

# NATURAL HISTORY NOTES

## CAUDATA — SALAMANDERS

**AMBYSTOMA VELASCI (Plateau Tiger Salamander). MORTALITY.** *Ambystoma velasci* is a salamander endemic to Mexico, and has been reported to feed on any vertebrates and invertebrates that can possibly be swallowed (Lemos-Espinal and Dixon 2013. *Amphibians and Reptiles of San Luis Potosí*. Eagle Mountain Publishing, LC, Eagle Mountain, Utah. 300 pp.), including conspecifics (Vite-Silva et al. 2009. *Bull. Maryland Herpetol. Soc.* 45:1). However, herein we report a case of a fatality of *A. velasci* due to the failed consumption of a dragonfly naiad.

At 1455 h on 20 September 2012, a male *A. velasci* (SVL = 66 mm) was found freshly dead on the edge of a pond (Fig. 1A) located in the vicinity of El Ocotoreo, municipality of Xichú, Guanajuato, Mexico (21.3143°N, 100.1088°W, WGS84, 2252 m elev.). After a closer examination, we found a live dragonfly naiad (Odonata) lodged deeply within its mouth (Fig. 1B). We speculate that the salamander died by the failure to subdue, kill, and pass the

lodged dragonfly naiad deeper into the digestive tract. Although dragonfly naiads are very common in ponds and similar areas where *A. velasci* is present, it still remains to be studied what proportions of them occur in the diet of *A. velasci*.

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**ADRIAN LEYTE-MANRIQUE**, Laboratorio de Biología, Departamento de Innovación Agrícola Sustentable, Instituto Tecnológico Superior de Salvatierra. Manuel Gómez Morán # 300, C.P. 39800, Col. Janicho, Salvatierra, Guanajuato, México (e-mail: aleyteman@gmail.com); **JUAN PABLO MORALES-CASTORENA**, Licenciatura en Biología, Instituto Tecnológico Superior de Irapuato. Carretera Irapuato-Silao, km 12.5 s/n, C.P. 36821, Irapuato, Guanajuato, México (e-mail: juanpa\_mora10@hotmail.com); **VICENTE MATA-SILVA**, Department of Biological Sciences, The University of Texas at El Paso, El Paso, Texas 79968, USA (e-mail: vmata@utep.edu).

**BOLITOGLOSSA CELAQUE (Celaque Climbing Salamander). DIET.** The plethodontid salamander *Bolitoglossa celaque* inhabits the highlands of southwestern Honduras in the departments of Intibuca, La Paz, and Lempira (McCranie and Castañeda 2007. *Guía de Campo de los Anfíbios de Honduras*. Bibliomanía!, Salt Lake City, Utah. 304 pp.), and is considered Endangered by the IUCN (Townsend and Wilson 2010. *In* Wilson et al. [eds.], *Conservation of Mesoamerican Amphibians and Reptiles*, pp. 461–486. Eagle Mountain Publishing, Eagle Mountain, Utah). No information has previously been reported regarding the diet of this species (McCranie and Wilson 1993. *Herpetologica* 49:1–15; McCranie and Wilson 2002. *Amphibians of Honduras*. Society for the Study of Amphibians and Reptiles, New York. 625 pp.; McCranie and Castañeda 2007, *op. cit.*).

We examined dietary items from ten preserved specimens of *B. celaque*: eight individuals (five juveniles [UF 156457, 156459, 156461, 156467–156468] and two females [UF 156463, 156465]) from Parque Nacional Celaque, Dept. Lempira (14.558°N, 88.674°W, WGS84, 2575 m elev.); one juvenile (UF 156484) from El Rodeo, Dept. Intibuca (14.461°N, 88.156°W, WGS84, 2170 m elev.); and one juvenile (UF 156473) from Reserva Biológica Guajiquiro, Dept. La Paz (14.145°N, 87.837°W, WGS84, 2160 m elev.). Dietary items were flushed from the mouth, throat, and stomachs of preserved specimens without dissection, stored in 70% EtOH, and examined using light stereomicroscopy. Identification was done to the lowest taxonomic order possible based on sample condition using the descriptors and keys provided by Borror and White (1970. *A Field Guide to Insects: America North of Mexico*. Houghton Mifflin Co., Boston, Massachusetts. 404 pp.).

Twenty-two individual diet items were identified, representing the insect orders Coleoptera (36.4%) and Hymenoptera (13.6%), arachnid orders Acari (18.2%) and Araneae (9.1%), and other arthropods represented by the class Diplopoda (9.1%), and order Isopoda (4.5%). Eight coleopteran specimens represented

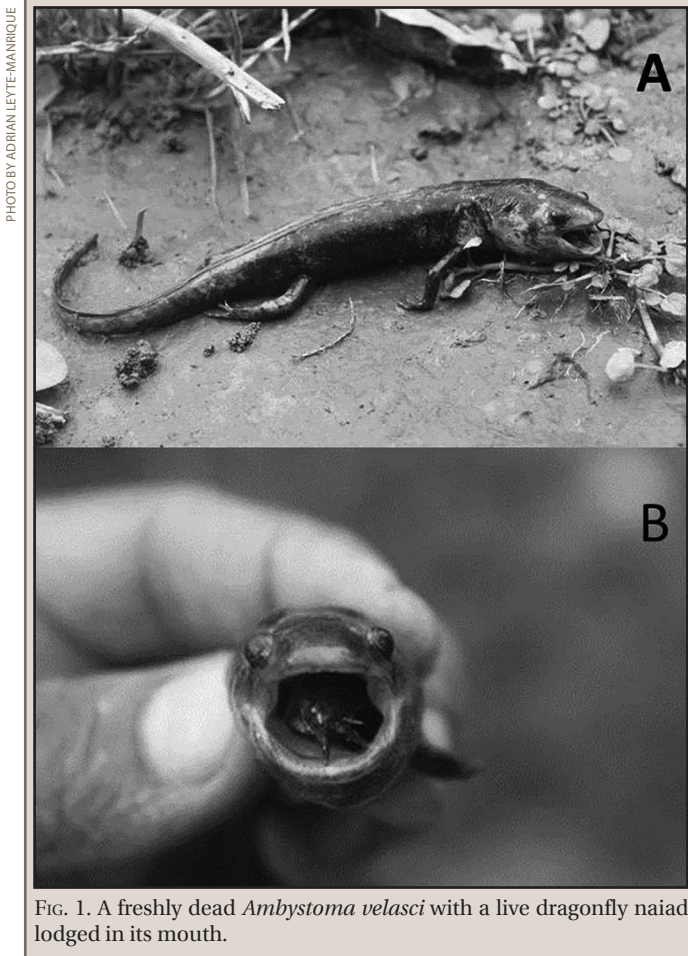


FIG. 1. A freshly dead *Ambystoma velasci* with a live dragonfly naiad lodged in its mouth.

PHOTO BY ADRIAN LEYTE-MANRIQUE

the majority of identified dietary samples; two specimens were larvae. Two adult coleopteran were identified to family representing Circulionidae and Staphylinidae. Hymenoptera were primarily identified based on wing and head morphology. Arachnida was represented by six specimens (27.3%), primarily from the subclass Acari. Within the order Araneae, one specimen could be identified to family Salticidae based on morphology. Diplopoda were identified based on the presence of two leg attachment points per segment and Isopoda (4.5%) based on morphology, color and patterning.

Five individuals contained multiple prey items. The highest prey diversity was observed in a juvenile (UF 156457, SVL = 23.2 mm) containing five unique prey items representing Coleoptera (Circulionidae), Diplopoda, Acari, Hymenoptera, and an unidentified larva. A single juvenile from Intibuca (UF 156484, SVL = 27.8 mm) contained four unique prey items, including Acari, Araneae, Hymenoptera, and Diplopoda. Another juvenile from Lempira (UF 156459, SVL = 31.9 mm) had three unique prey items from the Order Coleoptera including a larva and two adults (one Family Staphylinidae). One juvenile (UF 156473, SVL = 33.6 mm) from La Paz, one coleopteran and one hymenopteran (Family Sphecidae). A juvenile (UF 156468, SVL = 21.2 mm) from Lempira contained two Acari.

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**MICHAEL W. ITGEN** (e-mail: m.w.itgen@iup.edu), **ALEXANDER J. HESS** (e-mail: ajhess44@gmail.com), **ELLEN L. TEYGART** (e-mail: e.teygart@iup.edu), and **JOSIAH H. TOWNSEND**, Department of Biology, Indiana University of Pennsylvania, Indiana, Pennsylvania 15705-1081, USA (e-mail: josiah.townsend@iup.edu).

**BOLITOGLOSSA DIAPHORA** (El Cusuco Salamander). **DIET.** The plethodontid salamander *Bolitoglossa diaphora* is endemic to Parque Nacional Cusuco in the Sierra de Omoa in northwestern Honduras, and is considered Critically Endangered due to its limited distribution and the infrequency with which it is encountered (Townsend and Wilson 2008. Guide to the Amphibians and Reptiles of Cusuco National Park, Honduras. Bibliomania!, Salt Lake City, Utah. 322 pp.). Nothing has previously been reported regarding the diet of this species (McCranie and Wilson 1995. J. Herpetol. 29: 447–452; McCranie and Wilson. 2002. The Amphibians of Honduras. Society for the Study of Amphibians and Reptiles, New York. 625 pp.; Townsend and Wilson 2008, *op. cit.*).

We examined dietary items of nine preserved specimens of *B. diaphora* from Parque Nacional Cusuco, Dept. Cortés (15.495°N, 88.211°W, WGS84, 1520–1990 m elev.): three males (UF 144082, UF 156491, USNM 335046), five females (UF 144085, UF 156492–93, USNM 335047–8), and a single juvenile (UF 142739). Dietary samples were flushed from the mouth, throat, and stomachs of preserved specimens without dissection, stored in 70% EtOH, and examined using light stereomicroscopy. The identification of prey items was done to the lowest taxonomic level based on body parts and using descriptors and keys (Borror and White 1970. A Field Guide to Insects: America North of Mexico. Houghton Mifflin Co., Boston, Massachusetts. 404 pp.).

We found 14 individual prey items comprised of insect orders Hymenoptera (64.3%) and Coleoptera (7.13%), and two classes of arthropods: Arachnida (14.3%) and Diplopoda (14.3%). Seven of the Hymenoptera diet specimens were identified to the Family Formicidae and a single sample into the Family Sphecidae. The two arachnid samples represented the orders

Pseudoscorpionidae and Salticidae. Among *B. diaphora*, we found the maximum number of prey items within a single individual to be five. The female (UF 156492, SVL = 30.2 mm) with the largest sample had a single pseudoscorpionid and four Hymenoptera (Formicidae). One female (UF 144085, SVL = 41.9 mm) contained a single Hymenoptera (Formicidae) and a Coleopteran; another female (UF 335047, SVL = 35.7 mm) had consumed a Hymenoptera (Formicidae) and a Diplopoda.

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**ALEXANDER J. HESS** (e-mail: ajhess44@gmail.com), **MICHAEL W. ITGEN** (e-mail: m.w.itgen@iup.edu), **ELLEN L. TEYGART** (e-mail: e.teygart@iup.edu), and **JOSIAH H. TOWNSEND** (e-mail: josiah.townsend@iup.edu), Department of Biology, Indiana University of Pennsylvania, Indiana, Pennsylvania 15705-1081, USA.

**DESMOGNATHUS ABDITUS** (Cumberland Dusky Salamander). **PREDATION.** On 12 July 2015, we moved a small streamside rock along a tributary of Tennessee's Obed River, Morgan Co., Tennessee, USA (36.0820°N, 84.7610°W, WGS84) to discover a small adult *Desmognathus abditus* being consumed by an adult *Diadophis punctatus* (Ring-necked Snake). After being disturbed, the snake regurgitated the still-living salamander. *Diadophis punctatus* is a frequent predator of plethodontid salamanders, including *Desmognathus* (Ernst and Ernst 2003. Snakes of the United States and Canada. Smithsonian Books, Washington, DC. 668 pp.), but this is the first documented occurrence of predation of *Desmognathus abditus*, or any other species in the *Desmognathus ochrophaeus* complex, by *Diadophis punctatus*. Forester (1978. J. Herpetol. 12:537–541) conducted experimental encounters between *Diadophis punctatus* and *Desmognathus ochrophaeus* (now *Desmognathus ocoee*, Ocoee Dusky Salamander) and demonstrated attempted predation by the former and a strong flight response in the latter. Cupp (1994. Anim. Behav. 48:232–235) showed that *Desmognathus ochrophaeus* avoid substrates marked with the scent of *Diadophis punctatus*. However, we are not aware of any prior field observations of predation of members of the *Desmognathus ochrophaeus* complex by *Diadophis punctatus*.

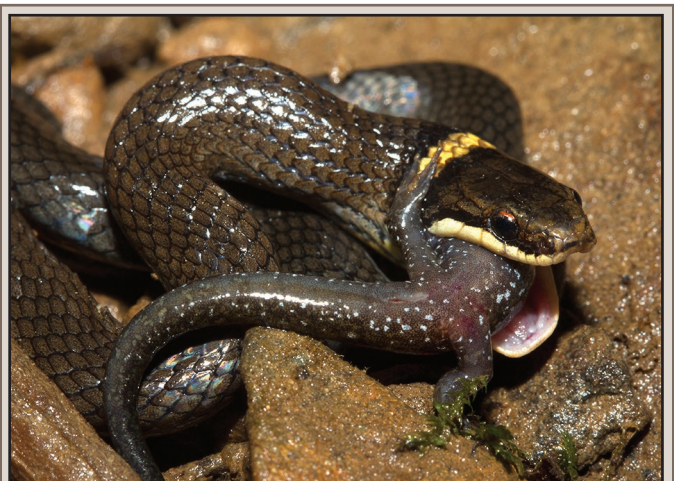


FIG. 1. Small adult *Desmognathus abditus* being consumed by an adult *Diadophis punctatus*.

**TYSON PAULSON**, Department of Ecology and Evolutionary Biology, University of Tennessee, Knoxville, Tennessee, 37996, USA (e-mail: tpaulson@vols.utk.edu); **SAUNDERS DRUKKER**, The University of the South, Seawanee, Tennessee, 37383, USA (e-mail: drukkss0@sewanee.edu); **TODD W. PIERSON**, Department of Ecology and Evolutionary Biology, University of Tennessee, Knoxville, Tennessee, 37996, USA (e-mail: tpierso1@vols.utk.edu).

**DESMOGNATHUS QUADRAMACULATUS (Black-bellied Salamander).** **MAXIMUM CLUTCH SIZE.** *Desmognathus quadramaculatus* is a semi-aquatic plethodontid of the southern Appalachians in the southeastern USA. The reproductive ecology of this species has been studied in sites throughout its range (Petranka 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington, DC. 587 pp.; Camp et al. 2000. Can. J. Zool. 78:1712–1722; Camp et al. 2002. Herpetologica 58:471–484). Average clutch size is typically 31–54, depending on locality (Petranka 1998, *op. cit.*). A previous note reported a maximum clutch size of 82 from northeastern Georgia, USA (Camp et al. 2010. Herpetol. Rev. 41:330). In the late morning of 01 June 2013 we discovered two *D. quadramaculatus* clutches attended by females (both escaped and were not captured) under small rocks (~15 × 8 × 5 cm) in a tributary of the Toccoa River in Union Co., Georgia, USA (34.7589°N, 84.0310°W; WGS84). We counted 71 eggs in the smaller clutch and 105 eggs in the larger clutch, which now represents the maximum clutch size for this species. We returned the rocks carefully to their position in the stream and returned to check the rocks five hours later to determine if the females returned to their clutch. The female attending the larger clutch had returned, but the other had not.

**KYLE BARRETT**, Department of Forestry and Environmental Conservation, 261 Lehotsky Hall, Clemson University, Clemson, South Carolina, 29631, USA (e-mail: rbarre2@clemson.edu); **DAVID A. STEEN**, Department of Biological Sciences, Auburn University, Auburn, Alabama, 36849, USA; **SEAN C. STERRETT**, Warnell School of Forestry and Natural Resources, University of Georgia, Athens, Georgia 30602, USA (e-mail: seansterrett@gmail.com); **WILLIAM B. SUTTON**, Department of Agricultural and Environmental Sciences, Tennessee State University, Nashville, Tennessee, 37206, USA (e-mail: wsutton@tnstate.edu); **SEAN P. GRAHAM**, Department of Biology, Geology, and Physical Sciences, Sul Ross State University, Alpine, Texas, 79832, USA (e-mail: sean.graham@sulross.edu).

**EURYCEA NAUFRAGIA (Georgetown Salamander).** **BEHAVIOR.** *Eurycea naufragia* is a neotenic spring and cave dwelling plethodontid salamander. This species is known from approximately 15 sites from the San Gabriel River watershed in Texas, an area that is undergoing rapid urbanization. The limited range of the species and its restricted habitats led to its recent listing as a threatened species. From 22 March to 03 May 2012, salamanders were trapped at a permanent spring in Williamson Co., Texas, USA (precise locality withheld due to conservation concerns). Each trap consisted of a fine mesh net 76.2 cm long with a 16.5 cm opening supported by wire at one end and the other end attached to a capped 5.08 × 29.2 cm PVC pipe, with a mesh covered opening on the side to allow water flow. Each week we conducted one diurnal and one nocturnal sampling event separated by 24 to 48 h. We randomized whether diurnal or nocturnal trapping was conducted first within each week. Three traps were placed at the same locations within the spring run (at the spring outflow, 1 m and 7 m downstream) for each sample. Diurnal sampling was conducted from 0700 h to 1900 h and nocturnal sampling from 1900 h to 0700 h. Based on a visual estimate of total length

(following Bowles et al. 2006. Hydrobiologia 553:111–120; Pierce et al. 2010. Southwest. Nat. 55:296–301; Bendik et al. 2014. Herpetol. Conserv. Biol. 9:206–222), each salamander was assigned to one of two size classes: juvenile (<5.1 cm total length) or adult (>5.1 cm total length). After processing, all salamanders were released back into the spring run at point of capture. For comparison of nocturnal and diurnal samples, we combined all salamanders captured in the three traps during a sampling event.

We captured more salamanders during the nocturnal sampling events ( $5.71 \pm 2.56$  salamanders, mean  $\pm$  SD) than during diurnal sampling events ( $1.14 \pm 1.07$ ). These differences, however, were not consistent across the two size classes. We captured more juvenile salamanders in nocturnal sampling events ( $4.57 \pm 2.30$ ) than in diurnal sampling events ( $0.14 \pm 0.38$ ). There was no significant difference in number of adult salamanders captured during nocturnal ( $1.14 \pm 1.46$ ) and diurnal sampling events ( $1.00 \pm 1.15$ ). The total number of salamanders that we captured in this study ( $N = 48$ ) was relatively low, but the results were nevertheless straightforward and suggest that juvenile *E. naufragia* salamanders are more active at night.

A number of other studies have concluded that terrestrial salamanders are more active at night (e.g., Hairston 1949. Ecol. Monogr. 19:47–73; Connette et al. 2011. Southeast. Nat. 10:109–120). However, only a few studies have examined daily activity in aquatic life stages and none have examined permanently aquatic species. A study on activity patterns of aquatic stream salamander larvae (*Desmognathus fuscus* [Northern Dusky Salamander], *Eurycea cirrigera* [Southern Two-lined Salamander], *E. guttulinata* [Three-lined Salamander], *Pseudotriton montanus* [Mud Salamander], and *P. ruber* [Red Salamander]) found higher nighttime activity (Connette et al. 2011, *op. cit.*). In a study of *E. bislineata*, aquatic larvae were more active at night (Petranka 1984. J. Herpetol. 18:48–55). Contrary to the current study, densities of *D. fuscus* aquatic larvae were similar during day and night (Orser and Shure 1975. Am. Midl. Nat. 93: 403–410).

Our observations suggest that juvenile *E. naufragia* are more active at night and that nocturnal surveys will result in higher abundance observations for this life stage. These conclusions are limited by only sampling during a single season and using a single survey method (traps). Nevertheless our observations suggest that investigators surveying larval or aquatic salamanders should be aware of potential differences in diurnal and nocturnal activity patterns that may affect survey results.

We thank the property owners for permission to survey salamanders on their land. The Texas Parks and Wildlife provided a scientific research permit for study of the salamanders. This study complied with all applicable institutional animal care guidelines.

**KIRA D. MCENTIRE** (e-mail: mcentire.kd@gmail.com) and **BENJAMIN A. PIERCE**, Department of Biology, Southwestern University, Georgetown, Texas, 78626, USA. Current address of KDM: Warnell School of Forestry and Natural Resources, University of Georgia, Athens, Georgia 30602, USA.

**PLETHODON CINEREUS (Eastern Red-backed Salamander).** **MORPHOLOGY.** Two color morphs are common in *Plethodon cinereus*, striped and unstriped (Petranka 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington, D.C. 587 pp.). Both morphs are present in Ohio, with the northwestern portion of the state containing a high frequency of the unstriped morph, which is typically far less common than the striped morph. South Bass Island, part of the Lake Erie archipelago, contains a well-documented monomorphic unstriped population (Pfingsten and Walker 1978. J. Herpetol. 12:163–167;



FIG. 1. Striped *Plethodon cinereus* found within a monomorphic unstriped population on South Bass Island, Ohio. This individual represents the only striped individual collected from the island.

Hantak, pers. obs.). To date, a single striped individual has been discovered on South Bass Island (Reichenbach 1981. Herpetol. Rev. 12:53) among hundreds of unstriped *P. cinereus* collected over decades (Pfingsten and Walker 1978, *op. cit.*; Reichenbach 1981, *op. cit.*; Hantak, pers. obs.). Thirty-six years after the sighting of the first striped individual on South Bass Island (Reichenbach 1979, pers. obs.), a second individual has been found (Fig. 1). It was discovered on 29 April 2015 on the Heineman property, South Bass Island, Ottawa Co., Ohio, USA (41.6465°N, 82.8234°W, WGS84). The individual was a juvenile (SVL = 22.75 mm; 0.26 g), and was found with three unstriped juveniles under a decaying log. This specimen was collected and preserved at Ohio University (MMH459), unlike the previous individual, which was only photographed. The genetics underlying the striped/unstriped color polymorphism of *P. cinereus* are currently not well understood; however, discordant results by Highton (1959. Copeia 1959:33–37; Highton 1975. Genetics 80:363–374) suggest that the genetics of the polymorphism may be geographically variable. Whether the striped morphs occur on South Bass Island as a consequence of a recent, novel mutation, or whether these individuals reflect the retention of an ancestral polymorphism, is not known.

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**MAGGIE M. HANTAK** (e-mail: mh433113@ohio.edu), **SHAWN R. KUCHTA**, Department of Biological Sciences, Ohio University, Athens, Ohio 45701, USA (e-mail: kuchta@ohio.edu); **CARI-ANN M. HICKERSON** (e-mail: chickerson@jcu.edu), **CARL D. ANTHONY**, Department of Biology, John Carroll University, University Heights, Ohio 44118, USA (e-mail: canthony@jcu.edu).

#### ANURA — FROGS

***HYLA CHRYSOSCELIS* (Cope's Gray Treefrog) × *HYLA CINEREA* (Green Treefrog). PUTATIVE NATURAL HYBRID.** Naturally occurring hybrid treefrogs have been occasionally found in the eastern United States. However, these hybrids are almost always between members of the same species group (e.g., Gerhardt 1974. Behaviour 49:130–151; Gerhardt et al. 1980. Copeia 1980:577–584; but see Anderson and Moler 1986. Copeia 1986:70–76). When *Hyla cinerea* group individuals were artificially crossed with *H. versicolor* group individuals, little reproductive success

was achieved, and those tadpoles that survived to metamorphosis showed severe phenotypic abnormalities, and abnormal or incomplete sexual development (Mecham 1965. Am. Midl. Nat. 74:269–308).

At 2145 h on 10 June 2014 we heard an unusual anuran advertisement call along Bayou Manual Road in Sherburne Wildlife Management Area in the Atchafalaya Basin of south-central Louisiana, USA (30.4026°N, 91.6748°W, WGS84). The call resembled that from a *Hyla*, but did not sound like any of the *Hyla* species known from the area (*H. cinerea*, *H. chrysoscelis*, and *H. squirella* [Squirrel Treefrog]). The dominant calls at that time in the immediate vicinity were from *H. chrysoscelis*, with *H. cinerea*, *H. squirella*, *Incilius nebulifer* (Gulf Coast Toad), and *Gastrophryne carolinensis* (Eastern Narrow-mouthed Toad) each vocalizing to lesser degrees.

We collected the individual and brought it to the laboratory for further study. The treefrog measured 45 mm (SVL), with an elongated body shape, appearing more like *H. cinerea* than *H. chrysoscelis* in that regard. The subocular spot typical of *H. chrysoscelis* and the lateral stripe typical of *H. cinerea* were both absent. The overall pattern was mottled, and his coloring changed dramatically from predominantly green to predominantly brown. Even while green, however, his lower legs remained gray. The inner thighs did not exhibit bright flash colors typical of *H. chrysoscelis* (Fig. 1). Mecham (1965, *op. cit.*) described similar physical characteristics to our hybrid in his laboratory-crossed female *H. cinerea* and male *H. chrysoscelis* hybrid treefrogs. Reciprocal crosses between male *H. cinerea* and female *H. chrysoscelis* produced different patterns and resulted in a lack of one or both eyes (Mecham 1965, *op. cit.*).

The frog did not respond to calls of recordings of *H. cinerea* but did vocalize in response to the recorded call of *H. chrysoscelis*. We made a recording of the call of the putative hybrid in the laboratory at an air temperature of 24.6°C. We analyzed only four calls for measurements of the pulse duration, pulse interval, and pulse period by using the measurement tool in Sound Ruler ver. 0.9.6 (Gridi-Papp [ed.]. 2007. SoundRuler: Acoustic Analysis for Research and Teaching. <http://soundruler.sourceforge.net>). The dominant frequency was found using the dfreq function in the R package seewave (Sueur et al. 2008. Bioacoustics 18:213–226). The analyses produced the following means: pulse duration 0.0703 s, pulse period 0.1171 s, pulse interval 0.0473 s, and pulse rate 8.782 pulses/s. The mean dominant frequency of the calls was 2169 Hz (Fig. 2) which is higher than the 1906 Hz mean dominant frequency (at 25.0°C air temperature) of a laboratory-reared 38.2 mm hybrid resulting from a cross between a female *H. cinerea* and a male *H. chrysoscelis* (Fortman and Altig 1974. Herpetologica 30:221–234). The call had a frequency spectrum within the range of frequencies by the putative parent species (Fig. 2). The pulse rate, however, lay intermediate between the putative parent species (much faster than *H. cinerea*, and much slower than *H. chrysoscelis*). The full audio recording has been accessioned into the Macaulay Library with catalog number ML 148096 (<http://macaulaylibrary.org/audio/148096>).

Flow cytometry was used (Jenkins et al. 2011. Reproduction 141:55–65) to determine whether this individual had produced viable spermatozoa. The putative hybrid showed 3.4% (SE = 0.009) viable testicular cells in a suspension of the macerated testis compared to a normal male *H. chrysoscelis*, which had 44.3% (SE = 0.014) viable testicular cells. The testes of the putative hybrid were smaller (3.67 mm length, 1.44 mm width) compared to the normal *H. chrysoscelis* (4.5 mm length, 2.37 mm width). No



FIG. 1. Photos of the putative hybrid treefrog (*Hyla chrysoscelis* × *H. cinerea*) captured in the Atchafalaya Basin.

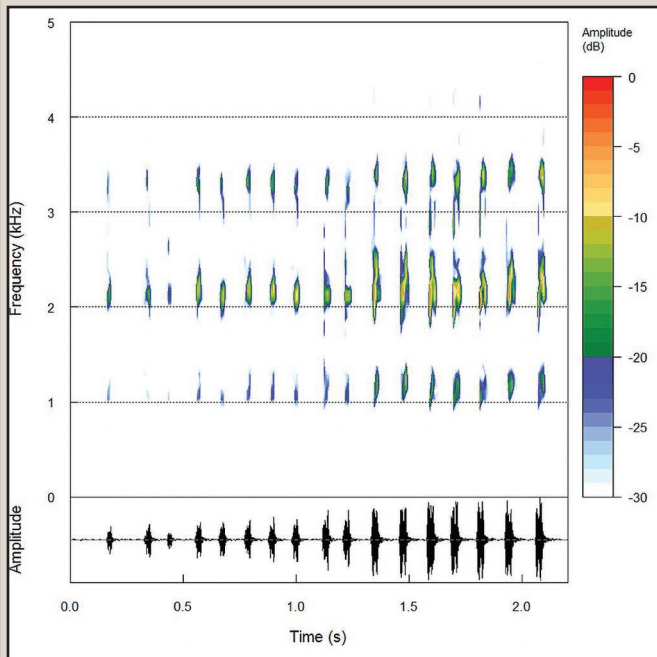


FIG. 2. Spectrogram of a call from the putative hybrid treefrog (*Hyla chrysoscelis* × *H. cinerea*) recorded at a distance of ca. 0.5 m from the calling frog at 24.6°C air temperature.

morphologically normal spermatozoa from the putative hybrid could be found by light microscopy, as cells appeared round and not like the cylindrical cells observed from the normal male *H. chrysoscelis*. Of the six adults Meacham (1965, *op. cit.*) sacrificed, all had either very small, rudimentary testes or lacked oviducts, and no sperm could be located in suspension. Meacham (1965, *op. cit.*) also stated that none of his grossly normal hybrids from female *H. cinerea* and male *H. chrysoscelis* that matured to adult size ever developed male throat pigment or definite vocal sacs, whereas this putative hybrid displayed both throat pigment and a vocal sac.

Flow cytometry was also used for high resolution nuclear DNA analysis to estimate the total genome size from nuclei of whole blood cells of the putative hybrid and the putative parental species, as species delineation can be discovered through the genetic complement. According to laboratory-generated genome

size data from *H. chrysoscelis* and *H. cinerea* collected in the same area (J. Jenkins, unpubl. data), and data from the Animal Genome Size database ([www.genomesize.com](http://www.genomesize.com)), the hybrid's diploid genomic complement was 9.8 pg, which was intermediate between the putative parental species.

Based on the phenotype, unusual call, small testes, lack of viable sperm, and intermediate genome size of this frog, we conclude that this treefrog is a hybrid of *H. chrysoscelis* and *H. cinerea*. Because the treefrog's characteristics are largely consistent with those described from laboratory crosses of male *H. chrysoscelis* and female *H. cinerea* (Meacham 1965, *op. cit.*), and because the reciprocal crosses typically resulted in high rates of abnormal early embryonic cleavage, very few tadpoles, and only one short-lived transformed individual (Pyburn and Kennedy 1960, *op. cit.*; Littlejohn 1961, *op. cit.*), we conclude that this individual is likely the result of a mating event between a male *H. chrysoscelis* and female *H. cinerea*. To our knowledge, natural hybrids between *H. chrysoscelis* and *H. cinerea* have not been previously reported (Dodd 2013. *Frogs of the United States and Canada*. Johns Hopkins University Press, Baltimore, Maryland. 982 pp.).

We thank Jeromi Hefner for collecting the reference frogs for the genetic component of this manuscript. We thank Jacqueline Perticone for laboratory assistance. Collection was authorized by LDWF permit # LNHP-14-071 and Sherburne WMA Special Use permit WL-Research-2008-02. The specimen was deposited in the LSU Museum of Natural Science (LSUMZ 99024). All handling of animals was conducted in accordance with approved IACUC protocols. Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government. This is contribution number 483 of the U.S. Geological Survey Amphibian Research and Monitoring Initiative (ARMI).

**BRAD M. GLORIOSO** (e-mail: [gloriosob@usgs.gov](mailto:gloriosob@usgs.gov)), **J. HARDIN WADDE**, **JILL A. JENKINS**, **HEATHER M. OLIVIER**, U.S. Geological Survey, 700 Cajundome Boulevard, Lafayette, Louisiana 70506, USA; **REBEKAH R. LAYTON**, Cape Girardeau, Missouri 63701, USA.

**HYPISIBOAS PULCHELLUS** (Montevideo Tree Frog, *Ranita de Zarzal*). **PREDATION.** Predation is one of the main causes of mortality in natural amphibian populations and may occur in any stage of the life cycle (Zug et al. 2001. *Herpetology. An Introductory Biology of Amphibians and Reptiles*. 2<sup>nd</sup> ed. Academic Press, San Diego. 630 pp.). Many authors have pointed out that arachnids (mainly Araneae) are one of the most important predators of tadpoles in the Neotropics. Most of these records belong to Pisauridae, Ctenidae, Lycosidae, Sparassidae, and Theraphosidae families (Menin et al. 2005. *Phyllomedusa* 4:39–47). However, predation on adult and juvenile amphibians has been poorly documented, mainly due to the difficulty of obtaining direct records in the field (Pombal 2007. *Rev. Bras. Zool.* 24:841–843).

At 2125 h on 9 November 2013, we recorded two predation events of *Hypisiboas pulchellus* juveniles by wolf spiders (Lycosidae). Both observations were made in flooded grasslands of Punta Lara Nature Reserve (34.8043°S, 58.0319°W; WGS84), Buenos Aires, Argentina. In the first case, the predator was an adult male *Lycosa erythrognatha*. It was collected and deposited in the collection of Invertebrate Zoology, La Plata Museum (MLP-Ar 19385). The second predator corresponded to a species belonging to an undescribed genus of the Lycosidae (Fig. 1). This specimen was not collected. During the period we observed both predation events the larval cycle of *H. pulchellus* was concluding (having started in spring) and we noted high densities of juveniles.

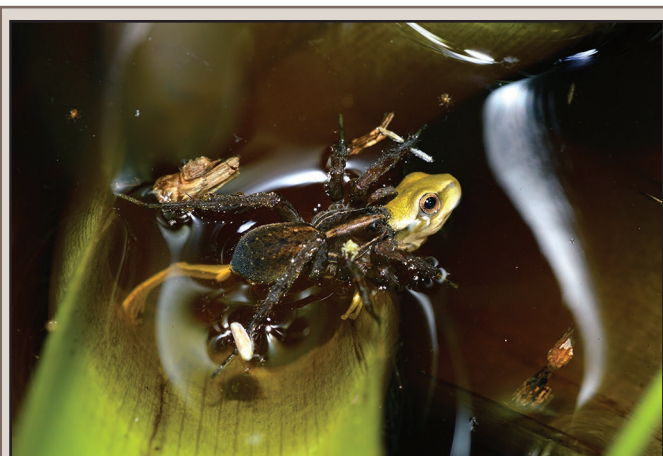


FIG. 1. Undescribed spider of the family Lycosidae (wolf spider) preying on a juvenile *Hypsiboas pulchellus* from Punta Lara Nature Reserve, Argentina.

Spiders are potential predators of both juvenile and adult anurans. Significant linear correlations between the body lengths of prey and predator have been demonstrated, with the size of the spider being similar or slightly smaller than the anuran prey (Menin et al. 2005. *Phyllomedusa* 4:39–47). The body lengths of *H. pulchellus* span 1.95–5 cm (Maneyro and Carreira 2012. *Guía de Anfibios del Uruguay*. Ediciones de la Fuga, Montevideo, Uruguay. 207 pp.), whereas the largest wolf spiders can reach more than 30 mm body length (Jocqué and Dippenaar-Schoeman 2015. *Spider Families of the World*. Royal Museum for Central Africa, Tervuren, Belgium. 336 pp.); therefore, we can infer that these spiders can prey on both juvenile and adult stages of *H. pulchellus*.

Here we present the first records of two species of lycosid spiders preying on *H. pulchellus*. Given that spiders of the Lycosidae are abundant in the Argentine Pampas grasslands (Platnick 2014. [www.wsc.nmbc.ch](http://www.wsc.nmbc.ch); 15 Jun 2015), they could have an important role in regulating *H. pulchellus* populations.

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**JORGELINA L. VILLANOVA** (e-mail: [jorgelinalv@gmail.com](mailto:jorgelinalv@gmail.com)), **PABLO E. SAIBENE**, CoAna, Conservación de Anfibios en Agroecosistemas, Calle 50 n 442, La Plata, Argentina; **M. GABRIELA AGOSTINI**, IEGEBA/UBA-CONICET, Grupo de Estudios sobre Biodiversidad en Agroecosistemas, Facultad de Ciencias Exactas y Naturales, Pabellón II, Ciudad Universitaria (C1428E-HA), Buenos Aires, Argentina (e-mail: [gabrielaagostini18@gmail.com](mailto:gabrielaagostini18@gmail.com)).

**ISCHNOCNEMA GUENTHERI** (Steindachner's Robber Frog). **PREDATION.** *Ischnocnema guentheri* is a litter frog of medium size with crepuscular/nocturnal activity and occasional diurnal activity (Pombal 1997. *Rev. Brasil. Biol.* 57:583–594; Dixo and Verdade 2006. *Biota Neotrop.* 6:1–20), especially in rain showers (Giaretta and Facure 2008. *Contemp. Herpetol.* 3:1–4). It is widespread in the Atlantic forest from southern Brazil to northeastern Argentina (Van Sluys et al. 2010. [www.iucnredlist.org](http://www.iucnredlist.org); 17 Mar 2015). We report predation upon *I. guentheri* by *Baryphthengus ruficapillus* (Rufous-capped Motmot). Our observation occurred during regular mist-netting (permits: CEMAVE/ICMBio no. 1237, INEA no. 051/2011, SISBIO 14210-7) at Parque Estadual da Ilha Grande (23.1638°S, 44.1888°W, WGS84; 690 m elev.), an oceanic

island at Angra dos Reis municipality, Rio de Janeiro State, Brazil. At 0820 h on 16 December 2014 we captured an adult *B. ruficapillus* with a *I. guentheri* (SVL = 31.5 mm; 2.4 g) in its bill. We deposited the frog in Museu Nacional do Rio de Janeiro, Amphibians Collection (MNRJ 88864). During focal observations in October and November 1997 of an active nest of *B. ruficapillus* in the same study area, frogs (unidentified) and reptiles, along with fruits, arthropods, and mollusks, were noted as part of the diet delivered to nestlings (Alves et al. 1999. *Ararajuba* 7:31–34). Prior published records of predation on frogs by *B. ruficapillus* (Alves et al. 1999, *op. cit.*) and *B. martii* (Rufous Motmot; Master 1999. *Wilson Bull.* 111:439–440; Alvarado et al. 2013. *Herpetol. Rev.* 44:298) were all observed during the breeding period. Motmots may prey on frogs over the whole year; however, these events may be easier to detect during the bird's breeding period as adults can be observed carrying prey items to be delivered to the chicks. As *I. guentheri* follows a cryptic strategy (Gomiero et al. 2006. *Biota Neotrop.* 6:1–5) and is present at low density at Ilha Grande (Rocha et al. 2001. *Austral Ecol.* 26:14–21) it is possible that *B. ruficapillus* is able to detect this frog moving in the litter during the day. Before our unique predation record of *I. guentheri* by a bird this frog was recorded as an unusual prey of the fish *Brycon opalinus* (Pirapitinga-do-sul), a characid species that regularly consumes fruits and insects (Gomiero et al. 2006, *op. cit.*).

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**JIMI MARTINS-SILVA** (e-mail: [jimi\\_martinelli@hotmail.com](mailto:jimi_martinelli@hotmail.com)), **CAIO C. C. MISSAGIA** (e-mail: [caiomissagia@gmail.com](mailto:caiomissagia@gmail.com)), **LÍVIA DIAS C.-SOUZA**, Programa de Pós-Graduação em Ecologia e Evolução, Universidade do Estado do Rio de Janeiro, Pavilhão Haroldo Lisboa da Cunha, Sala 224, Rua São Francisco Xavier, 524, Maracanã, 20550-013, Rio de Janeiro-RJ, Brazil (e-mail: [liviadiasnit@gmail.com](mailto:liviadiasnit@gmail.com)); **MAURÍCIO B. VECCHI** (e-mail: [mbvecchi@yahoo.com](mailto:mbvecchi@yahoo.com)) and **MARIA ALICE S. ALVES**, Departamento de Ecologia, Universidade do Estado do Rio de Janeiro, Pavilhão Haroldo Lisboa da Cunha, Sala 224, Rua São Francisco Xavier, 524, Maracanã, 20550-013, Rio de Janeiro-RJ, Brazil (e-mail: [masaal@globom.com](mailto:masaal@globom.com)).

**KALOULA PULCHRA** (Banded Bullfrog). **DEFENSIVE BEHAVIOR.** At ~1100 h on 12 August 2014 I observed a novel defensive behavior of *Kaloula pulchra* in Bawngkawn, Aizwal, Mizoram, India (23.7554°N, 92.7287°E, WGS84; 1022 m elev.). While I was holding each of the frogs (1 female and 3 males), they puffed up their bodies and released sticky secretions, which are among the recorded defensive behaviors of this species (Sazima 1974. *J. Herpetol.* 8:376–377). As I continued holding each frog I felt a tingling sensation in my palm and noticed the fourth and largest toe was vibrated by the frog in a very similar way a mouth organ player vibrates his playing hand. This vibration of the toe was followed by a forward body jerk. This continued for as long as I held the frog. Different defensive strategies are used in different phases of predation, and I assume that holding the frog tightly in my hand simulated ingestion. The behavior exhibited by *K. pulchra* is most similar to the “phalanx aggression” reported by Toledo et al. (2011. *Ethol. Ecol. Evol.* 23:1–25), which is exhibited by some frogs during ingestion. However, as defined by Toledo et al. (2011, *op. cit.*), this behavior includes morphological specializations in which the distal phalanges pierce the skin and abrade

the potential predator. Perhaps the vibration of the toe of *K. pulchra* simply produces a tingling sensation in the oral cavity of the predator, and may cause it to loosen the grip on the frog and the subsequent body jerk may set the frog free.

**JAYADITYA PURKAYASTHA**, Help Earth, Guwahati 781016, Assam, India; e-mail: mail.jayaditya@gmail.com.

**KALOULA WALTERI (Walter's Narrow-mouthed Frog). PREDATION.** *Kaloula walteri* is a small (SVL = 24.5–35.5 mm) endemic microhylid occurring at sea level to mid-montane rainforest (0–900 m elev.) on Luzon and Polillo Island, Philippines (Diesmos et al. 2002. *Copeia* 2002[4]:1037–1051). Among invertebrates, crabs are considered important frog predators and several predation incidents of frogs at various life stages by marine and freshwater crabs have been previously documented (Toledo 2005. *Herpetol. Rev.* 36:395–400; Wells 2007. *The Ecology and Behavior of Amphibians*. University of Chicago Press, Chicago, Illinois. 1148 pp.; Andrade et al. 2012. *Herpetol. Notes* 5:173–175; Pyke et al. 2013. *Herpetol. Notes* 6:195–199; Motta-Tavares et al. 2015. *Herpetol. Rev.* 46:73–74). Herein, we report an endemic *Sundathelphusa longipes* (Philippine Long-legged Freshwater Crab) eating an adult *K. walteri*.

At 0020 h on 26 March 2015, while conducting fieldwork at Mount Banahao in Barangay Bukal, Municipality of Majayjay, Laguna Province, Luzon Island, Philippines (14.0978°N, 121.482°E, WGS84; 851 m elev.), a freshwater crab (carapace = 23.6 × 19.8 mm) in a small pool with a rocky bottom (ca. 50 × 100 cm; water depth = 8 cm), beside a temporary stream, was observed grasping a deceased and mutilated *K. walteri* (SVL = 34.25 mm) in its claws. The crab immediately released the frog carcass when we approached closer. Upon further inspection, the frog's skin on the body, digits, and internal organs were completely consumed. The frog was identified based on head characteristics, size, and microhabitat. Another adult *K. walteri*, several tadpoles, and three adult crabs were also in the same pool. Although this may be the first reported Philippine frog predation by an invertebrate, it is also possible that the crab only scavenged an already dead frog. The frog (field number EYS 440) and crab (EYS 441) were preserved in 70% ethanol and deposited in the Herpetology Section of the National Museum of the Philippines.

**EMERSON Y. SY**, Philippine Center for Terrestrial and Aquatic Research, 1198 Benavidez St., Unit 1202, Tondo, Manila, Philippines (e-mail: emersonsy@gmail.com); **LOUISE ABIGAIL DE LAYOLA**; **LEVY V. NECISITO**, The Graduate School, University of Santo Tomas, España Boulevard, 1015 Manila, Philippines; **NIKKI DYANNE C. REALUBIT** and **ARVIN C. DIESMOS**, Herpetology Section, Zoology Division, National Museum of the Philip-

pines, Padre Burgos Avenue, Ermita 1000, Manila, Philippines (e-mail: arvin.diesmos@gmail.com).

**LEPTODACTYLUS FUSCUS (Whistling Frog). MYIASIS.** Several fly species, from the families Sarcophagidae, Calliphoridae, and Chloropidae, are agents of myiasis and their larvae can develop in living amphibians, often killing their hosts (Crump and Pounds 1985. *J. Parasitol.* 71:588–591). Myiasis have been recorded in anurans including the families Bufonidae, Centrolenidae, Craugastoridae, Dendrobatidae, Hylidae, Leptodactylidae, Odonophrynidae, and Ranidae (Bokermann 1965. *Acad. Bras. Cienc.* 37:525–537; Gómez-Hoyos et al. 2012. *Herpetol. Notes* 5:27–29). For leptodactylids, which are conspicuous elements of Neotropical assemblages, there are few available records that report only egg predation by fly larvae on *Leptodactylus bufonius* (Vizcachera White Lipped Frog), *L. fuscus*, and *L. pentadactylus* (South American Bullfrog) (Downie et al. 1995. *J. Nat. Hist.* 29:993–1003). In this study, we report observations of myiasis by two fly species in adult *L. fuscus*, representing the first evidence of myiasis on this species.

Anurans were surveyed at the Pantanal wetlands, in the Nhecolândia region, Brazil (19.6558°S, 57.0417°W, WGS84; 90 m elev.) from 11–19 February 2006. Individuals were caught in pitfall-traps with drift fences. All frogs were inspected for the presence of maggots; infected individuals were placed in plastic jars containing vermiculite, and maggots were allowed to pupate to identify them to species level. The following species of frogs were collected: *Rhinella schneideri* (Cururu Toad; N = 29), *Elachistocleis bicolor* (Two-colored Oval Frog; N = 13), *Pseudis paradoxa* (Paradox Frog; N = 15), *Physalaemus albonotatus* (Menwig Frog; N = 43), *L. chaquensis* (Creole Frog; N = 57), *L. podicipinus* (Pointed-belly Frog; N = 68), and *L. fuscus* (N = 122). *Leptodactylus fuscus* was the only species infected, with five individuals (4.1%) infected (mean intensity = 2.8 maggots per frog). Two fly species, belonging to two families were recovered from *L. fuscus*: *Megaselia scalaris* (Phoridae) and *Oxysarcodexia carvalhoi* (Sarcophagidae). Three (prevalence of 2.5%) of the frogs were infected with *Oxysarcodexia carvalhoi* with 3, 4, 2 maggots/frog, whereas two (prevalence of 1.6%) frogs were infected with *Megaselia scalaris* with 2 and 3 maggots per frog.

*Megaselia scalaris* is cosmopolitan and synanthropic and larvae are considered extremely opportunistic, with several cases of facultative myiasis reported on a wide variety of hosts, like arthropods (Arredondo-Bernal and Trujillo-Arriaga 1994. *Vedalia* 1:27), snakes (Silva et al. 1999. *J. Med. Entomol.* 36:630), and humans (Singh and Rana 1989. *J. Med. Entomol.* 26:228–229). Considered generalists, *Oxysarcodexia* are known for preferring uninhabited areas (Dias et al. 1984. *Mem. Inst. Oswaldo Cruz.* 79:83–91) with some cases of facultative myiasis reported in fish, mammals, and carcasses of humans (Mello-Patiu et al. 2014. *Rev. Bras. Entomol.* 58:142–146). Ecological interaction between flesh eating flies and frogs is an important area of research as previous studies have shown that these relationships are generally lethal (Crump and Pounds 1985, *op. cit.*).

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**EDNA PAULINO DE ALCANTARA** (e-mail: ednapaulino@gmail.com), **CRISTIANA FERREIRA DA SILVA** (e-mail: cristianasilva006@gmail.com), **MARCIANA CLAUDIO DA SILVA** (e-mail: marcianaclaudio@gmail.com), **ROBSON WALDEMAR ÁVILA**, Programa de Pós-Graduação em



FIG. 1. *Sundathelphusa longipes* with predated *Kaloula walteri*.

Bioprospecção Molecular, Laboratório de Herpetologia, Departamento de Ciências Biológicas, Universidade Regional do Cariri - URCA, Campus do Pimenta, Rua Cel. Antônio Luiz, 1161, Bairro do Pimenta, CEP 63105-100, Crato, Ceará, Brazil (e-mail: robsonavila@gmail.com); **DRAUSIO HONORIO MORAIS**, Departamento de Parasitologia, Instituto de Biociências, UNESP, Distrito de Rubião Jr., s/n°, CEP 18618-000, Botucatu, SP, Brazil (e-mail: drmoraisvt@gmail.com).

**LITHOBATES SPHENOCEPHALUS (Southern Leopard Frog). FALL BREEDING.** For two of the past three years, *Lithobates sphenoccephalus* has bred during the fall in Greene Co., Indiana, USA (39.1107°N, 87.2222°W; WGS84). On 16 March 2013, we began capturing overwintered (Gosner stage 25) *L. sphenoccephalus* tadpoles in funnel traps set for breeding *L. areolatus* (Crawfish Frog) at three seasonal/semipermanent wetlands. On 13 March 2015, we began capturing overwintered tadpoles at these three wetlands plus three additional wetlands. At four of these wetlands, *L. sphenoccephalus* were the only ranid tadpoles present, at the fifth they co-occurred with overwintered *L. catesbeianus* (American Bullfrog) tadpoles, at the sixth they co-occurred with overwintered *L. clamitans* (Green Frog) tadpoles.

McCallum et al. (2004. Southeast. Nat. 3:401–408) offer a detailed account of fall breeding in *L. sphenoccephalus* from Arkansas. Minton (2001. Amphibians and Reptiles of Indiana. Indiana Academy of Science, Indianapolis, Indiana. 404 pp.) reports spring breeding and occasional fall calling from Indiana. Our data are the first report confirming fall breeding from Indiana—at a latitude approaching the northern end of this species' range (Lannoo 2005. Amphibian Declines: The Conservation Status of United States Species. University of California Press, Berkeley, California. 1094 pp.)—and based on Minton's experience may represent a new phenomenon at this latitude. Given the documented effects of climate change on accelerating amphibian breeding phenology (Beebe 2002. Conserv. Biol. 16:1454; Blaustein et al. 2002. Conserv. Biol. 16:1454–1455), our observations suggest that in temperate climates, spring breeding phenology may be accelerated through the winter, into the previous fall, under suitable weather conditions (such as heavy rains; McCallum et al. 2004, *op. cit.*).

**ROCHELLE M. STILES**, Indiana State University, Rm. 135 Holmstedt Hall—ISU, Terre Haute, Indiana, 47809, USA (e-mail: rstiles2@sycamores.indstate.edu); **MICHAEL J. LANNOO**, Indiana University School of Medicine—TH, Rm. 135 Holmstedt Hall—ISU, Terre Haute, Indiana, 47809, USA (e-mail: mlannoo@iupui.edu).

**LITHOBATES SYLVATICUS (Wood Frog). CANNIBALISM.** It is known that larval *Lithobates sylvaticus* will cannibalize recently oviposited egg masses, newly hatched larvae, and smaller conspecifics (Petranka and Thomas 1995. Anim. Behav. 50:731–739). Although instances of cannibalism of older and more developed conspecifics by younger larvae is known to occur in other anurans (*Scaphiopus hurterii* [Hurter's Spadefoot], *S. bombifrons* [Plains Spadefoot; Bragg 1957. Wassman J. Biol. 15:61–68; Bragg 1964. Herpetologica 20:17–24], *S. multiplicata* [Mexican Spadefoot], *S. couchii* [Couch's Spadefoot; Pomeroy 1981. Unpubl. PhD. Dissert. Univ. of California] and *Osteopilus septentrionalis* [Cuban Treefrog; Crump 1986. Copeia 1986:1007–1009]), we were unable to find prior accounts of this phenomenon occurring in *L. sylvaticus*. Here we describe an instance of active cannibalism in *L. sylvaticus* where less developed and presumably younger larvae attacked and devoured an injured and nearly transformed conspecific.

At 2315 h on 16 June 2014 we observed a larval *Ambystoma maculatum* (Spotted Salamander) attacking a larval Wood Frog in an ephemeral wetland (ca. 3.5 m × 2 m and 45 cm deep) at the Smithsonian Environmental Research Center, Anne Arundel Co., Maryland, USA (38.9015°N, 76.5515°W, WGS84; 24 m elev.). The *A. maculatum* larva seized the *L. sylvaticus* larva by its hindquarters and limb and shook it with sideways sweeps of the head. The *L. sylvaticus* larva had fully formed fore and hind limbs, but its tail was not yet resorbed (ca. Gosner stage 42). Shortly after we approached the wetland the *A. maculatum* larva released the *L. sylvaticus* larva, presumably because it was disturbed by our flashlights. Once released, the *L. sylvaticus* larva appeared to be severely injured, and lethargically attempted to swim with irregular and weak lateral undulations. Within ca. 30 sec of its release by the *A. maculatum* larva, the injured *L. sylvaticus* larva was swarmed and consumed by ca. 10 conspecific larvae, only one of which had limbs (hind only; ca. stage 39, the rest appeared to < stage 30). What triggered the swarming behavior and sequence of predatory behaviors of the *L. sylvaticus* cannibals is unclear. It may have been initiated by biochemical cues released by the injured *L. sylvaticus* larvae during the *A. maculatum* attack (Crump 1986. Copeia 1986:1007–1009) and/or by its irregular swimming. Regardless of the specific trigger, it appears as if cannibalism by less developed larvae occurs in *L. sylvaticus* and may be an important component of its reproductive strategy.

**TODD A. TUPPER**, Biology Department, Northern Virginia Community College, Alexandria, Virginia, 22311, USA (e-mail: ttupper@nvcc.edu); **ROBERT AGUILAR**, Smithsonian Environmental Research Center, Edgewater, Maryland, 21037, USA (e-mail: aguilar@si.edu).

**LITORIA HAVINA. PREDATION.** *Litoria havina* is a poorly known treefrog recorded from the upper Fly and Kikori Rivers in the southern high rainfall zone of Papua New Guinea, and the Wondiwai and Fakfak regions of Papua Province, Indonesia (Menzies 2006. The Frogs of New Guinea and the Solomon Islands. Pensoft Publishers, Sofia, Bulgaria. 345 pp.). It occurs in swamps from 300–1300 m above sea level in tropical rainforest, and lays clutches of 10–20 large (ca. 4 mm diam) eggs on vegetation over water (Richards and Günther 2004. The IUCN Red List of Threatened Species. www.iucnredlist.org; accessed 1 Feb 2015). This note presents the first published observation of predation on *L. havina* in the field.

Between 29 June and 27 July 1993 we observed *L. havina* in several swamps around the township of Tabubil, Western Province, Papua New Guinea (5.26°S, 141.22°E, WGS84; 558 m elev.). While looking for frogs at night, we also observed one or more *Tropidonophis* sp. (Keelback Snake) in vegetation around most swamps we visited. On 9 July 1993 we observed a *Tropidonophis* moving among low vegetation in a swamp 13 km S of Tabubil along the Tabubil-Kiunga Road. On that night this swamp hosted a frog chorus containing adult *L. havina* and many tens of their egg masses were found at heights between 0.4 and 2.5 m above water level on the vegetation around the swamp. We saw the snake moving around the swamp over 2–3 h, and collected it just before we left the swamp late in the evening. Upon dissection of the snake we found an adult female *L. havina* and several egg masses in its stomach (Fig. 1). Although we did not directly observe predation, this confirmed not only our suspicions that *Tropidonophis* were predating adult *L. havina*, but also demonstrated that the snakes were eating the frogs' arboreal egg masses. We are unsure of the specific identity of the snake; four species of *Tropidonophis* (*T. doriae*, *T. mairii*, *T. multiscutellatus*, and *T.*



FIG. 1. An adult female *Litoria havina* (SVL ca. 37 mm) and *L. havina* eggs in the stomach of a *Tropidonophis* sp. (Keelback Snake) from near Tabubil in the Western Province of Papua New Guinea.

*statisticus*) occur in the general area where our observations were made (O'Shea 1996. A Guide to the Snakes of Papua New Guinea. Independent Publishing, Port Moresby, Papua New Guinea. 239 pp.).

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**GREGORY R. JOHNSTON** (e-mail: pelecanus85@gmail.com) and **STEPHEN J. RICHARDS**, South Australian Museum, North Terrace, Adelaide, 5000, Australia (e-mail: steve.richards@samuseum.sa.gov.au).

**PHYSALAEMUS PUSTULOSUS (Túngara Frog). SEXUAL COMMUNICATION.** At ca 1930 h on 14 June 2015 we made an interesting observation of sexual communication of a *Physalaemus pustulosus* in the Darien National Park in Darien (7.747°N, 77.536°W; WGS84), Panama.

Túngara Frogs produce mating calls (ca. 350 ms duration) that consist of a downward frequency sweep which can be produced alone or can be followed by 1–7 short, ca. 45 ms, bursts of sound called “chucks.” The call is accompanied by inflation and deflation of a relatively large vocal sac (Ryan 1985. The Túngara Frog. A Study in Sexual Selection and Communication. University of Chicago Press, Chicago, Illinois. 236 pp.). On this night we observed a small group of male Túngara Frogs, ca. 3–6, calling from a puddle on a trail. As chucks are typically always produced immediately after a whine, we were struck by what we thought was

a chuck produced in isolation. We then located the male producing the call in question. During ca. 5–10 min of observation, the male did indeed produce calls with only chucks. These chucks sounded similar to chucks typical of this species; although the amplitude seemed a bit lower than typical it was clearly audible. The male also produced whines in isolation and whines followed by chucks as is typical for this species, as well as what is best described as a “half-whine,” but he then returned to producing chucks in isolation. During this time we also observed the male inflating and deflating his vocal sac as if he were calling but without any audible call; this occurred several times. In all instances, whether or not accompanied by sound, the inflation-deflation of the vocal sac produced vibrations on the water's surface, which is merely an epiphenomenon of vibrating a structure on the water's surface. During all of these behaviors, chuck-only and half-whine calls, typical whine and whine-chuck calls, and muted vocal sac inflation-deflation, the male was alternating his display with neighboring calling males, as is typical for this species. Thus he was participating in the chorus in a typical manner even when producing an atypical signal.

One of us, MJR, has been studying this species for several decades (Ryan 1980. Science 209:523–525; Ryan 2011. In Losos [ed.], In Light of Evolution, Essays from the Laboratory and Field, pp. 185–203. Roberts and Company, Greenwood Village, Colorado) and only once previously did he observe a male producing a chuck-only. Examination of that male's larynx showed it was normal (MJR, unpubl. data; our current permits in the Darien did not allow collecting). Never, to our knowledge, has anyone observed a Túngara Frog inflating and deflating its vocal sac independent of sound production. The diurnal African frog *Phrynobatrachus krefftii* (Krefft's Puddle Frog) also shows this behavior which clearly is a communication signal (Hirschmann and Hödl 2006. Herpetologica 62:18–27). There are similar reports of muted vocal sac inflations for Bornean frogs in the genus *Staurois*, but their role in communication has not been investigated (Boeckle et al. 2009. Herpetologica 65:154–165). This observation is germane to the study of sexual communication in this species for several reasons. Female Túngara Frogs strongly prefer whines with chucks to whines-only (Gridi-Papp et al. 2006. Nature 441:38). Normally, males do not produce chucks without the preceding whine and females do not show phonotaxis to chucks-only. In addition, females do not accurately group whines and chucks to the same source (Ryan 1985, *op. cit.*). A chuck spatially displaced by 135° from a whine is perceptually bound to that whine by the female, (i.e., she perceives the two sounds as a single whine-chuck call), and she then approaches the chuck rather than the whine (Farris et al. 2002. Brain Behav. Evol. 60:181–188). Thus a male producing a chuck-only in a chorus could attract a female if his chuck follows the whine of another male calling within a 135° arc. We knew that; now we know that at least one male in the Darien can produce a chuck without a whine.

Vocal sacs recycle air between the lungs and the vocal sac, saving the male the effort of buccal pumping to fill the lungs between each call (Pauley et al. 2006. Comp. Physiol. Biochem. 79:708–719). In a number of frogs the inflation-deflation cycle of the vocal sac also serves as a visual cue (Starnberger et al. 2014. Anim. Behav. 97:281–288), and as mentioned above in *P. krefftii*, this is true even in the absence of accompanying sound. Our observations show that muted vocal sac inflation-deflation occurs in at least one Túngara Frog in the Darien. In Túngara Frogs the vocal sac inflation synchronous with a call enhances the attraction of the call (Taylor et al. 2008. Anim. Behav. 76:1089–1097), and typically

the vocal sac must be synchronous with the call to produce a salient bimodal display (Taylor et al. 2011. J. Exp. Biol. 214:815–820).

Finally, the movement of the vocal sac also produces water-surface ripples that enhance the saliency of a typical call (Halfwerk et al. 2014. Science 343:413–416). When the deviant male we observed inflated and deflated his vocal sac, not only was he producing a visual cue but vibrational cues as well. Although we have shown that the water-surface vibrations by themselves are not salient as a mating display, they do enhance the acoustic-only component of the male Túngara Frog's display (Halfwerk et al. 2014, *op. cit.*).

The female Túngara Frog is permissive in responding to and sometimes preferring sexual signals that typically do not exist in nature (Ryan et al. 2010. Curr. Zool. 56:343–357), thus acting on signal variation as it arises. Our observations of this one male Túngara Frog in the Darien rainforest show that there is more standing phenotypic, and perhaps genetic, variation for sexual signaling in this frog than previously appreciated. Thus, we now have evidence of variation arising in both signal production and perception, providing the raw materials necessary for complex anuran signals to evolve.

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**MICHAEL J. RYAN** (e-mail: mryan@utexas.edu), **CAITLIN LESLIE**, Department of Integrative Biology, 1 University Station C0930, University of Texas, Austin, Texas 78712, USA; Smithsonian Tropical Research Institute, Post Office Box 0843-03092, Balboa, Ancón, Panama; **EMMA S. RYAN**, Fine Arts Academy, McCallum High School, Austin, Texas 78756, USA.

**PLECTROHYLA POKOMCHI (Rio Sananja Spikethumb Frog).**

**ALTITUDINAL DISTRIBUTION.** *Plectrohyla pokomchi* is a critically endangered species of stream-breeding frog endemic to Guatemala. An adult female specimen (SVL = ca. 4 cm) was found climbing on the leaves of a tree fern *Cyathea* sp. (Fig. 1) about 2 m above the ground at 2032 h on 15 March 2014 at Apaj River source within Biotopo Protegido Mario Dary Rivera para la Conservación del Quetzal, Purulha, Guatemala (15.2070°N, 90.2326°W, WGS84; 2120 m elev.). This record extends the upper known vertical distribution from the highest elevation reported of 1900 m by 220



FIG. 1. *Plectrohyla pokomchi* found at 2120 m elev. in Purulha, Guatemala.

m (Duellman and Campbell 1992. Misc. Publ. Mus. Zool. Univ. Michigan 181:1–32). This species is considered to be declining severely, especially in the location where we found it (Mendelson et al. 2004. Rev. Biol. Trop. 52:991–1000). This record also indicates that, as of 2014, the species is still extant within the confines of the protected area mentioned above. A photographic voucher of the specimen was deposited at Colecciones Biológicas de la Universidad del Valle de Guatemala, Guatemala (UVG-F-0004).

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**DANIEL ARIANO-SÁNCHEZ**, Departamento de Biología, Universidad del Valle de Guatemala, Guatemala (e-mail: dariano@uvg.edu.gt); **JOHANNA GIL-ESCOBEDO**, Escuela de Biología, Facultad de Ciencias Químicas y Farmacia, Universidad de San Carlos de Guatemala (e-mail: qbjohana@yahoo.com).

**PRISTIMANTIS CERASINUS (Clay-colored Rain Frog). MORTALITY.**

*Pristimantis cerasinus* is a craugastorid frog found in humid lowland and premontane forests from Nicaragua to Panama (Savage 2002. The Amphibians and Reptiles of Costa Rica. University of Chicago Press, Chicago, Illinois. 934 pp.; Padial et al. 2014. Zootaxa 3825:1–132). At ca. 1100 h on 13 April 2013, an adult *P. cerasinus* was found in the web of a Golden Silk Orbweaver (*Nephila clavipes*, Araneidae) on the Lindero Sur trail at La Selva Biological Station, Costa Rica (10.4300°N, 84.0200°W; WGS 84). We identified the frog as *P. cerasinus* by the presence of heel tubercles, the absence of enlarged supraocular tubercles, the relative width and shape of finger toe pads, the dark brown coloration of the posterior thigh, paired suprascapular ridges shaped as inverted parentheses, and failure of the tip of toe V to reach the ultimate subarticular tubercle on toe IV (Savage 2002, *op. cit.*; Guyer and Donnelly 2005. Amphibians and Reptiles of La Selva, Costa Rica, and the Caribbean Slope: A Comprehensive Guide. University of California Press, Berkeley, California. 299 pp.). Although we did not verify that the frog was depredated by the spider, the frog was dead, its body was desiccated, and strands of spider web were wrapped tightly around the frog's left hind leg at three places.

To our knowledge, this is the first published record of death of a craugastorid frog due to *N. clavipes*. *Pristimantis cerasinus* is known to occupy arboreal perch sites in vegetation at night, and the individual may have jumped from a perch site to be ensnared in the web. *Nephila clavipes* webs are known to entrap hummingbirds (Graham 1997. J. Field Ornithol. 68:98–101), small songbirds (Cox and NeSmith 2007. Florida Field Nat. 35:46–48), and bats (Nyfeller and Knörnschild 2013. PLOS ONE 8:e58120). We are unaware of any records of *N. clavipes* consuming trapped vertebrates, although there are two records of *Nephila plumipes* feeding on unidentified anurans (McCormick and Polis 1982. Biol. Rev. 57:29–58).

We thank Kelsey Reider for verifying the identification of the frog and an anonymous reviewer for suggestions that improved this note. A digital photograph of the frog was vouchered at the Georgia Museum of Natural History (GMNH 50832).

**CARISSA GANONG**, Odum School of Ecology, 140 East Green Street, University of Georgia, Athens, Georgia 30602, USA (e-mail: carissa.ganong@gmail.com); **BRIAN FOLT**, Department of Biological Sciences and Auburn University Museum of Natural History, 331 Funchess Hall, Auburn University, Alabama 36849, USA (e-mail: brian.folt@gmail.com).

**PSEUDACRIS MACULATA (Boreal Chorus Frog). CALLING**

**PHENOLOGY.** *Pseudacris maculata* is a widespread hydrid found

throughout central North America (Dodd 2013. Frogs of the United States and Canada. Johns Hopkins University Press, Baltimore, Maryland. 982 pp.). Chorus frogs are known to be among the earliest calling species of the season throughout their range. For example, a study analyzing *Pseudacris* breeding call characteristics spanning from Oklahoma to South Dakota began as early as March (Platz 1989. Copeia 1989:704–712). However, occasional calls have been heard in northern Alberta, Canada, extending into late August and mid-September after breeding cessation (Dodd 2013, *op. cit.*), and *P. maculata* call in South Dakota on occasional cool and wet days through the summer (Smith, unpubl. data).

On the early afternoon of 11 October 2014, we heard breeding calls of *P. maculata* in an area about 4.25 km E of Provo, Fall River Co., South Dakota, USA (43.1882°N, 103.7820°W, WGS84; 1100 m elev.). The habitat was a roadside ditch overflow from a semi-permanent wetland. It was 18°C, clear with winds at 5.4 m/sec, and 37% humidity. We classified calling intensity as level II on the Amphibian Calling Index (ACI; Heyer et al. 1994. Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians. Smithsonian Institution Press, Washington D.C. 384 pp.). Later that night, we heard a full chorus (ACI level III) calling from pre-sunset and into the evening on the periphery of a permanent wetland in the ghost town of Ardmore, Fall River Co., South Dakota (43.0214°N, 103.6531°W; 1080 m elev.). The temperature was 16°C, wind at 8.2 m/sec, 54% humidity. Shortly before sunset on 18 October 2014, we located a third site, a cattle pond, where individual *P. maculata* were heard calling (ACI level I). This spot is located approximately 1.3 km E of Smithwick, Fall River Co., South Dakota (43.3038°N, 103.2022°W; 1005 m elev.). It was a clear day at 19°C with 4.9 m/sec winds and 42% humidity. Peak calling season for *P. maculata* within South Dakota is May–July (Dodd 2013, *op. cit.*) and they have been known to call as late as August (Ballinger et al. 2000. Trans. Nebraska Acad. Sci. 26:29–46). *Pseudacris maculata* has not been previously recorded calling later than September (Dodd 2013, *op. cit.*) anywhere in its range.

**BRIAN BLAIS** (e-mail: brian.blais@yellowjackets.bhsu.edu), **CHRISTINE BUBAC** (e-mail: bubac@ualberta.ca), and **BRIAN SMITH**, Department of Biology, Black Hills State University, 1200 University St., Spearfish, South Dakota 57799, USA (e-mail: brian.smith@bhsu.edu).

**PSEUDOPALUDICOLA POCOTO. PREDATION.** *Pseudopaludicola pocoto* is a newly described small frog species that can be found in open areas within the Caatinga in the states of Paraíba, Rio Grande do Norte, Ceará and Pernambuco in northeast Brazil (Magalhães et al. 2014. Herpetologica 70:77–88). We record a predation event on *P. pocoto* (SVL = 13.83 mm; 3 g) by the spider *Ancylometes rufus* (Fishing Spider; Fig. 1). Our observation took place at the Ecological Station Aiuaba (6.36065°S, 40.07285°W, WGS84; 425 m elev.), municipality of Aiuaba, state of Ceará, Brazil, during the course of an active search of the vicinity of a lake for frogs at 2030 h on 22 January 2015. The individuals were collected, euthanized, fixed in 10% formalin, and preserved in 70% alcohol. Voucher specimens are housed in the Laboratório Especial de Coleções Zoológicas do Instituto Butantan, São Paulo (*A. rufus*, IBSP 166751) and in the Coleção Herpetológica da Universidade Regional do Cariri (*P. pocoto*, URCA-H 10403). Only a few anuran species have been observed being preyed upon by *A. rufus*: *Ichnocnema ramagii* (Paraíba Robber Frog; De-Carvalho et al. 2010. Herpetol. Rev. 41:336–337), *Dendrophryniscus minutus* (Amazonian Tiny Tree Toad), *Dendropsophus minutus* (Lesser Tree Frog), *Hypsiboas geographicus* (Map Tree Frog), *Adenomera*



FIG. 1. Predation of *Pseudopaludicola pocoto* by *Ancylometes rufus*.

*andreae* (Lowland Tropical Bullfrog; Menin et al. 2005. Phylomedusa 4:39–47), *Dendropsophus melanargyreus* (Interior Tree Frog; Azevedo 2011. Biota Neotrop. 11:349–351), *Dendropsophus sarayacuensis* (Shreve's Sarayacu Tree Frog; Rodrigues and Arruda 2007. Herpetol. Rev. 38:437), and *Scinax alter* (Crubixa Snouted Tree Frog; Prado and Borgo 2003. Herpetol. Rev. 34:238–239). The record presented here increases our knowledge of the relationship between spiders and anurans, highlighting the existence of important trophic connections between these groups. This is the first predation event registered for *P. pocoto*.

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**CRISTIANA FERREIRA DA SILVA** (e-mail: cristianasilva006@gmail.com), **EDNA PAULINO DE ALCANTARA**, **TATIANA FEITOSA QUIRINO**, **ROBSON WALDEMAR ÁVILA**, Programa de Pós-Graduação em Bio-prospecção Molecular, Laboratório de Herpetologia, Departamento de Ciências Biológicas, Universidade Regional do Cariri - URCA, Campus do Pimenta, Rua Cel. Antônio Luiz, 1161, Bairro do Pimenta, CEP 63105-100, Crato, CE, Brazil; **LIDIANE APARECIDA FIRMINO DA SILVA**, Laboratório de Parasitologia de Animais Silvestres, Departamento de Parasitologia, Instituto de Biociências, UNESP - Universidade Estadual Paulista Distrito de Rubião Jr., s/n°, CEP 18618-000, Botucatu, SP, Brazil.

**RANA TEMPORARIA (Common Frog). MAXIMUM SIZE.** Maximum body size reported for *Rana temporaria* in the literature is 100 mm (Bannikov et al. 1977. A Guide to Amphibians and Reptiles of the USSR. Moscow, Prosveshchenie. 415 pp.; Gollmann et al. 2014. In Böhme [ed.], Handbuch der Reptilien und Amphibien Europas. Bd 5/III A: Froschlurche (Anura) III A (Ranidae I), pp. 305–437. AULA-Verlag, Wiebelsheim). On 28 September 2012, we found an adult female *R. temporaria* on the forest road near Sekowiec, Bieszczadzki National Park, Poland, in the San River valley (49.2360°N, 22.5637°E; WGS84). The frog was 110.1 mm SVL, representing a new maximum size for the species. This exceeds the maximum recorded SVL for the species by 10.1%. According to Gollman et al. (2014, *op. cit.*), *R. temporaria* reaches maximum body size in northern Europe along the transect of



FIG. 1. Maximum size *Rana temporaria* from Sekowiec, Bieszczadzki National Park, Poland. Coin size = 18.5 mm.

65°N. Our observation demonstrates that maximum sized frogs can be found not only in the north.

**KONSTANTIN D. MILTO** (e-mail: coluber@zin.ru) and **OLGA S. BEZMAN-MOSEYKO**, Zoological Institute, Department of Herpetology, St. Petersburg, Universitetskaya emb., 1, 199034, Russia.

**RHACOPHORUS PARDALIS (Harlequin Tree Frog). DEFENSIVE BEHAVIOR.** Defensive behavior of anuran amphibians was thoroughly reviewed in Toledo et al. (2011. Ethol. Ecol. Evol. 23:1–25), who recognized about 30 types of such behavior. Eye-protection has been described in a number of species (Toledo et al. 2011, *op. cit.*) and here we report this defensive behavior for *Rhacophorus pardalis*. Observations were made in the lowland mixed-dipterocarp rainforest near the Kuala Belalong Field Studies Centre in Ulu Temburong National Park (Brunei Darussalam; 4.546°N, 115.157°E, WGS84; 119 m elev.) at 2230 h on 5 February 2015. An adult male individual (SVL = 52.4 mm) was captured on understory vegetation (ca. 1.8 m above the forest floor) during a night survey. When attempting to capture the individual, the frog pressed its body to the ground, slightly arched its back and raised its forelimbs to its head. In this position the webbed front limbs completely covered its eyes and it displayed its red and yellow coloration almost completely (Fig. 1). The eyes were open and the individual remained in this position for at least 2 min. During subsequent handling the back remained arched and it stayed motionless. No defensive call or smell was emitted. This behavior was observed in one of the five individuals handled during this field survey. This type of defensive behavior has also been reported from two other treefrogs



FIG. 1. *Rhacophorus pardalis* displaying defensive behavior.

in the genus, *Rhacophorus feae* (Thao Whipping Frog; Duong and Rowley 2010. Herpetol. Rev. 41:342; Vinh et al. 2013. Herpetol. Rev. 44:129) and *Rhacophorus margaritifer* (Java Flying Frog; Streicher et al. 2011. Herpetol. Rev. 42:590).

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**ZDENĚK MAČÁT**, Department of Ecology and Environmental Sciences, Palacký University in Olomouc, Šlechtitelů 11, 78371, Olomouc, Czech Republic (e-mail: zdenek.macat@gmail.com); **HANYROL H. AHMAD SAH** (e-mail: spanish\_novia@yahoo.co.uk) and **T. ULMAR GRAFE**, Faculty of Science, Universiti Brunei Darussalam, Tungku Link, Gadong BE 1410, Brunei Darussalam (e-mail: grafe@biozentrum.uni-wuerzburg.de).

**RHINELLA GR. MARGARITIFERA (Mitred Toad). PREDATION.** *Rhinella gr. margaritifera* are a species complex of medium-sized toads that inhabit forest litter, occurring throughout Amazonian South America to eastern Panama (Frost 2015. <http://research.amnh.org/vz/herpetology/amphibia>; 9 Apr 2015). *Rhinella marina* is native from south Texas in the United States to southern Brazil (Lever 2001. The Cane Toad. The History and Ecology of a Successful Colonist. Westbury Publishing, Otley, West Yorkshire. 230 pp.). During a field expedition to the Serra Azul in western Pará state, city Monte Alegre, Brazil (1.1787°S, 54.1868°W; WGS84)



FIG. 1. Adult male *Rhinella marina* preying upon *Rhinella gr. margaritifera*.



FIG. 2. *Rhinella gr. margaritifera* released from the mouth of the adult male of *Rhinella marina*.

we observed an adult male *R. marina* swallowing a live adult *R. gr. margaritifera* near a weir at 2000 h on 13 January 2015 (Fig. 1). The *R. marina* started ingesting the toad headfirst leaving only the legs of *R. gr. margaritifera* out of the mouth (Fig. 1). We captured the *R. marina* and removed *R. gr. margaritifera* for the purpose of photographing it and identifying it (Fig. 2). We then released both individuals. *Rhinella marina* is considered a generalist and opportunistic predator that includes both invertebrates and vertebrates in its diet (Lever 2001, *op. cit.*).

**RAUL DE PAULA DA SILVA FRÓIS** (e-mail: raul.p.s.frois@gmail.com), **JOYCE CELERINO DE CARVALHO** (e-mail: joyce.celerino@gmail.com), **EMIL JOSÉ HERNÁNDEZ-RUZ**, Laboratório de Zoologia, Faculdade de Ciências Biológicas, Universidade Federal do Pará, Campus de Altamira, Rua Coronel José Porfírio, 2515 - CEP 68.372-040 - Altamira - PA, Brazil (e-mail: emilhjh@yahoo.com).

**RHINELLA MARINA (Cane Toad). REPRODUCTIVE ACTIVITY.** Amplexus in most anuran species lasts for a relatively short duration of a few hours to days (Wells 1977. *Anim. Behav.* 25:666–693, but see Dole and Durant 1974. *Copeia* 1974:230–235). The potential costs of amplexus include metabolic costs (McLister 2003. *Can. J. Zool.* 81:388–395), increased predation risk (Howard 1981. *Ecology* 62:303–310), decreased locomotor (sprint and swim) performance, and a reduction or loss of feeding opportunities (Bowcock et al. 2009. *Copeia* 2009:29–36). In laboratory experiments, feeding rates of amplexed female *Rhinella marina* were reduced and males did not feed at all (Bowcock et al. 2009, *op. cit.*). These laboratory results suggest that there may be significant costs involved in prolonged amplexus for both males and females. Toads may remain in amplexus overnight since egg deposition often doesn't begin until the following morning (Floyd 1983. Unpubl. PhD thesis. Griffith University, Australia. 315 pp.). However, amplexus over a period of days has not been reported under natural conditions (Bowcock et al. 2009, *op. cit.*).

Here we report prolonged amplexus of at least 14 days in a pair of *R. marina* in Paramaribo, Republic of Suriname (5.8288°N, 55.1436°W; WGS84). The amplexed pair (Fig. 1) was first observed at approximately 0830 h on 11 June 2014 and observed in amplexus on 10 different days between 0730–0900 h through 24 June 2014. They were still amplexed when observers left Suriname on 24 June 2014. All observations took place from an outdoor dining area approximately 2.5 m from a bird feeder stocked with bread and fruit which spilled to the ground where the amplexed pair and one other toad were periodically observed (Fig. 1). Although *R. marina* are considered to be primarily nocturnal, a lone female was photographed eating bread at 0845 h on 6 June 2014. Diurnal feeding and consumption of stationary anthropogenic food items (e.g., carrot peelings, corn kernels, black-eyed peas, and canned dog food) has been previously observed in *R. marina* (Alexander 1964. *Herpetologica* 20:255–259). Identification of the pair was achieved by comparing images taken of the pair over the duration and matching unique markings on the female between days (e.g., small white spot on the first tubercle posterior to male foreleg on the right lateral side; Fig. 1). In addition to the pair, no more than one other toad was observed at the same time. These observations demonstrate that prolonged amplexus in *R. marina* occurs under natural conditions. Although no measurements of male mass were taken, the male's concave sides, visible in the image taken on 17 June 2014 (Fig. 1), suggest that the male was not feeding. While not definitive, these observations lend credence to the laboratory results of Bowcock et al. (2009, *op. cit.*), that males do not feed while amplexed with



Fig. 1. Amplexed pair of *Rhinella marina* surrounded by pieces of bread in Paramaribo, Suriname.

females and males may be more negatively energetically impacted by prolonged amplexus than females, when the female has access to food.

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**CHRISTIAN A. D'ORGEIX** (e-mail: cdorgeix@vsu.edu), **VICTORIA B. KLLMKOWSKI**, Department of Biology, Virginia State University, Petersburg, Virginia 23806, USA; **ROOS VAN DE POEL-VERSLOOT**, Novemberstraat 21, 1335 EW Almere, The Netherlands.

**SCAPHIOPUS HURTERII (Hurter's Spadefoot). ENDOPARASITES.** We report, for the first time, on endoparasites from *Scaphiopus hurterii* from Louisiana. On 3 April 2012, we collected six adult *S. hurterii* (5 males, mean SVL = 66.8 mm, range 62.0–70.0 mm and 1 female, SVL = 68.0 mm) by hand from northern Louisiana (3.75 km NE Spearsville, Union Parish, Louisiana, USA; 32.9562°N, 92.5718°W, WGS84) and examined them for helminth parasites. *Scaphiopus hurterii* were euthanized with a concentrated chlorotone solution and their gastrointestinal tract, from the esophagus to rectum, was removed and split entirely, placed in a Petri dish containing amphibian saline (0.6% NaCl) and examined under a dissection microscope; we removed their lungs, gonads, and other visceral organs as well. Cestodes were stained with acetocarmine and mounted in Canada Balsam, and nematodes and acanthocephalans were studied as temporary mounts in glycerol. Voucher specimens of *S. hurterii* are deposited in the Arkansas State University Museum of Zoology (ASUMZ) Herpetological Collection, State University, Arkansas, and helminths are deposited in the Harold W. Manter Laboratory of Parasitology (HWML), University of Nebraska-Lincoln.

Five of six *S. hurterii* were infected with at least one helminth. Two of six had the cestode *Mesocostoides* sp. encapsulated within gastrointestinal tissues. Five of six were infected with the nematode *Oswaldocruzia pipiens*. One of six was infected with numerous nematodes, *Cosmocercoides variabilis*, in the rectum. One of six was infected with an unidentified oligacanthorhynchid acanthocephalan cystacanth; in this case, *S. hurterii* is likely a paratenic (transport) host. Amphibians are known as paratenic hosts of species of the acanthocephalan family

Oligacanthorhyncidae (Schmidt 1985. In Crompton and Nickol [eds.], *Biology of the Acanthocephala*, pp. 273–305. Cambridge University Press, Cambridge, UK). Development to the adult worm occurs when the amphibian is eaten by a suitable definitive host.

One female was infected with both *Mesocestoides* sp. and *O. pipiens* and one male (SVL = 70.0 mm) was infected with all four parasite species. Both *Mesocestoides* and *O. pipiens* have been reported in *Anolis carolinensis* (Green Anole) from Louisiana (Conn and Etges 1984. *Proc. Helminthol. Soc. Washington* 51:367–369) and in *S. hurterii* from Oklahoma previously (McAllister et al. 2005. *Texas J. Sci.* 57:383–389). *Cosmocercoides variabilis* has been reported from *Gastrophyrne carolinensis* (Eastern Narrowmouth Toad) from Louisiana (McAllister and Bursey 2005. *Comp. Parasitol.* 72:124–128) and from *S. hurterii* in Oklahoma (McAllister et al. 2005, *op. cit.*).

In summary, the acanthocephalan cystacanth represents a new paratenic host record for *S. hurterii* (HWML 64768), although not a new geographic record for the parasite in Louisiana (Elkins and Nickol 1983. *J. Parasitol.* 69:951–956). We suggest that additional *S. hurterii* from other parts of Louisiana be examined as new host and distributional records may be added to the growing list of helminths of this amphibian.

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**MATTHEW B. CONNIOR**, Life Sciences, Northwest Arkansas Community College, Bentonville, Arkansas 72712, USA (e-mail: mconnior@nwacc.edu); **CHRIS T. McALLISTER**, Science and Mathematics Division, Eastern Oklahoma State College, Idabel, Oklahoma 74745, USA (e-mail: cmcallister@se.edu); **CHARLES R. BURSEY**, Biology Department, Pennsylvania State University, Shenango Campus, Sharon, Pennsylvania 16146, USA (e-mail: cxb13@psu.edu).

**SCAPHIOPUS HURTERII (Hurter's Spadefoot). REPRODUCTION.** *Scaphiopus hurterii* is considered an explosive breeder associated with torrential rainfall. Because of these requirements, they are seldom observed breeding. Between 11 March and 3 April 2012, we observed this species breeding three times during torrential rainfall events at a site in extreme northern Louisiana (3.8 km NE Spearsville, Union Parish, Louisiana, USA; 32.9562°N; 92.5718°W, WGS 84). On 11 March (ambient temperature 16.1°C), we discovered a breeding site (Fig. 1A), consisting of a temporary pool in a cattle pasture and were able to capture a total of eight toads (five males, three females). On 21 March (ambient temperature 12.2°C), we were able to document another breeding event at the same site and were able to capture 11 individuals (nine males, two females). Finally, on 03 April (ambient temperature 15.5°C), we observed another breeding event and were able to capture six individuals (five males, one female). The mean snout-vent length (SVL) for a small sample of adult individuals was 63.2 mm (range 57–68 mm) for six females and 67.4 mm (range 62–71 mm) for nine males. Our male-biased captures are likely the result of our sampling time (ca. 2200–2400 h), since males migrate to breeding site first and start calling to attract females. Both calling males and amplexant pairs were observed during all three of these events. Previously, the lowest air temperature for calling males in Louisiana was 16°C (Dundee and Rossman 1989. *The Amphibians and Reptiles of Louisiana*. Louisiana State University Press, Baton Rouge, Louisiana. 300 pp.); however, rainfall more so than ambient temperature is likely a predictor of breeding. We also collected six egg clusters that were laid on vegetation (Fig.

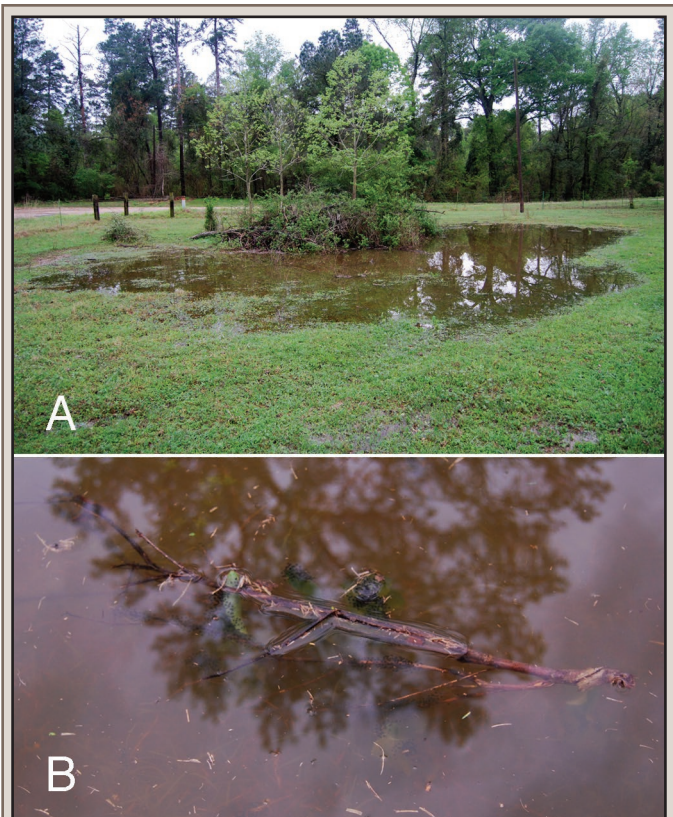


FIG. 1. A) *Scaphiopus hurterii* breeding site in Union Parish, Louisiana. B) *S. hurterii* egg clusters attached to vegetation in the temporary breeding pool in top photo.

1B) and mean egg counts were 100.8 (range 49–131). This is comparable to mean egg cluster counts of 111.8 in Arkansas (Trauth and Holt 1993. *Bull. Chicago Herpetol. Soc.* 28:236–239). Voucher specimens were deposited within the Arkansas State University Museum of Zoology (ASUMZ) Herpetology Collection, State University, Arkansas as ASUMZ 32017–32025.

This research was conducted under a Louisiana Department of Wildlife and Fisheries scientific collecting permit.

**MATTHEW B. CONNIOR**, Life Sciences, Northwest Arkansas Community College, Bentonville, Arkansas 72712, USA (e-mail: mconnior@nwacc.edu); **TOBIN FULMER**, 1033 Magnolia Drive, El Dorado, Arkansas 71730, USA; **CHRIS T. McALLISTER**, Science and Mathematics Division, Eastern Oklahoma State College, Idabel, Oklahoma 74745, USA (e-mail: cmcallister@se.edu); **STANLEY E. TRAUTH**, Department of Biological Sciences, Arkansas State University, State University, Arkansas 72467, USA (e-mail: strauth@astate.edu).

**TELMATOBIUS ATACAMENSIS (Atacama Water Frog). CANNIBALISM.** Among anurans, cannibalism has been documented both in tadpoles preying on conspecific eggs or tadpoles and in adults preying on those stages and/or on other postmetamorphic individuals (Polis and Myers 1985. *J. Herpetol.* 19:99–107). *Telmatobius atacamensis* is a medium-sized aquatic frog living in high altitude streams of a restricted area of the Puna Plateau of Salta Province, in northern Argentina (Lavilla and Barrionuevo 2005. *Monogr. Herpetol.* 7:115–165). As in most of the 62 species of *Telmatobius*, the diet of *T. atacamensis* is unknown, although some data exist for nine species (e.g., Lavilla 1984. *Acta Zool. Lilloana* 38:51–57; Wiens 1993. *Occ. Pap. Mus. Nat. Hist. Univ. Kansas* 162:1–76; Formas et al. 2005. *Monogr. Herpetol.* 7:103–114).

On 24 February 2005 a female *T. atacamensis* (SVL = 60.4 mm) was found in a small lateral pool (ca. 200 × 300 cm, 50 cm deep) that had lost contact temporarily with the stream Los Patos (24.3108°S, 66.2162°W, WGS84; 3945 m elev.), close to San Antonio de Los Cobres. The female was fixed 12 h after collection (FML SB0157). Upon examination of the female's stomach contents, a juvenile of the same species (SVL ca. 28 mm) was found. It was only partially digested at the anterior part of the head and therefore was perfectly recognizable. In the same pool, four adult *T. atacamensis* were found and many tadpoles and juveniles were observed.

This is the first case of cannibalism in *T. atacamensis*. Cannibalism has been recorded among species of *Telmatobius* so far only in *T. culeus* (Pérez Bejar 1998. Unpubl. dissertation Universidad de San Andres, Bolivia). Among the species of Ceratophryidae, a phylogenetically related group, cannibalism is common both in adults and larvae (Schalk et al. 2014. South. Am. J. Herpetol. 9:90–105). Cannibalism in aquatic environments has been associated with high concentrations of several cohorts in small bodies of water, a condition observed in our study site.

**J. SEBASTIÁN BARRIONUEVO**, Museo Argentino de Ciencias Naturales "Bernardino Rivadavia" Buenos Aires, Argentina; e-mail: sbarrionuevo@macn.gov.ar.

**THELODERMA ASPERUM** (Hill Garden Bug-eyed Frog). **DEFENSIVE BEHAVIOR.** Amphibians exhibit a wide range of defensive behaviors that differ between taxonomic groups (Toledo et al. 2011. Ethol. Ecol. Evol. 23:1–25). Herein, we report the anti-predator behavior of a southeast Asian rhacophorid frog, *Theلودerma asperum*. This genus currently includes 23 recognized species (Frost 2014. <http://research.amnh.org/vz/herpetology/amphibia/>; 31 Mar 2015). *Theلودerma asperum* inhabits lowland to mountain forests from northeast India through Myanmar and adjacent China, upland Thailand, Laos, central and northern Vietnam to southwest Guangxi and south Indonesia (Sumatra).

At 2308 h on 27 June 2012, we captured an adult female *T. asperum* (SVL = 30 mm) on vegetation (ca. 2 m above the forest floor) near Sa Pa town in mountainous subtropical forest of Hoang Lien Mountains, northern Vietnam (22.328°N, 103.826°E, WGS84; 1266 m elev.). After its capture, the individual was put on the ground where it immediately curled up into an arched and rigid posture. The head was ventrally flexed, all limbs were bent and kept close to the body (Fig. 1). Eyes were closed the whole time and the individual remained in this position for at least 15 min (Fig. 1A) and remained arched and motionless during subsequent handling (Fig. 1B). No defensive call or smell was emitted.

We consider the defensive behavior shown in this case as "shrinking or contracting behavior" (sensu Toledo et al. 2010. J. Nat. Hist. 44:1979–1988; Toledo et al. 2011, *op. cit.*), a type of death feigning (or thanatosis) behavior. There is a published technical report that gives a similar description of this behavior in *T. asperum* (see Pawar and Birand 2001. A Survey of Amphibians, Reptiles, and Birds in Northeast India. Centre for Ecological Research and Conservation, Mysore, India. 120 pp.). The genus *Theلودerma* is well known for cryptic coloration and body shape (e.g., Vitt and Caldwell 2014. Herpetology: An Introductory Biology of Amphibians and Reptiles. 4<sup>th</sup> ed., Elsevier, San Diego, California; Rauhaus et al. 2012. Asian J. Conserv. Biol. 1:51–66), which are types of passive defense employed by anurans (Toledo et al. 2011, *op. cit.*). For example, *T. asperum* is a tree bark and potentially a bird-dropping mimic and *T. corticale* (Mossy Frog) is mottled green and brown and resembles moss growing on rock



FIG. 1. Defensive behavior displayed by *Theلودerma asperum* in northern Vietnam. A) Dorsal view, B) ventral view.

(Vitt and Caldwell 2014, *op. cit.*). Therefore, they may use contracting behavior in addition to cryptic coloration to evade predation. A similar case of defensive behavior has been reported for another member of the family Rhacophoridae, *Rhacophorus feae* (Fea's Treefrog; Vinh et al. 2013. Herpetol. Rev. 44:129).

**DANIEL JABLONSKI**, Department of Zoology, Comenius University in Bratislava, Mlynská dolina B-1, 842 15, Bratislava, Slovakia (e-mail: daniel.jablonski@balcanica.cz); **DAVID HEGNER**, Měnská 3938/26, 466 04 Jablonec nad Nisou, Czech Republic.

**ZACHAENUS CARVALHOI** (Carvalho's Bug-eyed Frog). **DIET.** Frogs in the genus *Zachaeus* (Cycloramphidae) are associated with leaf litter in forested areas and are endemic to the Atlantic Forest of Brazil (Izecksohn 1982. Arq. Univ. Fed. Rural. R. de Janeiro 5:7–11). The information on diet for this genus is exclusive to *Z. parvulus* (Van Sluys et al. 2001. J. Herpetol. 35:322–325). Herein we present data on the diet of specimens of *Z. carvalhoi* present in the collections of the Universidade Federal de Juiz de Fora (UFJF 663, 674–678, 692, 708, 753, 760, 773, 781, 792–800, 819–830, 863–865) collected at three forest fragments in the municipality of Juiz de Fora, state of Minas Gerais, Brazil: Fazenda Floresta (21.7425°S, 43.2922°W; WGS84), Reserva Biológica Municipal Poço D'Anta (21.7541°S, 43.3108°W), and Parque Municipal da Lajinha (21.7922°S, 23.3808°W). We found identifiable items in 17 out of the 36 guts examined. The items were identified to the lowest possible taxonomic level. The primary items found were Coleoptera (76%) and Hymenoptera (ants; 58%), and occasional items were Myriapoda (11%), Arachnida

(Pseudoscorpionida; 11%), Hemiptera (Cercopidae 5%), Isoptera (5%), and Mollusca (Gastropoda, 5%). We also found plant matter in two individuals (11%).

The variety of prey items found in *Z. carvalhoi* indicates a generalist diet. These suggestions are consistent with data on the diet of other members in the family, with Hymenoptera and Coleoptera being the most common food items (e.g., Van Sluys et al. 2001, *op. cit.*; Siqueira et al. 2006. *J. Herpetol.* 40:520–525; Maia-Carneiro et al. 2012. *Zoologia* 29:277–279). The presence of Hymenoptera and Myriapoda in the diet of *Z. carvalhoi* is noteworthy, as individuals in these groups produce toxins that potentially could be biosequestered or transformed into skin chemicals (Hantak et al. 2013. *J. Chem. Ecol.* 39:1400–1406). The species in Cycloramphidae are not known to possess skin toxins, but do have macroglands (lateral glands in *Thoropa*, inguinal macroglands in *Cycloramphus*, and inguinal gland conglomerates in *Zachaeus*; Verdade 2005. Unpublished thesis, Universidade de São Paulo, Brazil), whose function and secretions have not been studied.

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**ANTONIO MOLLO NETO, VANESSA KRUTH VERDADE**, Centro de Ciências Naturais e Humanas, Universidade Federal do ABC, Av. dos Estados, 5001, CEP 09210-580, Santo André, São Paulo, Brazil (e-mail: vanessa.verdade@ufabc.edu.br); **ROSE MARIE HOFFMANN DE CARVALHO**, Instituto de Ciências Biológicas, Universidade Federal de Juiz de Fora, Rua José Lourenço Kelmer, s/n, Campus Universitário, CEP 36036-900, Juiz de Fora, Minas Gerais, Brazil; **MIGUEL TREFAUT RODRIGUES**, Instituto de Biociências, Universidade de São Paulo, Rua do Matão, 14, CEP 05508-090, São Paulo, São Paulo, Brazil.

### TESTUDINES — TURTLES

**CHELYDRA SERPENTINA (Snapping Turtle). DIET AND FORAGING BEHAVIOR.** *Chelydra serpentina* are omnivorous, consuming an extensive variety of foods including worms, mollusks, arthropods, and other invertebrates, fish, birds, amphibians, small mammals, small turtles, snakes, and other vertebrates, algae, aquatic macrophytes, and the fruits, stems, and leaves of higher plants (Ernst and Lovich 2009. *Turtles of the United States and Canada*, 2<sup>nd</sup> ed. Johns Hopkins University Press, Baltimore, Maryland. 827 pp.). On 14 May 2015 at 1310 h, I observed a large (carapace length ca. 40.0 cm) *C. serpentina* browsing on Skunk Cabbage (*Symplocarpus foetidus*) on land at a distance of ~2 m from the shoreline of a large pond in Espy, Columbia Co., Pennsylvania, USA (41.010206°N, 76.416294°W, WGS84; elev. ~150 m). The *C. serpentina* was observed for approximately 5 minutes at a distance of ~8 m. During observation, the *C. serpentina* removed Skunk Cabbage leaves by shearing the stalk near the base of each plant and subsequently consumed each leaf. When approached for closer observation, the *C. serpentina* became aware of my presence, ceased feeding, and assumed a defensive posture before retreating into the water. Closer inspection of the area in which this observation occurred revealed that approximately 40–50% of stems among ~20 clusters of Skunk Cabbage plants were sheared in a similar manner to those consumed by the observed *C. serpentina* (Fig. 1). Several partial fragments of Skunk Cabbage leaves were also noted on the surrounding substrate.

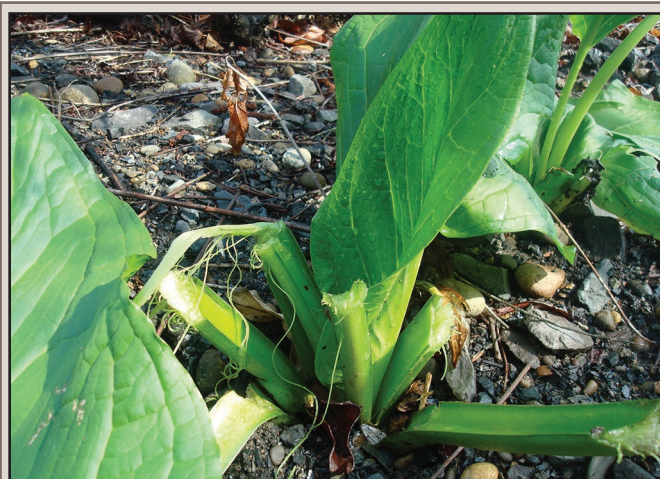


FIG. 1. Skunk Cabbage (*Symplocarpus foetidus*) stalks browsed by *Chelydra serpentina*.

Multiple markings in the substrate surrounding Skunk Cabbage clusters consistent with *C. serpentina* claw marks and a “slide” depression on the shoreline on which the individual *C. serpentina* traveled upon during retreat may suggest that either the same or multiple individuals frequent this area to feed upon Skunk Cabbage. I noted an additional area that displayed similar characteristics (browsed Skunk Cabbage and multiple *C. serpentina* claw markings) along the pond shoreline approximately 20 m from the first.

*Chelydra serpentina* occasionally browse vegetation on land. Ernst and Lovich (2009, *op. cit.*) report an observation of two large individuals on land browsing upon sedge grass. However, Skunk Cabbage appears to be an uncommon component of *C. serpentina* diet. Upon examination of the stomach contents of 470 *C. serpentina*, Alexander (1943. *J. Wildl. Manage.* 7:278–282) reported Skunk Cabbage in less than 1% of individuals studied. Observations reported herein suggest that terrestrial browsing of Skunk Cabbage by *C. serpentina* may be more typical in this species than previously documented. The pond shore and surrounding area in which these observations occurred is a portion of a once larger wetlands area that has been reduced and fragmented by development. Alternatively, *C. serpentina* may more commonly utilize Skunk Cabbage as a food source when other resources are limited.

I thank Amber L. Pitt for advice during the preparation of this note. Observations reported herein were conducted during turtle transect survey research approved by Bloomsburg University of Pennsylvania IACUC (Protocol #131, Summer 2015). Additional photographs of Skunk Cabbage browsed by *C. serpentina* and other aspects of the area described in this note are available from the author.

**SEAN M. HARTZELL**, Department of Biological and Allied Health Sciences, Bloomsburg University of Pennsylvania, Bloomsburg, Pennsylvania 17815, USA; e-mail: smh14844@huskies.bloomu.edu

**GOPHERUS AGASSIZII (Agassiz’s Desert Tortoise). ATTEMPTED PREDATION.** Desert Tortoises have many predators (Rostal et al. 2014. *Biology and Conservation of North American Tortoises*. Johns Hopkins University Press, Baltimore, Maryland. 190 pp.). Several ophidian species have been identified as potential predators (Ernst and Lovich 2009. *Turtles of the United States and Canada*. Johns Hopkins University Press, Baltimore,



FIG. 1. *Arizona elegans* attempting to prey on *Gopherus agassizii* at Edwards Air Force Base, Kern Co., California, USA.

Maryland. 827 pp.), but no published reports have mentioned *Arizona elegans* (Glossy Snake).

At 0827 h on 3 October 2013, we observed an *Arizona elegans* ca. 80 cm total length attempting to prey on an 8.6-yr old juvenile *Gopherus agassizii* (midline carapace length = 90.5 mm, width = 72.4 mm, height = 42.1 mm, weight = 137.3 g) that had been fitted with a radio-transmitter and released the previous day from a head-start facility at Edwards Air Force Base in the Mojave Desert, Kern Co., California, USA. When first observed, the tortoise was 2 cm outside the entrance of a rodent burrow, the snake was between the tortoise and burrow entrance, and the snake had the head of the tortoise firmly in its jaws. The tortoise initially was immobile and probably cold (air temperature at 1 cm 18.0°C, soil temperature 16.2°C). The snake coiled around the tortoise shell three times and pulled the tortoise head first, closer to, and partially within the burrow entrance. The snake appeared to use the radio transmitter attached to the 5<sup>th</sup> vertebral scute of the tortoise as purchase for its coils. The tortoise with the snake coiled around it was too large to be pulled further into the burrow, and the head and anterior half of the tortoise were not visible (Fig. 1). The right hind foot of the tortoise was pinned backwards by the snake's coils and was immobile. The snake appeared to squeeze the tortoise shell with its coils; at the same time, the snake's head was still out of view within the burrow and possibly still gripping the tortoise's head. At 0912 h, the tortoise and snake moved slightly, and the snake's head, with partially opened mouthed and disarticulated jaws, came into view, exiting the burrow along the bridge of the tortoise shell. One of the coils loosened. Both animals remained still for another 10 min. Observations ceased and were re-initiated at 1110 h, but neither the tortoise nor the snake was evident at the burrow. The tortoise had moved 20 m away and was basking at the entrance of a small mammal burrow. No injuries were apparent on head or limbs. After a few minutes, the tortoise walked into the burrow and turned sideways, almost entirely within the burrow. By 1345 h, the tortoise was 15 cm into the burrow tunnel and no longer visible. The tortoise dug the burrow deeper and did not emerge again until 10–11 October, when it moved to and enlarged another rodent burrow for fall-winter brumation. The juvenile tortoise had apparently been too large for the snake to eat and was still alive the following spring. Our observation is the first record of an *A. elegans* attempting to prey on a juvenile *G. agassizii*. The diet of *A. elegans*, based on evaluation of 205

museum specimens, is composed of lizards, birds, mammals, and insects (Rodríguez-Robles et al. 1999. J. Herpetol. 33:87–92). The diet differed significantly by snout–vent length, with larger snakes consuming birds, followed in descending order by mammals, and lizards. If *A. elegans* had attempted to prey on a recently hatched, soft-shelled juvenile tortoise, the predation likely would have been successful.

**ASHLEY SPENCELEY, JEREMY MACK** (e-mail: jmack@usgs.gov), and **KRISTIN H. BERRY**, U.S. Geological Survey, Western Ecological Research Center, Riverside, California 92518, USA (e-mail: kristin\_berry@usgs.gov).

**GOPHERUS AGASSIZII (Agassiz's Desert Tortoise). MECHANICAL INJURY.** On 3 June 2015 at 1024 h, a team of U.S. Geological Survey scientists located an immature *Gopherus agassizii* at Joshua Tree National Park, near the southern Cottonwood Canyon entrance, that had been injured by a large *Ferocactus cylindraceus* (California Barrel Cactus) spine. The *G. agassizii* was estimated to be four years old by counting growth rings on the plastron, and was 89.4 mm in carapace length and weighed 160 g. It was found basking on a flat spot on a north-facing, steep, rocky slope with the *F. cylindraceus* spine impaling it under the right leg. The area is typical of the Sonoran Desert in California, with several species of cacti, some of which are locally abundant.

The tip of the spine had entered the body at the right anterior axillary area and penetrated the lower body to the posterior portion of the neck, at a right angle to the long axis of the *G. agassizii*, along a plane parallel with the ground, and close to the inside of the plastron. The spine was removed; significant tissue debris had formed around the diameter of the spine for approximately a centimeter from the insertion spot. It is unknown how long the spine had been in the *G. agassizii* but the dark color of the spine



FIG. 1. Immature *Gopherus agassizii* with *Ferocactus cylindraceus* spine that was removed from its body. Built-up tissue can be seen on the removed spine from the left end to where it overlaps the seam between the second and third vertebral scutes of the *G. agassizii*.

suggests that either it had been present for a relatively long time or that the spine was from an already dead cactus. The length of the inserted portion of the spine was about 27 mm, and the total length was about 63 mm (Fig. 1). The average diameter of the spine was about 1.5 mm. The protruding portion of the spine had likely inhibited movement of the immature tortoise.

*Lanius excubitor* (Northern Shrike) has been known to impale hatchling *Testudo graeca graeca* (Moorish Tortoise) on spiny plants in Morocco (Barje et al. 2005. *Amphibia-Reptilia* 26[1]:113–115). We do not believe local shrikes (*Lanius ludovicianus*) are the cause of this event. The mean carapace length of *T. graeca graeca* reported in the study above was 28 mm, which is smaller than the mean carapace length of a *G. agassizii* hatchling at 40–50 mm (Ernst and Lovich 2009. *Turtles of the United States and Canada*, 2<sup>nd</sup> ed. Johns Hopkins University Press, Baltimore, Maryland. 827 pp.). *Lanius ludovicianus* in the southwestern United States weigh an average of 40 g and select prey weighing an average of 8 g (Bartholomew et al. 1953. *Physiol Zool.* 162–166; Slack 1975. *Auk* 812–814). Even if the event occurred in the *G. agassizii*'s first year, *G. agassizii* hatchlings are much bigger than *T. graeca graeca*, rendering *L. ludovicianus* an unlikely predator due to their small size (Barje et al 2005, *op. cit.*).

We do not know how this injury occurred but present three possibilities. First, it is possible the *G. agassizii* was feeding near a cactus or on a cactus flower and became impaled. However, *E. cylindraceus* is not listed specifically in *G. agassizii* diets (Grover and DeFalco 1995. *Desert Tortoise (Gopherus agassizii): Status-of-Knowledge Outline with References*. USDA For. Serv. Gen. Tech. Rep. Int-GTR-316). Given the rocky and steep terrain, a second possibility is that the *G. agassizii* may have fallen into a living or dead cactus. Third, it is also possible that an avian predator like a *Corvus corax* (Common Raven) may have picked up the tortoise and dropped it by chance on a *E. cylindraceus* (Boarman 2003. *Environ Manage.* 32:205–217). Mechanical injuries from other plant parts have been reported in *G. agassizii* (Medica 2007. *Herpetol Rev.* 38: 446–448). As cacti are prominent in the Sonoran Desert, this may happen to *G. agassizii* with some regularity. However, we are unaware of any previous reports of *G. agassizii* being impaled by large cactus spines.

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**AMANDA L. SMITH** (e-mail: amandasmith@usgs.gov), **LAURA A. TENNANT**, **JEFFREY E. LOVICH** (e-mail: jeffrey\_lovich@usgs.gov), and **TERENCE R. ARUNDEL**, U.S. Geological Survey, Southwest Biological Research Center, 2255 North Gemini Drive, MS-9394, Flagstaff, Arizona 86001, USA.

**KINOSTERNON HIRTIPES (Rough-footed Mud Turtle). AERIAL BASKING, WINTER ACTIVITY, HABITAT, AND NEW LOCALITY.** *Kinosternon hirtipes* occurs from extreme western Texas, south into northern and central Mexico (Ernst and Lovich 2009. *Turtles*

of the United States and Canada. 2<sup>nd</sup> ed. Johns Hopkins University Press, Baltimore, Maryland. 827 pp.). In Texas, *K. hirtipes* is restricted to the Alamito Creek drainage in Presidio Co. (Scud-day and Miller 1986. *The Status of the Chihuahuan Mud Turtle, Kinosternon hirtipes murrayi*. Report to United States Fish and Wildlife Service, Washington, D.C. 40 pp.), and classified as a threatened species owing to its limited distribution and continuing habitat degradation (Texas Parks and Wildlife Department. 2013. *Species of Conservation Concern*. Available from: www.tpwd.state.tx.us). *Kinosternon hirtipes* is one of the least-studied turtles in North America and very little is known concerning its natural history (Ernst and Lovich, *op. cit.*; Lovich and Ennen 2013. *Amphibia-Reptilia* 34:11–23). We here present observations of aerial basking by *K. hirtipes* made during late winter at a locality in Presidio Co., Texas, USA, describe the habitat at this site, and comment on the significance of our findings.

On 14 February 2009 (1400–1555 h), one of us (LM) observed two adult (straight-line carapace length ca. 140–160 mm) *K. hirtipes* basking in direct sunlight on exposed rocks in springfed pools about 50 m apart on the floor of Robbers Roost Canyon (30.0451°N, 103.9425°W; 1294–1304 m elev.). Both turtles were basking within 30 cm of the water; one on a horizontal surface and the other on a steep incline (ca. 40°). The carapace of one turtle was covered with a thick growth of algae. The carapace of the second turtle lacked algae and appeared dry, suggesting this individual had been basking > 30 minutes. We estimated the air and water temperature in Robbers Roost Canyon at the time the turtles were basking to be 18°C and 15°C, respectively. The minimum and maximum air temperature recorded at the nearest weather station (Marfa, Texas) on 14 February 2009 was -3.3°C and 18.8°C, respectively. Air temperature on the preceding day had likewise been relatively mild (range = 3.8–20°C) (Available from: www.wunderground.com). Small cyprinids (possibly Red Shiner [*Cyprinella lutrensis*]), sunfish (*Lepomis* spp.), and large-mouth bass (*Micropterus* spp.) were also present in the pools, the latter being potential predators of neonate *K. hirtipes* (Smith et al. 2015. *Herpetol. Rev.* 46:82–83).

The pools in Robbers Roost Canyon are up to 8 m wide in places, 3–4 m deep, relatively clear, and contain dense mats of muskgrass (*Chara* sp.) and filamentous algae. Narrow channels link the pools, which extend along the canyon floor for about 2 km before debouching into an arroyo leading southwest to Alamito Creek, a distance of approximately 6.0 km. Neither the arroyo nor Alamito Creek contain water except after heavy rainfall (Wilde and Platt 2011. *J. Big Bend Studies* 23:85–106). Robbers Roost Canyon appeared relatively undisturbed at the time of this observation; evidence of cattle grazing was minimal and woody riparian vegetation remained largely intact. There are no obvious habitat linkages between Robbers Roost Canyon and other wetlands in the Alamito Creek watershed known to harbor *K. hirtipes*, the nearest of which is 20 km SW (straight-line distance) at Plata (Scud-day and Miller, *op. cit.*). The intervening xeric landscape may function to isolate the *K. hirtipes* population at Robbers Roost Canyon.

Our observation of basking *K. hirtipes* in Robbers Roost Canyon is noteworthy for several reasons. First, to our knowledge this is the first report of aerial basking by *K. hirtipes*. A juvenile *K. hirtipes* that appears to be basking on a horizontal tree branch is pictured in Ernst and Lovich (*op. cit.*), although no details are provided in the accompanying figure caption or text. Aerial basking by *K. hirtipes* is not unexpected as this behavior is reportedly commonplace among North American Kinosternidae

(*Kinosternon arizonense*, *K. flavescens*, *K. sonoriense*, *K. subrubrum*, *Sternotherus carinatus*, *S. depressus*, *S. minor*, *S. odoratus*; reviewed by Ernst and Lovich, *op. cit.*). Our observation seems clearly related to thermoregulation given the turtles were basking in direct sunlight in early to mid- afternoon on a warm late winter day. Second, our observation constitutes the first report of winter activity in a natural population of *K. hirtipes*. Beltz (1954. *Herpetologica* 10:124) described an adult female that escaped from captivity and overwintered beneath a pile of leafy debris in southern California, but otherwise winter activity of *K. hirtipes* has gone unreported. Our observation lends support to an earlier suggestion by Iverson et al. (1991. *J. Herpetol.* 25:64–72) that *K. hirtipes* is probably sporadically active throughout the winter on warm days.

Robbers Roost Canyon also represents a new locality record for *K. hirtipes* in Texas where it was previously known from only six small wetlands in the Alamito Creek drainage (Scudday and Miller, *op. cit.*). At one time connectivity between these populations was probably maintained by Alamito Creek, a permanent free-flowing stream corridor linked by tributary creeks to riparian wetlands and springs throughout its drainage (Wilde and Platt, *op. cit.*). These wetlands later became isolated after Alamito Creek ceased flowing (except following heavy rainfall) due to hydrological changes wrought by over-grazing and water diversion in the late 1800s (Wilde and Platt, *op. cit.*). Without stream corridors to provide connectivity between occupied sites, the continued exchange of individuals among the remaining populations can seemingly be accomplished only by lengthy (> 5 km) overland movements across an arid landscape. Successful overland dispersal seems doubtful given the high rate of evaporative water loss reported for *K. hirtipes* and its inability to tolerate prolonged dehydration (Seidel and Reynolds 1980. *Comp. Biochem. Physiol.* 67A:593–598; Ligon and Peterson 2002. *Physiol. Biochem. Zool.* 75:283–293); however, further study is required to resolve this question of obvious conservation significance.

Finally, our observation compliments the few previously published descriptions of *K. hirtipes* habitat. Iverson et al. (*op. cit.*) reported a large population of *K. hirtipes* inhabiting a springfed stream flowing through arid grassland in Chihuahua, Mexico. The stream was described as clear and fast-flowing, 100–200 cm wide (average width = 100 cm) and 10–100 cm deep (average depth = 50 cm) with a sand-gravel substrate and deeply undercut banks where turtles sought refuge. Dense stands of *Typha* were established along the bank in backwater areas where the current was reduced. In another area of Chihuahua, Van Devender and Lowe (1977. *J. Herpetol.* 11:41–50) stated *K. hirtipes* is “very common in streams.” Ernst and Lovich (*op. cit.*) described a population of *K. hirtipes* inhabiting a livestock pond in Texas (480 m<sup>2</sup> and 4.0 m deep) “choked” with muskgrass (*Chara* sp.). Smith et al. (*op. cit.*) captured a record-sized *K. hirtipes* in a springfed wetland that had been dammed to form a livestock watering pond. The pond was clear, averaged 5.0 m deep with a relatively stable water level even during drought conditions, and supported abundant emergent aquatic vegetation (*Scirpus*, *Typha*, and *Poaceae*), mats of *Chara* sp., and filamentous algae. Taken together, our observation and reports of others suggest that permanent streams and springfed wetlands with an abundance of submerged and emergent aquatic vegetation provide habitat for *K. hirtipes*. Such habitats are probably crucial for the survival of *K. hirtipes* in west Texas (Ernst and Lovich, *op. cit.*; Smith et al., *op. cit.*).

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Department to SGP with the approval of the Sul Ross State University (SRSU) Institutional Animal Care and Use Committee. The Hardrock Mining Company and Jake and Martha McCandles are thanked for allowing us to conduct research on their properties. Support for this project was provided by Research Enhancement Grants from SRSU to SGP.

**STEVEN G. PLATT**, Department of Biology, Box C-64, Sul Ross State University, Alpine, Texas 79832, USA (current address: Wildlife Conservation Society - Myanmar Program, Office Block C-1, Aye Yeik Mon 1<sup>st</sup> Street, Hlaing Township, Yangon, Myanmar; e-mail: sgplatt@gmail.com); **LEWIS MEDLOCK**, 407 South Third Street, Alpine, Texas 79831, USA (e-mail: medlock.lewis@yahoo.com).

**MACROCHELYS APALACHICOLAE** (*Apalachicola* Alligator Snapping Turtle). **AERIAL BASKING**. The Alligator Snapping Turtle was recently split into three species (Thomas et al. 2014. *Zootaxa* 3786:141–165). Observations of basking *Macrochelys* are rare. Carr et al. (2011. *IRCF Reptiles & Amphibians* 18:2–5) reviewed nine previously documented basking events and Elsey and Bourgeois (2014. *Herpetol. Rev.* 45:688–689) recently reported two additional observations. With the exception of Thomas (2009. *Herpetol. Rev.* 40:336), who reported on *M. suwanniensis* in the Suwannee River, Florida (*M. temminckii* at time of observation), all previously reported aerial basking observations were of *M. temminckii*. Here we report the first two aerial basking observations for the newly recognized *M. apalachicola*.

On 13 May 2014 at 1603 h, EPH and JDM observed an immature *M. apalachicola* (estimated mass less than 4.5 kg) basking on the Choctawhatchee River, Holmes Co., Florida, USA. The turtle was perched on a willow trunk (*Salix* sp.) that was horizontal to the river surface (Fig. 1). The turtle was located 2 m out from the bank and approximately 0.5 m above the water. The turtle escaped into the water after a photo was taken. Air temperature was approximately 32°C under partly sunny skies.

A second immature *M. apalachicola* (similar in size to the above) was observed basking by JDM at 1547 h on 21 May 2014 on the Apalachicola River, Liberty Co., Florida, USA. This turtle was perched more than 1 m above the water's surface at the top of a nearly vertical snag located 5m out from the bank. The turtle was clinging to the snag with the head up, but upon detection it dropped into the river. Air temperature was approximately 32°C under mostly sunny skies.



FIG. 1. An immature *Macrochelys apalachicola* basking along the Choctawhatchee River, Holmes Co., Florida, USA.

**JONATHAN D. MAYS** (e-mail: jonathan.mays@myfwc.com), and **E. PIERSON HILL**, Florida Fish and Wildlife Conservation Commission, 1105 S.W. Williston Road, Gainesville, Florida 32601, USA (e-mail: pierson.hill@myfwc.com).

**MALACLEMYS TERRAPIN RHIZOPHORARUM (Mangrove Diamond-backed Terrapin).** **DIET.** *Malaclemys terrapin rhizophororum*, one of seven subspecies of *M. terrapin*, inhabits subtropical mangrove habitats in South Florida, USA. In temperate climates *M. terrapin* is largely carnivorous, feeding primarily on gastropods, bivalves, and decapod crustaceans (Tucker et. al. 1995. *Herpetologica* 51:167–181; Butler et. al. 2012. *Chelon. Conserv. Biol.* 11:124–128). In addition to its preferred prey, *M. t. rhizophororum* has also been reported to consume barnacles, fish, and vegetation (Tucker et. al. 1995, *op. cit.*; Butler et. al. 2012, *op. cit.*; Tulipani 2013. Ph.D. Dissertation. The College of William and Mary, Williamsburg, Virginia. 224 pp.). Herein, we report observations regarding the diet of *M. t. rhizophororum* from the southernmost extent of their range in the Florida Keys, USA.

On 9 April 2013, we collected opportunistic fecal samples from 29 adult female *M. t. rhizophororum* with straight plastron lengths (SPL) ranging from 145–175 mm (mean 158 mm  $\pm$  7) and one yearling *M. t. rhizophororum* (SPL 30 mm), from Barracouta Key (24.54799°N, 81.92127°W; WGS84) 12 miles W of Key West, Florida, USA. We identified 14 different categories of fecal remains, ten of which were classified as food (Table 1), with an additional four classified as non-food (e.g., Ostracoda [ostracods], parasites, sand/sediment, and other). The “other” category consisted of small bits of glass and an unidentifiable substance. *Cerithidea scalariformis* (Ladder Horn Snail) was the primary food item occurring in 100% of samples and accounted for approximately 97% of total dry mass for each mature terrapin as well as across all samples. Vegetation, unidentifiable gastropod and bivalve remains, *Melampus coffeus* (Coffee Bean Snail), crabs, and small fish constituted the remaining 3% of samples by weight. Gastropod opercula were documented in 93% of the samples, and although not identified to species, were frequently associated with the shell fragments of *C. scalariformis*. Crab remains were too fragmented for species identification but likely were *Uca* sp. (Fiddler Crab) based their small size and their common occurrence along the edge of the island. Insects were identified in 77% of the samples, but this food item may be over-represented because of difficulty distinguishing between prey and incidental drowning after terrapins were placed in collection buckets. Parasites were found in 48% of the samples examined, including the one yearling terrapin.

The one yearling terrapin's fecal sample contained the remains of four food (insect, crab, *C. scalariformis*, vegetation)

and three non-food items (parasites, sand, Ostracoda). Diets were similar between the two age groups with all items (food and non-food) documented in the yearling's fecal sample also documented in mature terrapins, but in different proportions. Unlike the mature adults, insects dominated the yearling's sample in both abundance and mass, with few crab or Ladder Horn Snail remains. Intriguingly, unlike adult female diet samples, the one yearling sample was dominated by beetle and other insect remains that were clearly ingested as prey and may be an important food item for smaller size classes. This could be due to their using habitats around dead wood, or their smaller head size may preclude them from producing the crushing jaw forces necessary to process harder-shelled prey.

All sampled mature *M. t. rhizophororum* were females, captured on the interior of the island during the end of the dry season. During the time of this study, *C. scalariformis* dominated the habitat while crabs and bivalves were found less frequently and concentrated along the edge of the island. This pattern of prey availability could explain the appearance of selective feeding on *C. scalariformis*, since these were more abundant and less mobile than crabs. Further investigation into the diet of *M. t. rhizophororum* is desirable, including samples from males and females in different seasons, to provide valuable information on the foraging ecology of terrapins living in the southernmost extreme of their range.

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**MATHEW J. DENTON** (e-mail: mdenton@usgs.gov) and **KRISTEN M. HART**, U.S. Geological Survey, Southeast Ecological Science Center, 3205 College Avenue, Davie, Florida 33314, USA (e-mail: Kristen\_hart@usgs.gov); **ANTON OELINIK**, Florida Atlantic University, 777 Glades Road, Boca Raton, Florida 33431, USA; **ROGER WOOD**, Richard Stockton College of New Jersey, 101 Vera King Farris Drive, Galloway, New Jersey 08205, USA;

TABLE 1. Frequency of occurrence (FO) and total dry weight (DW) of food items identified from *Malaclemys terrapin rhizophororum* fecal samples from Barracouta Key, Florida, USA in April 2013.

Food item	Mature (N = 29)		Immature (N = 1)	
	DW (g)	FO (%)	DW (g)	
Ladder Horn Snail ( <i>Cerithidea scalariformis</i> )	116.589	100	0.0001	
Vegetation fragments	1.176	97	0.0002	
Gastropod operculum	0.215	97	–	
Unidentifiable (combination of gastropods and bivalves)	1.007	93	–	
Insects	0.064	76	0.0208	
Coffee Bean Snail ( <i>Melampus coffeus</i> )	0.085	21	–	
Fiddler crab ( <i>Uca</i> sp.)	0.101	10	0.0003	
Fish bones (unknown sp.)	0.057	7	–	
Pointed Venus Clam ( <i>Anomalocardia auberiana</i> )	0.764	3	–	
Atlantic Pearl Oyster ( <i>Pinctada imbricata</i> )	0.001	3	–	

**JOHN BALDWIN**, Florida Atlantic University, 3200 College Avenue, Davie, Florida 33314, USA (e-mail: jbbaldwin@fau.edu).

**PELOMEDUSA GALEATA (South African Helmeted Turtle). MUTUALISTIC BEHAVIOR.** There are few published instances of turtles showing mutualistic behavior by removing ectoparasites from other organisms. In Ontario, Canada, *Chrysemys picta* (Painted Turtle) were observed removing leeches from *Chelydra serpentina* (Snapping Turtle), and this was judged to be the first documentation of active participation in any mutualism by any species of turtle (Krawchuk et al. 1997. Can. Field Nat. 111:315–317). This type of interaction was recorded between *C. picta* and



FIG. 1. *Pelomedusa galeata* inspecting the head of an adult male *Phacochoerus africanus* (Warthog).



FIG. 2. *Pelomedusa galeata* removing and eating a *Tabanus biguttatus* from the warthog.



FIG. 3. *Pelomedusa galeata* climbing onto the back of the *Phacochoerus africanus* to remove a tick. The *P. africanus* remained motionless throughout this encounter.

*C. serpentina* ten times, and the *C. serpentina* remained passive during these interactions. In South Africa, *Pelomedusa subrufa* were observed to remove ticks from *Diceros bicornis* (Black Rhinoceros) on several occasions, and the *D. bicornis* did not interfere with the turtles' activities (Deane 1969. Lammergeyer 2:69, Rochat 1969. Lammergeyer 2:69). These observations did not report a specific locality in South Africa, and may refer to either *P. subrufa* sensu stricto or *P. galeata*, following a recent taxonomic revision (Petzold et al. 2014. Zootaxa 3795:523–548).

We observed a lone adult male Warthog (*Phacochoerus africanus*) southeast of Hilltop Camp in the Hluhluwe section of the Hluhluwe-iMfolozi Park, KwaZulu-Natal, South Africa on 4 February 2015 at 1255 h. The *P. africanus* approached and then walked into a small roadside wallow; we observed it from 10 m away, while remaining inside our vehicle. As soon as the *P. africanus* entered the water, it was approached by two adult *Pelomedusa galeata*, and as it lowered itself into the water, the turtles began swimming around the warthog's body. The warthog stopped moving once the water level had reached its neck, with only the shoulders and the top of the back and rump above water. The turtles inspected the skin of the warthog and occasionally lunged forward at unseen items. The turtles' claws were frequently seen touching the warthog's skin as they swam around it, and they closely inspected the face and snout of the warthog with no adverse response (Fig. 1). The warthog's back had a Hippo Fly (Tabanidae: *Tabanus biguttatus*) attached to it, and after 5 min of observation, the warthog lowered itself further into the water. As soon as the fly was in reach of one of the turtles, it reached up onto the warthog's back and ate the fly (Fig. 2). The turtle then climbed onto the back and bit something on the warthog (Fig. 3). Upon review of our photographs, we were able to see at least ten ticks embedded in the left side of the warthog's body, and one tick was clearly the object that the turtle is biting in Fig. 3. Other than adjusting its body depth in the water, the warthog remained motionless throughout the observation time (approximately 10 min).

This is the first documentation of a mutualism between *Phacochoerus africanus* and *Pelomedusa galeata*. Taken together with published information on *P. subrufa/galeata* and *D. bicornis* in mud wallows, we expect that additional field observation will show that ectoparasite removal is an opportunistic mutualism by *Pelomedusa* spp. This behavior should be looked for in mud wallows during the dry season throughout the range of this genus, and the mammalian partners in this mutualism could include other common species that use these wallows (e.g., *Syncerus caffer* [African Buffalo], *Connochaetes taurinus* [Blue Wildebeest], and *Loxodonta africana* [African Elephant]).

**ANDREW W. JONES** (e-mail: ajones@cmnh.org), and **MICHELLE LEIGHTY JONES**, Cleveland Museum of Natural History, 1 Wade Oval Drive – University Circle, Cleveland, Ohio 44106, USA.

**STERNOTHERUS ODORATUS (Eastern Musk Turtle). DEFENSIVE BEHAVIOR.** *Sternotherus odoratus* is a small, freshwater turtle in which aerial basking is generally uncommon; however, this species will occasionally bask on logs, within tree limbs, and along shorelines (Nickerson 2000. Herpetol. Rev. 31:238–239; Ernst and Lovich 2009. Turtles of the United States and Canada, 2<sup>nd</sup> ed. Johns Hopkins Univ. Press, Baltimore, Maryland. 827 pp.). When disturbed, basking adult *S. odoratus* commonly escape by retreat into the water, while juveniles latch onto logs or tree limbs, presumably to impede removal (Ernst and Lovich 2009, *op. cit.*). On 21 June 2015 at 1220 h, I observed an adult *S. odoratus* basking



FIG. 1. Defensive posture of an adult *Sternotherus odoratus*.

along the shoreline of a small, unnamed pond within the Montour Preserve, Montour Co., Pennsylvania, USA (41.096794°N, 76.663693°W; WGS84). Instead of retreating into the water, when approached the *S. odoratus* retracted its head, tucked its limbs slightly underneath its plastron and tightly grasped the grassy substrate along the shoreline (Fig. 1). The behavior observed by the adult *S. odoratus* appears to be analogous to the grasping behavior described in juveniles by Ernst and Lovich (2009, *op. cit.*). This observation suggests that the defensive behavior employed by *S. odoratus* juveniles may be retained by adults in some populations. Furthermore, this note may represent the first account of this behavior occurring upon non-woody (i.e., logs, tree limbs) substrate.

Many thanks to Amber L. Pitt for identifying the *S. odoratus*, and to Michael B. Hartzell and Sarah C. Hartzell for transportation to the Montour Preserve.

**SEAN M. HARTZELL**, Department of Biological and Allied Health Sciences, Bloomsburg University of Pennsylvania, Bloomsburg, Pennsylvania 17815, USA; e-mail: smh14844@huskies.bloomu.edu.

#### CROCODYLIA — CROCODILIANS

**ALLIGATOR MISSISSIPPIENSIS (American Alligator). TELEMETRY UNIT RETENTION.** Numerous radio-telemetry studies have been conducted on American Alligators in Louisiana (Joanen and McNease 1970. Proc. SE Assoc. Game Fish Comm. 24:175–193; Joanen and McNease 1972. Proc. SE Assoc. Game Fish Comm. 26:252–275) and Florida (Rosenblatt et al. 2013. Estuarine, Coastal, and Gulf Sci. 135:182–190). Many telemetry studies are only able to collect data from animals for less than one year (see review in Rosenblatt, *op. cit.*). We herein report on the recovery of a surgically implanted telemetry unit in an American Alligator after over 13 years.

As part of a study on thermoregulation in alligators (Seebacher et al. 2003. Physiol. Biochem. Zool. 76:348–359) conducted in June–July 2001 (summer) and February 2002 (winter), 20 free-ranging alligators were implanted with temperature loggers, and seven of the alligators were also implanted with a

temperature-sensitive radio transmitter in each season (Seebacher et al., *op. cit.*). The study was conducted on Rockefeller Wildlife Refuge in Grand Chenier, Louisiana, USA (29.7167°N, 92.8167°W), a coastal marsh habitat. The transmitters and data loggers were surgically implanted into the peritoneal cavity via a small incision in the right flank of each alligator, as previously described (Seebacher et al., *op. cit.*). After the alligators were released to the wild, we recovered seven alligators in both the summer phase and the winter phase; obtaining continuous body temperature data for up to 17 days in summer and up to 13 days in winter for the short-term study (Seebacher et al., *op. cit.*).

On 3 September 2014, during the annual nuisance alligator harvest conducted on Rockefeller Refuge, one of the study animals from the summer 2001 phase was recaptured. During the lengthy time period since the initial capture and study, the identifying foot/web tag was lost. However, when the alligator was butchered at a processing shed, the radio transmitter spontaneously fell out of the peritoneal cavity and was recovered. Employees of the facility brought this to the attention of SFD, who inquired with RME and PLT as to the origin of the unit. The identifying number on the transmitter was from an alligator that was captured on 22 June 2001 and was released on 24 June 2001 after surgical implantation of the data logger and radio transmitter. The female alligator was initially 1.78 m total length and had a mass of 16.8 kg at capture in 2001. The exact length at recapture in 2014 was unknown, as the skin (with identifying CITES tag) had been separated from the carcass from which meat was being deboned when the transmitter was noted. However, six female alligators caught that day on Rockefeller Refuge with the same identifying tail notch as the marked study alligators ranged in length from 2.03–2.39 m total length. The number of days elapsed between release and recapture was 4821 days (13 years, 2 months, and 12 days).

It is noteworthy that this recovery was made after such a long time interval after implantation. The transmitter fell out of the abdominal cavity during processing; there was apparently no evidence of adhesions or complications from the earlier procedure; the alligator appeared healthy and robust. The transmitter appeared nearly pristine and the identifying numbers were clearly visible and no wear or erosions were seen on the protective coating on the unit. Of the seven alligators recovered with data loggers in the initial summer phase in July 2001, four also had telemetry transmitters; thus the unit recovered in 2014 was one of only three possibly remaining from the summer experimental phase conducted over 13 years earlier. It is also significant that the alligator had such long term survival, particularly after the region was adversely impacted by two major hurricanes (Hurricane Rita in 2005 [Lance et al. 2010. J. Exp. Zool. 313A:106–113], and Hurricane Ike in 2008). In some cases flooding from hurricanes pushed alligators north off the refuge, and alligators can disperse long distances (Lance et al. 2011. SENA 10:389–398), although we documented several cases of nest-site fidelity by nesting females on Rockefeller Refuge, even after Hurricane Rita and a subsequent catastrophic drought (Elsey et al. 2008. SENA 7:737–743).

We thank the staff at D & D in Gueydan, Louisiana for assistance in recovery of the telemetry transmitter.

**RUTH M. ELSEY** (e-mail: relsey@wlf.la.gov) and **PHILLIP L. TROSCLAIR, III**, Louisiana Department of Wildlife and Fisheries, Rockefeller Wildlife Refuge, 5476 Grand Chenier Highway, Grand Chenier, Louisiana 70643, USA; **SCHUYLER F. DARTEZ**, Louisiana Department of Wildlife and Fisheries, White Lake Wetlands Conservation Area, P.O. Box 480, 15926 Hwy 91, Gueydan, Louisiana 70542, USA; **FRANK SEEBACHER**, University of

Sydney, School of Biological Sciences, Heydon Laurence Building, Sydney, New South Wales 2006, Australia.

**CROCODYLUS ACUTUS (American Crocodile). ECTOPARASITISM.** Crocodilians host a diversity of parasites (Tellez 2013. A Checklist of Host-Parasite Interactions of the Order Crocodylia. University of California Press, Berkeley, California. 388 pp.). Although parasitism of crocodilians by endoparasites and aquatic ectoparasites is fairly well-documented (Cott 1961. Trans. Zool. Soc. Lond. 29:211–359; Webb and Manolis, 1983. Aust. Wildl. Res. 10:407–420; Riley and Huchzermeyer 2000. Copeia 2000:582–586), comparatively little is known regarding parasitism of crocodilians by terrestrial ectoparasites. Scattered reports exist describing crocodilian parasitism by ticks (Terenius et al. 2000. J. Med. Entomol. 37:973–976; Rainwater et al. 2001. J. Wildl. Dis. 37:836–839; Sejas, 2007. Interciencia 32:56–60), and even fewer reports exist regarding parasitism of crocodilians by hematophagous (blood-feeding) flies, although due to their affinity for aquatic habitats crocodilians are generally more vulnerable to the latter.

Hematophagous fly parasitism has been reported for *Crocodylus niloticus* (Nile Crocodile) (Hoare 1931. Parasitology 23:449–484; Cott, *op. cit.*) as well as multiple caiman species including *Caiman crocodilus* (Spectacled Caiman), *Melanosuchus niger* (Black Caiman), *Paleosuchus trigonatus* (Smooth-fronted Caiman), and *P. palpebrosus* (Dwarf Caiman) (Medem 1981.

Cespedesia 10:123–191; Henriques et al. 2000. Rev. Brasil. Zool. 17:609–613; Ferreira et al. 2002. Mem. Inst. Oswaldo Cruz, Rio de Janeiro. 97:133–136). However, to our knowledge no published accounts exist regarding hematophagous fly parasitism in New World crocodiles. Here, we report an observation of parasitism by a hematophagous fly on *C. acutus* in Costa Rica.

On 12 September 2007 at approximately 1530 h, we captured an adult (total length = 376 cm) male *Crocodylus acutus* in the lower Tarcoles River, Costa Rica (9.785892°N, 84.617481°W; WGS84) during a study of ocular disease in this crocodile population (Rainwater et al. 2011 J. Wildl. Dis. 47:415–426). The crocodile was captured by actively attracting it to bait on the river bank and then placing a breakaway snare around its upper jaw. Prior to capture, as the crocodile slowly crawled onto the bank toward the bait, we observed a *Fidena bicolor* (horse fly; Diptera: Tabanidae) hovering around the crocodile and eventually landing on its back (Fig. 1A). Following capture and during our examination of the animal, we observed a *F. bicolor* (possibly the same one) on the crocodile's right leg. The fly appeared to be feeding, as the tip of its proboscis was inserted between two scales on the leg (Fig. 2B) (Medem, *op. cit.*). The fly remained in the same position for approximately 10 sec and then flew away, possibly disturbed by our constant movement around the crocodile.

Although the horse fly *Fidena flavipennis* is known to feed on caiman in Costa Rica (John Burger, pers. comm.), to our knowledge this is the first report of ectoparasitism by a hematophagous fly on a New World crocodile and by *F. bicolor* on any crocodilian.

Voucher photographs of *Fidena bicolor* were deposited in the Campbell Museum, Clemson University (CUSC 2912). We thank John Burger for identifying the horse flies and Stanlee Miller for archiving the voucher photographs.

**THOMAS R. RAINWATER**, Baruch Institute of Coastal Ecology and Forest Science, Clemson University, P.O. Box 596, Georgetown, South Carolina 29442, USA (e-mail: trrainwater@gmail.com); **JUAN RAFAEL BOLAÑOS MONTERO**, Asociación de Especialistas en Crocodílicos, 200m Oeste y 150m Sur del Templo Católico, Heredia, Costa Rica; **BRADY R. BARR**, National Geographic Channel, 1145 17th Street NW, Washington, D.C. 20036, USA; **STEVEN G. PLATT**, Wildlife Conservation Society, Myanmar Program, Office Block C-1, Aye Yeik Mon 1<sup>st</sup> Street, Hlaing Township, Yangon, Myanmar.

**CROCODYLUS ACUTUS (American Crocodile). ECTOPARASITE.** Crocodilians are host to a diverse assemblage of parasite species, particularly endoparasites (Tellez 2013. A Checklist of Host-Parasite Interactions of the Order Crocodylia. University of Press, Berkeley, California. 388 pp.; Tellez and Nifong 2014. Intl. J. Parasitol. Parasitol. Wild. 3:227–235). Ectoparasitism, however, is not a common phenomenon. The thick epidermal layer, in addition to osteoderms, likely decreases the success rate of penetration or attachment of ectoparasites onto the crocodile. Thus, unlike the majority of other vertebrates, the crocodilian epidermis is perhaps the primary defense mechanism against ectoparasitism. Previous records of ectoparasitism, or micropredation, have documented penetration or attachment of ectoparasites between scale sutures and softer locations of the skin, such as on the legs, and around the border of the eyes and nose (Tellez 2013, *op. cit.*). Parasitic arthropods represent the largest group of ectoparasites to infect crocodiles, which include members from the order Diptera, Hemiptera, Ixodida, Porocephalida, and Sessilia (Tellez 2013, *op. cit.*). Here, we report the collection of an isopod (Phylum Arthropoda: Order Isopoda) from a wild crocodile in Belize, in concomitance to recording the first documentation of isopod parasitism among crocodilians.

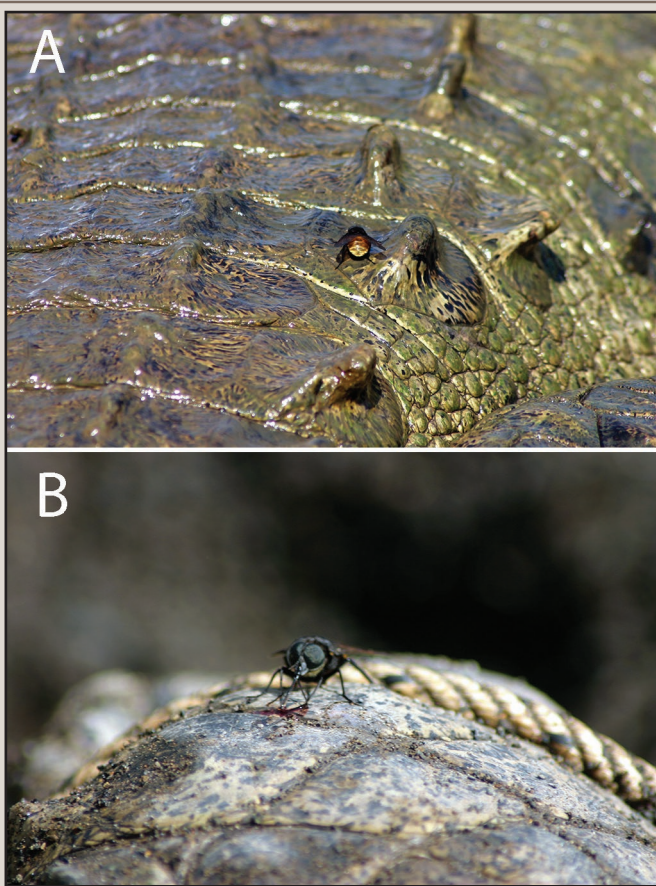


FIG. 1. A) *Fidena bicolor* (rear view) on the back of *Crocodylus acutus* in the Tarcoles River, Costa Rica. B) *Fidena bicolor* (front view) on the rear leg of *Crocodylus acutus* in the Tarcoles River, Costa Rica. Note the tip of the fly's proboscis inserted into the skin between scales.

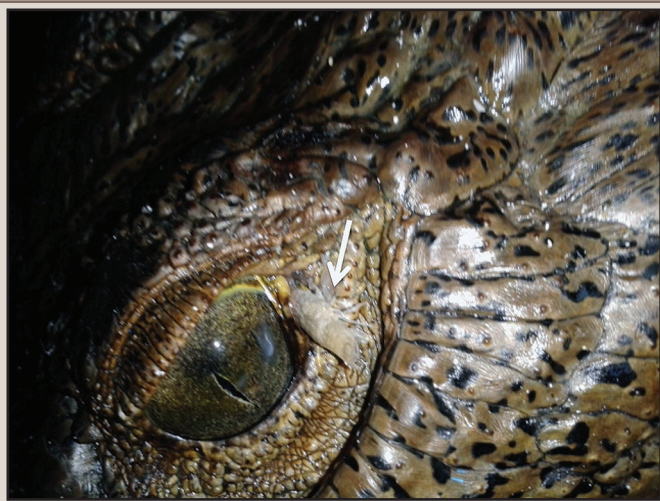


FIG. 1. *Crocodylus acutus* (American Crocodile) with parasitic isopod *Rocinela signata* on the eye.

On 26 August 2013, during a routine evening tagging survey, a female, sub-adult (total length = 115.40 cm) *Crocodylus acutus* was captured by hand for the first time and microchipped (#0A02153718) at 2015 h. The crocodile was located via spotlight under a home on stilts in the cove at the lagoon-side entrance to San Mateo, Ambergris Caye (17.933283°N, 87.9566694°W) in which the salinity of the water was measured at 31 ppt via a portable refractometer. The crocodile was only in fair condition in conjunction with a slightly sunken supertemporal fossae and relatively underweight. Approximately five isopods were randomly attached to the crocodile's nictating membrane of the left eye, as well as attached to the ear flaps. While the isopods were being removed from the eye, the importance of documenting the infection became apparent, as this was the second observation of isopods infecting *C. acutus* since July 2013. As such, photos were taken of the remaining isopod (Fig. 1). Upon returning from the crocodile survey, the isopod was placed in a small vial and preserved in alcohol until further taxonomic identification. Since this event, several additional *C. acutus* have been recorded with isopod infections of the eyes and ear flaps.

The isopod was identified as *Rocinela signata* from the family Aegidae, a common micro-predator and/or parasite of marine fish (Cavalcanti et al. 2012. Mar. Biol. Rec. 5:66–70). To our knowledge, this is the first record of *R. signata* infecting a marine-inhabiting reptile. It is likely that our findings are an example of accidental parasitism, or an anomaly of micro-predation on crocodiles. However, the decline of fish hosts around Ambergris Caye due to overfishing, pollution, and habitat destruction of fish nurseries for the construction of resorts (Young 2008. Trop. Conserv. Sci 1:18–33; Chenot-Rose, pers. obs.) is perhaps forcing isopods to exploit a new dietary niche or host, i.e., the crocodiles. Interestingly, the current rise of isopod eye infections parallels the recent emergence of ocular abnormalities among crocodiles inhabiting Ambergris Caye (Chenot-Rose, pers. obs.). Further exploration into the isopod-crocodile interaction should be pursued to determine if human transformation of the islands' mangrove ecosystem is indeed forming a new host-parasite dynamic.

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**MARISA TELLEZ**, Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara, Santa Barbara, California 93101, USA (e-mail: marisatellez13@gmail.com); **CHERIE CHENOT-ROSE**, ACES, San Pedro, Ambergris Caye, Belize (e-mail: giveacroc@comcast.net).

**MELANOSUCHUS NIGER (Black Caiman). DIET.** Many crocodilian species are known to consume fruits and seeds but diet information for some species is still lacking (Platt et al. 2013. J. Zool. 291:87–99). We captured an adult female *Melanosuchus niger* (SVL = 139 cm; total length = 255 cm; 57 kg) on 7 February 2014 near Yupukari, Guyana (3.6967°N, 59.3275°W; WGS84) and collected its stomach contents using the hose-Heimlich technique (Fitzgerald 1989. J. Herpetol. 23:170–172). While examining its stomach contents we found a partially digested seed measuring 2.7 × 2.9 cm and weighing 1.6 g. We identified the seed as coming from a tree in the Mimosoideae, a subfamily of Fabaceae. This observation constitutes the first record of seed consumption by *M. niger*, but we do not know if the seed was consumed intentionally or incidentally during other feeding activities.

**ADAM E. ROSENBLATT**, Yale University, School of Forestry and Environmental Sciences, 370 Prospect Street, New Haven, Connecticut 06511, USA (e-mail: adam.rosenblatt@yale.edu); **FERNANDO LI, ASHLEY HOLLAND, PETER TAYLOR**, Rupununi Learners Inc., Caiman House, Yupukari, Region 9, Guyana; **LEANNA KALICHARAN**, University of Guyana, P.O. Box 10-1110, Georgetown, Guyana

#### SQUAMATA — LIZARDS

**AMEIVULA ABAETENSIS. SAUROCHORY.** Two essential stages in the life cycle of plants, pollination and seed dispersal, could be directly affected by animals (Godínez-Álvarez 2004. Rev. Chil. Hist. Nat. 77:569–577). Some species of lizards feed on seeds, nectar, pollen, and fruit, being considered important disperser agents (e.g., Olesen and Valido 2003. Trends Ecol. Evol. 18:177–181; Casado and Soriano 2010. Ecotropicos 23:18–36; Gomes et al. 2014. Plant Biol. 16:315–322). Some lizards are seed dispersers of Cactaceae in Brazil. *Tropidurus cocorobensis* is considered a disperser of *Melocactus paucispinus* (Fonseca et al. 2012. Acta Bot. Bras. 26:481–492); *T. torquatus* a disperser of *M. violaceus* (Figueira et al. 1994. Biotropica 26:295–301); *T. semitaeniatus* a disperser of *M. ernestii* (Gomes et al. 2014, *op. cit.*); and *Ameivula ocellifera* a disperser of *M. glaucescens* (Fonseca et al. 2012, *op. cit.*). *Ameivula abaetensis* is a lizard endemic to the sand dune habitat (“restinga”) of northern Bahia State from Salvador Municipality to Pirambu Municipality, with a disjunct population in Areia Branca Municipality, all located in Sergipe State, Brazil. The diet of this lizard species consists of small arthropods and murici fruits (*Byrsonima microphylla*) (Dias and Rocha 2007. Braz. J. Biol. 67:41–46).

On 13 and 14 April 2014 we collected two adult females of *Ameivula abaetensis* (SVL = 67.87 mm, 61.79 mm) in a fragment of “restinga” habitat (36.84364°W, 10.69363°S, WGS84; 89 m elev.), Pirambu Municipality, Sergipe State, Brazil. The lizards were captured (collection permit: 42941-1 SISBIO/ICMBio), euthanized (protocol license: 16/2014 CEUA), and deposited in the collection of the Laboratório de Biologia e Ecologia de Vertebrados / Universidade Federal de Sergipe (LBEVL578; LBEVL579). The specimens were dissected, and food items identified and counted. Among them we recorded presence of fruits of *Melocactus violaceus* Pfeiff. subsp. *margaritaceus* N. P. Taylor. Each lizard had one