

Interactions between Sonoran Desert Toads (*Incilius alvarius*) and Mammalian Predators at the Northern Jaguar Reserve, Sonora, Mexico

Carmina E. Gutiérrez-González¹, Miguel A. Gómez-Ramírez², Daniela Gutierrez-Garcia³, Javier Valenzuela⁴, James C. Rorabaugh⁵, and Aaron D. Flesch⁶

¹Universidad Autónoma de Querétaro, Santiago de Querétaro, Querétaro, Mexico, carmina.gutierrez.gonzalez@outlook.com

²Universidad Autónoma de Querétaro, Santiago de Querétaro, Querétaro, Mexico, ekim357@gmail.com

³Callejón Zacatecas 2018. Col. Orizaba. Mexicali, Baja California, Mexico, beluga128@gmail.com

⁴Naturalia, A.C., El Cajón No. 9, Col. Santa Fe C.P. 83249, Hermosillo, Sonora, Mexico, bio_fj@live.com.mx

⁵P.O. Box 31, Saint David, Arizona 85630, jrorabaugh@hotmail.com

⁶School of Natural Resources and the Environment, University of Arizona, The Desert Laboratory - Tumamoc Hill, 1675 Anklam Road, Tucson, Arizona 85745, flesch@ag.arizona.edu

The Sonoran Desert Toad (*Incilius alvarius*) is a large (≤ 191 snout-vent length) anuran with relatively smooth skin, large, kidney-shaped parotoid glands, white glands or tubercles under the parotoid glands, and large, lumpy glands on the dorsal and lateral aspect of the limbs. When threatened, individuals are known to inflate their bodies and orient the parotoid glands toward the threat while making a hissing sound (Hanson and Vial 1956). The parotoid and other glands of this species secrete potent toxins that include indolealkylamines and bufogenins (Erspamer et al. 1967, Cei et al. 1968, McGill and Brindley 1978), as well as 5-MeO-DMT—a powerful hallucinogen that comprises 15% of the dry weight of the parotoid and tibial glands (Weil and Davis 1994). Musgrave and Cochran (1930) reported a fox terrier that bit into a Sonoran Desert Toad and died within 2-3 minutes, and a German Shepherd who touched its nose to a Sonoran Desert Toad and walked no more than 100 feet before its front legs buckled under it. The dog was paralyzed but later recovered. The hallucinogen 5-MeO-DMT has made glandular toxins from the Sonoran Desert Toad popular among recreational drug users (Most 1984), but it is also gaining prominence in alternative medicine, particularly for treating addictions.

Despite strong chemical defenses exhibited by this amphibian, Wright (1966) observed a Raccoon (*Procyon lotor*) in the Sierra Bacadéhuachi, Sonora, that preyed upon five Sonoran Desert Toads. It flipped the toads on their backs and eviscerated them through the abdomen, thus avoiding contact with the dorsal and lateral glands. Wright (1966) suggested that skunks (*Mephitis* sp.), Ringtails (*Bassariscus astutus*), Coatis (*Nasua narica*), Bobcats (*Lynx rufus*), Gray Foxes



Fig. 1. American Badger (*Taxidea taxus*) with a Sonoran Desert Toad (*Incilius alvarius*) in its mouth along lower Arroyo Babisal, Northern Jaguar Reserve, 8 January 2012 at 02:10 hrs.

(*Urocyon cinereoargenteus*), and other mammalian predators may also have learned how to safely prey upon these toads. Nonetheless, the only other reports of predation of which we are aware on metamorphosed individuals of this species were by snakes. Enderson and Bezy (2002) reported Sonoran Desert Toads in the diet of the Black-necked Gartersnake (*Thamnophis cyrtopsis*), including an individual at Buenos Aires National Wildlife Refuge, Arizona, that contained 14 small Sonoran Desert Toads. Villa et al. (2015) found a Central American Indigo Snake (*Drymarchon melanurus*) consuming a Sonoran Desert Toad on the Río Sonora, Sonora. Additionally, JCR once observed a captive Mexican Hog-nosed Snake (*Heterodon kennerlyi*) attempting to consume a juvenile Sonoran Desert Toad. However, when the toad was about half-way into the snake's mouth, the snake began to foam at the mouth, exhibited righting difficulties, and subsequently spit the toad out. The snake was incapacitated for a short while, but it recovered.

Since 2000, Naturalia, A.C., the Northern Jaguar Project, and their collaborators have monitored wildlife at the Northern Jaguar Reserve in east-central Sonora with motion-activated cameras (Gutiérrez-González et al. 2015). Among the data that have been collected are three images of nocturnal interactions between Sonoran Desert Toads and mammalian preda-

The Sonoran Desert Toad (*Incilius alvarius*) is a large (≤ 191 snout-vent length) anuran with relatively smooth skin, large, kidney-shaped parotoid glands, white glands or tubercles under the parotoid glands, and large, lumpy glands on the dorsal and lateral aspect of the limbs.

tors (Figs. 1-3). The most remarkable is Fig. 1, showing an American Badger (*Taxidea taxus*) with an adult Sonoran Desert Toad in its mouth. The image was taken on 8 January 2012 in lower Arroyo Babisal, which is in foothills thornscrub near the center of the Northern Jaguar Reserve (29.4167 N, -109.1241 W, 639 m elevation). Despite limited resolution, the identity of the toad is confirmed by its size; no other species of toad reaches such a large size in the region (Rorabaugh et al. 2011). The badger had the head of the toad in its mouth, and thus likely received a good dose of the glandular secretions. The image is also notable for the time of year. Sonoran Desert Toads are not typically active in January. Of 403 specimens from Sonora in 19 herpetological collections, only one was collected in January (UAZ 14145, R. Felger near the Guaymas Airport, January 1965). Badgers are adept at digging small mammals, particularly ground squirrels and pocket gophers, out of their burrows (Jameson and Peeters 1988). It seems likely this Badger excavated the toad from its winter retreat.

Two other photos, both during the summer monsoon season and thus peak activity period for the Sonoran Desert Toad, illustrate no more than minimal interest by mammalian predators. A Bobcat sniffing a Sonoran Desert Toad that appears to be sitting calmly and not in a defensive posture was documented on 6 July 2012 (Fig. 2). Additionally, on 3 July 2013 (Fig. 3) a large Sonoran Desert Toad was photographed jumping away from a Coyote (*Canis latrans*) that did not show any interest in the toad. Both of these events occurred in Arroyo Dubaral in foothills thornscrub at approximately 29.427 N, -109.137 W, 585 m elevation.

Acknowledgments—We thank the Northern Jaguar Project and Naturalia, A.C. for allowing us to use the images herein and for other help during the preparation of this article.

Literature Cited

Cei, J.M., V. Erspamer, and M. Roseghini. 1968. Taxonomic and evolutionary significance of biogenic amine and polypeptides in amphibian skin II. Toads of the genera *Bufo* and *Melanophryniscus*. *Systematic Zoology* 17:232-245.

Enderson, E.F., and R.L. Bezy. 2002. Field observations of anuran predation by the Black-necked Gartersnake (*Thamnophis cyrtopsis*) in southern Arizona. *Sonoran Herpetologist* 15(10):112-115.

Erspamer, V., T. Vitali, M. Roseghini, and J.M. Cei. 1967. 5-methoxy- and 5-hydroxy-indolealkylamines in the skin of *Bufo alvarius*. *Biochemistry and Pharmacology* 16:1149-1164.

Gutiérrez-González, C.E., Gómez-Ramírez, M.A., López-González, C.A., Doherty, P.F., Jr. 2015. Are private reserves effective for jaguar conservation? *PLoS ONE* 10(9): e0137541. doi:10.1371/journal.pone.0137541.



Fig. 2. Bobcat (*Lynx rufus*) sniffing a Sonoran Desert Toad (*Incilius alvarius*) along Arroyo Dubaral, Northern Jaguar Reserve, 6 July 2012 at 18:30 hrs.



Fig. 3. Coyote (*Canis latrans*) walking past a leaping Sonoran Desert Toad (*Incilius alvarius*) along Arroyo Dubaral, Northern Jaguar Reserve, 3 July 2013 at 20:17 hrs.

Jameson, E.W., and H.J. Peeters. 1988. *California Mammals*. University of California Press, California Natural History Guides 52, Berkeley, CA.

Most, A. 1984. *Bufo alvarius*: The Psychedelic Toad of the Sonoran Desert. Venom Press, Gila, AZ.

Musgrave, M.E., and D.M. Cochran. 1930. *Bufo alvarius*, a poisonous toad. *Copeia* 173:96-99.

Rorabaugh, J.C., M.A. Gómez-Ramírez, C.E. Gutiérrez-González, J.E. Wallace, and T.R. Van Devender. 2011. Amphibians and reptiles of the Northern Jaguar Reserve and vicinity, Sonora, Mexico: A preliminary evaluation. *Sonoran Herpetologist* 24(12):123-131.

Villa, R.A., T.R. Van Devender, C.M. Valdéz-Colonel, and T.R. Burkhardt. 2015. Peripheral and elevational distribution and a novel prey item for *Drymarchus melanurus* in Sonora, Mexico. *Mesoamerican Herpetology* 2(3):378-380.

Weil, A.T., and W. Davis. 1994. *Bufo alvarius*: a potent hallucinogen of animal origin. *Journal of Ethnopharmacology* 41:1-8.

Wright, J.W. 1966. Predation on the Colorado River Toad, *Bufo alvarius*. *Herpetologica* 2:127-128.