

Notes on Mexican Herpetofauna 20: Potential Herpetofaunal Predators of *Gerrhonotus parvus* in the San Isidro Canyon, Santiago, Nuevo León, Mexico

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Abstract

We present a systematic list of the amphibians and reptiles of San Isidro Canyon in the Parque Nacional Cumbres de Monterrey, Municipality of Santiago, Nuevo León. This area is unique within the park in supporting a population of *Gerrhonotus parvus*, a species that is endemic to the state of Nuevo León and is listed in the Official Norm Mexicana NOM-059-SEMARNAT-2010 under the categories of Special Protection and Endemic to Mexico and in the Red List of the International Union for the Conservation of Nature (IUCN) as endangered. The species is also known from the municipalities of Galeana, Los Rayones and Santiago. The objective of this research is to identify herpetofaunal species that may be potential predators of *G. parvus*. The site was surveyed between 1999 and 2013. The list contains 44 species, 31 of which we consider to be potential predators of *G. parvus*. Natural disasters and anthropogenic factors may also place ecological pressure on the population in of San Isidro Canyon.

Resumen

Se presenta una lista sistemática de los anfibios y reptiles del Cañón de San Isidro, ubicado en el Parque Nacional Cumbres de Monterrey en la sección del Municipio de Santiago, Nuevo León durante un período de colecta comprendido de 1999 a 2012. Esta área es la única dentro del Parque donde se localiza a *Gerrhonotus parvus*, una especie endémica de Nuevo León, conocida solo para los municipios de Galeana, Los Rayones y Santiago. La intención de este trabajo es conocer las especies de herpetofauna que pueden ser potenciales depredadores de *G. parvus*, que esta enlistada en la Norma Oficial Mexicana NOM-059-SEMARNAT-2010 bajo la categoría de Protección Especial, Endémica y que figura en la Lista Roja de la Unión Internacional para la Conservación de la Naturaleza (UICN) como en peligro. El listado consta de 44 especies, de las cuales consideramos 31 pueden ser en algún momento depredadores de esta especie. Así mismo debido a factores como desastres naturales y antropogénicos la presión ecológica sobre esta población del Cañón de San Isidro se ve incrementada.

Introduction

Predators are organisms that survive by eating other living animals either of the same or different species. They often have a choice of which prey to attack, and the traditional assumption is that predators generally pursue animals that are old, young, or slow and disabled Siiter (1999). Therefore predation is a necessary natural process for the survival of these predators and it eliminates the less apt individuals of the species. All serpents are carnivorous, and in general can consume a diversity of food items; they include generalists and specialists. There are many predators involved in the predator-prey dynamics, and olfaction plays a major role in detecting prey (Conover, 2007).

Anguids exhibit two foraging modes: active foraging (Vitt and Pianka, 1994), and “ambush”, “sit-and-wait” or “passive foraging” (waiting for a prey to come within sight) (Pianka, 1966; Vitt and Price, 1982). It is often assumed that anguids are active foragers, even though the behaviors of members of this family are poorly known. We are studying anguid behavior in

the field and laboratory.

On the other hand phrynosomatid lizards consume primarily invertebrates (Pianka and Vitt, 2003) and utilize an ambush (sit-and-wait) foraging mode (Vitt and Pianka 1994).

We found only a few publications (8) on *Gerrhonotus parvus*:

- Smith (1986) proposed a taxonomic change of *Gerrhonotus parvus* to *Elgaria parva* based on similarity of the head scalation to other members of this genus.
- Banda et al. (2002) documented a new locality for *G. parvus* (as *Elgaria parva*) in San Isidro Canyon, discussed the morphology and taxonomic rank of the species, and provided a description of the habitat that differs significantly from the type locality in Galeana, Nuevo León. San Isidro Canyon is a limestone canyon at an altitude of 1600 m. The first specimen was found on the floor of the canyon beside a rock wall, with decomposing organic matter as a substrate.

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- Bryson et al. (2003) documented several natural history aspects of *G. parvus* at the type locality and San Isidro Canyon with notes on some sympatric herpetofaunal species in the area.
- Banda-Leal et al. (2005) registered the largest known specimen from San Isidro Canyon, Santiago, Nuevo León, and the largest reported *G. parvus*. Previously the paratype from Galeana was the largest specimen, as reported by Knight and Scudday (1985) with 71.7 mm. SVL. It was maintained in captivity for about 5 years and was deposited in the collection at the Sull Ross University. A new specimen measured 76.5 mm (SVL), exceeding the paratype by 4.8 millimeters. This larger specimen was found in May at the base of the branch canyon which at that time was flooded. The specimen had recently left a water pond; unfortunately it died, and apparently had drowned. Lizards in branch canyons are at risk due to flooding of the area and formation of deep ponds.
- Conroy et al. (2005) used Bayesian analysis of DNA sequences to determine the phylogenetic position of *E. parva*, finding it to be the sister of *Gerrhonotus infernalis* and proposed placing it in the genus *Gerrhonotus* (rather than *Elgaria*, as originally described by Knight and Scudday [1985]).
- Lazcano and Bryson (2010) registered the occurrence of juvenile *G. parvus* for the first time in the San Isidro Canyon. The juvenile described had a complete tail and its coloration was very different from the adults, consisting of clear and very dark bands that are strongly contrasting, whereas the adults have bands that are not contrasting. The young are very different from young of the sympatric *G. infernalis*, which are very similar to adults of *G. infernalis*.
- Banda-Leal et al (2013) reported on the sympatric herpetofauna in the area.

- Bryson and Graham (2010) described *Gerrhonotus farri*, which falls within the group of small anguids that we have proposed.

Study Site

San Isidro Canyon is located in what is known as the Curvature of Monterrey and is within the Protected Natural Area known as Parque Cumbres de Monterrey, Nuevo León, in the municipality of Santiago. This canyon is located southwest of the municipality and is contiguous to the south with the state of Coahuila. The canyon is approximately 2 km in length, at an elevation of 1600 m with numerous rock walls that are about 400 m in height. It is constituted of limestone, and the walls have elements of desert *rosetófila* vegetation: *Agave lecheguilla* (lechuguilla), *Agave bracteosa* (squid agave), and *Dasylirium* sp. (sotol). The canyon floor mainly contains submontano elements such as: *Helietta parvifolia* (barreta), *Chilopsis linearis* (desert willow), *Cercis canadensis* (eastern redbud), *Gochnatia hypoleuca* (shrubby bullseye) and *Acacia rigidula* (blackbrush acacia), *Acacia farnesiana* (sweet acacia), *Acacia berlandieri* (Berlandier's acacia) and several oak species (*Quercus* spp. There is a gallery forest with a distinguishing element *Platanus occidentalis* (American sycamore) throughout the canyon. There is almost always water present, but in the dry season the water flow may be intermittent. In branch canyons small pools may form. We have found several of our specimens, including a neonate, in these branch canyons.

Materials and Methods

The list of potential herpetofauna predators of *G. parvus* was constructed using records found in the literature from the area of the Municipality of Santiago, Nuevo León, and field work in the

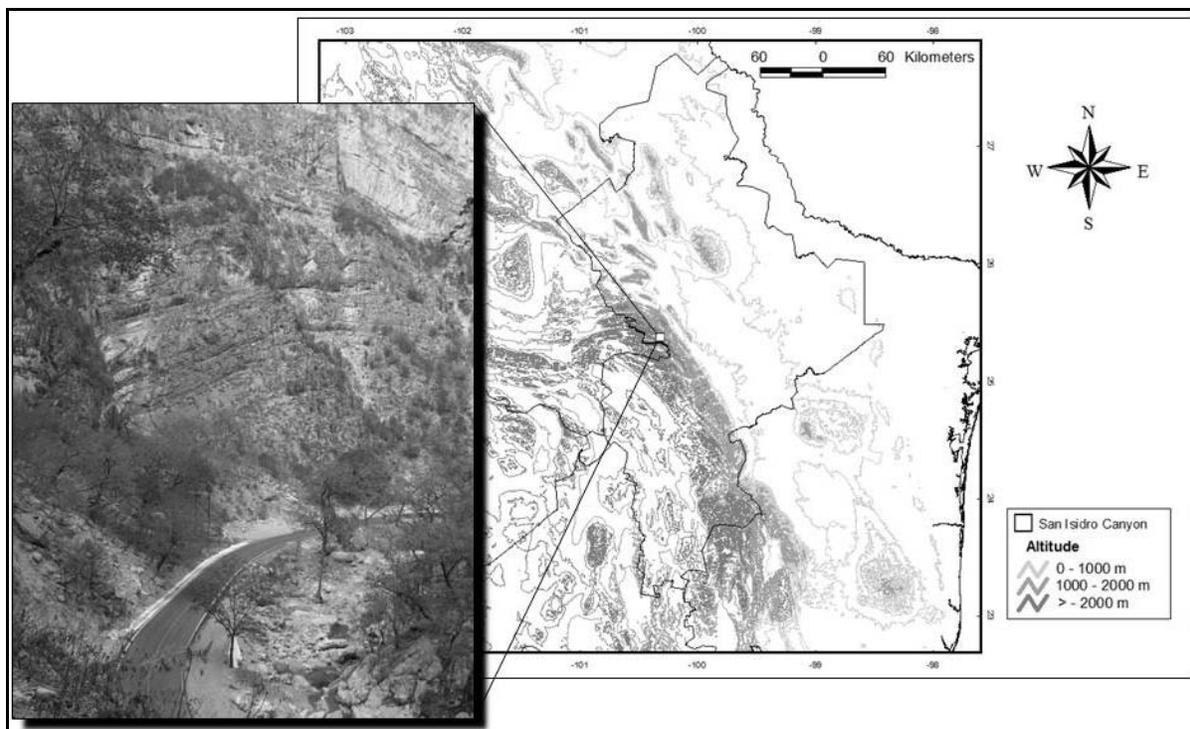


Figure 1: San Isidro Canyon, Santiago, Nuevo León, Mexico.

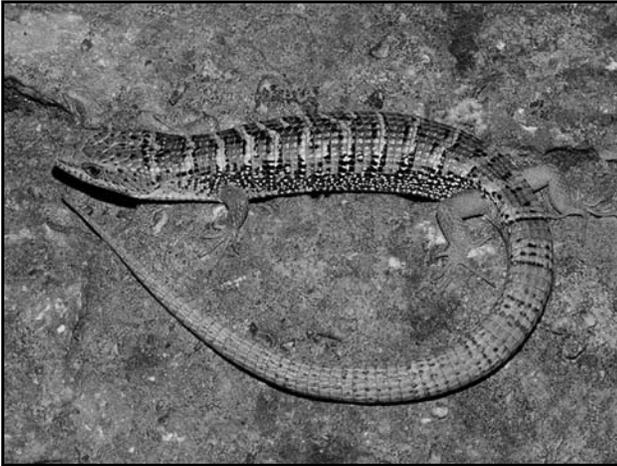


Figure 2. *Gerrhonotus parvus* male. UANL-6996. Photograph by Manuel Salazar-González.

study area since 1999. Authors from the Laboratory of Herpetology of the Faculty of Biological Sciences of the UANL and other herpetologists, mainly North American, have visited the study area about 4 or 5 times per year, monitoring species of the area in the past years and continuing into the present.

Results

From these field trips we took 15 pygmy alligator lizards (6 preserved and 9 kept alive in the laboratory) and found 22 specimens that were liberated in situ after data were taken. Of these, three were offspring, weighing 0.4, 0.63 and 0.98 g. Our adults can weigh up to 11 g. Specimens were located under dead plant matter and in crevices or active on the canyon floor close to the walls. All specimens were found from March to October.

On 7 May 2004, during a visit to the area, an adult *G. infernalis* was observed consuming a juvenile *G. parvus*, (pers. obs. by one of the authors). Due to the irregularity of the terrain the specimen could not be captured and escaped into crevices of the canyon rock walls.

A total of 31 (70.5%) of the 44 herpetofaunal species listed from the area are potential predators on *G. parvus*. They could at some point put pressure on this population of *G. parvus*.



Figure 4. *Gerrhonotus parvus* juvenile. UANL-7320. Photograph by Manuel Salazar-González.

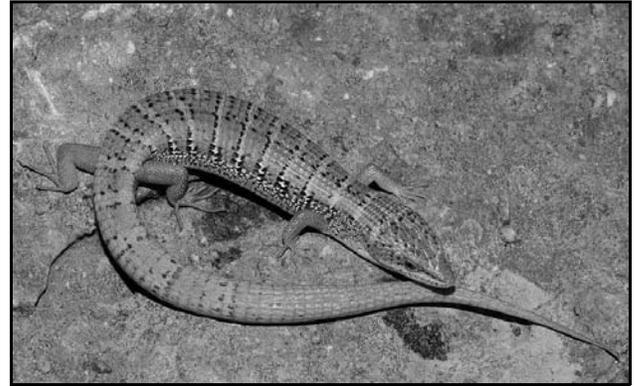


Figure 3. *Gerrhonotus parvus* female. UANL-7274. Photograph by Manuel Salazar-González.

Discussion

Species that may be consuming *G. parvus* are those, such as *Micrurus tener*, that have a specialized diet of lizards and other reptiles, or that often include them in their diet (Roze, 1999). *Micrurus tener* has been documented feeding on *Tantilla* sp. (Greene, 1997). Snakes of other genera, such as *Coluber constrictor oaxaca*, *Coluber schotti ruthveni*, *Coluber flagellum testaceus*, *Salvadora grahamiae lineata*, and *Lampropeltis m. mexicana*, prey upon lizards, as well as insects, frogs, others snakes, rodents, and birds (Greene, 1997; Reams and Aucone, 2001). The diet of these species changes during ontogeny.

Although *Lampropeltis* species feed on a wide range of vertebrates, lizards form an important part of their diet (Lemos-Espinal and Smith, 2007). Parham and Feldman (2003) observed a *Lampropeltis zonata* consuming a specimen of *Elgaria multicarinata*; Ashton and Smith (1999) report that a *Lampropeltis triangulum blanchardi*, which feeds primarily on mammals, was observed preying on a *Aspidoscelis angusticeps*.

Rossman et al. (1996) mentions that *Thamnophis proximus diabolicus* mainly feeds on amphibians, but on one occasion consumed a *Scincella lateralis*. *Thamnophis cyrtopsis cyrtopsis* is an inhabitant living in canyons and is a specialist feeding on amphibians, but occasionally this species' diet may include lizards, particularly in the dry season.



Figure 5. *Gerrhonotus parvus* habitat in San Isidro Canyon. Photograph by Javier Banda-Leal.

Trimorphodon tau tau also feeds frequently on lizards, including species of great size such as *Sceloporus cyanogenys* (Contreras-Lozano, 2006); it may also consume *Aspidoscelis scalaris gularis*, *G. infernalis*, *G. parvus*, *Plestiodon pineus*, *Sceloporus oregon*, *Sceloporus torquatus binocularis* and *Scincella silvicola caudaequinae*. These frequently share the same microhabitat. Another potential predator is *Ophedrys aestivus majalis* which is arboreal and has a diet that includes lizards; it may prey on *G. parvus* in vertical environments of the area.

Rattlesnakes, particularly *Crotalus lepidus lepidus*, are important predators of vertebrates in the area and include lizards as food items. *Sceloporus jarrovi jarrovi* and *Cophosaurus texanus scitulus* have been reported as part of the diet of this species (Bryson et al., 2002; Mata-Silva et al., 2011). Because of their size *C. l. lepidus* may consume any age category and are likely to feed on *G. parvus* adults. It has been documented that *Crotalus l. lepidus* includes anguids as a food item, as Banda-Leal et al. (2004) found scales and bones of *Barisia ciliaris* in the feces. Lazcano et al. (2004) documented finding a dead *C. l. lepidus* with a *Sceloporus parvus* in its mouth on the road in San Isidro Canyon. Mata-Silva et al. (2010) observed a *C. l. lepidus* feeding on a *Hypsiglena jani texana*.

Juvenile *Crotalus molossus molossus* also could be consuming *G. parvus*, although this species is not common in the canyon. Although *Crotalus atrox* consumes mammals, it can also feed on lizards. Repp and Schuett (2009), during a telemetry study, observed *C. atrox* preying on *Phrynosoma solare* and *Sceloporus magister*. It is possible that in the San Isidro Canyon, juvenile *C. atrox* may feed on lizards such as *Sceloporus t. binocularis*, *S. oregon*, *S. couchii*, *G. parvus* and *G. infernalis*. In another example Garcia-Padilla et al. (2011) documented *Crotalus tortugensis* eating *Sceloporus orcutti*, adding to our recognition that rattlesnakes are important predators of lizards.

Hypsiglena jani texana is small snake that may prey on *G. parvus*. In Colima, in 2010, one of the authors (pers. obs.) found a *Hypsiglena torquata* preying on an *Aspidoscelis lineatissima*, indicating that slower lizards such as anguids are likely included as food items.

Gerrhonotus infernalis is the only species confirmed to prey on *G. parvus*. It is a considerably larger and very aggressive species that frequents the same microhabitat: the bases of the canyon walls, crevices, and decomposing organic matter, including yucca trunks, leaf litter, dead squid agave, and sotol that lie on the floor of the canyon. It also prefers shaded sites and avoids sunny areas; this species is likely to encounter *G. parvus*. Another anguid, *Barisia ciliaris*, is also a potential predator species that lives in the area and prefers shaded sites.

Another common lizard in the area, *Sceloporus couchii*, is smaller, but could be another predator on offspring and juveniles. However this species prefers warmer, sunny areas. We have observed individuals of *S. t. binocularis* and *S. oregon*, after warming in sunny areas, feeding on insects in the cooler, shaded areas of the canyon where *G. parvus* may be present. Perkins et al. (1997) reported finding scales of *Xantusia vigilis*, which occur in yuccas and agaves, a habitat similar to that of *G.*

parvus, in the feces of *S. magister*. Castañeda et al. (2005) reported finding a female *C. texanus* that was eating a small conspecific male. *S. torquatus binocularis* and *S. oregon* frequent the rock walls of canyon, but occasionally visit the floor, where they become common potential predators. In a documented event Köhler and Fried (2012) mention finding a male *Sceloporus variabilis* feeding on a juvenile *Aspidoscelis deppei*, the entire predation event took about 10 minutes.

In addition to predation, other factors that may affect the population of *G. parvus* in the area are natural disasters and anthropogenic pressure. Even though the paved road to Laguna Sánchez, Santiago passes through the middle canyon, the site had remained relatively stable until in July 2010 Hurricane Alex devastated the area, flooded the canyon, and destroyed the road, leaving large impassible areas. Hurricanes are known to cause extraordinary damage to human settlements, but can also be responsible for amphibian and reptile displacement (Censky et al., 1998; Corn, 2005) and decrease populations (Cely, 1991; Woolbright, 1991; Schriever et al., 2009). After the hurricane, repair work on the road was conducted and eroded sites were filled temporarily to make the road passible. The eroded areas are now filled with asphalt and rubble left over from the road repairs. Subsequent to these events no specimens were found until 9 April 2012, when we sighted an adult female at the base of a branch canyon. It was on the side of the road, in a small area of approximately 1 m long by 1 m wide that had no repair residues. The lizard was captured and morphometric measurements were taken. It was released and immediately took refuge in the rock wall.

Conclusion

San Isidro Canyon is now the best known population of *G. parvus*. As a result of our investigations, more specimens have been sighted at this locality than any other. However, the population is under more ecological pressure by the factors discussed above. The number of potential predators is high and the 22 individuals found to date are low for anguid species (Mendoza-Quijano, 1997). Our estimations of potential herpetofaunal predators include snakes and lizards. Amphibian species present at this site were not considered to be predators of *G. parvus*, but this could vary among sites where the species is found.

In late September and early October of 2013, two powerful tropical depressions called "Manuel" and "Ingrid" affected Mexico. In particular Ingrid impacted the state of Nuevo León with intensive precipitation (maximum accumulation of ~750 mm and winds up to ~110 kph), affecting many rural areas of the state, and again destroying the area of San Isidro Canyon that had been reconstructed after Hurricane Alex. These two meteorological events, with precipitation greater than has been experienced in the last 50 years of observations, together affected the entire territory, destroying many rural communities, and increasing river flow. The effect on wildlife and natural protected areas has yet to be documented.

Acknowledgments

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area, allowing us to update the herpetofaunal list of San Isidro Canyon; the Universidad Autónoma de Nuevo León and San Antonio Zoo for financial support of this study; SEMARNAT for issuing collecting permit including most recently Oficio Num. SGPA/DGVS/01589/13 and Oficio Num. SGPA/DGVS/10021/13. We would also like to thank all the persons that participated in lab and field work. In particular Dr. Robert L.

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Table 1. Species reported in national and international collections for San Isidro Canyon and surrounding areas. NOM = protection status in the Mexican NOM-059-SEMARNAT-2010: A = *Amenazada* (Threatened); Pr = *Protección Especial* (Special Protection); SE = *Sin Estatus* (No Status). IUCN = status in the IUCN Red List of Threatened Species: LC = Least Concern, NT = Near Threatened, V = Vulnerable, E = Endangered. An X in the column headed PP denotes a potential predator on *Gerrhonotus parvus*. Common and scientific names follow Liner and Casas-Andreu (2008).

Taxon	Common Name in English	Status		PP
		NOM	IUCN	
Amphibia: Anura				
Family Bufonidae				
<i>Anaxyrus punctatus</i> (Baird and Girard, 1852)	Red-spotted Toad	SE	LC	
<i>Ollotis nebulifer</i> (Girard, 1854)	Gulf Coast Toad	SE	LC	
Family Eleutherodactylidae				
<i>Eleutherodactylus cystignathoides campi</i> (Stejneger, 1915)	Spotted Chirping Frog	SE	LC	
<i>Eleutherodactylus longipes</i> (Baird, in Emory, 1869)	Long-footed Chirping Frog	SE	V	
Family Hylidae				
<i>Ecnomiohyla miotympanum</i> (Cope, 1863)	Small-eared Treefrog	SE	NT	
<i>Smilisca baudinii</i> (A. M. C. Duméril and Bibron, 1841)	Mexican Treefrog	SE	LC	
Family Scaphiopodidae				
<i>Scaphiopus couchii</i> Baird, 1854	Couch's Spadefoot	SE	LC	
Reptilia: Squamata –Lizards				
Family Anguidae				
<i>Barisia ciliaris</i> (H. M. Smith, 1942)	Northern Alligator Lizard	Pr	LC	X
<i>Gerrhonotus infernalis</i> Baird, 1859 (1858)	Texas Alligator Lizard	Pr	LC	X
<i>Gerrhonotus parvus</i> Knight and Scudday, 1985	Pigmy Alligator Lizard	Pr	E	
Family Phrynosomatidae				
<i>Sceloporus couchii</i> Baird, 1859 (1858)	Couch's Spiny Lizard	SE	LC	X
<i>Sceloporus grammicus disparilis</i> Stejneger, 1916	Northeastern Graphic Lizard	Pr	LC	X
<i>Sceloporus oregon</i> H. M. Smith and B. C. Brown, 1941	Royal Lesser Minor Lizard	SE	V	X
<i>Sceloporus parvus</i> H. M. Smith, 1934	Northern Blue-bellied Lizard	SE	LC	X
<i>Sceloporus torquatus binocularis</i> Dunn, 1936	Nuevo Leon Torquate Lizard	SE	LC	X
Family Scincidae				
<i>Plestiodon pineus</i> (R. W. Axtell, 1960)	Pine Woods Short-nose Skink	SE	LC	
<i>Scincella silvicola caudaequinae</i> (H. M. Smith, 1950)	Horsetail Falls Ground Skink	Pr	LC	
Family Teiidae				
<i>Aspidocelis scalaris gularis</i> (Baird and Girard, 1852)	Texas Spotted Whiptail	SE	LC	X
Family Xantusiidae				
<i>Lepidophyma sylvaticum</i> E. H. Taylor, 1939	Madrean Tropical Night Lizard	Pr	LC	
Reptilia: Squamata –Snakes				
Family Colubridae				
<i>Coluber constrictor oaxaca</i> (Jan, 1863)	Mexican Racer	A	LC	X
<i>Coluber flagellum testaceus</i> Say, in James, 1823	Western Coachwhip	A	LC	X
<i>Coluber schotti ruthveni</i> (Ortenburger, 1923)	Ruthven's Whipsnake	SE	LC	X
<i>Drymarchon melanurus erebennus</i> (Cope, 1860)	Texas Indigo Snake	SE	LC	X

Table 1 (cont'd).

Taxon	Common Name in English	Status		PP
		NOM	IUCN	
<i>Drymobius margaritiferus margaritiferus</i> (Schlegel, 1837)	Northern Speckled Racer	SE		X
<i>Hypsiglena jani texana</i> Stejneger, 1893	Texas Nightsnake	Pr	LC	X
<i>Lampropeltis mexicana mexicana</i> (Garman, 1884 [1883])	San Luis Potosí Kingsnake	A	LC	X
<i>Leptodeira septentrionalis</i> (Kennicott, in Baird, 1859)	Northern Cat-eyed Snake	SE		X
<i>Ophedrys aestivus majalis</i> (Baird and Girard, 1853)	Western Rough Greensnake	SE	LC	X
<i>Pantherophis bairdi</i> (Yarrow, in Cope, 1880)	Baird's Ratsnake	SE	LC	X
<i>Pituophis deppei jani</i> (Cope, 1861 [1860])	Northern Mexican Pinesnake	A	LC	X
<i>Rhadinaea montana</i> H. M. Smith, 1944	Nuevo León Graceful Brown Snake	Pr	E	X
<i>Rhinocheilus lecontei</i> Baird and Girard, 1853	Long-nosed Snake	SE	LC	X
<i>Salvadora grahamiae lineata</i> Schmidt, 1940	Texas Patch-nosed Snake	SE	LC	X
<i>Senticolis triaspis intermedia</i> (Boettger, 1883)	Northern Green Ratsnake	SE	LC	X
<i>Storeria hidalgoensis</i> E. H. Taylor, 1942	Mexican Yellow-bellied Brownsnake	SE	V	X
<i>Tantilla rubra</i> Cope, 1876 (1875)	Red Black-headed Snake	Pr	LC	
<i>Thamnophis cyrtopsis cyrtopsis</i> (Kennicott, 1860)	Western Black-necked Gartersnake	SE	LC	X
<i>Thamnophis proximus diabolicus</i> Rossmann, 1963	Arid Land Ribbonsnake	A	LC	X
<i>Trimorphodon tau tau</i> Cope, 1870	Mexican Lyresnake	SE	LC	X
<i>Tropidodipsas sartorii sartorii</i> Cope, 1863	Sartori's Snail Sucker	SE	LC	
Family Crotalidae				
<i>Crotalus atrox</i> Baird and Girard, 1853	Western Diamondback Rattlesnake	Pr	LC	X
<i>Crotalus lepidus lepidus</i> (Kennicott, 1861)	Mottled Rock Rattlesnake	Pr	LC	X
<i>Crotalus cf. molossus</i>	Black-tailed Rattlesnake	Pr	LC	X
Family Elapidae				
<i>Micrurus tener</i> (Baird and Girard, 1853)	Texas Coral Snake	Pr	LC	X

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