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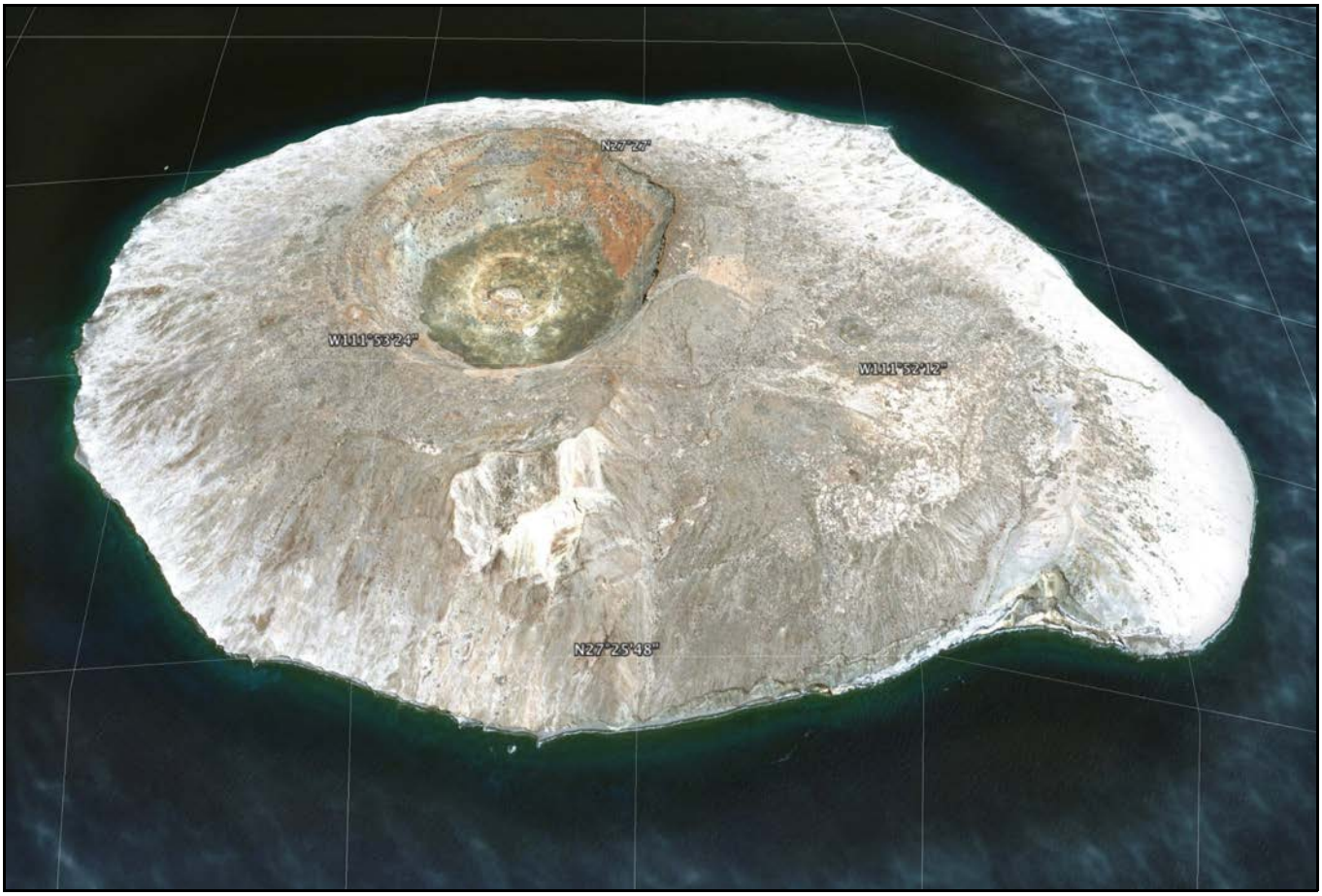

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Cover: Tortuga Island in the Gulf of California, Mexico. Google Earth image © 2018 DigitalGlobe

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Notes on the Herpetofauna of Northwestern Mexico 2: Tortuga Island, Gulf of California, Mexico

Gustavo Arnaud [1], David Lazcano [2] and Larry David Wilson [3]

Introduction

The Gulf of California islands belong to the Reserve and Refuge Areas for Migratory Birds and Wildlife and are sites of reproduction, nesting, resting, and feeding for marine wildlife and migratory birds (Tershy and Croll, 1994). In spite of this status, the population sizes, distribution, abundance, and natural history of most of the reptiles living on these islands are unknown.

The conditions of the islands are variable, because they are not homogeneous in origin, age, geology, or distance from the coast (Case et al., 2002). The islands of the Gulf of California are classified into three types: oceanic, continental, and land-bridge (Grismer, 2002). The oceanic islands have never been connected to Baja California peninsula or mainland Mexico. The continental islands were once connected to the Baja California peninsula and/or mainland Mexico, but became separated as a result of tectonic displacements along coastal fault zones, and broke off the trailing edge of the peninsula as it moved northwest. The landbridge islands are the commonest and youngest of all the islands in the Gulf of California, and were connected to Baja California or mainland Mexico, but for the most part, were cut off by a rise in sea level (Grismer, 2002).

The climate of the islands is very arid, with summer rains and little or no winter precipitation. The vegetation is dense in glens and along streams, contrasting with the rocky, arid slopes. Such places are a refuge for reptiles. These islands have a highly diverse terrestrial herpetofauna of 92 species, distributed on 68 islands, including one tortoise, 55 lizards, and 36 snakes. The percentage of endemicity is 48%, one of the highest in the world. Thirty-one taxa of lizards (56.4%) and 14 taxa of snakes (38.9%) are endemic to one or several islands (Blázquez et al., 2018). The species of the genus *Crotalus* are an important ecological element of the endemic fauna of these islands; they all play an important role as primary predators (Ruiz-Sanchez et al., 2019).

The Gulf of California islands are a priority for conservation of biodiversity in Mexico (Vázquez-Domínguez et al., 1998). Therefore, we need to understand the natural biodiversity and resources they support. Most of the islands are not inhabited by people; they are visited, however, by tourists, fishermen and scientists. The resulting impact on the terrestrial ecosystems has not yet been evaluated (López-Espinosa de los Monteros, 2002). In this context, we have documented herpetological information for the little-known Tortuga Island (*Isla Tortuga*).

Our Goals

Lack of information about the ecology and abundance of the Mexican insular herpetofauna makes it important to increase our knowledge of this group of vertebrates. We hope that through ecological and educational programs on mainland Baja California, we can foster greater awareness of the importance of this group of organisms and promote further protection and conservation of the islands.

Study Area

Tortuga Island is an oceanic island, located at 27°26'00" N and 111°52'00" W in the Gulf of California (Figure 1), and has an area of 11.36 km² (dimensions approximately 4.7 × 3.3 km).

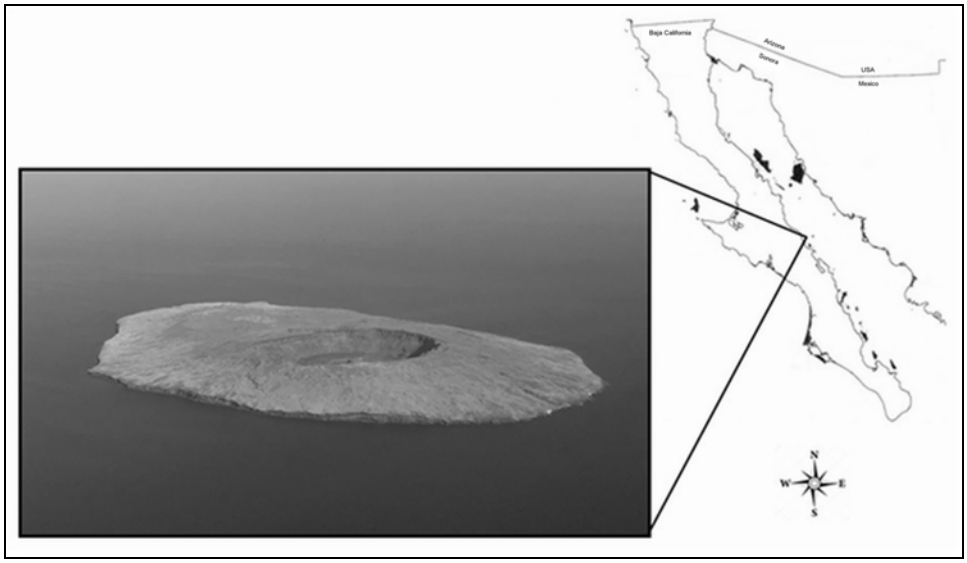

Figure 1. Location and physiography of Tortuga Island in the Gulf of California, Mexico. Source: Google Earth

1. Centro de Investigaciones Biológicas del Noroeste, La Paz, Baja California Sur, CP 23096, México. (garnaud04@cibnor.mx)

2. Laboratorio de Herpetología, Facultad de Ciencias Biológicas, Universidad Autónoma de Nuevo León, Apartado Postal 157, San Nicolás de los Garza, Nuevo León, C.P. 66450 México. (imantodes52@hotmail.com)

3. Centro Zamorano de Biodiversidad, Escuela Agrícola Panamericana Zamorano, Departamento de Francisco Morazán, Honduras; 16010 SW 207th Ave, Miami, FL 33187-1056, USA. (bufodoc@aol.com)

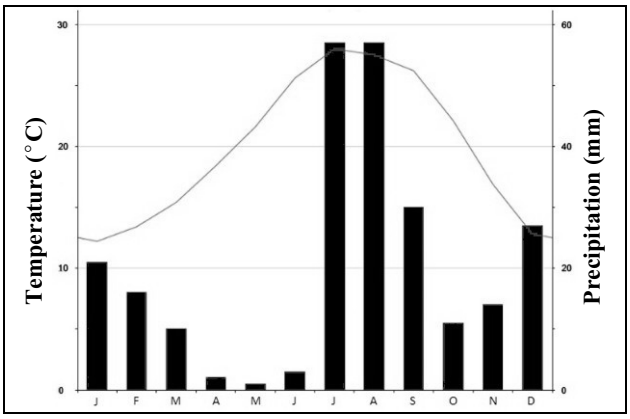

Figure 2. Annual climogram of the Tortuga Island region. The line graph shows average daily temperature using the scale on the left. The bar graph plots average monthly precipitation using the scale on the right.

The island is a volcanic cone with an elevation of 309 m (Murphy et al., 2002). The physiography is dominated by volcanic rocks. The island lacks beaches and its shoreline consists primarily of cliffs, which make it inaccessible. The island is covered by irregularly shaped volcanic rocks, within and under which reptiles take refuge. Tortuga is located 36.3 km from the city of Santa Rosalía in the municipality of Mulegé, Baja California Sur on the Baja California Peninsula, México. The human population of Santa Rosalía is 14,000. Tortuga island is uninhabited by humans; fishermen do not establish fishing camps because they are afraid of rattlesnakes, which they say are plentiful. Tourists too do not visit the island because of the snakes.

Climate

Isla Tortuga is very dry. The average annual temperature in the region is 23 °C; precipitation occurs primarily during July and August (57 mm), with 249 mm per year (Figure 2). Rains are minimal between January and June. The highest average monthly temperatures (over 34–35ºC) occur in June, July and August, whereas the minimum average monthly temperatures (about 4–5 °C) occur in January, February and December (García, 1981). In July, the soil reaches temperatures of 60 ° C, whereas the surface temperature of the rocks reaches 75 °C.

Geology

Tortuga Island is a volcanic island located on a fracture zone of an actively spreading fault that is present throughout the Gulf of California. The volcano is composed of tholeiitic basalt lava flows, vitric tuffs, and minor amounts of tholeiitic andesite. The island is a submarine volcano that is exposed above water and whose basaltic rocks have an age of 1.7 million years (Batiza, 1978).

Flora

The vegetation of the island is typical of the Sonoran Desert (Wiggins, 1980) is a sarcocaulescent scrub (Shreve, 1951); it consists of 79 species of vascular plants, represented by 33 families, of which Fabaceae and Cactaceae are the best represented, with 11 and 10 species, respectively, (Rebman et al., 2002). Although the vegetation is sparse on the slopes, there are small ravines where the dominant species are *Stenocereus gummosus* (sour pitaya), *Bursera* spp. (elephant tree), *Lophocereus schottii* (senita cactus), and *Lycium brevipes* (Baja desert thorn). On the high plains, the dominant species are *Stenocereus gummosus*, *Fouquiera diguetii* (desert coral), *Atriplex barclayana* (dwarf saltbush), *Pachycereus pringlei* (Mexican giant cactus), *Bursera* spp., *Colubrina viridis* (snakewood), and *Lycium brevipes*.

Mammals

The only mammal on the island is *Peromyscus dickeyi* (Dickey's mouse). This mouse is found in all habitats of the island, except at the bottom of the cone and is the primary food item for the rattlesnake species (*Crotalus tortugensis* = *C. atrox*).

Birds

The bird community of the island is composed of seven resident terrestrial species, among which are *Zonotrichia leucophrys* (white-crowned sparrow), *Pipilo chlorus* (green-tailed towhee), *Amphispiza bilineata* (black-throated sparrow), and *Corvus corax* (Raven). The wintering species are *Dendroica nigrescens* (black-throated gray warbler) and *Vermivora ruficapilla* (Nashville warbler) (Cody and Velarde, 2002).

Methods

Eight sampling visits were conducted during the course of five years (April, September 2009; April 2010; June, August 2011; July 2012; and October 2014). Sampling time was 2 or 3 nights and 2 to 3 days on each occasion. Reptiles were collected/observed during the day between 6:00 and 12:00 hrs and 19:00 and 03:00 hrs. Sampling was done on volcano slopes, canyons, and mesas by looking under rocks and among vegetation. Pitfall traps were not used due to the composition of the soil. The total man-hours were between 13 and 17 hours per trip.

Results

Five species of reptiles have been described for Isla Tortuga, as follows:

Family Phrynosomatidae

Sceloporus orcutti Stejneger, 1893
Granite Spiny Lizard / *Bejori Canarro*
This spiny lizard is present on the continental portion of the peninsula and other islands on both of its sides (Grismer, 2002). Adult males tend to be brownish in ground color with green throats. These lizards commonly are found on big rocks or on the ground at the bases of bushes.

Uta stansburiana Baird and Girard *in* Stansbury, 1852
Side-blotched Lizard / *Cachora*
This lizard is distributed on the Baja California peninsula and 42 islands in the Gulf of California. The species is present in the intertidal zone on the peninsula and other islands, but here this zone is small or does not exist on Isla Tortuga (Grismer, 2002). They have a dark brown ground color that matches the volcanic rock of the island. This species is present on all substrates and in all microhabitats.

A panoramic view of the inner crater. Photograph by Gustavo Arnaud.

A panoramic view of the inland plateau. Photograph by Gustavo Arnaud.

One of the lizard species present on Tortuga Island—the granite spiny lizard, *Sceloporus orcutti*. Photograph by Gustavo Arnaud.

One of three snake species present on Tortuga Island—the kingsnake, *Lampropeltis getula*. Photograph by Gustavo Arnaud.

Cliffs line the shores of Tortuga Island. Photograph by Gustavo Arnaud.

Senita cactus, *Lophocereus schottii*, on the island. Photograph by Gustavo Arnaud.

An excellent member of the cactus group on the island, *Stenocereus gummosus* (sour pitaya). Photograph by Gustavo Arnaud.

The endemic Dickey's mouse (*Peromyscus dickeyi*) is the only mouse found on Tortuga Island. Photograph by Gustavo Arnaud.

The rattlesnake on Tortuga Island, *Crotalus atrox* (= *C. tortugensis*). Photograph by Gustavo Arnaud.

Family Colubridae

Lampropeltis getula (Linnaeus, 1766)

Common Kingsnake / *Serpiente Real*

This species is present on the continental peninsula and islands on both sides (Grismer, 2002). The ground color of this snake is very dark brown and the head is nearly unicolored except for small, light-colored, well-separated spots on the labials. The dorsal bands are reduced to rows of small cream yellow spots. Four individuals were found at different sites on the slopes of the volcano, on or under rocks (June, August 2011; October 2014).

Family Dipsadidae

Hypsiglena torquata (Günther, 1860)

Collared Nightsnake / *Culebra Nocturna de Collar*

This *Hypsiglena* species also inhabits the continental peninsula and islands on both sides, but some authors consider it to be a subspecies endemic to the island (Grismer, 1999), which is not our position, however. These snakes are very dark in color dorsally, matching the dark volcanic substrate on which they occur (Grismer, 2002). They are nocturnal and not abundant, but can be found in all types of habitats. Two individuals were found under rocks on the slopes of the volcano (August 2011; July 2012).

Family Crotalidae

Crotalus atrox (= *C. tortugensis*) Van Denburgh & Slevin 1921.

Tortuga Island Diamondback Rattlesnake / *Cascabel de la Isla Tortuga*

Crotalus tortugensis was identified as a sister species of *C. atrox* (Grismer, 2002). However, genetic analyses showed that it is deeply phylogenetically nested within continental lineages of *C. atrox*, and for this reason it was placed in the synonymy of *C. atrox* (Castoe et al., 2007). This rattlesnake is very abundant on the island (Klauber, 1972). Grismer (2002) reported 26 individuals found during one night during summer; in this same station, but during July 2012, we found 31 individuals. On a night in spring 2010, we found 17 rattlesnakes, and on another spring night during 2011, we found 25 specimens. This rattlesnake is distributed in almost all habitats on the island, except the interior of the crater (Grismer, 2002), perhaps due to the absence of mice there; it is also absent in the narrow intertidal rocky area. Its diet is composed of rodents, reptiles, and birds. García-Padilla et al. (2011) confirmed the consumption on the island of *Sceloporus orcutti* by *Crotalus atrox* (as *C. tortugensis*). In 55 fecal samples analyzed (April 2009; April 2010; August 2011; July 2012), 62% contained remains of *Peromyscus*, 20% those of *Uta*, 12% of *Sceloporus*, and 6% unidentified birds (Arnaud, 2015). *Crotalus tortugensis* is listed by the Mexican wildlife agency with "Special Protection" (SEMARNAT, 2010).

Discussion

No population studies have been conducted yet for any of the species on Tortuga Island. Our knowledge of the herpetofauna is based on listings and specific observations undertaken by Klauber (1972), Grismer (2002), and our team. The general status of the island is good, primarily because of the low level of human visitation, due to the large number of rattlesnakes found on the island. The local fisherman refuse to camp on the island because of the presence of the rattlesnakes, but illegal collecting is still a threat. In this sense, the fear of rattlesnakes has become advantageous for the conservation of the herpetofauna of Tortuga Island. The marketing of the fauna of the islands has been detailed already (Mellink, 1995; Arnaud et al., 2008). The intensive collection for scientific purposes could be another source of adverse impact on the species occupying the island. The introduction of exotic species is yet another risk; for example, fishermen act as agents for the introduction of domestic cats (*Felis catus*) onto this island and elsewhere. Feral cats initially can cause the elimination of the *Peromyscus* mice that are the main food source for *C. atrox*, which could precipitate the extinction of this rattlesnake, as well as other resident species. Natural disturbances such as hurricanes or tropical storms, which are common every year in the Mexican Pacific Ocean, are also a potential source of risk for the herpetofauna of Tortuga Island. Hurricanes have direct effects via mortality and indirect effects via alteration of habitat. (Spiller et al., 1998; Schoener et al., 2000).

Islands are natural laboratories where evolutionary processes can be studied, due to the assumption that genetic flow is limited (Calsbeek and Smith, 2003). For these studies, it is necessary to have information not only on the list of native species, but also on their abundance, distribution and habitat requirements,

Reflection

Knowledge about the reptile species of Tortuga Island is a basis to develop awareness and environmental education programs for the users of the island or others in Peninsula area, so that they understand the benefits of conservation and become allies against the illegal collection of the rattlesnakes.

Acknowledgments

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affected the peninsula from 1998 to 2017. DL would like to dedicate this article to his 10-month-old granddaughter, Lia Alejandra Lazcano-Ruiz, who one day will learn that conservation of life on this beautiful planet is vital to the future of mankind.

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Head Triangulation in *Dipsas turgida* (Cope, 1868) (Dipsadidae, Dipsadinae, Dipsadini): A Potential Deimatic Behavior?

Paul Smith
faunaparaguay@gmail.com

FAUNA Paraguay
Encarnación
Paraguay
www.faunaparaguay.com

Para La Tierra
Centro IDEAL
Mariscal Estigarribia 321 c/ Tte. Capurro
Pilar, Ñeembucú
Paraguay

Abstract

Head triangulation as a defensive display is documented photographically for the first time in the South American snail-eating snake *Dipsas turgida* (Cope, 1868) in Paraguay. The role of the dorsal head pattern is highlighted as perhaps part of a deimatic display, and the possible association with fecal evacuation may be indicative of a cryptic complexity in such behaviors. It is suggested that in order to better explain seemingly ineffective defensive behaviors in snakes that more detailed field observations are required that adequately document the full range of behaviors observed rather than trying to fit behaviors into existing, broadly-defined categories.

Keywords: defensive behavior, snail-eating snake, Paraguay

Snakes of the genus *Dipsas* Laurenti, 1768, are slow-moving, non-venomous, non-aggressive, specialist mollusk feeders (Cadle and Myers, 2003; Cacciali, 2006). Six members of the genus occur in Paraguay (Cacciali et al., 2016), four of which were, until recently, placed in the genus *Sibynomorphus*—two widespread species: *D. ventrimaculata* (Boulenger, 1885) and *D. turgida* (Cope, 1868); and two restricted range species: *D. mikanii* (Schlegel, 1837) and *D. lavillai* (Scrocchi, Porto and Rey, 1993). *Sibynomorphus* is now considered a junior subjective synonym of *Dipsas* (Arteaga et al., 2018).

Dipsas turgida is a small snake (snout–vent length < 60 cm) found across northern Argentina, Paraguay, Bolivia, southern Brazil and Uruguay (Giraudo and Scrocchi, 2002; Carreira et al., 2005; Cacciali, 2008; Cacciali et al., 2016). It is a familiar garden snake in much of Paraguay, where it is known widely as *Ñanduriré*. Despite the completely inoffensive nature of the species it is commonly believed to be venomous, presumably because of its superficial resemblance to certain *Bothrops* vipers (Cacciali, 2008).

Although many animals possess an innate fear of snakes, their body form makes them particularly vulnerable to injury. Consequently many species employ a variety of defensive tactics in order to avoid predation, death or serious injury (Gallup, 1977; Greene, 1988; Martins, 1996; Passek and Gillingham, 1997; Humphreys and Ruxton, 2018). Cadle and Myers (2003) provided a review of defensive behaviors employed by snakes of the tribe Dipsadini (i.e., the genera *Dipsas*, *Sibon*, *Sibynomorphus* and *Tropidodipsas*) and considered head triangulation to be one of the most commonly performed displays. Head triangulation involves the raising and spreading of the quadrato-mandibular articulations so that the head appears considerably wider than the neck at their union. This display may be intended to mimic the typically triangular head shape of certain venomous Viperidae or it may have other, as yet unclear, functions. The mechanics of head triangulation were studied in unrelated species by Young et al. (1999).

Head triangulation has been reported in 12 species of Dipsadini, including two ex-*Sibynomorphus* species: *D. mikanii* and *D. neuwiedi* (Sazima, 1992; Cadle and Myers, 2003). More recently defensive displays were reported for the first time for *D. ventrimaculata* and *D. turgida* from Paraguay (Cabral et al., 2019). However head triangulation was not observed in either species. In this note I describe and illustrate what is apparently the first report of head triangulation in *Dipsas turgida*.

On 12 April 2019 an adult *D. turgida* (snout–vent length c. 35 cm) was encountered crossing a dusty road at night in Dry Chaco habitat at Fortín Toledo, Boquerón department (22°47'S, 59°57'W), at approximately 8 P.M. After capture, the snake

Figure 1. *Dipsas turgida* showing head triangulation. Fortín Toledo, Boquerón department, Paraguay. Photograph by the author, 12 April 2019.

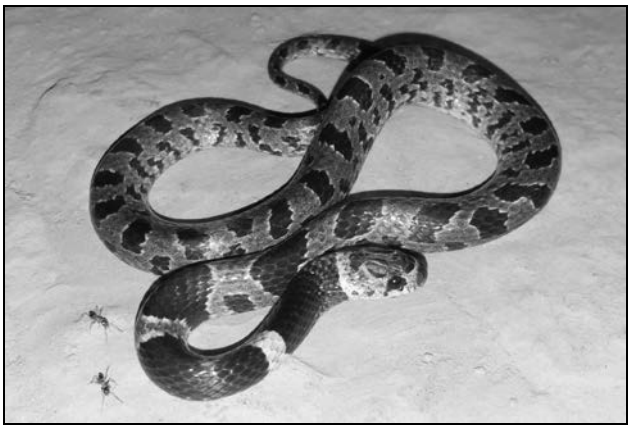

Figure 2. Same specimen following release, showing normal head shape. Photograph by the author, 12 April 2019.

immediately triangulated the head (Figure 1) and defecated a white, foul-smelling substance. The snake was handled for approximately five minutes during which it maintained the triangular head position, but performed no other associated defensive behaviors (e.g., body inflation, coiling, head-hiding) as have been reported in more complex performances by stressed dipsadids (Cadle and Myers, 2003; Cabral et al., 2019). When placed on the ground, the head shape was returned to normal (Figure 2) and the snake was allowed to go free.

Though the fact that Cadle and Myers (2003) remarked on the frequency of head triangulation in Dipsadini snakes means that the presence in *D. turgida* is not entirely unexpected, one aspect of this display that has not been commented on is the possible role of the dark dorsal cephalic spots. As can be seen in Figure 1 this posture gives a remarkably face-like (or skull-like) appearance to the head, emphasized by the white nuchal collar, which perhaps acts deimatically to exaggerate the size of the snake's head when it is faced by larger threats. Deimatic behaviors may be pre-emptive (designed to startle and avoid contact) or counterdefensive (performed in response to contact) (Umbers et al., 2015) but usually result from a failure of crypsis in slow-moving species that necessitates additional defensive action (Umbers and Mappes, 2015)

Cadle and Myers (2003) mentioned that voiding of fecal material or foul-smelling glandular secretions was observed in "many or most" newly caught dipsadid snakes, but they did not elaborate further on the behavior. They also seemed unimpressed by the effectiveness of head triangulation as a defense, noting "we suppose occasional predators must be deterred by it." Head spots are not present in all dipsadid snakes that exhibit head triangulation, but the observation reported here raises interesting study questions as to the potentially increased effectiveness of the display in those species that do possess them. Counterdefensive deimatic behaviors are often associated with the secretion of toxins or other chemical defenses, acting as a second line of defense should predation be attempted (Umbers et al., 2015). Thus the role of fecal evacuation becomes potentially more significant if understood as part of a more complex deimatic behavior.

Though this represents only a single observation of this behavior in this species, it may be rewarding for future researchers to take more careful note of the complexity of defensive behaviors in snakes and the contexts in which they are employed. The current practice of categorizing these behaviors according to broad, cross-taxa definitions may potentially be overlooking a hidden complexity.

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Notes on Reproduction of Great Basin Spadefoot Toads, *Spea intermontana* (Anura: Scaphiopodidae)

Stephen R. Goldberg
Biology Department, Whittier College
Whittier, CA 90608
sgoldberg@whittier.edu

Abstract

I report on a histological examination of gonads from 24 adult Great Basin spadefoot toads, *Spea intermontana*. Females in spawning condition were present from April to July (the extent of my female samples). The smallest mature female (in spawning condition) measured 48 mm SVL. The smallest mature male (sperm in lumina of seminiferous tubules) measured 35 mm SVL. The spawning cycle lacks synchrony as 50% (7/14) of adult female *S. intermontana* from spring–summer were not in spawning condition. Reproduction of *S. intermontana* may occur independent of rainfall.

Spea intermontana (Cope, 1883) ranges from south central British Columbia, into eastern Washington, Oregon and California through Nevada, northwestern Arizona and Utah, southern Idaho, northwestern Colorado and southwestern Wyoming (Green et al., 2013). The biology of *Spea intermontana* (as *Scaphiopus intermontanus*) is summarized in Hall (1998). Previous information on *S. intermontana* reproduction is in Hovingh et al. (1985) and Dodd (2013). *Spea intermontana* mating lasts for only 1–3 days (Buseck et al., 2005) and there is year to year variation in timing of breeding (Morey, 2005). Individuals are thought to reach sexual maturity in two to three years (Nussbaum et al., 1983; Green and Campbell, 1984). In this paper I provide additional information on reproduction of *S. intermontana* from a histological examination of gonadal material from museum specimens. Utilization of museum collections for obtaining reproductive data avoids removing additional animals from the wild.

A sample of 28 *S. intermontana* collected 1967 to 2017 (Appendix) consisting of 10 adult males (mean snout–vent length, SVL = 49.9 mm ± 8.7 SD, range = 35–65 mm, 14 adult females (mean SVL = 51.3 mm SVL ± 6.0 SD, range = 45–63 mm), three subadult females, SVLs = 40 mm, 43 mm, 44 mm, one unsexed *S. intermontana* SVL = 43 mm was examined from the herpetology collections of Brigham Young University (BYU), Provo, Utah, USA, the Natural History Museum of Los Angeles County (LACM), Los Angeles, California, USA, and the Museum of Natural History (UCM), University of Colorado at Boulder, USA.

A small incision was made in the lower part of the abdomen and the left testis was removed from males and a piece of the left ovary from females. Gonads were embedded in paraffin, sections were cut at 5 μm and stained with Harris hematoxylin followed by eosin counterstain (Presnell and Schreibman, 1997). Histology slides were deposited at BYU, LACM, or UCM. An unpaired *t*-test was used to test for differences between male and female SVLs (Instat, vers. 3.0b, Graphpad Software, San Diego, CA).

There was no significant difference between mean SVL of adult male versus adult females of *S. intermontana* ($t = 0.46$, $df = 22$, $P = 0.65$). The testicular morphology of *S. intermontana* is similar to that of other anurans as described in Ogielska and Bartmañska (2009a). Within the seminiferous tubules, spermatogenesis occurs in vesicles called cysts which remain closed until the late spermatid stage is reached; cysts then open and differentiating sperm reach the lumina of the seminiferous tubules (Ogielska and Bartmañska, 2009a). A ring of germinal cysts was located on the inner periphery of each seminiferous tubule. All ten males in my *S. intermontana* sample exhibited spermiogenesis. By month these were: May ($n = 3$), June ($n = 3$), July ($n = 4$). The smallest mature male in my sample measured 35 mm SVL (LACM 36678) and was from June. This *S. intermontana* male contained small amounts of sperm or clusters of metamorphosing spermatids in the seminiferous tubules. While the total amount of sperm in this small *S. intermontana* was less than that observed in larger specimens, I nevertheless considered it to be an adult. Wright and Wright (1970) reported *S. intermontana* adult males ranged from 40 to 59 mm SVL.

The ovaries of *S. intermontana* are typical of other anurans in being paired organs lying on the ventral sides of the kidneys; in adults the ovaries are filled with diplotene oocytes in various stages of development (Ogielska and Bartmañska, 2009b). Mature oocytes are filled with yolk droplets; the layer of surrounding follicular cells is thinly stretched. Two monthly stages were observed in the ovarian cycle of *S. intermontana* (Table 1): "Ready to Spawn," and "Not in spawning condition." The spawning cycle lacks synchrony as 50% (7/14) of adult female *S. intermontana* from spring–summer were not in spawning condition. Times of breeding for *S. intermontana* from different areas are in Table 2. These data indicate *S. intermontana* reproduction occurs in spring–summer. The smallest *S. intermontana* female in spawning condition measured 48 mm SVL (BYU 40688) and was from May. Three slightly smaller females that were not in spawning condition (SVL = 45 mm, LACM 122033; SVL = 45 mm, BYU 30662 and SVL = 46 mm, BYU 30659) were arbitrarily considered to be adults, bringing my mature *S. intermontana* female sample to 14. Wright and Wright (1970)

Table 1. Two monthly stages in the ovarian cycle of 14 *Spea intermontana*.

Month	*n*	Ready to spawn	Not in spawning condition
April	1	1	0
May	2	1	1
June	6	3	3
July	5	2	3

Table 2. Months of breeding by location for *Spea intermontana*.

Locality	Breeding Period	Source
Arizona	Spring	Brennan and Holycross, 2009
British Columbia	Early summer	Green and Campbell, 1984
Colorado	May to July	Hammerson, 1999
Idaho	April to June	Groves, 1989
Pacific Northwest	April to June	Nussbaum et al., 1983
Pacific Northwest	March to June	Hallock, 2005
Utah	April, May, June	Hovingh et al., 1985
Wyoming	April through July	Buseck et al., 2005
not given	April to July	Wright and Wright, 1970
not given	April to July	Stebbins and McGinnis, 2018

reported adult females of *S. intermontana* ranged from 45 to 63 mm SVL.

Atresia is a widespread process occurring in the ovaries of all vertebrates (Uribe Aranzábal, 2009). It is common in the amphibian ovary (Saidapur, 1978) and is the spontaneous digestion of a diplotene oocyte by its own hypertrophied and phagocytic granulosa cells which invade the follicle and eventually degenerate after accumulating dark pigment (Ogielska and Bartmañska, 2009b). See Saidapur and Nadakarni (1973) and Ogielska et al. (2010) for a detailed description of the stages of follicular atresia in the frog ovary. Atresia was noted in three *S. intermontana* ovaries (3/6, 50%) in spawning condition from June: (LACM 189182, UCM 24258, UCM 56222).

Spea intermontana differs from various other anurans from western North America in which breeding is correlated with summer precipitation (see Brennan and Holycross, 2009). Reproduction of *S. intermontana* is less predictable, timing may vary from year to year and may occur independent of rainfall (Morey, 2005). The factors that stimulate *S. intermontana* breeding are not well known (Morey, 2005) and warrant additional study.

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Appendix

Twenty-eight *Spea intermontana* examined by county, borrowed from the herpetology collections of Brigham Young University (BYU), Provo, Utah, USA, the Natural History Museum of Los Angeles County (LACM), Los Angeles, California, USA, the University of Colorado (UCM), Boulder, Colorado, USA.

Arizona, Apache County: LACM 121562, 122399; **California**, Inyo County: LACM 36677-36680, 187146, 188030, 189169, 189181, 189182, Mono County: LACM 187142, 189158; **Colorado**, Mesa County: UCM 18145, 24258, Moffat County: UCM 56222; **Idaho**, Butte County: BYU 30659, 30662, 30667, 30669, Canyon County: BYU 40686, 40688; **Utah**, Garfield County: LACM 90964, Kane County: LACM 122033, San Juan County: LACM 25363, Washington County: LACM 90965, 106147; **Washington**, Yakima County: LACM 51322.

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Movin' On Up! Some Notes on Arboreal Behaviors with Three Species of Fossorial Snakes: Sonoran Coralsnakes (*Micruroides euryxanthus*), Western Threadsnakes (*Rena humilis*) and Spotted Nightsnakes (*Hypsiglena chlorophaea*)

Roger A. Repp
9044 N. Valgrind Lane
Tucson, AZ 85743
repproger22@gmail.com

Early one morning, at a home located on the eastern-most limits of the city of Tucson, my friend Cyndy Wicker was plucking leaves off a grapevine. Said grapevine was growing up the side of a trellis that was affixed to the wall of her house. She was doing this because her yard tortoises loved to eat them. Cyndy is the spouse of my good friend Kent Jacobs, who has shared many a great outing with me in the field. For several years, Kent assisted with our radio-tracking endeavors for the Suizo Mountain Project. While Cyndy was not as enthused about snakes as Kent and me, she has always maintained a strong love for our local desert tortoises. For many years, she was the Desert Tortoise Adoption Coordinator for the Arizona Sonoran Desert Museum (ASDM). One of the unfortunate aspects of a town growing out of control is that tortoises are often uprooted from their homes, and many of the lovable, homeless creatures wind up on the doorstep of ASDM. Cyndy made sure that these tortoises got good homes, often providing her own yard as both a temporary, and at times, permanent residence.

We now desist with the digression, and go back to the vine and leaf picking. While in mid-pluck, so to speak, Cyndy was somewhat surprised when something plummeted in and out of her line of vision. The trajectory of that which passed before her eyes was downward, as is often the case for an object described with any derivative of the word "plummet." She felt the thud of the plummeting object as it scored a direct hit on her left foot. She cast her eyes upon her left foot quickly enough to note a gaudily-banded shoelace of a snake bouncing off her sneaker. Following that, it landed on the ground nearby. Said bouncing snake seemed to be stunned, and was immobile for several seconds. Upon noting that the snake was a Sonoran Coralsnake (*Micruroides euryxanthus*), Cyndy was also stunned and immobile for several seconds. She then called upon Kent to come and see. As is the wont of good husbands like Kent, he came and saw. They both identified the snake as a coralsnake, but Kent was sent on the run to get their field guide in order to be sure of their mutual deduction. The snake was cooperative enough to wait until Kent returned with Stebbins in hand. (Actually, he had Stebbins' field guide in hand. Kent's hand is too small to hold the actual Dr. Stebbins.) They searched through the field guide, and discovered that the snake that was under watch matched the artistic rendering and description of what Stebbins was calling a "Western" Coralsnake. It was a perfect trifecta of mutual agreement between Cyndy, Kent, and Dr. Stebbins. As if on cue, the considerate coralsnake waited until the identification was positive before jetting into a nearby hole. The snake was gone, but not forgotten. The deep-thinking couple then launched into some speculation centering on how it might come to pass that a coralsnake happened to be traveling downward in front of Cyndy's eyes. Several theories were presented and dismissed. In the end, they concluded that it was dropped by a raptor.

The first time I heard their story, as unusual as it seemed, I believed it. The two of them are honest folk (Cyndy once worked as a judge), and the fact that they are not hard-core herpers is in their favor. (Some herpers I know have proven to be the biggest liars on this planet.) And even if Cyndy and Kent *were* herpers, the tale of the falling coralsnake encounter is so off the wall (literally and figuratively) that it is hard to imagine *anybody* being imaginative enough to create such a fable. Not only did I believe their story, I remembered most of it. The only part I seem to have forgotten was their speculation that a raptor had dropped the snake. The fact is, Cyndy was only aware of the coralsnake from the moment it was viewed at eye level. (I'm thinking that would be about four feet, ten inches, above the ground. But I also think we will not being doing a measurement of that distance any time soon. I do believe that I have discovered the limits of Cyndy's patience with my recent questions about this incident. Asking for her to stand still while I take a tape measure to her eyeballs would likely result in me digging my dentures out of my underwear. Four feet, ten inches, is close enough.) Whatever happened before that eye-level moment is anybody's guess. It could indeed have been a raptor flying overhead and dropping a coralsnake bomb on her. The world will never know for sure.

My own theory is that the coralsnake was in the vine, somewhere above Cyndy's head, *before* she started gathering the feast for her herp cows. While I am uncertain of Cyndy's leaf plucking prowess, I would expect that she wanted that job over with as quickly as possible. She was probably plucking away at that vine at a brisk pace, with no reason to consider being delicate about the process. Anything that might be in that vine's embrace would be experiencing major perturbations to its substratum. My summation of the situation is that said perturbations to the grapevine caused the coralsnake to be jarred loose from its moorings, and down it came. My guess brings on some complications. The first might be: "How did the coralsnake get up the vine?" Well, a raptor could have dropped it there! (Keep reading, and be *amazed* at what happens between screech owls and threadsnakes). Another way it could have been above Cyndy's head in the vine would be to climb it. It is here that an expert on Sonoran Coralsnakes (is there such a person?) might step up and say "C'mon you *idiot*, everybody knows that they don't climb *anything*. They are strictly a fossorial species." This would leave me an opening to say "Ha! You don't know shit from apple butter, buddy!" Do they climb trees? I will say yes to that, but I'm more comfortable saying yes to the question of "*Can* they climb trees?" At least one can, and did!

On 24 June 2001, I was processing the first ever Sonoran Coralsnake to be found on our Suizo Mountain study plot. It had

Figure 1. (Left) Image of posed Sonoran (or Western) Coralsnake from Pinal County, Arizona. (Right) Shortly after the image to the left was taken, the coralsnake began a rapid ascent of the cottonwood tree that was used as its backdrop. It went approximately seven feet up before the alarmed photographer recaptured it. Image by Roger A. Repp, 24 June 2001.

been found the night before, and I brought it home to process and photograph. This one was not the first that I have attempted to photograph, but it *was* the first I have ever thoroughly measured. They have historically been the most uncooperative snake that this author has ever wrangled. I had no choice with this one but to utilize the crude method of chilling the snake down to perform the processing. By trial and error, I learned that 15 minutes in the refrigerator bought me three minutes of processing time. After many trips from the dining room table to the kitchen, I learned that my coralsnake was 391 mm (15.5 inches) snout–vent length. The tail was 31 mm (1.24 inches), adding up to 422 mm (16.9 inches) total length. The mass of the snake was 12 grams (0.4 ounces). The next phase to any proper processing ordeal is getting a photo voucher. For this, I wanted more than just an image of the snake on my dining room table. I wanted something pretty! In the center of my yard stood a cottonwood tree, and I determined that using the trunk as the snake's backdrop/backstop would work just fine. I ensured that the ground was made ready, while the snake waited patiently in the refrigerator one last time. When all was deemed ready, I placed the snake into a small cooler, dashed out of the house with it, and plopped it on the ground. I spent the next several minutes of my life trying to get that snake to remain in a posture that looked natural. No matter what I did, as soon as my hands released the snake, it would curl its head inward. Even when cooled down, it was impossible to get it to cooperate for even the two seconds it took to snap the shutter. I was greatly encouraged when it started to slowly ascend the trunk of the tree. Hell yeah—*anything* was better than what I was getting. I snapped a quick photo while this was happening. Knowledge of how much film might be left in the camera suddenly became important. I glanced down at the counter, to see that I only had three shots left. When I looked back at the snake, it was noted, with no small measure of alarm, that the snake was now over five feet up the trunk! And it was continuing up the trunk at a rate of speed that did not allow time for anything but dropping that camera in order to free up both hands to snag it. During the brief period of time it took to drop that camera and make my grab, I had to stand on tippy toes to get it—a distance of perhaps seven feet up! Had I waited another second, that snake would have been out of reach. That was the end of the photo documentation of that particular coralsnake (Figure 1). The author speculates that this was not the first time this snake had gone up a tree.

Thanks to the photos in Figure 1, we now know that a Sonoran Coralsnake *can* climb a tree. We also have presented evidence of a second coralsnake that *might* have climbed a grapevine. Further searches for other references to arboreal behavior in Sonoran Coralsnakes netted me less than nothing. On my request, Mike Dloogatch did find a single-sentence reference to a tropical species of coralsnake going arboreal. This in a book about snakes in trees! The sentence had this to say: "Coralsnakes (*Micrurus* spp.), highly venomous relatives of the Cobras, are most often found crawling on the ground or under logs or other objects on the forest floor, but I found a Coralsnake (*M. circinalis*) one night in a Trinidad forest, 2.5 m (8 ft) up, climbing a tree trunk covered with vines and aerial roots." (Sajdak, 2010; page 3). Until now, this may be the only reference in the world linking any species of coralsnake to tree climbing. We've definitively answered the question "can a Sonoran Coralsnake climb a tree?" A more difficult question would be "Why would a coralsnake climb a tree?" The snake in Figure 1 was likely trying to escape from me—and it came pretty close to doing that! With thoughts of "why" in my head, I asked Cyndy if their house had termites. Her answer was yes, although they were discovered at some point after the grapevine incident. This question was asked with thoughts of a favored food source of Sonoran Coralsnakes in mind. We speak of Western Threadsnakes (*Rena humilis*). Threadsnakes eat termites. Termites climb trees, and so do threadsnakes. I was once told that the best place to seek the local threadsnakes was around the base of palm trees on the University of Arizona campus. They often fall out of the termite nests that reside in them. Unlike Sonoran Coralsnakes, when one seeks answers to

Records of arboreal worm snakes.

Leptotyphlops albifrons [1]	Guyana, Trinidad?	0.5 m half dead tree; live bamboo twig by day near ground; under tree bark
Leptotyphlops dulcis [1,5]	Texas	1 m up in sycamore; Screech Owl nest
Leptotyphlops macrolepis [1]	Colombia	0.6 m up vertical concrete wall
Leptotyphlops macrorhynchus [1]	Pakistan	thatched roof
Leptotyphlops tenellus [1]	Brazil	2 m up tree trunk
Leptotyphlops tenellus [1]	Trinidad	in palm tree and under bark more than 1 m up
Leptotyphlops tesselatus [1]	Peru	in wall of adobe house
Ramphotyphlops angusticeps [1]	Guadalcanal	in fronds of palm tree 4 m up at night
Ramphotyphlops australis [1]	Australia	dead standing yacca grass tree
Ramphotyphlops braminus [2]	Australia	
Ramphotyphlops braminus [3]	India	1.5 m under peeling bark in termite infested coconut palm feeding on workers
Ramphotyphlops braminus [1]		in insect hole in sugarcane considerable height above ground
Ramphotyphlops cummingii [1]	Phillipines	beneath bark; in aerial fern root masses
Ramphotyphlops depressus [1]	New Guinea	climbing tree
Ramphotyphlops nigrescens [3]	Australia	5m up in tree; "To a scolecophidian following ant-trails, there may be little difference between underground and arboreal trails."
Ramphotyphlops olivaceus [1]	Indonesia	"arboreal and fossorial," climbing in vines 2–2.5 m up
Ramphotyphlops suluensis [4]	Phillipines	". . . the observations on *R. suluensis* indicate that this species is not incidentally climbing up trees, but might be more or less specialized on an arboreal life." Taylor 1922 found typhlopids in epiphytes. "Those blind snakes found in epiphytes have unusually long tails for typhlopids, being four to seven times as long as broad."
Typhlops arenarius [1]	Madagascar	1.5 m up in large tree
Typhlops richardii [1]	Puerto Rico	1.5 m in papayo tree

[1] Das and Wallach 1998
[2] Swanson 1981 *in* Gaulke 1995
[3] Shine and Webb 1990
[4] Gaulke 1995
[5] Gehlbach and Baldridge 1987

Figure 2. Appendix 2 from Sajdak (2010). Reprinted with permission from Krieger Publishing Company.

"Do threadsnakes climb trees?" on the web, 'Yes" comes cascading back from many directions. My first whack at the question of threadsnakes in trees was through the website of the Tucson Herpetological Society. It was there that I found a delightful natural history note on a threadsnake being attacked by ants (see Evans and Moll, 2009). The references led me to a citation of living threadsnakes (AKA blindsnakes) appearing in the nests of screech owls. The authors of this piece found multiple threadsnakes, in one case as many as 14, in the nest boxes of screech owls in Texas. Some of these had single beak indentations on their body, indicating that they were carried there purposefully and dropped into the nest. The authors suggest that these threadsnakes perform a service to the owls by feeding on the insect pests and parasites in the nest. (Gehlbach and Baldridge, 1987). And once again, Mr. Dloogatch came through with a chart from Sajdak (2010) that lists incidences of threadsnakes and blindsnakes (Sajdak lumps the two sister families together as "worm snakes") being anywhere from 0.5 meters above ground to 5 meters up, discovered in over a dozen locations worldwide. (Figure 2).

There is no convenient place for this author to state a rather inconvenient truth, so he will put it here. There are over 400 types of threadsnakes found around the world, and they are known by several different common names. Threadsnake seems to be the most accepted common name, but they are often referred to as either "blindsnake," or "wormsnake." Until recently, the genus for those found in North America was *Leptotyphlops*, but that has been changed to *Rena*. Those who do not like these names, common or otherwise, are encouraged to hold their tongues. They will likely be called something different by next week.

From 1989 through 2019, I have found a total of 22 Sonoran Coralsnakes. Back at the end 2006, when that number was 16, I worked out the number of field hours it took to find one. The hourly figure was that I found one for every 1,204 (rounded up) hours of effort. What this means to me is that if I started today, and spent the equivalent of a 40-hour workweek in the field, six months from now, I would probably find one! That pace has continued from 2006 through today, when six more have turned up. Once again, one every six months! Consistent, ain't I? And it would be fair to say that they are rarely seen.

I am working to make my angle of this observation of a coralsnake in a grapevine work for my purposes. I am not dismissing the possibility of a raptor dropping it in Cyndy's direction. Heck, for all the world will ever know, a clumsy screech owl may have accidentally dropped it into the vine while en route to its nest. (To Cyndy's knowledge, screech owls were never known to nest in the grapevine. Her answer to that question was "near the grapevine, yes, in the grapevine, no." That was the last and final question I asked of her before sensing the danger of *completely* pissing her off.)

We have suggested that coralsnakes eat threadsnakes. What we have not suggested is the great affinity that our local variety demonstrates for them. A quote from the book *Venomous Reptiles of Arizona* is in order here. "The explosive 'feeding frenzy' behavior occasionally seen in a healthy and very hungry adult Western (Sonoran) Coralsnake in the laboratory almost invariably is directed toward its preferred food species, the tiny blindsnake. This often occurs when close proximity of the prey is detected by smell and/or sound but it is not yet seen" (Lowe et al., 1989; p.27). Like the authors of this publication, those who

Figure 3. An adult Spotted Nightsnake (*Hypsiglena chlorophaea*) shown only for reader identification purposes. This specimen, highly disturbed by the photographer, is in the process of coiling in spiral fashion. While the purpose of such defensive behavior is not at all understood, almost everybody who has ever wrangled one sees them react thusly. Image by the author, Pinal County Arizona, 22 March 2015.

Figure 4. On the evening of 28 July 2017, this adult Spotted Nightsnake was first observed prowling the branches of an ironwood tree, approximately three meters above the ground. Image by author, Pinal County, Arizona.

keep Sonoran Coralsnakes will tell you that they go ballistic at the mere scent of a threadsnake. I am about 95% sure that the story I am about to relate came from a fellow by the name of Jim Kane, but my memory may be failing me with that detail. In any case, either Jim or Whatshisface once described an incident with a coralsnake observed on pavement that falls right in line with the notion of amped-up chemosensory response to threadsnakes. He said he encountered an adult Sonoran Coralsnake while road cruising, and that it was acting atypically. It was erratically jerking in a spasmodic circular fashion, while tongue-flicking the pavement. It was in the far right lane when he first saw it, and because of the way it was acting, he thought it had been injured by a passing vehicle. It was only when he stepped out of the vehicle to investigate further that he noted a threadsnake on the crawl moving across the far left lane. He stood guard over the scene, ready to move both snakes out of harm's way should another vehicle pass by. For the first five minutes or so, the coralsnake continued to wig out, but finally got hot on the scent, and jetted across the road in hot pursuit of the threadsnake, which at that point had moved off the road completely. His observation was interrupted when another vehicle was viewed rapidly approaching, and Jim had to occupy himself with moving his own vehicle out of the middle of the road, closing both doors of his pickup truck before doing so. While little is known about the Sonoran Coralsnake, it appears obvious that their hunting strategy strongly relies on chemosensory cues. That in turn might explain how a ground-dwelling coralsnake would be able to detect a threadsnake in either a tree, or a grapevine, and head up it to score a meal. Here ends all speculation of the coralsnake-in-the-vine story. Let it be said, let it be done, let it be over, amen!

On 28 July of 2017, John Slone and Marty Feldner joined me for a nocturnal visit to the flats north of Tucson. I have named these flats "the 'Winder Spot," as the area is, at that latitude, the easternmost extent of Sidewinders (*Crotalus cerastes*). The place has been described in several of these columns, but the short story is that it is not at all an area that looks like Sidewinder habitat. To be sure, there are many sandy washes that the Sidewinders use to move around, but those washes are flanked by majestic saguaro cactus and ironwood trees. The place can be stingy when it comes to finding snakes in great numbers, but for some reason, it yields some of the most incredible finds for those who seek them on this hallowed ground. We had no way of knowing as we headed out there that evening that one of these incredible events was about to transpire. For most of the ride out there, we were discussing Spotted Nightsnakes (*Hypsiglena chlorophaea*) (see Figure 3). The previous evening, Marty had found one of these prowling along the branch of a wolfberry bush, approximately 1 meter above the ground. We were all wracking our brains and regurgitating everything we knew about this species of rear-fanged snake, but could not come up with anything related to knowledge of them going arboreal for any reason. We arrived at Parker Wash, the main drainage of the 'Winder Spot, at 2050 hours. The temperature was 26.5°C (~80°F), with 20% cloud cover, 72% humidity, and negligible wind speed. It had rained the previous evening and early morning, and the forecast for heavy rains again this night had us fearful of camping in the wash (which we did anyway). We immediately grabbed our flashlights and cameras, and headed off into the night. Other than two Western Banded Geckos (*Coleonyx variegatus*), many rodents, and two Desert Spiny Lizards (*Sceloporus magister*) sleeping in the bushes, we weren't seeing much.

We were flanking either side of Parker Wash, occasionally going up the center, but we were each close enough to see the flashlights of the others, and maintained voice contact throughout the hike. At 2115 hours, Marty called out: "You aren't going to believe this—but I've got a nightsnake in a tree here." Sure enough, we gathered around Marty, and observed the second arboreal Spotted Nightsnake found in a 24-hour time period! The snake was estimated to be 60 cm in length—a large adult. And it was an estimated 3 meters up in the branches of an ironwood tree (Figure 4). The snake was on the move, crawling along a horizontal branch, but whether it was actively hunting, or confused by all the commotion below it, can't be ascertained. We speculated that at times, they climb to seek Tree Lizards

(*Urosaurus ornatus*) as a food source. Phil Rosen recently informed me that he has observed a Spotted Nightsnake eating a Tree Lizard (pers. comm., 2019). As we have seen hundreds of Tree Lizards in trees, we need not offer any further references to arboreality with the species. As nightsnakes are also known to eat other snakes (see Tucson Herpetological Society website), it is entirely possible that this one was seeking threadsnakes, or maybe even coralsnakes?

This here is Roger Repp, signing off from Southern Arizona, where the turtles are strong, the snakes are handsome, and the lizards are *all* above average.

Acknowledgment

The author wishes to acknowledge the *excellent* work of the Tucson Herpetological Society in general, and Jim Rorabaugh in particular, for maintaining and updating the species accounts of the reptiles and amphibians in the vicinity of southern Arizona on their website. With every local species of reptile suggested in this column, I went here first: https://tucsonherpsociety.org.

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What You Missed at the June Meeting: Show & Tell

John Archer
j-archer@sbcglobal.net

The June meeting was emceed by president **Rich Crowley** and photographed by **Erick Jaeschke**.

Joan Moore is known for bringing rare and/or large animals to June's Show & Tell. She says that she likes to bring snakes that are easily seen, but this year, in deference to her back, she brought us two Kenyan sand boas. Quelling fears of starving animals, Joan says that her best-feeding male eats 5–6 times per year but some males may eat only once a year. Kenyans apparently love to burrow because Joan will normally find the animals in the paper towel tubes that she keeps in their cages. She keeps them on Sani-Chip substrate, an aspen bedding that is a bit messy but absorbent and nice for burrowing animals. The male that she brought is 26 years old and the twice-as-large female was born in 2004. Both were gorgeous animals.

Elena Moss showed us her three-year-old woma python. Native to central Australia, these are fossorial animals that normally eat other reptiles, including spiny-tailed monitors and inland bearded dragons. Elena finds these animals docile except when they're hungry, and recommends always using sanitizer after handling other reptiles before engaging with these pythons. Womas reach adult size in two to three years and Elena hopes to breed her animals this fall. Coming from a line that is exceptionally handsome, the results should be impressive.

Gail Allison wore her "fake snake shoes and her real snake bracelet" to the meeting. A beautiful 16-year-old corn snake was wrapped around her arm. Gail acquired Mandy three years ago from a rescue. The snake has cataracts, but they don't seem to hinder her. A medium mouse every two weeks keeps Mandy at a good weight. Mandy was supposedly not safe in a household with kids when Gail adopted her, but the animal was proof of how proper handling and care can lead to an interesting companion animal.

Experienced lizard keeper **John Gutierrez** showed off his Pilbara dwarf monitor. He said that he appreciates the difference in care required by the smaller varanids compared to the larger ones he's kept. Native to Australia, they're rock climbers for which he keeps a hotspot at 130°. His little male is shy around people but getting better. The lizard eats "tons" of insects. He hopes to get a female and breed them. His next animals were a bit hard to see, but he graciously brought them around so each of us could admire the really small earless dragons that he also hopes to breed. Difficult to keep, he maintains a 107–110° hotspot and breeds tiny insects that the little lizards consume voraciously. His three-inch substrate is layered. The top stays dry but a lower layer is moist so that the lizards can access humidity when they need to. It was a special treat to see these little lizards that are kept by only a few people in the U.S.

Frank Sladek also brought two animals—two species of lizards that had special meaning during his childhood. One of the first reptile names he learned was chuckwalla because it's funny. He dreamed of having one someday and finally acquired a four-year-old male named Charles Walla, otherwise known as Chuck. Native to the U.S., chuckwallas are flat lizards that are strictly vegetarian. Common chuckwallas can grow to about 16 inches, and they like it hot. Chuck's basking area is 120°. The second lizard was an anole. He has fond memories of trying and failing to catch green anoles in Florida, so anoles hold a special place in his thoughts. He selected the Cuban false chameleon as a pet because it tends to be calm and inactive, a prerequisite for an animal that will be shown and held. He thinks they look like miniature dragons. These anoles eat snails in the wild, but in captivity will eat nearly any insect.

Nancy Kloskowski brought two snakes. She first showed a six-year-old cross between a bull snake and a black rat snake. She named it the unabbreviated version of B.S., because what else are you going to call a half-and-half bull/rat snake? She said it's getting darker as it gets older and to her it looks like a Texas rat snake. Her second snake was a four-year-old black-tailed cribo named Red Hot Chili Pepper. Native to Central and South America, it's a close relative of the indigo snake. She feeds it three small rats at a time and says it's very defensive while in its cage. When she tried to return it to the bag, it lived up to its reputation and became rather snappish. When asked about size, Nancy said they can grow to seven feet but hers was "this big" as she held up her snake.

Janice Kucera brought her Solomon Islands prehensile-tailed skink. She's had the roughly 35-year-old skink since 1991, when she purchased it for $75. She has two that are caged together. While their cage has branches that they climb on, most of the time they prefer the hide boxes. They'll eat romaine lettuce, kale, mixed vegetables and the occasional scrambled egg. They hate spinach. She keeps a large pan of water in the cage that must be changed often. They are live bearers and the babies are hard to keep alive. These days they are relatively uncommon in the pet trade.

A Mexican black kingsnake showed off its iridescent body as long-time member **Bob Hilger** proudly held her for viewing. Bob said that he's not bought an animal for close to 40 years, instead helping out your society and unwanted animals by adopting. Some years ago he acquired this beautiful snake as an adult. She is probably about 20 years old.

While holding his pretty little green anaconda, **Kyle Houlihan** said many people ask him why he keeps such big snakes. It's because he likes big animals. His first snake was a red-tailed boa, a big snake but not a Burmese python. His second snake was a Burmese python. His six-month-old male anaconda might grow to ten feet. Females can grow to 15 feet or more. Anacondas are native to South America. While not the longest snakes, they are the heaviest. They are aquatic, need high humidity, and require very large cages. His snake is food oriented and will often shoot out of the cage if it thinks it's going to be fed. Kyle uses a hook to remove him from the cage so the snake knows it's not feeding time.

From a long-time member to a brand-new member. **Caitlin Monesmith** occasionally struggled to contain Kaiju, her black-and-white Argentine tegu, as the lizard demonstrated the single mindedness that Caitlin attributed to this species. "Basically indestructible and unstoppable" are the words she used to describe them. Caitlin gave us an extensive education about tegus, including bringing skulls so we could see the difference in dentition between tegus and monitors. Tegus are durophagous so their teeth are blunt for crushing hard food items like mollusks, but Caitlin said that Kaiju will eat nearly anything it can get in its mouth.

Caitlin also revealed another method of getting free animals while doing good. Her lizard was taken from an invasive population in Florida. Probably a yearling when she acquired it from a trapper, she has gained an awesome pet and prevented a female from reproducing in the wild. A lizard lover who supports conservation and recognizes both the pros and cons of the animals, Caitlin is a welcome addition to our society.

Thus ended the June meeting.

Herpetology 2019

In this column the editorial staff presents short abstracts of herpetological articles we have found of interest. This is not an attempt to summarize all of the research papers being published; it is an attempt to increase the reader's awareness of what herpetologists have been doing and publishing. The editor assumes full responsibility for any errors or misleading statements.

EFFECTIVENESS OF NEST PROTECTION SCREENS

H. Pheasy et al. [2018, Chelonian Conservation and Biology 17(2):263-270] note that mammalian depredation of nests has been listed among the most significant threats to hatchling success in sea turtles. In 2013, at least 13% of green turtle (*Chelonia mydas*) and 25% of hawksbill turtle (*Eretmochelys imbricata*) nests were lost to domestic dog predation on Playa Norte, Costa Rica. In 2014 and 2015, plastic and bamboo protective screens were deployed to protect nests. Screens were deployed at different stages of the incubation period and the success of the nests analyzed. Predation rates increased as the seasons progressed with October and November being the peak depredation months, as well as the peak for hatchling emergences. Eggs remaining in nests that had been partially depredated had a significantly lower percentage of hatching success than eggs in undisturbed nests. There was no significant difference between timing of deployment and likelihood of a screen being breached. The likelihood of a screen being breached was highly dependent on the type of material used; bamboo screens were ca. 153% more effective than plastic and successfully prevented the complete predation of ca. 48% of nests. Bamboo screening is an inexpensive, environmentally inert, yet labor-intensive method for reducing nest depredation by domestic dogs. This screening method does not impact the hatching or emerging success of the nest.

ROADS AND SMALL TURTLE POPULATIONS

H. J. Howell and R. A. Seigel [2019, Journal of Herpetology 53(1):39-46] note that roads impact wildlife in a variety of direct and indirect ways. Roads may act as barriers to dispersal, lead to decreasing population size and genetic diversity, change animal behavior, result in direct mortality, and increase habitat disturbance. Road mortality is especially detrimental to long-lived species, such as freshwater turtles, whose population persistence relies on high adult and subadult survivorship to counter high egg and hatchling mortality. The spotted turtle (*Clemmys guttata*) is a small-bodied, freshwater turtle species that is listed as endangered in Canada and proposed for federal listing in the United States. The authors used a population viability analysis to attempt to quantify the impact that road mortality has on two distinct populations of spotted turtles. The baseline model for the North Wetland Complex (NWC) population predicted a probability of quasi-extinction within 150 yr of 20%. The baseline model for the South Wetland Complex (SWC) predicted a probability of quasi-extinction within 150 yr of 24%. Including an estimate of road mortality (modeled as a reduction in adult survival through annual catastrophic events) into the models, the probability of quasi-extinction within 150 yr changed to 93% for the NWC and 94% for the SWC. These results highlight the critical importance that anthropogenic additive adult mortality has on small populations of turtles and the necessity of detailed demographic studies to detect potential declines in populations of long-lived species.

AEROBIC PUSH-UPS BY SMOOTH SOFTSHELLS

M. V. Plummer and C. S. O'Neal [2019, Journal of Herpetology 53(1):27-31] observed the behavior of overwintering smooth softshell turtles, *Apalone mutica*, in an outdoor simulated pond with remote cameras. Submerged overwintering turtles partially buried themselves in a sand/mud substrate where they periodically raised and lowered the posterior portion of their body into the water column in a "push-up" fashion. Push-ups occurred with variable frequency and were similar in appearance and amplitude within and among individual turtles. Push-up frequency was positively correlated with water temperature and was paused more often at lower water temperatures. Push-up behavior of *A. mutica* was also observed under simulated winter conditions in laboratory aquaria. Turtles maintained in water with 95–100% dissolved oxygen content executed push-ups less frequently than turtles in water with lower oxygen content. These observations of push-up behavior in *A. mutica* in an outdoor enclosure and laboratory are consistent with a respiratory ventilation function. Softshell turtles, known to be highly intolerant of anoxia, ostensibly sustain aerobic metabolism by creating currents that replenish the oxygen-depleted boundary layer between the turtle's thin vascularized skin and oxygenated water.

MALARIA INFECTIONS IN FLORIDA ANOLES

T. M. Doan et al. [2019, Journal of Herpetology 53(1):22-26] note that Florida is home to the largest number of invasive reptile species, including the abundant *Anolis sagrei*, of any U.S. state. This lizard species has largely displaced the native *Anolis carolinensis* because of its superior competitive ability and tolerance of urbanized habitats. One facet of the invasion of *A. sagrei* that has not received attention in the literature is its interactions with parasites, including the malaria protozoan *Plasmodium*. The authors studied the relative prevalence of *Plasmodium floridense* in two *Anolis* species at three sympatric sites in central Florida to determine the factors that affect the parasite's prevalence, incidence, and effects on blood cell counts. After catching lizards and making blood smears, they examined slides for the presence of *Plasmodium* and counted relative erythrocyte/leukocyte ratios. Of the 101 lizards sampled, 31% of *A. carolinensis* were positive for *P. floridense*, as opposed to only 11% for *A. sagrei*. Date of capture was also an important factor, with June having the highest prevalence and March the lowest. Erythrocyte to leukocyte ratios differed with infection, averaging 3.15 ± 1.28 SD in infected lizards versus 4.28 ± 1.03 in uninfected lizards. Reduced infection by blood parasites may have been one of the many factors that allowed *A. sagrei* to successfully invade Florida and to become the superior competitor throughout its range. Additional studies of the effects of *Plasmodium* infection on competitive ability and fitness are needed to determine whether infection is a major contributor to invasion success.

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NEW CHS MEMBERS THIS MONTH

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Nicholas D'Andrea
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Tom Forest
Athena Gottlieb
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UPCOMING MEETINGS

The next meeting of the Chicago Herpetological Society will be held at 7:30 P.M., Wednesday, July 31, at the Peggy Notebaert Nature Museum, Cannon Drive and Fullerton Parkway, in Chicago. The speaker will be **Michael Burger**, author of *The Dragon Traders: A Collective History of the Reptile Trade in America and the Age of Herpetoculture*. Michael is a long-time CHS member who currently resides in Texas. His program is entitled "The Fascinating and Sometimes Profound History of Keeping Herps in America."

Sara Ruane, an assistant professor in the department of biological sciences at Rutgers University Newark, will speak at the August 28 meeting. Her talk will be on "Global Snake Diversity: Describing It, Understanding It, and Loving It!" Sara did her undergrad work at UMass Amherst, then received an MS at the University of Central Arkansas where she focused on turtle ecology, and a PhD at City University of New York with a focus on snake systematics.

The regular monthly meetings of the Chicago Herpetological Society take place at Chicago's newest museum—the **Peggy Notebaert Nature Museum**. This beautiful building is at Fullerton Parkway and Cannon Drive, directly across Fullerton from the Lincoln Park Zoo. Meetings are held the last Wednesday of each month, from 7:30 P.M. through 9:30 P.M. Parking is free on Cannon Drive. A plethora of CTA buses stop nearby.

Board of Directors Meeting

Are you interested in how the decisions are made that determine how the Chicago Herpetological Society runs? And would you like to have input into those decisions? The next board meeting, will take place at 7:30 P.M., August 16, 2019, at Papa Passero's Pizzeria, 6326 S. Cass Ave., Westmont. If you think you might like to attend, please email rcrowley@chicagoherp.org.

The Chicago Turtle Club

The monthly meetings of the Chicago Turtle Club are informal; questions, children and animals are welcome. Meetings normally take place at the North Park Village Nature Center, 5801 N. Pulaski, in Chicago. Parking is free. For more info visit the group's Facebook page.

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