavior has not yet been documented in turtles.

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***CYCLEMYS ATRIPONS* (Black-bridged Leaf Turtle). REPRODUCTION.** *Cyclemys atripons* is a semi-aquatic turtle restricted to extreme southwestern Cambodia and adjacent areas of southeastern Thailand (Iverson and McCord 1997. Proc. Biol. Soc. Washington 110:629–639), with an apparently disjunct population occurring in the Dangrek Mountains of northern Cambodia (Brakels et al. 2016. Cambodian J. Nat. Hist. 2016:20–22). The natural history and ecology of *C. atripons* remains poorly studied with virtually nothing known concerning reproduction in the wild and only limited observations available from captivity (Schilde 2003. Draco 35:35–39; Schilde 2004. Asiatische Sumpfschildkröten—Die Familie Geoemydidae in Südostasien, China und Japan. Natur und Tier, Verlag, Munster, Germany. 60 pp.; Burne 2012. The Batagur 2:22–28). We here describe the eggs and reproductive phenology of *C. atripons* in Cambodia.

On 24 April 2018, a villager presented a female *C. atripons* (176 mm straight-line carapace length, 159 mm plastron length measured from base of anal notch, 750 g, 5–6 plastron annuli) to the Koh Kong Reptile Conservation Center (KKRCC) near Koh Kong Town in Koh Kong Province, Cambodia. The villager chanced upon the turtle a few days previously as it crossed a dirt road in the nearby Peam Krasaop Wildlife Sanctuary (11.535°N, 103.1279°E; WGS 84; ca. 3 m asl). Habitat in the wildlife sanctuary is characterized by low hills covered in secondary semi-evergreen tropical forest. The climate is monsoonal with a wet season extending from mid-May through late-September. We temporarily housed the turtle in a fiberglass tub (1.0 × 1.5 × 0.8 m high) pending repatriation to the wild. The tub contained shallow water (20–30 cm) and aquatic plants with a substrate for basking.

On the night of 4–5 May 2018, the female turtle deposited a single egg (50 mm length, 27 mm width, 20 g) in the water. We recovered the egg the following morning (5 May 2018) and placed it in a plastic container filled with a mixture of soil and leaf litter to incubate at ambient temperatures. The female laid a second egg (53 mm length, 27 mm width, 30 g) at ca. 1200 h on 11 May 2018, again depositing the egg in the water. This egg was recovered shortly after laying and placed together with the first egg to incubate. The combined mass of the two eggs (clutch mass) was 50 g. The relative clutch mass (clutch mass/[gravid female body mass – clutch mass]; Iverson et al. 1991. J. Herpetol. 25:64–27) was 0.071 and relative egg mass (relative clutch mass/clutch size; Iverson et al. 1991, *op. cit.*) was 0.035. The female turtle was maintained at KKRCC for another two weeks, but when no additional eggs were forthcoming she was released at the approximate capture location on 25 May 2018. We terminated incubation in late June when it became apparent that both eggs were beginning to decompose. We examined the contents of each egg and found no evidence of embryonic development.

Data on clutch characteristics and reproduction in *C. atripons* comparable to ours are sparse and confined to the hobbyist literature. Schilde (2004, *op. cit.*) reported that two female *C. atripons* each deposited a single clutch of 1–4 eggs annually. Similarly, Burne (2012, *op. cit.*) stated that a long-term captive female produced a single clutch of up to six eggs each year. The staggered egg deposition that we noted was probably due to the lack of suitable nesting substrate in the tub where the female was housed, causing her to retain the second egg for an additional six days after laying the first. The length and width of the two eggs that we measured are somewhat less than the maximum length (61 mm) and width (36 mm) reported by Burne (2012, *op. cit.*), but within the approximate range (61–67 mm length, 24–28 mm width; N = 4) given by Schilde (2004, *op. cit.*). Our measurements of egg and clutch mass appear to be the only such data yet reported. Our observation of egg-laying in May suggests that *C. atripons* in Cambodia nests just prior to the beginning of the annual monsoon. In captivity, a single clutch incubated at 28°C hatched after 75 d (Schilde 2004, *op. cit.*). If incubation periods are similar in the wild, then hatchings will emerge during late July or early August, a period coinciding with the height of the monsoon when rainfall is heaviest. Villagers living near KKRCC that we interviewed reported occasionally finding *C. atripons* eggs concealed among leaf litter alongside small hill streams in the wildlife sanctuary. Assuming that plastron annuli accurately predict age (but see Brooks et al. 1997. J. Herpetol. 31:521–529), our annuli count suggests female *C. atripons* are capable of reproducing when relatively young (5–6 years).

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***EMYDOIDEA BLANDINGII* (Blanding's Turtle). DIET.** *Emydoidea blandingii* is an Illinois state-endangered, semi-aquatic emydid turtle with an omnivorous diet encompassing a wide-range of aquatic prey items; crayfish, annelids, mollusks, gastropods, aquatic insects, fish eggs, amphibians, filamentous algae, plant matter, and berries have all been reported by previous authors (Lagler 1943. Am. Midl. Nat. 29:257–312; Phillips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Natural History Survey Manual 8, Champaign, Illinois. 282 pp.; Ernst and Lovich 2009. Turtles of the United States and Canada. Second edition. Johns Hopkins University Press, Baltimore Maryland. 235 pp.). The presence of waterfowl or other birds in the diet of *E. blandingii* has only rarely been reported, with Lagler (1943, *op. cit.*) describing two isolated instances of fragmentary avian remains found in the digestive tracts out of 66 specimens examined. The remains were presumed to be those of domesticated ducks (Anatidae). Ernst and Lovich (2009, *op. cit.*) also note an instance of avian consumption (presumed carrion) by *E. blandingii.* The observation described herein adds to the few documented instances of avian consumption by *E. blandingii.*

In July 2019, while working as a wildlife technician under the Forest Preserve District of Kane County, JSC discovered the remains of unidentified avian plumage in the feces of an adult female *E. blandingii* from a palustrine wetland complex in Kane County, Illinois, USA. The turtle was captured through the use of an aquatic funnel trap array and was briefly held in captivity while awaiting radio transmitter fixation at the time of the observation. We postulate that this dietary event likely stems from one of two possible hypotheses: active predation, in which a wetland bird fledgling fell into the wetland and was then predated upon by *E. blandingii*, or an act of scavenging, wherein the *E. blandingii* discovered and fed upon a bird carcass post-mortem.

All animals collected were done so in accordance with Illinois Department of Natural Resources regulation and permitting (collection permit HSCP 19-14 and 5426).

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***GOPHERUS POLYPHEMUS* (Gopher Tortoise). ADULT MORTALITY.** *Gopherus polyphemus* has typically high adult survivorship, with some populations reaching a mean annual survivorship of 93.4% (Howell et al. 2019. J. Wildl. Manage. 84:56–65). Instances of adult mortality are not commonly reported outside of large mortality events, and most often result from disease, starvation, dehydration, or chronic stress (Gates et al. 2002. Florida Sci. 65:185–197; Cozad et al. 2020. Front. Vet. Sci. 7:120). Adult *G. polyphemus* also have few natural predators, which include *Canis familiaris* (Domestic Dog), *Canis latrans* (Coyote), and *Lynx rufus* (Bobcat; Ashton and Ashton 2008. The Natural History and Management of the Gopher Tortoise—*Gopherus polyphemus* [Daudin]. Krieger Publishing Company, Malabar, Florida. 275 pp.).

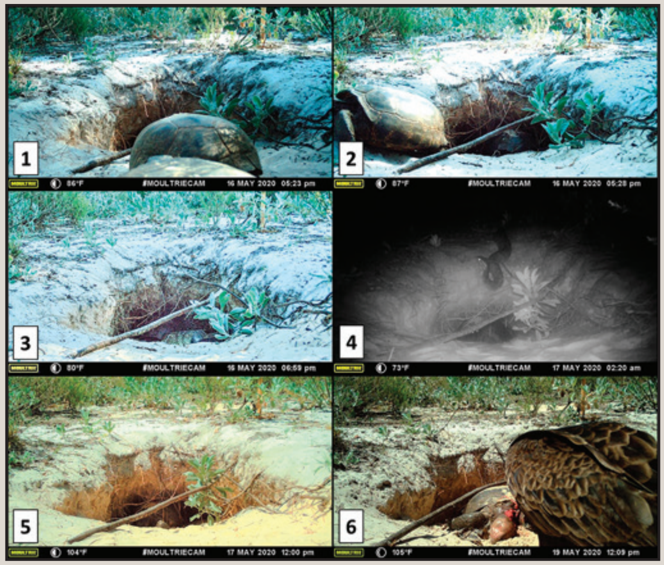

Fig. 1. A series of photographs taken by a game camera that document the mortality of an adult male *Gopherus polyphemus* at a burrow from St. Vincent Island, Florida, USA.

Breeding adults are valuable contributors to wildlife populations (Crouse et al. 1987. Ecol. 68:1412–1423; Crawford et al. 2014. J. Appl. Ecol. 51:359–366). Even small declines in survival of adult turtles over short periods of time can have long-term negative impacts (Dodd 1988. Am. Midl. Nat. 119:394–401; Bailey and Guyer 1998. Chelon. Conserv. Biol. 3:77–83; Fonnesbeck and Dodd 2003. J. Herpetol. 37:602–607). In 1987, *G. polyphemus* was federally listed as threatened in the portion of its range west of the Mobile and Tombigbee Rivers (Fish and Wildlife Service 1987. Fed. Reg. 52:129) and is currently a candidate for federal listing in the eastern portion of its range (U.S. Fish and Wildlife Service 2011. Fed. Reg. 76:45–130). Therefore, new sources of mortality are important to identify and address for the conservation of this at-risk species. Here, we present evidence for a possible novel source of mortality of an adult *G. polyphemus* by an *Agkistrodon piscivorus* (Cottonmouth). This event is particularly interesting as *A. piscivorus* is a known burrow commensal of *G. polyphemus* (Jackson and Milstrey 1989. *In* Gopher Tortoise Relocation Symposium Proceedings, pp. 86–98. Florida Fame and Freshwater Fish Commission, Tallahassee, Florida).

This observation took place on St. Vincent Island, Florida, USA, which is part of St. Vincent National Wildlife Refuge. In a series of successive images captured over an ca. 3-d period (1723 h on 16 May 2020 to 1209 h on 19 May 2020) an adult male *G. polyphemus* (T1) was documented entering a tortoise burrow (Fig. 1). An *A. piscivorus* can be observed inside of and then outside of the burrow, and the carcass of T1 is then evident. Although successive, there were photos captured in between those we included here. These photos did not add information to the event and are largely duplicates of photos we have included. In this set of photos, T1 was first documented approaching the burrow with another *G. polyphemus* in an apparent attempt to mate with the resident female (Fig. 1A). T1 was then seen inside the mouth of the burrow while the other tortoise was leaving the apron (Fig. 1B). In the next photo, ca. 1.5 hours later, T1 was in the mouth of the burrow, facing away from the camera, and an *A. piscivorus* was documented in the mouth of the burrow (Fig. 1C). Then, ca. 7.5 hours later, an *A. piscivorus* was observed on top of the burrow and T1 was still in the mouth of the burrow but had rotated to face the camera (Fig. 1D). T1 remained in the same location and position for 2 d, 10 h (Fig. 1E). T1 was then removed from the burrow by a *Cathartes aura* (Turkey Vulture) which thereby verified his mortality (Fig. 1F). The presumed carcass of T1 was eventually located, ca. 20 m from the burrow, confirming it was an adult male tortoise with carapace length of 25.5 cm. Unfortunately, all that remained was the carapace and plastron, so there was no physical evidence to evaluate the cause of mortality, including whether a snake bite had occurred.

Though circumstantial, the evidence from this series of photographs supports the possibility that this mortality was caused by envenomation by the *A. piscivorus* that visited the burrow. Other possible causes of mortality that would be coincidental to the snake arriving could be dehydration or disease. However, we have seen no external signs of disease on the island, and disease transmission would be difficult because of this isolated location. Thus, alternate explanations are possible, but the chance that a venomous burrow commensal was the source of mortality for an adult *G. polyphemus* is worth considering in the management of this species. Our observations suggest a need for additional research on adult mortality and the interactions among *G. polyphemus* and its burrow commensals.

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***GRAPTEMYS VERSA* (Texas Map Turtle). KYPHOSIS.** To date, kyphosis among *Graptemys* has been reported for *G. flavimaculata, G. geographica, G. gibbonsi* (Mitchell et al. 2019. Herpetol. Rev. 50:353–354.), *G. oculifera* (Selman and Jones. 2012. Chelon. Conserv. Biol. 11:259–261), and *G. sabinensis* (Irvin et al. 2015. Herpetol. Rev. 46: 81). Herein, I report the first documented *Graptemys versa* with a kyphotic shell condition. On 15 July 2009 at 1035 h, an adult female *G. versa* was captured in Menard County, Texas, USA, along the banks of the San Saba River (30.86683°N, 100.02458°W; WGS 84). The specimen demonstrated a kyphotic condition of the carapace (Fig. 1). The dimensions of her shell were: 16.2 cm carapace length, 13.2 cm carapace width, 15.4 cm plastron length, 10.7 cm plastron width, 7.5 cm shell height, 709 grams. Photographs of the specimen were deposited in the Texas Turtles Digital Collection (TTDC 173–176).

Fig. 1. Female *Graptemys versa* from Texas, USA showing kyphosis of the carapace.

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***KINOSTERNON FLAVESCENS* (Yellow Mud Turtle). REPRODUCTION.** *Kinosternon flavescens* is a highly terrestrial kinosternid occurring across a large portion of central North America, from Nebraska, USA south through the northern portions of Chihuahua, Coahuila, Nuevo León, and Tamaulipas, México (Seidel 1978. Cat. Am. Amphib. Rept. 216:216.1–216.4). Across their range, reproduction has generally been reported as occurring in the "spring" or after emergence from hibernation (Ernst and Lovich 2009. Turtles of the United States and Canada. Second edition. The Johns Hopkins University Press, Baltimore, Maryland. xii + 827 pp.; Fogell 2010. A Field Guide to the Amphibians and Reptiles of Nebraska. University of Nebraska—Lincoln, Lincoln, Nebraska. vi + 158 pp.). Despite their wide range, direct observations of copulation in the wild appear absent from the literature. Here, we report two observations of copulation in *K. flavescens* from Texas, USA.

At 1230 h on 13 August 2013, while conducting a mark-recapture study on *K. flavescens* in the Chihuahuan Desert, we (DRD, TJL) observed a copulating pair of *K. flavescens* at 2-Section Pond, C.E. Miller Ranch, Jeff Davis County, Texas, USA (30.63864°N, 104.63358°W; WGS 84). The site was an earthen, dugout pond that holds water intermittently, usually as overflow from another well-fed dugout earthen pond immediately adjacent. The pair were copulating in shallow water (ca. 10 cm deep) with abundant emergent vegetation, ca. 2 m from the shoreline. When encountered, it was mostly sunny, and the air temperature was 30.8°C. The pair was collected, measured, marked, and released back at the site of capture. Both the male (251.1 g, 102.6 mm SCL) and female (218.3 g, 94.35 mm SCL) showed visible damage to the carapace suggestive of Stage 1 of a recently described algae-associated shell disease (Christensen et al. 2020. J. Herpetol. 54:1–8). Additionally, both individuals had relatively clean shells with minimal algae, suggesting that they had recently arrived at this pond from nearby terrestrial habitats.

At 1130 h on 25 June 2019, while conducting surveys for Black-spotted Newts (*Notophthalmus meridionalis*), we (DRD, PSR) collected a copulating pair of *K. flavescens* from Newt Pond, Laguna Atascosa National Wildlife Refuge, Cameron County, Texas, USA (26.31061°N, 97.36511°W; WGS 84; Fig. 1A). This dugout, ephemeral pond, which sits within a former resaca bed, was previously used as an earthen cattle tank. The pond was moderately turbid, with a water temperature of 29.1°C and a pH of 8.03. The pair of turtles were captured with a dip net, photographed, and released back at site within ca. 5 min of capture. The pair remained copulating with the male securely grasping the female for several minutes after capture. Both the male (Fig. 1B) and female (Fig. 1C) showed visible damage to the carapace suggestive of Stage 2 of the previously mentioned algae-associated shell disease (Christensen et al. 2020, *op. cit.*). Photographs of both were deposited at the Biodiversity Collections, University of Texas at Austin (male: TNHC 115082; female: TNHC 115083). When encountered, it was a clear sky with an air temperature of 29.4°C. The previous day, 5.1–10.2 cm of precipitation fell in eastern Cameron County, with higher

PHOTOS BY DREW R. DAVIS

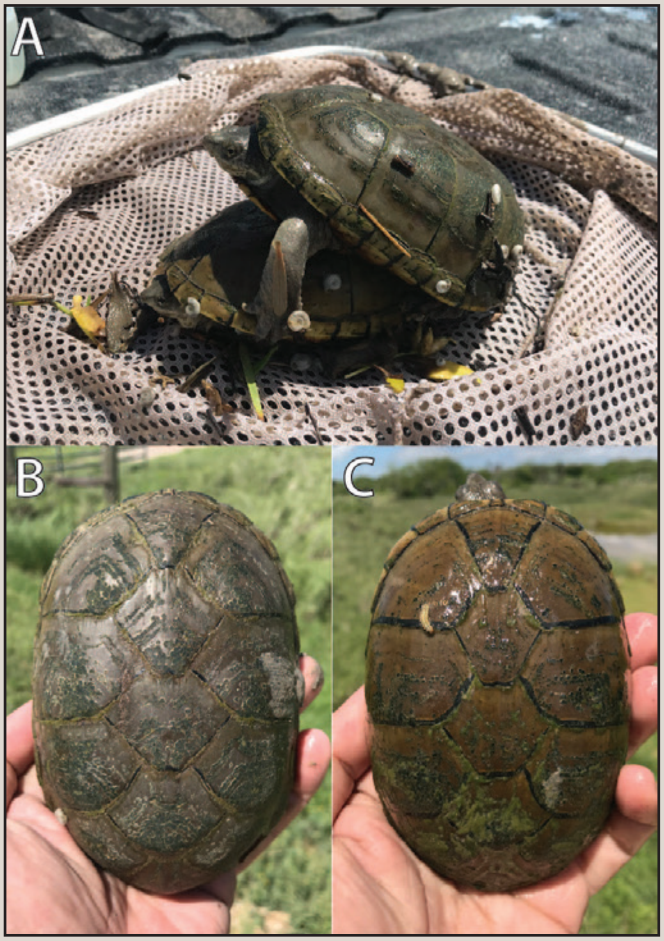

Fig. 1. Copulating pair of Yellow Mud Turtles (*Kinosternon flavescens*) found at Laguna Atascosa National Wildlife Refuge, Cameron County, Texas, USA on 25 June 2019 (A), with dorsal views of the male (B) and female (C).

precipitation totals (20.3–30.5 cm) falling ca. 25 km to the west. We suspect that movement from terrestrial uplands where *K. flavescens* spend a large portion of their time (Degenhardt et al. 1996. The Amphibians and Reptiles of New Mexico. University of New Mexico Press, Albuquerque, New Mexico. xix + 431 pp.; Legler and Vogt 2013. The Turtles of Mexico: Land and Freshwater Forms. University of California Press, Berkeley, California. xi + 402 pp.) to this site were triggered by this rainfall event, which resulted in copulation.

These two observations appear to be the first published accounts of *K. flavescens* copulation in Texas. Vermersch (1992. Lizards and Turtles of South-central Texas. Eakin Press, Austin, Texas. xiv + 170 pp.) states that information on *K. flavescens* reproduction is lacking from across the region and Hibbitts and Hibbitts (2016. Texas Turtles & Crocodilians. A Field Guide. University of Texas Press, Austin, Texas. xvi + 257 pp.) only state that mating occurs in the spring. In additional parts of their range, authors have remarked that copulation takes place in early May (Iowa, USA: LeClere 2013. A Field Guide to the Amphibians and Reptiles of Iowa. ECO Herpetological Publishing & Distribution, Rodeo, New Mexico. viii + 349 pp.) and "probably before June" (Kansas, USA: Collins et al. 2010. Amphibians, Reptiles, and Turtles in Kansas. Eagle Mountain Publishing, LC, Eagle Mountain, Utah. xvi + 312 pp.). Copulatory behaviors of *K. flavescens* were described by Mahmoud (1967. Copeia 1967:314–319) after observing captive animals in April and May. Additional copulation in *K. flavescens* has been observed in the late summer and fall, but again, these were observations of captive individuals (August: Thornton and Smith 1996. Bull. Chicago Herpetol. Soc. 31:204–205; October: Taylor 1933. Univ. Kansas Sci. Bull. 21:269–271). Our observations add to the understanding of this species' reproductive biology and is among the first to provide direct evidence of copulation in the field for *K. flavescens*.

Specimens were handled under a Texas Parks and Wildlife Scientific Permit for Research (SPR-1097-912; SPR-1018-294), approved IACUC protocols (AUP-2012-00112; AUP #18-28), and a USFWS Special Use Permit (STRC-12-17-18-CJP).

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***MACROCHELYS SUWANNIENSIS* (Suwannee Alligator Snapping Turtle). REPRODUCTION.** The mating season of *Macrochelys* (alligator snapping turtles) is primarily based on observations of captive turtles and interpolation from studies of reproductive physiology. Allen and Neill (1950. Ross Allen's Reptile Inst. Special Publ. 4:115) observed courting of presumed *M. suwanniensis* from February through April in captivity in northcentral Florida, USA, with coitus lasting as long as 25 min. Mating in captivity of the congeneric *M. temminckii* in Louisiana, USA occurred in March primarily at night, with most intense activity at a water temperature of 16.0°C and apparently declining as the water temperature reached 18.0°C (Harrel et al. 1996. Chelon. Conserv. Biol. 2:101105). In southwestern Georgia, USA, a peak in testosterone and estradiol levels of female *M. temminckii* in March and April corresponded with mating and ovulation, and appearance of wounds on males occurred only in April (Teare 2010. M.S. Thesis, Georgia Southern University, Statesboro, Georgia. 91 pp.).

On 7 December 2020, a mating pair of *M. suwanniensis* was observed in the Suwannee River in Lafayette County, Florida (30.11268°N, 83.22528°W; WGS 84). The male was atop and grasping the smaller female, which had been caught at night by a bush hook (i.e., limb line) set for catfish. Four other *M. suwanniensis* were caught by about 10 bush hooks set the same evening at this location. The encounter was recorded with a cellphone video illuminated by a headlamp (Fig. 1), and the male did not disengage from the female during the 23 min required to pull the turtles to the surface and remove the circle hook. This represents the first observation of *M. suwanniensis* mating in the wild and is the earliest observation of mating in *Macrochelys*. This early mating may be unique to *M. suwanniensis* or indicate that *M. temminckii* has the potential for a prolonged mating season in the southern portions of its range. Dobie (1971. Copeia 1971:645–658) found sperm in the vasa deferentia of adult males throughout the year in Louisiana, suggesting that copulation could occur during any month turtles are active. In Louisiana, vitellogenesis for the upcoming year is largely completed by the end of summer, follicles are retained over winter, and ovulation occurs in April (Tucker and Sloan 1997. Chelon. Conserv. Biol.

FIG. 1. Mating pair of *Macrochelys suwanniensis* on 7 December 2020 in the Suwannee River, Lafayette County, Florida, USA. The female was caught by the bush hook visible in the photograph.

2:587592). Limited data indicate that the nesting season of *M. suwanniensis* in Florida is similar to that of *M. temminckii* along the lower Apalachicola River, which is late April and May (Ewert et al. 2006. Chelon. Res. Monogr. 3:5871). Presumed *M. suwanniensis* in northcentral Florida oviposited 21 April–15 June in captivity (Allen and Neill 1950, *op. cit.*), and freshly-dug nests have been reported from 15 April to 21 May in Florida (Jackson and Thomas 2018. Herpetol. Rev. 49:321). If *M. suwanniensis* does not begin nesting until mid-April, some females may retain sperm for several months prior to ovulation. We note that the compromised ability of the hooked female to evade the male may have facilitated this early mating event, and which may represent an infrequent occurrence.

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***MACROCHELYS TEMMINCKII* (Alligator Snapping Turtle). LENTICULAR OPACITY.** The most common type of lenticular opacities of reptiles are lenticular scleroses and senile cataracts. Lenticular sclerosis is characterized by variable degrees of central-fiber compaction in the substance of the lens. This causes the lens to appear slightly gray and unclear when viewed with an ophthalmoscope but does not significantly interfere with transmission of light. Senile cataracts are common in aged animals. Most of the opacities mature slowly and apparently cause minimal visual impairment (Frye 1981. Biomedical and Surgical Aspects of Captive Reptile Husbandry. Veterinary Medicine Publishing Company, Edwardsville, Kansas. xiv + 456 pp.). Cataracts have been documented in turtles, including *Chelydra serpentina* (Occelli and Wolfer 2011. Vet. Ophthalmol. 14:275–283). Herein, we present the first documentation of an Alligator Snapping Turtle (*Macrochelys temminckii*) with lenticular opacities. Photographs were taken and placed into the Texas Turtles Digital Collection (TTDC).

On 16 June 2018 at 0930 h at the Trinity River, Arlington, Tarrant County, Texas, USA a large adult female *M. temminckii* was captured in a hoop trap (TTDC 179, 180; Fig. 1). This specimen had the following body dimensions: 50.6 cm midline carapace length, 54.1 cm maximum carapace length, 40.5 cm carapace width, 37.3 cm plastron length, 16.1 cm shell height, 6.4 cm pre-cloaca length, 27.8 cm post cloaca length, 15.5 cm head width, and 32.2 kg. Lenticular opacity was present in both eyes. However, no veterinary examination was performed to determine the exact type of opacity. The specimen was photographed, measured and marked with a subdermal passive integrated transponder and released (#93E011A).

FIG. 1. Female Alligator Snapping Turtle from Tarrant County, Texas, USA, with lenticular opacities.

The specimen in this report was handled under the authorization of Texas Parks and Wildlife Scientific Research Permit SPR-1017-201.

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***MACROCHELYS TEMMINCKII* (Alligator Snapping Turtle). OVERLAND MOVEMENT.** *Macrochelys temminckii* is a long-lived species capable of moving substantial distances along aquatic passageways. Although short overland movements do occur, these movements have typically been associated with gravid females heading towards nesting locations, and subsequently by hatchlings heading towards water. These nests have been observed up to 250 m (following the "shortest logical path") from the nearest body of water, with most nests occurring within 20 m of the water's edge (Ewert et al. 2006. Chelon. Res. Monogr. 3:58–71). Enge et al. (2014. Population status, distribution, and movements of the alligator snapping turtle in the Suwannee River, Florida. Final Report to Florida Fish and Wildlife Research Institute, Wildlife Research Laboratory, Gainesville, Florida. 47 pp.) reported one of the first instances of overland movement in *Macrochelys* not associated with nesting, where *M. suwanniensis* would move between the Suwannee River channel and its associated floodplain during dry periods. Herein, we described a similar observation of overland movement by an adult *M. temminckii* in southern Mississippi, USA.

On 1 June 2020, an adult *M. temminckii* was found on the road (31.0654°N, 89.2028°W; WGS 84) with injuries to the carapacial keels, suggesting the turtle had been hit by the undercarriage of a vehicle (Fig. 1). After the Central Mississippi Turtle Rescue was notified, LP arrived at the location to find the turtle gone.

Fig. 1. An adult *Macrochelys temminckii* showing recent damage to the carapacial keels, likely from an impact with the undercarriage of a vehicle from Mississippi, USA.

Fig. 3. Small wetland pond where the adult *Macrochelys temminckii* originated in Mississippi, USA. The turtle exited the pond along the smooth pathway just to the right of the picture center.

Fig. 2. *Macrochelys temminckii* tracks through the mud and sand substrate of the intermittent stream's floodplain in Mississippi, USA.

However, tracks were discovered along a dry creek bottom consisting of sand and mud substrates (Fig. 2). The distance of these tracks was recorded using a GPS, and, when tracks were lost due to areas of hardpacked soil and leaf litter, straight-line distance from the location of the previous tracks to where the trail was observed again was used. These tracks lead to where the *M. temminckii* resided, in a small wetland pond with an approximate maximum depth of 0.35 m, 4 m wide at the widest, and 8 m long within the floodplain of an intermittent stream (Fig. 3). When flowing, this stream is a tributary of a seemingly permanent backwater of Black Creek, ca. one km straight-line distance south. Based on the GPS measurement, the *M. temminckii* traveled 280 m overland from the small, heavily forested wetland to the roadside. The straight-line distance from the wetland to the road was 203 m.

The wetland pond was isolated from other water bodies, with no water source of any substantial size within the immediate vicinity. There were no *M. temminckii* tracks entering the pond, so the turtle likely resided within this small water body since the last heavy precipitation that would create a flowing stream, or long enough for tracks from a second overland movement to have eroded away by rainfall. Unfortunately, sex could not be determined based on the photos; however, June 1st would be later than usual for nesting in *M. temminckii*, as most nesting occurs from April to May in the southern part of the range (Ewert et al. 2006, *op. cit.*). This suggests that the overland movement was likely due to drying of the wetland pond and the search for a more permanent water body, similar to that reported by Enge et al. (2014, *op. cit.*). Because the turtle was not observed near the road on arrival, the 280 m traveled is a minimum distance and could be substantially farther as the turtle was moving upstream, potentially towards a larger forest pond and/or quarry pond, ca. 250 to 300 m straight-line distance from the road.

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***MACROCHELYS TEMMINCKII* (Alligator Snapping Turtle). RESPONSE TO FLOOD EVENT.** Natural causes of species displacement such as major stochastic flood events have rarely been discussed in the literature (Jones and Sievert 2009. Can. Field-Nat. 123:313–322). However, major flood events are thought to be a leading cause of movement or displacement for many species, including freshwater turtles. Habitats that have been anthropogenically altered and/or manipulated tend to be subject to increased flooding pressures (Bodie and Semlitsch 2000. Oecologia 122:138–146). The impact on wildlife in these

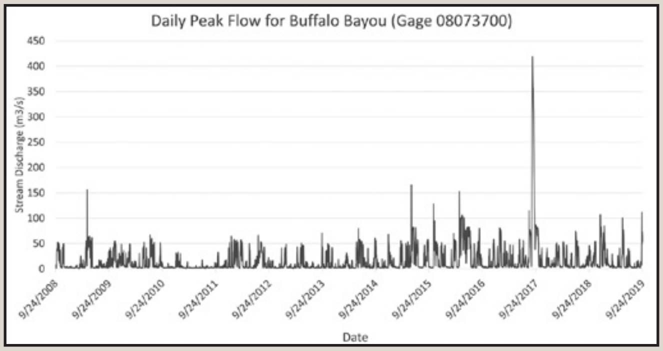

FIG. 1. Stream Discharge as it relates to flow rate (m^3/s) in Buffalo Bayou, Houston, Texas, USA, from September 2008 until September 2019. Note the number of peak-flow events above 100 m^3/s (http://waterdata.usgs.gov; 5 Feb 2021).

FIG. 2. A large *Macrochelys temminckii* observed during a flood event on Waugh Street Bridge, Houston, Texas, USA.

altered systems is largely unknown and little attention has been given to spatial ecology for many species within urbanized ecosystems (Yagi and Litzgus 2012. Copeia 2012:179–190).

The Turtle Survival Alliance-North American Freshwater Turtle (TSA-NAFT) Research Group has been conducting a long-term population study of *Macrochelys temminckii* in Harris County, Texas, USA, since 2016. All turtles captured have a series of morphological measurements taken, are given a visual health assessment, marked with a hard notch code adjusted from Cagle (1939. Copeia 1939:170–173), and inserted with a Passive Integrated Transponder (PIT) tag (Buhlman and Tuberville 1998. Chelon. Conserv. Biol. 3:102–104) before being released at the point of capture (see Munscher et al. 2020. Urban Nat. 32:1–15). On 10 February 2017, a large male *M. temminckii* was captured during this population assessment project. This male had a maximum carapace length of 556 mm and weighed 42.7 kg. All trapping locations are noted by global positioning system (GPS) with latitude and longitude points taken for each trap.

On 28 August 2017, Hurricane Harvey made its second landfall within Texas, coming to shore within the Houston metropolitan region. The system stalled for several days resulting in widespread, record-breaking catastrophic flooding across most of Harris County. On average the downtown Houston City area received ca. 102 cm of rain in a 4-d period (www.weather.gov; 5 Feb 2021). Some of the surrounding areas received over 152 cm of rain during this time span (www.weather.gov; 5 Feb 2021). The result was the failure of major flood convenance systems including Buffalo Bayou, the major waterbody that flows through downtown Houston, Texas. Buffalo Bayou's typical median flow rate is ca. 5.6 m^3/min. The flood event caused by Hurricane Harvey resulted in instantaneous values of ca. 50,000 m^3/min (Munscher et al. 2020, *op. cit.*).

On 13 September 2017, TSA-NAFT Research Group members EM and JG were contacted by Texas Parks and Wildlife Urban Biologist KN regarding a large *M. temminckii* that was found walking on Memorial Park Drive (a major roadway that is directly adjacent to Buffalo Bayou) by Houston Police. The turtle was taken to the Houston SPCA for temporary holding. Upon observing the turtle, it was determined that the turtle was a marked individual from the ongoing population survey in Buffalo Bayou. This individual was hard marked #10 and was confirmed by its PIT tag. This animal was previously captured and marked on 10 February 2017, ca. 217 m from where it was found by Houston Police after this flood event.

The distance traveled by this individual is well within the normal movement range documented for this species. Average daily movements up to 115.5 m were observed in a population in northeast Louisiana (Sloan and Taylor 1987. Proc. Ann. Conf. SEAFWA342-348). In an Oklahoma population, Riedle (2001. M.S. Thesis, Oklahoma State University, Stillwater, Oklahoma. viii + 121 pp.) calculated a mean linear home range of 778 m for both sexes combined and noted that females tend to make larger movements than males. In addition, our own observations in Buffalo Bayou for males are between 284–2285 m (unpubl. data). These comparisons show that this catastrophic flood event most likely had little effect on this large turtle's movement, and apparently did not displace the turtle. The turtle may have been discovered as it investigated previously unsubmerged habitat, as Buffalo Bayou has abrupt banks with no adjacent floodplain wetlands.

As city centers and urban sprawl continue to expand, pressure on urban aquatic systems will increase. It is estimated that over 60% of stream flow in the world is under human management and regulation (Bodie and Semlitsch 2000, *op. cit.*). The Buffalo Bayou system has a history of flooding. Over the past eleven years the bayou has reached flood stage (100-year flood events) eight times (Fig. 1; http://waterdata.usgs.gov; 5 Feb 2021). It could be that *M. temminckii* are adapted to ecosystems that experience regular, major flood events and as such may not be negatively affected by these events (Fig. 2). It has been suggested that some riverine species such as cooters (*Pseudemys*) and Western Pond Turtles (*Actinemys marmorata*) develop body dimensions that reduce drag and pull caused by flood waters (Jones and Sievert 2009, *op. cit.*). Additional research should be conducted on this and other systems to better understand this species' response to flooding events.

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***PODOCNEMIS UNIFILIS* (Yellow-spotted River Turtle). DIET.** *Podocnemis unifilis* feeds preferentially on vegetation, although it occasionally eats animals such as aquatic invertebrates, crustaceans, mollusks, and fish (Balensiefer and Vogt 2006. Chelon. Conserv. Biol. 5:312–317). The vegetation consumed includes aquatic and terrestrial herbaceous plants and shrubs that occur in seasonally flooded areas (Portal et al. 2002. Ci. Anim. Bras. 3:11–19; Oliveira et al. 2020. Agroecossistemas 12:83–98).

In 2010, we collected 49 individuals of *P. unifilis* (27 males, 15 females, 7 juveniles) during three field trips at three different hydrologic seasons: flooding (March), ebb (June), and dry (September). The field sites were located on the middle course of the Tocantins River and the lower Araguaia River, in the Brazilian states of Pará, Maranhão, and Tocantins, totaling about 300 km of river length (from the Tocantins River [5.01075°S, 49.32700°W] to the Araguaia River [5.86725°S, 48.27478°W] and back to the Tocantins River [5.38285°S, 47.83279°W]). Food samples were collected from each turtle's esophagus and stomach using a stomach flushing technique (Legler 1977. Herpetologica 33:281–284).

As previously demonstrated for the species, plant material was the predominant food category in the stomachs of the *P. unifilis*, corresponding in this case to nearly 100% of the total volume (Table 1), which is greater than that observed in populations studied in the lower Caquetá River, Colombia (where plant material was over 90% of the total volume in both low and high flood water levels; Figueroa et al. 2012. Rev. Colombiana Cienc. Anim. 4:441–453), in the middle course of the Solimões and lower Japura Rivers (plants = 79.6% of the total volume; Balensiefer and Vogt 2006, *op. cit.*) and the Guaporé River (plants = 89.5% of the total volume; Fachín-Terán et al. 1995. J. Herpetol. 29:536–547). In the present study, periphyton was the food item most consumed by males, at 74% of the volume, consumed by 18 individuals; in females periphyton was 31% of the volume, consumed by seven individuals, but it was not recorded in juveniles. Periphyton is a mixture of autotrophic and heterotrophic microorganisms that comprises algae, bacteria, fungi, and meiofauna (Wilzbach and Cummins 2008. *In* Jorgensen and Fath [eds.], Rivers and Streams: Physical Setting and Adapted Biota, pp. 3095–3106. Elsevier, Oxford, England). Periphyton is a common food source for invertebrates and vertebrates (Peters and Lodge 2009. *In* Likens [ed.], Littoral Zone, pp. 79–87. Elsevier, Oxford, England), including turtles (Balensiefer and Vogt 2006, *op. cit.*; Brito et al. 2016. Acta Herpetol. 11:1–13). Non-planktonic animal foods were not important in the diet of turtles in this population, as it was only detected in the stomach of one male at low volume.

Podocnemis unifilis can feed on various plant species and will eat different parts of the plant such as stems, leaves, trunks, fruits and seeds (Portal et al. 2002, *op. cit.*). However, this species is often considered to be a generalist feeder, and as noted above, it also eats various animal components such as invertebrates and fish (Balensiefer and Vogt 2006, *op. cit.*; Oliveira et al. 2020, *op. cit.*). The diet may be closely related to seasonal availability of food resources in occupied environments, in addition to age and sex preferences (Malvasio et al. 2003. Rev. Bras. Zool. 2003:161–168; Lara et al. 2012. Can. J. Zool. 90:1394–1401). Our data are in line with reported isotope analysis for *P. unifilis*, where it was concluded that a varied diet with animal and plant food items show high values of 15N, but the majority of the diet of individuals still consists of C3 plants (Lara et al., *op. cit.*).

TABLE 1. Composition of the diet of *Podocnemis unifilis* in the Tocantins and Araguaia rivers, Brazil. Frequency = frequency of occurrence; Number = individual specimens.

Food categories	Frequency (%)	Number (%)	Volume (ml/%)
Males N = 27			
Leaf	12 (44.44)	12 (18.75)	5.16 (6.32)
Periphyton	18 (66.67)	18 (28.13)	60.20 (73.76)
Fruit	1 (3.70)	1 (1.56)	0.40 (0.49)
Seed Myrtaceae	2 (7.41)	2 (3.13)	0.01 (0)
Plant stalks	3(11.11)	3 (4.69)	0.20 (0.25)
Unidentified seed	6 (22.22)	6 (9.38)	12.50 (15.31)
Unidentified vegetable	6 (22.22)	6 (9.38)	1.50 (1.84)
Larva Coleoptera	1 (3.70)	1 (1.56)	0.01 (0)
Sand	5 (18.52)	5 (7.81)	0.75 (0.92)
Unidentified debris	10 (37.04)	10 (15.63)	0.91 (1.11)
Females N = 15			
Leaf	2 (13.33)	2 (6.06)	4.10 (16.91)
Periphyton	7 (46.67)	7 (21.21)	7.58 (31.27)
Stalk vegetal	2 (13.33)	2 (6.06)	2.20 (9.08)
Unidentified seed	6 (40.00)	6 (18.18)	4.36 (17.99)
Unidentified vegetable	5 (33.33)	5 (15.15)	3.85 (15.88)
Sand	3 (20.00)	3 (9.09)	0.27 (1.11)
Unidentified debris	8 (53.33)	8.00 (24.24)	1.88 (7.76)
Juveniles N = 7			
Leaf	1 (14.29)	1 (14.29)	0.10 (15.87)
Unidentified debris	1 (14.29)	1 (14.29)	0.10 (15.87)
Sand	1 (14.29)	1 (14.29)	0.04 (6.35)
Unidentified material	4 (57.14)	4.00 (57.14)	0.39 (61.90)

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***PSEUDEMYS CONCINNA* (River Cooter). REPRODUCTIVE BEHAVIOR.** *Pseudemys concinna* has been documented nesting from late spring until early summer, but the period of courtship in nature is poorly known for this species. Courtship has been observed in October and typically takes place in the portions of the river with a slower current (Ward and Jackson 2008. *In* Rhodin et al. [eds.], Conservation Biology of Freshwater Turtles and Tortoises, pp. 006.1–006.7. Chelonian Research Monographs No. 5). On 17 January 2021 at 1127 h in the Clear Fork Trinity River directly under Rogers Road, Fort Worth, Tarrant County, Texas, USA (32.72367°N, 97.36448°W; WGS 84) we observed an adult female *P. concinna* swimming near the shore of the river in water that was ca. 0.3–0.6 m deep. For several minutes, two adult males were seen attempting to mount her. Although intromission was not witnessed, the exhibited behaviors suggest that this was a copulatory attempt. The day was sunny, and the air temperature was 14.4°C. Water temperature was not recorded. This is apparently the earliest known demonstrated reproductive behavior for wild River Cooters in Texas.

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***PSEUDEMYS FLORIDANA* (Coastal Plain Cooter) and *PSEUDEMYS CONCINNA* (River Cooter). PURPORTED SIZE RECORDS.** Williams and Bunkley-Williams (2021. Herpetol. Rev. 52:130–131) recently presented purported verified record sizes for the Coastal Plain Cooter (aka Florida Cooter), *Pseudemys floridana* (*P. concinna floridana* as presented). We here offer evidence to nullify these records as being based on taxonomic misidentification. Although it is not critical to this correction, we follow widespread recognition within the southeastern range states of Alabama, Florida, and Georgia (Mount 1975. The Reptiles and Amphibians of Alabama. Auburn University Agricultural Experiment Station, Auburn, Alabama. 347 pp.; Buhlmann et al. 2008. Turtles of the Southeast. University of Georgia Press, Athens, Georgia. 264 pp.; Jensen et al. 2008. Amphibians and Reptiles of Georgia. University of Georgia Press, Athens, Georgia. 575 pp.; Krysko et al. 2019. Amphibians and Reptiles of Florida. University of Florida Press, Gainesville, Florida. 706 pp.) and general reviews (Powell et al. 2016. Peterson Field Guide to Reptiles and Amphibians of Eastern and Central North America. Fourth edition. Houghton Mifflin Harcourt Co., New York, New York. 494 pp.; Turtle Taxonomy Working Group. 2017. Turtles of the World: Annotated Checklist and Atlas of Taxonomy, Synonymy, Distribution, and Conservation Status, 8th edition, pp. 1–292. Chelon. Res. Monogr. 7) that *P. concinna* and *P. floridana* are separate species.

Our immediate attention was drawn to the possibility of misidentification based on habitat, location, and prior identification. The two vouchered turtles (Auburn University Museum of Natural History [AUM] 8725, 8726; Fig. 1) were among a series of 30 *Pseudemys* caught in 1967 in Yates Springs (Decatur County, Georgia, USA; Williams and Bunkley-Williams 2021, *op. cit.*), a tributary of Spring Creek on the Flint River arm of the Apalachicola River (impounded downstream as Lake Seminole). A key ecological difference between *P. concinna* and *P. floridana* is that the former almost exclusively inhabits and often dominates the turtle fauna of lotic waters, particularly spring runs and tannic and alluvial rivers (Jackson 2006. *In* Meylan [ed.], Biology and Conservation of Florida Turtles, pp. 325–337. Chelonian Res. Monogr. 3.; Buhlmann et al. 2008, *op. cit.*; Ward and Jackson 2008. *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. 006.1–006.7. Chelon. Res. Monogr. 5), whereas the latter is predominantly characteristic of lentic waters (Thomas and Jansen 2006. *In* Meylan [ed.], Biology and Conservation of Florida Turtles, pp. 338–347. Chelon. Res. Monogr. 3; Buhlmann et al. 2008, *op. cit.*). Further, when originally presented with the two vouchered (and largest) specimens, R. H. Mount, who distinguished the two species (Mount 1975, *op. cit.*), identified them as *P. concinna*. One of us (JCG) had previously examined the specimens as well and considered them *P. concinna*.

We reexamined both specimens as well as photographs graciously provided to us by E. H. Williams, Jr. Both are entirely consistent with *P. concinna* (*P. c. concinna*) and their identities

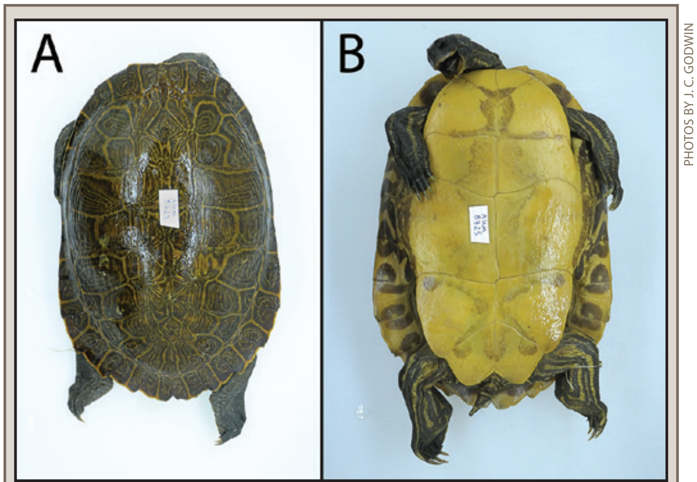

FIG. 1. Adult female *Pseudemys concinna* (AUM 8725): A) carapace; B) plastron.

verified by John B. Iverson. Features that clearly differentiate them from *P. floridana* (e.g., Jackson 2006, *op. cit.*; Thomas and Jansen 2006, *op. cit.*; Ward and Jackson 2008, *op. cit.*; Powell et al. 2016, *op. cit.*; Krysko et al. 2019, *op cit.*) include costal scute patterns dominated by concentric whorls with reverse C-like figures at the posterior edges of costals 1–3, a plastron with dark pigment following at least some of the seams between scutes (faint in some individuals, as in AUM 8726), broad, complete black bridge bars, a cervical scute with long, straight overlap and very short underlap, carapacial flare, and posterior marginal/peripheral notching. Corresponding characters of *P. floridana* are costal patterns dominated by vertical stripes, plastron devoid of dark pigmentation, absence or reduction of black bridge bars, cervical scute overlap somewhat subtriangular and underlap moderate, little carapacial flare, and relatively unnotched posterior periphery.

Because Williams and Bunkley-Williams (2021, *op. cit.*) based their conclusions on misidentified turtles, their purported size records as *P. floridana* should be dismissed. While large (34–35 cm straight-line carapace length [SCL]), they are commonly exceeded in size by *P. c. concinna* in natural populations. JCG's large trapping sample (identities confirmed genetically as *P. concinna* by Shaffer and Scott, unpubl. data) from the Mobile-Tensaw delta includes three females in the 37–39 SCL range, with the largest weighing 7.9 kg. The largest *P. concinna*, including *P. c. suwanniensis* (TTWG 2017, *op. cit.*), exceed 43 cm CL and 10 kg (Jackson 2006, *op. cit.*). Both *P. concinna* and *P. floridana* are documented from Decatur County (Jensen et al. 2008, *op. cit.*). The pseudemyd turtle fauna at Yates Spring today remains dominated by *P. concinna* (J. B. Jensen, pers. comm.), as it apparently has been for decades, and likely centuries.

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***STERNOTHERUS CARINATUS* (Razor-backed Musk Turtle) and *STERNOTHERUS PELTIFER* (Stripe-neck Musk Turtle). HYBRIDIZATION.** Interspecific and even intergeneric hybridization is not uncommon in turtles. It has been documented in marine turtles (Karl et al. 1995. J. Hered. 86:262–268), the family Geoemydidae (Stuart and Parham 2007. Conserv. Genet. 8:169–175),

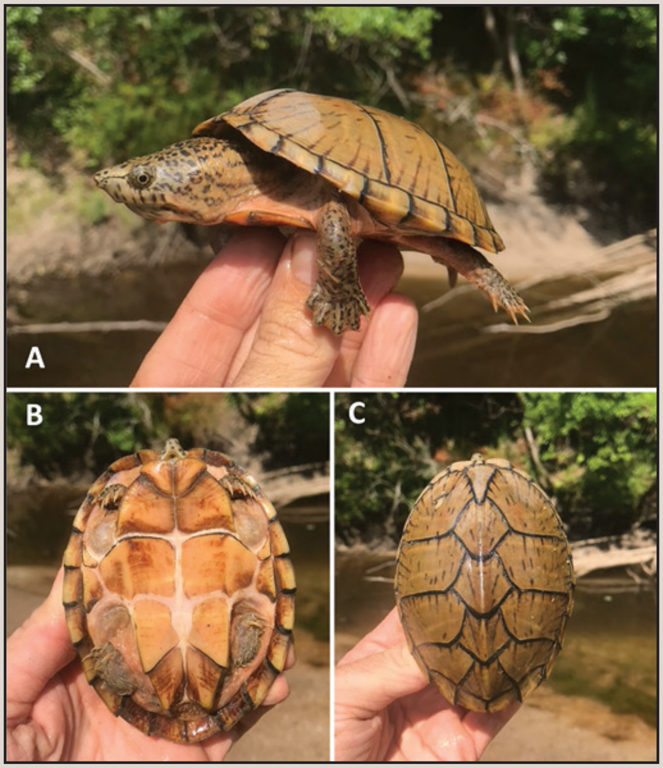

Fig. 1. Lateral (A), ventral (B), and dorsal (C) aspect of a hybrid *Sternotherus peltifer* × *S. carinatus* captured in June 2018 from a stream in Perry County, Mississippi. The turtle shows intermediate characteristics of both species, notably the prominent keel, the absence of a gular scute and mottled striping on the neck.

in North American box turtles (Clark 1935. Copeia 3:148–150), and map turtles (Freedberg and Myers 2012. Biol. J. Linn. Soc. Lond. 106:405–417; Godwin et al. 2014. Copeia 2014:725–742). While hybridization may allow for the sharing of novel alleles between species that may have adaptive significance, it can also affect the genetic integrity of threatened or endangered species, such as the hybridization of the Flattened Musk Turtle (*Sternotherus depressus*) and the Stripe-necked Musk Turtle (*Sternotherus peltifer*) due to habitat homogenization from reservoir construction (Scott and Rissler 2015. Biol. Conserv. 192:294–303; Scott et al. 2019. Mol. Ecol. 28:761–771). Herein, I report the hybridization of additional *Sternotherus* species that coinhabit the Pascagoula River system: the Razor-backed Musk Turtle (*S. carinatus*) and the Stripe-necked Musk Turtle (*S. peltifer*).

Sternotherus carinatus and *S. peltifer* overlap at the eastern and western peripheries of their geographic ranges, respectively. *Sternotherus peltifer* were formerly believed absent from the Pascagoula River system (Iverson 1977. Copeia 1977:502–517) until they were documented in the Chickasawhay River near Waynesboro, Mississippi, USA (McCoy et al. 1978. Herpetol. Rev. 9:109). Both species share similar lotic tendencies in allopatry, but in sympatry they exhibit different habitat associations: *S. carinatus* in larger lotic systems, *S. peltifer* in smaller lotic systems (GJB, unpubl. data). However, in intermediate lotic habitats, both species can occur syntopically.

On 27 June 2018, I captured a suspected hybrid between these two *Sternotherus* species at a syntopic site. The turtle exhibited a prominent keel and lacked a gular scute like *S. carinatus*, but there was striping present around the neck, a trait of *S. peltifer* not present in *S. carinatus* (Iverson 1979. Cat. Am. Amphib. Rept. 226:226.1–226.2). I collected and extracted a small tissue sample from interdigital webbing and sequenced a diagnostic region of the mitochondrial genome (cytochrome b) using primers designed by Shaffer et al. (1997. Syst. Biol. 46:235–268), as well as genotyped it across diagnostic microsatellite loci (*Scar08, Scar26, Scar27, Scar29, Scar38* and *Scar39* from Brown and Kresier [2020. Chelon. Conserv. Biol. 19:145–149]). The turtle had a *S. peltifer* mitochondrial haplotype and shared equal ancestry between *S. peltifer* and *S. carinatus* across the microsatellite loci, suggesting it was an F1 hybrid and the product of a female *S. peltifer* and male *S. carinatus* (Fig. 1).

This is the first reported hybrid of these two *Sternotherus* species. This turtle was caught during part of a larger study, and it is the only diagnosable hybrid out of 430 lotic *Sternotherus* sampled from the Pascagoula River drainage. This would suggest that hybridization is rare within the drainage, and it is perhaps precluded by habitat associations and potentially other pre- or postzygotic barriers. Further investigation of these interactions would prove interesting from the context of genetic barriers between closely related species in sympatry.

The turtle was handled and processed using appropriate IACUC protocols (USM #17101202) and state permits (MMNS 0530181) and was released after capture.

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***TERRAPENE CAROLINA* (Eastern Box Turtle). REPRODUCTION.** *Terrapene carolina* is a wide-ranging species with varying activity seasons across its extensive range from southern Maine through the Florida Keys and west to Texas, USA (Carr 1952. Handbook of Turtles: The Turtles of the United States, Canada, and Baja California. Comstock Publishing Associates, Ithaca, New York. xv + 542 pp.). Here, we accept the historic subspecific divisions in an inclusive *T. carolina* but note the present disparity in taxonomic classification for southern populations (Butler et al. 2011. Biol. J. Linn. Soc. 102:889–901; Martin et al. 2013. Mol. Phylogenet. Evol. 68:119–134). The length of the active season for *T. carolina* varies geographically and can affect the number of clutches produced within one season. Northern populations typically produce one clutch of four or more eggs during their shorter active season from late March to early November (Dodd 2001. North American Box Turtles: A Natural History. University of Oklahoma Press, Norman, Oklahoma. 231 pp.; Burke and Capitano 2011. Am. Midl. Nat. 165:137–142). There are limited data on the number of clutches produced throughout the year-long active season of southern populations of *T. carolina.* (Dodd 1994. Chelon. Conserv. Biol. 1:97–106; Dodd 2001, *op. cit.*; Burke and Capitano 2011, *op. cit.*). However, multiple clutches within one active season were reported for *T. carolina major* in the Florida panhandle (Jackson 1991. Florida Field Nat. 19:14–16).

We conducted a study to describe reproductive status for a population of *T. carolina* in southwestern Georgia, USA. The study took place at Ichauway, the research site of the Jones Center in Baker County, Georgia. Ichauway is an 11,769-ha property with second-growth *Pinus palustris* (Longleaf Pine) forest, mixed pine-hardwood forests, isolated wetlands, and wildlife food plots; the site is managed with frequent prescribed fire. Female *T. carolina* were collected opportunistically on roads from March to mid-November 2004 and were radiographed or hand-palpated to detect shelled eggs. Twenty female turtles were radiographed from 21 May–29 June using an InnoVet™ Summit Model v 15 200KV/200/MA X-ray machine (Summit Industries, Inc. Chicago, Illinois) at exposures of 62kb-1.7mililamps (mA) per second to detect shelled eggs (Gibbons and Green 1979. Herpetologica 35:86–89; Dodd 1997. Chelon. Conserv. Biol. 2:370-377; Hinton et. al. 1997. Chelon. Conserv. Biol. 2:409–414). An additional eight females were hand-palpated rather than radiographed to discern the presence of shelled eggs (Keller 1998. Wildl. Res. 25:527–531). We detected shelled eggs in 13 (65%) of the radiographed females and 5 (62%) of the hand-palpated turtles. Average clutch size for radiographed females was 3 eggs (range: 1–5 eggs/clutch). Gravid females were found from 21 May through 24 June. We recaptured 11 turtles (14.6%) across the sampling period. None of the captured individuals were gravid at their second capture; the time between initial and subsequent captures ranged from 10 to 137 d. Thus, we found no evidence of multiple clutches within a season for this southern population of *T. carolina.*

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***TERRAPENE CAROLINA BAURI* (Florida Box Turtle). DIET.** *Terrapene carolina bauri* are omnivorous and have been known to consume vertebrates, invertebrates, foliage, and fruits (Platt et al. 2009. Southeast. Nat. 8:335–346). Here, we report the consumption of the Banded Air Plant (*Tillandsia flexuosa*) by *T. c. bauri* in the southern portion of its range. At 1609 h on 10 December 2020 in Collier County, Florida, USA an adult female *T. c. bauri* (139 mm SCL) in an ongoing radio-telemetry study was tracked into an oak rosemary scrub habitat, composed predominantly of Live Oak (*Quercus geminata*). Upon inspection, the individual was observed feeding on an epiphyte attached to a small oak twig that had fallen from the canopy above. Within ca. 3 sec of approach, the turtle stopped feeding and retracted into its shell. Upon further inspection, the plant was identified as a Banded Air Plant (*Tillandsia flexuosa* syn. *T. aloifolia*), a threatened species in Florida (Larson et al. 2005. EDIS.8:7). The plant had large portions of its leaves missing, likely due to feeding by the turtle (Fig. 1). The turtle stayed in its shell for the remainder of the encounter and was left alone after GPS data was collected.

Fig. 1. *Tillandsia flexuosa* in hand with bite marks and missing pieces with a female *Terrapene carolina bauri* in the background, from Florida, USA.

Although the Banded Air Plant is a threatened and infrequently encountered species, it can be found within the oak scrub habitat shared with *T. c. bauri* as well as *Gopherus polyphemus* (Gopher Tortoise) and other herbivorous animals (Larson et al. 2005, *op. cit.*). Even though *T. c. bauri* have been known to feed on other species of the *Tillandsia* genus (Platt et al. 2009, *op. cit.*) they are unlikely contributors to population declines in *T. flexuosa* given the infrequency of encounters with these typically high growing epiphytes.

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***TERRAPENE ORNATA* (Ornate Box Turtle). DIET.** Ornate Box Turtles are mostly carnivorous with a diet consisting mainly of invertebrates and some carrion (Ernst and Lovich 2009. Turtles of the United States and Canada. Second edition. John Hopkins University Press, Baltimore, Maryland. 827 pp.). Insects such as ants, beetles, caterpillars, cicadas, crickets, and grasshoppers can make up a large portion of their diet (Legler 1960. Univ. Kansas Publ. Mus. Nat. Hist. 11:527–669; Ernst and Lovich 2009, *op. cit.*). Documented families of beetles predated by *T. ornata* include Cantharidae, Carabidae, Cerambycidae, Chrysomelidae, Curculionidae, Lampyridae, Phengodidae, Scarabaeidae, and Staphylinidae (Ernst and Lovich 2009, *op. cit.*; Forrester et al. 2019. Herpetol. Rev. 50:128–129). Dung beetles are common in the Great Plains, in part, due to their association with fecal matter of large ungulates, Domestic Cattle (*Bos taurus*), and historically, American Bison (*Bos bison*), and thus are the most important staple element of the diet of *T. ornata* (Legler 1960, *op. cit.*; Ernst and Lovich 2009, *op. cit.*).

At 1045 h on 20 September 2020, we observed a *T. ornata* consuming a *Geotrupes opacus* (Opaque Earth Boring Beetle; Geotrupidae) in the floodplain of the Platte River in central Nebraska, USA (Dawson County, Jeffrey Island, 6.0 km S, 6.3 km W Overton Post Office; 40.68563°N, 99.61306°W; NAD 83). The turtle was observed with a *G. opacus* hanging from its mouth, partially consumed. The area was sparsely vegetated, with friable, sandy soils about 60 m from an active channel of the Platte River. Many burrows of *Dipodomys ordii* (Ord's Kangaroo Rats) were in the area, which are known refugia for *T. ornata* in Nebraska (Converse and Savidge 2003. J. Herpetol. 37:665–670). Dominant vegetation in the immediate area included *Setaria* (foxtail), *Helianthus annuus* (Common Sunflower), and *Artemisia campestris caudata* (Field Sagewort).

Our observation represents the first documentation of predation for the family Geotrupidae by *T. ornata*. Unidentified beetles in the family Scarabaeidae (Scarab Beetles) and former subfamiles (including Geotrupinae) have been documented as prey for *T. ornata*, but not to a specific beetle species (Young 2015. T. Am. Entomol. Soc. 141:111–155). Despite inference to the frequency of dung beetles in the diet of *T. ornata* (Ernst and Lovich 2009, *op. cit.*), there is a lack of specific data on which species are being consumed by this turtle throughout its extensive distribution in the central and southern Great Plains (Young 2015, *op. cit.*). We suspect many species of dung beetles in the families of Aphodidae, Geotrupidae, and Scarabaeidae are common prey items for *T. ornata* throughout its distribution.

We thank Dave Zorn of the Central Nebraska Public Power and Irrigation District for access to Jeffrey Island to conduct biological research.

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TRACHEMYS SCRIPTA ELEGANS **(Red-eared Slider). DIET.** *Trachemys scripta* is a freshwater emydid native to the southeastern, southwestern, and midwestern portions of the United States (Ernst and Lovich 2009. Turtles of the United States and Canada. Second edition. Johns Hopkins University Press, Baltimore, Maryland. 827 pp.). Considered an opportunistic omnivore, this species is known to consume a wide variety of plant and animal taxa, including fish (Ernst and Lovich 2009, *op. cit.*). Fish species consumed by *T. scripta*, either alive or as carrion, include: *Lepomis cyanellus*, *L. macrochirus*, *Morone chrysops*, *Notropis hudsonius*, *Perca flavescens*, and *Umbra limi* (Ernst and Lovich 2009, *op. cit.*; Bassett and Forstner 2020. Herpetol. Rev. 51:840). Herein, we document the consumption of an additional fish species, *Fundulus grandis* (Gulf Killifish), by *T. scripta elegans* from the Pecos River in west Texas.

Fig. 1. *Trachemys scripta elegans* (ventral side up) and the remains of *Fundulus grandis* upon which this female was feeding. Both were captured in a baited hoopnet trap in the Pecos River, Texas, USA on 6 July 2020.

On 6 July 2020 at 0837 h, one of us (LGB) captured five *T. scripta elegans* in a baited hoopnet trap in the Pecos River, Pecos/Ward County, Texas, USA (31.31113°N, 102.87708°W; WGS 84; 734 m elev.). Along with the *T. scripta elegans* was a single *F. grandis* carcass, half of which was missing (Fig. 1). While the trap was still submerged, two of the *T. scripta elegans* could be seen feeding on the carcass. Immediately after placing the trap aboard our canoe, one of the *T. scripta elegans* continued to aggressively consume chunks of the carcass. *Fundulus grandis* was the most common bycatch among our 270 trap days at this site during the summer of 2020. Given that *T. scripta elegans* and *F. grandis* are syntopic at this site, it is possible that this predator-prey or scavenger-carrion relationship exists outside of trap-mediated interactions. Identifying such otherwise overlooked trophic relationships is useful for understanding how chelonian species satisfy their bioenergetic demands. Additionally, because *F. grandis* is a non-native constituent of the Pecos River ichthyofauna (Hillis et al. 1980. Southwest. Nat. 25:271–272), this observation may reflect the provision of biotic resistance by *T. scripta elegans*.

This study was approved by the Texas Parks and Wildlife Department (SPR-0102-191) and Texas State University IACUC (Protocol No. 2018097). We thank the NFWF for funding.

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CROCODYLIA — CROCODILIANS

CROCODYLUS SIAMENSIS **(Siamese Crocodile). ATTEMPTED PREDATION.** Observations of predation on crocodiles are sparse in the literature (Somaweera et al. 2013. Herpetol. Monogr. 27:23–51), in part because much of their activity is nocturnal and takes place underwater (Thorbjarnarson 1993. Copeia 1993:1166–1171). Furthermore, the smaller, presumably more vulnerable size-classes are wary, well-camouflaged, inconspicuous, and hence, easily over-looked by investigators (e.g., Platt et al. 2002. Herpetol. J. 12:81–84). Documentation of predation on crocodilians is consequently best known for well-studied and relatively abundant species with a notable paucity of records for other, less well-known species (Somaweera et al. 2013, *op. cit.*). *Crocodylus siamensis* is considered one of the rarest and most critically endangered crocodilians in the world and remains poorly studied in the wild (Platt et al. 2019. *In* Manolis and Stevenson [eds.], Crocodiles: Status Survey and Action Plan. IUCN/SSC Crocodile Specialist Group, Darwin); in particular, virtually nothing is known concerning predators and predation (Somaweera et al. 2013, *op. cit.*). Here, we report observations

PHOTO BY THORN PHUN

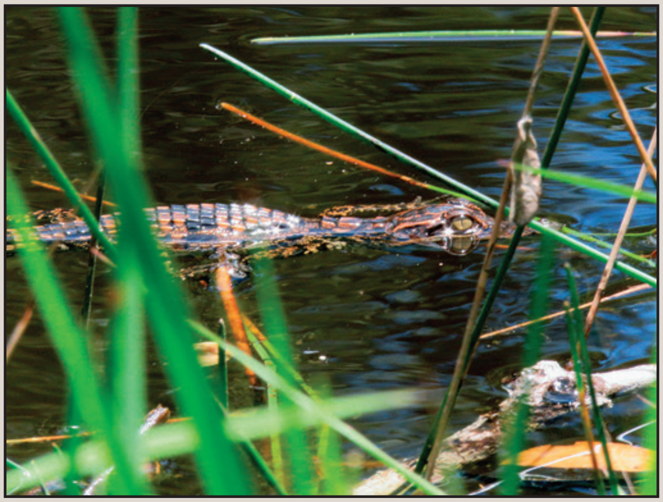

Fig. 1. Juvenile *Crocodylus siamensis* foraging around the periphery of a floating grass mat in Kean Tok wetland (Sre Ambel River System, Koh Kong Province, Cambodia). Seconds after the photograph was taken this crocodile was seized and pulled below the surface by a large snakehead (*Channa* sp.).

of the attempted predation of a small juvenile *C. siamensis* by a snakehead (*Channa* sp.) in Cambodia.

Our observation occurred at Kean Tok Wetland (11.3568°N, 103.7151°E; WGS 84; 10 m elev.) in the Sre Ambel River System of Koh Kong Province. Kean Tok is a floodplain oxbow lake (ca. 90 m wide × 600 m long) adjacent to the main channel of the Sre Ambel River and is subject to overbank and backwater flooding during the annual wet season (late May through early October). Small mats of floating grasses occur around the periphery of Kean Tok, which is otherwise open water and surrounded by dense evergreen riparian forest. Kean Tok constitutes important nesting habitat for a small population of *C. siamensis* inhabiting the upper reaches of the Sre Ambel River System (Platt et al. 2006. Herpetol. Nat. Hist. 9:183–188).

While searching for crocodile nests at Kean Tok on 14 July 2020, we encountered three juvenile *C. siamensis* swimming in open water (ca. 1.0 m depth) along the periphery of a floating grass mat (Fig. 1). Based on our estimates of total length (ca. 350 mm), these juveniles were probably about 11 months old (hatching in August-September; Platt et al. 2014. Croc. Spec. Group Newsl. 33:22–27). From 1114 h to 1150 h, we intermittently observed and photographed the crocodiles from a distance of 5–6 m. At 1148 h, a large *Channa* sp. suddenly appeared from below, seized a juvenile floating on the surface and pulled it underwater to a depth of about 30 cm. Although poor water clarity obscured observation to some extent, the crocodile could be seen struggling to escape from the fish and after 4–5 sec, the juvenile was released. Upon surfacing the crocodile appeared uninjured and swam rapidly into floating vegetation where it was lost from sight. To our knowledge, this observation constitutes the only report of predation or attempted predation on any size-class of *C. siamensis* yet suggests *Channa* may be a predator of juveniles.

Channa spp. are large predatory freshwater fish with some species exceeding 1.5 m in length, and native to Asia, but are widely established in other regions as the result of accidental and purposeful introductions (Courtenay and Williams 2004. Snakeheads [Pisces, Channidae] — A Biological Synopsis and Risk Assessment. U.S. Geological Survey, Circular 1251. 151 pp.). These fish are native and abundant in wetlands throughout the Sre Ambel River System and are generalist predators known to consume a varied diet that includes other fish, insects, crustaceans, amphibians, reptiles, young birds, and small mammals (Courtenay and Williams 2004, *op. cit.*). While hatchling or juvenile crocodilians have not been verified in the diet of *Channa* spp., the well-documented consumption of similar-sized (and larger) prey items (e.g., *Rattus* spp.; Courtenay and Williams 2004, *op. cit.*) suggest these large predaceous fish would be capable of swallowing small *C. siamensis*. In light of our observation, the introduced Bulls-eye Snakehead (*Channa marulius*) should also be considered a likely predator of small American Alligators (*Alligator mississippiensis*) where these fish have become established in southern Florida, USA (Courtenay and Williams 2004, *op. cit.*).

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SQUAMATA — LIZARDS

***ANOLIS AQUATICUS* (Water Anole). DEWLAP COLORATION.** Many reptiles and amphibians use color change for a variety of reasons, from camouflage to social signaling. The genus *Anolis* is a diverse lineage of lizards, with ca. 380 described species (Poe et al. 2017. Syst. Biol. 66:663–697) and are unique because males have a colorful throat flap, the dewlap (Nicholson et al. 2007. PLoS ONE 2:e274). *Anolis* dewlaps are incredibly diverse in terms of coloration and are used in social signaling from territory defense to attracting a mate (Nicholson et al. 2007, o*p. cit.*). Gorgetal scales are a prominent feature of each dewlap and form longitudinal rows on the dewlap (Fitch and Hillis 1984. Copeia 1984:315–323). The dewlap's coloration is an important aspect of sexual signaling, however, the role of gorgetal scale color is not widely studied. *A. aquaticus* are known to rapidly change body color in response to stressors (Boyer and Swierk 2017. Can. J. Zool. 95:213–219) and as an antipredator tactic (Wuthrich et al., in review). Here, we describe rapid gorgetal scale color change in *Anolis aquaticus*.

These observations were made at the Organization of Tropical Studies Las Cruces Biological Station in Coto Brus, Costa Rica in the summer of 2015 and were observed on field-captured *A. aquaticus* in premontane wet forests at ca. 1100 m elev. After capture we observed the gorgetal scales of the *A. aquaticus* rapidly change color from a dark brown to cream white (to the human eye) within seconds. In almost all 47 males collected, we observed pre- and post-body color change in the

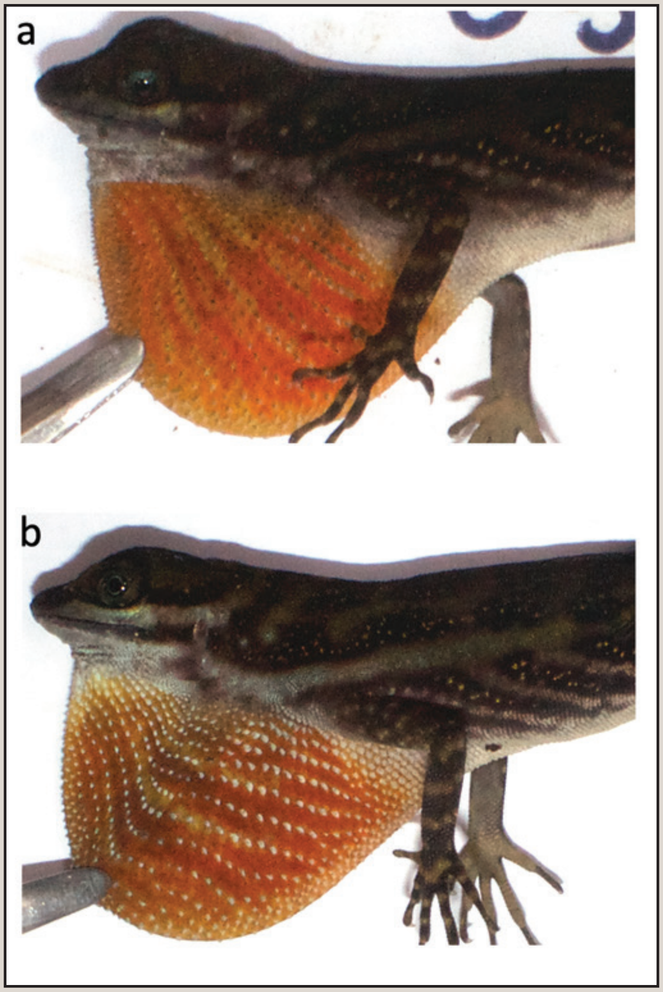

Fig. 1. Darkened (A) and lightened (B) gorgetal scales in a single adult male *Anolis aquaticus* from Costa Rica. Note that its lateral side displays corresponding darker and lighter coloration as the gorgetal scale color. Images were calibrated using a white standard in Adobe Photoshop (version 22.0.1).

field. In particular, one adult male *A. aquaticus* (6.2 cm SVL, 4.8 g) was photographed at 1151 h on 15 July 2015 with darker, brown gorgetal scales (Fig. 1A) and when photographed at 1214 h the gorgetal scales were a lighter, off-white color (Fig. 1B). Gorgetal scale color change has been reported in only two other anoles, *A. heteropholidotus* (Leenders and Watkins-Cowell 2003. Herpetol. Rev. 34:369) and *A. amplisquamosus* (Brown et al. 2018. IRCF Rept. Amphib. 25:127–128), and to our knowledge this is the first instance in *A. aquaticus*. Further investigation is needed to determine if the gorgetal scales of *A. aquaticus* change color in tandem with their dorsal and lateral scales (Brown et al. 2018, *op. cit.*).

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***ASPIDOSCELIS SEXLINEATA* (Six-lined Racerunner). HIBERNACULA.** Although many facets detailing the life history of *Aspidoscelis sexlineata* have been well studied (Fitch 1958. Univ. Kansas Publ. Mus. Nat. Hist. 11:11–62; Hardy 1962. Univ. Kansas Sci. Bull. 43:3–73), surprisingly little information exists pertaining to the brumation habits of this species (Etheridge et al. 1983. Copeia 1983:206–214). Herein, we describe the use of an active mammalian subterranean tunnel by *A. sexlineata* as an unusual hibernacula site.

On 16 November 2016, at ca. 0900 h, we incidentally encountered a torpid adult male *A. sexlineata* within an occupied Southeastern Pocket Gopher (*Geomys pinetus*) subterranean tunnel on the Wehle Forever Wild Tract in Bullock County, Alabama, USA (32.0344°N, 85.4702°W; WGS 84; 122 m elev.). We initially encountered the *A. sexlineata* ca. 25 cm below the surface of the ground after breaching the roof of the *G. pinetus* tunnel during excavation to set a live trap as part of a separate study. Our excavation site was on flat sandy ground and >1 m from the nearest *G. pinetus* surface mound. We found the racerunner resting on the tunnel floor and determined it was in a state of brumation by its lack of motion, cold body, and fully closed nictitating membranes over the eyes. We removed the *A. sexlineata* from the tunnel and placed it aside in full sun as we set our live trap. It slowly regained activity in ca. 15 min.

We discounted any coincidental displacement from a separate hibernacula site occurring within our excavation zone as it was observed only after the *G. pinetus* tunnel was opened from above and no other shallower intersecting burrows were noticed. On flat ground, *A. sexlineata* excavates hibernation burrows at descending angles that may exceed depths of 18 cm (Hardy 1962, *op. cit.*), and it is conceivable the racerunner may have incidentally dug into the *G. pinetus* tunnel while excavating its own hibernation burrow. Alternatively, it may have gained access to the tunnel system by incidentally excavating through the plugged hole of a nearby surface mound.

We found no studies documenting the use of occupied mammalian tunnels associated with *A. sexlineata* brumation, however this species has been documented using active geomyid tunnels and mounds (Funderburg and Lee 1968. J. Herpetol. 1:99–100; Connier and Chordas 2012. Herpetol. Rev. 43:644; Galán and Light 2017. Herpetol. Rev. 48:517–521), active *Peromyscus polionotus* burrows (Pearson and Nelson 1952. Copeia 1952:188–189) and abandoned, partially caved-in burrows of other fossorial small mammal species as temporary retreats or shelters (Vaughan 1961. J. Mammal. 42:171–174; Fitch 1958, *op. cit.*). While *A. sexlineata* may use active geomyid tunnels as refugia during seasonally active periods (Connier and Chordas 2012, *op. cit.*; Galán and Light 2017, *op. cit.*), to our knowledge this is the first documentation of *A. sexlineata* using an occupied *G. pinetus* tunnel as an apparent hibernacula site.

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***ASPIDOSCELIS TIGRIS SEPTENTRIONALIS* (Plateau Tiger Whiptail). CAUDAL SCOLIOSIS.** Spinal abnormalities, such as scoliosis (lateral curvature of the spine), kyphosis (excessive outward curvature of the spine), and lordosis (excessive inward curvature of the spine) in reptiles are relatively common in captive animals (Doneley et al. 2018. Reptile Medicine and Surgery in Clinical Practice. John Wiley & Sons Ltd, Hoboken, New Jersey. 520 pp.), but less commonly reported in wild animals. Among wild reptiles, chelonians seem to be particularly susceptible to such abnormalities (Davy and Murphy 2009. Can. J. Zool. 87:433–439), but they have also been noted among snakes (Gray

Fig. 1. *Aspidoscelis tigris septentrionalis* from Arizona, USA with caudal scoliosis.

Fig. 1. Beach scene on Isla de Útila, Honduras, where *Cnemidophorus ruatanus* occurred down to the high tide line.

et al. 2003. Bull. Chicago Herp. Soc. 38:4–6) and lizards (e.g., Datta and Hasan 2020. Herpetol. Bull. 152:34–35; Arrivillaga and Brown 2019. Herpetol. Bull. 148:43–44). Herein, I report an example of pronounced caudal scoliosis in a wild *Aspidoscelis tigris septentrionalis*.

On 31 May 2019, at 1601 h, I observed an adult *A. t. septentrionalis* running along a trail paralleling Havasu Creek, in Grand Canyon National Park, Arizona, USA (36.3057°N, 112.7601°W; WGS 84; 645 m elev.) with an atypical, malformed tail (Fig. 1). The tail had a series of six lateral bends, three bending to the left and three bending to the right, characteristic of scoliosis and appeared to originate on the lower spine. While the tail was malformed, the spine of the trunk appeared unaffected. No attempt was made to capture the animal because I was within the boundaries of a national park. The lizard appeared healthy and its behavior and locomotion did not seem impacted by the caudal scoliosis malformation. There are numerous examples of tail abnormalities in the genus *Aspidoscelis* including supernumerary tails (Bateman and Chung-MacCoubrey 2013. Herpetol. Rev. 44:663; Cordes and Walker 2013. Herpetol. Rev. 44:319; Heyborne et al. 2019. Herpetol. Rev. 50:569-570; Trauth et al., 2014. Herpetol. Rev. 45:492–493). However, to my knowledge this is the first documented case of caudal scoliosis for the genus *Aspidoscelis*.

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***CNEMIDOPHORUS RUATANUS* (Roatán Whiptail). INSULAR HABITATS and RELATIVE ABUNDANCE.** Isla de Útila, Departamento Islas de la Bahía, Honduras (16.1000°N, 86.9167°W), the smallest of the major bay islands after Roatán and Guanaja, has an area of ca. 45 km^2 and elevation to ca. 74 m. Here, we report on the habitat preferences and exceptional abundance of *Cnemidophorus ruatanus*, the most abundant diurnal reptile of the island, observed on Útila in December–January of 2006–2007. This along with diagnostically included populations in Belize, Guatemala, mainland Honduras and its islands Cayo Cochino Pequeño (see Montgomery et al. 2007. Southwest. Nat. 51:38–45; Montgomery et al. 2011. Herpetol. Conserv. Biol. 6:10–24), Útila, and Roatán (not known from Guanaja), and Nicaragua, constituted the taxon for which McCranie and Hedges (2013. Zootaxa 3722:301–316) resurrected the name *C. ruatanus* (type locality Isla de Roatán) from the synonymy of *C. lemniscatus*. We summarize observations on Isla de Útila compared with the restricted distribution and scarcity of the species on much smaller Cayo Cochino Pequeño (area of ca. 0.64 km^2; 15.97194°N, 86.4752°W; WSG 84; up to ca. 141 m elev.), the smallest Caribbean island (= cay) known to be inhabited by the species.

Based on preserved specimens of *C. ruatanus*, Montgomery et al. (2011, *op. cit.*) reported that females (57.6 ± 1.14, 50–67 mm SVL, N = 18) were of smaller mean and maximum size than males (67.9 ± 1.99, 61–74 mm SVL, N = 17) from Útila, as were females (61.2 ± 1.34, 51–67 mm SVL, N = 13) compared with males (65.7 ± 2.59, 61–75 mm SVL, N = 10) from Cayo Cochino Pequeño. Snout–vent length of nine lizards captured by hand on Útila in 2006–2007 were: females (52, 62, 62, 65, and 68 mm) and males (58, 72, 73, and 85 mm). Lizards of larger sizes were also observed; however, they eluded capture owing to extreme wariness.

We first observed *C. ruatanus* on Útila in a small area (ca. 15 m^2) at the base of an exposed hillside along Lozano Road ca. 1.5 km W of the airport (16.10472°N, 86.89388°W; WGS 84; ca. 30 m elev.). The vegetation included mixed forbs and grasses with ample exposed soil. Numerous individuals of *C. ruatanus* were active at the base of the hill, but none were observed on the exposed essentially vertical hill side. Approximately 150 m east of the exposed hillside in an ca. 800-m^2 area near a homesite foundation, we found *C. ruatanus* active in short grass interspersed with rock and dirt substrate, which was likely maintained by grazing animals. At Pumpkin Hill Beach (16.12277°N, 86.88194°W; WGS 84; ca. 1 m elev.) we observed a high density of lizards utilizing the rocky intertidal zone and the sand dune area above the high tide line. The area of occupancy in this locality was large, representing interspersed habitat along the north coast of the island, which continues east to the airport (16.11527°N, 86.87361°W; WGS 84; ca. 5 m elev.), where additional lizards were observed. This note recorded by CEM reflects the unedited reaction of the presence of Roatán Whiptail at Pumpkin Hill Beach "There are tons of lizards here. They are everywhere using the rocks that actually make up the high tide line [Fig. 1]. They use the sand up into the Dune area." That it was possible to capture four lizards of this wary species by hand at this site was also a reflection of lizard abundance. A snake species observed at Pumpkin Hill Beach that likely preys on *C. ruatanus* was *Leptophis mexicanus*. We also observed *C. ruatanus* in and around house foundations near the old airport on the southeast corner of the island on the eastern edge of the town of Útila (16.08750°N, 86.88916°W; WGS 84; ca. 1 m elev.). In this area of short grass and brush on a gravel substrate, lizards were utilizing debris and the foundations as cover objects. In this area lizards were also utilizing habitat down to the high tide line.

The lizard was abundant on the island in areas with no canopy cover and short vegetation interspersed with bare ground. Before and subsequent to these observations, Útila has seen rapid growth and development over the past two decades, including back-filling mangrove habitats. However, *C. ruatanus* is known to utilize human-occupied areas, so this species is one of the few that may not be negatively impacted by development, unlike the endemic Utilan Spiny-tailed Iguana, *Ctenosaura bakeri* (Maryon et al. 2018. The IUCN Red List of Threatened Species: e.T44181A125203850; iucnredlist.org, 24 July 2020).

We found that much of the eastern end of Útila with available open-structured environs resulting from human activities was the basis for the distribution and abundance of *C. ruatanus* on much of the island, encounters with which required no particular search strategy. However, the species was observed at only five restricted enclaves on tiny Cayo Cochino Pequeño, owing to the largely undisturbed and dense vegetative structure (Montgomery et al. 2011, *op. cit.*, table 1) of the cay, where locating individuals of the species required a deliberate and meticulous search strategy. The commonality of areas colonized by the species, both on the mainland and on islands, was either naturally occurring beach strands or areas with human altered open-structured vegetation (Walker et al. 2019. Herpetol. Rev. 50:687–690).

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COLOBOSAURA MODESTA **(Bahia Colobosaura). PREDATION.** *Colobosaura modesta* is a small to medium-sized (up to 150.0 mm SVL) lizard distributed across northern, eastern, and central Brazil (Pellegrino et al. 2001. Biol. J. Linn. Soc. 74:315–338). Like most gymnophthalmid lizards this species is a secretive leaf litter inhabitant that occurs in tropical savanna (e.g., cerrado, and forest habitats; Ávila-Pires 1995. Zool. Verhand. 299:1–706). Their known predators include three snake species (*Oxybelis aeneus*, *Oxyrhopus melanogenys*, and *Taeniophallus occipitalis*; Avila-Pires 1995, *op. cit.*), one lizard (*Tropidurus hispidus*; Costa et al. 2010. Herpetol. Rev. 41:87), and one frog (*Leptodactylus chaquensis*; De Alcantra et al. 2016. Herpetol. Rev. 47:296). Here, we report the predation of *C. modesta* by an avian predator, the Spot-backed Puffbird (*Nystalus maculatus*), in northern Brazil.

On 9 November 2017, at 1745 h, we observed a Spot-backed Puffbird carrying an adult *C. modesta* (43 mm SVL, 96 mm tail length) in its talons in a forest patch on the Laço de Ouro Farm, Municipality of Conceição do Araguaia, Pará, Brazil (8.0207°S, 49.2718°W; WGS 84; 218 m elev.). The bird then flew and perched on a small tree branch 5 m above the ground while holding the lizard by the head in its bill (Fig. 1). We approached the bird to get a better view of the predation event but when we got within 10 m the bird dropped the lizard and flew off. We collected the lizard and saw injuries to the head and body near the neck, and

PHOTO BY C.B. DE-CARVALHO

Fig. 1. *Nystalus maculatus* consuming an adult *Colobosaura modesta*, Pará, Brazil.

deposited is in the Zoological Collection of the Federal University of Goiás, Brazil (ZUFG 1250).

Puffbirds are understory to mid-canopy species and are known to predate lizards such as *Ameivula ocellifera* and *Polychrus acutirostris* (Crozariol and Gomes 2010. Atual. Ornitol. 154:4–5; Lisboa et al. 2020. Herpetol. Rev. 51:323–324) and to our knowledge this is the first record of avian predation on *C. modesta*.

The collection permit (No 2016/39794) was provided by the Secretaria de Estado de Meio Ambiente e Sustentabilidade (SEMAS), Pará, Brazil. We thank DBO Engenharia and Araguaia Nickel for the logistics support during the fieldwork.

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CROTAPHYTUS COLLARIS **(Eastern Collared Lizard). ANT BITE CAUSES PARTIAL CAUDAL LOSS.** During encounters with would-be predators, it is common for lizards to lose portions of their tails via severance or autotomy (Bateman and Fleming 2009. J. Zool. Lond. 277:1–14), although *Crotaphytus collaris* lack fracture septa. On 14 August 2020, at 1130 h, we noosed a neonate *C. collaris* (47.0 mm SVL) during a mark-recapture study at the Arcadia Lake Dam flood-control spillway, Edmond, Oklahoma, USA (35.6445°N, 97.3625°W; WGS 84; 303 m elev.). We found a single worker female Red Harvester Ant (*Pogonomyrmex barbatus*), attached to the lizard's tail, 6.5 mm from the distal end. The ant was dead yet both mandibles were firmly embedded on the tail, resulting in necrosis of the tail tissue (Fig. 1). We held the lizard until 0900 h, 16 August 2020, when the tail disarticulated cleanly at the bite site with the ant still attached. This observation indicates that *P. barbatus* bite trauma from the powerful dicondylic jaws that function for seed maceration and colony defense (Taber 1998. The World of Harvester Ants. Texas A&M University Press, College Station, Texas. 248 pp.) can cause partial caudal loss in neonate *C. collaris*. Recognition of alternate sources of caudal loss is noteworthy because tail damage

Fig. 1. Worker female Red Harvester Ant (*Pogonomyrmex barbatus*) found biting the tail of a neonate *Crotaphytus collaris* and dying while still attached.

is sometimes used to assess intensity of predation pressure in lizards (Bateman and Fleming 2009, *op. cit.*), and tail shortening may decrease escape speed (Miller et al. 2010. Biol. J. Linn. Soc. 99:241–249). Also, caudal shortening by any means may carry fitness costs in juvenile collared lizards because intact tails function in displays that signal potential predators (York and Baird 2016. Ethol. 122:37–44), and for distraction when stalking arthropod prey (Braun and Baird 2018. J. Herpetol. 52:113–115).

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***CTENOSAURA BAKERI* (Utila Spiny-tailed Iguana). DIET.** *Ctenosaura bakeri* is an endemic and Critically Endangered mangrove specialist found on the island of Utila, Islas de la Bahia, Honduras (Maryon et al. 2018. The IUCN Red List of Threatened Species 2018:e.T44181A125203850; 4 May 2021). Although considerable effort has been made to research and monitor populations of *C. bakeri*, as well as to keep and breed this species in captive zoo populations internationally (Goetz 2006. EAZA-ESB *Ctenosaura bakeri* husbandry guidelines and bibliography. 7 pp.), in situ natural history information for this iguana remains scarce in the literature. There is an apparent ontogenetic dietary shift in *C. bakeri* where juveniles eat a greater proportion of invertebrates and small vertebrates, such as lizards (Schulte and Kohler 2010. Salamandra 46:141–146; McCranie 2018. Bull. Mus. Comp. Zool. Spec. Publ. Ser. 2:240–246) and adults feed primarily on mangrove leaves and flowers, and less frequently on invertebrates such as crabs, arthropods (Gutsche 2003. Iguana 10:28–30) and small vertebrates (Dirkson and Gutsche 2006. Elaphe 14:51–52). Here we report on invertebrate predation by a juvenile *C. bakeri*, which took place in the suburban outskirts of the town of Utila (16.0982°S, 86.8996°W; WGS 84; 6 m elev.).

At 1030 h on 24 April 2018, we observed and recorded a juvenile *C. bakeri* feeding at a small colony of a meliponine stingless bees (three videos: http://dx.doi.org/10.26153/tsw/12565). We suspect the bees were in the genus *Trigona* (Hymenoptera: Apidae), some of which are known to relentlessly swarm and exhibit 'suicidal biting' as a nest defense strategy (Shackleton et al. 2015. Behav. Ecol. Sociobiol. 69:273–281). The *C. bakeri* was perched atop a concrete wall in a suburban garden and we estimated the spiny-tailed iguana to be ca. 7 cm SVL based on our previous juvenile measurements of this species. We infer the iguana had been present at the colony for some time before we observed it because the stingless bees were relentlessly defending the hive by swarming and biting the head and face of the *C. bakeri*. However, this did not deter the lizard which continued to capture bees out of the air as they emerged from the tube-like hive entrance (Fig. 1). During our 10-min observation, we watched the iguana catch, chew, and swallow at least eight bees.

Fig. 1. Juvenile *Ctenosaura bakeri* successfully catching a stingless bee (Apidea: Meliponine) from the air. While not clear in the photograph, a swarm of bees were attacking the iguana in an attempt to defend and deter predation of their nearby hive in the concrete wall.

In situ observations on the diet and feeding behaviors of juvenile *C. bakeri* remain rare and our observation documents feeding on a novel, eusocial prey species. In other *Ctenosaura*, insect foods are demonstrated to compensate for size-related nutritional requirements and digestive tract limitations; opportunistic foraging of insects may help immature iguanas progress quickly through high predation-risk growth periods by increasing nutritional and energetic gains (Durtsche 2000. Oecologia 124:185–195). Although various insects of the order Hymenoptera may be consumed by these iguanas, to our knowledge, this is the first observation of meliponine stingless bees in the diet of *Ctenosaura*.

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***EGERNIA STRIOLATA* (Tree Skink). ENDOPARASITES.** *Egernia striolata* is a species endemic to eastern and central Queensland, most of New South Wales except the coastal regions and the upper parts of the Great Dividing Range, scattered localities in Victoria, and the eastern parts of South Australia (Cogger 2014. Reptiles and Amphibians of Australia. CSIRO Publishing, Collingwood, Victoria, Australia. 1033 pp.). We are aware of only three parasite records for *E. striolata*, the haemosporidian *Plasmodium mackerrasae* (Telford 1979. J. Parasitol. 65:409–413), the nematode *Pharyngodon tiliquae* (Johnston and Mawson 1947. Trans. R. Soc. S. Aust. 71:22–27), and the tick *Amblyomma moreliae* (Roberts 1970. Australian Ticks. CSIRO Publishing, Melbourne, Australia. 267 pp.). The purpose of this note is to add to the endoparasite list for *E. striolata*.

In January 1999, Bull et al. (2001. Behav. Ecol. Sociobiol. 50:173–179) collected a series of *E. striolata* specimens from South Para Gorge in the Mount Lofty Ranges ca. 40 km northeast of Adelaide in South Australia. The lizards were housed individually in captivity, except captive born offspring that were housed with their mother, all under the same conditions, in the Animal House at the Bedford Park campus of the College of Science and Engineering of Flinders University in South Australia until 2018 (Bull et al. 2001, *op. cit.*). The lizards were not treated with anti-parasitic medications for nematodes and protozoa when brought into captivity. On 10 April 2018 seven of the *E. striolata* were humanly euthanized, and the digestive tracts were donated to us for examination.

Each digestive tract was slit open with a longitudinal incision and examined under a dissecting microscope. Nematodes were collected from the large intestine and preserved in 70% ethanol for long-term storage. To identify the nematodes we examined them under a compound microscope and used the reference keys of Anderson et al. (1974. CIH Keys to the Nematode Parasites of Vertebrates. Commonwealth Agricultural Bureaux, Bucks, England. 86 pp.) and descriptions in Jones (1992. Aust. J. Zool. 40:115–126) and Baylis (1930. Ann. Mag. Nat. Hist. 5:354–366), and followed prevalence and infection intensity definitions of Bush et al. (1997. J. Parasitol. 83:575–583). Nematodes were removed from the 70% ethanol and placed on a slide in a drop of undiluted glycerol under a cover slip.

The nematodes infecting the guts of *E. striolata* were identified as the pharyngodonids (Order Oxyurida) *Parapharyngodon fitzroyi* and *Pharyngodon tiliquae*. The prevalence of *Pa. fitzroyi* was 42.9% (N = 3) and infection intensity ranged from 14 to 54 (mean = 32.3, SD = 16.5), whereas the prevalence of *Ph. tiliquae* was 57.1% % (N = 4) and infection intensity ranged from 36 to 254 (mean = 149.5, SD = 77.4). Interestingly, none of the lizards were infected by both nematode species.

To the best of our knowledge this is the first report of *Pa. fitzroyi* and *Ph. tiliquae* infecting *E. striolata* in South Australia. Both nematode species are not likely to be pathogenic (Telford 1971. J. Am. Vet. Med. Assoc. 159:1644–1652; Adamson 1990. *op. cit.*), inhabit the posterior gut of omnivorous lizards and feed on bacterial flora (Adamson 1990. Ann. Parasitol. Hum. Comp. 65:31–35), and have been found in various lizard species, mainly other skinks, in Australia (Table 1). These nematodes can persist in captive hosts for extended periods of time, and we found them in lizards held in captivity for nine years.

Selected specimens were deposited in the Harold W. Manter Laboratory, University of Nebraska, Lincoln (HWML) as *Parapharyngodon fitzroyi* (HWML 112108) and *Pharyngodon tiliquae* (HWML 112107).

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Table 1. Reported hosts for *Parapharyngodon fitzroyi* and *Pharyngodon tiliquae* (QLD = Queensland; WA = Western Australia; NSW = New South Wales; SA = South Australia).

Host	Region	Reference
Parapharyngodon fitzroyi		
Ctenotus helenae	WA	Goldberg and Bursey (2012. Comp. Parasitol. 79:247–268)
Cyclodomorphus branchialis	WA	Jones (1992, *op. cit.*)
Egernia striolata	SA	herein
Pogona minor	WA	Goldberg et al. (2000. Comp. Parasitol. 67:109–114)
Tiliqua multifasciata	WA	Jones (1992, *op. cit.*)
Pharyngodon tiliquae		
Cyclodomorphus melanops	WA	Jones (1992, *op. cit.*)
Egernia cunninghamii	NSW	Johnston and Mawson (1947. op. cit.); Adamson (1984. Syst. Parasitol. 6:39–46)
Liopholis kintorei	SA	Adamson (1984, *op. cit.*)
Egernia stokesii	SA	Hallas et al. (2005. Comp. Parasitol. 72:119–120)
Egernia striolata	NSW	Johnston and Mawson (1947, *op. cit.*); Adamson (1984, *op. cit.*)
	SA	herein
Egernia whitii	NSW	Johnston and Mawson (1947, *op. cit.*); Adamson (1984, *op. cit.*)
Tiliqua multifasciata	WA	Jones (1992, *op. cit.*)
Tiliqua occipitalis	WA	Jones (1992, *op. cit.*)
Tiliqua scincoides	QLD	Baylis (1930, *op. cit.*); Johnston and Mawson (1947, *op. cit.*); Adamson (1984, *op. cit.*)

ENYALIUS CATENATUS **(Wied's Fathead Anole) and *STROBILURUS TORQUATUS* (Spiny-tail Lizard). PREDATION.** *Enyalius catenatus* is a medium-sized lizard found on tree trunks, shrubs, and in the leaf litter (Costa and Bérnils 2018. Herpetol. Bras. 7:11–58; Vanzolini 1972. Pap. Avul. Zool. 26:83–115), whereas *Strobilurus torquatus* is a medium-sized, arboreal lizard frequently observed close to the forest canopy and forest edges (Rodrigues et al. 1989. Rev. Bras. Genet. 12:747–759), and both species occur in the Atlantic Forest from the states of Ceará to Rio de Janeiro, Brazil (Costa and Bérnils 2018, *op. cit.*). *Attila spadiceus* (Bright-rumped Attila) is a common and widely distributed Neotropical flycatcher (Fitzpatrick et al. 2004. *In* Del-Hoyo et al. [eds.], Handbook of the Birds of the World: Cuckoo-Shrikes to Thrushes, Vol. 10, pp. 170–462. Lynx Editions, Barcelona) that forages in the forest understory up to the canopy and their diet consists mainly of insects and small vertebrates such as frogs and lizards (Skutch 1970. Ibis 113:316–322). Here, we describe the presence of *E. catenatus* and *S. torquatus* in diet of *A. spadiceus* chicks in Brazil.

On 9 November 2018, at 1504 h, at the Estação Ecológica de Murici (ESEC de Murici), Municipality of Murici, Alagoas, Brazil (9.2203°S, 35.8788°W; WGS 84; 457 m elev.), we observed a pair of *A. spadiceus* feeding lizards to two chicks, ca. 7–8 d old, at their nest, that was attached to a rock ca. 2 m above the ground. We observed both parents bring two lizards to the nestlings from a distance of ca. 20 m. At 1518 h the first parent landed at the nest carrying a juvenile *E. catenatus* and fed it to one of the chicks and quickly left the nest (Fig. 1A); about 20 sec later the second parent arrived at the nest with a sub-adult *S. torquatus* and gave it to the second chick (Fig. 1B); because there is no sexual dimorphism in this species, we could not differentiate which sex caught which lizard species. Both parent birds remained perched on a nearby tree and watched the chicks consume the lizards. It took 2 min for each chick to swallow their respective lizard's body with the lizard's tails sticking out of their beaks, but the chicks turned around and we could not see them finish ingestion. Small lizards such as *Anolis limifrons* and *Scincella cherriei* have been reported in the diet of *A. spadiceus* chicks from Costa Rica (Skutch 1970. Ibis 113:316–322), but to our knowledge this is the first report of *E. catenatus* and *S. torquatus* in their diet.

Fig. 1. Predation of *Enyalius catenatus* and *Strobilurus torquatus* by *Attila spadiceus* in the northern Atlantic Forest, Alagoas, Brazil: A) parent 1 delivering juvenile individual of *E. catenatus* to chick 1; B) parent 2 delivering individual of *S. torquatus* to chick 2.

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GEKKO HORSFIELDII **(Horsfield's Flying Gecko). PREDATION.** *Gekko horsfieldii* is a large (up to 80 mm SVL) arboreal gecko associated with lowland dipterocarp forests of southeast Asia, from Myanmar to some of the islands of the Sundas, including Borneo (Das 2010. A Field Guide to the Reptiles of South-east Asia. New Holland Publishers Ltd., London. 376 pp.). Information on its predators are poorly documented, although Macat et al. (2016. Phyllomedusa 15:65–67) reported an attempted predation by the colubrid snake, *Chrysopelea paradisi.* Here, we report predation on *G. horsefieldii* by a novel bird predator.

On 15 August 2015, at 0813 h, we observed a female Velvet-fronted Nuthatch (*Sitta frontalis*) foraging on a branch covered with thick epiphytic roots and orchids in the canopy of a mixed dipterocarp forest at the Belalong Canopy Walkway, within the Ulu Temburong National Park, Temburong District, Brunei Darussalam (4.5517°N, 115.1603°E; WGS84; 247 m elev.). The weather conditions were bright and overcast, but with good visibility allowing us to film the predation event with a Canon EOS 1D X MkIII camera, mounted with a EF500mm f4/L ISII USM lens, with 1.4x III converter, for a focal distance of 700 mm. While observing the bird we watched it capture, kill, and eventually consume a juvenile *G. horsfieldii* (Fig. 1) at a height of ca. 24 m

Fig. 1. A Velvet-fronted Nuthatch with a freshly killed *Gekko horsfieldii* at Belalong, Brunei Darussalam.

above ground. The nuthatch seized the lizard by the back of the head just behind the eyes; while subduing the lizard its tail fell off before the bird swallowed it headfirst. There are two syntopic *Gekko* species in this area, *G. horsfieldii* and *G. kuhli*, but we feel confident in our identification based on our recordings. *Gekko horsfieldii* has distinct W-shaped dorsal bars, pale labials, and lacks a broad terminal caudal flap; whereas *G. kuhli* possess a terminal caudal flap and lacks W-shaped dorsal bars.

This observation is novel for two reasons: it is the first report of avian predation of *G. horsfieldii*, and it is the first record of a Velvet-fronted Nuthatch preying on a gecko. Nuthatches are largely predators of insects and their larvae (Kwok 2009. Acta Ecol. Sinica 29:341–346), some species are known to eat plants, including seeds (Mohammadi et al. 2016. J. Zool. 299:116–124), but to our knowledge little is known about lizards in their diet.

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GLAUCOMASTIX ABAETENSIS **(Sand Dune Whiptail Lizard). DIET.** *Glaucomastix abaetensis* is a diurnal teiid endemic to restinga dune ecosystems on the north coast of Bahia and is distributed between the towns of Salvador and Conde, Brazil (Rosário et al. 2019. Zootaxa 4624:451–477). Like other teiids, they are active foragers and primarily prey on invertebrates (Dias and Rocha 2007. Braz. J. Biol. 67:41–46; Travassos et al. 2015. Salamandra 51:171–181). Here, we report a novel observation of *G. abaetensis* feeding on a reptile egg.

On 6 January 2020, at 0923 h, we saw an adult *G. abaetensis* digging into a slope along a road cut near Condominium Busca Vida, near the town of Camaçari, Brazil (12.8567°S, 38.2625°W; WGS 84; 15 m elev.). We watched the lizard actively forage for 3 min, by moving its head and tongue flicking the soil, a common foraging behavior for teiids (Sales and Freire 2015. J. Herpetol. 49:579–585). Occasionally the lizard would stop at one specific site where it then began to dig into the substrate. After digging for ca. 6 min, the lizard emerged from the hole with an egg in its mouth, and it then moved out of view where it presumably consumed it. We waited 30 min to see if the lizard would return before approaching the hole and found it had excavated a nest with one remaining egg (19 mm long, 11 mm wide; Fig. 1). Due to its shape, texture, flexibility, and location of where it was deposited, we believe it was a reptile egg (Packard et al. 1977. Biol. Ver. 52:71–105; Packard et al. 1982. Herpetologica. 38:136–155; Schleich and Kästle 1988. Reptile Egg-Shells SEM Atlas. Gustav Fischer Verlag, New York., New York. 123 pp.). Furthermore, teiid egg size and characteristics are relatively unique and can be used to distinguish their eggs from those of other syntopic lizard subfamilies (Castro et al. 2012. Bahia Anál. Dados 22:561–579; Menezes and Rocha 2014. An. Acad. Bras. Cienc. 86:707–722), and we suspect it may have been a conspecific, or that of another teiid species.

PHOTO BY MATEUS DA SILVA BONFIM

Fig 1. Nest excavated by the *Glaucomastix abaetensis* and remaining egg in sandy soil near Camaçari, Brazil.

Egg eating has been reported in other South American teiids, but because eggs are soft and digest quickly, are suspected to be an under-reported food item in standard stomach content diet studies (Mourthé 2010. Herpetol. Rev. 41:232–233; Albuquerque et al. 2018. J. Herpetol. 52:145–155). To our knowledge this is the first record of vertebrate egg eating in *G. abaetensis* and we emphasize the importance of direct field observations for a better understanding of lizard diets.

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HEMIDACTYLUS TURCICUS **(Mediterranean Gecko). ENDOPARASITES.** *Hemidactylus turcicus* is a native of western India, Somalia, the Middle East, and the Mediterranean region and is one of the most successful invasive species in the world (Kraus 2009. Alien Reptiles and Amphibians: A Scientific Compendium and Analysis. Springer Verlag, Berlin. 563 pp.). Since its introduction into the USA via the Port of Miami, Florida, around 1915, the range of this gecko has increased to include much of southern North America from Virginia and Florida west to California (Meshaka et al. 2006. Herpetol. Conserv. Biol. 1:145–150). A summation of the helminth parasites of both introduced and native *H. turcicus* was provided by McAllister and Bursey (2016. Acta Parasitol. 61:576–584). Here, we document a new host record for a tapeworm parasite of an introduced *H. turcicus*.

A single adult female *H. turcicus* (50 mm SVL) was collected by hand on 19 September 2020 from Mission Viejo, Orange County, California, USA (33.58938°N, 117.6643°W; WGS 84; 120 m elev.). We euthanized the lizard and preserved it in 10% formalin, and fecal samples were collected and placed in 2.5% potassium dichromate. Following fecal flotation in Sheather's sugar solution (specific gravity = 1.30), the flotation concentrate adhering to a coverslip was placed on a glass slide, examined under light microscopy, and found to contain cestode ova. We then removed the gastrointestinal tract from the preserved host lizard by cutting lengthwise and examined it under a stereomicroscope.

We found three individual tapeworms, *Oochoristica bezyi* (Cestoda: Linstowiidae) in the small intestine (Bursey and Goldberg 1992. Trans. Amer. Microsc. Soc. 111:3643). The life cycle of *Oochoristica* spp. includes tenebrionid beetles and other insects as intermediate hosts, alternating with various definitive amniote hosts (Conn 1985. J. Parasitol. 71:1016). Furthermore, *O. bezyi* appears to be a specialist to night lizards (*Xantusia*) and has been previously reported from several species, including *X. bezyi*, *X. henshawi*, *X. sierrae*, and *X. vigilis* from Arizona and California (Bursey and Goldberg 1992. Trans. Amer. Micros. Soc. 111:36–43; Goldberg et al. 1993. J. Helminthol. Soc. Washington 60:165–169; Goldberg et al. 2015. Herpetol. Rev. 48:309–312).

Several species of *Oochoristica* have been previously reported from introduced populations of *H. turcicus*, including *O. ameivae* from Texas, *O. harschi* from Texas, *O. javaensis* from Louisiana and Texas, *O. macallisteri* from Arizona, and *O. scelopori* from Texas (see McAllister and Bursey, *op. cit.*; McAllister and Bursey 2017. Acta Parasitol. 62:296–305), but to our knowledge *O. bezyi* has not been found in other lizards, native or non-native. Interestingly, none of the known *O. bezyi* host *Xantusia* species occur where this gecko was collected (Bezy 2019. Night Lizards: Field Memoirs and a Summary of the Xantusiidae. ECO Herpetological Publishing, Rodeo, New Mexico. 220 pp.), and it is unclear how it became infected. To our knowledge this is the first time the tapeworm *O. bezyi* has been reported from a lizard host family outside the Xantusiidae.

Voucher host deposited in the Natural History Museum of Los Angeles County (LACM 192606). Parasite voucher deposited in the Harold W. Manter Parasite Collection, University of Nebraska, Lincoln (HWML 112175).

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***JAPALURA VARIEGATA* (Variegated Mountain Lizard). PREDATION.** *Japalura variegata* is a diurnal, terrestrial lizard, reaching a maximum size of 110 mm SVL (Smith 1935. The Fauna of British India, Ceylon and Burma, Including the Whole of the Indo-Chinese Sub-region. Reptilia and Amphibia. Vol. II-Sauria. Taylor and Francis, London. 174 pp.) and is distributed across Nepal, northeastern India up to Mizoram, and Bhutan, at elevations of 500–3000 m (Uetz et al. 2021. www.reptile-database.org; 14 Feb 2021). There is little information on the ecology and natural history of *J. variegata*, including its predators (Jha and Thapa 2002. Reptiles and Amphibians of Sikkim. WWF, Kalimpong, India. 9 pp.), and herein, we report predation of *J. variegata* by a Common Green Magpie (*Cissa chinensis*).

On 31 January 2021, at 0734 h, while observing birds in a rural area of Tingvong village in North Sikkim, India (27.5549°N, 88.4766°E; WGS 84; 1496 m elev.), we observed a Common Green Magpie swoop down from a tree branch and catch an adult *J. variegata* that was basking on concrete next to a footpath. The bird caught the lizard in its beak and flew to a branch in a nearby tree where it vigorously swung the lizard around by its neck for a few seconds. The bird then flew to the ground, further away from the tree, holding the now dead lizard in its talons and started tearing and consuming the *J. variegata*. Less than a minute later the bird flew further into dense vegetation making it impossible for us to observe it completely consume the lizard.

The Common Green Magpie is mainly insectivorous, but occasionally preys on small reptiles (Madge 2020. *In* del Hoyo et al. [eds.], Birds of the World, version 1.0, Cornell Lab of Ornithology, Ithaca, New York). To our knowledge this is the first report identifying a predator of *J. variegata*.

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***KARUSASAURUS JORDANI* (Jordan's Girdled Lizard). SIZE AT BIRTH.** *Karusasaurus jordani* is a large rupicolous, viviparous lizard and little is known about its ecology or natural history with the exception of some notes on diet (Heaton et al. 2018. Herpetol. Rev. 49:329), female parturition reproductive cycles, litter size, and neonate body size (Heaton and DeBoer 2018. Herpetol. Rev. 49:330–331). Heaton and DeBoer (2018, *op. cit.*) determined litter size from dissected gravid females and to our knowledge there is no information on the size of *K. jordani* at birth, and in

Fig. 1. A) Neonate *Karusasaurus jordani* 3 d after birth at the National Museum of Namibia; B) the gravid adult female *K. jordani* upon capture at Moltkeblick, Namibia.

general, birth size is largely unknown for cordylids (Costandius and Mouton 2005. Afr. Zool. 41:103–112). Here we report on the size at birth, and coloration, of a single *K. jordani* that was born at the National Museum of Namibia.

We collected a gravid adult female *K. jordani* (ca. 112 mm SVL) on 27 January 2020 from Moltkeblick, Namibia (22.6498°S, 17.1809°W; WGS 84; 2430 m elev.). The female was held in captivity at the National Museum of Namibia, Windhoek, and on 14 February 2020 gave birth to a single neonate that was 49.8 mm SVL (106.8 mm total length) at birth. Measurements of eight wild caught *K. jordani* neonates, whose age was determined by the presence of umbilical scar, had an SVL range of 45–58 mm (Heaton and DeBoer 2018, *op. cit.*).

The dorsal coloration of the neonate *K. jordani* differed compared to the adult female (Fig. 1A). The neonate's dorsum was generally lighter colored with whitish and dark brown to black laterally elongate patches on a light brown background, and the head was dark brown with irregular cream spots. The head scales were smooth, while the body scales exhibited a single keel. The adult female (Fig. 1B) had similar coloration, but the patterns were faded to resemble an uneven light brown, while the head showed no patterning. Dorsal scales on the body and the head were heavily textured, so that the keels were less clear. Both lizards were released back at the females' capture site at Moltkeblick on 17 February 2020.

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***NACTUS AMPLUS* (Louisiade Giant Slender-toed Gecko). REPRODUCTION.** *Nactus amplus* is a recently described, sexually dimorphic, terrestrial gecko known only from Rossel and Sudest Islands, Louisiade Archipelago, Milne Bay Province, Papua New Guinea (Zug 2020. Smithson. Contrib. Zool. 651:1–92). Lizards with small geographic ranges are prone to extinction from pollution or detrimental natural events, which makes information on their biology particularly valuable (Meiri et al. 2018. Divers. Distrib. 24:262–273). In this note we report the first information on the reproductive biology of *N. amplus* from examining specimens in the herpetology collection of the Bernice P. Bishop Museum (BPBM), Honolulu, Hawaii, USA.

A sample of five females were collected in 2004: two collected in April (BPBM 19847, 19848) from Sudest Island (11.4198°S, 153.4126°E, WGS 84; 127 m elev.) and three collected in May (BPBM 19864, 19867, 19869), from Rossel Island (11.3544°S, 154.2232°E; WGS 84; 28 m elev.). The SVL of each specimen was measured to the nearest mm from the tip of the snout to the posterior margin of the vent. We opened the body and removed the left ovary and embedded it in paraffin for histological examination. Slides were stained in hematoxylin followed by eosin counterstain. Oviductal eggs were counted.

Four females had a mean SVL of 73.4 mm (SD = 9.90, range: 62–84 mm), were not reproductively active and contained non-vitellogenic ovarian follicles. One female (BPBM 19848: 77 mm SVL) contained two oviductal eggs which is the first information on the reproductive biology of *N. amplus*. Reproductive examination of additional monthly samples of *N. modicus* are needed to ascertain timing of events in the reproductive cycle.

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***NACTUS ERUGATUS* (Milne Bay Smooth-tailed Slender-toed Gecko). REPRODUCTION.** *Nactus erugatus* is a recently described species known only from six specimens from the southeastern terminus of the Owen Stanley Range and adjacent Pini Range of Milne Bay Province, Papua New Guinea; it is bisexual (Zug 2020. Smithson. Contrib. Zool. 651:1–92). Lizards with small geographic ranges are prone to extinction from pollution or detrimental natural events, which makes information on their biology particularly valuable (Meiri et al. 2018. Divers. Distrib. 24:262–273). In this note we report information on the reproductive biology of *N. erugatus* from specimens examined from the herpetology collection of the Bernice P. Bishop Museum (BPBM), Honolulu, Hawaii, USA.

In May 2002, FK collected three paratypic females, one (BPBM 15449) from the Pini Range, Milne Bay Province (10.4184°S, 150.3070°E; WGS 84; 300 m elev.) and two (BPBM 15451, 15452) from Mt. Pekopekowana, Owen Stanley Mountains, Milne Bay Province (10.2851°S, 150.182°E; WGS 84; 330 m elev.). The left ovary was removed, embedded in paraffin and histological sections were cut at 5µm and stained by hematoxylin followed by eosin counterstain. We counted oviductal eggs and measured SVL of each specimen to the nearest mm from the tip of the snout to the posterior margin of the vent.

The lizards ranged from 68–72 mm (mean SVL = 70.0 mm, SD = 2.0) and all were adults. Both BPBM 15449 and 15451 exhibited early yolk deposition in the form of basophilic granules in ovarian follicles. BPBM 15452 contained two oviductal eggs and was also undergoing concurrent yolk deposition indicating *N. erugatus* may produce a second egg clutch. Our note indicates reproduction occurs in May but examination of additional monthly samples of *N. erugatus* are needed to ascertain timing of events in the reproductive cycle.

We thank Carla Kishinami (formerly of BPBM) for permission to examine *N. erugatus*.

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***NACTUS MODICUS* (Louisiade Slender-toed Gecko). REPRODUCTION.** *Nactus modicus* is a recently described gecko known only from Nimowa, Sudest, and Rossel islands in the eastern Louisiade Archipelago of Milne Bay Province of Papua New Guinea (Zug 2020. Smithson. Contrib. Zool. 651:1–92). Lizards with small geographic ranges are prone to extinction from pollution or detrimental natural events, which makes information on their biology particularly valuable (Meiri et al. 2018. Divers. Distrib. 24:262–273). In this note we report information on the reproductive biology of *N. modicus* from specimens examined from the herpetology collection of the Bernice P. Bishop Museum (BPBM), Honolulu, Hawaii, USA.

We examined a series of four males (BPBM 19833, 19852–19854) and six females (BPBM 19831, 19832, 19837, 19838, 19845, 19847) collected from Sudest Island (11.5150°S, 153.4626°E; WGS 84; 269 m elev.), six females (BPBM 19870, 19873, 19875, 19876, 19878, 19880) collected from Rossel Island (11.3597°S, 154.1831°E; WGS 84; 838 m elev.), and two females (BPBM 19881, 19882) collected from Nimowa Island (11.3133°S, 153.2588°E; WGS 84; 140 m elev.). The Sudest Island *N. modicus* were collected in April 2004 and those from Rossel and Nimowa were collected in May 2004. The SVL of each specimen was measured to the nearest mm from the tip of the snout to the posterior margin of the vent. We removed the left gonad from each specimen and embedded it in paraffin. We then cut 5-µm histological sections and stained by hematoxylin followed by eosin counterstain and counted enlarged follicles > 4 mm length and oviductal eggs.

Males had a mean SVL of 57.0 mm (SD = 2.8; range: 55–61 mm; N = 4) and females had a mean SVL of 56.1 mm (SD = 7.4; range: 42–67 mm; N = 14). All four *N. modicus* males exhibited spermiogenesis determined by the lumina of the seminiferous tubules being lined by sperm or clusters of metamorphosing spermatids. Four females were not reproductively active and contained non-vitellogenic ovarian follicles, but ten of the *N. modicus* females exhibited reproductive activity. Two of these exhibited early yolk deposition in the form of basophilic granules in the ooplasm, five each contained two enlarged ovarian follicles (>4 mm diameter), and three each contained two oviductal eggs. Reproductive examination of additional monthly samples of *N. modicus* are needed to ascertain timing of events in the reproductive cycle of this little understood species.

We thank Carla Kishinami (formerly of BPBM) for permission to examine *N. modicus*.

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PHRYNOSOMA SOLARE **(Regal Horned Lizard). HIBERNATING BLOOD-SQUIRTING DEFENSE.** On 28 February 2008 eight adult hibernating female *Phrynosoma solare* were excavated in the Altar Valley, Pima County, Arizona, USA (32.0365°N, 111.3962°W; WGS 84; 822 m elev.). The lizards had been in hibernation since September 2007, all having been tracked and successfully nested following radio-transmitter (Holohil PD-2) attachment in late May, June, and early July. The purpose of their excavation was to remove the radio-transmitters from the lizards without terminating hibernation (each lizard was successfully reinterred at site of excavation). Lizards were gently exhumed by blowing air through a flexible clear-plastic tube (ca. 6 mm internal diameter) and a drinking straw, and by digging with an 18 cm metal spatula. The depth to the highest point on the lizard's mid-backs was 1–2 cm in all but one lizard. The radio-transmitters were quickly removed by horizontally cutting, with a single-edged razor blade, through the clear silicone adhesive patch adhering it to the upper portion of the lizards' backs (Fig. 1). During removal from their buried hibernation site the lizards were inadvertently aroused enough so that several opened their eyes. Excavations were begun at 1110 h MST and were photographed at various stages. During lizard excavations it was noted that several had a loose covering of slightly damp soil adhering around the head (covering the eyelids) and many had soil adhering around the body as well, possibly the result of recent rains at the site.

Fig. 1. Adult female Regal Horned Lizard (*Phrynosoma solare*) from Arizona, USA showing blood oozing from between soil-adhering eyelids and head and spreading down to the lizard's jaws. This was followed by two forceful blood-squirts from the same left eye.

During the eighth excavation at 1225 h, after the lizard's dorsal surface had been exposed, but before the lizard was moved from its resting site, blood oozed through soil particles adhering over the lizard's left eyelids and spread down the adhering soil onto the jaw (Fig. 1). After this the lizard was gently extracted from its resting site for removal of its radio-transmitter. During this procedure the lizard executed a single squirt of blood that again came from its left eye, following a trajectory of 45° above the lizard's horizontal plane and passing posteriorly over the lizard's back for a distance of about 0.5 m. After removal of the radio-transmitter the lizard repeated a second similar left-eye blood-squirt. Although blood squirting in this and other species of horned lizards has previously been noted during human and canid encounters (Middendorf and Sherbrooke 1992. Copeia 1992:519–527; Sherbrooke and Middendorf 2001. Copeia 2001:1114–1122; Sherbrooke and Middendorf 2004. Copeia 2004:652–658), there are no previous reports of blood-squirting as a potential defense by hibernating horned lizards.

The types of potential predators responsible for excavation of a horned lizard during months of hibernation may be a restricted subset of those that a horned lizard may encounter during times of emergent surface activities. Potential predators unlikely to excavate hibernating lizards would include raptors, roadrunners, snakes, and predatory lizards (Sherbrooke 2003. Introduction to Horned Lizards of North America. University of California Press, Berkeley, California. 178 pp.; Sherbrooke 2008. J. Herpetol. 42:145–152; Sherbrooke and May 2008. Herpetol. Review 39:156–162). A blood-squirting defense is not used and presumably is ineffective with grasshopper mice (*Onychomys torridus*; Sherbrooke 1991. Am. Midl. Nat. 126:187–195), but blood-squirting might be an effective defense with canid or felid predators that unearth hibernating horned lizards (Sherbrooke and Middendorf 2004, *op. cit.*; Sherbrooke and Mason 2005. Southwest. Nat. 50:216–222; Sherbrooke et al. 2012. Herpetol. Rev. 43:386–391). Blood-squirting executed from a subterranean hibernation site like this would be done without visual identification (or categorization) of the molesting-intruder. Hibernating horned lizards may have few alternative defenses to employ given their physiologically lethargic state and probable, but not always, low-body temperature when exhumed. Under such conditions, rapid initial blood-squirting may be a successful defense against appropriate probing predators if chemical components in the blood plasma remain present and potent as deterrents throughout hibernation.

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***PLESTIODON GILBERTI* (Gilbert's Skink). PREDATION.** The skink *Plestiodon gilberti* is a secretive, diurnal lizard found in grasslands, deserts, and mountain forests in western North America (Stebbins 2003. A Field Guide to Western Reptiles and Amphibians. Third edition, revised. Houghton Mifflin Company, Boston, Massachusetts. 533 pp.). Their predators include snakes, lizards, small mammals (Lemm 2009. *In* Jones and Lovich [eds.], Lizards of the American Southwest, pp. 449–451. Rio Nuevo Publishers, Tucson, Arizona), and birds such as hawks (Fitch et al. 1946. Condor 48:205–237), owls (Woods and Clark 2015. Herpetol. Rev. 46:259–260), ravens (Williams 2019. Herpetol. Rev. 50:144), and egrets (Clark and Hagen 2013. Herpetol. Rev. 44:681). Loggerhead Shrikes commonly prey on lizards and are well known for caching prey by impaling it on thorns or other sharp objects such as barbed wire (Clark and Shields 2012. Son. Herpetol. 25:132–133). Here, we report predation of *P. gilberti* by a Loggerhead Shrike (*Lanius ludovicianus*).

PHOTO BY NOAH MORALES

Fig. 1. *Plestiodon gilberti* from California, USA impaled on barbed wire, likely by a Loggerhead Shrike.

On 7 December 2020 at 0730 h, in an open hilly grassland in the western edge of the San Joaquin Valley in Merced County, California, USA, we discovered a recently killed (< 2 d) juvenile *P. gilberti* impaled on a barbed wire fence (Fig. 1). We also found numerous other prey items impaled by a shrike on the fence including grasshoppers, dragonflies, beetles, and small mice over the course of three days. Loggerhead Shrikes were fairly common in the vicinity and we observed one ca. 300 m from the kill site. Although we did not observe the shrike capture and kill the *P. gilberti*, cached prey on fences is a reliable technique to understand shrike diets (Clark and Shields 2012, *op. cit.*). At least two skink species, *P. inexpectatus* and *Sincella lateralis*, have been reported as Loggerhead Shrike prey (Clark 2011. Son. Herpetol. 24:20–22), but to our knowledge this is the first instance of shrike predation on *P. gilberti*.

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***SCELOPORUS CONSOBRINUS* (Prairie Lizard). ELEVATION.** Fishers Peak is a basalt-capped northward projecting spur of Raton Mesa in southern Colorado, USA and is within the newly designated Fishers Peak State Park in Las Animas County. During amphibian and reptile surveys of the new park on 18 September 2020 we found two adult *Sceloporus consobrinus* along the rim of the summit. The lizards were observed at elevations of 2925 m (37.0966°N, 104.4641°W; WGS 84) and 2881 m (37.0985°N, 104.4622°W; WGS 84), which represent elevational records for the species. The vegetation on the mesa top is comprised of grasses with occasional small *Cercocarpus montanus* near the rim and both lizards were observed basking on basalt boulders in the vicinity of these shrubs (Fig. 1).

A previous high elevation observation for this species was at 2805 m in Phantom Canyon, Teller County, Colorado (Banta and Kimmel 1965. J. Colorado-Wyoming Acad. Sci. 5:56). Although Lahti and Leaché (2009. *In* Jones and Lovich [eds]. Lizards of the American Southwest: A Photographic Field Guide, pp. 210–213. Rio Nuevo Publishers, Tucson, Arizona) reported an elevation range of ca. 0–3000 m, the upper elevation may have been based on a specimen (University of Colorado Museum of Natural History [UCM] 6506) collected in 1953 with a reported locality of "8 mi east

Fig. 1. Adult *Sceloporus consobrinus* basking at the highest elevation site observed for this species on Fishers Peak, Las Animas County, Colorado, USA.

Santa Fe" (A. Leaché, pers. comm.). This collection data for the record followed the standards of the time where details pertained to a general area, place names, or road mileages, often without other useful information to identify a precise location. Although the estimated coordinates for this specimen map to an elevation of ca. 3000 m, the coordinates have an uncertainty of 64,590 m. Because of the large uncertainty associated with this record, we suspect the actual collection site may have been at a significantly lower elevation, and therefore we reject this elevation record. Furthermore, Degenhardt et al. (1996. Amphibians and Reptiles of New Mexico. University of New Mexico Press, Albuquerque, New Mexico. 431 pp.) state these lizards range to ca. 2750 m in the state. As currently understood, *S. consobrinus* in eastern Colorado comprises forms that prior to the reorganization of this group of lizards by Leaché and Reeder (2002. Syst. Biol. 51:44–68) had been considered subspecies of *S. undulatus*: *S. u. garmani*, a form generally encountered in level, sandy areas, and *S. u. erythrocheilus*, a saxicolous form seldom found away from boulders and outcrops. The lizard in this observation was *S. u. erythrocheilus*.

These observations were made during an amphibian and reptile survey project contracted through the Colorado Parks and Wildlife Resource Stewardship Program. We thank Megan Lahti and Adam Leaché for their help reviewing pertinent locality information in the range of this species.

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***SCINCELLA ASSATA* (Red Forest Skink). DIET.** *Scincella assata* occurs at low and moderate elevations on the Pacific versant from the coasts of Jalisco, Mexico, to eastern El Salvador and southwestern Honduras (McCranie 2018. Bull. Mus. Comp. Zool. Spec. Publ. Ser. 2:1–666). Little is known about the species natural history, including its diet, and only a few specimens of *S. assata* have been collected from the leaf litter, or under rocks, logs, or other debris (Álvarez del Toro 1982. Los Reptiles de Chiapas. Instituto de Historia Natural del Estado, Chiapas, México. 248 pp.; Ramírez-Bautista 1994. Manual y Claves Ilustradas de los Anfibios y Reptiles de la Región de Chamela, Jalisco: Cuadernos 19. Instituto de Biología UNAM, México. 127 pp.; McCranie 2018, *op. cit.*). Herein, we provide the first diet records for *S. assata*.

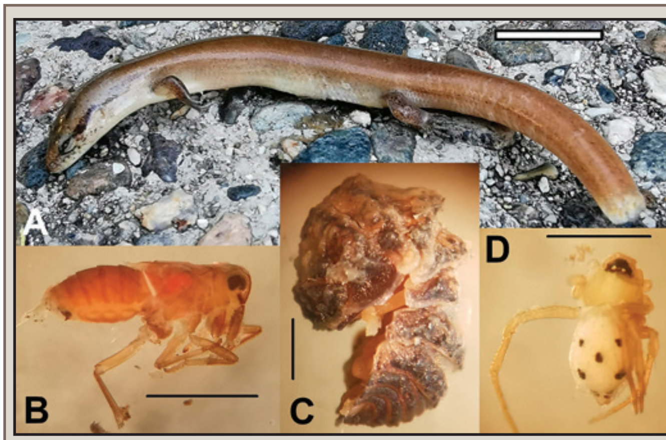

Fig. 1. A) *Scincella assata* from El Tequesquite, Jalisco, Mexico (bar = 1 cm); B) nymph of water boatmen bug (bar = 1 mm); C) woodlouce (*Venezillio* sp.; bar = 1 mm); D) cobweb spider (Theriidinae; bar = 1 mm).

On 15 July 2020 we collected an adult female *S. assata* (40 mm SVL; Fig. 1A) in a grassland grazed by cattle near a stream near the town of El Tequesquite, Municipality of Tomatlán, Jalisco, Mexico (20.0626°N, 105.2979°W; WGS 84; 70 m elev.; deposited, without catalog number, at the Colección Estación de Biologia Chamela, EBCh, Universidad Nacional Autónoma de México). After euthanizing the lizard, we removed the stomach contents and examined them under an Olympus optical microscope. Prey items were identified to the lowest taxonomic level possible using specialized literature (Borror and White 1970. Insects: Peterson Field Guides. Houghton Mifflin Company, Boston, Massachusetts. 404 pp.; Brusca and Brusca 2003. Invertebrates. Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts. 936 pp.; Ubick et al. 2005. Spiders of North America: An Identification Manual. American Arachnology Society, Poughkeepsie, New York. 377 pp.).

Our dissection revealed both aquatic and terrestrial prey from three arthropod orders. The lizard had two partially digested water boatmen bug nymphs (Hemiptera: Corixidae), one partially digested adult woodlouse *Venezillio* sp. (Isopoda: Armadillidae), and one small undigested cobweb spider of the subfamily Theridiinae (Araneae: Theridiidae; Fig. 1B–D). To our knowledge these are the first reported prey items for *S. assata* and suggests the species feeds on a variety of invertebrates similar to other species of *Scincella* (García-Vázquez et al. 2010. Copeia 2010:373–381).

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***TARENTOLA MAURITANICA* (Common Wall Gecko). ENDOPARASITES.** *Tarentola mauritanica* ranges naturally in various coastal Mediterranean regions of the Old World and has been introduced into the Western Hemisphere in Mexico, Argentina, Chile, and Uruguay, and since the mid-1990s, has also been documented in San Diego County, California, USA (Mahrdt 1998. Herpetol. Rev. 29:52). Although a great deal is known about its ectoparasites (Bertrand et al. 2012. Acarologia 52:353–366) and blood and coccidian parasites (Alvarez-Calvo 1977. Medit. Conf. Parasitol. 1:14–15; Matuschka and Bannert 1986. J. Protozool. 33:309–311; Abdel-Aziz et al. 2013. Int. J. Adv. Res. 1:526–534; Tomé et al. 2016. J. Parasitol. 102:476–480), information on its helminth parasites is only known from its native range (Roca 1985. Riv. di Parassitol. 46:2731; Roca et al. 1994. Vie et Mil. 33:177–179). Indeed, nothing is available on any of its parasites from introduced individuals in the USA, and here, we document two new host records for endoparasites of *T. mauritanica*.

On 17 September 2020, one adult female (57 mm SVL) and one juvenile (27 mm SVL) *T. mauritanica* were collected by hand in Pacific Beach, San Diego County, California, USA (32.8044°N, 17.2300°W; WGS 84; 25 m elev.). We euthanized the lizards, collected fecal samples and placed them in 2.5% potassium dichromate, and preserved lizards in 10% formalin. Following fecal flotation in Sheather's sugar solution (specific gravity = 1.30), the flotation concentrate on a coverslip was placed on a glass slide and examined under light microscopy. The fecal sample from the adult female was found to contain nematode ova and we then removed the gastrointestinal tract, split it lengthwise, and examined it under a stereomicroscope. We found two taxa of nematodes: three (one male, two female) *Parapharyngodon californiensis* in the intestine, and five larval *Physaloptera* sp. in the stomach.

Three species of *Parapharyngodon* have been previously reported from *T. mauritanica*, including *P. bulbosus*, *P. echinatus*, and *P. micipsae* from Spain (Roca 1985, *op. cit.*). *Parapharyngodon californiensis* has been previously reported from *Sceloporus orcutti*, *Xantusia bolsonae*, *X. henshawi*, and *X. vigilis*, all from California or Mexico but is not known from native gecko species (Goldberg et al. 2013. Herpetol. Rev. 44:149). Members of *Parapharyngodon* are strictly monoxenous (Anderson. 2000. Nematode Parasites of Vertebrates: Their Development and Transmission. Second edition. CABI Publishing, Oxon, UK. 650 pp.) with infection occurring through contact with substrate contaminated with fecal materials (Telford 1971. J. Am. Vet. Med. 159:1644–1652). It is unknown how this *T. mauritanica* picked up this specific parasite as none of the native host species are known to occur in the area where this invasive species was found. This suggests that this *T. mauritanica* population may have been moved to this locality from elsewhere in San Diego and has implications for the spread of *T. mauritanica*. The most proximate alternate host species known from are rock crack specialists elsewhere in San Diego (Weintraub 1980. Cat. Amer. Amph. Rept. 265.1265.2; Bezy 2019. Night Lizards: Field Memoirs and a Summary of the Xantusiidae. ECO Herpetological Publishing and Distribution, Rodeo, New Mexico. 220 pp.). *Physaloptera* spp. occur in the stomach of a number of terrestrial vertebrates with such regularity that the genus is commonly called "the stomach worm." Telford (1970. Am. Midl. Nat. 83:516–554) reported this helminth to be the most common nematode recovered from southern California lizard species. Because insects serve as intermediate hosts to *Physaloptera* sp., diet is the primary factor for infection. To our knowledge, this is the first report of typical North American helminths infecting this introduced lizard species, creating continued concern for invasive lizards playing a role in homogenizing endemic parasite communities of North American lizards.

Voucher host deposited in the Natural History Museum of Los Angeles County (LACM 192605). Nematode vouchers are deposited in the Harold W. Manter Parasite Collection, University of Nebraska, Lincoln (HWML 112173 [*P. californiensis*], 112174 [*Physaloptera* sp.]).

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SQUAMATA — SNAKES

***AGKISTRODON BILINEATUS* (Common Cantil). DIET.** *Agkistrodon bilineatus* ranges from Mexico to Guatemala, El Salvador, and Honduras (Porras et al 2013. Amphib. Rept. Conserv. 7:48–73). Adults feed on a variety of vertebrates, including fishes, mammals, amphibians, and reptiles (Gloyd and Conant 1990. Snakes of the *Agkistrodon* Complex: A Monographic Review. Society for the Study of Amphibians and Reptiles, Contributions to Herpetology, No. 6, Ithaca, New York. 614 pp.; Loc-Barragán and Carbajal-Marquéz 2016. Mesoam. Herpetol. 3:733–734), while juveniles may eat invertebrates and frogs (Gloyd and Conant 1990, *op. cit.*). Here, we report for the first time an *Anolis nebulosus* lizard as part of the diet of a juvenile *A. bilineatus*.

FIG. 1. *Anolis nebulosus* consumed by *Agkistrodon bilineatus* in Santiago Pinotepa Nacional, Oaxaca, Mexico.

At 1500 h on 5 August 2020, a juvenile *A. bilineatus* (Fig. 1) was accidentally killed during construction of a road through lowland deciduous forest in the municipality of Santiago Pinotepa Nacional, Oaxaca, Mexico (16.36277°N, 98.17444°W; WGS 84). The specimen was collected and deposited in the Collection of Amphibians and Reptiles of the Universidad Autónoma Metropolitana- Iztapalapa (CAR-I 1504: 350 mm total length, 55 mm tail length). Later, we dissected the specimen and found in its stomach an adult male *A. nebulosus* (Clouded Anole; 120 mm total length, with incomplete tail).

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***AGKISTRODON CONTORTRIX* (Eastern Copperhead). REPRODUCTION, MALE COMBAT, and PHENOLOGY.** Male combat in snakes is a sexually dimorphic trait in adults, primarily expressed during breeding periods, and under certain conditions confers reproductive advantages to winners by way of priority-of-access to sexually active females (Duvall et al. 1993. *In* Seigel and Collins [eds.], Snakes: Ecology and Behavior, pp. 165–200. McGraw-Hill, New York, New York; Shine 1994. Copeia 1994:326–346; Schuett 1997. Anim. Behav. 54:213–224; Schuett et al. 2001. Acta Ethol. 4:31–49; Shine 2003. Proc. Royal Soc. Lond. B 270:995–1004). Male combat is ubiquitous in North American pitvipers, including *A. contortrix* (Carpenter 1986. Smithson. Herpetol. Inform. Serv. 69:1–18; Shine 1994, *op. cit.*; Schuett 1997, *op. cit.*), and in most circumstances is coincident with breeding activities (Schuett 1997, *op. cit.*; Shine 2003, *op. cit.*). Depending on the geographic location, *A. contortrix* exhibit mating and male-male combat in late summer to early fall, and again in early spring; a pattern termed bimodal (Fitch 1960. Univ. Kansas Mus. Nat. Hist. Misc. Publ. 13:85–288; Schuett 1992. *In* Campbell and Brodie

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Fig. 1. Male *Agkistrodon contortrix* engaged in male combat on 21 October 2020.

[eds.], Biology of the Pitvipers, 169–184. Selva, Tyler, Texas; Aldridge and Duvall 2002. Herpetol. Monogr. 16:1–25), or, more rarely, only in late summer and early fall, i.e., unimodal pattern (Smith et al. 2010. J. Zool. 280:362–370; Smith et al 2015. Biol. J. Linn. Soc. 115:185–194.). Gloyd and Conant (1990. Snakes of the *Agkistrodon* Complex: A Monographic Review. Contributions in Herpetology 6. Society for the Study of Amphibians and Reptiles, Oxford, Ohio. 614 pp.), Schuett (1992, *op. cit.*), and Aldridge and Duvall (2002, *op. cit.*) provide overviews of mating seasons of *A. contortrix* and other North American pitvipers. Here, we document a case of late-season male combat in wild *A. contortrix* from North Carolina.

On 21 October 2020, at ca. 1606 h EST, Louise and Jeffrey Barker observed and filmed two putative male *A. contortrix* engaged in male combat in forested habitat in Beaufort County, North Carolina, USA (Fig. 1). The observation time in total was ca. 10 min; 150 sec of video was recorded (http://doi.org/10.13012/B2IDB-9209722_V1). Both individuals, each ca. 1 m total length, showed classic species-specific behavioral acts that have been described for male combat in captive *A. contortrix* (see inventory of acts in Schuett 1997, *op. cit.*), and included challenge, hook, entwine, stiffen, and topple. Following a topple, they quickly resumed the vertical stereotypical position. The video ends before a winner is decided. No female was observed in the vicinity. Although the present snakes were not sexed, we feel that based on extensive behavioral research (Schuett 1997, *op. cit.*) the most parsimonious conclusion is that both individuals were males. Populations of *A. contortrix* from South Carolina show a bimodal mating pattern (GWS, pers. obs.).

Male combat in wild *A. contortrix* has been reported outside of spring, including late June (Gloyd 1947. Nat. Hist. Misc. 12:1–4) and August (Mitchell 1981. Catesbeiana 1:7–9; Shively and Mitchell 1994. Banisteria 3:29–30). Schuett (1997, *op. cit.*) documented late-season (September–October) male combat in a laboratory colony of *A. contortrix* derived from populations in southern Texas. To the best of our knowledge, the present observation is the latest documented case of male combat in wild *A. contortrix*.

Fitch (1960, *op. cit.*, pp. 157–161) determined presence of active spermatozoa in the cloaca indirectly indicated recent mating activity in female Copperheads from eastern Kansas. This research showed the mating season to be bimodal (i.e., fall and spring); the latest dates for finding active spermatozoa were late October to early November. Although never witnessed, it is possible that male combat could occur late in the season, too (Fitch 1960, *op. cit.*, p. 134; GWS, pers. obs.).

We thank Louise and Jeffrey Barker for observing and recording this interaction, and for generously giving us permission to use the video and photograph for this note.

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***AGKISTRODON CONTORTRIX* (Eastern Copperhead). SPATIAL ECOLOGY.** Males and non-perinatal females of *Agkistrodon contortrix* are known to perform distant, looping seasonal migrations to summer ranges for foraging and mating (Fitch 1960. Univ. Kansas Publ. Mus. Nat. Hist. 13:85–288; Smith et al 2009. Herpetol. Monogr. 23:45–73). By contrast, gravid females move less, fast during much of gestation, and lose mass after parturition (Fitch 1960, *op. cit.*; Smith et al. 2009, *op. cit.*). Post-partum female pitvipers may extend movements and forage prior to hibernation (Martin 1992. *In* Campbell and Brodie [eds.], Biology of The Pit Vipers, pp. 259–278. Selva, Tyler, Texas), but this tendency has been demonstrated to diminish in northern populations (Martin et al. 2008. *In* Hayes et al. [eds.], The Biology of Rattlesnakes, pp. 447–462. Loma Linda University Press, Loma Linda, California). However, this behavior has not been reported in *A. contortrix* (Gloyd and Conant 1990. Snakes of the *Agkistrodon* Complex: A Monographic Review. Contributions in Herpetology 6. Society for the Study of Amphibians and Reptiles, Oxford, Ohio. 614 pp.; Smith et al. 2009, *op. cit.*). Here we report two atypical cases of fall migration to distant foraging grounds in radio-tracked post-partum female *A. contortrix* from the northeastern-most population of this species.

We radio-tracked a sample of *A. contortrix* (9 adult females and 15 males) at one site in Norfolk County, Massachusetts, USA, between 2017 and 2018. The sample contained two perinatal females (F06: 299 g, 720 mm SVL; F23: 278 g, 685 mm SVL) captured on 9 and 24 April 2017, respectively. Neither female had well-defined follicles at the time of capture, as determined by palpation, thus were included in the study, but later we discovered they were gravid. We intracelomically implanted snakes with crystal controlled, 2 stage, 3.6 g, 150–151 mhz radio-transmitters (R-1860, Advanced Telemetry Systems, Inc., Isanti, Minnesota), following established techniques (Reinert and Cundall 1982. Copeia 1982:702–705; Briant et al. 2010. Aust. Vet. J. 88:443–448) and relocated each individual twice per week, yielding 53 and 56 locations (± 5 m), respectively, between release and hibernation the following fall. We mapped relocations using ArcGIS 10.6 (ESRI, Redlands, California), and computed maximum horizontal displacement and migratory distances (m), 100% minimum convex polygon area (MCP – (ha)), and 95% kernel utilization distribution areas (KUD (ha), band-width = 20), using Adehabitat LT and Adehabitat HR packages (Callenge 2006. Ecol. Mod. 197:516–519) in R (R Core Team, 2020). We estimated percentage of upland and wetland habitat within 95% KDU areas using 2016 land cover data-layer (MASS GIS, Bureau of Geographic Information, Commonwealth of Massachusetts), modified after ground-truthing.

Perinatal snakes F06 and F23 moved ca. 521 m and 375 m from hibernacula, respectively, and had home ranges (100%

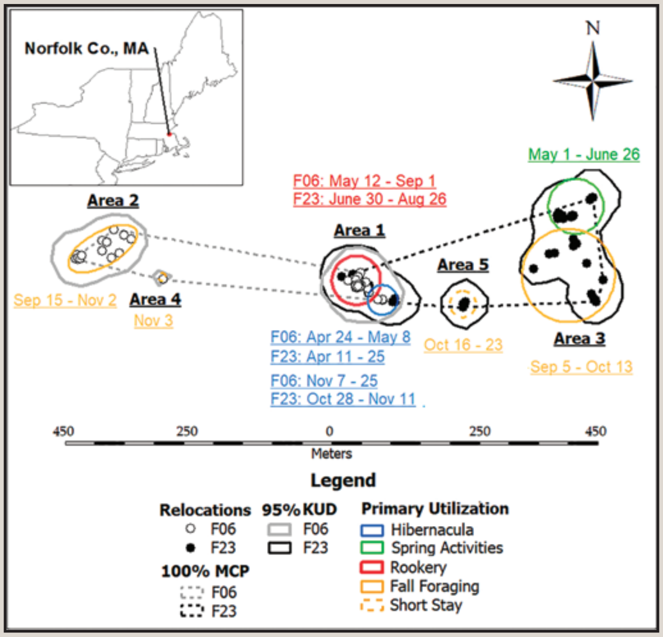

Fig.1. Spatial-temporal patterns of home ranges and movements in two perinatal females of *Agkistrodon contortrix* from Massachusetts, USA.

MCP) ca. 3.19 ha and 4.76 ha (Fig. 1), laying within the 61.5th MCP percentile estimated for non-perinatal females (Smith et al. 2009, *op. cit.*). For both snakes, home ranges consisted of 2 major activity areas (KDU 95%; F06: Area 1 = 1.29 ha, 100% upland; Area 2 = 1.36 ha, 73% forested wetland, 27% upland; F23: Area 1 = 1.5 ha, 100% upland; Area 3 = 2.9 ha, mosaic of 87% upland and 13% forested wetland), separated by migratory paths (ca. 300 m and 400 m) that included small (ca. 0.04 ha and 0.45 ha) upland sites utilized for short periods of time (1 and 8 d; Fig. 1). Females shared rookery and hibernacula encompassed in Area 1 (Fig. 1). In the spring, F06 moved from the hibernaculum to the adjacent rookery, encompassed in Area 1, for ca. 112 d where foraging, gestating, shedding, and birthing occurred. After parturition (1 September), F06 migrated ca. 465 m west to Area 2 (Fig. 1) for foraging and basking (ca. 48–61 d) then returned to hibernaculum in late fall (2–3 November; Fig. 1). F23 migrated ca. 335 m east to Area 3 within 4 d of release in late April. We observed F23 basking with conspecifics, including males, and molting in the upland for ca. 56 d. In late June, F23 returned to Area 1 for ca. 57 d to complete gestation and parturition. After parturition F23 migrated to Area 3 again for ca. 38 d. During this period, we found her digesting a large meal by a dry stream bed and basking on several occasions. Both females returned to hibernacula in late fall (28 Oct and 7 Nov), after non-perinatal females and males, which returned between 5 September and 23 October. Neither female exited hibernation the following spring and are presumed dead.

Movements in snakes are driven by the individual's energetics and availability of prey (Shine and Madsen 1996. Ecology 77:149–156). In female snakes, effective foraging and thermoregulation are crucial for recovering costs of reproduction (Duvall et al 1991. *In* Campbell and Brodie [eds.], Biology of The Pit Vipers, pp. 321–336. Selva, Tyler, Texas). Fasting during hibernation and much of gestation, along with high energetic cost of gestation forces female *A. contortrix* to reproduce in alternate years, and forage for at least a year to recover energy reserves needed for future reproduction (Fitch 1960, *op. cit.*; Graves and Duval 1995. Herpetol. Monogr. 9:102–119). After parturition, female pitvipers are emaciated (Fitch 1960, *op. cit.*; Duvall et al. 1991, *op. cit.*), increase movements (Secor 1992. *In* Campbell and Brodie [eds.], Biology of The Pit Vipers, pp. 389–393. Selva, Tyler, Texas), and forage prior to hibernation (Martin 1992, *op. cit*), which may increase survivorship over the winter. In other studies of *A. contortrix*, gravid females have been shown to have small home ranges typically encompassing their hibernacula (Fitch 1960 *op. cit.*; Smith et al 2009 *op. cit.*) and to return to hibernacula earlier than non-perinatal females and males (Gloyd and Conant 1990 *op. cit.*).

Here we describe two post-partum female *A. contortrix* that exhibited fall migration, foraged in distant areas, and returned to hibernacula later than conspecifics, but likely did not survive the winter. Should winter mortality in post-partum females of *A. contortrix* approach some critical threshold, the snake may be precluded from establishing new populations and radiating further northwards under current climate conditions. *Agkistrodon contortrix* is listed as Endangered in Massachusetts (https://www.mass.gov/regulations/321-CMR-1000-massachusetts-endangered-species-act; 31 March 2021). Evidence above justifies state regulatory authorities consider extending the end of the activity season (along with applicable management implications) of *A. contortrix* in Massachusetts to the end of November.

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***AGKISTRODON PISCIVORUS* (Cottonmouth). DIET.** *Agkistrodon piscivorus* is a large-bodied, widely distributed, crotaline snake inhabiting a variety of wetland and estuarine habitats from the eastern seaboard to central Texas, USA (Gloyd and Conant 1990. Snakes of the *Agkistrodon* Complex: A Monographic Review. Society for the Study of Amphibians and Reptiles, Oxford, Ohio. 620 pp.). It is a dietary generalist and is known to ambush live prey as well as a scavenge on carrion (Burkett 1966. Univ. Kansas Publ. Mus. Nat. Hist. 17:435–491; Martof et al. 1980. Amphibians and Reptiles of the Carolinas and Virginia. University of North Carolina Press, Chapel Hill, North Carolina. 264 pp.). Here, we document an *A. piscivorus* consuming an invasive species of ecological and economic importance.

At 1715 h, on 12 July 2019, at Land Between the Lakes National Recreation Area, Lyon County, Kentucky, USA (36.92127°N, 88.06381°W; WGS 84; 109 m elev.), an *A. piscivorus* (76.2 cm SVL) was observed scavenging the carcass of a *Hypophthalmichthys molitrix* (Silver Carp) in a tributary of the Cumberland River Reservoir. The site was a shaded gravel bottomed streambed. The *A. piscivorus* was coiled next to the dead *H. molitrix* in ca. 1–2 cm of water near the edge of the stream. The *H. molitrix* carcass was ca. 3 times larger by mass than the *A. piscivorus*, making consumption impossible. Consequently, the *A. piscivorus* was observed attempting to bite off and consume pieces of the decaying fish. We observed the snake attempting to eat the fish for 5 min, at which point the snake moved down the tributary after we had approached it.

Since 1987, *H. molitrix*, have been found in the Cumberland and Tennessee river basins and in the past decade have become an increasingly important invasive species in these watersheds (White 2014. Trans. Am. Entomol. Soc. 140:83–99). *Hypophthalmichthys molitrix* are native to several rivers in eastern Asia and feed on benthic macroinvertebrates as well as phytoplankton and zooplankton (White 2014, *op. cit.*; Li and Fang 1990. Acta Zool. Sinica 36:24–250). To our knowledge, this is the only case where an *A. piscivorus* has been documented actively feeding not just on silver carp but an invasive species of fish.

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BUNGARUS FASCIATUS **(Banded Krait). DIET.** *Bungarus fasciatus* is a nocturnal elapid snake widely distributed in eastern and parts of central and western states of the Indian subcontinent (Whitaker and Captain 2004. Snakes of India: The Field Guide. Draco Books. Chengalpattu, India. 479 pp.). It is also found in Bangladesh, Indonesia, Laos, Malaysia, Singapore, Bhutan, Nepal, Thailand, Vietnam, and southern China (www.reptile-database.org; 10 Aug 2020). *Bungarus fasciatus* is known to feed mostly on various snakes including venomous *B. caeruleus* (Common Krait), snake eggs, skinks, rats, and sometimes fish (Whitaker and Captain 2004, *op. cit*).

On 26 October 2019, at ca. 2045 h, CB and AB observed a *B. fasciatus* (ca. 152 cm total length) preying on a *Bungarus lividus* (Lesser Black Krait; ca. 107 cm total length), within a compound of a village house at Railghumti, Cooch Behar, West Bengal, India (26.3228°N, 89.4618°E; WGS 84; 46 m elev.). *Bungarus lividus* is a medium-sized, nocturnal venomous elapid, known from northeastern states of India (Smith 1943. Handbook of Indian Snakes. Cosmo Publications, New Delhi, India. 418 pp.), Nepal, Bangladesh, possibly Bhutan (www.reptile-database.org; 10 Aug 2020). The *B. fasciatus* bit and held its prey by the head (Fig. 1). Both entangled each other in a coil. The struggle lasted for ca. 40 min. Slowly, the prey snake gave up and loosened its grip on the *B. fasciatus*. The prey was then devoured headfirst in ca. 15 min. This is the first instance of *B. fasciatus* preying upon *B. lividus*

Fig 1. *Bungarus fasciatus* preying on a *Bungarus lividus* in West Bengal, India.

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CHILOMENISCUS STRAMINEUS **(Variable Sandsnake). PREDATION.** *Chilomeniscus stramineus* is a small, predominantly fossorial species found in arid regions of south-central Arizona and parts of northwest Mexico (Brennan and Holycross 2006. A Field Guide to Reptiles and Amphibians in Arizona. Arizona Game and Fish Department, Phoenix, Arizona. 150 pp.). *Lanius ludovicianus* (Loggerhead Shrike) is a carnivorous passerine widespread in North America, known for impaling prey on sharp points such as thorns or barbed wire for later consumption (Kaufman 1996. Lives of North American Birds. Houghton Mifflin Company, Boston, Massachusetts. 675 pp.). *Lanius ludovicianus* are regular squamate predators, with records of 18 species of lizard and 15 species of snake impaled (Clark 2011. Son. Herpetol. 24:20–22). However, no previous records exist of *L. ludovicianus* predation on *Chilomeniscus* (Holycross and Mitchell 2020. Snakes of Arizona. ECO Publishing, Rodeo, New Mexico. 860 pp.). Here, we report a novel observation of the impalement of *C. stramineus* by *L. ludovicianus*.

At 1146 h on 12 December 2019, a deceased adult *C. stramineus* was observed impaled ca. 1.5 m off the ground (Fig. 1), presumably by *L. ludovicianus*, in a *Celtis pallida* shrub along

PHOTO BY STEVE JONES

Fig. 1. *Chilomeniscus stramineus* impaled on a *Celtis pallida* thorn, presumably by *Lanius ludovicianus*, in Arizona, USA.

an arroyo in upland Sonoran desertscrub, near the northern boundary of McDowell Sonoran Preserve, Maricopa County, Arizona, USA (33.8131°N, 111.8316°W; WGS 84). Though not observed, this was likely followed by predation. This observation is noteworthy because *C. stramineus* is rarely observed surface-active diurnally, and therefore, is not expected to often come into contact with *L. ludovicianus*. We thus believe that this observation represents an opportunistic predation event, in keeping with the generalist feeding habits of *L. ludovicianus*, and do not suspect that *C. stramineus* faces significant predation pressure from *L. ludovicianus*.

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***COLUBER CONSTRICTOR* (North American Racer). FORAGING BEHAVIOR.** *Coluber constrictor* is a widely distributed, swift-moving, diurnal snake species of relatively large size. Known for their active foraging behaviors and reliance on visual cues, individuals of *C. constrictor* feed on a variety of both vertebrate and invertebrate prey (Fitch 1963 Univ. Kansas Publ. Mus. Nat. Hist. 15:351–468). Included among invertebrate prey species are larval and adult lepidopterans (Fitch 1963, *op. cit.*). However, we were unable to find recorded observations that described how lepidopterans are captured, or more specifically, whether volant adults are caught mid-flight. Although arboreal snakes are regularly observed seizing winged vertebrates mid-flight (i.e., birds and bats), recorded observations of terrestrial snakes capturing volant invertebrate prey mid-flight are rare.

At 1540 h on 22 October 2020, at Tickfaw State Park in Livingston Parish, Louisiana, USA (30.381°N, 90.654°W; WGS 84) we observed an adult *C. constrictor* (ca. 90 cm SVL) attempting to depredate an adult lepidopteran (Pieridae) in mid-flight. Both observers initially detected the snake moving rapidly away from us with its head elevated. Soon after, the snake made an upward lunge. The snake then oriented toward us, moving rapidly with its head still elevated, clearly in pursuit of a low-flying lepidopteran flying ca. 30 cm above the ground. After the direction change, the snake made another upward lunge. Immediately after the second lunge, the lepidopteran's flight path crossed directly in front of us. The snake continued to pursue the lepidopteran until appearing to notice our presence, at which point it reacted by stopping ca. 1 m in front of us. After remaining momentarily motionless, the snake again changed direction and moved swiftly away from us.

This individual failed to capture its quarry, although it is unclear whether it failed because of an inability to capture the intended prey item, or because of observer interference. Still, we believe this observation is a compelling demonstration of the potential ability of individuals of *C. constrictor* to seize volant prey mid-flight. An individual of *Malpolon monspessulanus* (Montpellier Snake) was recently described engaging in similar behavior, resulting in the successful capture of a lepidopteran mid-flight (Pleguezuelos and Feriche 2019. Bol. Asoc. Herpetol. Esp. 30:9–10). Both species exhibit comparable foraging behavior, potentially making this foraging mode more common than previously recognized. Given the broad geographic range of *C. constrictor*, investigations into the distribution and frequency of this behavior are warranted.

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***CONTIA TENUIS* (Common Sharp-tailed Snake). REPRODUCTION.** Cryptic snake species often present difficulties in observing behaviors. *Contia tenuis* is such a species, with a lack of observational data about a number of life-history characteristics, including reproduction (Ernst and Ernst 2003. Snakes of the United States and Canada. Smithsonian Books, Washington, D.C. 668 pp.). At 1530 h on 2 August 2020, a pair of mating *C. tenuis* (Fig. 1) were observed under a cover board in the San Juan Island National Historical Park on San Juan Island, Washington, USA. Photographs were taken of the event and the snakes were not further disturbed at the site of observation. Prior accounts of the reproductive life-history of *C. tenuis* have included observations of gravid females, as well as neonates, but to our knowledge, direct observations of mating events for this species have not yet been reported. Additionally, the timing of this observation appears to be unusual in that it occurred outside of the spring breeding season that is believed to be common for this species (Leonard et al. 1996. Northwest. Nat. 77:47–49).

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Fig. 1. Mating *Contia tenuis* from San Juan Island, Washington, USA.

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***CORONELLA AUSTRIACA* (Smooth Snake) and *ZAMENIS LONGISSIMUS* (Aesculapian Snake). DEFENSIVE BEHAVIOR.** Caudal movements in snakes are well known (Carpenter 1977. Am. Zool. 12:217–223) and, depending on the species, can be used for different purposes, including predatory (caudal luring and caudal distraction; Mullin 1999. Great Basin Nat. 59:361–367), courtship (Senter et al. 2014. PLoS ONE 9:e107528), and defense behaviors (Greene 1973. J. Herpetol. 7:143–161; Allf et al. 2016. Am. Nat. 188:475–483). Defensive tail vibration has become complex in rattlesnakes, but has been observed in several snake families, including Colubridae, and its potential functions might include inducing the predator to attack the tail instead of other parts of the body, confusing the predator, or discouraging predation by advertising a venomous bite (Deshmukh et al. 2020. IRCF Rept. Amphib. 27:68–70). Here, we report novel observations of defensive tail-vibrating behavior in two species of colubrid snakes, supported by video records.

Coronella austriaca is a small aglyphous colubrine (Geniez 2018. Snakes of Europe, North Africa and the Middle East. Princeton University Press, Princeton, New Jersey. 379 pp.) with a Euro-Siberian (with Caucasian and Anatolian extensions) chorotype (Sindaco et al. 2013. The Reptiles of the Western Palearctic. Edizioni Belvedere, Latina, Italy. 543 pp.). At 1407 h on 9 June 2019 (ca. 16°C, overcast), GJM observed an adult *C. austriaca* basking in an alpine meadow in Alpe di Serdena, Ticino, Switzerland (46.12°N, 9.06°E; WGS 84; 1700 m elev.). It did not attempt to flee, so the observer tried to elicit a reaction by touching it and the response was a quick vibration of the tail, repeated with each new touch (http://dx.doi.org/10.26153/tsw/12556). Subsequently, the *C. austriaca* was left undisturbed in its initial position, from which it did not move.

Zamenis longissimus is a large aglyphous colubrine (Geniez 2018, *op. cit.*; Di Nicola et al. 2019. Anfibi & Rettili d'Italia. Edizioni Belvedere, Latina, Italy. 568 pp.) with a Siberian-European (European) + Mediterranean chorotype (Sindaco et al. 2013, *op. cit.*). At 0900 h on 27 October 2020 (ca. 15°C, cloudy), near Solfagnano, Perugia, Italy (43.21°N, 12.23°E; WGS 84; 230 m elev.), NP observed an adult *Z. longissimus* active in a mixed oak forest. The *Z. longissimus* did not attempt to escape, instead starting a defensive display, with anterior S-shape and tail-vibrating behavior (http://dx.doi.org/10.26153/tsw/12557). Shortly thereafter, the *Z. longissimus* was left undisturbed and did not move from the observation point.

Although the two observations occurred in different snake species and different habitats, they shared cloudy weather associated with relatively low ambient temperatures, a combination of conditions that do not allow adequate thermoregulation. Among the hypothesized reasons that could induce some snake species to implement defensive tail-vibrating behavior is low body temperature limiting the possibility of escape (Mori and Burghardt 2004. Herpetol. J. 14:79–87; Deshmukh et al. 2020, *op. cit.*). Further field investigation will be useful to investigate the circumstances and the possible correlation with certain climatic/environmental conditions in which these behaviors occurred.

An approximate description of tail vibration in *Z. longissimus* appears in a popular book (Frösch 1985. Gli incompresi. Jam, Lodrino. 212 pp.), and this behavior has also recently been reported for a captured individual, which started the tail vibration while the front of its body was covered by human hands (Dyugmedzhiev 2020. Herpetol. Bull. 154:21–31). Within the same genus, tail-vibrating behavior has been documented for *Z. situla* (Leopard Snake; Bruno and Maugeri 1990. Serpenti d'Italia e d'Europa. Mondadori, Milano, Italy. 224 pp.). A variety of defensive behaviors are documented for *C. austriaca*, but tail vibration is not among them (Engelmann 1999. *In* Böhme [ed.], Handbuch der Reptilien und Amphibien Europas. Band 3/I: Schlangen [Serpentes] I, pp. 200–246. AULA-Verlag, Wiesbaden).

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***CROTALUS BASILISCUS* (Mexican West Coast Rattlesnake). DIET.** *Crotalus basiliscus* is a large rattlesnake (to 204.5 cm SVL) restricted to western Mexico, occurring from western Chihuahua and southern Sonora to northwestern Michoacán at elevations from near sea level to 2400 m (Ernst and Ernst 2012. Venomous Reptiles of the United States, Canada, and Northern Mexico. Vol. 2. Johns Hopkins University Press, Baltimore, Maryland. 391 pp.). This species is diurnal and terrestrial and has been reported to feed on mammals (rodents), and perhaps birds or juvenile lizards (García and Ceballos 1994. Guía de Campo de los Reptiles y Anfibios de la Costa de Jalisco, México. Fundación Ecológica de Cuixmala, A.C. – Instituto de Biología, UNAM, México. 184 pp; Ernst and Ernst 2012, *op. cit.*). However, to date food items have not been identified to species level. Here, we report the Gleaning Mouse (*Peromyscus spicilegus*) as prey of *C. basiliscus.*

In November 2017, we visited the Maple Forest (*Acer binzayedii*) near Talpa de Allende town, Jalisco, Mexico (20.21314°N, 104.75792°W; WGS 84; 1770 m elev.). During a diurnal survey, we found a recently killed (with a blow to the head) juvenile female *C. basiliscus* (880.6 mm SVL). Its stomach contained an adult female *P. spicilegus* (126.18 mm head–body length), which was not digested. The mouse was identified using Godinez and Guerrero (2014. Therya 5:633–678), based on teeth, ears, and tail shape, rear foot length, and coat color of ankles and body.

Fig. 1. Dorsal view of *Crotalus basiliscus* and its prey, *Peromyscus spicilegus.* Scale bar = 5 cm.

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***CROTALUS SCUTULATUS* (Mohave Rattlesnake). LOCOMOTION.** The most common form of locomotion for most snake species is lateral undulation, sometimes referred to as horizontal undulatory, serpentine, or sinusoidal progression. Sidewinding is a form of locomotion typically used to move across loose substrates by species such as *Crotalus cerastes* (Sidewinder) of North America and *Cerastes cerastes* (Saharan Horned Viper) of northern Africa and southern portions of the Arabian Peninsula. Sidewinding is also used by other snake species when navigating smooth surfaces on which their usual lateral undulations are ineffectual (Klauber 1972. Rattlesnakes: Their Habits, Life Histories, and Influence on Mankind. University of California Press, Berkeley, California. 1533 pp.). *Crotalus scutulatus* typically utilize quick serpentine locomotion during flight (Bartholomew and Nohavec 1995. Great Basin Nat. 55:282–283). Sidewinding movement has also been documented for *C. scutulatus*, though Klauber (1972) noted they are rather clumsy sidewinders.

On 25 October 2020, at ca. 1430 h, a sidewinding *C. scutulatus* was observed in the Mojave Desert of San Bernardino County, California, USA, by David Evans. Evans was driving on a dirt road when he encountered an adult *C. scutulatus* on the shoulder of the road. Evans pulled over, leaned out the window of his vehicle, and used his cell phone to obtain photographs and videos of the snake. Videos are available at: http://dx.doi.org/10.26153/tsw/12558. The *C. scutulatus* moved away from the observer, with its head and neck raised in a loose S-shape and used sidewinding locomotion to climb a slight incline of loose sandy substrate on the edge of the dirt road as it moved toward a Creosote Bush (Fig. 1). Upon reaching the shade of the bush, the snake continued moving away from the observer and further into the shade of the bush, using slow lateral undulations.

Fig. 1. Screen capture from video of *Crotalus scutulatus* moving left to right. The sidewinding snake created discrete tracks where it pushed off the sand and gaps between the tracks where the snake lifted its body to the next track, which is characteristic of sidewinding locomotion.

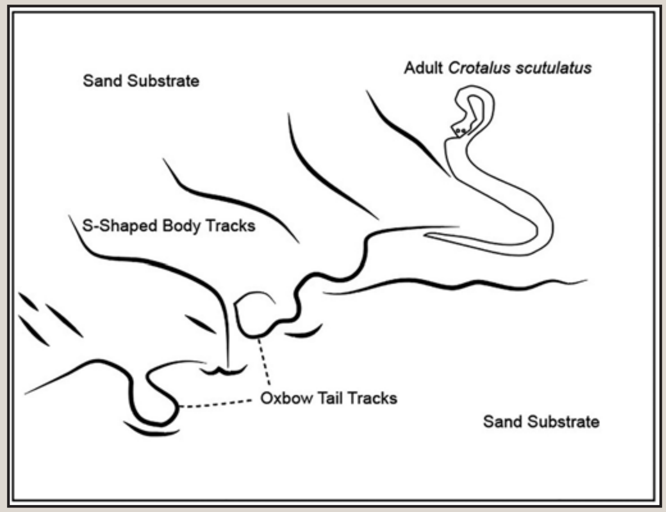

Fig. 2. Sketch of the tracks left by the sidewinding *Crotalus scutulatus* in California, USA on 25 October 2020.

The tracks created by the sidewinding *C. scutulatus* consist of imprints similar to tracks left by *Cerastes cerastes* with a couple of notable differences. Tracks left by *C. cerastes* moving across a flat sandy surface typically have a J-shape that includes the hook of the J laid down by the head and neck, and a T-shaped terminus made by the tail at the other end of the straight middle segment (Klauber 1972, *op. cit.*). The gaps between successive J tracks are created by the snake lifting its head laterally over the ground surface, touching down at the hook end of the next J track, followed by the entire length of the snake being lifted over the gap and laid down along the straight segment in a continuous fluid motion.

In the case of the sidewinding *Crotalus scutulatus*, the head and neck were raised throughout the process, so did not leave the hook-shaped marks (Fig. 1, 2). The middle segment of each track is curved in the shape of an open S instead of the straight middle segment typical of *Cerastes cerastes* tracks, apparently due to irregularities in the sand surface. The video further reveals that the anterior two thirds of the snake moved over a slight berm of sand using sidewinding movement and leaving sidestepping tracks, while the tail end formed a series of open loops from which the snake pushed forward then dragged the tail to the next open loop. This concertina movement of the posterior third of the snake left a series of oxbow, crescent, and question-marked shapes until the end of the video, when the snake moved across relatively flat terrane and left a longer track without the irregular tail marks.

The track left by the *C. scutulatus* when it moved away from the bush prior to its encounter by the observer (visible below the sidewinding snake in Fig. 1 and in the first video) indicates that it moved by lateral undulations. Although sidewinding locomotion in rattlesnakes is usually associated with *Crotalus cerastes*, the video of this sidewinding *C. scutulatus* documents that this species can effectively execute sidewinding locomotion, at least when fleeing.

I thank Robert Hansen, Mike Cardwell, Gordon Schuett, and Joe Mendelson for encouraging me to publish this observation; and Barry Harding for providing the sketch (Fig. 2). I am grateful to David Evans for documenting this event and for allowing me to use his photographs and videos in reporting this unusual behavior.

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***DABOIA PALAESTINAE* (Palestine Viper). COMBAT.** Male-male combat in most snakes involves a "combat dance" in which each male coils around the other, raises its head and neck, and tries to "top" its opponent. "Topping" is a behavior in which a combatting snake achieves the more dorsal position and pushes its rival's head and neck toward the ground. The combat dance is well documented in the Viperidae (Shine 1978. Oecologia 33:269–277; Shine 1994. Copeia 1993:326–346) and in members of several other snake families (Senter et al. 2014. PLoS ONE 9:e107528). Here, we report an observation of combat in *Daboia palaestinae*, a viper species for which combat behavior has not previously been recorded.

The incident reported here was documented in a pair of videos recorded by David Bakhshian on 21 April 2020 (http://dx.doi.org/10.26153/tsw/12564). The setting was an avocado orchard 1–2 km northwest of Kibbutz HaMaapil, Hefer Valley Regional Council, Central District, Israel (the Kibbutz is located at 32.37837°N, 34.98304°E). The two snakes were in a dirt footpath bordered by a strip of low, dry, dead vegetation and trees beyond (Fig. 1). During the combat, both snakes stayed on the footpath. Video 1 has a duration of 165 s, during most of which one snake exhibits combat behavior toward the other. Video 2 has a duration of 49 s and records the movements of the two snakes as they depart the scene after combat ceases. In video 1, each snake frequently raises its head and neck high (Fig. 1), and the smaller snake makes frequent attempts at topping. To gain leverage for topping, it is common in male-male combat in snakes for a combatant to form a hook around its opponent's neck with its own neck and use the hook to push the opponent's neck downward (Carpenter 1977. Am. Zool. 17:217–223; Akester 1979. Herpetologica 35:124–128; Gillingham et al. 1983. J. Herpetol. 17:265–270; Schuett and Gillingham 1989. Amphibia-Reptilia 10:243–266). In video 1, the smaller snake makes 26 attempts to hook the larger snake's neck for a downward push (Fig. 1). The larger snake frequently dodges those attempts by moving forward. Four of the smaller snake's attempts to hook and push down the larger snake's neck are successful. At 106 s, the smaller snake produces a successful downward push without a hook, by placing its head atop that of the larger snake and pushing downward. Throughout the footage, there are no instances of biting, closed-mouth strikes, mouth gaping, body flattening, head pinning, dorsal body looping, head-jerking, or coiling around each other.

Only the smaller snake exhibits combat behavior. The larger snake consistently declines to return the combat behavior. Instead, it repeatedly moves forward to position its raised neck in front of that of the smaller snake. Gliding forward while a courting male approaches from behind is a behavior that is known in female vipers (Gillingham et al. 1983, *op. cit.*; Andrén 1986. Amphibia-Reptilia 7:353–383; Do et al. 2017. J. Asia-Pac. Biodiv. 10:583–586). Also, head lifting by the female is part of the courtship ritual in several viper species (Garcia de Langlada 1975. J. Herpetol. 9:349-351; Armstrong and Murphy 1979. Univ. Kansas Mus. Nat. Hist. Spec. Publ. 5:1–88; Schuett and Duvall 1996. Anim. Behav. 51:367–373; Do et al. 2017, *op. cit.*; Grazziely dos Santos Amorim et al. 2019. Herpetol. Notes 12:225–227). It is therefore possible that the incident reported here is one of male combat directed toward a female, which is uncommon in snakes. To our knowledge, it has been previously reported only in captive *Vipera berus* (Kelleway 1982. Brit. J. Herpetol. 5:225–230) and wild *Agkistrodon contortrix* (Graham and Sorrell 2010. Herpetol. Rev. 41:359–360).

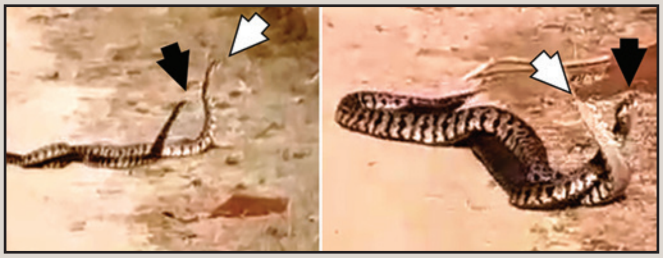

Fig. 1. Stills from video 1, showing the two *Daboia palaestinae* at 43 s and 67 s into video 1. Black arrow = head of the smaller snake. White arrow = head of the larger snake.

We thank David Bakhshian for making the videos and for allowing us to use them for this study. We also thank the reviewers for helpful suggestions that improved this paper.

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***DEMANSIA PSAMMOPHIS* (Yellow-faced Whip Snake), *NOTECHIS SCUTATUS* (Tiger Snake), *POGONA BARBATA* (Eastern Bearded Dragon). ECTOPARASITES.** Ticks are common ectoparasites of many reptiles. With the exception of a few species, such as *Ornithodoros moubata* and *Otobius lagophilus*, in which some instars do not feed (Bacha 1957. J. Parasitol. 43:560–565; Davis 1947. J. Parasitol. 33:495), almost all tick instars are haematophagous and tend to be behaviorally and physiologically adapted to parasitize particular hosts (McCoy et al. 2013. Front. Cell. Infect. Microbiol. 3:57). A fundamental aspect in the understanding of the natural history of ticks is therefore to determine which hosts it utilizes at different stages of its lifecycle, and of the nearly 1000 recognized tick species, the natural history of many remains poorly known (Hoogstraal 1985. Adv. Parasitol. 24:135–238).

The southern reptile tick, *Bothriocroton hydrosauri* has been reported to parasitize several reptile species and is one of the most in-depth studied reptile tick species in the world (Barker and Walker 2014. Zootaxa 3816:1–144). The main host of all post-embryonic stages (larvae, nymphs and adults) of *B. hydrosauri* is *Tiliqua rugosa* (Barker and Walker 2014, *op. cit.*) and after engorgement the tick usually detaches from *T. rugosa* while the lizard rests under a refuge (usually a low shrub) at night (Bull and Smyth 1973. Aust. J. Zool. 21:103–110; Kerr et al. 2003. Austral Ecol. 28:152–160). *Bothriocroton hydrosauri* therefore also find its hosts by remaining in the refuge after hatching or molting and becoming active when disturbed by a potential host in the refuge (Downes 1984. J. Parasitol. 70:164–166). Atypical hosts are most likely parasitized by *B. hydrosauri* when they make use of refuges that had been used by infested *T. rugosa*. In spite of the extensive research that has been done on *B. hydrosauri*, there is little information on early life stage instars and the attachment sites of *B. hydrosauri* on atypical reptile hosts. Herein we report on the parasitism of immature *B. hydrosauri* on three atypical reptile hosts in Yorke Peninsula, South Australia.

On 2 November 2019, we collected a *Demansia psammophis*, caught in a funnel trap that had been set ca. 60 m S of Elephant Road within an open mallee habitat, with a sandy substrate, in Warrenben Conservation Park, South Australia (35.1094°S, 137.0291°E; WGS 84; 27 m elev.); a *Pogona barbata*, caught by hand as it was crossing South Coast Road, 12 km E of Marion

Bay (35.2211°S, 137.0979°E; WGS 84; 19 m elev.), and a *Notechis scutatus* found DOR 8.8 km NE of Marion Bay (35.1791°S, 137.0405°E; WGS 84; 29 m elev.). Each reptile had different life stages of *B. hydrosauri* attached to them. We found one nymphal tick attached to the right mid-body flank of the *D. psammophis*; two were attached to the *N. scutatus*, one on the dorsal plain on the neck and one to the left mid-body flank; six larval ticks were attached to the gular fold of the *P. barbata*. The surrounding habitat of where the *N. scutatus* was found was remnant low open mallee by the roadside and a cleared paddock beyond, and where the *P. barbata* was caught the road had a mallee habitat on either side. All ticks were collected and deposited at the parasites collection of South Australian Museum, Adelaide, South Australia (J 24506–24508, J 24515–24520).

Our observations report on one new atypical host, *D. psammophis*, and provides additional information on the life stages and attachment sites of *B. hydrosauri* of reptiles in Australia. *Bothriocroton hydrosauri* has been previously reported as an ectoparasite of *N. scutatus* in Tasmania and *P. barbata* in New South Wales and South Australia, but no information was provided on the instar stages or the attachment sites of the ticks (Roberts 1953. Aust. J. Zool. 1:111–161).

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***DOLICHOPHIS CASPIUS* (Caspian Whipsnake). DIET.** The range of *Dolichophis caspius* includes southern Europe, the Crimea, and the foothills of the northern slope of the Greater Caucasus and extends to western Kazakhstan. The diet of the species includes mainly reptiles (lizards and snakes), as well as small mammals (hamsters, young hares, shrews), birds, and less often amphibians and large insects (Bannikov et al. 1977. Guide to Amphibians and Reptiles of the USSR Fauna. Moscow, Prosveshchenie. 414 pp.; Glandt 2015. Die Amphibien und Reptilien Europas. Alle Artenim Portrat. Quelle & Meyer Verlag Wiebelsheim. 716 pp.). On 27 May 2019, in the foothills of Dagestan in the vicinity of the site "Sarykum Dunes" of the reserve "Dagestansky," Dagestan, Russia (43.18733°N, 47.37133°E; 80 m elev.), we found a dead young *D. caspius* with a *Xerotyphlops vermicularis* (Eurasian Blind Snake) in its stomach (Fig. 1). *Xerotyphlops vermicularis* is widespread and common in this locality at the northern limit of the species' range. This observation demonstrates the generalist feeding habits of *D. caspius*, including eating small fossorial snakes.

Fig. 1. Young *Dolichophis caspius* from Dagestan, Russia with *Xerotyphlops vermicularis* in its stomach.

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***ERYTHROLAMPRUS MILIARIS* (Military Ground Snake). DIET and SCAVENGING.** *Erythrolamprus miliaris* is a dipsadid snake widely distributed in South America (Uetz et al. 2020. The Reptile Database, http://www.reptile-database.org, 27 Oct 2020). It has a generalist diet, composed of mammals, reptiles, amphibians, and fish, although it presents a preference for anurans and tadpoles, including *Boana albomarginata* (Van Der Burg 2020. Herpetol. Notes 13:739–746). Herein, we describe an event of scavenging upon *B. albomarginata* by *E. miliaris*.

The observations were made on a dirt road (26.28400°S, 48.53548°W; WGS 84; 25 m elev.), Municipality of Guaramirim, Santa Catarina, Brazil. At 0840 h on 15 September 2018, we encountered an *E. miliaris* smelling a road-killed anuran, which was later identified as a *B. albomarginata*. We stopped the vehicle and began to observe the snake with the aid of binoculars. After sniffing and touching the anuran with its tongue, the snake began to eat it (Fig. 1). Scavenging by *E. miliaris* has been reported as a rare behavior (Sazima and Strussmann 1990. Rev. Bras. Biol. 50:463–468), but its occurrence may be more frequent than it appears.

PHOTO BY IVO R. GHIZONI-JR

Fig. 1. *Erythrolamprus miliaris* feeding upon a road killed *Boana albomarginata* in Santa Catarina, Brazil.

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***GEOPHIS DUGESII* (Dugès' Earth Snake). MAXIMUM ELEVATION.** *Geophis dugesii* is a dipsadid species endemic to Mexico, with a distribution restricted to the low and high areas of the Sierra Madre Occidental and up to the Transverse Volcanic Axis in Sonora, Chihuahua, Sinaloa, Durango, Nayarit, Zacatecas, Aguascalientes, Jalisco, Michoacán, and Guanajuato (Vázquez-Díaz and Quintero-Díaz 2005. Anfibios y Reptiles de Aguascalientes. CONABIO, CIEMA. 318 pp.; Heimes 2016. Herpetofauna Mexicana. Vol. 1 Snakes of Mexico. Chimaira, Frankfurt am Main, Germany. 240 pp.). It occurs in pine-oak forest and subtropical scrub at elevations of 1400–2350 m (García-Balderas and Quintero-Díaz 2012. Herpetol. Rev. 43:621; Heimes 2016, *op. cit.*; Vázquez-Díaz and Quintero-Díaz 2005, *op. cit.*; Arenas-Monroy et al. Herpetol. Rev. 43:620).

On 14 September 2019, at 2216 h, we located an adult male *G. dugesii* (350 mm total length, 60 g) under a rock in oak-pine forest in Sierra Fría, Aguascalientes, Mexico (22.09926°N, 102.69661°W; WGS 84) at an elevation of 2713 m, which is the highest elevation known for the species to date. A photo voucher of this individual is deposited at the San Diego Natural History Museum (SDSNH_HerpPC_05431, photo voucher). Our observation increases the elevation of *G. dugesii* by 211 m with respect to the previous record in Guanajuato state. The specimen was collected under permission (SEMARNAT SGPA/DGVS/00966/20) issued to the first author.

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***GLOYDIUS BLOMHOFFII* (Mamushi). DIET.** *Gloydius blomhoffii* is a small pit viper, which is endemic to Japan and widely distributed throughout the Japanese Archipelago. Its natural diet consists of various taxa—arthropods (mainly centipedes) and small vertebrates (fish, amphibians, birds, and mammals)—but, in contrast to other terrestrial vertebrates, reptiles have been infrequently recorded as its prey (Mori and Moriguchi 1988. Snake 20:98–113; Hamanaka et al. 2014. Bull. Herpetol. Soc. Japan 2014:167–181). Here, I report the first incontestable record of predation on a Japanese five-lined skink (Reptilia: Scincidae: *Plestiodon* sp.) by *G. blomhoffii*, which was found in the collection at the Osaka Museum of Natural History (OMNH).

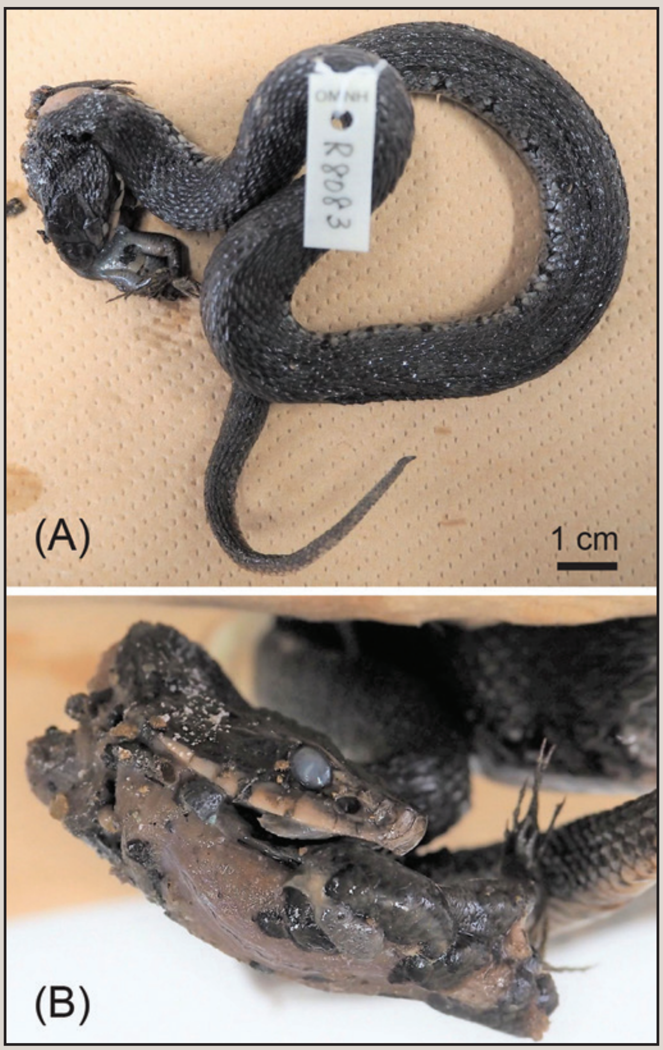

Fig. 1. *Gloydius blomhoffii* (OMNH R8083) killed in Wakayama Prefecture, Japan (A) with *Plestiodon* sp. in its mouth (B).

A *Plestiodon* sp. was discovered in the mouth of *G. blomhoffii* (ca. 44.4 cm SVL, ca. 7.2 cm tail length; OMNH R8083) collected at 1306 h on 28 April 2012, at Koya-cho, Ito-gun, Wakayama Prefecture, Japan (34.1926°N, 135.5687°E; WGS 84; 737.1 m elev.), on a gravel road in the forest. The skink was being ingested headfirst; its scales were partially removed and the tail was fragmented (Fig. 1). Because this specimen was derived from roadkill, the snake might have been run over during or after predation on the skink. Although *Eumeces latiscutatus* (currently *P. finitimus*; Okamoto and Hikida 2012. Zootaxa 3436:1–23) was reported in the natural prey of *G. blomhoffii* (Uchida and Imaizumi 1939. Ornithol. Mamm. Rep. 9:143–208), this prey-predator relationship was inferred based only on scales and tail found in the stomach of the viper. Thus, the possibility of secondary predation could not be rejected. Due to the poor condition of the present skink specimen, it could not be identified to species. Nevertheless, my report provides clear evidence that *G. blomhoffii* prey upon *Plestiodon* skinks.

I thank Nobutaka Urano (Urano Animal Hospital) for providing the specimen, and Taku Okamoto (Kyoto University) for his advice concerning my skink identification.

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***HELICOPS MODESTUS* (Olive Keelback). PREDATION.** *Helicops modestus* is endemic to Brazil, occurring in the southeastern inner Atlantic Forest and in southern portions of the Cerrado (Nogueira et al. 2020. South Am. J. Herpetol. 14:1–274). These snakes are known for their aquatic habits and their close phylogenetic relationships with genus *Hydrops* and *Pseudoeryx* (Zaher et al. 2009. Zootaxa 49:115–153). *Helicops modestus* feeds mainly on fishes and anurans (Barbo et al. 2011. South Am. J. Herpetol. 6:135–160), but documentation of their predators is scarce.

On 10 July 2018, at 1402 h, we documented predation on *H. modestus* by a *Chloroceryle amazona* (Amazon Kingfisher), at "Museu de arte da Pampulha", in Municipality of Belo Horizonte (19.8518°S, 43.9737°W; WGS 84), Minas Gerais, Brazil. The male *C. amazona* was observed with the snake in its beak. It was perched on a branch above the lake, pecking and bashing the juvenile *H. modestus* (ca. 22 cm total length) against the branch (Fig. 1). The snake didn't display any effective antipredator response, just some failed attempts to escape with erratic movements. This behavior of beating the *H. modestus* was observed several times, until the *H. modestus* appeared dead and was swallowed head first by the kingfisher.

Chloroceryle amazona resides along bodies of water from southern Mexico to South America, being present throughout all biomes of Brazil (Willard 1985. Ornithol. Monogr. 36:788–797). Its diet is basically piscivorous, although in some cases, arthropods, crustaceans and amphibians have been reported as prey (Davis and Graham 1991. Auk. 108:780–789). Although consumption of a snake was unusual, there were no novelties in how the *C.*

PHOTO BY CLAUDIO DIAS COELHO

Fig. 1. *Helicops modestus* in the beak of a male *Chloroceryle amazona* from Minas Gerais, Brazil.

amazona subdued the *H. modestus*. In fact, this tactic of hitting the prey against the substrate and swallowing it headfirst is commonly observed (Davis and Graham 1991, *op. cit.*). To our knowledge, this is the first documented record of predation on *Helicops* by a *Chloroceryle*.

We are thankful to Claudio Dias Coelho, who provided the photos and some of the data needed to write this report, contributing to an increase in citizen science in Brazil. We are grateful to CNPq for promoting resources to Brazilian researchers, including two of us. Funding was provided by research grants from CNPq to LSA (130723/2020-7) and AB (105886/2020-3).

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***HETERODON SIMUS* (Southern Hog-nosed Snake). REPRODUCTION and NESTING.** *Heterodon simus* is a highly fossorial species associated with xeric sandhill habitats within the declining Longleaf Pine (*Pinus palustris*) ecosystem of the southeastern USA. Its relative rarity and secretive nature have confounded documentation of certain basic natural history information. Natural nests have long gone unreported (Jensen et al. 2008. Amphibians and Reptiles of Georgia. The University of Georgia Press, Athens, Georgia. 575 pp.), with reproductive information being limited to observations of copulating pairs and egg clutches that were either oviducal or deposited by captive females (e.g., Palmer and Braswell 1995. Reptiles of North Carolina. University of North Carolina Press, Chapel Hill, North Carolina. 412 pp.; Beane et al. 2014. Copeia 2014:168–175). Herein, we describe an apparent failed natural nest of *H. simus*.

On 23 May 2020, one of us (DCS) found a gravid female *H. simus* (ca. 425 mm SVL, 485 mm total length, 153 g) crossing a sand road (ca. 15 km NW of Wagram, Scotland County, North Carolina, USA). She was confirmed gravid by a radiograph and surgically implanted with a radio transmitter (Holohil SB-2T, Holohil Systems, Ltd., Carp, Ontario) on 26 May 2020, released on 31 May 2020 at point of capture, and monitored frequently (located on 52 of the 71 dates between 1 June and 10 August). For the entire monitoring period, the snake utilized relatively

Fig. 1. Burrow used as refugium and nest by *Heterodon simus*, Scotland County, North Carolina, USA.

Fig. 2. Excavated nest chamber of *Heterodon simus*, Scotland County, North Carolina, USA.

open sandhills dominated by *P. palustris*, *Quercus incana* (Bluejack Oak), *Q. laevis* (Turkey Oak), and *Aristida stricta* (Carolina Wiregrass), and on a two- to three-year prescribed burn rotation. From 6 June to 14 July, she utilized a single burrow of her own construction (Fig. 1) and was found underground in that refugium on 25 dates, and on the surface only twice, during that period. On both occasions observed on the surface (30 June and 1 July) she was basking ca. 5 m from the burrow and still appeared noticeably gravid. Between 15 and 27 July, she used four additional burrows, all within 61 m of the most-used burrow, and on 27 July she was observed active on the surface

Fig. 3. Eggshells from failed nest of *Heterodon simus*, Scotland County, North Carolina, USA.

and no longer appeared gravid. On 10 August 2020, she was found dead and partially consumed by a predator. The condition of the remains suggested a raptor.

We suspected eggs had been deposited in the burrow the snake used for the longest period (6 June–14 July). From 25 August–5 October, a hardware cloth nest protector was placed over that burrow, as well as over each of the four additional burrows known to have been used between 6 June and 1 August. Each burrow was monitored daily. No indications of hatching or emergence were noted. On 31 October 2020, we carefully excavated the most-utilized burrow. A nest chamber was located off a side tunnel ca. 61 cm lateral distance from the burrow entrance. The chamber measured ca. 7 × 7 cm and was situated at the interface of the topsoil and roots of a tussock of *A. stricta* and the underlying layer of sandy soil (Fig. 2). The bottom of the chamber was ca. 25 cm below the surface. The chamber contained six non-adherent eggshells in an advanced state of degradation; none appeared to have hatched (Fig. 3). Although it was difficult to determine the precise number of ova visible in the radiograph, it was clearly more than six and may have been greater than 13. It is possible that some eggs were either reabsorbed or never developed fully, were infertile or otherwise deteriorated completely before we discovered the nest chamber, were deposited in another location, or were consumed by an underground predator. JCB and SJH found the shed skin of an adult *Cemophora coccinea copei* (Northern Scarlet Snake), a known reptile egg predator, within ca. 1 m of the nest burrow on 3 July. The remains of the female and eggshells are deposited in the herpetology collection of the North Carolina State Museum of Natural Sciences (NCSM 104650).

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HYDROPHIS PLATURUS XANTHOS **(Golfo Dulce Yellow Seasnake). HARASSMENT BY DOLPHINS.** Within the true sea snakes (Elapidae: Hydrophiinae), *Hydrophis platurus xanthos* is a recently described subspecies endemic to the inner basin of Golfo Dulce, Costa Rica (Bessesen and Galbreath 2017. ZooKeys 686:109–123). Golfo Dulce is a semi-enclosed embayment with a profound inner basin (>200 m) and effective sill and shallow outer basin that prevent free exchange with the Pacific Ocean masses (Svendsen et al. 2006. Rev. Biol. Trop. 54:147–170). In contrast to black-and-yellow conspecifics residing outside the gulf, the geographically bound *H. p. xanthos* is bright canary yellow with significantly smaller body size (49 cm average total length; Bessesen and Galbreath 2017, *op. cit.*).

At 1239 h on 21 January 2012, two *Tursiops truncatus* (Bottlenose Dolphins) travelling in Golfo Dulce with a larger group broke off and began harassing an adult *H. p. xanthos.* Loose skin covering the snake's body indicated it may have been in the process of ecdysis when it was attacked (Fig. 1). This species employs a knotting behavior to aid shedding (Pickwell 1971. Copeia 1971:348–350; BLB, pers. obs.) which might have attracted the cetaceans. The dolphins tossed the serpent back and forth for 5–7 min in what appeared to be play, and then moved away to follow their group. The snake remained at the surface, knotting itself into a ball. It was netted for brief examination and deemed limp but alive, with teeth marks on the skin, especially around the head and neck (Fig. 1). After being returned to the water, its fate was unknown.

Hydrophis platurus outside Golfo Dulce possess black dorsums with yellow ventral surfaces and black spots or bands on the tail paddle (Bessesen 2012. Herpetol. Rev. 43:22–26). This coloration is considered aposematic as the species possesses neurotoxic venom and appears noxious, having few natural predators (Kropach 1975. *In* Dunson [ed.], The Biology of Sea Snakes, pp. 185–213. University Park Press, Baltimore, Maryland). Nevertheless, there are reports of *H. platurus* being attacked by octopus (van Bruggen 1961. Basteria 25:73–74), pufferfish (Pickwell et al. 1983. Calif. Fish Game 699:172–177), Lava Gulls (Reynolds and Pickwell 1984. Copeia 1984:786–789), pelicans (Álvarez-León and Hernández-Camacho 1998. Caldasia 20:93–102), Magnificent Frigatebirds (Sheehy et al. 2011. Herpetol. Rev. 42:443), Wood Storks (Solórzano and

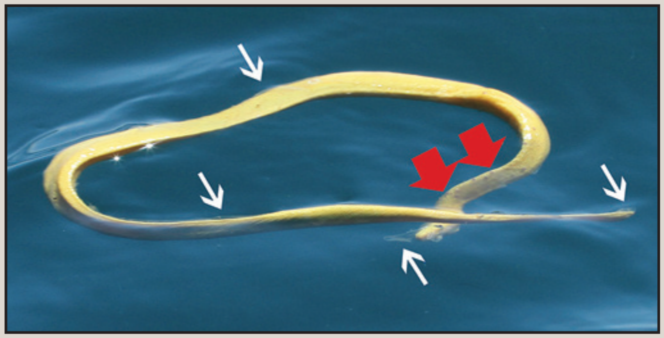

PHOTO BY DAVID HERRA-MIRANDA

Fig. 1. *Hydrophis platurus xanthos* floating limp in Golfo Dulce, Costa Rica after being tossed around by two *Tursiops truncatus* (Bottlenose Dolphins) and left with multiple tooth marks (red arrows; white arrows point to loosened skin).

Kastiel 2015. Mesoam. Herpetol. 2:121–123), and Common Black Hawks (Solórzano and Sasa 2017. Mesoam. Herpetol. 4:431–433), suggesting it is vulnerable to harm by a variety of organisms. Although dolphins apparently do not predate *H. platurus* (Kropach 1975, *op. cit.*), Ineich and Loyer (1998. Bull. Soc. Étud. Océan. 276:86) and Durso et al. (2015. Herpetol. Rev. 46:104) described *T. truncatus* in French Polynesia and Mexico, respectively, playing with one in a similar fashion to our observations. This is the first documented attack on *H. p. xanthos*, but local fishermen have reported seeing dolphins harassing yellow sea snakes on other occasions as well, and it remains unclear whether xanthic coloration has greater or less aposematic effect with respect to marine mammals or other potential assailants.

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***LEPTODEIRA NIGROFASCIATA* (Black-banded Cat-eyed Snake). DIET.** *Leptodeira nigrofasciata* is found along the Pacific versant from Mexico to Costa Rica (Leenders 2019. Reptiles of Costa Rica: A Field Guide. Comstock Publishing Associates, Ithaca, New York. 470 pp.). Rarely encountered, this semi-arboreal snake species is mostly nocturnal, feeding on skinks, anoles, leptodactylid and hylid frogs (Duellman 1958. Bull. Am. Mus. Nat. Hist. 114:1–152; Solórzano 2004. Serpientes de Costa Rica. Instituto Nacional de Biodiversidad, Santo Domingo de Heredia, Costa Rica. 321 pp.). Here, we report the predation of the lizard *Marisora brachypoda* by *L. nigrofasciata*.

On the afternoon of 17 June 2019, in the Heloderma Natural Reserve in the Zacapa Department, Guatemala, we captured an *L. nigrofasciata* by hand and placed it in a cotton bag to hold for photos. While in the bag the snake regurgitated what was later identified as a juvenile *M. brachypoda*. The skink's tail was found separated from the body, most likely occurring after it had been injested. *Marisora brachypoda* is a species of short-limbed skink native to much of Central America, ranging throughout Mexico, Costa Rica, El Salvador, Guatemala, and Nicaragua (Hedges and Conn 2012. Zootaxa 3288:1–244). This species is diurnal and is typically found living in xeric habitats with low vegetation and numerous open basking spots (Leenders 2019, *op. cit.*). Records of predation on *M. brachypoda* by snakes are not well-reported but it may be inferred that most appropriately sized lizard eating snakes would prey upon this species (Hedges and Conn 2012, *op. cit.*). To the best of our knowledge, this is a first report of *L. nigrofasciata* preying upon this species of skink. The snake was released soon after.

Fig. 1. *Leptodeira nigrofasciata* (A) and regurgitated *Mesoscincus managuae* (B) from Zacapa Department, Guatemala.

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***LYCODON CAPUCINUS* (Common Wolf Snake). ECTOPARASITISM.** *Lycodon capucinus* is a common colubrine snake with a wide distribution throughout the Philippines and southeast Asia; it is frequently found in agricultural and residential areas at low elevations (Brown et al. 2013. ZooKeys 266:1–120). Ticks have been recorded parasitizing snakes particularly in captive python, cobras, and rat snakes in India (Catherine et al. 2017. J Parasit Dis. 41:952–958). To our knowledge, there are no records of tick parasitism from Philippine Colubridae.

On 13 February 2017, by a corn field near Mt. Cagua in Barangay Santa Clara, Gonzaga, Cagayan Province, Luzon, Philippines (18.228°N, 122.060°E; WGS 84; 278 m elev.), we found a dead *L. capucinus* with a damaged head (Fig. 1A), likely killed by local residents. Upon preservation, it was found that the snake was being parasitized by a partly engorged tick attached at its anal plate (Fig. 1B), identified as a female *Amblyomma helvolum*. To the best of our knowledge, *L. capucinus* appears to

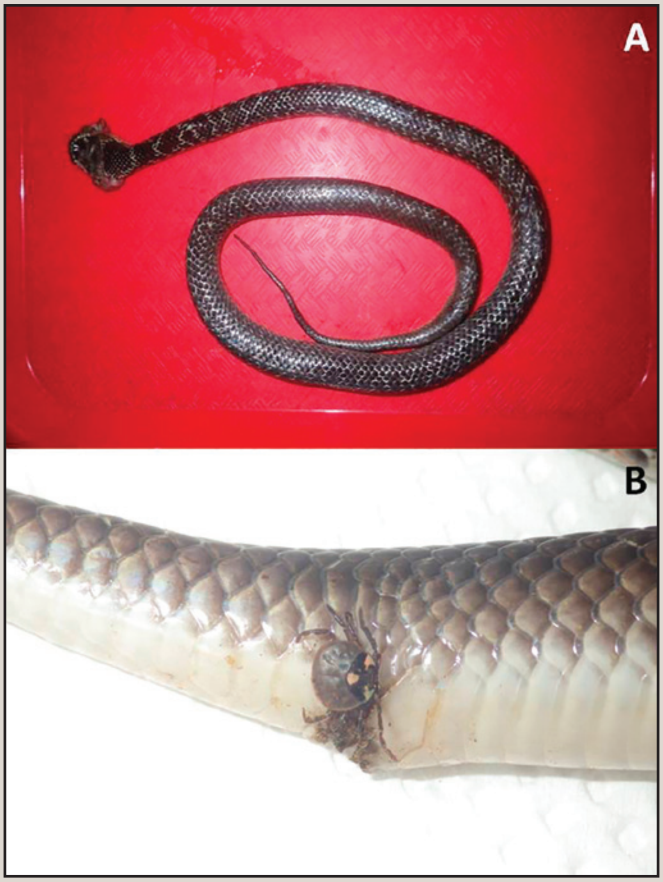

Fig. 1. *Lycodon capucinus* (A) parasitized by female *Amblyomma helvolum* (B) from Luzon Island, Philippines.

be a new snake host for this tick species. The snake (ACD 11146) and ectoparasite (MAT P01) were preserved in 70% ethanol and deposited at the Terrestrial Laboratory 707, Central Laboratory Building, University of Santo Tomas.

We thank Gerald Thomas Soliven of the University of Santo Tomas for providing reference on the identity of the tick species and Gerrut Norval of Flinders University in Australia for the tick species verification and sex determination. We would also like to thank the Department of Environment and Natural Resources of the Philippines for granting us the Wildlife Gratuitous Permit (No. 2017-03) approved by the Protected Area Management Board of Northern Sierra Madre Natural Park and Baua and Wangag Watershed Forest Reserve.

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***MASTICOPHIS FLAGELLUM* (Western Coachwhip). DIET.** On 18 September 2020, at the Dunagan Visitor Center at Monahans Sandhills State Park, Ward County, Texas, USA (29.19611°N, 103.00357°W; WGS 84), we purged a live *Masticophis flagellum* under the supervision of a state park staff member. The snake (female, 122 cm SVL, 27.2 cm tail length) had recently ingested a male *Plestiodon obsoletus* (Great Plains Skink; 12.5 cm SVL, 10.4 cm tail length). *Masticophis flagellum* is a known predator of multiple lizard species, including multiple *Phrynosoma* spp., *Sceloporus* spp., *Aspidoscelis* spp., and *Plestiodon* spp. (Ernst and Ernst 2003. Snakes of the United States and Canada. Smithsonian Institution Press, Washington, D.C. 202 pp.; Beane 2013. Herpetol. Notes 6:285–287). Here, we report the first predation of *P. obsoletus* by *M. flagellum*.

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***NAJA SIAMENSIS* (Indo-Chinese Spitting Cobra). DIET.** Many cobras (*Naja* spp.) are considered to be opportunistic generalist predators, as some are known to feed on a wide variety of prey including small mammals, amphibians, birds, lizards, and other snakes (Layloo et al. 2017. Afr. J. of Herpetol. 66:147–153). *Naja siamensis* is distributed throughout parts of Thailand, Cambodia, Laos, and southern Vietnam (Teynié and David 2007. Russ. J. Herpetol. 14:39–44). Although the species is relatively common through much of its range, surprisingly little is known about the diet of *N. siamensis* in the wild. In captivity however, it is known to consume rodents, amphibians, chicks, and other snakes (Chanhome et al. 2011. Asian Biomed. 5:311–328). Here, we report an observation of a juvenile *N. siamensis* preying on a small *Hypsiscopus plumbea* (Rice Paddy Snake).

At 1320 h on 16 September 2020, a juvenile *N. siamensis* (ca. 37 cm total length) was discovered as it was ingesting a *H. plumbea* (ca. 23 cm total length) within a university dormitory building in Nakhon Ratchasima, Thailand (14.8918°N, 102.0179°S; WGS 84). Both snakes were behind a cabinet within the dormitory bedroom. The *N. siamensis* had ingested ca. 75% of the snake prey when volunteer rescue team personnel and university security staff interrupted the predation event and proceeded to capture the *N. siamensis*, which regurgitated the dead *H. plumbea* (Fig. 1). The snakes were then promptly translocated to a forest patch nearby.

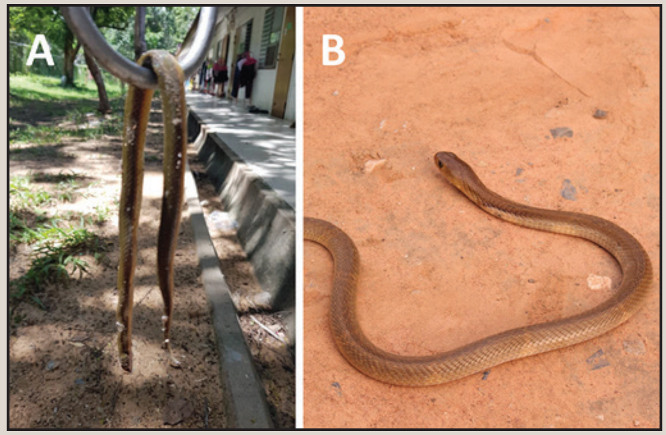

Fig. 1. *Hypsiscopus plumbea* (A) regurgitated by a juvenile *Naja siamensis* (B) inside a dormitory room in Nakhon Ratchasima, Thailand.

This observation confirms that snakes do make up at least part of the diet of *N. siamensis* in the wild. The *H. plumbea* appeared to be quite large prey for the juvenile *N. siamensis*, therefore we are uncertain the *N. siamensis* would be able to successfully complete ingestion had it not been disturbed. However, despite the prey's relatively large size, the cobra's venom was able to kill the *H. plumbea*, suggesting that *N. siamensis* venom is quite effective on squamate prey, such as homalopsid snakes.

Additionally, this observation highlights the dangerous tendency for some venomous snakes to enter human habitations in search of prey. This has also been documented in *Bungarus candidus* (Malayan Krait), another active foraging and highly venomous elapid, on the same university campus in Nakhon Ratchasima, Thailand (Hodges et al. 2020. J. of Threat. Taxa 12:15947–15950). It is presumed that the snakes likely entered either through the gap underneath the door or the bathroom's floor drain, thus displaying how important it can be to seal gaps where small snakes may be able to enter anthropogenic structures.

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***NERODIA ERYTHROGASTER* (Plain-Bellied Watersnake). DIET.** *Nerodia erythrogaster* was considered by Ernst and Barbour (1989. Snakes of Eastern North America. George Mason University Press, Fairfax, Virginia. 282 pp.) as "mostly a fish eater." However, based on extensive literature review, Gibbons and Dorcas (2004. North American Watersnakes: A Natural History. University of Oklahoma Press, Norman, Oklahoma. 438 pp.) report that *N. erythrogaster* tends to feed on more amphibians than do other watersnakes. Unknown "aquatic insects" per Ashton and Ashton (1981. Handbook of Reptiles and Amphibians of Florida.

Fig. 1. Stomach contents of *Nerodia erythrogaster* from Oklahoma, USA; A) contents *in situ* showing head (arrow) and body of caterpillar; B) extracted whole caterpillar; scale is 1 mm/line.

Part 1, The Snakes. Windward Publishing, Miami, Florida. 176 pp.) are also listed in their table but there is no mention of the species eating terrestrial insects and/or other arthropods. In a study conducted in Oklahoma, Preston (1970. Ph.D. dissertation, University of Oklahoma, Norman. vi + 79 pp.) reported that 11 of 79 (14%) *N. erythrogaster* had food in their stomachs, including frogs, a tadpole, three fish, and one crawfish. Here, I report a novel instance of *N. erythrogaster* feeding on terrestrial insects and other arthropods in southeastern Oklahoma.

On 25 August 2020, an adult female (735 mm SVL) *N. erythrogaster* was collected by hand at a residence in Hochatown, McCurtain County, Oklahoma, USA (34.17108°N, 94.75184°W; WGS 84). It was euthanized by an intraperitoneal injection of sodium pentobarbital (Nembutal®), and a mid-ventral incision was made to expose the gastrointestinal contents, which contained insects and other arthropods (Fig. 1A, B). An intact lepidopteran caterpillar, portions of a grasshopper, beetle elytra, a harvestman (Arachnida), and several pine (*Pinus*) needles were identified from stomach contents. The snake was deposited in the Arkansas State University Museum of Zoology (ASUMZ) Herpetological Collection, State University, Arkansas, USA as ASUMZ 34100.

I thank S. E. Trauth (ASUMZ) for expert curatorial assistance. A Scientific Collecting Permit was issued to CTM by the Oklahoma Department of Wildlife Conservation, no. 1551646.

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***OLIGODON OCTOLINEATUS* (Eight-lined Kukri Snake). ABOREALITY.** Members of the genus *Oligodon* (kukri snakes) are typically terrestrial specialists of squamate eggs as well as small vertebrates (de Queiroz and Rodríguez-Robles 2006. Am. Nat. 167:684–694), with the exception of *O. annulifer* which is often arboreal (Harrington et al. 2018. Biol. J. Linn. Soc. 125:61–71). *Oligodon octolineatus* is a widespread lowland species, known from Sundaland, including the Malay Peninsula, Sumatra, Borneo, Java, the Sulu Archipelago, and Sulawesi (Das 2010. A Field Guide to the Reptiles of South-east Asia. New Holland Publishers [UK] Ltd., London. 376 pp.). Limited information on the ecology of *O. octolineatus* has been documented, although it has been observed climbing palm fronds ca. 1 m from ground (Will 2018. Singapore Biodiv. Rec. 2018:32).

On 16 May 2015, an adult *O. octolineatus* was observed at ca. 2030 h within lowland forest on the trunk of a tree ca. 3.5 m above ground, under the tree canopy. The locality was within a community forest at Upper Baleh (3.34518°N, 115.3088°E; WGS 84), Kapit Division, central Sarawak, East Malaysia. On 24 August 2018, a second specimen (Lee Kong Chian Natural History Museum, National University of Singapore [ZRC] 2.549) was encountered in lowland forest adjacent to the Matang Wildlife Centre (1.5500°N, 110.4167°E; WGS 84), Kuching Division, western Sarawak, East Malaysia, ca. 2.2 m up on a tree at 1915 h.

Fig. 1. *Oligodon octolineatus* on a tree trunk in the vicinity of the Matang Wildlife Centre, Sarawak, East Malaysia.

It was an adult (total length ca. 45 cm), observed motionless in a head-down position, the body supported by the peeling bark of the tree (Fig. 1). These records from Borneo constitute the first records of arboreality in *O. octolineatus* and are suggestive of natural activities such as foraging and resting in such habitats.

I thank Kelvin K. P. Lim for verifying the identity of the species and for the digital voucher number, the Institute of Biodiversity and Environmental Conservation, Universiti Malaysia Sarawak for support; and the Sarawak Forest Department for research permit (NCCD.907.4.4.[Jld.7]–38).

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***OPHEODRYS AESTIVUS* (Rough Greensnake). DIET.** *Opheodrys aestivus* is a slender, arboreal, invertivorous colubrine snake distributed throughout the mid-Atlantic and southeastern USA, west to eastern Kansas, central Texas, and northeastern Mexico (Ernst and Ernst 2003. Snakes of the United States and Canada. Smithsonian Institution Press, Washington, D.C. 668 pp.). Prey include spiders and insects, especially lepidopteran larvae but also adults (van Hyning 1932. Copeia 1932:37; Hamilton and Pollack 1956. Ecology 37:519–526; Plummer 1981. J. Herpetol. 15:425–432; Brown 1979. Brimleyana 1:113–124; Baldwin 2007. M.S. Thesis, Marshall University, Huntington, West Virginia. vi + 74 pp.). Lepidopterans from the families Pieridae, Noctuidae, Phalaenidae, Hesperiidae, Geometridae, Sphingidae, and Nymphalidae have been reported, but almost never at the genus or species level.

At 1432 h on 7 October 2019, GM found an adult *O. aestivus* consuming an adult *Danaus plexippus* (Monarch Butterfly) in *Solidago altissima* (Tall Goldenrod) in an unmowed right-of-way with characteristics of a piedmont prairie along the Atlanta Beltline Eastside Trail, Fulton County, Georgia, USA (33.76241°N, 84.36052°E; WGS 84; iNaturalist 34038016). This is remarkable because, in addition to being a novel prey record for *O. aestivus*, *D. plexippus* are chemically defended by cardenolide toxins that they sequester from feeding on *Asclepias* milkweeds as larvae. Whether or not the *O. aestivus* later suffered any ill effects is unknown. Cardiotonic steroid resistance through mutations to the Na^+/K^+-ATPase has been documented in numerous snake species, but *Opheodrys* have not yet been examined (Mohammadi et al. 2016. Proc. Roy. Soc. B Biol. Sci. 283:20162111). The concentration of cardenolides in monarch butterflies varies depending on host plant chemistry, but monarchs can concentrate cardenolides to higher concentrations than occurs in plant leaves (Jones et al. 2019. J. Chem. Ecol. 45:264–277). Adaptation to similar dietary toxins across vertebrate and invertebrate prey taxa is known from other snakes (Yoshida et al. 2020. Proc. Nat. Acad. Sci. 117:5964–5969), and this example suggests that the extent of convergence may be even wider than is currently known (Feldman et al. 2012. Proc. Nat. Acad. Sci. 106:13415–13420; Feldman et al. 2016. Heredity 116:84–91).

Fig. 1. *Opheodrys aestivus* preying on *Danaus plexippus* (Monarch Butterfly).

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***OPHEODRYS AESTIVUS* (Rough Greensnake). NEST FAILURE.** The maternal selection of a nest site that provides a favorable environment for the normal development of eggs and embryos is a critical behavioral choice for the lifetime fitness of an oviparous species with no parental care (Refsnider 2016. Avian Biol. Res. 9:76–88). Poor choices are sometimes made, however, as in the following example of a nesting *Opheodrys aestivus*.

In the course of radiotracking *O. aestivus* at the Gilliam Biological Research Station in White County, Arkansas, USA, I discovered a gravid *O. aestivus* in the process of nesting in the hollow of a small tree (Fig. 1A). The 445 mm SVL female had been implanted with a transmitter and released on 9 July 2020 at the forest edge of a powerline right-of-way. On 13 July 2020, she was found nesting in a small hollow oak tree 42 m into the forest from the forest edge. The tip of one turgid egg could be seen just inside the hollow. Four months later on 11 November 2020, I confirmed the presence of shriveled *O. aestivus* eggs in the tree hollow with an endoscope. I physically opened the nesting chamber to find four desiccated fully shelled unhatched eggs and a small amount of dry powdery duff. Each egg contained the remains of an embryonic snake.

Gravid female *O. aestivus* are known to make nesting migrations averaging 56 m from their home ranges to deposit their eggs in the hollows of small living trees (Plummer 1989. Herpetol. Rev. 20:87–89; Plummer 1990. Herpetologica 46:190–195). The eggs are not embedded within a moist substrate in the hollows but are provided the moist microenvironment necessary for normal development by virtue of being sheltered in a small enclosed space surrounded by living tree tissue (Plummer 1990, *op. cit.*). Although the unusual tree-hollow nesting behavior of *O. aestivus* has been previously described, the present report is noteworthy in two respects. First, previous reports of tree hollow nesting by *O. aestivus* were of successful nests, some of which had produced hatchlings in multiple years (Plummer 1989, *op. cit.*; Plummer 1990, *op. cit.*), whereas the present report describes an unsuccessful *O. aestivus* nest. Why the nest was unsuccessful is unknown, but one possibility is that the eggs did not survive because of their close proximity to the desiccating effects of

Fig. 1. A) Gravid female *Opheodrys aestivus* in the process of depositing her eggs in a small hollow of a living oak tree at the Gilliam Biological Research Station in central Arkansas, USA, on 13 July 2020. B) The section of the nesting tree that contained the entrance to the nesting chamber (arrow). Most of the tree 5 cm above the entrance appeared to be dead or dying on 11 November 2020.

circulating air as a result of physical changes in the nest chamber environment and poor nest site choice. The tree had broken over and splintered 5 cm above the tree hollow entrance, which resulted in deteriorating tree tissue above the nest chamber (Fig. 1B) and partial exposure of the nest chamber from above. In addition, the close (2 cm) proximity of the eggs to the tree hollow entrance may have contributed to increased air circulation from below. In successful *O. aestivus* nests, the eggs were deposited an average of 58 cm higher than the tree hollow entrance (Plummer 1990, *op. cit.*), 29 times farther from the outside circulating air than in the present case.

It is also noteworthy that the female did not completely enter the tree hollow as in previous studies of successful nests (Plummer 1989, *op. cit.*; Plummer 1990, *op. cit.*). Only the posterior part of the female's body a short distance anterior from her vent was inserted into the tree hollow (Fig. 1A). The partial entrance behavior of the snake likely reflected the small size of the tree and enclosed hollow. The size of nest trees in previous studies of successful *O. aestivus* nests ranged from 10–20 cm in diameter at 1 m tree height (Plummer 1990, *op. cit.*), whereas the tree diameter in the present case was only 4 cm at 1 m tree height.

In the laboratory, female *O. aestivus* chose to nest on substrates within a wide range of moisture levels, most of which had little effect on the eggs or hatchlings, including hatching success. Only the driest substrate (-2000 kPa) resulted in shorter and lighter hatchlings (Plummer and Snell 1988. Copeia 1988:58–64). Successful natural nests were all wetter than this moisture level Plummer 1990, *op. cit.*). In the present natural nest, excessive drying during incubation as a result of nest site deterioration and poor maternal nest site selection, may have resulted in the death of all the eggs in the nest.

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***OPHIOPHAGUS HANNAH* (King Cobra). DIET.** *Ophiophagus hannah*, the longest venomous snake in the world, is broadly distributed across south and southeast Asia (David and Vogel 1996. The Snakes of Sumatra: An Annotated Checklist and Key with Natural History Notes. Edition Chimaira, Frankfurt am Main, Germany. 260 pp.). *Ophiophagus hannah* feed primarily on other snakes, including conspecifics (Smith 1943. The Fauna of British India, Ceylon and Burma, Including the Whole of the Indo-Chinese Sub-Region: Reptilia and Amphibia. Vol. 3 Serpentes. Taylor and Francis, London. 583 pp.) and occasionally consume monitor lizards (*Varanus* spp.; Whitaker and Captain 2004. Snakes of India: The Field Guide. Draco Books, Chennai, India. 481 pp.).

On 26 October 2020 we received a call from the forest department officials of Konanduru Village, Shivamogga, Karnataka, India (13.8080°N, 75.2455°E; WGS 84). An *O. hannah* (ca. 3.5 m total length) was sighted entangled in a fish net next to a plantation. At 1830 h, the cobra was rescued (pipe and bag method), bagged in a cotton cloth bag and transported to a nearby release site ca. 1500 m away in safer habitat (i.e., forest patch). The cobra had regurgitated a recently consumed snake inside the cotton bag. The regurgitated snake (ca. 1 m total length) was identified as a *Daboia russelii* (Russell's Viper). Another instance of *O. hannah* feeding on *D. russelii* was observed by NK on 25 November 2008 at 0930 h in Bellur village, Shivamogga, Karnataka, India (13.9286°N, 75.3480°E; WGS 84). To the best of our knowledge, there has been no previous records of *O. hannah* feeding on *D. russelii*, despite the wide distribution of this viper within the range of *O. hannah.*

We would like to thank the locals of Konanduru village for their cooperation. We are grateful to Shasidhar N and Nagaraj K from the forest department for coordinating with king cobra rescue and release. Special thanks to Karnataka state Forest Department (KFD) and Agumbe Rainforest Research Station (ARRS) for their continuous support.

PHOTO BY NAGARAJ K

Fig. 1. *Daboia russelii* regurgitated by an *Ophiophagus hannah* in India.

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***OXYRHOPUS GUIBEI* (False Coral Snake). COLOR PATTERN ANOMALY.** The color pattern of coral snakes seems to be a conservative character and it is largely used for species identification (Silva-Jr et al. 2016. *In* Silva-Jr [ed.], As Cobras-corais do Brasil: Biologia, Taxonomia e Envenenamentos, pp 79–168. PUC Goiás, Goiás, Brazil). Anomalies in color pattern of coral snakes are not common, though there are some scarce documented cases in the literature (Azevedo et al. 2018. Herpetol. Notes. 11:553–555).

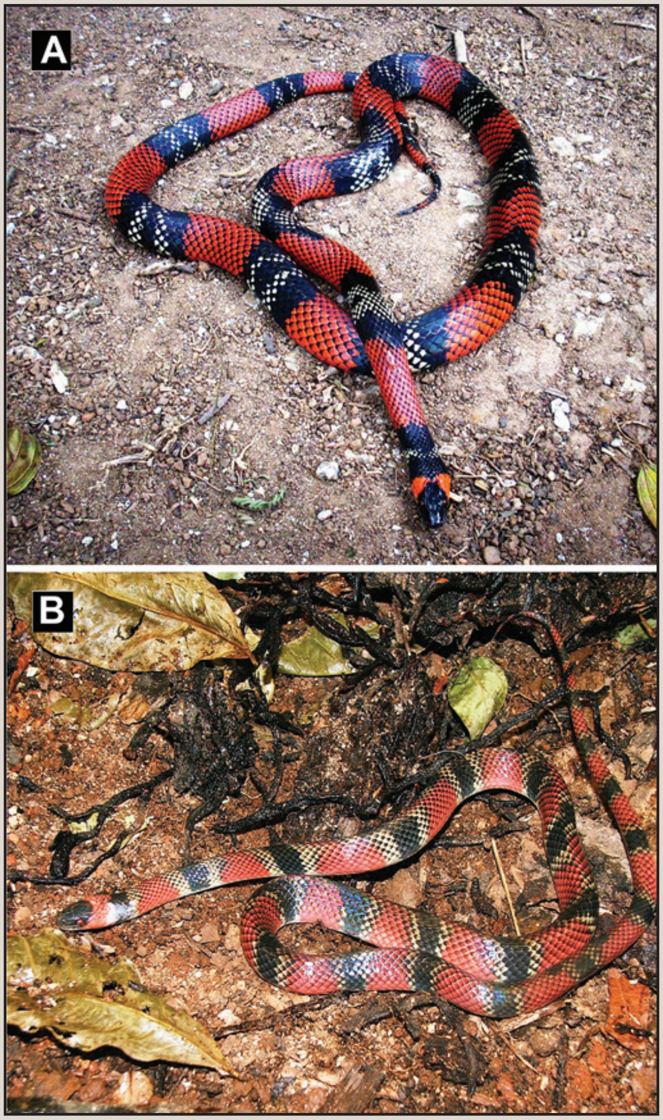

Fig. 1. Color patterns of *Oxyrhopus guibei*: A) individual presenting the normal triadal pattern with red rings (from São Paulo, São Paulo, Brazil); B) individual with abnormal monadal pattern and pinkish rings (from Jundiaí, São Paulo, Brazil).

Oxyrhopus guibei is very common in the Cerrado and Atlantic Forest in Brazil (Nogueira et al. 2019. South Am. J. Herpetol. 14[sp1]:1–274) and it is easily distinguished from sympatric coral snakes by the color pattern, consisting of a triadal pattern (two narrow white/yellow rings, delimited by three black medium-sized black rings, between two large red rings; rings are incomplete or not connected ventrally; Fig. 1A; Hoge and Romano 1977. Mem. lnst. Butantan. 40/41:55–62). Here I report a case of color pattern anomaly in *O. guibei*.

An adult *O. guibei* (> 1 m SVL) was collected by an anonymous collector in the Municipality of Jundiaí, São Paulo, Brazil (23.16667°S, 46.86667°W; WGS 84) on 20 July 2007, and was delivered to Instituto Butantan by the City Hall (IBSP76014; this specimen was lost in a fire that destroyed the herpetological collection of the Instituto Butantan in 2010). In contrast to the typical color pattern of *O. guibei* (Fig. 1A), this specimen presented a monadal pattern: one medium-sized black ring, delimited by two narrow yellow rings, between two large pinkish rings; also with incomplete or not-connected ventral rings (Fig. 1B). Several studies discuss the influence color or color pattern abnormalities could impose to the fitness of an individual in nature (Azevedo et al. 2018. Herpetol. Notes. 11:553–555). In the case of False Coral Snakes, these features are crucial to survivorship, since they use Batesian mimicry to deter predation from visually oriented predators (Sazima and Abe 1991. Stud. Neotrop. Fauna E. 26:159–164). Nevertheless, the anomaly presented here may have not played a negative role in this individual's fitness, since it did not mischaracterize the coral snake pattern.

I thank Felipe Gobbi Grazziotin for authorizing the use of Butantan Institute data, and Livia Marcia Correa for searching the files of the institute to find them.

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***PTYAS MUCOSA* (Oriental Ratsnake). DIET.** *Ptyas mucosa* is a large-bodied colubrid snake that is known to feed on frogs, rats, bats, birds, lizards, turtles, and snakes (Das and Das 2018. A Naturalist's Guide to the Reptiles of India, Bangladesh, Bhutan, Nepal, Pakistan, and Sri Lanka. Prakash Books, New Delhi, India. 176 pp.). Although most sources report that *P. mucosa* is a generalist predator with a catholic diet, few report prey at the species level. Herein, I report six dietary observations for *P. mucosa* from Karnataka, India, three of which include novel prey items.

At 1620 h on 4 January 2020, I observed a ca. 1.5 m total length [TL] *P. mucosa* feeding on a shrew (Mammalia: Soricidae) headfirst in a fallow paddy field in the vicinity of Tallur, Karnataka, India (13.53177°N, 75.13968°E; WGS 84). Disturbed by my presence, the snake abandoned the prey and moved away. In Begar, Karnataka, India (13.50685°N, 75.19546°E; WGS 84) at 1800 h on 27 August 2019, a ca. 2 m TL *P. mucosa* regurgitated nine juvenile *Hoplobatrachus tigerinus* (Indian Bullfrogs), the first of which was still alive and hopped away. While attending snake rescue calls in urban Bengaluru, Karnataka, India (12.97237°N, 77.74838°E; WGS 84), I made the following four observations: 1) a ca. 2.5 m TL *P. mucosa* was feeding on an adult *Columba livia* (Rock Pigeon) head-first on 14 June 2017; 2) a ca. 2 m TL *P. mucosa* regurgitated an adult female *Duttaphrynus melanostictus* (Asian Toad) on 24 December 2015; 3) another *P. mucosa* (158 cm SVL, 215 cm TL) regurgitated a *Rattus rattus* (Black Rat) on 2 June 2017; and 4) a ca. 2 m TL *P. mucosa* attempted to feed on a *Cynopterus sphinx* (Greater Short-nosed Fruit Bat) that had been killed by a *Felis catus* (Domestic Cat), but it was disturbed by humans and left the area; an hour later, the snake returned and began feeding on the bat again, and was again disturbed by humans, after which the snake fled. Such prey retrieval behavior has been previously recorded in *P. mucosa* (Mao et al. 2008. Herpetol. Rev. 39:100). The shrew, Rock Pigeon, and fruit bat are novel prey, while the remaining prey items have been previously reported (Wall 1921. Snakes of Ceylon. H. R. Cottle Govt. Printer, Colombo, Sri Lanka. 520 pp.).

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***RHABDOPHIS CHRYSARGOS* (Specklebelly Keelback). DIET.** *Rhabdophis chrysargos* are described as generalist predators, feeding on small mammals, birds, lizards, and frogs (Chan-ard et al. 2015. A Field Guide to the Reptiles of Thailand. Oxford University Press, New York, New York. 229 pp.). Documented anuran prey species include: *Ingerophrynus philippinicus* (Sy and Apolonio

2018. SEAVR 2018:28-29), *Leptobrachium abbotti* (Wells 2005. Malaysian Nat. 58:38–39), and *Leptobrachium* sp. (Manthey and Denzer 2013. SAURIA 35[3]:3–22). Here, we augment this prey list with the first report of the genus *Hylarana*.

At 1800 h on 4 April 2018, we observed an adult *R. chrysargos* preying upon an adult *Hylarana erythraea* (Green Paddy Frog) on the bank of a man-made canal surrounded by sugar cane and fallow fields in Udom Sap, Thailand (14.5390°N, 101.9573°E; WGS 84). The surrounding native habitat predominantly consisted of Dry Evergreen and Dry Dipterocarp forests, although large swaths of land had been cleared and converted to agriculture. We were alerted to the predation by distress calls from the *H. erythraea*. The frog continued vocalizing for 3 min as it was consumed hind legs first and upside down. This process concluded after a total of 7 min.

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***RHABDOPHIS SUBMINIATUS* (Red-necked Keelback). DIET.** *Rhabdophis subminiatus* is known to feed on frogs, lizards, and small mammals (Whitaker and Captain 2004. Snakes of India: The Field Guide. Draco Books, Chennai, India. 481 pp.). Among anurans, *R. subminiatus* is reported to feed on *Duttaphrynus melanosticus* (Mohammadi and Hill 2012. Trop. Nat. Hist. 12:123–125), *Uperodon globulosus* (Shihan and Kabir 2015. Zoos' Print 30:21), *Fejervarya* sp. (Rahman et al. 2012. Herpetol. Rev. 43:350), *Hylarana taipehensis* (Shalauddin et al. 2019. Herpetol. Rev. 50:401), and *Polypedates leucomystax* (Harman and Master 2019. Herpetol. Rev. 50:602). Herein, we report predation on the anuran *Odorrana mawphlangensis* by *R. subminiatus*.

A specimen of *R. subminiatus* (deposited at the National Zoological Collection, Zoological Survey of India, Shillong; VR/ERS/ZSI/638; 85.5 cm total length) was collected from Sikhul Lui, near Murlen Village in Champhai District of Mizoram, India (23.66417 °N, 93.28944°E; WGS 84; 1425 m elev.). During preservation, an incision was made in the abdominal region of the specimen, revealing a partially digested *O. mawphlangensis* (Fig. 1). *Odorrana mawphlangensis* was recently reported from Hmuifang in Aizawl district, Mizoram, India (Lalremsanga 2017. Herpetol. Rev. 48:120).

Fig. 1. Partially digested *Odorrana mawphlangensis* recovered from the gut of *Rhabdophis subminiatus* collected from Mizoram, India.

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***RHINOCHEILUS LECONTEI* (Long-nosed Snake). ABERRANT COLORATION.** The colubrid snake *Rhinocheilus lecontei* is widely distributed in the southwestern USA and northern Mexico (Medica 1975. Cat. Am. Amphib. Rept. 175:175.1–175.4) and displays considerable color and pattern variation across this extensive range (Manier 2004. Biol. J. Linn. Soc. 83:65–85). The color pattern of typical *R. lecontei* is characterized by a yellowish white background with alternating red and black saddles along the length of the body. The dorsal surfaces of the red saddles are marked with a black dot in the middle of each scale whereas the dorsal surfaces of the black saddles are marked with a white dot in the middle of each scale (Stebbins 2003. A Field Guide to Western Reptiles and Amphibians. Third edition, revised. Houghton Mifflin Co., Boston, Massachusetts. 533 pp.). A less common black-and-white pattern type (formerly considered a distinct subspecies, *R. l. clarus*) occurs at lower frequency, mostly in desert portions of the range (Shannon and Humphrey 1963. Herpetologica 19:153–160; Manier 2004,

Fig. 1. Aberrantly colored *Rhinocheilus lecontei* from California, USA, post death, a few hours after collection.

Fig. 2. Head shot of the snake taken in the field immediately following discovery.

op. cit.). Documented variants include a true albino in Texas (Norris and Berardi 2003. Herpetol. Rev. 34:254), a striped neonate in Arizona (McCrystal and Ivanyi 2005. Southwest. Nat. 50:494–496), and amelanistic specimens from Durango, Mexico (Hendricks 1974. J. Herpetol. 8:185) and Arizona (Brennan et al. 2020. *In* Holycross and Mitchell [eds.], The Snakes of Arizona, pp. 318–327. ECO Publishing, Rodeo, New Mexico). Here, we report an observation of aberrant coloration from a specimen of *R. lecontei* from the Inner Coast Range of Stanislaus County, California, USA.

On 6 May 2020 at 2100 h, we came across a freshly road-killed adult (79 cm SVL, 13 cm tail length) *R. lecontei* displaying aberrant coloration (Fig. 1). The pattern scheme of this animal was consistent with *R. lecontei* in the area but differed in coloration. The black saddles and scales were replaced by a light caramel color. The red saddles were a deeper color than typically seen in *R. lecontei.* Lateral surfaces of the red saddles were marked by scales possessing the caramel coloration, consistent with the rest of the body. The base color of the body and ventral surfaces were yellowish cream, similar to that of more typically marked animals. The eyes were red with a black pupil (Fig. 2), a trait seen in normal *R. lecontei.* We believe that this animal is displaying a form of hypomelanism (sensu Bechtel 1995. Reptile and Amphibian Variants: Colors, Patterns, and Scales. Krieger Publishing Co., Malabar, Florida. 206 pp.) that reduces (but does not exclude) the presence of melanin. Skin was preserved following collection made under California Department of Fish and Wildlife license #1059601248.

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***SISTRURUS MILIARIUS BARBOURI* (Dusky Pigmy Rattlesnake). DIET**. *Sistrurus miliarius* use olfactory cues to select the sites at which they will ambush prey including lizards, frogs, and arthropods (Roth et al. 1999. Copeia 1999:772–774). At 2031 h on 4 October 2020, in the Hickory Mound Unit of Big Bend Wildlife Management Area in Taylor County, Florida, USA (30.05032°N, 83.84042°W; WGS 84), I observed an *S. m. barbouri* (ca. 35 cm SVL) dead on the road. Emerging from the mouth and left side of the snake appeared to be tail segments of an *Ophisaurus* sp. (Fig. 1). Considering the surrounding habitat, best defined as coastal hydric hammock, and coloration of the tail segments, the prey item was likely *O. ventralis.* While predation on lizards is well documented in *Sistrurus*, this is, to my knowledge, the only published report of *Ophisaurus* predation by *S. miliarius* in the wild (Neill 1960. Quart J. Florida Acad. Sci. 23:173–200; Ernst 1992. Venomous Reptiles of North America. Smithsonian Institution Press, Washington, D.C. 236 pp.; Ernst and Ernst 2003. Snakes of the United States and Canada. Smithsonian Institution Press, Washington, D.C. 668 pp.).

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***SISTRURUS TERGEMINUS EDWARDSII* (Desert Massasauga). REPRODUCTION.** Reproduction in north temperate vipers tends to show a biennial frequency, with mating occurring in the spring or early fall (Schuett et al. 2005. Anim. Behav. 70:257–266). Considerable variation is present in mating season among taxa, with some species mating at only one of these two periods, while others mate during both periods. Natural history of *Sistrurus tergeminus edwardsii* has been well characterized, particularly in southeastern Colorado, USA populations (Hobert et al. 2004.

Fig. 1. Road-killed *Sistrurus miliarius barbouri* with *Ophisaurus* sp. tail segments from Florida, USA.

PHOTOS BY NEIL BALCHAN

Fig 1. Adult pair of *Sistrurus tergeminus edwardsii* as found copulating on road and close-up showing engorged cloaca of female in Colorado, USA.

Southwest. Nat. 49:321–326; Wastell and Mackessy 2011. Copeia 2011:29–37; Wastell and Mackessy 2016. J. Herpetol. 50:594–603). Although aspects relating to reproduction, including presence of ova and parturition timing, have been documented for this taxon, timing of mating in the field remains poorly understood. This observation represents, to our knowledge, the first published record of wild mating in *S. t. edwardsii* in Colorado.

At 1218 h on 29 April 2019, a pair of *S. t. edwardsii* were observed copulating on a dirt road in Lincoln County, Colorado (39.04580°N, 103.35870°W; Fig. 1). Conditions were full sun with moderate wind, and air temperature was ca. 20°C. The male snake was the larger of the two individuals (ca. 400 mm SVL) and the female considerably smaller (ca. 335 mm SVL). An additional five adult *S. t. edwardsii* were found on the same road that day from 1146–1209 h with air temperatures ranging from ca. 17–20°C. After photographing the pair, the snakes were moved off of the road to protect them from vehicular traffic. The two individuals remained copulating following their relocation.

This observation confirms spring mating activity for Colorado populations of *S. t. edwardsii.* Mating seasons are an important component of natural history, as they may influence activity patterns, home ranges, and habitat use throughout the year (ciski and Borowski 2008. Mamm. Biol. 73:119–127). Additionally, periods of increased movement may be correlated with mating times, and road mortality can be mitigated by understanding when this increased movement occurs. It remains unclear if *S. t. edwardsii* also mates during the fall season in Colorado populations, as males and females have been found in close association but not copulating, but continued field study of this species may reveal further insight into the occurrence of fall mating.

All snake handling was done under Colorado Parks and Wildlife scientific collecting license 19HP0974 to SPM.

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***SONORA SEMIANNULATA* (Western Groundsnake). COMBAT.** The males of many species of snakes engage in combat behavior, whereby males entwine, bite, and seek to raise the anterior portion of the body above the other male (Carpenter 1986. Smithson. Herpetol. Info. Serv. 69:1–18; Shine 1978. Oecologia 33:269–277). Despite the ubiquity of this behavior, many aspects of this behavior have not been formally documented among the majority of snake species.

On 20 April 2020 at ca. 1150 h AJ recorded an agonistic interaction between two adult *Sonora semiannulata* in Prescott, Yavapai County, Arizona, USA (http://doi.org/10.7302/3xdz-sq80). The behavior was ongoing when the observation started. Two black and red morph *S. semiannulata* had entwined nearly the full length of their bodies around one another. While intertwined with tails tightly wrapped around one another, both snakes exhibited caudocephalic waves down the length of their body and rolled to expose their ventral surfaces. Both snakes also raised their anterior body, including the head, off of the substrate to press the other snake downward or laterally. This action was occasionally accompanied by rapid head movements that may have indicated biting. The interaction ended when the snakes disentangled themselves and one snake fled rapidly, perhaps due to the presence of multiple observers. The snakes were not captured at the end of the interaction.

Although the sex of each participant in the behavior was not confirmed at the time of the observation, the behavior that we recorded was likely male-male combat for several reasons. First, while courtship behaviors can overlap substantially with combat behaviors and involve intertwining, caudocephalic waves, and biting (Ernst and Ernst 2003. Snakes of the United States and Canada. Smithsonian Institution Press, Washington, D.C. 668 pp.), in courtship these behaviors are normally exhibited only by the male, not by both participants as we observed. Second, there was no evidence of everted hemipenes in either snake at any point in the interaction, which would be present at least during the latter stages of courtship, but not male-male combat. Finally, relative tail length has been used historically to sex *Sonora*, with females measuring ca. 0.8 of a standardized male ratio (e.g., females have shorter tails than males, averaging <17% of SVL; Kassing 1961. Texas J. Sci. 13:185–203). Using ImageJ, we assessed tail:SVL ratios independently for a frame in each of the two videos in which both cloacae were simultaneously visible (frame 119 of IMG_5247.MOV and frame 487 of IMG_5248.MOV). All of the tails measured >20% of the SVL and the ratio of the snakes to each other were 0.94 and 0.99, suggesting the snakes were both male.

Male-male combat has been documented in two close relatives of *S. semiannulata*, including *S. episcopa* (Kassing 1961, *op. cit.*; Kroll 1971. Texas J. Sci. 23:300) and *S.* (*Chionactis*) *annulata* (Goode and Schuett 1994. Herpetol. Nat. Hist. 2:115–117). Recently, Broussard et al. (2021. Herpetol. Rev. 52:360) recorded an agonistic encounter between unsexed *S. semiannulata* of two different morphs (red and black and uniform) similar to our observation. However, our observation offers stronger evidence that the individuals were both male, and documents an agonistic encounter between individuals of the same color morph.

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***TANTILLA WILCOXI* (Chihuahuan Black-headed Snake). DIET.** Despite some snakes of the genus *Tantilla* being called "centipede snakes," relatively few out of the 66 *Tantilla* species have been properly documented to feed upon these myriapods; in Mexico, these species are *T. bocourti*, *T. calamarina*, *T. flavilineata*, *T. nigriceps*, *T. rubra*, and *T. schistosa* (Wilson and Mata-Silva 2014. Mesoam. Herpetol. 1:4 –95). Other species have been hypothesized to prey upon centipedes but have not been supported by observations or dietary data. For example, *Tantilla wilcoxi*, which is believed to "subsist largely on small invertebrates, perhaps primarily on millipedes, centipedes and scorpions" (Lemos-Espinal and Smith 2007. Anfibios y Reptiles del Estado de Coahuila, México. CONABIO, Mexico City, Mexico. 550 pp.).

At ca. 2330 h on 8 June 2020, while traveling in the road San Roberto-Linares (24.6804°N, 100.1674°W; WGS 84; 1905 m elev.) in the Municipality of Galeana, Nuevo León, México, we collected a road-killed female *T. wilcoxi* (34 cm total length; Fig. 1), the stomach of which contained a medium sized scolopendromorph centipede, including the last pair of legs which helped in identifying it as an adult Common Desert Centipede, *Scolopendra polymorpha* (Maldonado 1998. M.S. Thesis, The University of Texas at El Paso, El Paso, Texas. 110

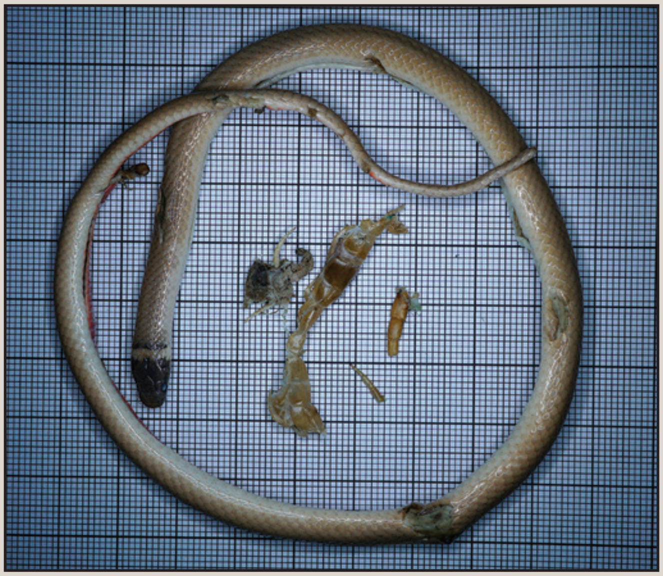

Fig. 1. Female *Tantilla wilcoxi* that had consumed an adult Common Desert Centipede (*Scolopendra polymorpha*) from Nuevo León, Mexico.

pp.). This record suggests that *T. wilcoxi* feeds on centipedes and constitutes, to our knowledge, the first record of an identified prey item for this species. The specimen and prey are deposited in the Herpetological Collection of the Universidad Autónoma de Nuevo León (UANL 8510).

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***THAMNOPHIS EQUES MEGALOPS* (Northern Mexican Gartersnake). PREDATION.** *Thamnophis eques megalops* is a semiaquatic, federally threatened species (U.S. Fish and Wildlife Service 2014. Fed. Reg. 79:38678–38746) that occurs in Arizona and New Mexico, USA, and northern Mexico (Rossman et al. 1996. The Garter Snakes: Evolution and Ecology. University of Oklahoma Press, Norman, Oklahoma. 332 pp.). Within Arizona, *T. e. megalops* was historically widely distributed in riparian corridors along Agua Fria, Bill Williams, Colorado, Gila, Salt, San Pedro, Santa Cruz, and Yaqui rivers and their tributaries (Jones et al. 2020. *In* Holycross and Mitchell [eds.], Snakes of Arizona, pp. 440–455. ECO Publishing, Rodeo, New Mexico), but extensive population declines have significantly reduced their current range (Brennan and Holycross 2006. A Field Guide to Amphibians and Reptiles in Arizona. Arizona Game and Fish Department, Phoenix, Arizona. 150 pp.). A combination of factors including habitat loss from water development projects, loss of native amphibian prey, and competition and predation by non-native fish, bullfrogs, and crayfish have contributed to their decline (U.S. Fish and Wildlife Service 2014, *op cit.*). Although crayfish have been implicated as a contributing factor in the decline of *T. e. megalops*, there has been no direct evidence for this to date. Here we report predation on *T. e. megalops* by the non-native, invasive crayfish, *Orconectes virilis* (Northern Crayfish) in western Arizona.

PHOTO BY DUSTIN WOOD

Fig.1. *Thamnophis eques megalops* specimen following a predation event by *Orconectes virilis* at Havasu NWR, Arizona, USA.

While checking Gee minnow traps during a *T. e. megalops* survey at 0830 h on 23 July 2019, we found a young *T. e. megalops* in a trap with four *O. virilis* at Willow Marsh on the west side of Topock Marsh at Havasu National Wildlife Refuge in Mohave County, Arizona, USA (34.77722°N, 114.53082°W; WGS 84; 140 m elev.). After opening the trap we discovered that the crayfish had eaten the posterior portion of the snake (Fig. 1). The snake was exhibiting faint writhing and mouth gaping, suggesting that the predation event had only recently started. In a crayfish prey selection study, Fernandez and Rosen (1996. Effects of the introduced crayfish *Orconectes virilis* on native aquatic herpetofauna in Arizona. Final report to Arizona Game and Fish Department. 69 pp.) described an *O. virilis* feeding on a neonate *T. cyrtopsis* from the tail first, and after an hour there were no visible remains.

Where invasive, *O. virilis* have been reported to contribute to the decline in native aquatic vertebrate and invertebrate communities (Davidson et al. 2010. Biocontrol Sci. Tech. 20:297–310) and to our knowledge this is the first record confirming *O. virilis* predation on wild *T. e. megalops* in Arizona. This observation occurred within a Gee minnow trap and though *O. virilis* has been implicated in the decline of native aquatic species, it remains unclear how frequently crayfish are able to capture free-ranging *T. e. megalops*. The population of *T. e. megalops* at Havasu National Wildlife Refuge was only recently discovered in 2015, which was the first record on the Lower Colorado River since 1904 (Cotten et al. 2013. Herpetol. Rev. 44:111; Lester and Swackhamer 2015. Herpetol. Rev. 46:577). Crayfish are common and widespread at the refuge, and can present a risk to *T. e. megalops*, but it is encouraging the gartersnake has persisted at Havasu NWR. This specimen was collected under an Arizona Game and Fish Department Scientific Collecting License (#SP657026) and an ESA Section 10(a)(1)(A) Recovery Permit.

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***THAMNOPHIS RUFIPUNCTATUS* (Narrow-headed Gartersnake). DIET.** *Thamnophis rufipunctatus* is primarily a predator of fishes (Holycross et al. 2020. *In* Holycross and Mitchell [eds.], Snakes of Arizona, pp. 451–452. ECO Publishing, Rodeo, New Mexico). Only two publications have documented amphibians in their diet. Stebbins (1954. Amphibians and Reptiles of Western North America, McGraw-Hill Book Company, New York, New York. 414 pp.) reported that *T. rufipunctatus* from Chihuahua Mexico had eaten an *Ambystoma roseaceum* larva, but those populations subsequently have been assigned to *Thamnpophis unilabialis* (Wood et al. 2011. Mol. Ecol. 20:3856–3878). Currently, *T. rufipunctatus* is only found in the southwestern United

States (Wood et al. 2011, *op. cit.*). Woodin (1950. Herpetologica 6:39–40) reported that captive *T. rufipunctatus* were "indifferent eaters" and ate fish and amphibian prey (*Bufo punctatus*) in captivity. Here, we report the first record of *Anaxyrus microscaphus* as prey for a free ranging *T. rufipunctatus.*

While conducting surveys for gartersnakes on 26 May 2020, along Saliz Creek, ca. 14.4 air km southwest of Reserve, Gila National Forest, Catron County, New Mexico, USA (33.62317°N, 108.89473°W; WGS 84; 1775 m elev.), one of us (IJR) found a male *T. rufipunctatus* (480 mm SVL, 156 mm tail length, 53.0 g without prey) under a fallen Ponderosa Pine (*Pinus ponderosa)* log within 5 m of the water. Upon capture, the snake regurgitated a *Rhinichthys osculus* (Speckled Dace; 57 mm total length, 1.8 g) and a larval *A. microscaphus* (Museum of Southwestern Biology, University of New Mexic [MSB] 100946: 39 mm total length, 0.6 g). Fish and tadpole identification conducted on site by BLC and RDJ and tadpole identity was confirmed by J. Tomasz Giermakowski.

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THAMNOPHIS SIRTALIS PARIETALIS **(Red-sided Gartersnake) and *THAMNOPHIS PROXIMUS PROXIMUS* (Orange-striped Ribbonsnake). WINTER MORTALITY.** During the winter in Missouri, USA, *Thamnophis sirtalis parietalis* take shelter in animal burrows or congregate in deep cracks of south-facing limestone bluffs or rocky hillsides (Johnson 2000. The Amphibians and Reptiles of Missouri. Missouri Department of Conservation, Jefferson City, Missouri. 400 pp.). Winter mortality of this species has been reported due to water level fluctuations leading to freezing in Canadian communal dens (Gregory 1982. *In* Gans and Pough [eds.], Biology of the Reptilia, Vol. 13, pp. 53–154. Academic Press Inc., New York, New York; Shine and Mason 2004. Biol. Conserv. 120:201–210). Here, I report an incident from Missouri involving *T. s. parietalis* and *T. p. proximus* presumably overwintering in animal burrows that became inundated with water, resulting in mortality of the first species, and potential mortality of the second if intervention had not occurred.

On 9 February 2020, at 1400 h, a *T. s. parietalis* (59.7 cm SVL, 15.9 cm tail length) was observed partially under the ice about 30 cm from shore on the north bank of a ca. 0.6 ha manmade pond in Sullivan County, Missouri (40.07232°N, 93.13375°W; NAD 83; 243.2 m elev.). The pond was covered with ice except for a few shallow water areas within ca. 12–50 cm from the shore. Upon returning to the pond the following day, the snake was in the same location, and was unresponsive when touched and limp when removed from the water and ice. Air and water temperatures at the capture site were 1.1°C and -0.6°C, respectively. Within 2 m of the above mentioned snake, two *T. p. proximus* (individual 1: 51.4 cm SVL, 17.8 cm tail length; individual 2: 26 cm SVL , 10.8 cm tail length) were noticed about 1 m from the shore, with the smaller snake under about 0.6 cm ice, and the larger under about 2.5 cm ice. While the bodies of both were limp, the snakes illustrated slight head movements and slow tongue flicks. All snakes were captured and each species maintained separately in enclosures in a heated room, with temperatures averaging ca. 7.8°C. The following day with an air temperature of 4.4°C, another non-responsive and limp *T. s. parietalis* (68.6 cm SVL) was found in the icy water within 2 m of where the other snakes were located. It was also captured and maintained as described above, and became responsive within a few hours, demonstrating tongue flicks and slight head and body movements. The first *T. s. parietalis* was determined dead the day following capture, and the other 13 days later, but both *T. p. proximus* survived, and were released near the point of capture on 31 March 2020.

The shoreline of the pond in which these snakes were found had recently moved about 9 m up a gradual slope due to a clogged overflow pipe and precipitation. It is hypothesized that the snakes were overwintering in animal burrows near the shore prior to flooding, and then driven from those burrows as the shoreline advanced, rendering them underwater. As they attempted to escape the burrows and potential drowning, they were trapped beneath the surface of the frozen pond or in near freezing water along the shore.

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THAMNOPHIS SIRTALIS SEMIFASCIATUS **(Chicago Gartersnake). SCAVENGING and DIET.** Scavenging in snakes has been documented across a wide variety of taxa, but discussion of this potentially important phenomenon has been overlooked in the literature (DeVault and Krochmal 2002. Herpetologica 58:429–436). Here, we report scavenging of American Beaver (*Castor canadensis*) meat by a *Thamnophis sirtalis semifasciatus.*

At ca. 0730 h on 3 September 2020, DME observed an adult *T. s. semifasciatus* halfway in a wire cage trap (61 × 7.6 × 12.7 cm; Comstock Custom Cage LLC) set to capture weasels (*Mustela* sp.) within Lakewood Forest Preserve in Lake County, Illinois, USA (42.2524°N, 88.1098°W; WGS 84). The snake was stuck between the wire mesh due to a bulge in its abdomen (Fig. 1). This trap had been baited with Gusto Long-Distance Call Lure (Minnesota Trapline Products Inc.) and a piece of beaver meat (ca. 4 cm in diameter) but the meat was gone. After careful manipulation, DME was able to free the snake, which then regurgitated a piece of raw flesh inferred to be the missing beaver meat. The snake was released unharmed.

Thamnophis sirtalis is a generalist species with a broad diet, consuming fish, amphibians, reptiles, birds, mammals, and invertebrates, as well as carrion (Sajdak and Sajdak 1999. Herpetol. Rev. 30(4):229; Feldman and Wikinson 2000. Herpetol. Rev. 31:248; Ernst and Ernst 2003. Snakes of the United States and

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Fig. 1. *Thamnophis sirtalis semifasciatus* stuck in a wire cage trap in Illinois, USA after consuming a piece of American Beaver (*Castor canadensis*) meat used as bait for weasels (*Mustela* sp.).

Canada. Smithsonian Books, Washington, D.C. 668 pp.). Despite being the most studied reptile in North America (Ernst and Ernst 2003, *op. cit.*), we believe this is the first published report of any subspecies of *T. sirtalis* consuming beaver meat, and perhaps the first recorded instance of a snake consuming beaver meat in the wild. Our observation adds further evidence to the idea that *T. sirtalis* is a generalist with plasticity in foraging behavior (Burghardt and Krause 1999. J. Comp. Psychol. 113:277–285; Ernst and Ernst 2003, *op. cit.*).

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TRIMERESURUS FLAVOMACULATUS **(Philippine Pit Viper). MAXIMUM BODY LENGTH.** *Trimeresurus flavomaculatus* is a large and semi-arboreal viperid snake endemic to the Philippines (Leviton 1964. Philipp. J. Sci. 93:251–276). Body size is variable among the 50 described species of *Trimeresurus*, with maximum total lengths ranging from 480 mm (*T. strigatus*; Feldman et al. 2015. Glob. Ecol. Biogeogr. 25:187–197) to 1600 mm (*T. sumatranus*; Vogel 2006. Venomous Snakes of Asia. Edition Chimaira, Frankfort au Maim, Germany. 148 pp.). We collected an adult female *T. flavomaculatus* (Sam Noble Oklahoma Museum of Natural History [OMNH] 46849) on 27 May 2018, in 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.). Post-euthanasia but prior to fixing the specimen, the following measurements were taken: 1308 mm SVL, 220 mm tail length, 950 g. This total length (1528 mm) is 39.9% larger than the previous record specimen (1092 mm total length; Leviton et al. 2014. *In* Williams and Gosliner [eds.], The Coral Triangle. The 2011 Hearst Philippine Biodiversity Expedition, pp. 473–530. California Academy of Sciences, San Francisco, California). The large size of this specimen supports *T. flavomaculatus* as the second largest member of the genus, behind *T. sumatranus*. Body size is hypothesized to be constrained in arboreal vipers; the largest known vipers are terrestrial (e.g., *Lachesis*; Alencar et al. 2017. Proc. R. Soc. B. 284:20171775). However, some arboreal species of *Trimeresurus* exhibit exceptionally large body sizes that are comparable to many large terrestrial vipers.

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