Rhadinaea montana Smith, 1944. The Nuevo León Graceful Brown Snake is the only species endemic to Nuevo León. This snake is restricted in distribution to "the northern Sierra Madre Oriental in central Nuevo León" (Liner, 1996: 640.1). Harry Hoogstraal and party collected the holotype in 1938, at "Ojo de Agua, near Galeana, Nuevo León, México" (Liner, 1996: 640.1). This snake has been recorded at elevations from 700 to 2,131 m (Wilson and Johnson, 2010), and has been found in "primary open pine-oak forest and dry grassland," but not in agricultural land inside Parque Nacional Cumbres de Monterrey; it also has been noted to be "threatened by fragmentation of primary habitat through agricultural expansion (cropland [e.g., corn and wheat] and cattle ranching)" (Mendoza-Quijano (2007). This individual was found along the road to Dulce Nombres in the municipality of Zaragoza, at an elevation of 2,582 m, apparently an elevational record. Wilson et al. (2013a) assessed its EVS as 14, placing it at the lower limit of the high vulnerability category. Its conservation status has been determined as Endangered by IUCN, and as a species of special protection (Pr) by SEMARNAT. © Terry Hibbits

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The herpetofauna of Nuevo León, Mexico: composition, distribution, and conservation

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Abstract: The herpetofauna of Nuevo León, Mexico, is comprised of 139 species, including 22 anurans, four salamanders, 106 squamates, and seven turtles. We delineate the distribution of these species among the seven physiographic regions we recognize. The number of species in these regions ranges from 20 in the Sierras Transversales to 87 in the Gran Sierra Plegada. The species occupy from one to seven regions ($\bar{x}$ = 2.6). The greatest number of single-region species (30) is restricted to the Gran Sierra Plegada. About 58% of the species in Nuevo León are confined to one or two physiographic regions, which is of great conservation significance. We developed a Coefficient of Biogeographic Resemblance (CBR) matrix in which the number of shared species ranges from 13 to 45. We utilized these data to build a UPGMA dendrogram, which indicates that the seven physiographic regions cluster into two groups, of which one is composed of two adjacent highland regions in the southwestern portion of the state that primarily are covered by xeric vegetation, and the other comprises five interconnected mountainous regions in the northern and eastern portions of the state that in general gradually become lower in elevation; more mesic habitats also occur in those regions. The most distinctive herpetofaunal assemblage is located within the Gran Sierra Plegada, which contains the most species (87) and a relatively low herpetological resemblance score with all the other regions (average of .41). We allocated the members of the herpetofauna to four distributional categories, of which the largest number is comprised of the non-endemic species (96), followed by the country endemics (38), the non-natives (4), and the state endemics (1). We identified the principal environmental threats as urban development, industrial pollution, deforestation, highway deaths, mining and energy projects, intentional killing, pesticide use, and excessive collecting and commercial trade. We evaluated the conservation status of the native species by using the SEMARNAT, IUCN, and EVS systems, of which the EVS proved to be the most helpful. The number of species in the three EVS categories increased from low (42) to medium (55), and decreased to high (38). In addition, we utilized the EVS rankings to evaluate how the species in the IUCN categories of NE and LC might be assessed more accurately. We also utilized a means for determining Relative Herpetofaunal Priority (RHP), a simple scheme

for ascertaining the rank order of a physiographic regional herpetofauna dependent on the number of state and national endemic species, in addition to the number of high vulnerability EVS species. By employing these two measures, we determined the Gran Sierra Plegada to occupy rank number one in both cases. Additionally, we discuss the ability of the state's 32 protected areas to provide sanctuary for the members of the herpetofauna. Based on our analysis, we developed a set of conclusions and recommendations for the perpetual protection of the herpetofauna of Nuevo León.

Key Words: Anurans, caudates, conservation status, physiographic regions, protected areas, protection recommendations, squamates, turtles

Resumen: La herpetofauna de Nuevo León, México consiste de 139 especies, incluidos 22 anuros, cuatro salamandras, 106 squamatos, y siete tortugas. Delineamos la distribución de estas especies entre las siete regiones fisiográficas aquí reconocidas. El número de especies en estas regiones va de 20 en las Sierras Transversales a 87 en la Gran Sierra Plegada. Las especies ocupan de una a siete regiones ($\bar{x}$ = 2.6). El número más grande de especies ubicadas en una sola región (30) está restringido a la Gran Sierra Plegada. Alrededor del 58% de las especies de Nuevo León están confinadas a una o dos regiones fisiográficas, las cuales son de mayor conservación prioritaria. Desarrollamos una matriz de Coeficiente de Similitud Biogeográfica (CSB) en el cual el número de especies compartidas es 13 a 45. Utilizamos estos datos para construir un dendrograma de UPGMA el cual indica que las siete regiones fisiográficas forman dos grupos, de los cuales uno está compuesto de dos regiones altas contiguas y cubiertas principalmente de vegetación xerófila, localizada en la porción suroeste del estado, y el otro incluye cinco regiones montañosas interconectadas que en general se convierten gradualmente de baja altitud en las porciones norte y este del estado; con hábitats más húmedos. El ensamblaje herpetofaunístico mas distintivo se localiza en la Gran Sierra Plegada, que contiene la mayoría de las especies (87) y un valor de similitud herpetológica relativamente bajo en relación a las demás regiones (promedio de .41). Asignamos los miembros de la herpetofauna a cuatro categorías de distribución, del cual el número más grande está formado por las especies no endémicas (96), seguido de las especies endémicas al país (38), las no nativas (4), y las endémicas al estado (1). Identificamos las principales amenazas ambientales como el desarrollo urbano, contaminación industrial, deforestación, mortalidad causada por carreteras, actividad minera, proyectos energéticos, muerte deliberada, uso de pesticidas, y colecta y venta excesivas. Evaluamos el estatus de conservación de las especies nativas usando los sistemas de SEMARNAT, IUCN, y EVS, de los cuales el EVS resultó ser el más informativo. El número de especies en las tres categorías de EVS se incrementó de la categoría baja (42) a la categoría media (55), y disminuyo en la categoría alta (38). Adicionalmente, utilizamos los rangos de EVS para evaluar cómo las especies en las categorías de NE y LC de la UICN podrían ser evaluadas de una forma más precisa. También utilizamos un medio para determinar la Prioridad Herpetofaunística Relativa (PHR), un marco básico para determinar el rango de orden de una herpetofauna de una región fisiográfica dependiente del número de especies endémicas al país y al estado, aunado al número de especies con un valor de EVS de alta vulnerabilidad. Utilizando estas dos medidas, determinamos que la Gran Sierra Plegada ocupa el rango número uno en ambos casos. Adicionalmente, discutimos la habilidad de las 32 áreas protegidas del estado para proporcionar protección a los miembros de la herpetofauna. Basado en nuestro análisis, desarrollamos un conjunto de conclusiones y recomendaciones para la protección perpetua de la herpetofauna de Nuevo León.

Palabras Claves: Anuros, caudatos, estatus de conservación, recomendaciones para protección, regiones fisiográficas, squamatos, tortugas

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DEDICATION

We are honored to dedicate this paper to our friends James R. and Mary Dixon. Jim and Mary have been part of the herpetological community for many years. For most of us, Mary Dixon was a charming and refreshing sight at scientific meetings for several decades. Her engaging personality made her a high point of any gathering of biologists, whether herpetologists or not. Mary and Jim built a strong, family-centered life, as noted by Forstner et al. (2015) and McAllister and Forstner (2015), which includes five children, 11 grandchildren, and 13 great-grandchildren. Jim Dixon, of course, was the herpetologist half of this dynamic pair and the one to whom we all owe a considerable debt of friendship and collegiality, and in the case of J. D. Johnson, appreciation for his service as PhD program advisor at Texas A&M University. During his long career, Jim created an imposing compendium of scientific papers and books, including the descriptions of a long list of genera and species of anurans, salamanders, lizards, and snakes from the length and breadth of the Western Hemisphere. His many books dealt comprehensively with the Texas herpetofauna and that of the Mexican states of Querétaro and San Luis Potosí. Those of us who are following in his footsteps will be referring to his work for a long time to come. In the aftershock of Jim's recent demise, we must again express our gratitude to Mary for her friendship. She formed part of a couple that is a symbol of love for nature. She is the strong woman who for decades was our mentor's partner.

In dangerous times, there is no sin greater than inaction. Robert Langdon, fictional protagonist

—Dan Brown (2013)

INTRODUCTION

Nuevo León is one of six Mexican states that border the United States; however, that border is the narrowest of the six, and is only 15 km long as it abuts southern Texas (www.wikipedia.org; accessed 2 May 2016). The state also narrows at the southern end, and at this point is crossed by the Tropic of Cancer. Nuevo León is bordered to the west and north by Coahuila, to the east by Tamaulipas, and to the southwest by San Luis Potosí.

With an area of 64,156 km^2, Nuevo León is the 13th largest state in Mexico, and the 14th most densely populated, at 73 people per km^2 (www.wikipedia.org; accessed 2 May 2016). Given that species richness among the states of Mexico generally decreases from south to north and that the northern portion of the state lies within the boundaries of the Chihuahuan Desert, an area relatively inhospitable to amphibians, one might expect that the area/species value would be relatively low when compared to the neighboring state of Tamaulipas or those farther south. The area/species value for Nuevo León is 64,156/139 = 461.6 and that for Tamaulipas is 80,249/184 = 436.1 (Terán-Juárez et al., 2016). Toward the southern extreme of the country, however, the area/species ratio for Oaxaca is 93,757/442 = 212.1 (Mata-Silva et al., 2015) and that for Chiapas is 73,311/330 = 222.2 (Johnson et al., 2015a). These figures indicate that the area/species ratios for two states in southern Mexico are 2.1–2.2 times the size of those for Nuevo León.

MATERIALS AND METHODS

Our Taxonomic Position

The taxonomic position we adopted in this paper is the same as that explained in earlier papers on other Mexican states (Johnson, et al., 2015a, b; Mata-Silva et al., 2015; Terán-Juárez et al., 2016; Woolrich-Piña et al., 2016). Details of this position were presented in these papers.

Anaxyrus punctatus (Baird and Girard, 1852). The Red-spotted Toad is distributed from "southeastern California through southern Nevada and southern Utah to southwestern and southeastern Colorado (excluding high elevations) and southwestern Kansas (USA), thence south to southern Baja California, Sinaloa, Aguascalientes, Jalisco, Guanajuato, San Luis Potosí, Hidalgo, and Tamaulipas (Mexico)" (Frost, 2015). This individual came from Cañon de Ballesteros, in the municipality of Santa Catarina. Wilson et al. (2013b) calculated its EVS as 5, placing it in the lower portion of the low vulnerability category. Its conservation status has been considered as Least Concern by IUCN, but this species is not listed by SEMARNAT. © Elí García-Padilla

Incilius nebulifer (Girard, 1854). The Gulf Coast Toad ranges from the "Gulf coast of Mississippi west through East and Central Texas almost to the Big Bend region of that state (USA); south through eastern Coahuila, Nuevo Leon, San Luis Potosí, and Tamaulipas to Hidalgo and central Veracruz, Mexico." (Frost, 2015). This individual was found on the road to Grutas de Bustamante, Sierra de Gomas, in the municipality of Bustamante. Wilson et al. (2013b) calculated its EVS as 6, placing it in the middle of the low vulnerability category. Its conservation status has been considered as Least Concern by IUCN; this species is not listed by SEMARNAT.

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Craugastor augusti (Dugès, 1879). The Common Barking Frog occurs from "Arizona to Texas in the United States, and in Mexico from Sonora to Oaxaca, and from Chihuahua, Coahuila, Nuevo León, and Tamaulipas to Puebla" (Lemos-Espinal and Dixon, 2013: 42). This juvenile was found at Parque Ecológico Chipinque in the municipality of San Pedro Garza García. Wilson et al. (2013b) ascertained its EVS as 8, placing it in the upper portion of the low vulnerability category. Its conservation status has been evaluated as Least Concern by IUCN; this species is not listed by SEMARNAT. © David Lazcano

Updating the Herpetofaunal List

We based our herpetofaunal list primarily on those published recently in Lemos-Espinal and Cruz (2015) and Lemos-Espinal et al. (2016), with some comments on selected taxa (see below). Nevárez-de los Reyes, et al. (2016) and García-Padilla et al. (2016b; this issue), however, added *Crotalus ornatus* and *Coniophanes imperialis*, respectively, to the state's list. We based our names for the taxa we deal with on the Taxonomic List in the *Mesoamerican Herpetology* website (www.mesoamericanherpetology.com; accessed 14 August 2016).

System for Determining Distributional Status

We used the system developed by Alvarado-Díaz et al. (2013) for the herpetofauna of Michoacán to determine the distributional status of members of the herpetofauna of Nuevo León. Mata-Silva et al. (2015), Johnson et al. (2015a), Terán-Juárez et al. (2016), and Woolrich-Piña et al. (2016) also used this system, which consists of the following four categories: SE = endemic to Nuevo León; CE = endemic to Mexico; NE = not endemic to Mexico; NN = non-native in Mexico.

Systems for Determining Conservation Status

To assess the conservation status of the herpetofauna of Nuevo León, we used the same systems (i.e., SEMARNAT, IUCN, and EVS) as Alvarado-Díaz et al. (2013), Mata-Silva et al. (2015), Johnson et al. (2015a), Terán-Juárez et al. (2016), and Woolrich-Piña et al. (2016). Descriptions of these three systems are available in these papers.

LITERATURE SURVEY

Lemos-Espinal and Cruz (2015) and Lemos-Espinal et al. (2016) presented a brief history of herpetology in Nuevo León, detailing the work done primarily by non-nationals; however, they omitted a significant number of studies undertaken by Mexican herpetologists, particularly those from the Universidad Autónoma de Nuevo León (UANL), presumably because most are unpublished theses and dissertations completed in the Facultad de Ciencias Biológicas, UANL, which have had insufficient circulation, or studies published in herpetological society journals in the United States. We briefly discuss this literature below.

Martín del Campo (1953) was the first Mexican to investigate the herpetofauna of the state, and the first to report the following taxa: *Gerrhonotus liocephalus infernalis* (= *G. infernalis*), *Scincella laterale* (= *S. silvicola*), *Drymarchon corais erebennus* (=*D. melanurus*), *Elaphe subocularis* (= *Bogertophis subocularis*), *Leptodeira maculata* (=*L. septentrionalis*), *Micrurus fulvius tener* (= *M. tener)*, and *Trimorphodon upsilon* (= *T. tau*). The herpetofauna in the central portion of the state was studied by Aseff-Martínez (1967), who recorded 45 species, including nine amphibians, one turtle, and 35 squamates, of which five species (*Hypopachus cuneus cuneus* [= *H. variolosus*]; *Lepidophyma flavimaculatum tenebrarum* [= *L. sylvaticum*]; *Sceloporus s. spinosus* [= *S. spinosus*]; and *Kinosternon f. flavescens* [= *K. flavescens*] were recorded for the first time.

One of the few studies on the herpetofauna of the municipalities of Lampazos and Anáhuac, in the northern region of Nuevo León, was completed by Velasco-Torres (1970), who found *Bufo compactilis* (= *Anaxyrus speciosus*) and *Rana pipiens* (= *Lithobates berlandieri*) in Arroyo Blanco, 1 km south of the town of Lampazos, and *Phrynosoma cornutum* and *Gopherus berlandieri* 10 km east of Anáhuac. In the southern portion of the state, Treviño-Saldaña (1978) reported 57 species and subspecies, with seven being new state records, including *Holbrookia maculata approximans* (= *H. approximans*), *Sceloporus jarrovii cyanostictus* (= *S. cyanostictus*), *Crotalus durissus neolonensis* (= *C. totonacus*), *C. lepidus morulus* (= *C. morulus*), *Natrix v. valida* (= *Thamnophis valida*), *Thamnophis macrostemma megalops* (= *T. eques*), and *Kinosternon integrum*. Additionally, his work expanded the geographic distribution in the state of *Ambystoma tigrinum velasci* (= *A. velasci*), *Bufo cognatus* (= *Anaxyrus cognatus*), *B. punctatus* (= *A. punctatus*), *Cnemidophorus inornatus* (= *Aspidoscelis inornata*), and *Gerrhonotus liocephalus infernalis* (= *G. infernalis*).

The distribution of viperids in Nuevo León was examined by Vallejo-Gamero (1981), who reported the presence of six species of pitvipers, including *Sistrurus catenatus* and *Agkistrodon bilineatus taylori* (= *A. taylori*), although the geographic distributions of these two species were not assessed in detail. He also mentioned that *Crotalus atrox* was found in all the municipalities of the state, and reported *C. lepidus* from the mountainous area of Lampazos but provided no specimens as reference. Benavides-Ruiz (1987), carried out a herpetofaunal survey in the municipality of Santiago, and recorded 40 species and subspecies. Of these, two amphibians (*Bufo punctatus* [= *Anaxyrus punctatus*] and *Hylactophryne augusti* [= *Craugastor augusti*]) were new municipality records, and two snakes (*Leptophis mexicanus* and *Tropidodipsas sartorii*) were new state records.

Eleutherodactylus cystignathoides (Cope, 1877). The Rio Grande Chirping Frog occurs from "the Rio Grande embayment (Texas, USA) to central Nuevo León, Tamaulipas, eastern San Luis Potosí, Hidalgo, and central Veracruz (Mexico). Commensal in much of residential Southeast Texas north to the Dallas area, northwestern Louisiana, and Mobile, Alabama, USA" (Frost, 2015). This individual was encountered in the Cañon del Ejido El Potrero, Sierra de Gomas, in the municipality of Villaldama. Wilson et al. (2013b) calculated its EVS as 12, placing it in the upper portion of the medium vulnerability category. Its conservation status has been considered as Least Concern by IUCN; this species is not listed by SEMARNAT. © Manuel Nevárez-de los Reyes

While studying the ecological aspects of the Parque Ecológico Chipinque, Nájera (1997) produced a preliminary list of the herpetofauna of the park, which frequently is visited by people living in the Monterrey metropolitan area. Thereafter, Banda-Leal (2002) studied the same area after a wildfire in 1998, and reported the amphibians of the park as representing three families, including the Bufonidae (one species), Hylidae (one species), and Leptodactylidae (four species), for a total of six anurans. He also reported the squamates in the park as representing five families of lizards, including the Phrynosomatidae (nine species), Scincidae (two species), and Anguidae, Teiidae, and Xantusiidae (one species each), for a total of 14 lizard species, and four families of snakes, including the Colubridae (18 species), Elapidae (one species), Leptotyphlopidae (one species), and Viperidae (three species), for a total of 23 species.

Rheohyla miotympanum (Cope, 1863). The Small-eared Treefrog is a Mexican endemic found from "Nuevo León and Coahuila (Sierra Madre Oriental) to Guanajuato (Sierra Santa Rosa), Hidalgo, and Oaxaca, adjacent Veracruz, and central Chiapas in eastern and central Mexico" (Frost, 2015). This individual was encountered in Parque Natural La Estanzuela, in the municipality of Monterrey. Wilson et al. (2013b) calculated its EVS as 9, placing it at the upper limit of the low vulnerability category. Its conservation status has been considered as Near Threatened by IUCN; this species is not listed by SEMARNAT. © Elí García-Padilla

Lithobates berlandieri (Baird, 1859). The Rio Grande Leopard Frog ranges from "central and western Texas and southern New Mexico (USA) through eastern Chihuahua to central Veracruz and Hidalgo, Mexico; introduced into the lower Colorado River and lower Gila River drainages of Sonora and Baja California del Norte, Mexico, and California and Arizona, USA." (Frost, 2015). This individual was found near Santiago, in the municipality of Santiago. Wilson et al. (2013b) calculated its EVS as 7, placing it at the middle portion of the low vulnerability category. Its conservation status has been considered as Least Concern by IUCN, and as a species of special protection (Pr) by SEMARNAT. © Emiliano Méndez-Salinas

Lazcano et al. (2004) provided a preliminary list of the herpetofauna of the Sierra San Antonio Peña Nevada, in the southwestern part of the state. The list contains two salamander species, five anuran species, nine lizard species, and 16 snake species. Contreras-Lozano (2006) analyzed the distribution of the herpetofauna in the Sierra de Picachos, a mountain range located northeast of Monterrey's metropolitan area. He extended the geographic distribution of several species, and for the first time in the state provided information on substrate preference. He also substantiated the presence of *Trimorphodon tau*, significantly extending the distribution of this species in the region, since all previous records were restricted to the Cerro de la Silla area (Martin del Campo, 1953; Nevárez-de los Reyes et al., 1999). Gallardo-Valdez (2006) analyzed the distribution of the herpetofauna and its vegetational associations in the municipality of Cadereyta-Jiménez, in the Área Nacional Protegida (ANP = Natural Protected Area) of Sierra "Cerro de la Silla" and the localities of Boquillas and Atongo, and recorded 43 species. Lazcano et al. (2006) studied the herpetofauna of Parque Ecológico Chipinque and reported seven anuran species, 15 lizard species, and 23 snake species, for a total of 45 species. Lazcano et al. (2007) examined the herpetofauna of the juniper forest and related habitat types in the state protected area of San Juan y Puentes, reported a total of 45 species from the area, including 10 anuran species, 11 lizard species, 23 snake species, and one turtle species. Lazcano et al. (2009) documented 46 species in the Sierra "Cerro de la Silla," including eight anuran species, 12 lizard species, and 26 snake species.

In a general discussion of the problem of invasive species as they impact the native herpetofauna in northeastern Mexico, Lazcano et al. (2010) provided a list of 63 exotic species of amphibians, crocodilians, lizards, snakes, and turtles that commonly are sold in pet stores in the metropolitan area of Monterrey, Nuevo León. This list included two species of anurans, three species of crocodilians, 28 species of lizards, 22 species of snakes, and eight species of turtles. The authors indicated that most of the species sold as pets in the capital city potentially could become invasive species, and in nearly all cases their ecological impact remains undocumented. In the book *Serpientes de Nuevo León*, Lazcano et al. (2010) noted that 62 species of snakes are found in the state. In their updated edition (*In press*), they are increasing that number to 65.

Contreras-Lozano (2011) and Contreras-Lozano et al. (2011) studied the herpetofauna of "Cerro El Potosí" in Galeana, Nuevo León, and reported 41 species. Dixon et al. (2011) discussed the systematic status of three species of the snake genus *Rhadinaea* in the Sierra Madre Oriental of eastern Mexico, of which one, *R. montana*, is restricted to Nuevo León. The principal question with these three related taxa was whether *R. montana* and *R. gaigeae* should be recognized as one or two species. These authors concluded that they likely represent separate species, and thus we consider *R. montana* to be a state endemic in Nuevo León.

Scaphiopus couchii Baird, 1854. Couch's Spadefoot Toad is found from "southeastern California to southeastern Colorado and southwestern Oklahoma (USA) and south to northern Nayarit, Zacatecas, San Luis Potosí, northern México, Hidalgo, and northern Veracruz (Mexico)." (Frost, 2015). This individual came from Rancho El Lobo, in the municipality of Villaldama. Wilson et al. (2013b) calculated its EVS as 3, placing it at the lower limit of the low vulnerability category. Its conservation status has been considered as Least Concern by IUCN; this species is not listed by SEMARNAT. © Manuel Nevárez-de los Reyes

Ambystoma velasci. Dugès, 1888. The Plateau Tiger Salamander is a Mexican endemic occurring from "northwestern Chihuahua south along the eastern slope of the Sierra Madre Occidental and southern Nuevo Leon to Hidalgo in the Sierra Madre Oriental, west to Zacatecas, and south into the Transverse Volcanic range of central Mexico." (Frost, 2015). This individual came from Ejido San José de González, in the municipality of Galeana. Wilson et al. (2013b) calculated its EVS as 10, placing it at the lower limit of the medium vulnerability category. Its conservation status has been considered as Least Concern by IUCN, and as a species of special protection (Pr) by SEMARNAT.

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Lazcano et al. (2012) examined the herpetofauna of the ANP Cerro El Topo Chico, an isolated mountain range surrounded by the Montrerrey metropolitan area. This study recorded the presence of 16 anuran species, 17 lizard species, 33 snake species, and one turtle species. García-Bastida (2013) studied the ecology of *Gerrhonotus infernalis* in Parque Ecológico Chipinque. Although this species is abundant in mountainous areas of the state, limited information was available on the biology of this species. Narváez-Torres and Lazcano-Villareal (2013) examined the herpetofauna of Parque Nacional Cumbres de Monterrey, and indicated the presence of 19 species of amphibians, squamates, and chelonians. Chávez et al. (2014) provided the first record of *Senticolis triaspis* for Cerro de La Silla, which currently represents the northernmost locality for this species in the state. Farr et al. (2015) studied the geographic distribution of *Crotalus totonacus* in Nuevo León, indicating that the ANP Cerro de la Silla represents the northernmost locality for this species.

A number of recent studies have focused on the herpetofauna of Nuevo León. Parra-Olea et al. (2014) noted the presence of 23 species of amphibians (20 anurans and three salamanders), and Flores-Villela and García-Vázquez (2014) reported 115 species of squamates and turtles, of which 37 are lizards, 49 are snakes, and six are turtles. Most recently, Lemos-Espinal and Cruz (2015) and Lemos-Espinal et al. (2016) indicated the herpetofauna of Nuevo León to be composed of 132 species, with 23 species of amphibians and 109 of squamates and turtles.

Lemos-Espinal (2015) edited a book on the herpetofauna of the US–Mexico border states, which include Nuevo León. The checklist at the end of the book indicates that of these six states, the smallest herpetofauna is that of Nuevo León. The number of species listed is 132, seven fewer than we record here for the state, but this number is only one species less than the one for Coahuila (133), a state substantially larger than Nuevo León. The disproportionately small herpetofauna known for Coahuila likely results from much of its area lying within the Chihuahuan Desert, and also because of the inaccessibility of many portions of the state for fieldwork (Lemos-Espinal and Smith, 2015). *Crotalus ornatus*, known from the Chihuahuan Desert and central Texas, was recorded for the first time in Nuevo León by Nevárez-de los Reyes et al. (2016), who found a specimen in the municipality of García. Finally, Gárcia-Padilla et al. (2016c; this issue) report *Eleutherodactylus verrucipes* as new to the herpetofauna of the state.

PHYSIOGRAPHY AND CLIMATE

Physiographic Regions

We used the classification system of physiographic regions (= subprovinces) developed by INEGI (1986) to analyze the distribution of the herpetofauna of Nuevo León. This system consists of seven regions (Fig. 1), which we briefly describe below (see INEGI, 1986).

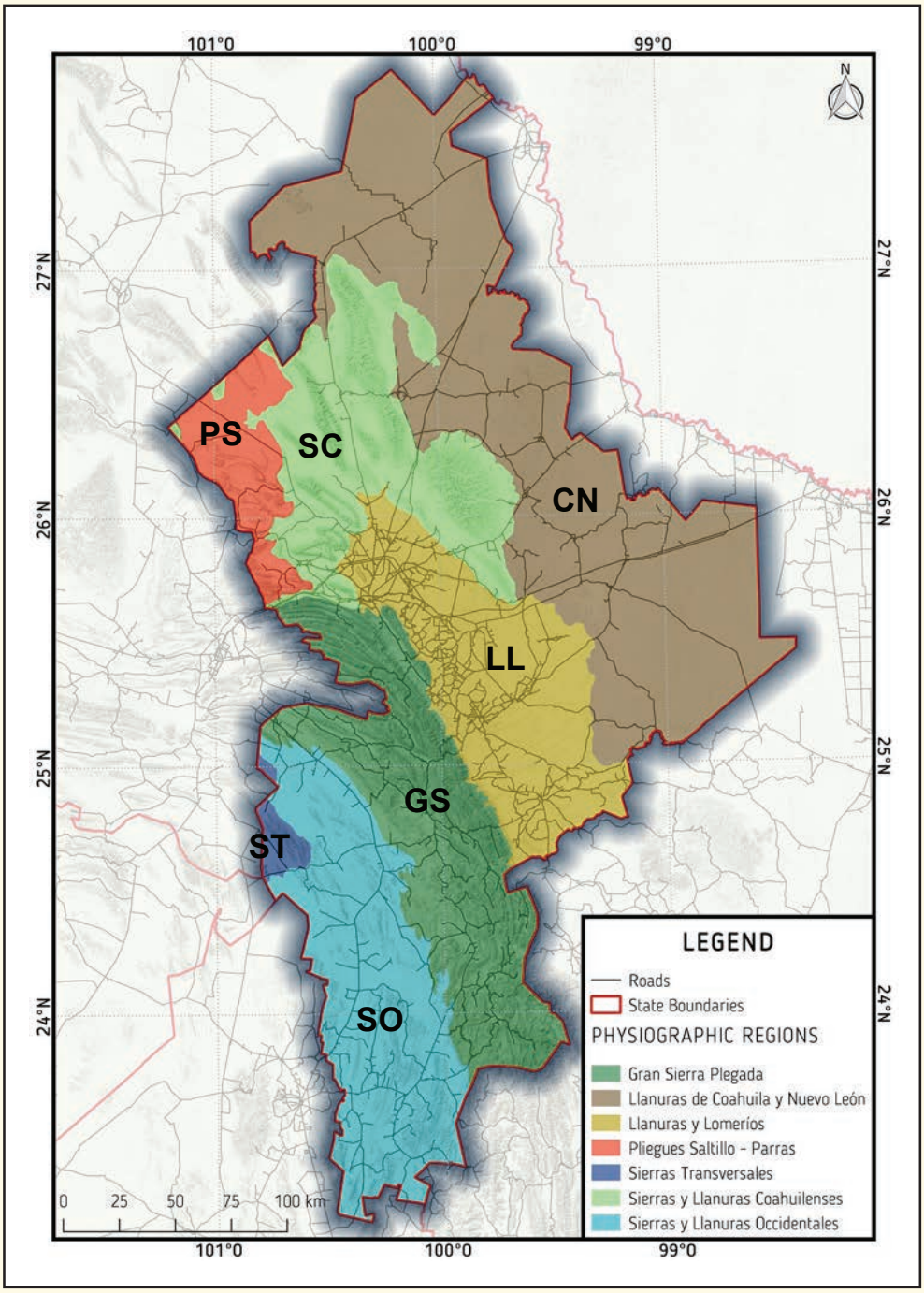

Fig. 1. Physiographic regions of Nuevo León, Mexico, slightly modified from INEGI (1986). Abbreviations are as follows: CN = Llanuras de Coahuila y Nuevo León; SC = Sierras y Llanuras Coahuilenses; LL= Llanuras y Lomeríos; PS = Pliegue Saltillo Parras; GS = Gran Sierra Plegada; ST = Sierras Transversales; and SO = Sierras y Llanuras Occidentales.

Gran Sierra Plegada (GS).—The topography of this region predominantly is mountainous, but it also contains hills, plateaus, and valleys (Figs. 2, 3). This region is located somewhat parallel to the Gulf of Mexico, and represents an orographic barrier that favors the deposition of moisture on the eastern slopes, which prevents the westward movement of moist winds. Heavy rainfall has led to the dissolution of limestone rocks in the area, resulting in a karstic environment. At the foot of the mountains, these processes have led to the formation of vast cavern systems and springs. Moreover, a broad elevational gradient is present in this area.

Fig. 2. *Llanuras de Coahuila y Nuevo León*. Tamaulipan thorn scrub near Los Herreras, elevation 90 m. During the dry season, as pictured here, the low trees are separated by expanses of open ground; during the wet season, these open areas support grasses and other herbaceous plants. © Manuel Nevárez-de los Reyes

Fig. 3. *Sierras y Llanuras Coahuilenses*. Vista of Sierra de Gomas, elevation 1,750 m, with a view to the west of Sierra de Enmedio and Sierra Minas Viejas. The vegetation present in the valley is either Tamaulipan thorn scrub or microphyllous scrub; piedmont and rosetophyllous scrub are present on the slopes, succeeded at higher elevations by oak forest and then pine forest. © Manuel Nevárez-de los Reyes

This region begins east of Saltillo, Coahuila, and extends southward to the vicinity of Ciudad Valles, San Luis Potosí; thus, the region includes sections in Coahuila, Nuevo León, Tamaulipas, and San Luis Potosí, and is dominated by folded layers of limestone, with prominent structural axes of anticlines and synclines. The flexed region that lies east of Saltillo and south of Monterrey is known as "Anticlinorio de Arteaga," a structural sequence of folds that together make up a general anticline. A great reverse geological fault lies on the eastern edges of the Gran Sierra, while smaller ones extend relatively parallel to it and its structural axes.

Parallel gypsum and phosphoritic outcrops also are present, particularly on the west side of the Gran Sierra, with some normal faults toward the western edges. In general, summits in the Gran Sierra surpass 2,000 m in elevation, with the highest around 3,000 m on Cerro El Potosí, Nuevo León, and at the summit north of Miquihuana, Tamaulipas. Karsted features are present in the Gran Sierra, where Grutas de García displays karstification even under arid conditions.

The area covered by this region includes the entire municipalities of General Zaragoza, Iturbide, Rayones, Santa Catarina, and Santiago, and parts of the municipalities of Allende, Aramberri, Galeana, Garza García, Guadalupe, Juárez, Linares, Montemorelos, and Monterrey, covering a total area of 808 km^2. Throughout the region, two shallow soil types predominate: rendzina and litosol.

In general terms, two fundamental forms of plant landscapes are present in the region: forests and scrublands. In the forest category, pines dominate the area. In the scrubland group, desert rosetophyllous scrub, piedmont scrub, and chaparral dominate the region. Other types of native plant formations in the Gran Sierra Plegada occur in small patches of grassland, halophytic vegetation, or alpine prairie, but they have minimal influence in shaping the overall landscape. Alpine prairie, however, only covers the top of Cerro El Potosí, the highest mountain in the state. This alpine prairie is composed of low-lying shrubs that don't exceed 80 cm in height and only develop within the semi-cold climates at elevations above 3,700 m, so this plant community is uncommon in northwestern Mexico.

Llanuras de Coahuila y Nuevo León (CN).—The total area of this region (Fig. 4) is 9,603 km^2; the region is bordered to the east by the Río Grande and equivalent regions in Tamaulipas (Terán-Juárez et al., 2016), to the

Fig. 4. *Sierras y Llanuras Coahuilenses*. View of Cerro Boludo and Pico Candela, located north of Bustamante. The plain in the foreground lies at an elevation of 484 m and is located in a transitional zone between Tamaulipan thorn scrub and microphyllous scrub.
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west by the Sierras y Llanuras Coahuilenses (SC), and Llanuras y Lomeríos (LL) to the south. Thus, the region comprises sections of the states of Coahuila, Nuevo León, and Tamaulipas, and is characterized by the presence of plains interrupted with scattered low hills composed of conglomerates, at elevations ranging from 75 to about 500 m. One of the most extensive plains extends from Anahuac, Nuevo León, to Nueva Rosita, Coahuila, at an average elevation of around 500 m.

Tamaulipan thornscrub and mesquite (*Prosopis* spp.) are the most characteristic vegetation types in this region. They alternate on deep vertisol or shallower xerosol soils in all topographic systems, with the exception of on the plateau, which occupies a very small area in the northwestern portion of the state. Tamaulipan thornscrub is distributed at elevations from 80 to 340 m, with a physiognomy of thornscrub in areas of low relief and of semi-thorn scrubland on the lower sections of areas with higher relief. Large patches of Purple Sage or Cenizo (*Leucophyllum* sp.) are present in some areas, indicative of a high degree of disturbance to the native scrub vegetation, as this species numerically dominates sympatric native species that are found in low frequency and are small in size. Disturbance primarily is due to excessive overgrazing by livestock. Mesquite dominates at elevations from 75 to 400 m. Piedmont scrub or Tamaulipan thornscrub predominates in some middle sections, and a prevelance of halophytic elements that tolerate soils with high salt concentrations are present in the lower areas. The piedmont scrub is distributed at elevations from 120 and 420 m, on hills and plains with a semi-thornscrub physiognomy. Some deciduous thornscrub and deciduous hardwood forests also are found in the region, and oak and pine-oak forests occur at higher elevations.

In the northwestern portion of the region, a rocky substrate throughout the hills and plateau develops a microphyllous desert scrub formation with an appearance of scrubland containing either semi-thorn, thorny, or thornless shrubs. This type of vegetation also is present on some alluvial plains interspersed with low hills.

Halophytic vegetation is found within small areas of the plains and valleys where high salt concentrations are present in the soils. Halophytic grassland also occurs on plains with saline soils. Natural grassland occurs in some areas of the plains at elevations from 135 to 290 m. The introduced grasses on the plains and valleys primarily are composed of one species, Buffelgrass (*Pennisetum ciliare*), which is distributed at elevations from 190 to 270 m, and covers small hilly areas and the alluvial plains.

This region encompasses the entire municipalities of Anáhuac, Lampazos, Sabinas Hidalgo, Vallecillo, Parás, Agualeguas, Cerralvo, General Treviño, Ocampo, Los Aldamas, Los Herreras, General Bravo, Doctor Coss, China, and parts of Los Ramones and General Terán.

Aquiloeurycea galeanae (Taylor, 1941). The Galeana False Brook Salamander is a Mexican endemic found in the "areas surrounding Galeana and Iturbide in southern Nuevo León, Mexico" (Frost, 2015). This individual was encountered near Peña Nevada, in the municipalty of Zaragoza. Wilson et al. (2013b) calculated its EVS as 18, placing it in the upper portion of the high vulnerability category. Its conservation status has been considered as Near Threatened by IUCN, and as a threatened species (A) by SEMARNAT. © Elí García-Padilla

Llanuras y Lomeríos (LL).—This region (Fig. 5) occupies about 9,657 km^2, and encompasses the municipalities of Apodaca, Cadereyta Jiménez, El Carmen, Ciénega de Flores, General Zuazua, Hualahuises, Marín, Pesquería, and San Nicolás de los Garza, as well as parts of Allende, General Escobedo, General Terán, Juárez, Linares, Montemorelos, Monterrey, Los Ramones, and Salinas Victoria. It consists of a small low sierra, the Sierra de Las Mitras, small low hills, and extensive plains. The soils predominately are deep and dark vertisols. The predominant vegetation is Piedmont scrub. Another common type of vegetation is Tamaulipan Thorn Scrub, often with densely distributed high shrubs, which is found on low hills with intermediate plains and low hill systems. Some oak and pine-oak forests occur at higher elevations, animal pastures are found on soft hills within the plains, and some mesquites and patches of deciduous thorny and deciduous forest also can be found.

Fig. 5. *Llanuras y Lomeríos*. View of open piedmont scrub vegetation, with isolated elements of Palma Pita (*Yucca filifera*), on hillsides located along a dirt road from Zuazua to Higueras, at an elevation of 430 m. © Manuel Nevárez-de los Reyes

Pliegues Saltillo–Parras (PS).—This physiographic region (Figs. 6), also known as the northern plateau, consists of mountains, hills, and plains with outcrops of shales and sandstones. In Coahuila, this region stretches from south of Monclova to near Saltillo, but only a small portion is present in northwestern Nuevo León (ca. 3,004 km^2), where it includes parts of the municipalities of García and Mina. Soils in the mountains and hills primarily are lithosols, associated with mountainous and hilly areas, calcaric regosols associated with alluvial plains, and rendzina soils associated with hilly areas.

The vegetation is characterized mostly by desert microphyll scrub and desert rosetophyllous scrub. Desert rosetophyllous scrub is found in all the topographic systems at elevations from 750 to 1,300 m, and is composed of species like Lechuguilla (*Agave lechuguilla*) and thorned or thornless shrubs. Desert microphyll scrub is found at lower elevations (650–800 m) than desert rosetophyllous scrub, except on mountains and hills. Other types of plant communities cover small areas; natural grassland covers low hilly areas, halophytic vegetation is found on plains with rocky bases and saline soils, and piedmont scrub occurs on folded mountains.

Sierras Transversales (ST).—This region (Fig. 7) extends almost perpendicularly to the main axis of the Sierras y Lanuras Occidentales. Only a small extension of this region enters Nuevo León (527 km^2; 0.82% of the state), and is composed mostly of desert plains that cover part of the municipality of Galeana. Lithosols less than 10

Fig. 6. *Pliegue Saltillo Parras*. View of microphyllous scrub composed of Ocotillo (*Fouquieria splendens*) and Creosote Bush (*Larrea tridentata*) located along the road between Mina and Icamole, at an elevation of 615 m. A portion of Cerro de la Popa is visible in the background. © Manuel Nevárez-de los Reyes

Fig. 7. *Gran Sierra Plegada*. Oak-Pine forest along the road to La Meseta de Chipinque, Garza García, a private eco-park used by tourists and sportspeople, close to the Monterrey metropolitan area, at an elevation of ca. 950 m. © Manuel Nevárez-de los Reyes

cm deep comprise the primary soil in the region, which is associated with calcium and haptic xerosols limited by a layer of hard caliche (petrocalic phase). These soils are typical to dry and subhumid temperate climates.

Two main plant communities are present in this area: desert microphyll scrub and desert rosetophyllous scrub. The first type is associated with slopes and alluvial plains, at an average elevation of 2,040 m. Desert rosetophyllous scrub is present at elevations from 2,040 to 2,200 m, with species such as lechuguilla, cacti, and some thornless species.

Sierras y Llanuras Coahuilenses (SC).—This region (Figs. 8, 9) begins along the edge of the Rio Grande between Ojinaga, Chihuahua, and Acuña, Coahuila, where it splits into two branches, with the longest entering northwestern Nuevo León. This region occupies an area of approximately 8,853 km^2, including the entire municipalities of Abasolo, Bustamante, Ciénega de Flores, Doctor González, Higueras, Salinas Victoria, Hidalgo, and Villaldama, as well as parts of Agualeguas, Cerralvo, García, Garza García, Lampazos, Mina, and Sabinas Hidalgo. The region primarily is composed of folded mountain ranges of carbonate origin that are oriented from northwest to southeast. Its structural axes are well defined, especially in the south where they are elongated with eroded anticlinal ridges.

Most of this region lies at elevations from 1,000 to 2,000 m, with three structural features associated with it in Nuevo León: the Sierra de Sabinas Hidalgo, the elongated Sierra del Potrero, and the eroded anticline ridges. The anticline ridges extend northeast of Monterrey to the Sierra de Picacho, and contain structures with strong igneous intrusions along the northern edge. These anticline ridges contain extended alluvial plains formed from limestone, shale, and gypsum. A clear predominance of lithosols of residual origin is present, which are underdeveloped and shallow and do not exceed 10 cm in depth. Depending on the topography in which they are found, however, different soil associations also are formed.

Various plant communities are present in the region, including 15 formations that range from lowland seasonal evergreen forests to human-established grassland used for livestock grazing. The most extensive plant formation is piedmont scrub, which covers a number of topographic features, and develops at elevations from 240 and 1,100 m in areas with diverse floristic structures and semi-dry climates.

Fig. 8. *Gran Sierra Plegada*. Cañón de San Isidro, within Parque Nacional Cumbres de Monterrey, with piedmont scrub-oak and rosetophyllous vegetation growing on the rock walls, at an elevation of 1,600 m. © Manuel Nevárez-de los Reyes

Fig. 9. *Sierras Transversales*. Pine forest with elements of piedmont scrub near Puerto de Pastores, south of Galeana, at an elevation of 2,100 m. © Manuel Nevárez-de los Reyes

Sierras y Llanuras Occidentales (SO).—In Nuevo León, this region (Fig. 10) is located between the ST and GS regions, and between northern San Luis Potosí and the southwestern corner of Tamaulipas. It occupies an area of 10,149 km^2, which represents 15.8% of the state's area, and includes the entire municipalities of Doctor Arroyo, Mier, and Noriega, and part of the municipalities of Galeana and Aramberri.

This region mostly consists of a network of limestone-covered mountain ranges with north to south orientations, which are linked by more level spaces covered with alluvium. The northern and southern plains are found at elevations from 1,500 to 2,000 m. An outcropping of intrusive igneous rocks also is present in the southern part of the region. The mountains usually are steep and somewhat elongated, with summits reaching elevations of 3,180 m (Cerro El Potosí). Smaller mountain ranges, such as El Cateado and Las Mazmorras, reach elevations slightly above 2,000 m. The plains are covered with alluvium, frequently contain a caliche layer under the thin soils, and widen along the eastern end of the region.

The vegetation type primarily is determined by the climate, topography, and edaphic features, but mostly consists of some variation of scrubland. In microphyllous desert scrub, for example, only Honey Mesquite (*Prosopis glandulosa*), Creosotebush (*Larrea tridentata*), and Tarbush (*Flourensia cernua*) are found in the higher area; the middle area is composed of prickly-pear cactus (*Opuntia* spp.) and Lechuguilla (*Agave lechuguilla*). Desert roseotophyllous scrub is present within the entire region; the most common species in the higher area is Creosotebush (*Larrea tridentata*), and Lechuguilla (*Agave lechuguilla*) and different types of maguey (*Agave* spp.) are present in the lower area. Other types of plant formations are found in localized areas. Piedmont scrub is present in the municipalities of Mier and Noriega. Natural grasslands are distributed in small patches in this region, and the numerically dominant grasses include grama (*Bouteloua* spp.) and threeawn (*Aristida* spp.). Grasslands commonly are used for livestock grazing, and some areas are overgrazed. The halophytic and human-fabricated pastures are not representative of the region. In the mountains of Santa Gertrudis and San José de Raíces, as well as in other locations in the southern part of the region, chaparral can be found at an average elevation of 2,120 m. Mezquital mainly is found in the southern part of the region, in addition to small areas with halophytic vegetation and pine forest.

Fig. 10. *Sierras y Llanuras Occidentales*. View of piedmont scrub, with Giant Barrel Cactus (*Echinocactus platyacanthus*) and Guapilla (*Hechtia* sp.), near Puerto de Pastores, south of Galeana, at an elevation of 2,100 m. © Manuel Nevárez-de los Reyes

Climate

Temperature.—We designed a table with the monthly minimum, mean, and maximum temperatures for one locality in each of the seven physiographic regions in the state (Table 1). The values for the Sierras Transversales are from the closest locality in Coahuila (La Ventura) with available climatic data. The elevation of these localities ranges from 194 m on the Llanura de Coahuila y Nuevo León to 1,867 m in the Sierras Transversales.

The mean annual temperature (MAT) typically declines with increasing elevation in Nuevo León, with one exception (Table 1). At the lowest extreme for which we have data (194 m), at Anáhuac in the Llanuras de Coahuila y Nuevo León, the MAT is 22.7°C, which is the highest value in Table 1. The MAT decreases with increased elevation at the following stations, as follows: 22.1 (403, Ejido Marín, Llanuras y Lomeríos); 21.0 (565, Rancho de Gomas, Sierras y Llanuras Coahuilenses); 20.4 (945, La Popa, Pliegues Saltillo Parras); 18.2 (1,609, Galeana, Gran Sierra Plegada); and 18.0 (1,867, La Ventura, Coahuila). The only exception to this trend is at Cerrito del Aire (1,630 m), in the Sierras y Llanuras Occidentales, where the MAT is 16.7°C. Based simply on the normal lapse rate, the MAT at this locality should be close to that at Galeana, in the Gran Sierra Plegada. The annual monthly minimum temperature ranges from 11.6 to 20.0°C lower than the annual monthly maximum temperature ($\bar{x}$ = 15.0°C). During the year, the mean monthly temperatures peak at some point from June to August, and are lowest in either December or January (Table 1).

Table 1. Monthly minimum, mean (in parentheses), maximum, and annual temperature data (in °C) for the physiographic regions of Nuevo León, Mexico. Localities and their elevation for each of the regions are as follows: Llanuras de Coahuila y Nuevo León—Anáhuac (194); Sierras y Llanuras Coahuilenses—Rancho de Gomas (565 m); Llanuras y Lomeríos—Ejido Marín (403 m); Pliegue Saltillo Parras—La Popa (945 m); Gran Sierra Plegada—Galeana (1,609 m); Sierras Transversales—La Ventura, Coahuila (1,867 m); and Sierras y Llanuras Occidentales—Cerrito del Aire (1,630 m). Data taken from: www.smn.cna.gob.mx; accessed 9 May 2016.

Physiographic Region	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Llanuras de Coahuila y Nuevo León	19.8 (12.8) 5.8	22.5 (15.2) 8.0	27.1 (19.6) 12.1	31.1 (24.0) 16.8	34.3 (27.5) 20.6	36.7 (29.8) 22.9	37.5 (30.7) 23.8	37.5 (30.7) 24.0	34.1 (27.9) 21.7	29.8 (23.4) 17.0	24.3 (17.5) 10.8	20.1 (13.3) 6.6	29.6 (22.7) 15.8
Sierras y Llanuras Coahuilenses	20.3 (13.0) 5.6	22.5 (14.9) 7.3	26.4 (18.6) 10.9	29.8 (22.2) 14.5	32.2 (25.6) 18.9	33.4 (27.2) 21.1	33.2 (27.7) 21.5	33.6 (27.4) 21.3	30.5 (24.9) 19.4	27.5 (21.3) 15.1	23.8 (16.8) 9.9	20.3 (13.0) 5.6	27.8 (21.0) 14.3
Llanuras y Lomeríos	20.2 (14.1) 7.9	22.5 (16.1) 9.8	26.2 (19.7) 13.2	29.6 (23.4) 17.3	32.0 (26.4) 20.8	33.6 (28.2) 22.7	34.0 (28.4) 22.9	34.2 (28.5) 22.9	31.0 (25.9) 20.9	27.4 (22.3) 17.3	23.7 (18.0) 12.2	20.0 (14.0) 8.1	27.9 (22.1) 16.3
Pliegue Saltillo Parras	19.2 (12.9) 6.7	21.4 (14.8) 8.2	25.9 (18.5) 11.2	29.7 (21.9) 14.1	31.9 (24.3) 16.7	33.0 (25.5) 18.0	32.9 (25.7) 18.6	32.5 (25.4) 18.3	29.6 (23.4) 17.2	27.6 (20.9) 14.3	23.7 (17.2) 10.7	21.0 (14.4) 7.8	27.4 (20.4) 13.5
Gran Sierra Plegada	23.4 (14.6) 5.7	23.5 (15.3) 7.1	25.5 (17.4) 9.3	26.3 (19.0) 11.7	27.8 (20.6) 13.5	29.1 (21.9) 14.6	28.1 (20.9) 13.7	28.0 (20.8) 13.6	25.8 (19.4) 12.9	24.8 (17.9) 11.1	23.6 (15.9) 8.2	23.2 (14.7) 6.3	25.8 (18.2) 10.6
Sierras Transversales	21.5 (11.7) 1.9	23.1 (13.1) 3.1	26.8 (16.0) 5.3	29.4 (18.5) 7.5	32.3 (21.6) 10.9	32.6 (22.5) 12.3	31.3 (22.3) 13.3	30.8 (21.7) 12.6	30.8 (21.5) 12.2	29.9 (19.4) 8.8	25.5 (15.5) 5.6	21.9 (12.0) 2.1	28.0 (18.0) 8.0
Sierras y Llanuras Occidentales	20.7 (11.6) 2.5	22.3 (13.0) 3.6	24.5 (15.3) 6.1	27.2 (17.9) 8.6	28.5 (19.9) 11.3	27.9 (20.3) 12.8	27.3 (19.8) 12.3	27.3 (19.9) 12.5	26.5 (19.3) 12.0	25.0 (17.3) 9.6	22.8 (14.3) 5.8	20.2 (11.5) 2.7	25.0 (16.7) 8.3

Gerrhonotus lugoi McCoy, 1970. Lugo's Alligator Lizard is a Mexican endemic distributed from the Cuatro Ciénegas region in Coahuila eastward to west-central Nuevo León (Lemos-Espinal et al., 2015; García-Vázquez et al., *In press*). This individual was found at Rancho el Cuatro, in the municipality of Mina. Wilson et al. (2013a) calculated its EVS as 16, placing it in the middle portion of the high vulnerability category. Its conservation status has been considered as Least Concern by IUCN; this species is not listed by SEMARNAT.

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Precipitation.—Precipitation in Nuevo León is highest during the months of May through October, the rainy season, and lowest from November through April, the dry season (Table 2). The data in Table 2 demonstrate that 74.2–82.6% ($\bar{x}$ = 77.4%) of the annual precipitation falls during the rainy season. The highest amount of precipitation occurs during the months of August or September, usually in September, and depending on the location the lowest amount falls during November, December, January, February, or March, i.e., any of the months of the dry season, except for April. The annual rainfall ranges from 256.3 mm in the Pliegues Saltillo Parras to 541.1 in the Llanuras y Lomeríos, with the higher value 2.1 times more than the lower one. Annual rainfall does not reach 600 mm in any of the regions we recognize in Nuevo León.

Table 2. Monthly and annual precipitation data (in mm) for the physiographic regions of Nuevo León, Mexico. Localities and their elevation for each of the regions are as follows: Llanuras de Coahuila y Nuevo León—Anáhuac (194 m); Sierras y Llanuras Coahuilenses—Rancho de Gomas (565 m); Llanuras y Lomeríos—Ejido Marín (403 m); Pliegue Saltillo Parras—La Popa (945 m); Gran Sierra Plegada—Galeana (1,609 m); Sierras Transversales—La Ventura, Saltillo, Coahuila (1,867 m); and Sierras y Llanuras Occidentales—Cerrito del Aire (1,630 m). The shaded area indicates the months of the rainy season. Data taken from: www.smn.cna.gob.mx; accessed 9 May 2016.

Physiographic Region	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Llanuras de Coahuila y Nuevo León	18.0	20.6	15.5	29.7	59.9	53.7	38.1	63.0	88.5	45.8	20.8	16.9	470.6
Sierras y Llanuras Coahuilenses	15.8	12.6	14.8	18.9	31.4	34.3	67.7	55.0	97.1	27.7	12.8	14.2	402.3
Llanuras y Lomeríos	24.9	16.7	19.5	32.7	53.5	63.8	59.4	74.9	111.5	44.0	17.6	22.6	541.1
Pliegue Saltillo Parras	9.9	7.3	5.5	11.2	22.3	31.2	28.9	38.4	58.2	17.7	12.3	13.4	256.3
Gran Sierra Plegada	6.7	9.4	19.3	27.7	42.3	42.4	33.9	57.8	66.7	38.2	8.4	9.0	361.8
Sierras Transversales	14.8	12.8	9.3	22.8	37.4	55.9	41.8	46.9	46.9	38.7	10.5	9.1	346.9
Sierras y Llanuras Occidentales	21.3	19.6	13.2	19.4	74.0	68.9	68.3	85.2	88.6	45.5	5.8	11.7	521.5

COMPOSITION OF THE HERPETOFAUNA

Families

The herpetofauna of Nuevo León is allocated to 31 families, including 11 of amphibians (nine anuran and two caudate families), 16 of squamates, and four of turtles (Table 3). The total number is 52.5% of the 59 families represented in Mexico (J. Johnson, unpublished). Compared to the recently surveyed herpetofauna of Tamaulipas, Nuevo León is represented by one less salamander family, seven fewer squamate families, and three fewer turtle families (Terán-Juárez et al., 2016). Two of the 31 families only are represented in the state by non-native species (Gekkonidae and Typhlopidae). The other 29 families constitute 49.2% of the 59 native families in Mexico (J. Johnson, unpublished). No caecilians are represented among the amphibians in Nuevo León, since these legless creatures are not known to occur north of the southern border of Nayarit or south-central Veracruz (Woolrich-Piña et al., 2016). Within the remainder of the herpetofauna, no crocodylians are recorded formally from the state, although one species might occur there. The most speciose amphibian families in Nuevo León are the Bufonidae (six species), Eleutherodactylidae (four), Scaphiopodidae (three), and Plethodontidae (three), which amounts to slightly more than six-tenths of this group of 26 species (Tables 3, 4). The largest families within the remainder of the herpetofauna are the Anguidae (four species), Phrynosomatidae (25), Scincidae (three), Teiidae (three), Colubridae (31), Dipsadidae (nine), Leptotyphlopidae (three), Natricidae (10), Viperidae (10), and the Emydidae (three); the 101 species in these 10 families comprise about nine-tenths of the 113 included species (Table 3).

Table 3. Composition of the native and non-native herpetofauna of Nuevo León, Mexico.

Orders	Families	Genera	Species
Anura	9	14	22
Caudata	2	3	4
Subtotals	**11**	**17**	**26**
Squamata	16	52	106
Testudines	4	5	7
Subtotals	**20**	**57**	**113**
Totals	**31**	**74**	**139**

Genera

The herpetofauna of Nuevo León is arranged into 74 genera, including 14 of anurans, three of salamanders, 52 of squamates, and five of turtles. The total number is 34.3% of the 216 genera now recorded from Mexico (Duellman et al., 2016; J. Johnson, unpublished). This number of genera is 29 fewer than the number of native genera in the adjacent state of Tamaulipas (Terán-Juárez et al., 2016). The most speciose genera of amphibians in Nuevo León are *Anaxyrus* (four species) and *Eleutherodactylus* (four); in the rest of the herpetofauna, these genera are *Sceloporus* (18), *Crotalus* (eight), *Lampropeltis* (four), *Tantilla* (five), and *Thamnophis* (six).

Gerrhonotus parvus Knight and Scudday, 1985. The Pygmy Alligator Lizard is a Mexican endemic found in the Gran Sierra Plegada region of southeastern Coahuila and south-central Nuevo León (Lemos-Espinal et al., 2016). This individual was encountered at Cañón de San Isidro, in the municipality of Santiago. Wilson et al. (2013a) calculated its EVS as 17, placing it in the middle portion of the high vulnerability category. Its conservation status has been considered as Endangered by IUCN, and as a species of special protection (Pr) by SEMARNAT.
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Species

Currently, the herpetofauna of Nuevo León consists of 139 species, including 22 anurans, four salamanders, 106 squamates, and seven turtles (Table 3). These numbers include 135 native and four non-native species (Table 4). The number of native amphibian species in Mexico currently is 388 (J. Johnson, unpublished); thus, the 25 native species in Nuevo León comprise 6.4% of the total for the country. The number of native species in the remainder of the herpetofauna of Mexico amounts to 886; therefore, the 110 native species in Nuevo León constitutes 12.4% of the total for the country. In summary, the native herpetofauna of the state of 135 species makes up 10.6% of the 1,275 species recorded for all of Mexico (J. Johnson, unpublished). Compared to the adjacent state of Tamaulipas (Terán-Juárez et al., 2016), 45 fewer species (both native and non-native) are found in Nuevo León.

Table 4. Distribution of the amphibians, squamates, and turtles of Nuevo León, Mexico, by physiographic region. Abbreviations are as follows: CN = Llanuras de Coahuila y Nuevo León; SC = Sierras y Llanuras Coahuilenses; LL= Llanuras y Lomeríos; PS = Pliegue Saltillo Parras; GS = Gran Sierra Plegada; ST = Sierras Transversales; and SO = Sierras y Llanuras Occidentales. * = species endemic to Mexico; ** = species endemic to Nuevo León; and *** = non-native species. See text for description of these regions.

Taxa	Physiographic Regions of Nuevo León							Number of Regions Occupied
	CN	SC	LL	PS	GS	ST	SO	
Anura (22 species)								
Bufonidae (6 species)								
Anaxyrus cognatus							+	1
Anaxyrus debilis	+	+	+	+				4
Anaxyrus punctatus	+	+	+	+	+	+	+	7
Anaxyrus speciosus	+	+						2
Incilius nebulifer	+	+	+	+	+			5
Rhinella horribilis	+	+	+		+			4
Craugastoridae (1 species)								
Craugastor augusti					+		+	2
Eleutherodactylidae (4 species)								
Eleutherodactylus cystignathoides	+	+	+		+			4
Eleutherodactylus guttilatus		+			+			2
*Eleutherodactylus longipes**		+	+		+			3
*Eleutherodactylus verrucipes**					+			1
Hylidae (2 species)								
*Rheohyla miotympanum**					+			1
Smilisca baudinii			+		+			2
Leptodactylidae (1 species)								
Leptodactylus fragilis		+	+					2
Microhylidae (2 species)								
Gastrophryne olivacea	+	+	+	+	+			5
Hypopachus variolosus			+					1
Ranidae (2 species)								
Lithobates berlandieri	+	+	+	+	+		+	6
*Lithobates catesbeianus****	+							1
Rhinophrynidae (1 species)								
Rhinophrynus dorsalis			+					1

Scaphiopodidae (3 species)								
Scaphiopus couchii	+	+	+	+	+	+	+	7
Spea bombifrons							+	1
Spea multiplicata							+	1
Caudata (4 species)								
Ambystomatidae (1 species)								
*Ambystoma velasci**							+	1
Plethodontidae (3 species)								
*Aquiloeurycea galeanae**					+			1
*Chiropterotriton miquihuanus**					+			1
*Chiropterotriton priscus**					+			1
Squamata (106 species)								
Anguidae (4 species)								
*Barisia ciliaris**					+			1
Gerrhonotus infernalis		+			+			2
*Gerrhonotus lugoi**				+				1
*Gerrhonotus parvus**					+			1
Crotaphytidae (2 species)								
Crotaphytus collaris		+		+	+			3
Crotaphytus reticulatus	+							1
Eublepharidae (1 species)								
Coleonyx brevis	+	+		+	+			4
Gekkonidae (1 species)								
*Hemidactylus turcicus****	+	+	+	+	+			5
Phrynosomatidae (25 species)								
Cophosaurus texanus	+	+	+	+	+	+	+	7
*Holbrookia approximans**							+	1
Holbrookia lacerata	+							1
Phrynosoma cornutum	+	+	+	+		+	+	6
Phrynosoma modestum		+		+	+	+	+	5
*Phrynosoma orbiculare**					+		+	2
*Sceloporus cautus**					+			1
*Sceloporus chaneyi**					+			1
*Sceloporus couchii**		+			+			2
Sceloporus cowlesi	+							1
*Sceloporus cyanogenys**	+	+	+	+	+			5
*Sceloporus cyanostictus**		+						1
*Sceloporus goldmani**						+	+	2
Sceloporus grammicus	+	+	+	+	+	+	+	7
Sceloporus marmoratus	+		+		+			3
Sceloporus merriami				+				1
*Sceloporus minor**					+			1
Sceloporus olivaceus	+	+	+	+	+			5
*Sceloporus ornatus**		+		+	+			3
*Sceloporus parvus**		+	+	+	+	+	+	6
Sceloporus poinsetti		+		+	+			3
*Sceloporus samcolemani**					+			1

*Sceloporus spinosus**					+		+	2
*Sceloporus torquatus**					+			1
Uta stansburiana				+				1
Scincidae (3 species)								
*Plestiodon dicei**					+			1
Plestiodon obsoletus	+	+	+	+				4
Plestiodon tetragrammus	+	+	+	+				4
Sphenomorphidae (1 species)								
*Scincella silvicola**					+			1
Teiidae (3 species)								
Aspidoscelis gularis	+	+	+	+	+		+	6
Aspidoscelis inornata				+				1
Aspidoscelis marmorata				+				1
Xantusiidae (1 species)								
*Lepidophyma sylvaticum**					+			1
Colubridae (31 species)								
Arizona elegans	+	+	+	+				4
Bogertophis subocularis		+		+				2
Coluber constrictor					+			1
Drymarchon melanurus	+	+	+	+	+			5
Drymobius margaritiferus			+		+			2
Ficimia streckeri	+		+					2
Gyalopion canum		+		+		+	+	4
Lampropeltis alterna		+		+	+			3
Lampropeltis annulata	+	+	+		+			4
*Lampropeltis mexicana**					+		+	2
Lampropeltis splendida		+		+		+	+	4
Leptophis mexicanus					+			1
Masticophis flagellum	+	+	+	+	+	+	+	7
Masticophis schotti	+	+	+	+	+	+	+	7
Masticophis taeniatus				+				1
Opheodrys aestivus		+	+		+			3
Oxybelis aeneus					+			1
Pantherophis bairdi		+			+			2
Pantherophis emoryi	+	+	+	+		+	+	6
Pituophis catenifer	+	+	+	+	+			5
*Pituophis deppei**					+	+	+	3
Rhinocheilus lecontei	+	+	+	+		+	+	6
Salvadora grahamiae	+	+	+	+	+			5
Senticolis triaspis					+			1
Sonora semiannulata	+	+		+				3
Tantilla atriceps	+	+	+	+		+	+	6
Tantilla hobartsmithi	+							1
Tantilla nigriceps	+		+					2
Tantilla rubra					+			1
Tantilla wilcoxi					+		+	2
*Trimorphodon tau**					+			1

Dipsadidae (9 species)								
*Adelphicos newmanorum**					+			1
Amastridium sapperi					+			1
Coniophanes imperialis			+					1
Diadophis punctatus					+			1
Heterodon kennerlyi	+	+	+					3
Hypsiglena jani	+	+		+	+	+	+	6
Leptodeira septentrionalis	+	+	+		+			4
*Rhadinaea montana***					+			1
Tropidodipsas sartorii					+			1
Elapidae (1 species)								
Micrurus tener		+			+			2
Leptotyphlopidae (3 species)								
Rena dulcis			+		+			2
*Rena myopica**		+	+		+			3
Rena segrega		+						1
Natricidae (10 species)								
Nerodia erythrogaster		+	+		+			3
Nerodia rhombifer	+	+	+					3
Storeria dekayi	+		+					2
*Storeria hidalgoensis**					+			1
Thamnophis cyrtopsis		+		+	+			3
Thamnophis eques							+	1
*Thamnophis exsul**					+			1
Thamnophis marcianus	+	+	+	+	+	+		6
Thamnophis proximus	+	+	+		+			4
*Thamnophis pulchrilatus**							+	1
Typhlopidae (1 species)								
*Indotyphlops braminus****		+	+		+			3
Viperidae (10 species)								
*Agkistrodon taylori**		+			+		+	3
Crotalus atrox	+	+	+	+	+	+	+	7
Crotalus lepidus		+		+	+		+	4
Crotalus molossus					+		+	2
*Crotalus morulus**					+			1
Crotalus ornatus				+				1
Crotalus pricei					+			1
Crotalus scutulatus		+		+	+	+	+	5
*Crotalus totonacus**					+			1
Sistrurus catenatus							+	1
Testudines (7 species)								
Emydidae (3 species)								
Pseudemys gorzugi	+	+						2
*Trachemys scripta****	+		+					2
Trachemys venusta			+					1
Kinosternidae (2 species)								
Kinosternon flavescens	+	+	+					3

*Kinosternon integrum**							+	1
Testudinidae (1 species)								
Gopherus berlandieri	+	+	+	+				4
Trionychidae (1 species)								
Apalone spinifera	+	+	+					3

COMMENTS ON THE SPECIES LIST

Several species on the list of the herpetofauna of Nuevo León require some commentary, as follows:

***Rhinella horribilis*.** Acevedo et al. (2016) revised the taxonomy of the Marine Toad, *Rhinella marina*, and substantiated the recognition of two species, one in the western sector of the range, to which they applied the resurrected name *Rhinella horribilis* (Wiegmann, 1833), and one in the eastern sector, to which the name *Rhinella marina* (Linnaeus, 1758) applies. These authors based the recognition of these two species on both morphological and molecular differences. Frost (2016) gave the range of *R. horribilis* as the "lower Rio Grande Valley region of southern Texas (USA) and southern Sonora and southwestern Chihuahua (Mexico) south along the coastal plains through tropical lowland Mexico and Central America to the west slope of the Venezuelan Andes, western and northern Colombia, west coast of Ecuador, and extreme northwestern Peru."

***Lithobates* species**. Two species of ranid frogs occur in Nuevo León. Since the work of Frost et al. (2006), these taxa have borne the names *Lithobates berlandieri* and *L. catesbeianus*. This taxonomy has not been accepted universally, however, especially as the Frost et al. approach has been accepted at the Amphibian Species of the World website (and still is, as of this writing) and not at the AmphibiaWeb site (where the more traditional taxonomy has been followed, using the generic name *Rana* for these species and many others). The following note appears at the AmphibiaWeb site for the species *Rana berlandieri*: "This species was placed in the genus *Lithobates* by Frost et al. (2006). However, Yuan et al. (2016, Systematic Biology, doi: 10.1093/sysbio/syw055) showed that this action created problems of paraphyly in other genera. Yuan et al. (2016) recognized subgenera within *Rana* for the major traditional species groups, with *Lithobates* used as the subgenus for the *Rana palmipes* group. AmphibiaWeb recommends the optional use of these subgenera to refer to these major species groups, with names written as *Rana* (*Aquarana*) *catesbeiana*, for example." Given, however, that the Yuan et al. (2016) taxonomy appeared recently (on 19 July 2016), we prefer to allow some time to transpire to see how this taxonomic arrangement will be accepted by the herpetological community, and herein continue to use the generic name *Lithobates* for the two ranid species in Nuevo León.

Lithobates catesbeianus. Lemos-Espinal et al. (2016) did not list the Bullfrog as occurring in Nuevo León. This species, however, is introduced into the state, as reported by the IUCN SSC Amphibian Specialist Group (2015), and we treat it as non-native.

Chiropterotriton miquihuanus. Lemos-Espinal et al. (2016) did not list *C. miquihuanus* for the state of Nuevo León. Rovito and Parra-Olea (2015), however, reported several specimens from the state in their descriptions of *C. cieloensis* and *C. infernalis*.

Gerrhonotus lugoi. Lemos-Espinal et al. (2016) did not list this anguid lizard as occurring in Nuevo León. García-Vazquez et al. (*In press*), however, are reporting this species from the state on the basis of a single animal observed and photographed in the municipality of Mina. This voucher represents the first record of this species from outside the vicinity of the Cuatro Ciénegas Basin, in Coahuila.

Sceloporus consobrinus. Lemos-Espinal et al. (2016) reported *Sceloporus consobrinus* as part of the Nuevo León herpetofauna in their recent checklist. In a study of the molecular phylogenetics of the *Sceloporus undulatus* species group, however, Leaché (2009) restricted the distribution of *S. consobrinus* to the United States and indicated the member of the *undulatus* group to be found within Nuevo León to be *S. cowlesi*, which is the name we use here.

Crotaphytus collaris (Say, 1823). The Collared Lizard occurs from "Missouri to Arizona, in the United States, and in Mexico in the area between the Sierra Madre Occidental and Sierra Madre Oriental to San Luis Potosí…" (Lemos-Espinal and Dixon, 2013: 104). This individual came from the Extremo Oeste del Cañón de Bustamante, in the municipality of Bustamante. Wilson et al. (2013a) calculated its EVS as 13, placing it at the upper limit of the medium vulnerability category. Its conservation status has been considered as Least Concern by IUCN, and as a threatened species (A) by SEMARNAT. © Manuel Nevárez-de los Reyes

Coleonyx brevis Stejneger, 1893. The Texas Banded Gecko ranges from "southwestern Texas and south-central New Mexico southward through Chihuahua east of the Sierra Madre Occidental to northern Zacatecas, all Coahuila and central Nuevo León" (Lemos-Espinal et al., 2015: 183). This individual was found at Cañón de Ballesteros, in the municipality of Santa Catarina. Wilson et al. (2013a) calculated its EVS as 14, placing it at the lower limit of the high vulnerability category. Its conservation status has been considered as Least Concern by IUCN, and as a species of special protection (Pr) by SEMARNAT. © Emiliano Méndez-Salinas

Sceloporus variabilis. Unlike Lemos-Espinal et al. (2016), we do not list *S. variabilis* for Nuevo León, but based on Mendoza-Quijano et al. (1998) we recognize *S. marmoratus* from the Llanuras de Coahuila y Nuevo León region and *S. parvus* from the rest of the state.

Coniophanes imperialis. Lemos-Espinal et al. (2016) did not include this species for Nuevo León in their checklist. García-Padilla et al. (2016b; this issue) are reporting the first record of this snake for the state.

Storeria hidalgoensis. Pyron et al. (2016) synonymized *S. hidalgoensis* with *S. occipitomaculata* using only a few morphological characters; no samples were used for molecular analysis. In our opinion, the few morphological traits, even though the authors indicated they could not be used to justify full species rank for *S. hidalgoensis*, were inadequate to synonymize the two species. As discussed by Johnson et al. (2015b), their action involved a case of insufficient taxon sampling. Of greater importance is the fact that the closest geographic populations of the two forms are separated by hundreds of kilometers. Thus, on a geographical basis, *S. hidalgoensis* should be considered a separate evolutionary lineage. Using more morphological characters and especially molecular samples should provide ample evidence for a lack of gene flow between the two species. The practice of considering *hidalgoensis* as an allopatric "subspecies" of *S. occipitomaculata* also goes against our phylogenetic philosophy, as allopatric subspecies are not formal taxa and should be considered full species (Johnson et al., 2015b). Until additional work is conducted using sufficient morphological features and molecular data, and the geographic ranges of these taxa are confirmed not to be in contact, we will continue to recognize *S. hidalgoensis* as a distinct species.

Rena segrega. Lemos-Espinal et al. (2016) did not list *Rena segrega*. Herein we add this species to the state list based on a specimen (Universidad Autónoma de Nuevo León 3168) collected by Francisco Noel González 8 February 1980 in Villa de García.

Crotalus morulus. Like Terán-Juarez et al. (2016) did for Tamaulipas, we added this species to our list based on Bryson et al. (2014), who tentatively recommended elevating this taxon to full species level. We agree that their data indicate that *C. morulus* is a separate evolutionary lineage. This species is restricted to the Gran Sierra Plegada in which *C. lepidus* also is found, albeit at lower elevations than the former.

Cophosaurus texanus Troschel, 1852. The Greater Earless Lizard is found from "western Texas, southern New Mexico, southeastern Arizona and northwestern Sonora southward through eastern Chihuahua into San Luis Potosí" (Lemos-Espinal et al., 2015: 203). This individual was encountered at Ojo de Agua de San Lorenzo, Cañón de Bustamante, in the municipality of Bustamante. Wilson et al. (2013a) calculated its EVS as 14, placing it at the lower limit of the high vulnerability category. Its conservation status has been considered as Least Concern by IUCN, and as a threatened species (A) by SEMARNAT. © Manuel Nevárez-de los Reyes

Phrynosoma cornutum (Harlan, 1824). The Texas Horned Lizard occurs from "Kansas southwestward to southeastern Arizona, southward through all of northern Mexico east of the Sierra Madre Occidental, but including the valleys of northeastern Sonora and both sides of Sierra de San Luis in extreme northeastern Sonora and northwestern Chihuahua, and most of Coahuila except to about the latitude of southern Nuevo León" (Lemos-Espinal et al., 2015: 208–209). This individual was found near Mina, in the municipality of Mina. Wilson et al. (2013a) calculated its EVS as 11, placing it in the lower portion of the medium vulnerability category. Its conservation status has been considered as Least Concern by IUCN; this species is not listed by SEMARNAT. © Elí García-Padilla

Crotalus ornatus. Anderson and Greenbaum (2012) resurrected this taxon from the synonymy of *C. molossus*. These authors, however, did not record *C. ornatus* from Nuevo León. Nevárez-de los Reyes et al. (2016) reported this rattlesnake from the state, and García-Padilla et al. (2016a; this issue) are reporting a second specimen.

Trachemys venusta. The taxonomy of the *Trachemys scripta* species complex of turtles has been contentious for many years, although the group has been the subject of several recent papers. Some of us commented on the latest situation in Terán-Juárez et al. (2016) for Tamaulipas, which was an update of the information presented in Johnson et al. (2015b). Previous to Parham et al. (2015), the native lowland species in northeastern Mexico was considered as *T. ornata*, although there was some debate about *T. scripta* (*elegans* pattern class) being native to Mexico or introduced from the Unites States along the border. Parham et al. (2015) presented evidence that the native lowland form along the Gulf versant of Mexico and into Central America was *T. venusta*, and we follow this position for Nuevo León. We also contend that *T. scripta* populations most likely are introductions from other populations outside the state. We are worried that populations of all species of *Trachemys* in northeastern Mexico (i.e., *T. gaigeae*, *T. taylori*, *T. venusta*) are in danger of hybridizing with *T. scripta* due to introductions from the ever-popular pet trade.

PATTERNS OF PHYSIOGRAPHIC DISTRIBUTION

We employed the system of seven regions developed by INEGI (Instituto Nacional de Estadística y Geografía), referred to as "subprovinces" by this agency, in examining the physiographic distribution of members of Nuevo León's herpetofauna. We indicate the distribution of these species in Table 4 and summarize these data in Table 5.

The total number of species among the seven regions ranges from a low of 20 in the Sierras Transversales to a high of 87 in the Gran Sierra Plegada. The numbers of species for the other five regions, in increasing order, are 38 (Sierras y Llanuras Occidentales), 48 (Pliegues Saltillo-Parras), 51 (Llanuras de Coahuila y Nuevo León), 55 (Llanuras y Lomeríos), and 67 (Sierras y Llanuras Coahuilenses). The lowest number of 20 in the Sierras Transversales is 23.0% of the highest one of 86 in the Gran Sierra Plegada. As indicated for Tamaulipas (Terán-Juárez et al., 2016), the least speciose region is adjacent to the most speciose area in the southern portion of the state; however, the Sierras Transversales only occupy a small portion of Nuevo León.

Table 5. Summary of distribution occurrence of herpetofaunal families in Nuevo León, Mexico, by physiographic province. See Table 4 for explanation of abbreviations.

Families	Number of Species	Distributional Occurrence						
		CN	SC	LL	PS	GS	ST	SO
Bufonidae	6	5	5	4	3	3	1	2
Craugastoridae	1	—	—	—	—	1	—	1
Eleutherodactylidae	4	1	3	2	—	4	—	—
Hylidae	2	—	—	1	—	2	—	—
Leptodactylidae	1	—	1	1	—	—	—	—
Microhylidae	2	1	1	2	1	1	—	—
Ranidae	2	2	1	1	1	1	—	1
Rhinophrynidae	1	—	—	1	—	—	—	—
Scaphiopodidae	3	1	1	1	1	1	1	3
Subtotals	**22**	**10**	**12**	**13**	**6**	**13**	**2**	**7**
Ambystomatidae	1	—	—	—	—	—	—	1
Plethodontidae	3	—	—	—	—	3	—	—
Subtotals	**4**	**—**	**—**	**—**	**—**	**3**	**—**	**1**
Totals	**26**	**10**	**12**	**13**	**6**	**16**	**2**	**8**
Anguidae	4	—	1	—	1	3	—	—
Crotaphytidae	2	1	1	—	1	1	—	—
Eublepharidae	1	1	1	—	—	1	—	—
Gekkonidae	1	1	1	1	1	1	—	—
Phrynosomatidae	25	8	11	7	11	17	6	9
Scincidae	3	2	2	2	2	1	—	—
Sphenomorphidae	1	—	—	—	—	1	—	—
Teiidae	3	1	1	1	3	1	—	1
Xantusiidae	1	—	—	—	—	1	—	—
Subtotals	**41**	**14**	**18**	**11**	**19**	**27**	**6**	**10**
Colubridae	31	14	17	14	15	19	8	10
Dipsadidae	9	3	3	3	1	7	1	1
Elapidae	1	—	1	—	—	1	—	—
Leptotyphlopidae	3	—	2	2	—	2	—	—
Natricidae	10	4	5	5	2	6	1	2
Typhlopidae	1	—	1	1	—	1	—	—
Viperidae	10	1	4	1	4	8	2	6
Subtotals	**65**	**22**	**33**	**26**	**22**	**44**	**12**	**19**
Emydidae	3	2	1	2	—	—	—	—
Kinosternidae	2	1	1	1	—	—	—	1
Testudinidae	1	1	1	1	1	—	—	—
Trionychidae	1	1	1	1	—	—	—	—
Subtotals	**7**	**5**	**4**	**5**	**1**	**—**	**—**	**1**
Totals	**113**	**41**	**55**	**42**	**42**	**71**	**18**	**30**
Sum Totals	**139**	**51**	**67**	**55**	**48**	**87**	**20**	**38**

As expected, the greatest absolute and relative numbers of species in two component groups in the herpetofauna are found in the Gran Sierra Plegada (Table 5). These groups are the amphibians (16 of 26 species; 61.5%), and the squamates (71 of 106; 67.0%). Turtles, by contrast, are represented most prominently in the Llanuras de Coahuila y Nuevo León and the Llanuras y Lomeríos (five species in each region), whereas none are recorded from the Gran Sierra Plegada.

Members of the herpetofauna of Nuevo León occupy from one to seven physiographic regions (Table 4), as follows: one (58 of 139 species; 41.7%); two (23; 16.5%); three (18; 12.9%); four (14; 10.1%); five (10; 7.2%); six (nine; 6.5%); and seven (seven; 5.0%). The most broadly occurring species (occupying seven regions) constitute the anurans *Anaxyrus punctatus* and *Scaphiopus couchii*, the lizards *Cophosaurus texanus* and *Sceloporus grammicus*, and the snakes *Masticophis flagellum*, *M. schotti*, and *Crotalus atrox*. As expected, all seven of these species not only occur broadly in Nuevo León, but also outside the state in Mexico and to varying degrees in the United States.

Of the 139 species comprising the Nuevo León herpetofauna, 81 (58.3%) are found in only one or two of the physiographic regions in the state, which is of sizable conservation significance. This proportion is similar to that for Tamaulipas (58.2%; Terán-Juárez et al., 2016). The mean regional occupancy value is 2.6, which only is slightly higher than the comparable value (2.5) for Tamaulipas (Terán-Juárez et al., 2016). The number of species occupying a single physiographic region in Nuevo León ranges from none in the Sierras Transversales to 31 in the Gran Sierra Plegada. The remainder have single-digit numbers of single-region species, including the Sierras y Llanuras Coahuilenses (two), Llanuras y Lomeríos (four), Llanuras de Coahuila y Nuevo León (five), Pliegues Saltillo-Parras (seven), and the Sierras y Llanuras Occidentales (nine).

As in Tamaulipas (Terán-Juárez et al., 2016), the physiographic region of greatest conservation significance in Nuevo León is the Gran Sierra Plegada, because it contains the largest total number of species (87, including 13 anurans, three salamanders, 27 lizards, and 44 snakes), the largest number of single-region species (31, including two anurans, three salamanders, 10 lizards, and 16 snakes; see below), 32 country endemics (82.1% of a total of 37), and the only state endemic (*Rhadinaea montana*). Below we discuss the steps that have been taken in the state to secure a future for the herpetofauna of this region.

Phrynosoma modestum Girard, 1852. The Round-tailed Horned Lizard is distributed from "western Texas and southeastern Colorado to southeastern Arizona and southward through the Chihuahuan Desert, including extreme northeastern Sonora, and the western slope of the Sierra Madre Oriental to Nuevo León and San Luis Potosí" (Lemos-Espinal et al., 2015: 214). This individual came from Ejido Acuña, in the municipality of Doctor Arroyo. Wilson et al. (2013a) calculated its EVS as 12, placing it in the lower portion of the medium vulnerability category. Its conservation status has been considered as Least Concern by IUCN; this species is not listed by SEMARNAT.

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In the following lists, * = endemic to Mexico, ** = endemic to Nuevo León, and *** = non-native to Nuevo León. The distribution of the following 31 species is restricted to the Gran Sierra Plegada:

*Eleutherodactylus verrucipes**
*Rheohyla microtympanum**
*Aquiloeurycea galeanae**
*Chiropterotriton miquihuanus**
*Chiropterotriton priscus**
*Barisia ciliaris**
*Gerrhonotus parvus**
*Sceloporus cautus**
*Sceloporus chaneyi**
*Sceloporus minor**
*Sceloporus samcolemani**
*Sceloporus torquatus**
*Plestiodon dicei**
*Scincella silvicola**
*Lepidophyma sylvaticum**
Coluber constrictor
Leptophis mexicanus
Oxybelis aeneus
Senticolis triaspis
Tantilla rubra
*Trimorphodon tau**
*Adelphicos newmanorum**
Amastridium sapperi
Diadophis punctatus
*Rhadinaea montana***
Tropidodipsas sartorii
*Storeria hidalgoensis**
*Thamnophis exsul**
*Crotalus morulus**
Crotalus pricei
*Crotalus totonacus**

The distribution of the following nine species is limited to the Sierras y Llanuras Occidentales region:

Anaxyrus cognatus
Spea bombifrons
Spea multiplicata
*Ambystoma velasci**
*Holbrookia approximans**
Thamnophis eques
*Thamnophis pulchrilatus**
Sistrurus catenatus
*Kinosternon integrum**

The following seven species are restricted to the Pliegues Saltillo-Parras region:

*Gerrhonotus lugoi**
Sceloporus merriami
Uta stansburiana
Aspidoscelis inornata
Aspidoscelis marmorata
Masticophis taeniatus
Crotalus ornatus

The following five species are found only in the Llanuras de Coahuila y Nuevo León region:

*Lithobates catesbeianus****
Crotaphytus reticulatus
Holbrookia lacerata
Sceloporus cowlesi
Tantilla hobartsmithi

The following four species are known only from the Llanuras y Lomeríos region:

Hypopachus variolosus
Rhinophrynus dorsalis
Coniophanes imperialis
Trachemys venusta

The following two species occur only in the Sierras y Llanuras Coahuilenses:

*Sceloporus cyanostictus**
Rena segrega

Finally, as noted above, no species are limited to the Sierras Transversales.

We built a Coefficient of Biogeographic Resemblance (CBR) matrix (Table 6) to examine the herpetofaunal relationships among the seven physiographic regions we recognize. The number of shared species ranges from 13 to 45. The lower value is that between three pairs of regions, i.e., the Llanuras de Coahuila y Nuevo León (CN) and the Sierras Transversales (ST), the Llanuras y Lomeríos and the ST, and the Gran Sierra Plegada (GS) and the ST. The higher value is that between the Sierras y Llanuras Coahuilenses (SC) and the Gran Sierra Plegada (Table 6). The range and mean of shared species numbers for each of the seven regions, arranged according to the increasing mean number, are as follows: Sierras Transversales (20) = 13–19 (15.7); Sierras y Llanuras Occidentales (38) = 14–22 (18.3); Llanuras de Coahuila y Nuevo León (52) = 13–41 (27.5); Gran Sierra Plegada (86) = 13–45 (27.8); Pliegues Saltillo-Parras (48) = 18–42 (27.8); Llanuras y Lomeríos (55) = 13–43 (28.5); and Sierras y Llanuras Coahuilenses (67) = 18–45 (35.0). These data indicate that in general a relationship is present between the mean number and range of shared species and the total number of species found in these regions, except for the Gran Sierra Plegada. This region is an exception to the trend because of the relatively high number of single-region species (31) found there. The highest number of species shared for a given region is with another region sharing a common border; the common border between the Gran Sierra Plegada and the Sierras y Llanuras Coahuilenses is rather narrow (Fig. 1).

Llanuras de Coahuila y Nuevo León (51)—41—Sierras y Llanuras Coahuilenses (67)*

Sierras y Llanuras Coahuilenses (67)—45—Gran Sierra Plegada (87)*

Llanuras y Lomeríos (55)—43—Sierras y Llanuras Coahuilenses (67)*

Pliegues Saltillo-Parras (48)—42—Sierras y Llanuras Coahuilenses (67)*

Gran Sierra Plegada (87)—45—Sierras y Llanuras Coahuilenses (67)*

Sierras Transversales (20)—19—Sierras y Llanuras Occidentales (38)*

Sierras y Llanuras Occidentales (38)—22—Gran Sierra Plegada (87)*

Five of the seven comparisons involve the Sierras y Llanuras Coahuilenses, the region with the second highest number of species (Tables 5, 6). As indicated above, this region also contains the highest mean number of shared species. This central position in Tamaulipas is occupied by the Gran Sierra Plegada segment in that state (Terán-Juárez et al., 2016), but not in Nuevo León because of the high number of single-region species in its segment.

Table 6. Pair-wise comparison matrix of Coefficient of Biogeographic Resemblance (CBR) data of herpetofaunal relationships for the seven physiographic regions in Nuevo León, Mexico. Underlined values = number of species in each region; upper triangular matrix values = species in common between two regions; and lower triangular matrix values = CBR values. The formula for this algorithm is $CBR = 2C/N_1 + N_2$ (Duellman, 1990), where C is the number of species in common to both regions, N_1 is the number of species in the first region, and N_2 is the number of species in the second region. See Table 4 for explanation of abbreviations, and Fig 3. for the UPGMA dendrogram produced from the CBR data.

	CN	SC	LL	PS	GS	ST	S0
CN	**51**	41	41	30	26	13	14
SC	0.69	**67**	43	42	45	18	21
LL	0.77	0.70	**55**	28	32	13	14
PS	0.61	0.73	0.54	**48**	29	18	20
GS	0.38	0.58	0.45	0.43	**87**	13	22
ST	0.37	0.41	0.35	0.53	0.24	**20**	19
SO	0.31	0.40	0.30	0.47	0.35	0.66	**38**

The CBR data in Table 6 indicate a range of values from 0.24 to 0.77. The lowest value is that between the Gran Sierra Plegada and the Sierras Transversales. The highest one is that between the Llanuras de Coahuila y Nuevo León and the Llanuras y Lomeríos. The highest CBR value for each of the seven regions is as follows:

Llanuras de Coahuila y Nuevo León (51)—0.77—Llanuras y Lomeríos (55)

Sierras y Llanuras Coahuilenses (67)—0.73—Pliegues Saltillo-Parras (48)

Llanuras y Lomeríos (55)—0.77—Llanuras de Coahuila y Nuevo León (51)

Pliegues Saltillo-Parras (48)—0.73—Sierras y Llanuras Coahuilenses (67)

Gran Sierra Plegada (86)—0.59—Sierras y Llanuras Coahuilenses (67)

Sierras Transversales (20)—0.66—Sierras y Llanuras Occidentales (38)

Sierras y Llanuras Occidentales (38)—0.66—Sierras Transversales (20)

These relationships are rather different than the ones shown using shared species numbers, with only three of the seven comparisons involving the same regions as for shared species numbers. These are the Pliegues Saltillo-Parras—Sierras y Llanuras Coahuilenses, Gran Sierra Plegada—Sierras y Llanuras Coahuilenses, and Sierras Transversales—Sierras y Llanuras Occidentales comparisons. None of the seven regions is represented in these comparisons more than any other.

Based on the data in Table 6, we produced a UPGMA dendrogram to conveniently depict, in a hierarchical manner, the overall herpetofaunal resemblance among Nuevo León's seven physiographic regions (Fig. 11). The patterns indicate two major clusters of herpetofaunal resemblance, of which one includes two montane regions primarily located in the southwestern portion of the state (Sierras y Llanuras Occidentalis [SO] and Sierras Transversales [ST]); the other cluster is composed of typically interconnected montane regions that, in most cases, gradually become lower in elevation in the northern and eastern portions of the state (Llanuras de Coahuila y Nuevo León [CN], Llanuras y Lomeríos [LL], Sierras y Llanuras Coahuilenses [SC], Pliegues Saltillo -Parras [PS], and Gran Sierra Plegada [GS]). The CN and LL regions show the highest faunal resemblance (77%), followed closely by the SC (70%) when paired with the first two combined. All three regions share common borders with each other, and in many places contain similar environments. The SC also borders the PS and a small northwestern section of the GS; the GS also abuts the western border of the LL, but only has a resemblance score of 45% with that region. Of the five-member cluster, the GS contains the most species (87) and the most distinctive herpetofauna (only 46% herpetofaunal resemblance with the four other regions combined). This situation is similar to that for this physiographic region found in neighboring Tamaulipas (135 species; 46% with five other regions combined; Terán-Juárez et el., 2016), although the GS in that state contained 48 more species than in Nuevo León. In addition, it wasn't the most distinctive physiographic region; the SO was the most distinctive in Tamaulipas, demonstrating only a 23% herpetofaunal resemblance with the six other regions combined.

The other cluster of two regions (ST and SO) shows a moderate biogeographic resemblance score (66%). Most of the ST is located in adjacent Coahuila, as only 527 km² (.08%) of Nuevo León's total area encompasses this region. The ST also comprises the fewest reported species (20) of all the physiographic regions in Nuevo León.

In summary, the data from Table 6 and its depiction in Fig. 12 indicate that species richness is highest in larger regions sharing common borders and containing substantial segments within lower elevations and more mesic environments, as opposed to regions containing primarily highland species occupying extensive amounts of xeric habitats. As expected, this same pattern is reflected in the values of the biogeographic resemblance scores between the regions. As an example, the highest resemblance scores are between neighboring regions that reflect similar environmental regimes of habitat types and elevation ranges. The GS, the region with the highest elevational range and more mesic habitats, is the most distinctive in species richness (48 more species than the SC, the next highest region). The GS also contains, by far, the most number of species (31) known from a single region (Table 4), including *Rhadinaea montana*, the one species endemic to Nuevo León. In addition, the GS shows relatively low biogeographic resemblance values ($\bar{x}$ = .41) with the other six regions.

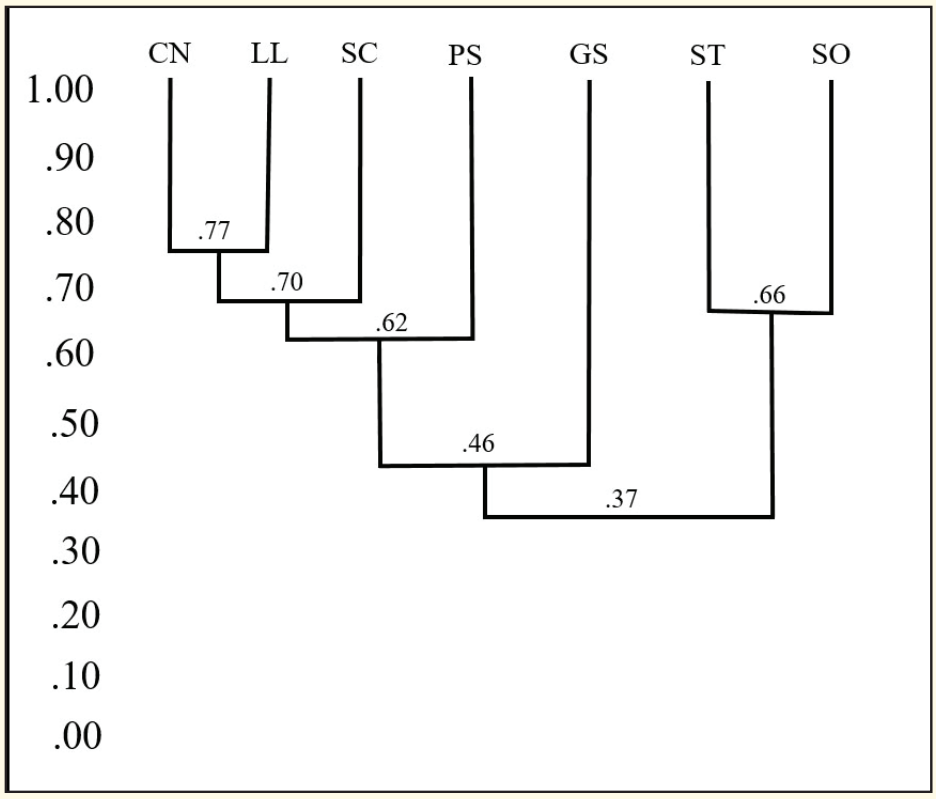

Fig. 11. A UPGMA generated dendrogram illustrating the similarity relationships of species richness among the herpetofaunas of the seven physiographic regions in Nuevo León (based on data in Table 6). See Table 4 for explanation of abbreviations. We calculated the similarity values using Duellman's (1990) Coefficient of Biogeographic Resemblance (CBR).

Fig. 12. *Urban Development*. This photograph of the capital city of Monterrey, taken from the Chipinque area in the Gran Sierra Plegada in June of 2016, illustrates how urban expansion is invading the most biodiverse and conservation significant portion of the state of Nuevo León, the Gran Sierra Plegada. This image also documents the presence of smog overlying the city and of mining activities on the slopes of the mountain in the middle distance. © Manuel Nevárez-de los Reyes

DISTRIBUTION STATUS CATEGORIZATIONS

We used the same system of four categories as the authors on the herpetofaunas of Michoacán (Alvarado-Díaz et al., 2013), Oaxaca (Mata-Silva et al., 2015), Chiapas (Johnson et al., 2015a), Tamaulipas (Terán-Juárez et al., 2016), and Nayarit (Woolrich-Piña et al., 2016) to characterize the distribution of members of the herpetofauna of Nuevo León. The categories are non-endemic, country endemic, state endemic, and non-native. We organized these data in Table 7 and summarize them in Table 8.

Table 7. Distributional and conservation status measures for members of the herpetofauna of Nuevo León, Mexico. Distributional Status: SE = endemic to state of Nuevo León; CE = endemic to country of Mexico; NE = not endemic to state or country; and NN = non-native. Environmental Vulnerability Score (taken from Wilson et al. 2013a,b): low (L) vulnerability species (EVS of 3–9); medium (M) vulnerability species (EVS of 10–13); and high (H) vulnerability species (EVS of 14–20). IUCN Categorization: CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least Concern; DD = Data Deficient; and NE = Not Evaluated. SEMARNAT Status: A = threatened; P = endangered; Pr = special protection; and NS = no status. See text for explanations of the EVS, IUCN, and SEMARNAT rating systems.

Taxa	Distributional Status	Environmental Vulnerability Category (Score)	IUCN Categorization	SEMARNAT Status
Anaxyrus cognatus	NE	L (9)	LC	NS
Anaxyrus debilis	NE	L (7)	LC	Pr
Anaxyrus punctatus	NE	L (5)	LC	NS
Anaxyrus speciosus	NE	M (12)	LC	NS
Incilius nebulifer	NE	L (6)	LC	NS
Rhinella horribilis	NE	L (3)	LC	NS
Craugastor augusti	NE	L (8)	LC	NS
Eleutherodactylus cystignathoides	NE	M (12)	LC	NS
Eleutherodactylus guttilatus	NE	M (11)	LC	NS
*Eleutherodactylus longipes**	CE	H (15)	VU	NS
*Eleutherodactylus verrucipes**	CE	H (16)	VU	NS
*Rheohyla miotympanum**	CE	L (9)	NT	NS
Smilisca baudinii	NE	L (3)	LC	NS
Leptodactylus fragilis	NE	L (5)	LC	NS
Gastrophryne olivacea	NE	L (9)	LC	Pr
Hypopachus variolosus	NE	L (4)	LC	NS
Lithobates berlandieri	NE	L (7)	LC	Pr
*Lithobates catesbeianus***	NN	—	—	—
Rhinophrynus dorsalis	NE	L (8)	LC	Pr
Scaphiopus couchii	NE	L (3)	LC	NS
Spea bombifrons	NE	M (10)	LC	NS
Spea multiplicata	NE	L (6)	LC	NS
*Aambystoma velasci**	CE	M (10)	LC	Pr
*Aquiloeurycea galeanae**	CE	H (18)	NT	A
*Chiropterotriton miquihuanus**	CE	H (18)	NE	NS
*Chiropterotriton priscus**	CE	H (16)	NT	Pr
*Barisia ciliaris**	CE	H (15)	NE	NS
Gerrhonotus infernalis	NE	M (13)	LC	NS
*Gerrhonotus lugoi**	CE	H (16)	LC	NS

*Gerrhonotus parvus**	CE	H (17)	EN	Pr
Crotaphytus collaris	NE	M (13)	LC	A
Crotaphytus reticulatus	NE	M (12)	VU	A
Coleonyx brevis	NE	H (14)	LC	Pr
*Hemidactylus turcicus***	NN	—	—	—
Cophosaurus texanus	NE	H (14)	LC	A
*Holbrookia approximans**	CE	H (14)	NE	NS
Holbrookia lacerata	NE	H (14)	NT	A
Phrynosoma cornutum	NE	M (11)	LC	NS
Phrynosoma modestum	NE	M (12)	LC	NS
*Phrynosoma orbiculare**	CE	M (12)	LC	A
*Sceloporus cautus**	CE	H (15)	LC	NS
*Sceloporus chaneyi**	CE	H (15)	EN	NS
*Sceloporus couchii**	CE	H (15)	LC	NS
Sceloporus cowlesi	NE	M (13)	NE	NS
*Sceloporus cyanogenys**	CE	M (13)	NE	NS
*Sceloporus cyanostictus**	CE	H (16)	EN	NS
*Sceloporus goldmani**	CE	H (15)	EN	NS
Sceloporus grammicus	NE	L (9)	LC	Pr
Sceloporus marmoratus	NE	M (11)	NE	NS
Sceloporus merriami	NE	M (13)	LC	NS
*Sceloporus minor**	CE	H (14)	LC	NS
Sceloporus olivaceus	NE	M (13)	LC	NS
*Sceloporus ornatus**	CE	H (16)	NT	A
*Sceloporus parvus**	CE	H (15)	LC	NS
Sceloporus poinsettii	NE	M (12)	LC	NS
*Sceloporus samcolemani**	CE	H (15)	LC	NS
*Sceloporus spinosus**	CE	M (12)	LC	NS
*Sceloporus torquatus**	CE	M (11)	LC	NS
Uta stansburiana	NE	L (7)	LC	A
*Plestiodon dicei**	CE	M (12)	NE	NS
Plestiodon obsoletus	NE	M (11)	LC	NS
Plestiodon tetragrammus	NE	M (12)	LC	NS
*Scincella silvicola**	CE	M (12)	LC	A
Aspidoscelis gularis	NE	L (9)	LC	NS
Aspidoscelis inornata	NE	H (14)	LC	NS
Aspidoscelis marmorata	NE	H (14)	NE	NS
*Lepidophyma sylvaticum**	CE	M (11)	LC	Pr
Arizona elegans	NE	L (5)	LC	NS
Bogertophis subocularis	NE	H (14)	LC	NS
Coluber constrictor	NE	M (10)	LC	A
Drymarchon melanurus	NE	L (6)	LC	NS
Drymobius margaritiferus	NE	L (6)	NE	NS
Ficimia streckeri	NE	M (12)	LC	NS
Gyalopion canum	NE	L (9)	LC	NS
Lampropeltis alterna	NE	H (14)	LC	A

Lampropeltis annulata	NE	M (12)	NE	NS
*Lampropeltis mexicana**	CE	H (15)	LC	A
Lampropeltis splendida	NE	M (12)	NE	NS
Leptophis mexicanus	NE	L (6)	LC	A
Masticophis flagellum	NE	L (8)	LC	A
Masticophis schotti	NE	M (13)	LC	NS
Masticophis taeniatus	NE	M (10)	LC	NS
Opheodrys aestivus	NE	M (13)	LC	NS
Oxybelis aeneus	NE	L (5)	NE	NS
Pantherophis bairdi	NE	H (15)	LC	NS
Pantherophis emoryi	NE	M (13)	LC	NS
Pituophis catenifer	NE	L (9)	LC	NS
*Pituophis deppei**	CE	H (14)	LC	A
Rhinocheilus lecontei	NE	L (8)	LC	NS
Salvadora grahamiae	NE	M (10)	LC	NS
Senticolis triaspis	NE	L (6)	LC	NS
Sonora semiannulata	NE	L (5)	LC	NS
Tantilla atriceps	NE	M (11)	LC	A
Tantilla hobartsmithi	NE	M (11)	LC	NS
Tantilla nigriceps	NE	M (11)	LC	NS
Tantilla rubra	NE	L (5)	LC	Pr
Tantilla wilcoxi	NE	M (10)	LC	NS
*Trimorphodon tau**	CE	M (13)	LC	NS
*Adelphicos newmanorum**	CE	M (12)	NE	Pr
Amastridium sapperi	NE	M (10)	LC	NS
Coniophanes imperialis	NE	L (8)	LC	NS
Diadophis punctatus	NE	L (4)	LC	NS
Heterodon kennerlyi	NE	M (11)	NE	NS
Hypsiglena jani	NE	L (6)	NE	NS
Leptodeira septentrionalis	NE	L (8)	NE	NS
*Rhadinaea montana***	SE	H (14)	EN	Pr
Tropidodipsas sartorii	NE	L (9)	LC	Pr
Micrurus tener	NE	M (11)	LC	NS
Rena dulcis	NE	M (13)	LC	NS
*Rena myopica**	CE	M (13)	LC	NS
Rena segrega	NE	L (8)	NE	NS
Nerodia erythrogaster	NE	M (11)	LC	A
Nerodia rhombifer	NE	M (10)	LC	NS
Storeria dekayi	NE	L (7)	LC	NS
*Storeria hidalgoensis**	CE	M (13)	VU	NS
Thamnophis cyrtopsis	NE	L (7)	LC	NS
Thamnophis eques	NE	L (8)	LC	A
*Thamnophis exsul**	CE	H (16)	LC	A
Thamnophis marcianus	NE	M (10)	LC	A
Thamnophis proximus	NE	L (7)	LC	A
*Thamnophis pulchrilatus**	CE	H (15)	LC	NS

*Indotyphlops braminus****	NN	—	—	—
*Agkistrodon taylori**	CE	H (17)	LC	A
Crotalus atrox	NE	L (9)	LC	Pr
Crotalus lepidus	NE	M (12)	LC	Pr
Crotalus molossus	NE	L (8)	LC	Pr
*Crotalus morulus**	CE	H (16)	NE	NS
Crotalus ornatus	NE	M (13)	NE	NS
Crotalus pricei	NE	H (14)	LC	Pr
Crotalus scutulatus	NE	M (11)	LC	Pr
*Crotalus totonacus**	CE	H (17)	NE	NS
Sistrurus catenatus	NE	M (13)	LC	Pr
Pseudemys gorzugi	NE	H (16)	NT	A
*Trachemys scripta****	NN	—	—	—
Trachemys venusta	NE	M (13)	VU	Pr
Kinosternon flavescens	NE	M (12)	LC	NS
*Kinosternon integrum**	CE	M (11)	LC	Pr
Gopherus berlandieri	NE	H (18)	LC	A
Apalone spinifera	NE	H (15)	LC	Pr

As Terán-Juárez et al. (2016) found with the herpetofauna of Tamaulipas, the largest number of species lies in the non-endemic category (Table 8). This situation was expected because like Tamaulipas, Nuevo León shares a border, albeit narrow, with Texas in the United States. Of 139 total species, 95 (68.3%) are non-endemic. Of these 95 non-endemic species, 90 (64.7% of the total of 139) are shared with the United States, based on the accounting available at the Center for North American Herpetology website (CNAH.org; accessed 3 May 2016). The remaining five species (*Amastridium sapperi*, *Leptophis mexicanus*, *Tantilla rubra*, *Tropidodipsas sartorii*, and *Trachemys venusta*) range south of Mexico into Central America (Table 8). The proportion of non-endemic species in Nuevo León compares fairly well with that in Tamaulipas (65.2%; Terán-Juárez et al., 2016).

The country endemics constitute the next highest category of species in Nuevo León (Table 8), and consist of 39 species (28.1% of the total of 139). These species are assigned to the following families: Eleutherodactylidae (two species), Hylidae (one), Ambystomatidae (one), Plethodontidae (three), Anguidae (three), Phrynosomatidae (14), Scincidae (one), Sphenomorphidae (one), Xantusiidae (one), Colubridae (three), Dipsadidae (one), Leptotyphlopidae (one), Natricidae (three), Viperidae (three), and Kinosternidae (one). Three of the 39 species are anurans, four are salamanders, 31 are squamates, and one is a turtle. The total proportion of country endemics in Nuevo León also is close to that documented in Tamaulipas (26.6%; Terán-Juárez et al., 2016).

Only a single species (*Rhadinaea montana*) is endemic to Nuevo León (Table 8), compared to 10 in Tamaulipas (Terán-Juárez et al., 2016). Four species (*Lithobates catesbeianus*, *Hemidactylus turcicus*, *Indotyphlops braminus*, and *Trachemys scripta*) are non-native in Nuevo León, compared to five species in Tamaulipas (Terán-Juárez et al., 2016). In Nuevo León, the anuran and the turtle have been introduced by humans from populations in the United States—the anuran as a food species and the turtle as a pet species. The lizard and the snake are species from the Old World, likely introduced through the transportation of products for human use.

The total number of Mexican endemic species in Nuevo León is 40, which is 28.8% of the 139 species comprising the entire herpetofauna, and somewhat less than the comparable figure for Tamaulipas (32.1%; Terán-Juárez et al., 2016). The number of Mexican endemics in Nuevo León is 5.2% of the 773 species known from the entire country (J. Johnson, unpublished), and also less than the comparable figure for Tamaulipas (7.7%; Terán-Juárez et al., 2016).

Table 8. Summary of the distributional status of herpetofaunal families in Nuevo León, Mexico.

Families	Number of Species	Distributional Status			
		Non-endemic (NE)	Country Endemic (CE)	State Endemic (SE)	Non-native (NN)
Bufonidae	6	6	—	—	—
Craugastoridae	1	1	—	—	—
Eleutherodactylidae	4	2	2	—	—
Hylidae	2	1	1	—	—
Leptodactylidae	1	1	—	—	—
Microhylidae	2	2	—	—	—
Ranidae	2	1	—	—	1
Rhinophrynidae	1	1	—	—	—
Scaphiopodidae	3	3	—	—	—
Subtotals	**22**	**18**	**3**	**—**	**1**
Ambystomatidae	1	—	1	—	—
Plethodontidae	3	—	3	—	—
Subtotals	**4**	—	**4**	—	—
Totals	**26**	**18**	**7**	**—**	**1**
Anguidae	4	1	3	—	—
Crotaphytidae	2	2	—	—	—
Eublepharidae	1	1	—	—	—
Gekkonidae	1	—	—	—	1
Phrynosomatidae	25	11	14	—	—
Scincidae	3	2	1	—	—
Sphenomorphidae	1	—	1	—	—
Teiidae	3	3	—	—	—
Xantusiidae	1	—	1	—	—
Subtotals	**41**	**20**	**20**	**—**	**1**
Colubridae	31	28	3	—	—
Dipsadidae	9	7	1	1	—
Elapidae	1	1	—	—	—
Leptotyphlopidae	3	2	1	—	—
Natricidae	10	7	3	—	—
Typhlopidae	1	—	—	—	1
Viperidae	10	7	3	—	—
Subtotals	**65**	**52**	**11**	**1**	**1**
Emydidae	3	2	—	—	1
Kinosternidae	2	1	1	—	—
Testudinidae	1	1	—	—	—
Trionychidae	1	1	—	—	—
Subtotals	**7**	**5**	**1**	**—**	**1**
Totals	**113**	**77**	**32**	**1**	**3**
Sum Totals	**139**	**95**	**39**	**1**	**4**

Sceloporus olivaceus Smith, 1934. The Texas Spiny Lizard is found from "northern central Texas southward through the Gulf of Mexico coastal plain to southern Tamaulipas, westward nearly to the Big Bend area of Texas and eastern Coahuila" (Lemos-Espinal et al., 2015: 239). This individual was encountered at the Extremo Este del Cañón de Bustamante, in the municipality of Bustamante. Wilson et al. (2013a) calculated its EVS as 13, placing it at the upper limit of the medium vulnerability category. Its conservation status has been considered as Least Concern by IUCN; this species is not listed by SEMARNAT. © Manuel Nevárez-de los Reyes

PRINCIPAL ENVIRONMENTAL THREATS

In this section we discuss the factors we perceive as the primary threats to the herpetofauna of Nuevo León, which need to be addressed in the near future in order to guarantee both the economic development of the state and the survivability of its natural ecosystems.

Urban Development

Unfortunately, the expansion of any city proceeds at the cost of its surrounding natural ecosystems (Fig. 12). The city of Monterrey was founded on 20 September 1596, but urban development was not a significant factor until after World War Two when industrialization brought about the substitution of imported products for nationally created ones (Garza, 1995, 2003), at the expense of the natural surroundings. The metropolitan area of Monterrey currently consists of 12 municipalities that contain 90% of the human population of the state. Its surface area encompasses 6,794 km^2, with an average density of 109.1 people/km^2 (SEDESOL et al., 2007). Currently, an estimated two million vehicles are in the state, whereas 14 years ago that number was 900,000; the present estimate is equivalent to nearly 500 vehicles/1,000 people (www.elfinanciero.com.mx/monterrey/debe-frenar-expansion-urbana.html; accessed 8 July 2016.). Consistent and unplanned urban development undoubtedly represents a direct threat to the state's ecosystems (Fig. 13). Sadly, this threat has caused some surrounding hills to become biological islands, as has occurred with Cerro del Topo Chico (Lazcano et al., 2012) and it is about to happen with Cerro de las Mitras; both sites are designated as state protected areas. Another site facing a similar fate is the federally protected area of Cerro de la Silla, where the level of development has disrupted some of its continuity with the Sierra Madre Oriental (Gran Sierra Plegada).

Fig. 13. *Urban Development*. Deforestation for development purposes disrupts the activities of flora and fauna, including members of the herpetofauna. This view illustrates the consequences of recent removal of Tamaulipan Thorn Scrub in the northwestern sector of the Monterrey metropolitan area. The tracks in the middle of the image are those of an apparently disoriented snake.

Industrial Pollution

Monterrey also is known as an industrial city. By the year 2005, close to 50% of the total emissions of NOx and COV in the region were generated by vehicles, while particles (PM10 and PM2.5) were generated primarily by aerial sources. Almost all emissions of SO_2 (98%) were produced by the industrial sector, and CO emissions (96%) by vehicles (INECC, 2011; www2.inecc.gob.mx/publicaciones/libros/652/monterrey.pdf; www2.inecc.gob.mx/publicaciones/consultaPublicacion.html?id_pub=652). Currently, we are not aware of the magnitude of the effect of these emissions on the environment, and more specifically on the herpetofauna.

Deforestation for Agricultural and Ranching Purposes

Another factor detrimental to the herpetofauna in Nuevo León is deforestation (authorized or not; Fig. 14) and the consequent use of this land for agricultural (Fig. 15) and ranching activities (Fig. 16). Indeed, this activity also constitutes a threat to the herpetofauna, since it practically eliminates or reduces all of the potential microhabitats utilized by different species (Mata-Silva et al., 2015; Johnson et al., 2015a; Terán-Juárez et al., 2016; Woolrich-Piña et al., 2016). In particular, agricultural activity is significant in the valleys and plains, especially in the municipalities located in the central and southern regions where more than 82% of the land surface is allocated to this purpose (www.agronuevoleon.gob.mx/oeidrus/perfilagr.pdf; accessed 16 August 2016). Conversely, a surface of ca. 5, 535,938 ha (86% of the state's land surface) is used for livestock activity, with 90% of this land represented by natural grazing areas, 0.3% by irrigated grassland, and 9.7% by seasonal grassland. Natural grazing areas are predominant in the northern and central regions, as well as in the lower areas of the Sierra Madre Oriental. Municipalities in the northern and central parts of the state contain ca. 71% of this area (www.agronuevoleon.gob.mx/oeidrus/perfgan; accessed 16 August 2016).

Fig. 14. *Logging*. Both legal and illegal logging constitute a major threat to the herpetofauna by depriving these creatures of shelter sites, encouraging soil loss, and creating increased temperatures at the ground level. © Manuel Nevárez-de los Reyes

Fig. 15. *Habitat Modification for Purposes of Agriculture*. This image, from Laguna de Sánchez in the Gran Sierra Plegada, indicates how agricultural development causes loss of the original vegetation and promotes the use of agrochemicals, as well as other threats to the herpetofauna. © Manuel Nevárez-de los Reyes

Fig. 16. *Impact of Ranching*. Domesticated animals, a herd of goats in this image, represent a threat to the herpetofauna due to the consumption of vegetation, trampling of the soil, and soil erosion. © Manuel Nevárez-de los Reyes

Effect of Roads

In addition to the fragmentation of habitats and organismic populations, the loss of herpetofauna on roads is a widely documented problem (Van der Ree et al., 2011; Puc-Sánchez et al., 2013; Fig. 17); however, the impact of vehicular traffic on the Mexican herpetofauna, including that of Nuevo León, remains practically unevaluated. The principal roads in Nuevo León are federal highways 85 and 85D (Linares–Monterrey– Nuevo Laredo), 57 (San Roberto–Saltillo), 40 and 40D (Saltillo–Monterrey–Reynosa), 53 (Monterrey–Miguel Alemán), 54 (Monterrey–Monclova), 58 (Linares–San Roberto), and state highway 1 (Monterrey–Colombia) (www.mapacarreteras.org/e2555-nuevo-leon.html; accessed 26 July 2016), and these roads are assumed to have a significant impact on local wildlife populations. Because herpetofauna uses these roads for several reasons (Puc-Sánchez et al., 2013), conservation programs aiming to minimize the number of road-kills should be implemented. For example, in the vicinity of Monterrey the most common species seen dead on roads are *Crotalus atrox*, *Masticophis flagellum*, *Pantherophis emoryi*, and *Pituophis catenifer* (MNR and DL, pers. observ.).

Mining and Energy Projects

Large areas in the state are coming under pressure for energy purposes (Fig. 18), such as natural gas (Cuenca de Burgos) in the Llanuras de Coahuila y Nuevo León physiographic region (www.dof.gob.mx/nota_detalle.php?codigo=5234595&fecha=21/02/2012; accessed 26 July 2016). New roads are being built to access areas where wells are being drilled, and such activities inevitably remove the vegetation and affect the habitats used by members of the herpetofauna.

Fig. 17. *Effects of Roads*. All roads, especially paved ones, represent a major threat to the herpetofauna. Here, a Western Diamond-backed Rattlesnake (*Crotalus atrox*) was found dead on State Highway no. 1, in Bustamante, Nuevo León. © Manuel Nevárez-de los Reyes

Fig. 18. *Energy Projects*. This image of a wind power field in García, Nuevo León, at a point where three physiographic regions (Gran Sierra Plegada, Sierras y Llanuras Coahuilenses, and Pliegues Saltillo-Parras) come together, illustrates both the pros and cons of alternative energy production. These types of projects provide a means for decreasing dependence on nonrenewable fossil fuels, but result in known and unknown environmental costs. Creating such energy fields involves the removal of vegetation, which directly impacts the terrestrial fauna, including the herpetofauna, and causes the death of birds coming into contact with the turbine blades. The impact of the noise and vibrations produced by such endeavors on the herpetofauna, however, are unknown. According to information published in the media, the construction of similar projects in various parts of the state is planned (www.eleconomista.com.mx/estados/2015/02/02/luz-verde-nuevo-parque-eolico-nuevo-leon). © Manuel Nevárez-de los Reyes

Elimination of the Herpetofauna due to Cultural Beliefs and Practices

Humans have a long way to go with regard to respecting the co-occupants of our planet, and to improve this situation we must increase public awareness about wildlife. Many squamates, particularly snakes (Fig. 19), are slaughtered throughout the country due to fear and superstition (Mata-Silva et al., 2015; Johnson et al., 2015a; Terán-Juárez et al., 2016; Woolrich-Piña et al., 2016), and the state of Nuevo León is no exception. People kill these organisms whenever they are encountered, because of the misconception that most are venomous. In Nuevo León, lizards of the genera *Barisia* and *Gerrhonotus* are killed for this reason, as well as some amphibians, especially toads. Some species of rattlesnakes also are killed for human consumption, often because of the popular belief that their meat can prevent or cure human cancer. Thus, we must design and implement new and more effective strategies to educate the people of Nuevo León on the importance of understanding and protecting their natural patrimony.

Fig. 19. *Elimination of Herpetofauna due to Cultural Beliefs and Practices*. This image was taken at Ejido Acuña, in the municipality of Doctor Arroyo. The boy is holding a freshly decapitated Black-tailed Rattlesnake (*Crotalus molossus*), which could be used for food or as a folk remedy. © Elí García-Padilla

Plestiodon dicei (Ruthven and Gaige, 1933). Dice's Short-nosed Skink is a Mexican endemic occurring from central Nuevo León eastward to central and southern Tamaulipas (Feria-Ortiz et al., 2011). This individual was found near Galeana, in the municipality of Galeana. Wilson et al. (2013a) calculated its EVS as 12, placing it in the upper portion of the medium vulnerability category. Its conservation status has not been evaluated by IUCN; this species is not listed by SEMARNAT. © Elí García-Padilla

Use of Pesticides

Although the effect of pesticides on amphibians has been documented in other parts of the world (Brühl et al., 2013), unfortunately this is not the case in Nuevo León. For this reason, we are unsure how amphibian populations in the state are being affected and responding to these chemicals. Nonetheless, studies should address this situation in order to implement the appropriate control measures. Specifically, studies in the valleys and plains of the northern and central municipalities of the state, the areas with the greatest amount of agricultural activity (www.agronuevoleon.gob.mx/oeidrus/perfilagr.pdf; accessed 16 August 2016), would be the most significant.

Collecting and Commercial Trade

Poachers and hobbyists collect some species illegally. Because of the lack of information, the impact such activities on native populations are difficult to estimate (Fitzgerald et al., 2004). Colubrids of the genera *Lampropeltis* and *Pantherophis* are the most affected, and the viperids *Agkistrodon taylori* and *Crotalus* spp. also are of interest to some collectors. Among the rattlesnakes, montane species such as *C. lepidus, C. morulus,* and *C. pricei*, and the lowland *C. totonacus* are the most desirable. Several squamates are used in traditional medicine and esoteric endeavors, and can be seen in popular markets in Monterrey's metropolitan area, such as Mercado Juárez and Mercado Campesino. Toads (*Incilius* and *Rhinella*), horned lizards (*Phrynosoma* spp.), and rattlesnakes (*Crotalus* spp.), are the most commonly seen taxa (www.animanaturalis.org/n/2619/trafico_ilegal_amenaza_al_60_por_ciento_de_reptiles_mexicanos; accessed 16 August 2016).

CONSERVATION STATUS

We employed the same three systems as Alvarado-Díaz et al. (2013), Mata-Silva et al. (2015), Johnson et al. (2015a), Terán-Juárez et al. (2016), and Woolrich-Piña et al. (2016) to examine the conservation status of members of the Nuevo León herpetofauna. Except where updates were needed, we extracted the data for the IUCN and EVS systems from Wilson et al. (2013a, b), and those for the SEMARNAT system from SEMARNAT (2010).

Lepidophyma sylvaticum Taylor, 1939. The Madrean Tropical Night Lizard is a Mexican endemic found from "west-central Nuevo León southward to western Tamaulipas, north-central San Luis Potosí, eastern Querétaro, Hidalgo, and northern Veracruz (Lemos-Espinal and Dixon, 2013: 155). This individual came from Monumento Natural Cerro de la Silla, in the municipality of Monterrey. Wilson et al. (2013a) calculated its EVS as 11, placing it in the lower portion of the medium vulnerability category. Its conservation status has been considered as Least Concern by IUCN, and as a species of special protection (Pr) by SEMARNAT. © Elí García-Padilla

The SEMARNAT System

The SEMARNAT system is a means of assessing the conservation status for members of the Mexican flora and fauna that was created and is maintained by the Secretaría de Medio Ambiente y Recursos Naturales, Mexico's environmental ministry. The head of this ministry is a member of the federal executive cabinet. "The Secretariat is charged with the mission of protecting, restoring, and conserving the ecosystems, natural resources, assets and environmental services of Mexico with the goal of fostering sustainable development" (www.wikipedia.org; accessed 8 May 2016). The SEMARNAT system is used by Mexican herpetologists to evaluate and rate the conservation status of some members of the nation's herpetofauna. For this system, we provide the available ratings for members of the native Nuevo León herpetofauna in Table 7, and summarize them in Table 9.

Three categories are ranked in the SEMARNAT system: endangered (P), threatened (A), and under special protection (Pr). Previously, Alvarado-Díaz et al. (2013), Mata-Silva et al. (2015), Johnson et al. (2015a), Terán-Juárez et al. (2016), and Woolrich-Piña et al. (2016) determined that many Mexican species remain uncategorized, so we follow those authors and place them in a "no status" (NS) category.

Of the 135 native species in Nuevo León, 88 (65.2%) have not been assessed (i.e., the NS species; Table 9). This proportion is even higher than the comparable figure for Tamaulipas (59.2%; Terán-Juárez et al., 2016). Of the remaining 47 species (34.8%), none is allocated to the endangered (P) category, 24 (17.8% of 135 species) to the threatened (A) category, and 23 (17.0%) to the special protection (Pr) category (Table 9).

Given that more than six of every 10 species have not been evaluated using this system, it does not provide significant value in determining the conservation status of the Nuevo León herpetofauna. Of the 24 threatened (A) species, the majority are snakes (13 species in three families), while the rest are salamanders (one species in one family), lizards (eight species in three families), and turtles (two species in two families). Of the 23 species of special protection (Pr), the majority are snakes (10 species in three families), and the remainder are anurans (four species in four families), salamanders (two species in two families), lizards (four species in four families), and turtles (three species in three families).

Table 9. SEMARNAT categorizations for herpetofaunal species in Nuevo León, Mexico, arranged by families. Non-native species are excluded.

Families	Number of Species	SEMARNAT Categorizations			
		Endangered (P)	Threatened (A)	Special Protection (Pr)	No Status (NS)
Bufonidae	6	—	—	1	5
Craugastoridae	1	—	—	—	1
Eleutherodactylidae	4	—	—	—	4
Hylidae	2	—	—	—	2
Leptodactylidae	1	—	—	—	1
Microhylidae	2	—	—	1	1
Ranidae	1	—	—	1	—
Rhinophrynidae	1	—	—	1	—
Scaphiopodidae	3	—	—	—	3
Subtotals	**21**	—	—	**4**	**17**
Ambystomatidae	1	—	—	1	
Plethodontidae	3	—	1	1	1
Subtotals	**4**	—	**1**	**2**	**1**
Totals	**25**	—	**1**	**6**	**18**
Anguidae	4	—	—	1	3
Crotaphytidae	2	—	2	—	—
Eublepharidae	1	—	—	1	—
Phrynosomatidae	25	—	5	1	19
Scincidae	3	—	—	—	3
Sphenomorphidae	1	—	1	—	—
Teiidae	3	—	—	—	3
Xantusiidae	1	—	—	1	—
Subtotals	**40**	—	**8**	**4**	**28**
Colubridae	31	—	7	1	23
Dipsadidae	9	—	—	3	6
Elapidae	1	—	—	—	1
Leptotyphlopidae	3	—	—	—	3
Natricidae	10	—	5	—	5
Viperidae	10	—	1	6	3
Subtotals	**64**	—	**13**	**10**	**41**
Emydidae	2	—	1	1	
Kinosternidae	2	—	—	1	1
Testudinidae	1	—	1		
Trionychidae	1	—	—	1	
Subtotals	**6**	—	**2**	**3**	**1**
Totals	**110**	—	**23**	**17**	**70**
Sum Totals	**135**	—	**24**	**23**	**88**

The IUCN System

The pattern of deficiencies in the global IUCN system of conservation assessment is exhibited in each Mexican state-level herpetofauna examined (Alvarado-Díaz et al., 2013; Mata-Silva et al., 2015; Johnson et al., 2015a; Terán-Juárez et al., 2016; and Woolrich-Piña et al., 2016) , as well as that of Mexico and Mesoamerica as a whole (Wilson et al., 2013a, b; Johnson et al., 2015b), with some variation. In Mexico, this pattern has been documented for states at the southern end (Oaxaca and Chiapas), the northeastern extreme (Tamaulipas), and the west-central portion (Michoacán and Nayarit). Herein we examine whether this pattern is evident in another of the US–Mexico border states—Nuevo León.

We placed the IUCN ratings currently available for the herpetofauna of Nuevo León in Table 7 and summarize the results in Table 10. These ratings are the result of a global amphibian assessment conducted in 2004 (Stuart et al., 2010) and an assessment for the rest of the Mexican herpetofauna in 2007 (www.natureserve.org/sites/default/files/projects/files/reptile_assessment_fact- sheet_low1_0; accessed 9 May 2016). Assessments are available now for 116 of 135 species (85.9%), excluding the four non-native species, a proportion slightly higher than that for the adjacent state of Tamaulipas (81.0%; Terán-Juárez et al., 2016). These species have been allocated to five IUCN categories, minus the Extinct, Extinct in the Wild, Critically Endangered, and Data Deficient categories, which do not apply to the Nuevo León herpetofauna. We summarize these allocations in Table 10, as follows: Endangered (EN) = 5 (3.7% of 135 species); Vulnerable (VU) = 5 (3.7%); Near Threatened (NT) = 6 (4.4%); and Least Concern (LC) = (100; 74.1%). Interestingly, as relatively high as the percentage of LC species is for Tamaulipas (61.4%), that for Nuevo León is significantly higher (74.1%).

Lampropeltis annulata Kennicott, 1861. The Mexican Milksnake is distributed in Nuevo León, Querétaro, and Tamaulipas, and perhaps Coahuila, eastern San Luis Potosí, and Hidalgo (Ruane et al., 2014). This individual was encountered at Paso del Coyote, in the municipality of Montemorelos. Wilson et al. (2013a) calculated its EVS as 12, placing it in the upper portion of the medium vulnerability category. Its conservation status has not been evaluated by IUCN, and this species is not listed by SEMARNAT. © Manuel Nevárez-de los Reyes

Table 10. IUCN Red List categorizations for herpetofaunal families in Nuevo León, Mexico. Non-native species are excluded. The shaded columns to the left are the "threat categories," and those to the right the categories for which too little information on conservation status exists to allow the taxa to be placed in any other IUCN category, or they have not been evaluated.

Families	Number of Species	IUCN Red List categorizations						
		Critically Endangered	Endangered	Vulnerable	Near Threatened	Least Concern	Data Deficient	Not Evaluated
Bufonidae	6	—	—	—	—	6	—	—
Craugastoridae	1	—	—	—	—	1	—	—
Eleutherodactylidae	4	—	—	2	—	2	—	—
Hylidae	2	—	—	—	1	1	—	—
Leptodactylidae	1	—	—	—	—	1	—	—
Microhylidae	2	—	—	—	—	2	—	—
Ranidae	1	—	—	—	—	1	—	—
Rhinophrynidae	1	—	—	—	—	1	—	—
Scaphiopodidae	3	—	—	—	—	3	—	—
Subtotals	**21**	—	—	**2**	**1**	**18**	—	—
Ambystomatidae	1	—	—	—	—	1	—	—
Plethodontidae	3	—	—	—	2	—	—	1
Subtotals	**4**	—	—	—	**2**	**1**	—	**1**
Totals	**25**	—	—	**2**	**3**	**19**	—	**1**
Anguidae	4	—	1	—	—	2	—	1
Crotaphytidae	2	—	—	1	—	1	—	—
Eublepharidae	1	—	—	—	—	1	—	—
Phrynosomatidae	25	—	3	—	2	16	—	4
Scincidae	3	—	—	—	—	2	—	1
Sphenomorphidae	1	—	—	—	—	1	—	—
Teiidae	3	—	—	—	—	2	—	1
Xantusiidae	1	—	—	—	—	1	—	—
Subtotals	**39**	—	**4**	**1**	**2**	**26**	—	**7**
Colubridae	31	—	—		—	27	—	4
Dipsadidae	9	—	1		—	4		4
Elapidae	1	—	—		—	1	—	—
Leptotyphlopidae	3	—	—		—	3	—	—
Natricidae	10	—	—	1	—	9	—	—
Viperidae	10	—	—		—	7	—	3
Subtotals	**63**	—	**1**	**1**	—	**51**	—	**11**
Emydidae	2	—	—	1	1	—	—	—
Kinosternidae	2	—	—	—	—	2	—	—
Testudinidae	1	—	—	—	—	1	—	—
Trionychidae	1	—	—	—	—	1	—	—
Subtotals	**6**	—	—	**1**	**1**	**4**	—	—
Totals	**110**	—	**5**	**3**	**3**	**81**	—	**18**
Sum Totals	**135**	—	**5**	**5**	**6**	**100**	—	**19**
Category Totals	**135**	**10**			**106**		**19**	

We organized the Nuevo León values for these categorizations into three summary categories, as follows: EN+VU = 10 (7.4%); NT+LC = 106 (78.5%); and NE = 19 (14.0). These proportional values vary somewhat with the comparable ones for Tamaulipas (respectively, 12.8%, 65.4%, and 21.8%). The value for the two threat categories in the state (no CR species are recorded) is only somewhat more than one-half of that for Tamaulipas. The value for the Nuevo León NE species (no DD species are recorded) also is significantly lower than that for the adjacent state. Comparably, the value for the NT+LC species for Nuevo León is 13.1 percentage points higher than the one for Tamaulipas. Even though 179 native species are found in Tamaulipas, compared to 135 in Nuevo León, there are only 11 fewer species in the NT+LC grouping in Nuevo León (106) than in Tamaulipas (117). Several earlier studies on the herpetofauna of various states of Mexico (Alvarado-Díaz et al., 2013; Mata-Silva et al., 2015; Johnson et al., 2015a; Terán-Juárez et al., 2016; and Woolrich-Piña et al., 2016) have demonstrated that users of the IUCN methodology tend to rely heavily on the LC category when assessing the conservation status of members of the Mexican herpetofauna, providing the impression that many of these creatures face limited conservation challenges. The question arises, therefore, as to whether the herpetofauna of Nuevo León is in better shape from a conservation perspective than that of Tamaulipas. We examine this question below.

The EVS System

Wilson et al. (2013a, b) and Johnson et al. (2015b) discussed the development and use of the EVS (Environmental Vulnerability Score) system of conservation assessment, as well as its advantages over the methodology of the IUCN system; therefore, we do not repeat this information here.

The EVS system has been used to assess the herpetofauna of several states in Mexico, including Michoacán (Alvarado-Díaz et al., 2013), Oaxaca (Mata-Silva et al., 2015), Chiapas (Johnson et al., 2015a), Tamaulipas (Terán-Juárez et al., 2016), and Nayarit (Woolrich-Piña et al., 2016), and several countries in Central America, including Guatemala (Acevedo et al., 2010), Honduras (Townsend and Wilson, 2010), Belize (Stafford et al., 2010), Nicaragua (Sunyer and Köhler, 2010), Costa Rica (Sasa et al., 2010), and Panama (Jaramillo et al., 2010). Herein, we applied this system to the herpetofauna of Nuevo León (Tables 7, 11). The range of EVS values ranges from 3, the lowest possible score, to 18, two fewer than the highest possible score. No species in Nuevo León, therefore, is accorded a score of 19 or 20. The most frequent EVS values (for 10 or more species) are 11 (14), 12 (16), 13 (15), 14 (12), and 15 (12). These values fall within the medium or the lower portion of the high vulnerability category. Thus, we provided these scores for 69 species, 51.1% of the 135 species for which EVS values can be calculated. We applied a score of 3, at the lower end of the range, to three species of anurans, one each in the families Bufonidae (*Rhinella horribilis*), Hylidae (*Smilisca baudinii*), and Scaphiopodidae (*Scaphiopus couchii*), which are the same three species identified in Tamaulipas (Terán-Juárez et al., 2016). At the upper end of the range, we placed a score of 18 on two species of plethodontid salamanders (*Aquiloeurycea galeanae* and *Chiropterotriton miquihuanus*) and one testudinid turtle (*Gopherus berlandieri*).

As with other studies, we divided the scores for the members of the Nuevo León herpetofauna into three categories (Table 11), i.e., low (3–9), medium (10–13), and high (14–19). Like the study on the Tamaulipan herpetofauna (Terán-Juárez et al., 2016), the number of EVS values increase from the low category to the medium one (42 and 54, respectively), and then decrease to the high category (39). The reason for this pattern is the same as it was for the herpetofauna of Tamaulipas, i.e., in both states a major segment of the herpetofauna is shared with the United States (119 of 184 [64.7%] in Tamaulipas and 90 of 139 [64.7%] in Nuevo León). Of the 90 species in Nuevo León shared with the United States, 75 (83.3%) also are shared with Tamaulipas. As with Tamaulipas, several of the 90 species shared with the United States do not range farther north than southernmost Texas (*Hypopachus variolosus*, *Leptodactylus fragilis*, *Rhinella horribilis*, *Smilisca baudinii*, *Coniophanes imperialis*, *Drymobius margaritiferus*, *Leptodeira septentrionalis*, and *Tantilla atriceps*), and another two into southern Arizona (*Oxybelis aeneus* and *Tantilla wilcoxi*). In addition, seven of these nine species also range into Central America (with the exception of the two species of *Tantilla*) and even a few into South America.

Table 11. Environmental Vulnerability Scores (EVS) for the herpetofauna of Nuevo León, Mexico, arranged by family. Shaded area to the left encompasses low vulnerability scores, and the one to the right high vulnerability scores. Non-native species are excluded.

Families	Number of Species	Environmental Vulnerability Scores															
		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Bufonidae	6	1	—	1	1	1	—	1	—	—	1	—	—	—	—	—	—
Craugastoridae	1	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—
Eleutherodactylidae	3	—	—	—	—	—	—	—	—	1	1	—	—	1	1	—	—
Hylidae	2	1	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—
Leptodactylidae	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—
Microhylidae	2	—	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—
Ranidae	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—
Rhinophrynidae	1	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—
Scaphiopodidae	3	1	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—
Subtotals	**21**	**3**	**1**	**2**	**2**	**2**	**2**	**3**	**1**	**1**	**2**	—	—	**1**	1	—	—
Ambystomatidae	1	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—
Plethodontidae	3	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	2
Subtotals	**4**	—	—	—	—	—	—	—	**1**	—	—	—	—	—	**1**	—	**2**
Totals	**25**	**3**	**1**	**2**	**2**	**2**	**2**	**3**	**2**	**1**	**2**	—	—	**1**	**2**	—	**2**
Anguidae	4	—	—	—	—	—	—	—	—	—	—	1	—	1	1	1	—
Crotaphytidae	2	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—
Eublepharidae	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—
Phrynosomatidae	25	—	—	—	—	1	—	1	—	3	4	4	4	6	2	—	—
Scincidae	3	—	—	—	—	—	—	—	—	1	2	—	—	—	—	—	—
Sphenomorphidae	1	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Teiidae	3	—	—	—	—	—	—	1	—	—	—	—	2	—	—	—	—
Xantusiidae	1	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—
Subtotals	**39**	—	—	—	—	**1**	—	**2**	—	**5**	**8**	**6**	**7**	**7**	**3**	**1**	—
Colubridae	31	—	—	4	4	—	2	2	4	3	3	4	3	2	—	—	—
Dipsadidae	8	—	1	—	1	—	2	1	1	1	1	—	1	—	—	—	—
Elapidae	1	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—
Leptotyphlopidae	3	—	—	—	—	—	1	—	—	—	—	2	—	—	—	—	—
Natricidae	10	—	—	—	—	3	1	—	2	1	—	1	—	1	1	—	—
Viperidae	10	—	—	—	—	—	1	1	—	1	1	2	1	—	1	2	—
Subtotals	**63**	—	**1**	**4**	**5**	**3**	**7**	**4**	**7**	**7**	**5**	**9**	**5**	**3**	**2**	**2**	—
Emydidae	2	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—
Kinosternidae	2	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—
Testudinidae	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Trionychidae	1	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—
Subtotals	**6**	—	—	—	—	—	—	—	—	**1**	**1**	—	—	**1**	**2**	—	**1**
Totals	**108**	—	**1**	**4**	**5**	**4**	**7**	**6**	**7**	**13**	**14**	**15**	**12**	**11**	**7**	**3**	**1**
Sum Totals	**135**	**3**	**2**	**6**	**7**	**6**	**9**	**9**	**9**	**14**	**16**	**15**	**12**	**12**	**9**	**3**	**3**
Category Totals	**135**	**42**							**54**				**39**				

As in previous studies (Mata-Silva et al., 2015; Johnson et al., 2015a; Terán-Juárez et al., 2016; Woolrich-Piña et al., 2016), we compared the results of the IUCN categorizations with those determined with the EVS system (Table 12). The data in this table indicate that only 26.3% (10 of 38) of the high vulnerability species are placed in the two applicable IUCN threat categories (no species are allocated to the CR category). This proportion is comparable to that seen with the Tamaulipan herpetofauna (24.5%; Terán-Juárez et al., 2016). At the other extreme of the fully evaluated IUCN categories (LC), 100 species make up 2.4 times the number of low vulnerability species (41; Table 12); this value is even higher than the comparable one (2.1) for the Tamaulipan herpetofauna (Terán-Juárez et al., 2016). Thus, as demonstrated in similar studies (Mata-Silva et al., 2015; Johnson et al., 2015a; Terán-Juárez et al., 2016; Woolrich-Piña et al., 2016) the results of the two systems do not correspond well with one another.

Table 12. Comparison of Environmental Vulnerability Scores (EVS) and IUCN categorizations for members of the herpetofauna of Nuevo León, Mexico. Non-native species are excluded. No species are allocated to the CR or DD IUCN categories. Shaded area at the top encompasses low vulnerability category scores, and the one at the bottom high vulnerability category scores.

EVS	IUCN Categories					Totals
	Endangered	Vulnerable	Near Threatened	Least Concern	Not Evaluated	
3	—	—	—	3	—	3
4	—	—	—	2	—	2
5	—	—	—	5	1	6
6	—	—	—	5	2	7
7	—	—	—	6	—	6
8	—	—	—	8	1	8
9	—	—	1	8	—	9
10	—	—	—	9	—	9
11	—	—	—	12	2	14
12	—	1	—	11	4	16
13	—	2	—	11	3	16
14	1	—	1	8	2	12
15	2	1	—	8	1	12
16	1	1	3	2	1	8
17	1	—	—	1	1	3
18	—	—	1	1	1	3
Totals	**5**	**5**	**6**	**100**	**19**	**135**

Two principal reasons are available as to why the IUCN and the EVS systems are at odds with one another with respect to evaluating the conservation status of the Nuevo León herpetofauna. The first is that a number of species have not been evaluated using the IUCN methodology; we indicate 19 such species in Table 12. These species, along with calculations for their EVS values, are listed in Table 13. Most of these species either have been recognized relatively recently, or their distributions extend south of Mexico and presumably will be allocated to one of the fully assessed categories once the results of the reptile assessments conducted for Central America (in 2012) or that will be conducted in the appropriate areas of South America are published. Other authors (Wilson et al., 2013a, b; Johnson et al., 2015b) have noted that one of the persistent disadvantages of the IUCN system is that its practitioners are not able to stay current with taxonomic advances. Another problem is that an inordinate amount of time is taken for the results of the IUCN countrywide assessments to be finalized and presented to the public. The EVS values for these 19 NE species range from 5–18 and fall into the three vulnerability categories as follows: low (four species); medium (nine); and high (six). Until such time as the official IUCN assessments are forthcoming, we submit that the four low vulnerability species should be allocated to the LC category, the medium vulnerability species to the NT category, and the high vulnerability species to one of the three threat categories. Importantly, seven of these 19 species are country endemics (Table 13).

Table 13. Environmental Vulnerability Scores for members of the herpetofauna of Nuevo León, Mexico, currently not evaluated (NE) by the IUCN. Non-native taxa are not included. * = country endemic species.

Taxa	Environmental Vulnerability Score			
	Geographic Distribution	Ecological Distribution	Reproductive Mode/Degree of Persecution	Total Score
*Chiropterotriton miquihuanus**	6	8	4	18
*Barisia ciliaris**	5	7	3	15
*Holbrookia approximans**	5	6	3	14
Sceloporus cowlesi	4	6	3	13
Sceloporus cyanogenys	4	6	3	13
Sceloporus marmoratus	2	6	3	11
*Plestiodon dicei**	5	4	3	12
Aspidoscelis marmorata	4	7	3	14
Drymobius margaritiferus	1	1	4	6
Lampropeltis annulata	4	3	5	12
Lampropeltis splendida	4	5	3	12
Oxybelis aeneus	1	1	3	5
*Adelphicos newmanorum**	5	5	2	12
Heterodon kennerlyi	3	4	4	11
Hypsiglena jani	1	3	2	6
Leptodeira septentrionalis	2	2	4	8
*Crotalus morulus**	5	6	5	16
Crotalus ornatus	4	4	5	13
*Crotalus totonacus**	5	7	5	17

Leptophis mexicanus Duméril, Bibron, and Duméril, 1854. The Mesoamerican Parrot Snake occurs from "on the Atlantic versant from southern Tamaulipas, Mexico, to north-central Costa Rica and discontinuously on the Pacific versant from eastern Oaxaca, Mexico, to northwestern Costa Rica" (McCranie, 2011: 146). This individual was found in Parque Natural la Estanzuela, in the municipality of Monterrey. Wilson et al. (2013a) calculated its EVS as 6, placing it in the middle portion of the low vulnerability category. Its conservation status has been considered as Least Concern by IUCN, and as a threatened species (A) by SEMARNAT. © Carlos Velasco-Macías

The other reason for the considerable disagreement between the IUCN and EVS systems is that, in our opinion, the IUCN system places far too many species in the LC category. In Nuevo León there are 100 such species, which is 74.1% of the total number of species for which EVS values can be calculated (Table 14). With about three-quarters of the herpetofaunal species in Nuevo León provided with this status, we realistically conclude that relatively little concern has been given to the sustainability of these creatures. Conspicuously, the EVS values associated with these 100 species range from 3 to 18, the entire range for the Nuevo León herpetofauna as a whole (Table 11). The absolute and relative numbers of EVS values in the LC category are as follows: 3 (three; 3.0%); 4 (two; 2.0%); 5 (five; 5.0%); 6 (five; 5.0%); 7 (six; 6.0%); 8 (eight; 8.0%); 9 (eight; 8.0%); 10 (9; 9.0%); 11 (12; 12.0%); 12 (11; 11.0%); 13 (11; 11.0%); 14 (eight; 8.0%); 15 (eight; 8.0%); 16 (two; 2.0%); 17 (one; 1.0%); and 18 (one; 1.0%). When arranged into the standard EVS groups, the results are as follows: low (37, 37.0%); medium (43, 43.0%); and high (20, 20.0%). Based on the same assumption as expressed in the previous paragraph, we suggest that the low category species should be placed in the LC category, the medium ones in the NT category, and the high category species should not remain in the LC category. The 20 high category species and their EVS calculations are as follows (* = Mexican endemic):

*Gerrhonotus lugoi** (5+8+3 = 16)
Coleonyx brevis (4+6+4 = 14)
Cophosaurus texanus (4+7+3 = 14)
*Sceloporus cautus** (5+7+3 = 15)
*Sceloporus couchii** (5+7+3 = 15)
*Sceloporus minor** (5+6+3 = 14)
*Sceloporus parvus** (5+7+3 = 15)
*Sceloporus samcolemani** (5+7+3 = 15)
Aspidoscelis inornata (4+7+3 = 14)
Bogertophis subocularis (4+7+3 = 14)
Lampropeltis alterna (4+7+3 = 14)
*Lampropeltis mexicana** (5+7+3 = 15)
Pantherophis bairdi (4+7+4 = 15)
*Pituophis deppei** (5+5+4 = 14)
*Thamnophis exsul** (5+7+4 = 16)
*Thamnophis pulchrilatus** (5+6+4 = 15)
*Agkistrodon taylori** (5+7+5 = 17)
Crotalus pricei (2+7+5 = 14)
Gopherus berlandieri (4+8+6 = 18)
Apalone spinifera (3+6+6 = 15)

Pantherophis bairdi (Yarrow, 1880). Baird's Ratsnake ranges discontinuously from "western central Texas and the Big Bend region through central Coahuila to southern Tamaulipas" (Lemos-Espinal et al., 2015: 360). This individual was encountered on the road to Grutas de Bustamante, Sierra de Comas, in the municipality of Bustamante. Wilson et al. (2013a) calculated its EVS as 15, placing it in the lower portion of the high vulnerability category. Its conservation status has been considered as Least Concern by IUCN; this species is not listed by SEMARNAT. © Manuel Nevárez-de los Reyes

The most obvious feature of these 20 species is that the majority are country endemics (11 of 20 [55.0%]). In addition, most are limited in geographic (value is 4 or 5; 18 of 20 species [90.0%]) or ecological distribution (values of 6–8; 19 of 20 species [95.0%]). In total, all 20 species are limited in geographic or ecological distribution, or both. Consequently, we believe that all of these species should be removed from the LC category, and otherwise allocated as follows: CR (*Gerrhonotus lugoi*, *Agkistrodon taylori*, *Thamnophis exsul*, and *Gopherus berlandieri*); EN (*Sceloporus cautus*, *S. couchii*, *S. parvus*, *S. samcolemani*, *Lampropeltis mexicana*, *Pantherophis bairdi*, *Thamnophis pulchrilatus*, and *Apalone spinifera*); and VU (*Aspidoscelis inornata*, *Coleonyx brevis*, *Cophosaurus texanus*, *Sceloporus minor*, *Bogertophis subocularis*, *Crotalus pricei*, *Lampropeltis alterna*, and *Pituophis deppei*). These suggested changes are not within our ability or responsibility to accomplish, but their EVS values can be used by appropriate agencies in Nuevo León to determine how much attention should be paid to these important components of the herpetofauna.

Table 14. Environmental Vulnerability Scores for members of the herpetofauna of Nuevo León, Mexico, assigned to the IUCN Least Concern category. Non-native taxa are excluded. * = country endemic species.

Taxa	Environmental Vulnerability Score			
	Geographic Distribution	Ecological Distribution	Reproductive Mode/Degree of Persecution	Total Score
Anaxyrus cognatus	3	5	1	9
Anaxyrus debilis	1	5	1	7
Anaxyrus punctatus	1	3	1	5
Anaxyrus speciosus	4	7	1	12
Incilius nebulifer	1	4	1	6
Rhinella horribilis	1	1	1	3
Craugastor augusti	2	2	4	8
Eleutherodactylus cystignathoides	2	6	4	12
Eleutherodactylus guttilatus	2	5	4	11
Smilisca baudinii	1	1	1	3
Leptodactylus fragilis	1	2	2	5
Gastrophryne olivacea	3	5	1	9
Hypopachus variolosus	2	1	1	4
Lithobates berlandieri	4	2	1	7
Rhinophrynus dorsalis	2	5	1	8
Scaphiopus couchii	1	1	1	3
Spea bombifrons	3	6	1	10
Spea multiplicata	1	4	1	6
*Aambystoma velasci**	5	4	1	10
Gerrhonotus infernalis	5	5	3	13
*Gerrhonotus lugoi**	5	8	3	16
Crotaphytus collaris	3	7	3	13
Coleonyx brevis	4	6	4	14
Cophosaurus texanus	4	7	3	14
Phrynosoma cornutum	1	7	3	11
Phrynosoma modestum	4	5	3	12
*Phrynosoma orbiculare**	5	4	3	12
*Sceloporus cautus**	5	7	3	15
*Sceloporus couchii**	5	7	3	15

Sceloporus grammicus	2	4	3	9
Sceloporus merriami	4	6	3	13
*Sceloporus minor**	5	6	3	14
Sceloporus olivaceus	4	6	3	13
*Sceloporus parvus**	5	7	3	15
Sceloporus poinsettii	4	5	3	12
*Sceloporus samcolemani**	5	7	3	15
*Sceloporus spinosus**	5	4	3	12
*Sceloporus torquatus**	5	3	3	11
Uta stansburiana	3	1	3	7
Plestiodon obsoletus	3	5	3	11
Plestiodon tetragrammus	4	5	3	12
*Scincella silvicola**	5	4	3	12
Aspidoscelis gularis	2	4	3	9
Aspidoscelis inornata	4	7	3	14
*Lepidophyma sylvaticum**	5	4	2	11
Arizona elegans	1	1	3	5
Bogertophis subocularis	4	7	3	14
Coluber constrictor	1	6	3	10
Drymarchon melanurus	1	1	4	6
Ficimia streckeri	3	7	2	12
Gyalopion canum	4	3	2	9
Lampropeltis alterna	4	7	3	14
*Lampropeltis mexicana**	5	7	3	15
Leptophis mexicanus	1	1	4	6
Masticophis flagellum	1	3	4	8
Masticophis schotti	4	5	4	13
Masticophis taeniatus	1	5	4	10
Opheodrys aestivus	3	7	3	13
Pantherophis bairdi	4	7	4	15
Pantherophis emoryi	3	6	4	13
Pituophis catenifer	4	1	4	9
*Pituophis deppei**	5	5	4	14
Rhinocheilus lecontei	1	3	4	8
Salvadora grahamiae	4	2	4	10
Senticolis triaspis	2	1	3	6
Sonora semiannulata	1	1	3	5
Tantilla atriceps	2	7	2	11
Tantilla hobartsmithi	3	6	2	11
Tantilla nigriceps	3	6	2	11
Tantilla rubra	2	1	2	5
Tantilla wilcoxi	2	6	2	10
*Trimorphodon tau**	5	4	4	13
Amastridium sapperi	4	4	2	10
Coniophanes imperialis	2	3	3	8
Diadophis punctatus	1	1	2	4
Tropidodipsas sartorii	2	2	5	9

Micrurus tener	1	5	5	11
Rena dulcis	4	8	1	13
Rena humilis	4	3	1	8
*Rena myopica**	5	7	1	13
Nerodia erythrogaster	3	4	4	11
Nerodia rhombifer	1	5	4	10
Storeria dekayi	1	4	2	7
Thamnophis cyrtopsis	2	1	4	7
Thamnophis eques	2	2	4	8
*Thamnophis exsul**	5	7	4	16
Thamnophis marcianus	1	5	4	10
Thamnophis proximus	1	2	4	7
*Thamnophis pulchrilatus**	5	6	4	15
*Agkistrodon taylori**	5	7	5	17
Crotalus atrox	1	3	5	9
Crotalus lepidus	2	5	5	12
Crotalus molossus	2	1	5	8
Crotalus pricei	2	7	5	14
Crotalus scutulatus	2	4	5	11
Sistrurus catenatus	3	5	5	13
Kinosternon flavescens	3	6	3	12
*Kinosternon integrum**	5	3	3	11
Gopherus berlandieri	4	8	6	18
Apalone spinifera	3	6	6	15

Tantilla atriceps (Günther, 1895). The Mexican Black-headed Snake is found from "extreme southern Texas southward through central Coahuila to extreme northeastern Durango and northern Tamaulipas and San Luis Potosí" (Lemos-Espinal et al., 2015: 382). This individual came from Rancho La Boca, on the border of the municipalities of Bustamante and Mina. Wilson et al. (2013a) calculated its EVS as 11, placing it in the lower portion of the medium vulnerability category. Its conservation status has been considered as Least Concern by IUCN, and as a threatened species (A) by SEMARNAT. © Manuel Nevárez-de los Reyes

Leptodeira septentrionalis (Kennicott, 1859). The Northern Cat-eyed Snake occurs from "extreme southern Texas, in the United States, to northern Colombia and Venezuela, on the Atlantic versant, and in disjunct areas of Mexico and Central America on the Pacific versant, and thence continuously in South America to northwestern Peru (Lemos-Espinal and Dixon, 2013: 197). This individual was encountered at Cañón de Bustamante, in the municipality of Bustamante. Wilson et al. (2013a) calculated its EVS as 8, placing it in the upper portion of the low vulnerability category. Its conservation status has not been evaluated by IUCN; this species is not listed by SEMARNAT.

RELATIVE HERPETOFAUNAL PRIORITY

Johnson et al. (2015a) developed the concept of Relative Herpetofaunal Priority (RHP), a simple measure of the relative importance of the herpetofauna recorded in the physiographic regions recognized in any geographical entity (e.g., the state of Chiapas in Johnson et al., 2015a), as indicated by (1) the proportion of state and country endemics relative to the entire physiographic regional herpetofauna, and (2) by the absolute number of high EVS species in each regional herpetofauna.

We constructed two tables to ascertain the RHP for the Nuevo León herpetofauna, one for the endemicity values (Table 15) and the other for the high EVS values (Table 16). The data in Table 15 demonstrate that the combined numbers of country and state endemics, at 32 (80.0% of a total of 40 species), by far is highest for the Gran Sierra Plegada. The proportion of these species is not as high as for this region in Tamaulipas (91.5%; Terán-Juárez et al., 2016). The Gran Sierra Plegada, thus, occupies RHP rank order one for endemicity values. The remainder of the regions (and the size of their respective endemic herpetofaunal components) in rank order, from highest to lowest (2 to 6), is as follows: Sierras y Llanuras Occidentales (11; 27.5%); Sierras y Llanuras Coahuilenses (eight; 20.0%); Llanuras y Lomeríos (four; 10.0%); Pliegues Saltillo-Parras (four; 10.0%); Sierras Transversales (three; 7.5%); and Llanuras de Coahuila y Nuevo León (one; 2.5%). Two regions (Llanuras y Lomeríos and Pliegues Saltillo-Parras) occupy the same rank (4).

Table 15. Number of herpetofaunal species in four distributional categories among the seven physiographic regions of Nuevo León, Mexico. Rank determined by adding the state and country endemics.

Physiographic Provinces	Non-endemics	Country Endemics	State Endemics	Non-natives	Totals	Rank Order
Llanuras de Coahuila y Nuevo León	47	1	—	3	51	6
Sierras y Llanuras Coahuilenses	57	8	—	2	67	3
Llanuras y Lomeríos	48	4	—	3	55	4
Pliegue Saltillo Parras	44	4	—	1	49	4
Gran Sierra Plegada	52	32	1	2	87	1
Sierras Transversales	17	3	—	—	20	5
Sierras y Llanuras Occidentales	27	11	—	—	38	2

In Table 16 we determined the number of herpetofaunal species in each of the three EVS categories, i.e., low, medium, and high. Based on the total number of high category species, the most important physiographic region, by far, is the Gran Sierra Plegada, with 26 species of a total of 85 (30.6%). The remainder of the regions (and the number of their respective high EVS species) in rank order, from highest to lowest (2 to 7), are as follows: Sierras y Llanuras Coahuilenses (14; 21.5% of 65); Pliegues Saltillo-Parras (10 species; 20.8% of 48 species); Sierras y Llanuras Occidentales (eight; 21.1% of 38); Llanuras de Coahuila y Nuevo León (six; 12.5% of 48); Llanuras y Lomeríos (five; 9.8% of 52); and Sierras Transversales (four; 20.0% of 20).

Table 16. Number of herpetofaunal species in the three EVS categories among the seven physiographic regions of Nuevo León, Mexico. Rank determined by the relative number of high EVS species. Non-native species are excluded.

Physiographic Provinces	Low	Medium	High	Totals	Rank Order
Llanuras de Coahuila y Nuevo León	20	22	6	48	5
Sierras y Llanuras Coahuilenses	23	28	14	65	2
Llanuras y Lomeríos	24	23	5	52	6
Pliegue Saltillo Parras	19	19	10	48	3
Gran Sierra Plegada	27	32	26	85	1
Sierras Transversales	8	8	4	20	7
Sierras y Llanuras Occidentales	15	15	8	38	4

The rank orders demonstrated for the seven physiographic regions in Table 15 (country and state endemics) and those in Table 16 (high EVS category) are not identical, as indicated below, because in Table 15 two regions occupy rank 4.

Gran Sierra Plegada (1, 1)

Sierras y Llanuras Coahuilenses (3, 2)

Sierras y Llanuras Occidentales (2, 4)

Pliegues Saltillo-Parras (4, 3)

Llanuras y Lomeríos (4, 6)

Llanuras de Coahuila y Nuevo León (6, 5)

Sierras Transversales (5, 7)

Based on these two RHP measures, the region with the highest priority is the Gran Sierra Plegada, because it contains the highest number of country endemics, the only state endemic, and the highest number of high vulnerability species. The portion of this mountain range in Tamaulipas occupies the same priority position (Terán-Juárez et al., 2016). The next priority position is occupied by the Sierras y Llanuras Coahuilenses and the Sierras y Llanuras Occidentales, which lie to the north and south of the Gran Sierra Plegada, respectively (Fig. 1). We believe the RHP measure can provide a basic idea how scarce conservation funds can be allocated best. Our position, however, is not intended to ignore the conservation needs of herpetofaunal species in other physiographic regions of the state.

PROTECTED AREAS IN NUEVO LEÓN

One of the most important components of a sustainable program for protecting the world's biodiversity is a well-supported and managed system of sufficiently large and diverse protected areas. On the surface, such a system would appear to exist in Nuevo León, and we assembled a list of 32 such areas in the state (Table 17). To assess the effectiveness of these areas, we examined a number of the characteristics of these areas in Table 17, in a similar fashion as for the states of Tamaulipas (Terán-Juárez et al., 2016) and Nayarit (Woolrich-Piña et al., 2016).

Perusal of the data in Table 17 indicates that of the 32 areas, only two are national parks (Cumbres de Monterrey and El Sabinal) and one is a national monument (Cerro de la Silla). These areas are under federal jurisdiction. The remaining areas are uncategorized ecological conservation areas or urban parks, which are under state jurisdiction. Only the national parks and the national monument have been in existence before the year 2000, Parque Nacional El Sabinal since 1938, Parque Nacional Cumbres de Monterrey since 1939, and Monumento Nacional Cerro de la Silla since 1991. Twenty-three of the state-level areas were decreed in the year 2000, and the remaining three in 2002. The three urban parks were decreed in 2005, 2008, and 2011.

Crotalus lepidus Kennicott, 1861. The Rock Rattlesnake is found from "southeastern Arizona, west-central and southern New Mexico, and much of southwestern Texas, in the United States, and in Mexico along the Sierra Madre Occidental from Chihuahua and Sonora southward to eastern Nayarit and Durango, and east of these mountains to the Sierra Madre Oriental in Nuevo León and Tamaulipas, and southward to western and central San Luis Potosí and westward to Zacatecas and Aguascalientes" (Lemos-Espinal and Dixon, 2013: 251). This individual was encountered at Ejido La Rinconada, in the municipality of García. Wilson et al. (2013a) calculated its EVS as 12, placing it in the upper portion of the medium vulnerability category. Its conservation status has been considered as Least Concern by IUCN, and as a species of special protection (Pr) by SEMARNAT. © Emiliano Méndez-Salinas

Table 17. Characteristics of the Natural Protected Areas (ANPs) in Nuevo León, Mexico. Abbreviations for the facilities in the ANPs are as follows: A = administrative services; R = park guards; S = systems of pathways; and V = facilities for visitors. * = modified 17 Nov 2000. The state ANPs (Natural Protected Areas) are not categorized (NC). Information in part from: www.conanp.gob.mx/que_hacemos/parques_nacionales.php; accessed 17 May 2016.

Name	Category	Date of Decree	Area (ha)	Municipalities	Jurisdiction	Physiographic Regions	Facilities Available	Occupied by Landowners	Herpetofaunal Survey Completed	Management Plan Available
Cumbres de Monterrey	Parque Nacional	24 Nov 1939*	177,396	Allende, García, Montemorelos, Monterrey, Rayones, Santa Catarina, Santiago, San Pedro Garza García	Federal	GS	R,S	Yes	Yes	Yes
Cerro de la Silla	Monumento Natural	26 April 1991	6,045	Monterrey, Guadalupe, and Juárez	Federal	GS	R,S	No	Yes	Yes
El Sabinal	Parque Nacional	25 Aug 1938	8.0	Cerralvo	Federal	CN	A,R,S,V	No	No	No
Trinidad y Llano Salas	NC**	24 Nov 2000	1, 972.3	Aramberri	State	SO	None	No	No	Yes
La Trinidad	NC	24 Nov 2000	132.4	Aramberri	State	SO	None	No	No	Yes
San Juan y Puentes	NC	24 Nov 2000	21.7	Aramberri	State	SO	None	No	Yes	Yes
Sandia el Grande	NC	24 Nov 2000	1,902.7	Aramberri	State	GS	None	No	No	Yes
Acuña	NC	24 Nov 2000	1,228.4	Dr. Arroyo	State	SO	None	No	No	Yes
El Refugio de Apanaco	NC	24 Nov 2000	815.3	Dr. Arroyo	State	SO	None	No	No	Yes
Cerro “El Peñón”	NC	24 Nov 2000	103.4	Dr. González	State	SC	None	No	No	Yes
La Purísima (Bosque de Enebro)	NC	24 Nov 2000	18.3	Iturbide	State	GS	None	No	No	Yes
La Purísima (Bosque de Oyamel)	NC	24 Nov 2000	844.5	Iturbide, Aramberri	State	GS	None	No	No	Yes
Las Flores	NC	24 Nov 2000	82.0	Linares	State	CN	None	No	No	Yes
San Elías	NC	24 Nov 2000	653.9	Mier, Noriega	State	SO	None	No	No	Yes
Cañón “Pino del Campo”	NC	24 Nov 2000	2,567.2	Mier, Noriega	State	SO	None	No	No	Yes
Vaquerías	NC	24 Nov 2000	1,121.2	General Terán	State	CN	None	No	No	Yes

Santa Marta de Abajo	NC	24 Nov 2000	27.2	General Zaragoza	State	GS	None	No	No	Yes
Cerro “Picachos”	NC	24 Nov 2000 1 Oct 2003	33,602.8 75,872.6	Sabinas Hidalgo, Agualeguas, Cerralvo, Salinas Victoria, Higueras, Marín, Dr. González	State	SC	None	No	Yes	Yes
Cerro “El Potosí”	NC	24 Nov 2000	989.4	Galeana	State	GS	None	No	Yes	Yes
Sierra “Corral de los Bandidos”	NC	24 Nov 2000	1,175.0	García	State	PS	None	No	No	Yes
Cerro “La Mota”	NC	24 Nov 2000	9,432.3	García, Santa Catarina	State	PS	None	No	No	Yes
Sierra “El Fraile” y “San Miguel”	NC	24 Nov 2000	23,506.4	García, Abasolo, Hidalgo, General Escobedo, El Carmen, Mina	State	SC	None	No	No	Yes
Sierra Las Mitras	NC	24 Nov 2000	3,744.2	Monterrey, San Pedro Garza García, General Escobedo, Santa Catarina	State	SC	None	No	No	Yes
Cerro El Topo	NC	24 Nov 2000	1,093.3	Monterrey, San Nicolás, General Escobedo	State	SC	None	No	Yes	Yes
Sierra “Cerro de la Silla”	NC	24 Nov 2000	1,0620.4	Monterrey, Juárez, Santiago, Allende, Cadereyta	State	GS	None	No	Yes	Yes
Baño de San Ignacio	NC	24 Nov 2000	4,225.4	Linares	State	Ll	None	No	No	Yes
Llano de la Soledad (Perrito llanero)	NC	14 Jan 2002	7697.0	Galeana	State	SO	None	No	No	Yes
La Trinidad (Perrito llanero)	NC	14 Jan 2002	3,282.6	Galeana	State	SO	None	No	No	Yes
La Hediondilla (Perrito llanero)	NC	14 Jan 2002	4,381.90	Galeana	State	SO	None	No	No	Yes
Cerro del Obispado	Urban Park	13 June 2005	18.4	Monterrey	State	SC	A,R,S,V	No	No	Yes
Parque Lineal Río Santa Catarina	Urban Park	11 Sept 2008	677.4	San Pedro Garza García, Guadalupe, Juárez, Santa Catarina	State	GS, Ll, SC	A,R,S,V	No	No	No
Nuevo Parque Ecológico La Pastora	Urban Park	21 Dec 2011	143.7	Guadalupe	State	SC	A,R,S,V	No	No	Yes

The protected areas in the state range in size from Parque Nacional El Sabinal (8 ha) to Parque Nacional Cumbres de Monterrey (177,396 ha). El Sabinal is the smallest of Mexico's national parks, and is more like an urban park because of its location within the limits of Ciudad Cerralvo (Google Earth; accessed 27 May 2016) in the northeastern portion of the state. The park offers federal protection to a large cluster of cypress trees. Aside from the two national parks, the other protected areas range in size from Cerro del Obispado (an urban park; 18 ha) to Cerro "Picachos" (an ecological conservation area; 75,873 ha).

Protected areas are represented in all of the physiographic regions in Nuevo León, except for the Sierras Transversales, the smallest of the seven regions in the state (Table 17). The number of protected areas in each of the remaining eight regions are as follows: Llanuras de Coahuila y Nuevo León (three); Sierras y Llanuras Coahuilenses (eight); Llanuras y Lomeríos (one); Pliegues Saltillo-Parras (two); Gran Sierra Plegada (nine); and Sierras y Llanuras Occidentales (10). An encouraging fact is that the nine areas in the Gran Sierra Plegada, the region of greatest conservation significance, amount to 188,286 ha, with an additional 677 ha shared with elements of the Llanuras y Lomeríos and Sierras y Llanuras Coahuilenses regions (Table 17). The amount of area (ha) located within the other five regions represented in the system of protected areas is as follows: Llanuras de Coahuila y Nuevo León (1,211); Sierras y Llanuras Coahuilenses (104,482, not including a relatively small portion found within the Parque Lineal Río Santa Catarina, which also overlaps in the Gran Sierra Plegada and Llanuras y Lomeríos regions); Llanuras y Lomeríos (4,225); Pliegues Saltillo-Parras (10,607); and Sierras y Llanuras Occidentales (22,753).

We examined the facilities available in the 32 protected areas (Table 17), and the results demonstrate that of the four categories (administrative services, park guards, systems of pathways, and facilities for visitors), all are present in only four areas (12.5%) —Parque Nacional El Sabinal, Parque Urbano Cerro del Obispado, Parque Urbano Lineal Río Santa Catarina, and Nuevo Parque Ecológico La Pastora. All of these areas are relatively small, ranging in size from 8 to 677 ha. At the other extreme, 26 of the 32 (81.3%) lack all of the facilities we believe are necessary for a well-functioning protected area. Only park guards and systems of pathways are present in the remaining two areas (Table 17).

Crotalus molossus Baird and Girard, 1853. The Black-tailed Rattlesnake occurs from northwestern Arizona and southwestern New Mexico on the west, southward along the Pacific Coastal Plain, Sierra Madre Occidental, and Mexican Plateau to Michoacán, and from Coahuila and Nuevo León on the east, southward along the Sierra Madre Oriental and Mexican Plateau to northwestern Oaxaca (Anderson and Greenbaum, 2012). This individual came from Ejido Acuña, in the municipality of Doctor Arroyo. Wilson et al. (2013a) calculated its EVS as 8, placing it in the upper portion of the low vulnerability category. Its conservation status has been considered as Least Concern by IUCN, and as a species of special protection (Pr) by SEMARNAT. © Elí García-Padilla

Regarding the occupancy of these protected areas by landowners, the good news is that only one is present in this state; the bad news is that it happens to be the largest and most important area in the state, Parque Nacional Cumbres de Monterrey (Table 17). Article 27 of the Mexican Constitution states that "The ownership of land and waters within the boundaries of the national territory is vested originally in the Nation, which has had and has the right to transmit title thereof to private constituting private property," and also that "the nation shall at all times have the right to impose on private property the modalities dictated by the public interest, as well as regular, on social benefit, the use of natural elements of appropriation in order to make an equitable distribution of public wealth and take care of their conservation." Therefore, to make declaration decree for a Natural Protected Area, in any of its forms, the land is not expropriated or acquired, but the owners must abide by established use restrictions in the original decree or the zoning. In many cases, this causes landowners within the ANPs to disregard the restrictions, which prevents or hinders the objectives for which the parks were created.

Generally speaking, management plans are available for most of the protected areas in the state (Table 17). These plans are not available for two of the 32 areas, Parque Nacional El Sabinal and Parque Lineal Río Santa Catarina.

A major deficiency of the protected areas system is that herpetofaunal surveys have been completed for only seven of the 32 areas (Table 17). Fortunately, four of the seven areas are located in the Gran Sierra Plegada; the other three are the Sierras y Llanuras Coahuilenses (one) and the Sierras y Llanuras Occidentales (two).

To determine how well represented the herpetofauna is within the protected areas in which herpetofaunal surveys have been conducted, we assembled the available information for these seven areas (Table 18). The data in this table indicate that 116 species have been recorded from these areas, which is 83.5% of the total of 139 species known from Nuevo León. These 116 species include two of four salamanders (50.0%), 18 of 22 anurans (81.8%), 93 of 106 squamates (87.7%), and three of seven turtles (42.9%). These species are allocated among the distributional categories (Table 7) as follows: non-endemic species—81 of 96 species (84.4%); country endemics—31 of 38 (81.6%); state endemics—1 of 1 (100%); and non-natives—3 of 4 (75.0%).

Table 18. Distribution of herpetofaunal species in Natural Protected Areas of Nuevo León, Mexico based on herpetological surveys. Abbreviations are as follows: * = species endemic to Mexico; ** = species endemic to Nuevo León; and *** = non-native species.

Taxa	Natural Protected Areas						
	Cumbres de Monterrey	Cerro de la Silla	San Juan y Puentes	Picachos	El Potosí	Cerro del Topo	Sierra "Cerro de la Silla"
Anura (18 species)							
Bufonidae (6 species)							
Anaxyrus cognatus	+						
Anaxyrus debilis	+						
Anaxyrus punctatus	+		+	+			
Anaxyrus speciosus	+						
Incilius nebulifer	+	+		+			+
Rhinella horribilis	+	+		+	+		
Craugastoridae (1 species)							
Craugastor augusti	+	+			+		+
Eleutherodactylidae (3 species)							
Eleutherodactylus cystignathoides	+	+		+		+	+
Eleutherodactylus guttilatus	+	+			+		
*Eleutherodactylus longipes**	+	+					+

Hylidae (2 species)							
*Rheohyla miotympanum**	+	+					+
Smilisca baudinii	+	+		+			+
Leptodactylidae (1 species)							
Leptodactylus fragilis	+	+					+
Microhylidae (2 species)							
Gastrophryne olivacea	+						
Hypopachus variolosus	+			+			
Ranidae (1 species)							
Lithobates berlandieri	+			+			
Scaphiopodidae (2 species)							
Scaphiopus couchii	+		+				
Spea multiplicata	+						
Caudata (2 species)							
Plethodontidae (2 species)							
*Aquiloeurycea galeanae**					+		
*Chiropterotriton priscus**	+				+		
Squamata (94 species)							
Anguidae (3 species)							
*Barisia ciliaris**	+				+		
Gerrhonotus infernalis	+	+		+	+		
*Gerrhonotus parvus**	+						
Crotaphytidae (1 species)							
Crotaphytus collaris	+						
Eublepharidae (1 species)							
Coleonyx brevis	+			+			
Gekkonidae (1 species)							
*Hemidactylus turcicus****	+					+	
Phrynosomatidae (21 species)							
Cophosaurus texanus	+		+	+			
*Holbrookia approximans**			+				
Holbrookia lacerata	+						
Phrynosoma cornutum	+	+					
Phrynosoma modestum	+						
*Phrynosoma orbiculare**	+				+		
*Sceloporus cautus**	+				+		
*Sceloporus couchii**	+			+			
Sceloporus cowlesi	+						
*Sceloporus cyanogenys**		+		+		+	+
*Sceloporus goldmani**	+						
Sceloporus grammicus	+	+	+	+	+		+
Sceloporus marmoratus	+	+		+			+

*Sceloporus minor**	+	+			+		+
Sceloporus olivaceus	+	+		+			+
*Sceloporus ornatus**	+						
*Sceloporus parvus**	+			+	+		
Sceloporus poinsetti	+			+			
*Sceloporus samcolemani**	+				+		
*Sceloporus spinosus**	+		+				
*Sceloporus torquatus**	+	+			+		+
Scincidae (3 species)							
*Plestiodon dicei**	+	+		+	+		+
Plestiodon obsoletus	+						
Plestiodon tetragrammus	+			+			
Sphenomorphidae (1 species)							
*Scincella silvicola**	+	+					+
Teiidae (2 species)							
Aspidoscelis gularis	+	+	+	+			+
Aspidoscelis marmorata			+				
Xantusiidae (1 species)							
*Lepidophyma sylvaticum**	+	+					+
Colubridae (30 species)							
Arizona elegans	+						
Bogertophis subocularis	+						
Coluber constrictor	+	+					+
Drymarchon melanurus	+	+		+			+
Drymobius margaritiferus	+	+					+
Ficimia streckeri	+						
Gyalopion canum	+						
Lampropeltis alterna	+	+					+
Lampropeltis annulata	+					+	
*Lampropeltis mexicana**	+						
Lampropeltis splendida	+						
Leptophis mexicanus	+	+					+
Masticophis flagellum	+		+				
Masticophis schotti	+	+	+	+			+
Masticophis taeniatus	+						
Opheodrys aestivus	+	+					+
Oxybelis aeneus	+						
Pantherophis bairdi	+	+		+			+
Pantherophis emoryi	+	+	+	+			+
Pituophis catenifer	+						
*Pituophis deppei**	+		+		+		
Rhinocheilus lecontei	+						

Salvadora grahamiae	+	+	+			+	
Senticolis triaspis	+	+					
Sonora semiannulata	+	+					+
Tantilla atriceps	+	+		+		+	+
Tantilla nigriceps	+						
Tantilla rubra	+	+	+				+
Tantilla wilcoxi	+		+				
*Trimorphodon tau**	+	+		+			+
Dipsadidae (8 species)							
*Adelphicos newmanorum**	+						
Amastridium sapperi	+						
Diadophis punctatus	+						+
Heterodon kennerlyi	+						
Hypsiglena jani	+						
Leptodeira septentrionalis	+	+		+			+
*Rhadinaea montana***	+	+					
Tropidodipsas sartorii	+	+					+
Elapidae (1 species)							
Micrurus tener	+	+					+
Leptotyphlopidae (2 species)							
Rena dulcis	+						
*Rena myopica**	+			+			+
Natricidae (9 species)							
Nerodia erythrogaster	+						
Nerodia rhombifer	+						
Storeria dekayi	+			+			
*Storeria hidalgoensis**	+	+					+
Thamnophis cyrtopsis	+						
Thamnophis eques					+		
*Thamnophis exsul**	+				+		
Thamnophis marcianus	+						
Thamnophis proximus	+						
Typhlopidae (1 species)							
*Indotyphlops braminus****		+					+
Viperidae (8 species)							
*Agkistrodon taylori**	+						
Crotalus atrox	+	+	+			+	+
Crotalus lepidus	+						+
Crotalus molossus	+		+				
*Crotalus morulus**	+	+					
Crotalus pricei	+				+		
Crotalus scutulatus	+						

*Crotalus totonacus**	+	+					+
Testudines (3 species)							
Emydidae (1 species)							
*Trachemys scripta****				+			
Kinosternidae (1 species)							
Kinosternon flavescens	+						
Testudinidae (1 species)							
Gopherus berlandieri	+			+		+	
Totals	**109**	**45**	**17**	**31**	**19**	**8**	**40**

Of the seven protected areas for which herpetofaunal surveys are available, obviously the most important is Parque Nacional Cumbres de Monterrey, because of the 116 species recorded from all seven areas included in Table 18, 109 (94.0%) are documented therein (Table 19). Of these 109 species, 80 are non-endemic species (of 82), 28 are country endemics (of 31), and one is the only state endemic (Table 19). Of significant conservation importance is that this national park lies directly to the southwest of the capital city Monterrey, the largest urban area in Nuevo León. Protection of this park in the face of human population growth in the state is the most outstanding challenge facing conservation professionals in Nuevo León, as well those throughout Mexico.

Although not nearly as important as the PN Cumbres de Monterrey, the other six areas also are of conservation concern, especially three in which a dozen country endemics are found, i.e., Cerro de la Silla, El Potosí, and Sierra "Cerro de la Silla" (Table 19).

Table 19. Summary of the distributional status of herpetofaunal species in protected areas in Nuevo León, Mexico. Totals = total number of species recorded in all of the listed protected areas.

Protected Areas	Number of Species	Distributional Status			
		Non-endemic (NE)	Country Endemic (CE)	State Endemic (SE)	Non-native (NN)
Cumbres de Monterrey	109	79	28	1	1
Cerro de la Silla	45	31	12	1	1
San Juan y Puentes	17	14	3	—	—
Pichachos	31	24	6	—	1
El Potosí	19	7	12	—	—
Cerro del Topo	8	6	1	—	1
Sierra "Cerro de la Silla"	40	27	12	—	1
Totals	**117**	**82**	**31**	**1**	**3**

Given that more than eight of every 10 species found in Nuevo León inhabit one or more of the seven protected areas included in Table 18, 23 species in the state still are not known from any protected area. Below we list the 14 non-endemic species, eight country endemic species, and one non-native species. The non-endemic species are: *Rhinophrynus dorsalis*, *Spea bombifrons*, *Aspidoscelis inornata*, *Crotaphytus reticulatus*, *Sceloporus merriami*, *Uta stansburiana*, *Coniophanes imperialis*, *Crotalus ornatus*, *Rena segrega*, *Sistrurus catenatus*, *Tantilla hobartsmithi*, *Apalone spinifera*, *Pseudemys gorzugi*, and *Trachemys venusta*. The country endemic species are: *Eleutherodactylus verrucipes*, *Ambystoma velasci*, *Chiropterotriton miquihuanus*, *Gerrhonotus lugoi*, *Sceloporus chaneyi*, *Sceloporus cyanostictus*, *Crotalus morulus*, *Thamnophis pulchrilatus*, and *Kinosternon integrum*. The single non-native species is *Lithobates catesbeianus*, which is desirous to exclude from the natural protected areas. Demonstrating the presence of the 14 non-endemic and eight country endemic species in one or more of the protected areas in Nuevo León is one of the major conservation objectives in the state.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

A. The Nuevo León herpetofauna presently consists of 139 species, including 22 anurans, four salamanders, 106 squamates, and seven turtles. The total comprises 11.0% of the 1,275 species currently known from Mexico (J. Johnson, unpublished).

B. The number of herpetofaunal species among the seven physiographic regions recognized in Nuevo León ranges from 20 in the Sierras Transversales to 87 in the Gran Sierra Plegada.

C. The species shared between physiographic regions range from 13 between the Sierras Transversales and the Llanuras de Coahuila y Nuevo León, Llanuras y Lomeríos, and Gran Sierra Plegada, to 45 between the Sierras y Llanuras Coahuilenses and Gran Sierra Plegada regions. The CBR values range from 0.24 between the Gran Sierra Plegada and Sierras Transversales regions and 0.77 between the Llanuras de Coahuila y Nuevo León and Llanuras y Lomeríos regions. The UPGMA analysis demonstrates that the herpetofaunal resemblance among the regions is divided into two clusters. One cluster is between the Sierras Transversales and Sierras y Llanuras Occidentales (.66 resemblance score), which are adjacent to one another, are primarily mountainous, and contain mostly xeric vegetation. The other cluster of five interconnected regions (Llanuras de Coahuila y Nuevo León, Llanuras y Lomeríos, Sierras y Lanuras Coahuilenses, Pliegues Saltillo-Parras, and Gran Sierra Plegada) contain highland and lowland sections consisting of similar plant assemblages, including more mesic types. The most distinctive herpetofauna is in the Gran Sierra Plegada, as indicated by moderately low herpetofaunal resemblance scores among the five regions (average of .41).

D. A moderately high level of herpetofaunal endemism is found in Nuevo León. Of the 139 species known from the state, the distribution of 40 (28.8%) is restricted to Mexico. The distribution of only one of these endemic species, however, is restricted to Nuevo León. Although a significant proportion of the species in Nuevo León also occur in the United States (90 of 139 [64.7%]), the proportion of endemism still is much higher than that in Chiapas (17.6%), a state inhabited by a large number of species shared with neighboring Guatemala and other areas of Central America. Still, the percentage of endemism for Nuevo León (28.8%) is less than one-half of that for all of Mexico (60.5%; 767/1,268), because of the proportion of species shared with the United States.

Crotalus morulus Klauber, 1952. The Tamaulipan Rock Rattlesnake is a Mexican endemic occurring in "the Sierra Madre Oriental in southwestern Tamaulipas, central Nuevo León, and southeastern Coahuila" (Campbell and Lamar, 2004: 558). This individual was found at Cerro de la Silla, in the municipality of Monterrey. Wilson et al. (2013a) calculated its EVS as 16, placing it in the middle portion of the medium vulnerability category. Its conservation status has not been evaluated by IUCN, and this species is not listed by SEMARNAT.

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Crotalus pricei Van Denburgh, 1895. The Twin-spotted Rattlesnake is found from "southeastern Arizona, in the United States, southward in Mexico through the Sierra Madre Occidental in Sonora, Chihuahua, and Durango, and in the Sierra Madre Oriental, in Coahuila, Nuevo León, and Tamaulipas, with isolated populations in San Luis Potosí and Aguascalientes" (Lemos-Espinal and Dixon, 2013: 254). This individual was encountered at Ejido Corona del Rosal, in the municipality of Galeana. Wilson et al. (2013a) calculated its EVS as 14, placing it at the lower limit of the high vulnerability category. Its conservation status has been considered as Least Concern by IUCN, and as a species of special protection (Pr) by SEMARNAT. © Manuel Nevárez-de los Reyes

E. The distributional status of members of the Nuevo León herpetofauna is as follows (in order of the size of the categories): non-endemic species (95; 68.3% of 139 species); country endemics (39; 28.1%); state endemics (1; 0.7%); and non-natives (four; 2.9%).

F. The principal environmental threats in Nuevo León include urban development, industrial pollution, farming and ranching, road effects, mining and energy projects, outright killing, pesticide use, and collecting and commercial trade.

G. We used the SEMARNAT, IUCN, and EVS systems to assess the conservation status of the members of the Nuevo León herpetofauna. We found the SEMARNAT system to be of limited value, because only 34.8% of the native members of the herpetofauna have been evaluated. Otherwise, no species are placed in the endangered category (P), 24 in the threatened category (A), and 23 in the special protection category (Pr).

H. The IUCN system is widely used, but has been criticized for a number of reasons in several papers dealing with portions of the Mesoamerican herpetofauna (Alvarado-Díaz et al., 2013; Wilson et al., 2013a, b; Mata-Silva et al., 2015; Johnson et al., 2015a, b). Johnson et al. (2015a: 324) summarized these reasons as follows: "(1) irrespective of the area in Mesoamerica examined, a sizable portion of the species involved have not been evaluated (we placed them in the NE category); (2) because the species are too poorly known to be placed into one of the fully-assessed categories, a considerable portion are allocated to the DD category; and (3) because the largest group of species is placed in the LC category, which generally includes a sizable number of species we believe should be placed in one of the three threat categories or the NT category." With reference to the herpetofauna of Nuevo León, the category, number, and percentage of the 135 native species are as follows: EN (five, 3.7%); VU (five, 3.0%); NT (six, 4.4%); LC (100, 74.1%); and NE (19, 14.1%). No species have been allocated to the CR or DD categories.

I. Wilson et al. (2013a, b) demonstrated that the EVS system for evaluating conservation status addresses the deficiencies of the SEMARNAT and IUCN systems. Once we ascertained the EVS scores for members of the Nuevo León herpetofauna and divided them into low, medium, and high categories of vulnerability, the number of species in these categories increased from low (42; 31.1% of 135 species for which EVS scores can be calculated) to medium (54; 40.0%), and decreased to high (39; 28.9%). As concluded by Johnson et al. (2015a: 325), we also conclude that, in the case of Nuevo León, these sorts of activities should be undertaken as quickly as possible, given the rate that humans are transforming natural habitats.

J. A comparison of the IUCN and EVS categorizations demonstrates that only 26.3% of the high vulnerability species are placed in the IUCN threat categories, and that about 2.4 times the number of low vulnerability species has been allocated to the LC category. As previously documented, these two systems of conservation evaluation do not agree well with one another.

K. An evaluation of the species placed in the NE, and LC categories by IUCN compared to their respective EVS values indicates that many species in Nuevo León are incorrectly placed within the IUCN categories and should be re-assigned to more correctly assess their prospects for survival.

L. We employed the Relative Herpetofaunal Priority (RHP) measure to determine the conservation significance of the seven regional herpetofaunas in Nuevo León. One method of determining the RHP involves adding the country and state endemics, and by using this method we found the conservation importance of the regional herpetofaunas to be greatest for the Gran Sierra Plegada, next greatest for the Sierra y Llanuras Occidentales and the Sierras y Llanuras Coahuilenses, the Pliegues Saltillo-Parras, the Llanuras y Lomeríos, the Sierras Transversales, and finally the Llanuras de Coahuila y Nuevo León. The other method of calculating the RHP is based on the number of high vulnerability species, and by utilizing this method we found the following ranking, from high to low: Gran Sierra Plegada, Sierra y Llanuras Coahuilenses, Pliegues Saltillo-Parras, Sierras y Llanuras Occidentales, Llanuras de Coahuila y Nuevo León, Llanuras y Lomeríos, and Sierras Transversales.

Sistrurus catenatus (Rafinesque, 1818). The Massasauga is found "from southeastern Arizona, southern New Mexico, and most of Texas northeastward to central New York and southern Ontario, Canada; several isolated population occur in Mexico" (Campbell and Lamar, 2004: 611). The isolated populations in Mexico are reported from the states of Coahuila, Nuevo León, and Tamaulipas (Lemos-Espinal, 2015). This individual was encountered near La Escondida, in the municipality of Aramberri. Wilson et al. (2013a) determined its EVS as 13, placing it at the upper limit of the medium vulnerability category. Its conservation status has been assessed as Least Concern by IUCN, and as a species of special protection (Pr) by SEMARNAT. © Robert W. Hansen

Pseudemys gorzugi Ward, 1984. The Western River Cooter occurs "along the Rio Grande and adjacent parts of its tributaries downstream from the lower parts of the Pecos and Devil's rivers" (Lemos-Espinal et al., 2015: 121). These individuals were photographed in the Cañón de Bustamante, in the municipality of Bustamante. Wilson et al. (2013a) calculated its EVS as 16, placing it in the middle portion of the high vulnerability category. Its conservation status has been considered as Near Threatened by IUCN, and as a threatened species (A) by SEMARNAT. © Manuel Nevárez-de los Reyes

M. We constructed a list of 32 protected areas in Nuevo León along with a set of their pertinent characteristics, which indicates, among other aspects, that only three are under federal jurisdiction; the remaining areas are under state jurisdiction. Although management plans are available for all but two of these areas, herpetofaunal surveys have been at least partially completed for only seven of the areas.

N. Even though herpetofaunal lists are available for only seven protected areas, collectively they harbor 116 of the 139 species known from the state. Fortunately, one of these survey areas is Parque Nacional Cumbres de Monterrey, from where 109 of these 116 species have been recorded, including 79 non-endemics, 28 country endemics, one state endemic, and one non-native species.

O. Given that 116 species are known from the seven protected areas we surveyed, 23 species still are not represented from any such area. Thus, herpetofaunal surveys need to be continued in order to identify the protected areas in which these species occur, which include 14 non-endemic and eight country endemic species. One non-native species, on the other hand, is not known from any protected area in Nuevo León.

Recommendations

A. We demonstrated that efforts to conserve the Nuevo León herpetofauna are benefitted by the more than 80% representation of the 139 species within several protected areas in the state. Most of these 116 species are recorded from Parque Nacional Cumbres de Monterrey, i.e., 109 species; the remainder are scattered among a few of the other protected areas where herpetofaunal surveys have been conducted. Such documentation is an important first step toward providing continued protection for the Nuevo León herpetofauna. The next step would be to establish continued monitoring efforts to determine the population stability of the constituent species in these areas, and to expand efforts to conduct surveys in additional areas. Such efforts are critical, inasmuch as the most important

protected area in the state, Parque Nacional Cumbres de Monterrey, lies in an area that is 99% in private hands. Nonetheless, Mexican law stipulates that all the national territory belongs to the government and that permission for private use can be given under specified restrictions. With the lands located within PN Cumbres de Monterrey, private individuals are obligated to use these lands in ways stipulated by measures in the park declaration acts (both at the state and federal levels), with the goal of protecting the flora and fauna. This reality, however, does not preclude the need for continued monitoring of the park's known herpetofauna, as recommended by Narváez-Torres and Lazcano-Villarreal (2013), inasmuch as the use restrictions often are violated.

B. Another threat to the herpetofauna of PN Cumbres de Monterrey is the continued expansion of the Monterrey metropolitan area, which lies next to the eastern border of the park. In 2010, the population of this metropolitan area was 4,080,329, which comprised 87.7% of the entire population of the state (4,653,458); this metropolitan area is the third largest in the country (www.wikipedia.org; accessed 19 August 2016). Population growth in this metropolitan area constitutes the gravest threat to the local herpetofauna now and in the future, and provides the most significant reason for the continued monitoring of herpetofaunal populations in PN Cumbres de Monterrey.

C. Another recommendation to protect the herpetofauna of Nuevo León is to determine the protected areas that contain populations of the 23 species that currently are not known from any protected area, and to include them in the appropriate monitoring programs. More fieldwork is necessary, especially in the northern portion of the state, where species recorded in Texas might be found. The impact of roadkills on herpetofaunal populations throughout the state also should be given more attention.

D. Ultimately, efforts to safeguard the herpetofauna of Nuevo León will depend upon the allocation of sufficient funds to upgrade the facilities in the state's protected areas, so that the flora and fauna within them actually can be protected.

Ozone depletion, lack of water, and pollution are not the disease—they are the symptons*. The* disease *is overpopulation.* Bertrand Zobrist, fictional character

—Dan Brown (2013)

Gopherus berlandieri (Agassiz, 1857). The Texas Tortoise is found from "southern Texas and eastern Coahuila southward east of the Sierra Madre Oriental through much of Nuevo León and Tamaulipas to extreme northern Veracruz" (Lemos-Espinal et al., 2015: 143). This individual was encountered at Rancho La Boca, on the border of the municipalities of Bustamante and Mina. Wilson et al. (2013a) calculated its EVS as 18, placing it in the upper portion of the high vulnerability category. Its conservation status has been considered as Least Concern by IUCN, and as a threatened species (A) by SEMARNAT. © Manuel Nevárez-de los Reyes

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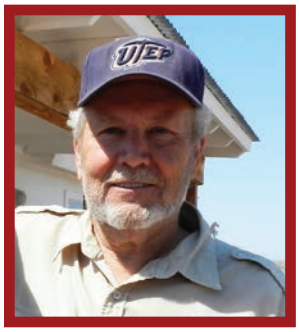
Manuel Nevárez-de los Reyes is a biologist who graduated from the Universidad Autónoma de Nuevo León in San Nicolás de los Garza, Mexico. His initial interest was in the study of amphibians and reptiles, but his professional life led him to investigate other areas, such as environmental impact and the study of cacti. From 1997 to 2007 he served as head of Environmental Protection in the Residencia Regional de Construcción Noreste of the Federal Electricity Commission. Manuel has been involved with numerous workshops and conferences, and has authored both popular science and peer-reviewed articles on herpetology and cacti. Among his accomplishments, he discovered a new genus and species of cactus, *Digitostigma caput-medusae*, and in 2002 co-authored its original description. The following year he created "Proyecto Digitostigma," a nursery dedicated to the commercial propagation of this and other cacti species, which contributes to their knowledge and conservation. Manuel currently is pursuing a Ph.D. in Wildlife Management and Sustainable Development at the Universidad Autónoma de Nuevo León, with a thesis entitled "Ecological distribution of the herpetofauna of the Sierra de Gomas in northern Nuevo León," under a grant from the National Council of Science and Technology.

David Lazcano is a herpetologist who earned a Bachelor's degree in Chemical Science in 1980, and a Bachelor's degree in Biology in 1982. In 1999 he earned a Master's degree in Wildlife Management, and later a Ph.D. in biological sciences with a specialty in Wildlife Management (2005), all gained from the Facultad de Ciencias Biológicas of the Universidad Autónoma de Nuevo León. Currently, he is a full-time professor at the same institution where he teaches courses in Animal Ethology, Biogeography, Biology of Chordates, and Wildlife Management. He also is the head of Laboratorio de Herpetología and Coordinación de Intercambio Académico de la Facultad de Ciencias Biológicas at UANL. Since 1979, he has been a teaching and providing assistance in both undergraduate and graduate programs. His research interests include studying the herpetofaunal diversity of northeastern Mexico, as well as the ecology, biogeography, and captive maintenance techniques of montane herpetofauna.

Elí García-Padilla is a herpetologist primarily focused on studying the ecology and natural history of the Mexican herpetofauna. His research efforts have centered on the Mexican states of Baja California, Tamaulipas, Chiapas, and Oaxaca. His first experience in the field was researching the ecology of the insular endemic populations of the rattlesnakes *Crotalus catalinensis*, *C. pyrrhus*, and *C. tortugensis* in the Gulf of California. For his Bachelor's degree he presented a thesis on the ecology of *Crotalus muertensis* on Isla El Muerto, Baja California, Mexico. To date, he has authored or co-authored 60 peer-reviewed scientific publications. Currently, he is employed as a formal Curator of Reptiles from Mexico in the electronic platform "Naturalista" of the Comisión Nacional para el Uso y Conocimiento de la Biodiversidad (CONABIO; www.naturalista.mx). One of his main passions is environmental education, and for several years he has been working on a variety of projects that include the use of audiovisual media as a powerful tool to reach large audiences and to promote the importance of the knowledge, protection, and conservation of the Mexican biodiversity. Elí's interests include wildlife and conservation photography, and his art has been published in several recognized scientific, artistic, and educational books, magazines, and websites.

Vicente Mata-Silva is a herpetologist from Río Grande, Oaxaca, Mexico. His interests include ecology, conservation, natural history, and geographic distribution of the herpetofaunas of Mexico (particularly Oaxaca) and the southwestern United States. His Bachelor's thesis at the Universidad Nacional Autónoma de México (UNAM) compared herpetofaunal richness in Puebla, Mexico, in habitats with different degrees of human-related disturbance. Vicente's Master's thesis at the University of Texas at El Paso (UTEP) focused primarily on the diet of two syntopic whiptail lizard species, one unisexual and the other bisexual, in the Trans-Pecos region of the Chihuahuan Desert. His dissertation, also at UTEP, was on the ecology of the rock rattlesnake, *Crotalus lepidus*, in the northern Chihuahuan Desert. To date, Vicente has authored or co-authored over 90 peer-reviewed scientific publications. Currently, he is a researcher and lecturer at the University of Texas at El Paso. He also is the Distribution Notes Section Editor for the journal *Mesoamerican Herpetology*.



Jerry D. Johnson is Professor of Biological Sciences at The University of Texas at El Paso, and has extensive experience studying the herpetofauna of Mesoamerica, especially that of southern Mexico. Jerry is the Director of the 40,000-acre "Indio Mountains Research Station," and was a co-editor on *Conservation of Mesoamerican Amphibians and Reptiles* and co-author of four of its chapters. He is also the senior author of the recent paper "A conservation reassessment of the Central American herpetofauna based on the EVS measure" and is Mesoamerica/Caribbean editor for Geographic Distribution section of *Herpetological Review*. Johnson has authored or co-authored over 100 peer-reviewed papers, including two 2010 articles, "Geographic distribution and conservation of the herpetofauna of southeastern Mexico" and "Distributional patterns of the herpetofauna of Mesoamerica, a Biodiversity Hotspot." One species, *Tantilla johnsoni*, has been named in his honor. Presently, he is an Associate Editor and Co-chair of the Taxonomic Board for the journal *Mesoamerican Herpetology*.

Larry David Wilson is a herpetologist with lengthy experience in Mesoamerica. He has authored or co-authored over 340 peer-reviewed papers and books on herpetology, including two papers published in 2013 entitled "A conservation reassessment of the amphibians of Mexico based on the EVS measure" and "A conservation reassessment of the reptiles of Mexico based on the EVS measure," one in 2014 entitled "Snakes of the genus *Tantilla* (Squamata: Colubridae) in Mexico: taxonomy, distribution, and conservation," four in 2015 entitled "A conservation reassessment of the Central American herpetofauna based on the EVS measure," "The herpetofauna of Oaxaca, Mexico: composition, physiographic distribution, and conservation status," "The herpetofauna of Chiapas, Mexico: composition, distribution, and conservation," and "A checklist and key to the snakes of the *Tantilla* clade (Squamata: Colubridae), with comments on taxonomy, distribution, and conservation," and one in 2016 entitled "The herpetofauna of Tamaulipas: composition, distribution, and conservation." Larry is the senior editor of *Conservation of Mesoamerican Amphibians and Reptiles* and the co-author of seven of its chapters. His other books include *The Snakes of Honduras*, *Middle American Herpetology*, *The Amphibians of Honduras*, *Amphibians & Reptiles of the Bay Islands and Cayos Cochinos, Honduras*, *The Amphibians and Reptiles of the Honduran Mosquitia*, and *Guide to the Amphibians & Reptiles of Cusuco National Park, Honduras*. To date, he has authored or co-authored the descriptions of 70 currently recognized herpetofaunal species, and seven species have been named in his honor, including the anuran *Craugastor lauraster*, the lizard *Norops wilsoni*, and the snakes *Oxybelis wilsoni*, *Myriopholis wilsoni*, and *Cerrophidion wilsoni*. Currently, Larry is an Associate Editor and Co-chair of the Taxonomic Board for the journal *Mesoamerican Herpetology*.