


Other Contributions

NATURE NOTES

Amphibia: Anura

***Smilisca sordida*. Predation by a Tropical Screech Owl (*Megascops choliba*).** Although *Smilisca sordida* is an abundant treefrog found at low and moderate elevations from northeastern Honduras to west-central Panama (Savage, 2002), predation records are scarce; only a record of a wandering spider (*Ancylometes bogotensis*) preying on this anuran at Golfito, Costa Rica, has been reported (Dehling, 2007). On 16 February 2015, at ca. 1930 h, one of us (GG) heard the continuous calls of a bird, then located and photographed a Tropical Screech Owl (*Megascops choliba*) with an individual of *S. sordida* in its talons (Fig. 1A). The owl quickly killed its prey by beating the frog's head against a branch and pecking it (Fig. 1B), and later ingested the frog. The event occurred inside a garden in Palmares de Pérez Zeledón, Provincia de San José, Costa Rica (9°19'13.54"N, 83°39'49.38"W; WGS84), elev. 600m. We were able to determine the species of frog because *S. sordida* is abundant at this location (VA, pers. observ.), as well as by its snout shape, yellow skin color with a brown color pattern, and the presence of white vocal sacs (Savage, 2002).



Fig. 1. (A) A Tropical Screech Owl (*Megascops choliba*) holds a *Smilisca sordida* in its claws. (B) The owl kills the frog by beating it on a branch and pecking it with its beak.  © Gustavo Granados

Megascops choliba is a widespread species of owl, but its diet only has been reported from a few localities throughout its range (Motta-Junior, 2002; Delgado, 2007). Prey items include arthropods (e.g., insects, spiders), small terrestrial mammals (e.g., rodents), and small birds and bats (Stiles and Skutch, 1989; Delgado, 2007), but members of this genus occasionally are known to prey on amphibians (Motta-Junior, 2002; Artuso, 2010). Moreover, once frogs are consumed their identification to genus or species level sometimes is not possible, because most dietary studies are based on pellets (Motta-Junior, 2002). Two similar predation attempts by owls on anurans have been reported: Martins et al. (1993) noted a Barn Owl (*Tyto alba*) preying on *Hypsiboas faber*, and Ramírez-Fernández and Solís-del Valle (2014) documented a Spectacled Owl (*Pulsatrix perspicillata*) preying on *Rhinophrynus dorsalis*. Thus, owing to the rare opportunity to record photographic evidence of avian predation on a frog in tropical conditions (Acosta and Morún, 2014), herein we report the first predation event on *S. sordida* by an owl.

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Reptilia: Squamata (lizards)

***Ctenosaura similis*. Cannibalism.** Although cannibalism in reptiles is a relatively rare occurrence, the fact that it happens at all is of high biological interest (Robbins et al., 2013). This behavior has been described in several reptile species (see Mitchell, 1986).

Mora (1991) discussed cannibalism in the Black Iguana (*Ctenosaura similis*), and described five cases in which all but one entailed extenuating circumstances. The one observation that did not was in the field, and involved a young adult *C. similis* cannibalizing a hatchling. Mora (1991) indicated that cannibalism in *C. similis* would occur in overcrowded situations or as opportunistic predation, and also noted that this behavior was shown by female *C. similis* feeding on hatchlings as a response to habitat conditions.

On 17 August 2014 we observed an adult free-ranging female of *C. similis* preying on a juvenile (ca. 3-months old) at Playa Naranjo, Sector Santa Rosa (= Parque Nacional Santa Rosa), Área de Conservación Guanacaste, Costa Rica (Fig. 1). The event occurred at 1150 h on a warm sunny day, along a trail near the ranger station. The female was observed pursuing and grabbing the juvenile, which in response bit the female's fingers (Fig. 2).

The hatching-season for *C. similis* in northwestern Costa Rica is in late May and coincides with the beginning of the rainy season, a time of year when food availability usually is scarce (Mora, 1991; Mora, 2010). Owing to the effects of El Niño (ENSO) a drought was occurring at Sector Santa Rosa in 2014, and in typical years by mid- August the rains should have settled in and plenty of food resources would have been available. The scarcity of food resources would have led adult *C. similis* to cannibalize on young individuals; the 3-month old *C. similis* also might have had lower probabilities for survival because of the lower numbers of insects available, its primary food source, in addition to fewer plant resources (Mora, 2010).

The shortage of food for *C. similis* at Sector Santa Rosa before the beginning of the rainy season might have led to high mortality, and the nutritional benefits of cannibalism would have been high (Eickwort, 1973). Mora (1991) pointed out that hatchling *C. similis* would be a good alternative food source for some adults when facing an extended dry season, which was the situation at Sector Santa Rosa in 2014 due to the El Niño event. Thus, adults would have taken advantage of this situation and many young individuals probably succumbed to predation.




Fig. 1. An adult female *Ctenosaura similis* captures a young individual of the same species at Sector Santa Rosa, Área de Conservación Guanacaste, Costa Rica.  © Flávio H. G. Rodrigues



Fig. 2. As a defensive response, the juvenile *Ctenosaura similis* bites the fingers of the adult.

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These two conditions, the nutritional benefit for adults and the potential for high mortality in juveniles, would favor the occurrence of cannibalism in *C. similis*. Later in the year the probability of cannibalism would decrease, because of the separation of habitats occupied by the age classes (Mora, 2010). We are not aware, however, if adult *C. similis* cannibalize only in this type of situation or if this behavior is more extensive. The case of cannibalism reported by Mora (1991) involved a newborn individual in close proximity to a female at Parque Nacional Palo Verde, Costa Rica, which also lies in Tropical Dry Forest. The ca. 3-month old *C. similis* preyed upon at Playa Naranjo was sharing the habitat (less dense vegetation) with adults (Mora, 2010), but eventually juveniles in this area move to more protected habitats.

Although predation on young individuals by adults has been studied in vertebrates, the extent of occurrence and the potential benefits still are unknown in reptiles (Jenssen et al., 1989). Keren-Rotem et al. (2006) suggested that aggression by adults toward juveniles in areas of intraspecific habitat separation may be a more common occurrence than previously thought, including in cases where ontogenetic habitat changes only can be explained by intraspecific competition for resources (Blanco et al., 2012).

The working hypotheses on the occurrence of cannibalism in reptiles assume that it occurs as an opportunistic feeding event, but these hypotheses have not been formally described (Robbins et al., 2013). An increase in juvenile density would increase opportunity via encounter rates, and a decrease in food availability would increase the demand (Robbins et al., 2013), which were the conditions at Sector Santa Rosa in 2014. A factor that likely affects the density of juveniles in areas inhabited by adults is the distance between the general population and the nesting areas (Robbins et al., 2013), but this situation has not been studied in *C. similis*.

Severe hunger confinement or some other stressful situation may cause a reptile to depart from its normal behavior and eat another (Hoser, 1993). As a result, *C. similis* would exhibit an opportunistic strategy in overcrowded conditions that includes cannibalism and saurophagy, as has been reported for other lizards (Blanco et al., 2012). The cannibalistic event described here occurred during an extended dry season at Sector Santa Rosa. Cannibalism could offer a number of advantages for a predator in natural populations by eliminating potential competitors,

among other things. *Ctenosaura similis* is an abundant species in Sector Santa Rosa, and cannibalism can help reduce competitive pressure in the future. A moderate level of cannibalism reduces inter-cohort competition, enabling the coexistence of many cohorts (Claessen et al., 2000, Žagar and Carretero, 2012), a phenomenon referred to as the “lifeboat mechanism” because it could save a population from extinction (Cushing, 1991).

In cases where cannibalism is not a common occurrence, such as in *C. similis*, it apparently occurs as a by-product of normal predatory behavior (Polis and Myers, 1985) because this species is an opportunistic feeder, like most other species of *Ctenosaura* (Mora, 2010). In some cases, cannibalism has been linked to island populations as a symptom of scarce resources and high lizard densities (e.g., Pérez-Mellado and Corti, 1993). Polis (1981) suggested that cannibalism could be a density self-regulation process in populations with high densities, which could be the case for *C. similis* at Sector Santa Rosa.

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***Lepidophyma occulor* Smith, 1942. Maximum Size.** The distribution of *Lepidophyma occulor* is known from about 20 localities in Mexico, from the states of Querétaro, San Luis Potosí, and Hidalgo at elevations from 400 to 1,000 m (Canseco-Márquez et al., 2004; Lemos-Espinal and Dixon, 2013; Lara-Tufiño, 2014; Ramírez-Bautista et al., 2014). This species has been reported from a variety of vegetation types, including xeric shrub, scrub submontane, pine forest, and tropical forest, and from such microhabitats as crevices in limestone rocks (Bezy and Camarillo-Rangel, 2002; Ramírez-Bautista et al., 2014).

Lepidophyma occulor is one of the larger members of its genus, with a reported maximum snout–vent length (SVL) in females of 105 mm and 90 mm in males (Bezy and Camarillo-Rangel, 2002; Lemos-Espinal y Dixon, 2013); few specimens of this species, however, have been available in systematic studies (Bezy, 1984; Bezy and Camarillo-Rangel, 2002).

During hepatofaunal surveys conducted in the municipality of Pisaflores (between latitudes 21°08' and 21°09'N and longitudes 98°53' and 99°05'W, datum WGS84) in the state of Hidalgo, two specimens of *L. occulor* were collected and subsequently deposited in the scientific collection of amphibians and reptiles of the Centro de Investigaciones Biológicas (CIB) at the Universidad Autónoma del Estado de Hidalgo (UAEH).

The first specimen (CIB-4554) is an adult female (Fig. 1) collected at Puerto Oscuro (21°17'40.66"N, 98°58'28.93"W, datum WGS84); elev. 471 m; 04 July 2013. The lizard was found at 1820 h in tropical evergreen forest, under a rock next to a river. The SVL = 145 mm, and the tail length (TL) = 121 mm (tail regenerated). The second specimen (CIB-4555) is an adult male (Fig. 2) collected at Miraflores (21°10'02.43"N, 99°01'10.91"W, datum WGS84); elev. 420 m; 29 November 2013. This individual was found at 1720 h in tropical deciduous forest, inside a rock crevice at a depth of 47 cm; the crevice was located 140 cm from ground level. The SVL = 128 mm, and the TL = 151 mm (tail regenerated).

The previous maximum-recorded SVL for *L. occulor* was 105 mm for females and 90 mm for males (Bezy and Camarillo-Rangel, 2002). This report not only surpasses the known maximum SVL for this species, but also for the genus. The previous maximum SVL for the genus was 127 mm, for the *L. flavimaculatum* complex (see Bezy and Camarillo-Rangel, 2002).



Fig. 1. Female *Lepidophyma occulor* (CIB-4554) from Puerto Oscuro, Pisaflores, Hidalgo, Mexico.

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Fig. 2. Male *Lepidophyma occulor* (CIB-4555) from Miraflores, Pisaflores, Hidalgo, Mexico.

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***Iguana iguana*. Predation by Tayras (*Eira barbara*).** Green Iguanas are the largest lizards in Central America, reaching a total length of 2 m and a weight of 4 kg (Savage, 2002). These herbivorous and frugivorous lizards are ecologically plastic and fairly abundant in their habitats, and their large size and active foraging behavior make them easy to locate by predators. Many mammal, bird, and reptile species prey on the eggs and different age classes of *I. iguana* (Greene et al., 1978), and this lizard also an important dietary component of many human communities (Savage, 2002).

On 13 December 2008, one of us (RO) witnessed a predation attempt by two Tayras, *Eira barbara* (Mammalia: Mustelidae), on an *I. iguana* at Earth University, Provincia de Limón, Costa Rica (10°12'49"N, 83°35'12"W; WGS 84), elev. 40 m. An adult male *I. iguana* had jumped or fallen from a tree, and quickly was pursued by two young *E. barbara*. The mustelids evidently were attracted by the sound of the falling animal, and chased the iguana for about 20 m until they cornered it along a creek (Fig. 1). At first, the *Eira* seemed puzzled as to what to do with the large reptile, but eventually one of them bit the lizard on the head and neck (Fig. 2), and soon after the other began to concentrate on the tail (Fig. 3). Excited from the chase, and perhaps stimulated by the taste (or scent) of blood, the Tayras began to make guttural noises and appeared to lose interest in their surroundings. The trio struggled for a while, partially in the water, but at a certain point the *Iguana* liberated itself and with a burst of speed escaped, as the young *Eira* appeared confused. The photographs were taken by RO ca. 10 m from the scene, and at times the *Eira* acknowledged his presence by exposing their teeth and growling. The episode lasted about 10 minutes.

Galef et al. (1976) reported on a predation event involving an adult Tayra and a Green Iguana at Barro Colorado Island, Panama. In eastern Colombia, Tayras are known to hunt in pairs around the base of large trees, and to attack *Boa constrictor* of considerable size (Defler, 1980).



Fig. 1. Two young Tayra (*Eira barbara*) pursue and begin to examine an adult male *Iguana iguana*.



Fig 2. One of the Tayras bites the *Iguana* on the head, before biting its neck.



Fig 3. The second Tayra joins in, concentrating and biting the tail of the *Iguana*.

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***Norops woodi*. Predation by a Red-headed Barbet (*Eubucco bourcierii*).** Anoles often are preyed by birds classified in several different taxonomic families (Poulin et al., 2001; Cantwell and Forrest, 2013). Many of these predators are insectivorous and/or frugivorous bird species, and the frequency with which they prey on anoles varies from site to site (e.g., islands), season of the year (e.g., dry season), food abundance, and prey availability (Wunderle, 1981; McLaughlin and Roughgarden, 1989; Aborn and Froehlich, 1995; Pérez-Rivera, 1997; Poulin et al., 2001; Lopes et al., 2005; Losos, 2009; Cantwell and Forrest, 2013; Sandoval-Comte et al., 2014). Moreover, predation by small birds on herpetofauna frequently is considered an opportunistic interaction, because it requires great effort (Pérez-Rivera, 1997; Acosta and Morún, 2014). Here we present predation information upon a *Norops woodi*, an anole from the highlands of Costa Rica and western Panama whose natural history remains little known (Savage, 2002), by a barbet (*Eubucco bourcierii*) that inhabits the same elevational belt and habitat (Stiles and Skutch, 1989). We also report the use of the dewlap by the anole as a possible visual advertising signal against a potential predator in field conditions.

On 17 March 2014, on a trail to Cerro Chirripó (Canton de Pérez Zeledón, Provincia de San José, Costa Rica (9°27'N, 83°33'W; WGS84), elev. ca. 1,500 m, we observed a mixed flock of birds containing Red-headed Barbets (*Eubucco bourcierii*) foraging. We then saw a male barbet attacking a male *N. woodi* by striking the lizard's head against a branch (ca. 4 m in height) with its beak. The anole was displaying its dewlap (extending and retracting it) prior to and during the attack. After struggling for at least 10 minutes both animals fell to the ground, where the barbet killed and ingested the anole (Fig. 1). The capture behavior, subjugation, and consumption of the anole was similar to that reported for other songbirds and small non-passerine birds on other herpetofauna (Hendricks and Hendricks, 2002; Sandoval et al., 2008; Acosta and Morún, 2014; Sandoval-Comte et al., 2014).

Information on the display behavior of anoles is lacking in most descriptions of bird attacks (Van Riper et al., 1979; Aborn and Froehlich, 1995), and we hypothesize that *N. woodi* sent a signal either to the barbet (e.g., indicating that the predator has been detected) or to conspecifics (e.g., indicating eminent attack). The use of visual signals at the presence of opportunistic predators with sharp vision (Leal, 1999), such as small birds, may be a stereotypic response of anoles to predation attempts by birds (Aborn and Froehlich, 1995; Pérez-Rivera, 1997). For example, Leal (1999) reported similar behavior in *Anolis cristatellus* using predator models under controlled conditions. Also, anoles are capable of identifying common and opportunistic avian predators, which likely reduce the probability of successful attacks by birds (Leal, 1999; Cantwell and Forrest, 2013). Despite this fact, attacks on anoles may occur with relative frequency since barbets and similar-sized birds can consume meat, arthropods, and small vertebrates (Ripley, 1945; Sandoval-Comte et al., 2014).



Fig.1. Sequence of photographs showing an *Eubucco bourcierii* striking a *Norops woodi* against a branch. Subsequently, the bird consumed the lizard.  © Manuel Cabalceta

This note represents the first record of a *Eubucco* killing and consuming an anole, and the first report of avian predation upon *N. woodi*. We conclude that even if the consumption of small vertebrates is less frequent than that of fruits and arthropods for many small birds (Poulin et al., 2001; Acosta and Morún, 2014; Sandoval-Comte et al., 2014), predation is a strong evolutionary force that has shaped the behavior of many species. Its documentation is necessary to enlighten aspects on behavioral responses of predators and prey (Shean, 1987), and of the poorly understood trophic relationships in tropical environments such as Neotropical montane forests (Poulin et al., 2001; Sandoval et al., 2008; Acosta and Morún, 2014; Sandoval-Comte et al., 2014).

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Reptilia: Squamata (Snakes)

***Bothriechis schlegelii*. Predation and Color Pattern.** The pitviper *Bothriechis schlegelii* occurs from southern Mexico to south-central Colombia, on the Atlantic versant, and on the Pacific versant in western Costa Rica and Panama southward to western Ecuador and northern Peru (Campbell and Lamar, 2004; McCranie, 2011; C. Barrio-Amorós, unpublished). Its diet is known to consist of frogs, lizards, birds, and mammals, of which the latter includes rodents, bats, and a mouse opossum (Savage, 2002; Campbell and Lamar, 2004; Solórzano, 2004; Sorrell, 2009).

Although several authors have reported bats in the diet of *B. schlegelii*, I am not aware of any published photographs of such an occurrence in nature. On 30 January 2015, at 0830 h, at Parque Nacional Volcán Tenorio (Río Celeste), Quepos, Costa Rica, a park ranger found a *B. schlegelii* eating an undetermined species of bat, taken by the head and apparently trying to swallow it while perched on a branch about 2 m from the ground. The ranger showed the encounter to a tourist (Willeminj van den Boom, from La Haye, Netherlands), who photographed the event (Fig. 1). About three hours later Ms. van den Boom returned to the scene and found the snake and bat basically in the same position, and wondered if the snake was having trouble swallowing its prey. She left the scene in order not to disturb the snake, so it is unknown if the snake finished its meal.



Fig. 1. An adult *Bothriechis schlegelii* from Parque Nacional Volcán Tenorio (Río Celeste), Provincia de Alajuela, Costa Rica, attempts to swallow an unidentified species of bat. Note the unusual dorsal color pattern of pronounced paravertebral stripes.

© Willeminj van den Boom

The color pattern of the *B. schlegelii* in Fig. 1 is unusual, especially for an individual from Costa Rica. Savage (2002: 725) reported the color pattern for *B. schlegelii* from Costa Rica as follows: “Dorsal ground color bright yellow, pink, green, olive green, silver, to dark gray green or charcoal; yellow morph almost uniform or with sprinkling of black, green, and/or red dots; others usually with black outlined light (red, orange, yellow, silver, pale green) spots, blotches or crossbands; rarely with a middorsal dark stripe...” The color pattern of another Costa Rican *B. schlegelii* found at Parque Nacional Manuel Antonio, Quepos, Provincia de Puntarenas shows some similarities, but the paravertebral stripes are red and more pronounced (Fig. 2). Striped dorsal patterns in certain snakes can be a genetic trait (for an overview, see Bechtel, 1995) or a birth defect caused by exposure of the pregnant female to sub-optimal temperatures (Ross and Marzec, 1990). Future herpetocultural work might shed some light on the cause(s) behind the paravertebral striping in *B. schlegelii* from Costa Rica.



Fig. 2. An adult female *Bothriechis schlegelii* from Parque Nacional Manuel Antonio, Quepos, Provincia de Puntarenas, showing pronounced paravertebral striping. 📷 © Alejandro Solórzano

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***Conophis lineatus*. Arboreal Behavior.** Commonly known as the Guardacamino (= Road Guarder), this relatively abundant snake inhabits low and moderate elevations on the Atlantic versant from Veracruz and Oaxaca, Mexico, to north-central Nicaragua, and on the Pacific versant from Chiapas, Mexico, to northwestern Costa Rica, including the Meseta Central (Campbell, 1998; Savage, 2002; McCranie, 2011); based on personal communication, Scott (1983) also reported this species as occurring in secondary growth in Parque Nacional Corcovado in southwestern Costa Rica.

Conophis lineatus is a well known diurnal but sometimes crepuscular species that has been found in open pasture or crawling in the open, below second growth vegetation, hiding beneath vines on the sandy bank of a riverbed, on the forest floor, under logs or planks, and concealed in the root system of a small tree (Scott, 1983; McCranie, 2011). Several authors have reported the diet of this snake as consisting primarily of lizards, mostly the terrestrial *Aspidoscelis* and *Holcosus*, although one individual was photographed preying on a young *Ctenosaura similis* on a sandy beach (Hernández-Gallegos et al., 2008). In addition, this species is known to feed on frogs (unspecified), toads (*Incilus luetkenii*), snakes (in captivity), the eggs of ground nesting birds, and small rodents (Ditmars, 1931; Mittleman, 1944; Wellman, 1963; Scott, 1983; Mays, 2010).

Based on a captive individual of *C. lineatus*, Henderson and Binder (1981) reported that the snake excavated the substrate from underneath a rock in a terrarium, and clearly made a retreat for itself. Scott (1983) noted that the cone-shaped head in this species barely is differentiated from the body, and Savage (2002) indicated that the decurved and concave rostral suggests that *C. lineatus* burrows into the substrate, as this species frequently escapes capture by entering the burrows of other animals. Thus, based on morphological head characteristics, several field and captive behavioral observations, and the reported diet, this species purportedly leads a highly terrestrial existence.

On 23 February 2015, at ca. 1100 h, one of us (BMA) observed and photographed a *C. lineatus* coiled in a Mandarin Orange Tree (*Citrus reticulata*) about 4 m from the ground (Fig. 1) at Barrio Las Mesas, Brasil de Santa Ana, Provincia de San José, Costa Rica (9°56.331'N, 84°13.831'W; WGS 84), elev. ca. 900 m. The snake remained still for several minutes, then quickly moved to another part of the tree but did not descend to the ground. This report is the first to demonstrate arboreal behavior in *C. lineatus*. We suggest that in highly modified habitats, such as agricultural areas with sufficient foliage, individuals of *C. lineatus* might be drawn to climb trees in search of prey or to seek shelter.



Fig. 1. An adult *Conophis lineatus* coiled on the branches of a Mandarin Orange Tree.

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***Hydrophis platurus*. Predation by a Wood Stork (*Mycteria americana*).** The Yellow-bellied Seasnake is an abundant species along the Pacific Ocean of the Americas (Cambell and Lamar, 2004). This species lives near or at the surface in deep water, usually 1–20 km from shore, and is the only truly pelagic seasnake (Voris, 1983). In Costa Rica, *H. platurus* often is encountered in gulfs, bays, and areas relatively close to the shore, and strong seasonal winds and vigorous waves often cast individuals onto beaches (Solórzano, 2004).

Hydrophis platurus has been reported to be relatively immune from predatory attack owing to its aposematic coloration, and because noxious chemicals in its skin also act as a deterrent to predators (Heatwole, 1975, 1999). Predators of *H. platurus* include crabs (likely *Ocypode* spp.; partially eaten individuals have been reported protruding from crab holes), a pufferfish (probably *Sphoeroides annulatus*), Tiger Sharks (*Galeocerdo cuvier*), a Leopard Seal (*Hydruga leptonyx*), and possibly a young Galapagos Sea Lion (*Zalophus wollebaeki*) (Duellman, 1961; Heatwole and Finnie, 1980; Reynolds and Pickwell, 1984; Masunaga et al., 2007; Sheehy et al., 2011). Of these, the pufferfish and seal subsequently regurgitated the snakes, and the sea lion was observed vomiting but the body of a snake was not found. Birds also are known predators of seasnakes (Heatwole, 1999), and in the case of *H. platurus* a Lava Gull (*Larus fuliginosus*) was observed bringing an individual onto a research vessel but dropped it onto the deck when it was startled (Reynolds and Pickwell, 1984), and Frigatebirds (*Fregata magnificens*) have been reported to carry snakes for a short distance before dropping them into the water (Wetmore, 1965; Sheehy et al., 2011). Diagonal or V-shaped scarring on individuals of *H. platurus* from Costa Rica led Sheehy et al. (2011) to suggest that such incidents may be relatively common, and that attempted predation by birds likely is the explanation for the scars.

At ca. 0700 h on 3 January 2014, one of us (TK) observed a Wood Stork (*Mycteria americana*) capturing and eating an individual of *H. platurus* on the beach at Refugio de Vida Silvestre Ostional, Santa Cruz, Provincia de Guanacaste, Costa Rica. The snake apparently had become trapped on the beach as the tide changed. Black Vultures (*Coragyps atratus*) were present in the area, but made no effort to go near the snake. A Wood Stork (*M. americana*) soon approached the snake and began biting it vigorously (Fig. 1A) before picking it up by the tail and walking away (Fig. 1B). A smaller stork joined the scene (Fig. 1C), and the larger stork then grabbed the snake by the head to fully immobilize it (Fig. 1D) and flew vertically for a short distance (Fig. 1E), before landing and consuming it (Fig. 1F). We are not aware, however, if the stork suffered any ill effects or regurgitated the snake.



Fig. 1 (A–F). A Wood Stork (*Mycteria americana*) preying on a Yellow-bellied Seasnake (*Hydrophis platurus*) at Refugio de Vida Silvestre Ostional, Santa Cruz, Provincia de Guanacaste, Costa Rica. Sequence of events described in the text.

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***Thamnophis eques*. Antipredator Behavior.** *Thamnophis eques* is a relatively wide-ranging gartersnake, with a distribution extending from central and southeastern Arizona and adjacent New Mexico, in the United States, southward in Mexico through the Sierra Madre Occidental and the western portion of the Chihuahuan Desert, through to the Cordillera Volcánica and southern portion of the Mexican Plateau to Puebla, and with a disjunct population in Oaxaca (Rossman et al., 1996; McCranie and Wilson, 2001). Its elevational distribution also is broad, ranging from sea level to 3,000 m (Wilson and Johnson, 2010).

In discussing gartersnakes as models for studying behavior, Rossman et al. (1996: 90–91) stated that, “In terms of behavior, *Thamnophis* may be the most variable genus within the large family Colubridae” (now divided into several families), and indicated several reasons why “we have learned more about the behavior of *Thamnophis* than any other group of snakes.” Indeed, numerous studies on the natural history and ecology of garternakes have been published, and Rossman et al. (1996) provided an excellent overview of their behavior.

With regard to antipredator behavior, Arnold and Bennett (1988) examined the heritability of antipredator displays with numerous captive neonates of *T. radix*, as well as with a smaller field sample composed of individuals of all sizes that showed the same diversity of displays. These authors demonstrated that (1) antipredator displays can be highly variable within a population, (2) the behavior of individuals is consistent, and (3) behavioral differences, in part, are heritable. They also noted that snakes initially would flee when subjected to a threat, but after tiring would ball up and hide the head while waving the tail, or strike repeatedly. Rossman et al. (1996) remarked that other species of *Thamnophis* probably exhibit similar behaviors.

Tonic immobility is a natural state of paralysis that an animal displays when restrained. In a study involving immobility and supination in *T. elegans*, Gregory and Gregory (2006) noted that tonic immobility is a common response to a physical restraint, as opposed to a threat, and usually has been treated by authors as an anti-predator behavior. Although tonic immobility in snakes often has been compared with death feigning in the classic sense (e.g., *Heterodon*), differences exist; the two phenomena, however, appear to be closely related (Burghardt, 1991).

Gregory and Gregory (2006) commented that in field studies with various species of *Thamnophis*, once individuals were handled and released some did not escape but remained immobile for some time. In field studies with *T. elegans*, they reported instances of individuals voluntarily remaining on their backs (supination) when placed there, a behavior that usually has been associated with death feigning. Herein, we report on an event that occurred with a captive *T. eques*, which appears to show elements of tonic immobility and supination, as well as similarities with death feigning.

During a collecting trip by J. R. McCranie and LDW to the Mexican state of Aguascalientes in 1977, a number of specimens were brought back to the United States to be photographed before being preserved and sent to the LSUMZ collection. During a photo session conducted by J. R. McCranie and LWP, an individual of *T. eques* (LSUMZ 35168) collected 10.1 km WNW of Congoja (see McCranie and Wilson, 2001) began to display noteworthy behavior. A staged set was prepared for the photo shoot, and the snake was handled to obtain the desired positioning for the photographs. After several shots were taken (Fig. 1A), the snake erupted into convulsive movements, twisting its body in a writhing motion while moving along the set and opening the vent to expose its hemipenes (Fig. 1B), before lying on its back and becoming immobile with the anterior portion of its head partially tucked under the body (Fig. 1C). The snake remained in this position for several minutes before slowly moving the head upward, apparently to gain a better view (Fig. 1D). The snake then began to turn its body upright, slowly and methodically, while simultaneously waving the tail (Fig. 1E). The tail waving soon intensified and involved a series of undulating tail curls, and the snake hid part of its head under a coil. After a minute or two the snake raised the head and remained still, with the tail held in a tight curl (Fig. 1F).

Tail waving and curling in newly captured *T. eques* is a common occurrence (Conant, 2003; LWP and LDW, pers. observ.). Interestingly, Conant (2003) reported young *T. eques* often hiding the head toward the center of the body or under a loop, and when individuals were picked up to be photographed they sometimes would lie in a more-or-less straight line, but when placed on the set soon would coil.

The amount of morphological variation displayed by *T. eques* is extensive (e.g., see Manjarrez and Macías García, 1993; Conant, 2003), and has led to the recognition of 10 subspecies (www.reptile-database.org; accessed 9 February 2015). Conant (2003) described seven of these subspecies from isolated endorheic lakes in the Transvolcanic Belt of Mexico. Because what today is regarded as *T. eques* actually might comprise a complex of species, it would be interesting to compare certain aspects of behavior in this gartersnake from across its range.



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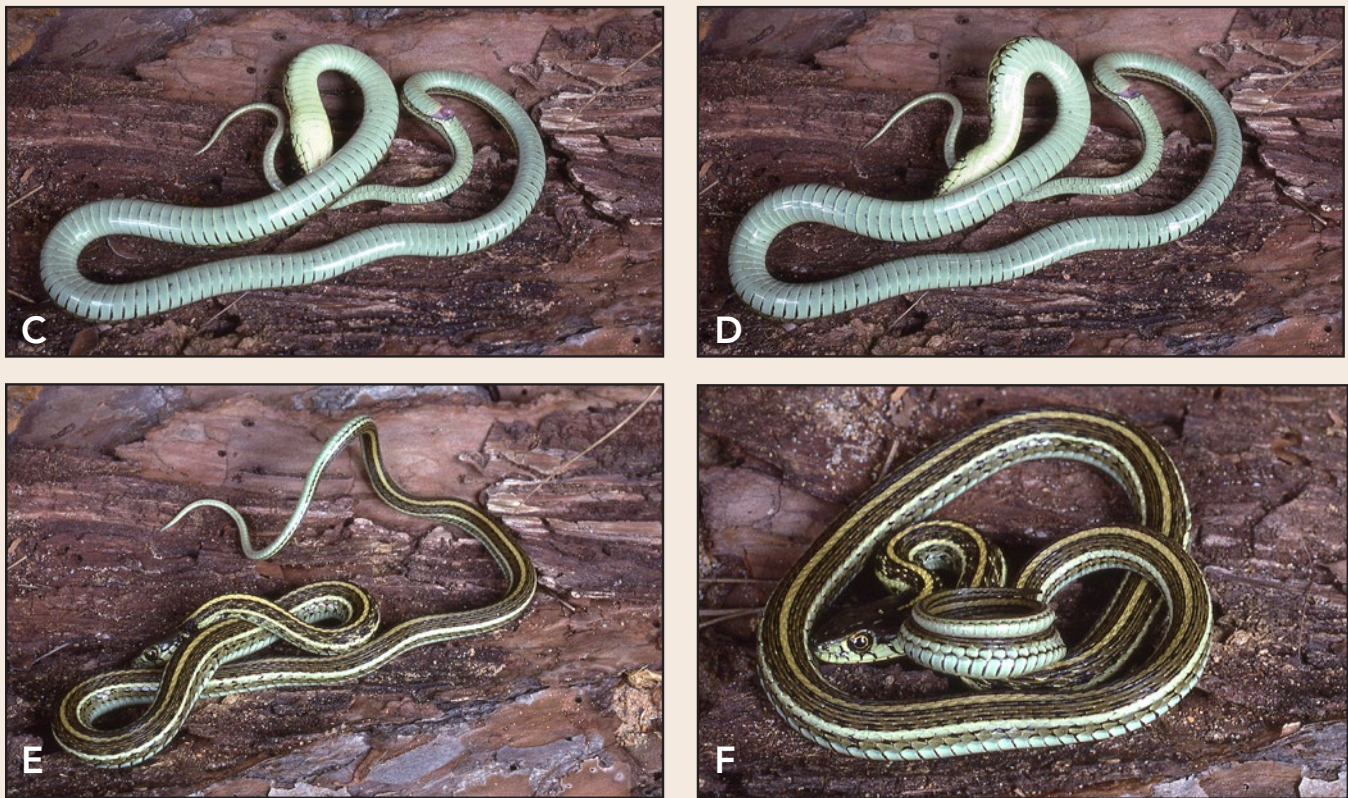



Fig. 1. (A–F) Behavioral sequence of events displayed by a captive *Thamnophis eques* from 10.1 km WNW of Congoja, Aguascalientes, Mexico. See text for explanation.  © Louis W. Porras

Acknowledgments.— We thank Douglas A. Rossman for an earlier discussion regarding the behavior of *Thamnophis*, and James R. McCranie for allowing the photo session described in this note to take place in his home.

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DISTRIBUTION NOTES

Reptilia: Squamata (snakes)

Family Dipsadidae

Coniophanes michoacanensis Flores-Villela and Smith, 2009. MEXICO: GUERRERO: Municipio de Zihuatanejo de Azueta, Ixtapa-Zihuatanejo (17.68645°N, -101.636246°W, WGS 84); elev. 19 m; 31 December 2011. Rafael Alejandro Calzada-Arciniega. The individual was found under a stump at the edge of a wetland area. Photographs of the snake were deposited in the Museo de las Ciencias Biológicas “Enrique Beltrán” (Fig. 1; photo vouchers MCBFESIR-290–291), which represent the third record for the species and second for the state of Guerrero. This locality extends the known distribution of this species in Guerrero ca. 46.8 km [airline] from the first state record, at 7 km NE of Vallecitos, Zihuatanejo (17.9432°N, 101.2802°W, 800 m) (Mertz et al., 2012). The other record for the species (the holotype) is from Michoacán, Municipio de Aquila, El Farito, 8 km NW of Caldea de Campos, elev. 17 m (Flores-Villela and Smith, 2009). The record in this note provides additional distributional information for this little-known species.



Fig. 1. *Coniophanes michoacanensis* from Guerrero, Municipio de Zihuatanejo de Azueta, Ixtapa-Zihuatanejo.

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Northernmost populations of spiny-tailed iguanas (*Ctenosaura*)


Many representatives of tropical amphibian and reptile genera in the Americas reach their northern limits in the lowlands and foothills of Sonora on the Pacific versant, and Tamaulipas and Nuevo León on the Caribbean versant of Mexico. The distributions of a few of these extend into the United States. The northernmost tropical deciduous forest and tropical foothills thornscrub, and a great number of associated animals with tropical affinities occur in Sonora at 28–30°N latitude, owing to relatively wet summers and to high mountains to the north that block incursions of cold arctic air masses and the freezing temperatures experienced at similar latitudes elsewhere in northern Mexico and the United States (Martin and Yetman, 2000; Felger et al., 2001). Many tropical amphibians and reptiles reach their northern limits in Sonora in tropical deciduous forest or the drier, lower stature foothills thornscrub, the transitional vegetation into Sonoran desertscrub, desert grassland, and oak woodland (Martin et al., 1998). Examples include Sinaloa Toad (*Incilius mazatlanensis*), Northwest Mexico Leopard Frog (*Lithobates magnaocularis*), Mexican Treefrog (*Smilisca baudinii*), Boa Constrictor (*Boa imperator*), Mexican West Coast Rattlesnake (*Crotalus basiliscus*), Central American Indigo Snake (*Drymarchon melanurus*), Río Fuerte Beaded Lizard (*Heloderma exasperatum*), Pacific Coast Parrot Snake (*Leptophis diplotropis*), Western White-bellied Spiny Lizard (*Sceloporus albiventris*), Spotted Box Turtle (*Terrapene nelsoni*), and Mexican Lyresnake (*Trimorphodon tau*) (see Rorabaugh, 2008).

Spiny-tailed Iguanas (*Ctenosaura*) are moderate to large lizards (to 1,300 mm total length) of the tropics distributed from northern Mexico to Colombia and characterized by whorls of large, spiny scales on the tail (Savage, 2002). Eighteen species are recognized (The Reptile Database, 2015), of which the most northern is the Sonoran Spiny-tailed Iguana (*C. maculophaga*); it occurs from northern Sinaloa and southwestern Chihuahua to northern Sonora, Mexico (Hollingsworth, 2004; Enderson et al., 2009). Four species, however, have been introduced to and are established in the United States (Arizona, Florida, and Texas) well north of their native ranges (Crother, 2012). In Texas, the Western Spiny-tailed Iguana (*C. pectinata*) occurs in and near the Gladys Porter Zoo in Brownsville at 25.883°N (Locey et al., 2008; all coordinates herein are in WGS84). In Florida, the Black Iguana (*C. similis*) occurs at least as far north as 27.4°N in Manatee County, and *C. pectinata* occurs north to Hollywood, Broward County at 26.0°N (Krysko et al., 2011). The northernmost population of *Ctenosaura* occurs at the Arizona-Sonora Desert Museum near Tucson, Arizona at 32.244°N (Edwards et al., 2005). It originated from lizards that were captured in Mexico and released on the grounds of the museum in the 1970s, although additional escapees may have added to the founder population. Genetic studies revealed the presence of two mitochondrial DNA signatures: *C. maculophaga* and the Isla San Esteban Spiny-tailed Iguana (*C. conspicuosa*), although hybrids may be present as well (Edwards et al., 2005).

We surveyed opportunistically for *C. macrolopha* in northern Sonora from 2009 to 2012, perused pertinent literature, as well as specimens and data in 28 herpetological collections. The oldest collection of *C. macrolopha* in this region is USNM 17178, collected in 1890 in Nogales, Arizona, which is on the border and adjacent to Nogales, Sonora. Bailey (1928: 21) commented on this specimen, indicating that, “the United States National Museum catalogue record shows that it was ‘brought into town by a boy who was leading it around by a string.’ George B. Marsh procured the specimen from the boy, and turned it over to P. L. Jouy, who sent it to the Museum at Washington.” Based on our surveys and perusal of literature and museum collections, no other *Ctenosaura* have been collected at or near Nogales, Arizona, or in Nogales, Sonora or other areas that far north in Sonora. We presume this lizard was captured farther south, in Mexico, and exported across the border.

Enderson et al. (2009) listed the northernmost *C. macrolopha* in Sonora as UAZ 56701-PSV from “northwest of Benjamín Hill, Municipio de Benjamín Hill.” That photo voucher consists of three individuals photographed by TRV at Rancho El Carrizo, 20.5 km south of Benjamín Hill and 16.9 km west of Mexican Highway 15 (30.0447200°N, -111.2286100°W) in mesquite-dominated Sonoran desertscrub at 726 m elevation. Other extreme northern collections from Sonora include: (1) UAZ 01525 collected April 1955 at 6.2 km (rd) NW Opodepe, Río San Miguel (29.96429°N, -110.66350°W, elev. 788 m; the Río San Miguel is a major, western tributary of the Río Sonora), (2) MZFC 14558 collected at Presa Rudolfo Félix Valdes (no date), Río Sonora (29.22902°N, -110.70712°W, elev. 286 m), and (3) UAZ 39192 collected June 1974 at 6.1 km (rd) S Óputo (= Villa Hidalgo) along the Río Bavispe in foothills thornscrub (30.108457°N, -109.330230°W, elev. 649 m). The latter specimen is the northernmost record we found in museum collections or the literature.



Fig. 1. *Ctenosaura macrolopha* (UAZ 57454-PSV) photographed 28 July 2009 in Arroyo los Chihuis (= Venado) to the east of the Río San Miguel (30.241403°N, -110.675343°W, elev. 882 m) in foothills thornscrub. This is the northernmost naturally occurring locality for *Ctenosaura*.  © Stephen L. Minter

Our surveys resulted in three photo vouchers of *C. macrolopha* north of UAZ 39192, and new, northern records along the mainstem of the Río Sonora, Sonora, Mexico (Table 1). The northernmost naturally-occurring locality for the species (and the genus *Ctenosaura*) is UAZ 57454-PSV (Fig. 1), photo vouchered by SLM in Arroyo Los Chihuis near the Río San Miguel (30.241403°N), followed by UAZ 57455-PSV also vouchered by SLM along the Río San Miguel at Rancho El Estero, 3.5 km (by air) N of Tuape (30.18028°N), and UAZ 57456-PSV vouchered by TRV at Benjamín Hill (30.169440°N, which is in the Arroyo El Carrizo/Río Asunción drainage). Prior to our work, the northernmost *C. macrolopha* in the Río Sonora Valley was MZFC 14558, noted above, from Presa Rudolfo Félix

Valdes. We photo vouchered the species well upstream of that locality at Aconchi (29.825677°N) and 16 km N of Aconchi (29.92972°N, Table 1). TRV and A.L. Reina-G observed, but were not able to photograph, a *C. macrolopha* in the Río Sonora Valley on 17 August 2001, at 6.5 km (by air) S of Sinoquipe (30.097780°N, -110.246940°W, elev. 730 m).

Four of the five northern localities in Table 1 are in towns or at ranches. The lizards are less wary and easier to observe in these situations, but rock walls and buildings may also provide shelter against winter cold. Given the introductions at the Arizona-Sonora Desert Museum and the 1890 collection from Nogales, Arizona, one could argue that association of the species with human structures at sites in Table 1 could indicate introductions. We think this is unlikely. Throughout its range, *C. macrolopha* commonly is associated with human structures. Also, the northernmost locality (Arroyo los Chihuis) and the northernmost observation in the Río Sonora Valley (6.5 km [by air] S of Sinoquipe) were not associated with human habitations or structures. In these northern areas, lizards often shelter in holes in mesquites (*Prosopis velutina* or *P. glandulosa*) or other trees.

TABLE 1. Northern localities of <i>Ctenosaura macrolopha</i> photo-vouchered by the authors.				
Locality in Sonora, Mexico	Habitat	Date	Collector	University of Arizona Catalog Number ^a
16 km N of Aconchi along Hwy 89, 29.92972°N, -110.21448 W, elev. 638 m	Rock walls and buildings. Foothills thornscrub to the east, riparian thickets along the Río Sonora to the west.	5 Sep 2012	TRJ, JDB	UAZ 57453-PSV
Aconchi, 29.825677°N, -110.228825°W, elev. 615 m	Buildings in town. Mesquite (<i>Prosopis velutina</i>) thickets to the west along the Río Sonora and foothills thornscrub to the east.	5 Sep 2012	JCR	UAZ 57452-PSV
Benjamín Hill, 30.1694400°N, -111.0986100°W, elev. 737 m	Buildings in town. Sonoran desertscrub outside of town.	2 Aug 2009	TRV and A.L. Reina-G	UAZ 57456-PSV
Arroyo los Chihuis (=Venado) to the east of the Río San Miguel, 30.241403°N, -110.675343°W, elev. 882 m	Arroyo in foothills thornscrub	28 July 2009	SLM	UAZ 57454-PSV
Rancho El Estero, 3.5 km (by air) N of Tuape, Río San Miguel floodplain, 30.18028°N, -110.68722°W, elev. 909 m.	Mesquites near ranch houses in the Río San Miguel floodplain. Foothills thornscrub on adjacent uplands.	28 July 2009	SLM	UAZ 57455-PSV

^aAlso vouchered in the Madrean Archipelago Biodiversity Assessment online database (www.madrean.org/maba/symbfauna/).

In the ríos San Miguel and Sonora valleys, *C. macrolopha* localities lie within fingers of foothills thornscrub that extend along these rivers into otherwise more temperate vegetation communities (e.g. desert grasslands, oak woodlands). The same is true for UAZ 39192 from 6.1 km (rd) S Óputo, which is in foothills thornscrub that follows the Río Bavispe into northeastern Sonora. The distribution of *C. macrolopha* apparently follows these corridors of tropical communities at moderate (615–909 m) elevations. We would not be surprised if the species occurs along these corridors at least as far north as the foothills thornscrub community extends: at least to Cucurpe on the Río San Miguel (30.331°N), north of Arizpe on the Río Sonora (30.336°N), and to near Presa La Angostura on the Río Bavispe (30.438°N). In the Benjamín Hill area, *C. macrolopha* occupies desertscrub, in the Plains of Sonora subdivision of the Sonoran Desert, which extends as far north as Santa Ana (30.540°N). At some point the natural distribution of *C. macrolopha* likely is limited by freezing temperatures. Although the population at the Arizona-Sonora Desert Museum near Tucson is evidence that under the right conditions, freezing temperatures north into south-central Arizona do not preclude breeding populations. To the west of Benjamín Hill, we assume increasing aridity becomes limiting (see Bogert and Oliver, 1945: 327).

The Río Sonora is a major corridor for foothills thornscrub and tropical species into the Sonoran Desert in the Hermosillo area. In 1963, Ted Papenfuss collected a *Drymarchon melanurus* (MVZ 76497) from 56 kilometers

(by road) west of Hermosillo where riparian habitats enter xeric environments on the coastal plain of the Gulf of California. The locality is near the present town of Miguel Alemán in the extensive agricultural area known as La Costa de Hermosillo. This suggests that before the construction of the Presas Abelardo L. Rodríguez and Rudolfo Félix Valdes reservoirs on the Río Sonora and associated agricultural and rural development, other species with tropical affinities may have occurred west onto the coastal plain, as well.

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First record of the coralsnake, *Micrurus nebularis* Roze 1989, from the state of Puebla, Mexico

The coralsnake, *Micrurus nebularis*, was described on the basis of six specimens from the vicinity of Ixtlán de Juárez, southern Sierra de Juárez, Oaxaca, Mexico (Roze, 1989). Since the species' description, only two more specimens have been reported: one from just south of Ixtlán de Juárez (Campbell and Lamar, 2004), and one from Sierra de Monteflor in north-central Oaxaca (Canseco Márquez and Gutiérrez Mayén, 2010).

Micrurus nebularis differs from similar coralsnakes by the presence of 23–24 and 26–28 monodal black bands in males and females, respectively; 203–208 and 218–223 ventrals in males and females, respectively; the anterior portion of head covered by a black mask (mask covering from tip of snout to level of three-fourths of frontal or beyond, supraoculars and adjacent portion of parietals, upper postocular, anterior half of lower postocular or beyond, most of 4th supralabial, first three infralabials, and anterior portion of anterior chinshields), and by nearly lacking or lacking black tips and saddle-like black spots on the red scales and the absence of supraocloacal tubercles in males (Roze, 1989; Canseco-Márquez and Campbell, 2003). *Micrurus nebularis* is most similar to *M. pachecogili*, which is restricted to the desert region of the Tehuacán-Cuicatlán Valley in southern Puebla and northern Oaxaca. *Micrurus nebularis*, however, is reliably distinguished from the latter species by the presence of fewer ventrals (203–208 vs. 218–223 in males, and 218–223 vs. 235–242 in females of *M. pachecogili*) and a more extensive black mask on the head that extends from tip of the snout to the anterior portion of the parietals (vs. a black mask on the head that does not reach the parietals in *M. pachecogili*; Canseco-Márquez and Campbell, 2003).

On 10 September 2014, at ca. 1900 h, we collected an adult male *Micrurus nebularis* (field number ANMO 4246) on Mexico Hwy. 182, Vigastepec, Municipality of Coxcatlán, Puebla, Mexico (18.18676N, 97.04615W; WGS 84); elev. 1996 m. The specimen was found dead on the road, apparently soon after it was run over by a vehicle. The vegetation alongside the road consisted of oak forest with elements of tropical deciduous forest. Roze (1989) described the vegetation in the region of the type-locality as cloud forest and pine-oak woodlands. The vegetation around Ixtlán de Juárez, however, is pine-oak-madroño forest on the upper slopes, grading into tropical deciduous forest and arid tropical scrub in the lower valleys (Campbell and Lamar, 2004), which resembles the vegetation where the Pueblan specimen was collected. The specimen was deposited in the herpetological collection of the Museo de Zoología “Alfonso L. Herrera,” Facultad de Ciencias, Universidad Nacional Autónoma de México (MZFC 28872). Our record is the ninth for the species and the first for the state of Puebla and outside of Oaxaca, extending the known range ca. 73 km (airline) NNW of the closest record (Canseco Márquez and Gutiérrez Mayén, 2010) and ca. 113 km (airline) NNW from the type locality (Roze, 1989; Fig. 1). Additionally, it represents the northernmost record of *M. nebularis* and the closest locality to records of *M. pachecogili* (Canseco Márquez and Gutiérrez Mayén, 2010; Fig. 1).

MZFC 28872 shows most of the diagnostic characters of *Micrurus nebularis*. Given the scarcity of known specimens for the species, we proceed to describe MZFC 28872 as follows (measurements in mm): adult male; head length = 13.31, snout–vent length = 525.50, and tail length = 87.34. Head slightly distinct from body; snout rounded from above, projecting anteriorly far beyond lower jaw; rostral 1.41 times wider than high; prefrontals twice as long as internasals; frontal hexagonal, 1.29 times longer than its distance to tip of snout; supraocular large, extending far beyond anterior and posterior margins of orbit; parietals 1.53 times longer than wide, their distance to tip of snout 1.10 times longer than their length; temporals 1 + 1 + 2, upper tertiary temporal the largest; supralabials 7/7, 3rd and 4th entering the orbit; nasals divided, anterior nasal 1.23 times longer than posterior nasal; preocular 1.11 times longer than high; postoculars 2, upper postocular about as long as high, lower postocular nearly twice higher than long; mental triangular, 1.56 times wider than long; infralabials 7/7, 1st pair in medial contact, 4th the largest; 1st–4th in contact with anterior chinshields, 4th in contact with posterior chinshields; posterior chinshields 1.53 times longer than anterior chinshields; and midgulars 2. Dorsal scale rows 17-15-15; ventrals 210; subcaudals 47; dorsal scales smooth, lacking tubercles throughout length of body; and subcloacal scute divided, with right one divided horizontally.

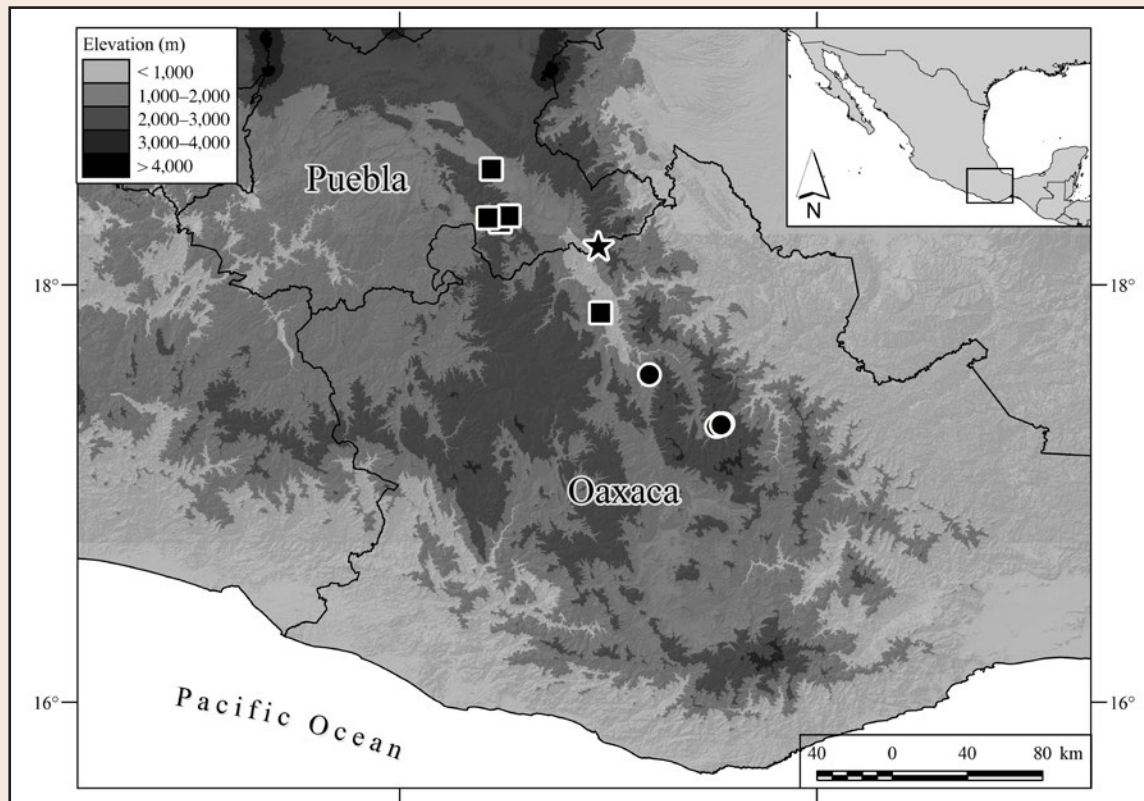


Fig. 1. Geographic records for *Micrurus nebularis* (circles) and *M. pachecogili* (squares). The star represents the new record of *M. nebularis*.

Anterior portion of head covered by black mask; posterior margin of mask extends across posterior one-fourth of frontal and anteriormost portion of parietals, curves lateroventrally along posterior margin of upper postoculars and anteroventrally along anterior margin of lower postoculars, between posterodorsal and anteroventral corners of 4th supralabials, and from middorsal edge to anteroventral corner of 3rd infralabials and medial margin of 2nd infralabials, then curves anteriorly across middle of 1st infralabials and medially across mid-mental. Black, midventral, triangular spot present on posterior halves of anterior chinshields. Yellow parietal crossband follows black anterior mask posteriorly, extending posteriorly to posterior portion of parietals; its posterior margin curves lateroventrally across middle of upper tertiary temporal, anteriormost portion of lower tertiary temporal on left side and posteriormost portion of secondary temporal on right side, middle of 7th supralabials, posterior one-fourth of 6th infralabials, two gulars, posterior margin of posterior chinshields, and middle of 1st midgular. Black occipital crossband follows yellow parietal band posteriorly, covering posterior portion of parietals and extending posteriorly to 5th transversal row of dorsals, its posterior margin curving anteroventrally to mid-posterior margin of 2nd ventral.

Twenty six black body rings, each about three scales-wide on anterior portion of body, four scales-wide at level of midbody, and four and one half scales-wide on posterior portion of body; red rings three scales-wide, their scales grading to dark brown posteriorly; yellow rings narrow, about one to one and one half scales-wide, except for ring immediately anterior to level of vent; latter ring four scales-wide. Seven black tail rings, last one including tip of tail, each about five scales-wide, except for ring at tip of tail; latter ring four scales-wide; six yellow tail rings, each about three scales-wide. This specimen differs from all of the other known specimens of the species in that the black mask does not cover the anterior chinshields, and in that it exhibits a black triangle on the anterior chinshields and the highest count of black body rings known for males of this species.

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MISCELLANEOUS NOTES

First recorded female specimen of *Norops fungosus* (Myers, 1971)

Norops fungosus is an arboreal anole endemic to moderate elevations (1,200–1,600 m asl) of the Cordillera de Talamanca in eastern Costa Rica and western Panama (Savage, 2002; Köhler, 2008). To date, only a handful of specimens of *N. fungosus* have been collected (Myers, 1971; Köhler et al., 2008), and all have been males. *Norops fungosus* has been assigned to the *N. pentaprion* group based on morphological similarity, although no genetic data has been used to test this relationship. The initial description of *N. fungosus* (Myers, 1971) was based on a single male from near Cerro Pando, Panama. The only other recorded locality for *N. fungosus* in Panama is Reserva Forestal Fortuna, where a single male was collected (Köhler et al., 2008).

On 2 June 2012 a female *Norops fungosus* was found by four of the authors (JGP, DL, SB, KEN) in front of the Centro de Investigaciones Jorge L. Arauz within the Reserva Forestal Fortuna, Chiriquí Province, Panama (8.72190°N, 82.23726°W; WSG 84, elev. 1,216 m). The individual was found at 2245 h, asleep on a leaf above a small roadside stream. The specimen was deposited at the Museo de Vertebrados de la Universidad de Panama (MVUP-2095). Another female of *N. fungosus* was found nearby on the same date at 2141 h, sleeping 2.5 meters above the ground in shrubbery at the forest edge near the midpoint of the trail leading from Highway 21 to the Lost and Found Eco Lodge (8.67405°N, 82.21977°W), elev. 1,200 m, near La Fortuna (EW). To our knowledge, these represent the first documented females of *N. fungosus*.

Morphologically, we observed no significant differences between the males and females of *N. fungosus*, except for the dewlap. Similar to all other members of the *N. pentaprion* group, a dewlap is present in females of *N. fungosus* (Köhler, 2010), a feature lacking in females of most anoles but present in some arboreal species (Schwartz and Henderson, 1991; Nicholson et al., 2007). The dewlap in both females was small and pale yellow (Fig. 1), compared to the larger red-colored dewlaps of male *N. fungosus* (Fig. 2). Distinctive black coloration was evident in the lining the mouth and throat of both females (Fig 1., inset), which also is present in males (Myers, 1971).



Fig. 1. Female *Norops fungosus* (MVUP-2095) collected at Reserva Forestal Fortuna.

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Fig. 2. Dewlap of a male *Norops fungosus*.

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Range extension and notes on the natural history of *Trimetopon barbouri* Dunn, 1930 (Serpentes: Colubridae)

The leaf-litter snakes, those small individuals that are cryptozoic or fossorial and move primarily through the leaf litter, are one of the most understudied groups because they are rarely encountered. The lack of data is even more magnified in the Neotropics, where some species still are known from one or a few individuals (e.g., *Tantilla albiceps* Barbour 1925, and until recently, *Geophis bellus* Myers 2003 [Myers, 2003; Köhler, 2008; E. Lara, unpublished].)

The genus *Trimetopon*, with a distribution in Costa Rica and Panama (Köhler, 2008), includes six species that are among the shortest colubrids known; they also are among the most understudied species of snakes. Data on the natural history of these snakes, such as period of activity, behaviors, diet, and reproductive cycle are scarce or lacking for most species, and generalized across the genus (Solórzano, 2004; Herse and Ray, 2014).

Trimetopon barbouri Dunn 1930, is endemic to Panama and its elevational range extends from 20 to 800 m asl (Jaramillo et al., 2010). Until recently, this species only was known from near the Panama Canal (Myers and Rand, 1969; Rand and Myers, 1990; Köhler, 2008) and one specimen in the Florida Museum of Natural History from the Darién Province (FMNH 170151). Ray et al. (2013) reported an individual from far eastern Coclé Province, and then extended the range to central Coclé Province near Parque Nacional G.D. Omar Torrijos H. (Fig. 1). No additional data were collected on the natural history of these individuals, however, because the former was released immediately and the latter was found dead.

Here we report a further range extension for the species and describe some natural history attributes.

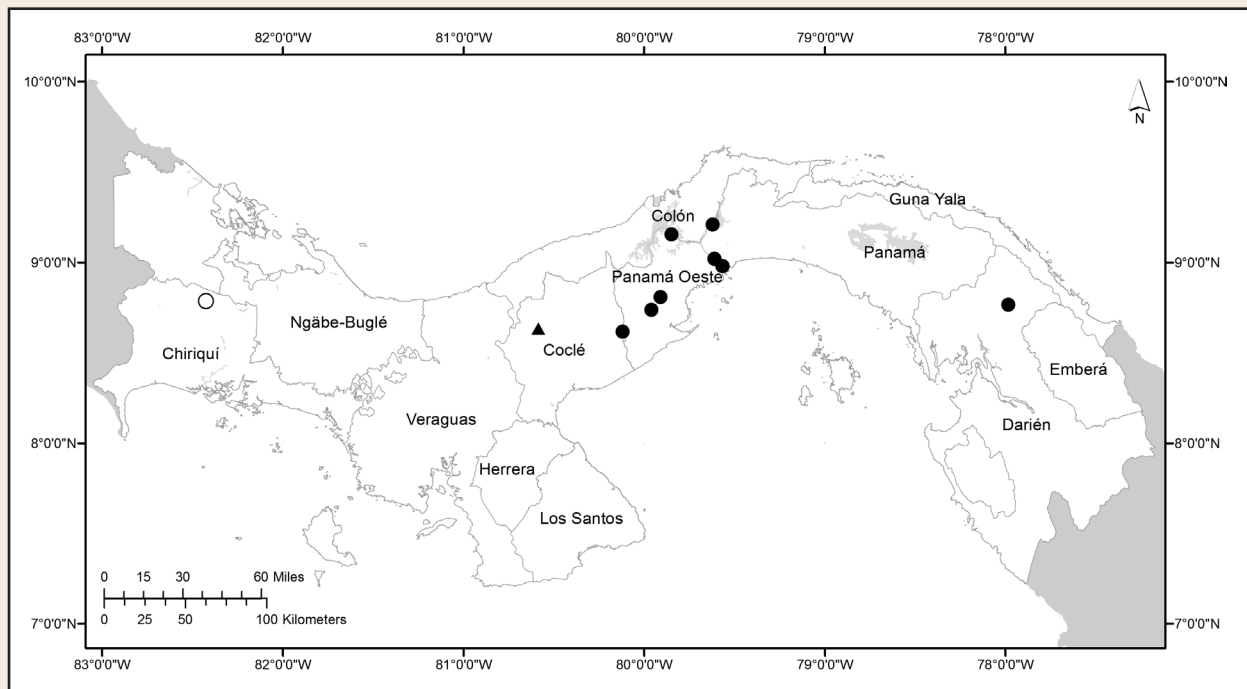


Fig. 1. Map of all known populations of *Trimetopon barbouri* in Panama. The star designates the holotype. Solid circles are published records or from specimens in museums. The triangle designates the individuals found in La Barrigón, Coclé Province. The open circle is the new record at Serenity Vista in Chiriquí Province reported herein.

Range Extension

On 08 August 2014, at 1100 h, Veronica Villarreal found a *T. barbouri* (field number JMR 2014-024; Fig. 2) in an apartment on JD's property (Fig. 3a-c) in Jaramillo Arriba, Boquete, Chiriquí Province, Republic of Panama (8.787965°N, 82.427544°W; WGS84, 1,142 m asl; Fig. 1). The snake was found on the floor in front of a sofa (Fig. 3c), dead and desiccated.

The specimen measures ca. 170 mm in snout–vent length (SVL), with a total length of ca. 190 mm (tail length = 10.5% of total length); we could not determine its sex. We identified the snake by the characteristic spots on the head and the alternating pale and dark stripes on the lateral and dorsal sides. The ventral surface is cream with darker pigmentation posteriorly and on the tail. The prefrontals are separate, as in other specimens of *T. barbouri*; in other members of the genus the prefrontals are fused. The scalation is as follows, with the counts of the holotype in parentheses (Dunn, 1930): 15 (15) dorsal scales at midbody, 140 (153) ventral scales, and 58 (58) subcaudals.

This record extends the known range of the species by over 200 km straight-line distance. As indicated above, *T. barbouri* is endemic to Panama, and the other five species occur in Costa Rica where three are endemic and the other two are found just across the political border into Panama (Köhler, 2008). Given the small size of *T. barbouri*, its elusiveness, and the seemingly adequate habitat in the area, its distribution might extend to the Costa Rican border and beyond.


Furthermore, this specimen represents an elevational range extension for the species, of ca. 800 m from the individual recently found in La Barrigón, Coclé Province (Ray et al., 2013). The elevational range now extends from near sea level in the area of the Panama Canal (Myers and Rand, 1969; Jaramillo et al., 2010) to over 1,100 m, suggesting that the species could be found in most any suitable habitat in Panama, regardless of elevation.



Fig. 2. *Trimetopon barbouri* (JMR 2014-024) found at Serenity Vista, Chiriqui Province, Panama. Inset shows right side of the head. The animal was dead and desiccated when found.

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Fig. 3. Vegetation along the back of the apartment where a *Trimetopon barbouri* (JMR 2014-024) from Serenity Vista, Chiriquí Province, Panama, was found.  © Jane Derry

Natural History

As the above individual of *T. barbouri* was found dead in a human structure, little can be gathered on its natural history, other than perhaps dehydration is a real threat to these small, leaf-litter snakes. In the past year, however, a live individual was found in La Barrigón, Coclé Province, the same community and just a couple of hundred meters from the site of the individual described in Ray et al. (2013).

The second individual from La Barrigón (field number: JMR 925; Fig. 4) was found on 14 June 2013 at ca. 1830 h by Leslie Brinkman and Mike Itgen, as it was crawling on a narrow, natural trail that leads to La MICA Biological Station, community of La Barrigón, Coclé Province (8.628011°N, 80.579295°W; Fig. 1). The general habitat in the area consists of small patches of secondary forest intermixed with cleared areas for concrete-block houses and small agricultural plots where corn, yuca, or oranges are cultivated. Where present, the leaf litter is fairly thick, as is the understory beneath a canopy of trees, which reach a height of 7–10 m or higher. The snake was found in a forested patch with thick leaf litter. The time of movement suggests a crepuscular activity period, at least when moving above the leaf litter.

This individual was a male that measured 84 mm SVL and 28 mm tail length (tail = 25% of total length). Its small size suggests it may be a juvenile, but this could not be confirmed. Like the other individuals we found, this one shows the characteristic spots on the head, pale and dark alternating stripes on the dorsum (Ray et al., 2013), separate prefrontals, and the presence of a loreal scale. The scale counts are as follows: 15 scale rows at midbody, 143 (153 in the holotype and 145 in the other La Barrigón animal) ventrals, and 62 (58 in the holotype and 53 in the other La Barrigón animal) subcaudals.

When the snake was captured, it tried to flee by wiggling and attempting to body thrash within the grip of the capturer. It did not attempt to strike or bite nor did it excrete any noticeable musk or fecal material, although fecal matter may have been quite small given the size of the snake.

The snake was palpated for dietary items, but nothing was regurgitated. Nothing could be determined on the reproductive status of the individual.



Fig. 4. Small, likely juvenile, male *Trimetopon barbouri* (JMR925) found near La MICA Biological Station, La Barrigón, Coclé Province, Panama. A United States quarter provides a size scale. © Julie M. Ray

Conservation

Jaramillo et al. (2010) listed the IUCN conservation status of *T. barbouri* as Vulnerable. The discovery of additional populations of the species outside of the Panama Canal Zone and the extension of the range well into western Panama provides evidence that perhaps the species is more common than previously thought. At the very least, additional populations will help ensure the future of the species, especially given the current threats to populations in the Canal Zone where the construction of roads, houses, and other structures, including the Canal expansion project, is further modifying the habitat.

Conclusion

The small leaf litter snakes of the Neotropics remain relatively understudied, but recent publications on such are beginning to provide more information on their geographic distribution and natural history. Researchers must continue to collect and submit information on these species when they are found, in order to continue to fill information gaps. Such data will be essential as more habitats are destroyed and conservation plans are needed to protect tracts of unaltered forest that are left or restored altered forest toward its historic condition.

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