Introductory page. *Pantherophis bairdi* (Yarrow, 1880). The distribution of Baird's Ratsnake extends from "the Edwards Plateau and Big Bend region in southwestern Texas southward through central Coahuila and Nuevo León to the Sierra Madre Oriental of southern Tamaulipas" (Heimes, 2016: 122); this species also occurs in southeastern Chihuahua. This individual was photographed in scrub vegetation at Sierra Rica, a Natural Protected Area in the municipality of Manuel Benavides, Chihuahua. Wilson et al. (2013a) determined its EVS as 15, placing it in the lower portion of the high vulnerability category. The IUCN has considered its conservation status as Least Concern, but this species is not listed by SEMARNAT. *Photo by Sara G. Sáenz-González*.

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The herpetofauna of Chihuahua, Mexico: composition, distribution, and conservation status

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Abstract.—The herpetofauna of the Mexican state of Chihuahua presently consists of 186 species, including 35 anurans, five salamanders, 133 squamates, and 13 turtles. The members of the herpetofauna are distributed among nine physiographic regions, ranging from 58 species in the Sierras y Llanuras de Durango to 128 in the Gran Meseta y Cañones Chihuahuenses. The number of species shared between the areas ranges from 14 to 70. The Coefficient of Biogeographic Resemblance values range from 0.23 to 0.83. A UPGMA dendrogram indicates that the closest relationships among the nine physiographic regions are those adjacent to one another, in a series of swaths of two to three regions generally oriented in a northwestern to southeastern direction from the southwestern to the northeastern sectors of the state. The level of endemism in Chihuahua is relatively limited and consists of 61 country endemics and one state endemic species. The distributional categorization of the entire herpetofauna consists of 61 country endemics, one state endemic, 121 non-endemics, and three non-native species. We placed the 121 non-endemic species in the following distributional categories: MXUS (108), USCA (six), MXCA (three), MXSA (three), and USSA (one). The principal environmental threats to the herpetofauna of Chihuahua are land conversion and habitat loss, water management (quality and quantity), invasive species, climate change, fires, illegal trade, diseases and parasites, on and off-road activities, mining, pollution, human consumption, animal grazing and agriculture, fear and confusion by people, and miscellaneous threats. We evaluated the conservation status of each native species by using the SEMARNAT, IUCN, and EVS systems, of which the EVS proved to be the most useful. We used the Relative Herpetofaunal Priority method to rank the physiographic regions and found that the Gran Meseta y Cañones Chihuahuenses is of the greatest importance. Finally, we provide a set of conclusions and recommendations to help improve the future protection of the herpetofauna of Chihuahua.

Keywords. Anurans, caudates, conservation status, physiographic regions, protected areas, protection recommendations, squamates, turtles

Resumen.—La herpetofauna del estado mexicano de Chihuahua actualmente consiste de 186 especies, que incluye 35 anuros, cinco salamandras, 133 escamados y 13 tortugas. Los miembros de la herpetofauna se distribuyen en nueve regiones fisiográficas, desde 58 especies en las Sierras y Llanuras de Durango hasta 128 en la Gran Meseta y Cañones Chihuahuenses. El número de especies compartidas entre las áreas oscila entre 14 y 70. Los valores del Coeficiente de Semejanza Biogeográfica oscilan entre 0,23 y 0,83. Un dendrograma de la UPGMA indica que las relaciones más cercanas entre las nueve regiones fisiográficas son aquellas que son adyacentes, en una serie de franjas de dos a tres regiones generalmente orientadas en dirección noroeste a sureste, desde el sector suroeste al noreste del estado. El nivel de endemismo en Chihuahua es relativamente limitado y consiste de 61 especies endémicas a nivel nacional y una especie endémica a nivel estado. La categorización distribucional de toda la herpetofauna consiste de 61 especies endémicas en el país, una endémica al estado, 121 no endémicas y tres especies no nativas. Colocamos las 121 especies no endémicas en las siguientes categorías de distribución: MXUS (108), USCA (seis), MXCA (tres), MXSA (tres) y USSA (una). Las principales amenazas ambientales a la herpetofauna de chihuahua son: Conversión de suelo y pérdida de hábitat; gestión del agua (calidad y cantidad); especies invasoras; cambio climático; incendios; comercio ilegal; enfermedades y parásitos; actividades dentro y fuera de la carretera; minería; contaminación; consumo humano; pastoreo de animales y agricultura; miedo y confusión por parte de la gente; y amenazas diversas. Evaluamos el estado de conservación de cada especie nativa utilizando los sistemas de SEMARNAT, UICN y EVS, de los cuales el EVS resultó ser el más útil. Utilizamos el método de Prioridad Relativa Herpetofaunística para determinar la región fisiográfica de mayor importancia, es decir, la Gran Meseta y Cañones Chihuahuenses. Finalmente, brindamos un conjunto de conclusiones y

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recomendaciones para ayudar a mejorar la protección futura de la herpetofauna de Chihuahua.

Palabras Claves. Anuros, áreas protegidas, caudados, escamosos, estatus de conservación, recomendaciones de protección, regiones fisiográficas, tortugas

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"I've been buried in life. My own, of course, but much of my life's work has focused on the lives of animals, plants, and microbes and their evolution and behavior. It has included the evolution and behavior that shapes the individual lives of my favorite mammal, Homo sapiens. My life also has entailed efforts to influence society to move rapidly in the direction of improving all life, and lives, by limiting human population growth, increasing racial, gender, and economic equity, and conserving our environmental life-support systems abundantly supplied with nonhuman lives. A vision for a better and more sustainable life for all people living on the one-and-only habitable planet in our solar system has arisen naturally from my lifelong studies of butterflies and my distress at the loss of their natural habitats."

Preface in Life: *A Journey through Science and Politics* by Paul R. Ehrlich (2023)

Introduction

Chihuahua is the largest of the 32 federal entities in Mexico (31 states + Mexico City), and with an area of 247,412.6 km^2, which represents 12.6% of the country's surface. Sonora, Chihuahua's neighbor to the west, is the second largest state in the country, with a surface area of 179,354.7 km^2 (9.1% of the country's surface) and Coahuila, its neighbor to the east, is the third largest with an area of 151,594.8 km^2, representing 7.7% of the country's surface (INEGI 2021a). Chihuahua is one of six Mexican states that borders the United States of America (USA), as it is bordered by portions of New Mexico and Texas (Rand McNally 1998).

To the north, the state of Chihuahua is bordered by the USA, to the east by Coahuila de Zaragoza, to the south by Durango, to the southwest by Sinaloa, and to the west by Sonora. In 2020, the total population of Chihuahua was 3,741,869, which represented 3.0% of the national population (INEGI 2022).

The states with the lowest density of inhabitants/km^2 in Mexico are Chihuahua, Durango, and Baja California Sur. Chihuahua has a density of 15.1 inhabitants/km^2, and ranks 30th, after Durango (14.9 inhabitants/km^2) and Baja California Sur (10.8 inhabitants/km^2). The low human population density of Chihuahua likely is due to the location of the Chihuahuan Desert and the highlands of the Sierra Madre Occidental (see Addendum).

According to INEGI (2021b), Chihuahua includes four terrestrial ecoregions of Mexico: North American deserts (45.8%), temperate sierras (28.2%), southern semi-arid elevations (23.4%), and hot dry tropical forest (2.6%). The biophysical characteristics in the state of Chihuahua provide adequate conditions for biodiversity at the ecosystem, species, and genetic levels (Reyes-Gomez and Valero-Padilla 2014). The development and maintenance of a biodiversity information system for Chihuahua is conducted by the organizations that manage scientific knowledge and information (CONABIO and SEDUE, Gobierno de Chihuahua 2015).

The objectives of this paper are to update the list of amphibians and reptiles of Chihuahua, to discuss their distribution by physiographic subprovince, to identify the environmental threats impinging on them, and to document their conservation status, as we have done for the other entries in the Mexican Conservation Series, as discussed below.

Materials and Methods

Our Taxonomic Position

In this paper, we follow the same taxonomic position as explained in previous works on other portions of Mesoamerica (Johnson et al. 2015a,b; Mata-Silva et al. 2015; Terán-Juárez et al. 2016; Woolrich-Piña et al. 2016; Nevárez-de los Reyes et al. 2016; Cruz-Sáenz et al. 2017; Gonzalez-Sánchez et al. 2017; Woolrich-Piña et al. 2017; Lazcano et al. 2019; Ramírez-Bautista et al. 2020; Torres-Hernández et al. 2021; Cruz Elizalde et al. 2022; Barragán-Vázquez et al., 2022; Leyte-Manrique et al., 2022; Peralta-García et al., 2023). Johnson et al. (2015a) can be consulted for a statement of this position, with special reference to the subspecies concept. In addition, we adopted the recent change in the family name for the anoline lizards promulgated by De Queiroz (2022, 2023), i.e., from Dactyloidae to Anolidae.

System for Determining Distributional Status

We used the system developed by Alvarado-Díaz et al. (2013) for the herpetofauna of Michoacán to ascertain the distributional status of members of the herpetofauna of Chihuahua. Subsequently, Mata-Silva et al. (2015), Johnson et al. (2015a), Terán-Juárez et al. (2016), Woolrich-Piña et al. (2016), Nevárez-de los Reyes et al. (2016), Cruz-Sánchez et al. (2017), González-Sánchez et al. (2017), Woolrich-Piña et al. (2017), Lazcano et al. (2019), Ramírez-Bautista et al. (2020), Torres-Hernández et al. (2021), Cruz Elizalde et al. (2022), Barragán-Vázquez et al. (2022), Leyte-Manrique et al. (2022), and Peralta-García et al. (2023), also used this system, which consists of the following four categories: SE = endemic to Chihuahua; CE = endemic to Mexico; NE = not endemic to Mexico; and NN = non-native in Mexico.

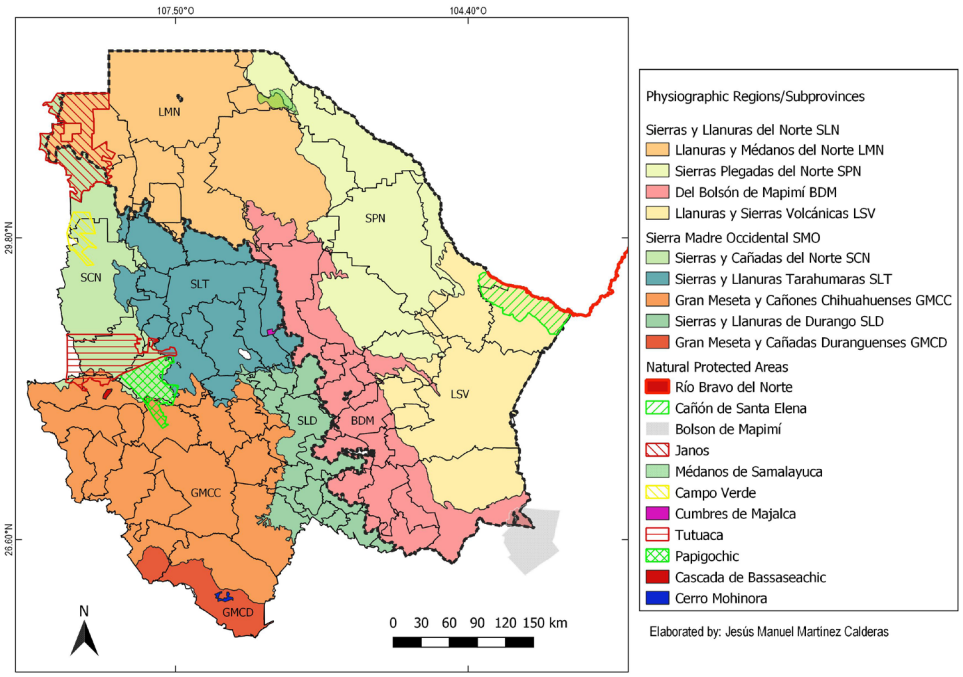


Fig. 1. Physiographic regions and Natural Protected Areas (NPAs) in the state of Chihuahua, Mexico. The northwest to southeast oriented solid black line separates the subprovinces of the Sierra Madre Oriental from those of the Sierras y Llanuras del Norte.

Systems for Determining Conservation Status

To evaluate the conservation status of the herpetofauna of Chihuahua, we employed the three systems (i.e., SEMARNAT, IUCN, and EVS) used by Alvarado-Díaz et al. (2013), Mata-Silva et al. (2015), Johnson et al. (2015a), Terán-Juárez et al. (2016), Woolrich-Piña et al. (2016), Nevárez-de los Reyes et al. (2016), Cruz-Sánchez et al. (2017), González-Sánchez et al. (2017), Woolrich-Piña et al. (2017), Lazcano et al. (2019), Ramírez-Bautista et al. (2020), Torres-Hernández et al. (2021), Cruz Elizalde et al. (2022), Barragán-Vázquez et al. (2022), Leyte-Manrique et al. (2022), and Peralta-García et al. (2023). Detailed descriptions of these three systems appear in earlier papers in this series and are not repeated here.

The Mexican Conservation Series

The Mexican Conservation Series (MCS) began in 2013 with a study of the herpetofauna of Michoacán (Alvarado-Díaz et al. 2013), as part of a set of five papers designated as the "Special Mexico Issue" published in *Amphibian & Reptile Conservation*. The basic format of the entries in the MCS was established in that paper, i.e., to examine the composition, physiographic distribution, and conservation status of the herpetofauna of a given Mexican state or group of states. Two years later, the MCS resumed with a paper on the herpetofauna of Oaxaca (Mata-Silva et al. 2015), and that year Johnson et al. (2015a) authored a paper on the herpetofauna of Chiapas. Three entries in the MCS appeared the following year, on Tamaulipas (Terán-Juárez et al. 2016), Nayarit (Woolrich-Piña et al. 2016), and Nuevo León (Nevárez-de los Reyes et al. 2016). Three more entries, on Jalisco (Cruz-Sáenz et al. 2017), the Mexican Yucatan Peninsula (González-Sánchez et al. 2017), and Puebla (Woolrich-Piña et al. 2017) were published in 2017. These entries were followed by one on Coahuila (Lazcano et al. 2019) and another on Hidalgo (Ramírez-Bautista et al. 2020). In the ensuing two years, papers on Veracruz (Torres-Hernández et al. 2021), Querétaro (Cruz-Elizalde et al. 2022), Tabasco (Barragán-Vázquez et al. 2022), Guanajuato (Leyte-Manrique et al. 2022), and finally Baja California Peninsula (García-Peralta et al. 2023) were published. Thus, this paper on the herpetofauna of Chihuahua is the 17th (and final) entry in this series.

Physiography and Climate

Physiographic Regions

Two of the 15 physiographic provinces in Mexico are present in Chihuahua (INEGI 2021b), the Sierra Madre Occidental (SMO), with five subprovinces, and the Sierra y Llanuras del Norte (SLN), with four subprovinces (Fig. 1). Below we describe the physiography of the provinces and subprovinces for Chihuahua, according to INEGI (1999, 2003), as well as their vegetation.

Sierra Madre Occidental (SMO) Province and its five subprovinces

This province (Fig. 1) begins with only a tiny portion on the border with the USA, and it extends southeastward to end in the vicinity of the "Eje Neovolcánico" province, located south of the state of Chihuahua. The SMO is the longest mountain system in Mexico, with average elevations ranging from 2,000 to 2,500 m (Rzedowski 2006), although in Chihuahua they reach up to 3,300 m. This province covers 43.4% of the state's surface area and includes five subprovinces: Sierras y Cañadas del

Fig. 2. Sierras y Cañadas del Norte (SCN). Near the entrance of Cueva de la Olla, showing Parry's Agave (*Agave parryi*) and pine trees, Casas Grandes, Chihuahua. *Photo by Ana Gatica-Colima*.

Fig. 3. Sierras y Llanuras Tarahumaras (SLT). Cumbres de Majalca National Park, "Cañón de la Gringa," Chihuahua. Note the volcanic and volcanoclastic rocks within the pine-oak vegetation. *Photo by Ramón I. Miramontes-Cinco*.

Norte (SCN), Sierras y Llanuras Tarahumaras (SLT), Sierras y Llanuras de Durango (SLD), Gran Meseta y Cañones Chihuahuenses (GMCC), and Gran Meseta y Cañadas Duranguenses (GMCD). This region includes dry and semi-dry to temperate and semi-cold climates in the highest areas (INEGI 2003).

Sierras y Cañadas del Norte (SCN). According to INEGI (1999), the dominant topoform in this subprovince consists of high elevation sierras such as the Sierra San Luis (900–2,500 m). Some of the municipalities in this subprovince are Madera, Casas Grandes, Guerrero, and Temosachi. This region consists of a sierra with steep slopes, which physiographically is classified as a high sierra with ravines (Fig. 2). To the west it reaches elevations of 1,000 m, but to the east the elevations are higher than 2,000 m, with a maximum of 2,700 m. The terrain is characterized by acidic volcanic rock with large basaltic layers present on the San Luis, Hachita Hueca, and La Breña mountains, among others. Located in the northwest of the SMO province, it occupies 7.3% of the state's surface. This subprovince is drained by several streams, including the Sirupa, Tutuaca, and Rio Chico, which are tributaries of the Aros River; the Chuhuichupa, a tributary of the Bavispe River; and the San Pedro and Piedras Verdes rivers (INEGI 2003).

The principal vegetation in the communities of this subprovince consists of *Pinus engelmannii*, *P. durangensis*, *P. arizonica*, *Abies religiosa*, *Pseudotsuga menziessi*, *Quercus sideroxyla*, *Q. arizonica*, and *Q. rugosa*. To a lesser degree, elements of chaparral, grassland, and low deciduous forest, as well as agricultural areas, occur in this region (Alva-Álvarez et al. 2018).

Sierras y Llanuras Tarahumaras (SLT). Located in the west-central portion of Chihuahua (Fig. 3), this subprovince is characterized by high and low elevation topoforms that are structurally oriented in a northwest to southeast direction. The subprovince is highly modified in its relief, as hills that are associated with ravines ("cañadas") and slopes ("bajadas") have formed in lower topographic areas where valleys and plains are the dominant topoforms, such as in the extensive

Fig. 4. Sierras y Llanuras de Durango (SLD). Rancho La Catorce, Santa Bárbara, Chihuahua. Pictured here are Oak Trees (*Quercus* sp.) and Agave sp. *Photo by Laura I. Heredia-González*.

Cuauhtémoc valley. The plains along the edges of this valley are associated with soft hills, and occasionally with plateaus. Historically, the geologic evolution in this area has allowed for the development of an endorheic basin within the normal northwest to southeast fault pattern. Flooding is common in these areas, such as in the Bustillos and Los Mexicanos lagoons, of which the latter is the most significant (INEGI 1999).

According to INEGI (2003), this subprovince is located entirely within the state and covers 10.5% of the state's surface area, and it includes the following municipalities: Bachíniva, Namiquipa, Riva Palacio, Cuauhtémoc, and portions of Buenaventura, Carichí, Cusihuiriachi, Chihuahua, Galeana, Santa Isabel, Gómez Farías, Gran Morelos, Guerrero, Ignacio Zaragoza, Madera, Matachí, and Temósachi. The headwaters of the Papigóchic and Santa María rivers and some tributaries of the Conchos River are located in this region. This subprovince includes three groups of north–south oriented ranges in the Sierra Tarahumara, the Sierra La Montosa-Las Tunas-El Rosal, and the Sierra del Nido. The elevations in this region range from 2,400 to 2,700 m. The terrain is composed predominately of acidic volcanic rocks, but to the west basaltic rocks dominate. The valley is composed of old conglomeratic alluvium.

Grasslands in this subprovince are dominated by *Bouteloua gracilis* and *Muhlenbergia rigida* (Estrada et al. 1997). In the highest mountains, especially in Cumbres de Majalca National Park, temperate vegetation such as pine, oak, and derivative forest are predominant and include *Pinus leiophylla* var. *chihuahuana*, *P. cembroides*, *P. engelmannii*, *Cupressus arizonica*, *Fraxinus velutina*, *Quercus hypoleucoides*, *Q. rugosa,* and *Q. grisea* (Estrada et al. 2003). In a recent study conducted by Vega-Mares et al. (2020) in La Sierra Azules, 30 km SW of the city of Chihuahua, 742 taxa in 353 genera were documented, with approximately 60% of the flora affiliated with the desert region, and the remainder in the temperate mountains.

Sierras y Llanuras de Durango (SLD). Located in the south-central part of the state, this subprovince (Fig. 4) is shaped like a narrow band with a north to south orientation. The elevations range from 1,300 to 2,360 m (Sierra La Boca). The prominent topoforms are valleys and slopes associated with smaller hills, and sometimes with isolated sierras of limited elevation (INEGI 1999). According to INEGI (2003), this subprovince lies on the eastern side of the SMO, covers 5.4% of the state's surface, and includes the following municipalities: Huejotitán, San Francisco del Oro, and Santa Bárbara, and parts of Allende, Balleza, Coronado, Cuauhtémoc, Cusiuriachi, Chihuahua, Doctor Belisario Domínguez, Santa Isabel, Gran Morelos, Hidalgo del Parral, Matamoros, Rosales, Rosario, Satevó, Saucillo, El Tule, and Valle de Zaragoza. The relief in this region consists of chains of small mountains, plateaus, and hills, but plains at elevations of 1,500 m and peaks that exceed 2,000 m also are present. The terrain is characterized by limestone rocks, shales, and slates, although acid igneous rocks predominate, and there are occasional outcrops of tertiary conglomeratic alluvium. Herbaceous vegetation predominates, and mostly consists of grasses. *Bouteloua gracilis* and *B. curtipendula* are abundant in non-disturbed areas. Trees only occur along streams and on the base of the mountains. The most common are *Juniperus* spp., which sometimes are dominant, as well as *Pinus cembroides* and oaks, principally *Quercus grisea*, *Q. emoryi*, and *Q. chihuahuensis* (González-Elizondo et al. 2007).

Gran Meseta y Cañones Chihuahuenses (GMCC). This subprovince (Fig. 5) is characterized by high sierras with well-defined canyons, like those found in Barrancas del Cobre, and contains extensive plateaus where canyons and intermountain valleys have formed. According to INEGI (1999), the high elevations in this region range from 500–2,740 m (Cerro Guichique). The GMCC covers 18.1% of the state's surface, is located in the southwestern portion of the state, and includes the municipalities of Batopilas, Bocoyna, Chínipas, Guachochi, Guazapares,

No. 1. *Anaxyrus cognatus* (Say, 1822). The distribution of the Great Plains Toad "extends throughout the Great Plains of the United States and extreme southern Canada, and southward in the Great Basin west of the Rocky Mountains from southern Utah to extreme northern Sinaloa, and east of the Sierra Madre Occidental nearly to the Transvolcanic Belt of south-central Mexico" (Lemos-Espinal and Dixon 2013: 34–35). This individual was photographed in scrub vegetation near the city of Chihuahua. Wilson et al. (2013b) calculated its EVS as 9, placing it at the upper level of the low vulnerability category. We assessed the conservation status of this toad as Least Concern, but this species is not listed by SEMARNAT. *Photo by Eric Centenero-Alcalá*.

No. 2. *Anaxyrus debilis* (Girard, 1854). The distribution of the Green Toad "extends from western Kansas and southeastern Colorado through southern New Mexico and western Texas, in the United States, and into much of the central plateau of Mexico" (Lemos-Espinal and Dixon 2013: 35–36). The image of this individual was taken in spiny shrub vegetation in Aldama, Chihuahua. Wilson et al. (2013b) calculated its EVS as 7, placing it in the middle portion of the low vulnerability category. The IUCN evaluated its conservation status as Least Concern, and this species was placed in the Special Protection category by SEMARNAT. *Photo by Sebastian Ochoa Rodríguez*.

No. 3. *Anaxyrus mexicanus* (Brocchi, 1879). The Mexican Spadefoot Toad occurs in "pine-oak and pine forests of the Sierra Madre [Occidental] of eastern Sonora and eastern Chihuahua, south to southwestern Durango and adjacent Sinaloa, Mexico" (Frost 2023). This individual was photographed on a rock in pine forest vegetation in Guachochi, Chihuahua. Wilson et al. (2013b) determined its EVS as 13, placing it at the upper limit of the medium vulnerability category. The IUCN status of this toad currently is listed as Least Concern, and this species is not listed by SEMARNAT. *Photo by Eric Centenero-Alcalá*.

No. 4. *Anaxyrus punctatus* (Baird and Girard, 1852). The distribution of the Red-spotted Toad "extends throughout the arid and semiarid areas of the southwestern United States, and in Mexico it occurs throughout Baja California and the Pacific slopes into Sinaloa, and across the Mexican Plateau as far south as Jalisco and Hidalgo (Lemos-Espinal and Dixon 2013: 37–38). This individual was photographed on a rock with associated microphyllous vegetation in the city of Chihuahua, Chihuahua. Wilson et al. (2013b) calculated its EVS as 5, placing it in the middle portion of the low vulnerability category. The conservation status of this toad has been determined as Least Concern by IUCN, and this species is not listed by SEMARNAT. *Photo by Sebastian Ochoa Rodríguez*.

Maguarichi, Nonoava, Urique, and Uruachi, as well as large portions of the municipalities of Carichí, Ocampo, and San Francisco de Borja, and small portions of Balleza, Cusihuiriachi, Guadalupe and Calvo, Guerrero, Doctor Belisario Domínguez, Morelos, Moris, Rosario, Satevó, Temósachi, and El Tule. Large plateaus in this subprovince are interrupted by deep canyons, including Barrancas del Cobre, which is 55 km long and contains pronounced peaks through which the Urique River crosses. The headwaters of this river are in the east-central portion of the province, and the Fuerte River also flows through this region. The average elevation is 2,200 m, although the highest areas are located in the eastern half of the subprovince, and range from 2,700 to 3,000 m. Notably, Cerro Las Iglesias attains an elevation of 3,100 m. The terrain is dominated by ignimbrite rocks with some basaltic outcrops (INEGI 2003). The vegetation of Barrancas del Cobre includes oak forest in the higher elevations (> 2,000 m), where trees such as *Quercus arizonica*, *Q. toumeyi*, *Q. oblongifolia*, *Pinus leiophylla*, and *P. engelmannii*, are predominant; the huizaches shrubs include *Acacia farnesiana* (250–300 m), which are associated with *Acacia cochliacantha*, *Ipomoea chilopsidis*, *Randia thurberi*, *Rhus tepetate*, and *Quercus chihuahuensis*, among others. The mauto *Lysiloma divaricatum* forest is formed by an association of trees and shrubs adapted to high temperatures, and includes *Lysiloma wootonii*, *Ceiba pentandra*, *Guazuma ulmifolia*, *Senna atomaria*, *Ipomoea arborescens*, *Caesalpinia platyloba*, *Pachycereus pectin-arboriginum*, *Stenocereus thurberi*, *Bursera lancifolia*, *B. pinicellata*, *B. grandiflora*, *Cordia sonorae*, *Buddleja marrubifolia*, *Quercus albocincta*, *Q. tuberculata*, *Prosopis palmeri*, *P. articulata, Chloroleucon mangense*, and *Fouquieria mcdougalii*. Continuing to the fig river forest are species such as *Ficus petiolaris*, *F. pertusa*, and *F. conitifolia*, guamuchil *Pithecellobium dulce*, and tempisque *Sideroxylon tepicense*, which grow along the edges of the Batopilas and Urique rivers, and are joined with other species such as *Brongniartia alamosana*, *Coccoloba goldmanii*, *Tabenuia chrysantha*, *T. Impetiginosa*, *Platimiscium trifoliolatum*, *Vitex mollis*, and *V. pyramidata* (Lebgue et al. 2005). The predominant vegetation types are pine forest, oak forest, and combinations of these species with alamillo, and important species like *Picea chihuahuana*, *Pseudotsuga* spp., and *Abies concolor* (WWF 2008). In a herpetological study in Chínipas Canyon, Chihuahua, Santoyo-Brito and Lemos-Espinal (2010) characterized three different plant associations in the lower level (200–1,200 m) of this region, which includes tropical deciduous forest composed of *Bursera fagaroides*, *Guazuma ulmifolia*, *Ipomoea arborescens*, and *Lysiloma ivaricada*; oak forest at elevations from 1,200–1,750 m, with *Quercus chihuahuensis* at the higher elevations (1,750–2,500 m); and pine forest with *Pinus ayacahuite*, *P. durangensis*, *P. engelmanni*, and *P. leiophylla*.

Gran Meseta y Cañadas Duranguenses (GMCD). Most of this subprovince is characterized by high elevations associated with canyons, and plateaus with glens (Fig. 6). According to INEGI (1999), the elevations range from 700 to 3,300 m (Cerro Mohinora). Located to the south of the municipality of Guadalupe y Calvo and Morelos, this subprovince covers 2.1% of the surface area of Chihuahua,

Fig. 5. Gran Meseta y Cañones Chihuahuenses (GMCC). Rio Urique, north of Huasarorare, Guachochi, Chihuahua, within pine and gallery forest. *Photo by Jesús M. Martínez-Calderas*.

and thus is the smallest in the state. The plateau is greatly dissected where the canyon rivers flow, and basaltic and intermediate rocks dominate the terrain (INEGI 2003). A study by García-García et al. (2019) reported the diversity and vertical structure (three levels) of a pine-oak forest in Guadalupe y Calvo by examining the phytosociological relative value in a managed forest. That study determined the common species as *Pinus durangensis*, *Quercus sideroxyla*, *Q. fulva*, *Pinus arizonica*, and *Arbutus xalapensis*, and demonstrated their relative presence in the levels as *Pinus durangensis*, *Q. fulva*, *Arbutus xalapendis*, *Quercus sideroxyla*, and *P. arizonica*. According to Martínez (1991), the vegetation is dominated and conditioned by elevation, with the presence of coniferous forest and a small belt of subalpine vegetation near the summit.

Sierras y Llanuras del Norte (SLN) and its four subprovinces

This province (Fig. 1) extends from the border of the state of Texas (USA) to near Nazas de Durango and encompasses the arid region of the state. The Chihuahuan Desert has been delimited by various authors, including Morafka (1977) who defined it based on the distribution of amphibians and reptiles, highlighting the Pleistocene isolation and divergence between the Chihuahuan and Sonoran deserts. He considered evidence of vicariant events ranging from the late Neogene to the late

Fig. 6. Gran Meseta y Cañadas Duranguenses (GMCD). The summit of Cerro Mohinora (3,300 m), located in a Natural Protected Area in the municipality of Guadalupe y Calvo, Chihuahua. *Photo by César F. Hernández-Urbina*.

Fig. 7. Llanuras y Médanos del Norte (LMN). The core area of Médanos de Samalayuca, a Natural Protected Area in Juárez, Chihuahua. Sierra Presidio lies in the background. *Photo by Jesús M. Martínez-Calderas*.

Pleistocene, which separated the herpetofauna of the western continental deserts (Sonoran, Sinaloan, and Mohave) and the eastern (Chihuahuan) along the Sierra Madre Occidental.

The SLN is made up of abrupt mountains that rise to 3,000 m and plains with elevations of 800–1,000 m. This province covers 56.5% of the surface area of the state. The dominant climates are very dry, semi-warm, and temperate, but a region of temperate semi-dry climate lies next to the SMO (INEGI 2003). The four subprovinces in this region are the Llanuras y Médanos del Norte (LMN), Sierras Plegadas del Norte (SPN), Del Bolsón de Mapimí (BDM), and Llanuras y Sierras Volcánicas (LSV).

Llanuras y Médanos del Norte (LMN). This subprovince (Fig. 7) is located in northwestern Chihuahua, where the dominant topoforms include folded and steep mountain ranges, oriented in various directions (e.g., northwest to southeast). The elevations of this topoform range from 2,300 to 2,500 m (Cerro Grande and Sierra La Escondida). The most common associations are slopes and hills, which define the floodplains, and the terrain is occasionally rocky or hard but generally salty and subject to flooding. The city of Samalayuca stands out for its distinctiveness (INEGI 1999). According to INEGI (2003), this subprovince borders the USA to the north and Sonora to the west, and covers 17.4% of the state's surface area. It includes the municipalities of Ascensión and Nuevo Casas Grandes, and parts of Ahumada, Buenaventura, Casas Grandes, Janos, Galeana, and Juárez. The Casas Grandes and Santa María rivers penetrate the southern portion of the subprovince and terminate in this region. Here, the plains have wide slopes, small but steep mountain ranges, and dune fields, and the average elevation is about 1,000 m. The terrain is characterized by alluvium, limestone, and acidic volcanic rocks that compose the mountains and hills, as well as basaltic rocks that are present in the middle of the subprovince. In a study conducted in the Janos-Casas Grandes Prairie Dog Complex in the extreme northwestern Chihuahua, Ceballos et al. (2010) indicated a mosaic of native grasslands and shrublands. The grasslands are dominated by the annual grasses, including Sixweeks Threeawn (*Aristida adscensionis*), Needle Grama (*Bouteloua aristidoies*), and Sixweeks Grama (*B. barbata*), and numerous forbs; perennial

Fig. 8. Sierras Plegadas del Norte (SPN). Southwest of Sierra Presidio, in the municipality of Guadalupe, Chihuahua. Note the typical rosetophyllous vegetation. *Photo by Ana Gatica-Colima*.

Fig. 9. Del Bolsón de Mapimí (BDM). A scene showing water from the Conchos River flowing to Rosetilla Dam, Saucillo, Chihuahua. *Photo by Ana Gatica-Colima*.

grasses include Poverty Treeawn (*Aristida divaricate*), Ear Muhly (*Muhlenbergia arenacea*), Burrograss (*Scleropogon brevifolius*), Vine Mesquite (*Panicum obtusum*), Tobosagrass (*Pleuraphis mutica*), Blue Grama (*Bouteloua gracilis*), Black Grama (*B. eripoda*), and Red Grama (*B. trifida*); and the shrublands are dominated by mesquite, ephedra, and Cholla (*Opuntia imbricata*). Quiñonez-Martínez et al. (2018) reported that the vegetation in Ejido Villa Luz at the Médanos de Samalayuca Natural Protected Area is characterized by xeric scrub, with dominant shrubs such as *Larrea tridentata* and *Prosopis juliflora* var. *glandular*. They also indicated some lesser abundant species such as *Atriplex canescens*, *Fouquieria splendens*, *Flourensia cernua*, and *Yucca* sp.; additionally, some dunes are devoid of vegetation, while others contain shrubs such as *Prosopis juliflora* var. *glandulosa*, *Atriplex canescens*, *Poliomintha incana*, and *Artemisia filifolia*, as well as some Cactaceae.

Sierras Plegadas del Norte (SPN). This subprovince (Fig. 8) is located in northeastern Chihuahua, and is oriented in a north to south direction. It contains different types of topoforms, including elongated sierras with a northwest to southeast orientation, which contain anticlinal structures of folded rocks composed of carbonate that date back to the Cretaceous. Occasionally, these topoforms are associated with hills and plateaus, and many of the hills are steep and branched. The plains are located in desert areas, and have developed on alluvial fills. Salty terrain is associated with the hills and slopes, which sometimes becomes flooded because of its development on rocky terrain (INEGI 1999).

This subprovince contains 13.6% of the state's surface area, and is located in the north-central portion of the state. It includes the municipalities of Praxedis G. Guerrero, and parts of Ahumada, Aldama, Coyame, Guadalupe, Juárez and Julimes. The slopes are associated with hills that are interrupted by small and elongated mountain ranges, with plains located near the capital of Juárez. In general, the elevation in this area is about 1,000 m. The terrain is rocky and characterized by desert plains with rocky terrain, but in Samalayuca it becomes more saline and sometimes floods (INEGI 2003).

Macias-Duarte et al. (2004) studied the Aplomado Falcon (*Falco femoralis*) in two areas: Sueco (in the

Fig. 10. Llanuras y Sierras Volcánicas (LSV). A Creosote Bush (*Larrea tridentata*), photographed about 5.8 mi from Benito Juárez, Manuel Benavides, Chihuahua. The higher elevations of Santa Elena Canyon are seen in the background. *Photo by Ana Gatica-Colima*.

municipalities of Ahumada and Chihuahua) and Tinaja Verde (in the municipality of Coyame). The vegetation in these areas consists of open grasslands dominated by *Bouteloua gracilis*, *B. hirsuta*, and *B. eriopoda*, with *B. curtipendula*, *Aristida* spp., *Hilaria mutica*, and *Enneapogon desvauxii* as subdominant species. These grasslands are invaded by woody species, with *Acacia constricta*, *Ephedra trifurca, Flourensia cernua*, and *Larrea tridentata* being the most prominent. Additionally, open halophytic grasslands typically occur in swales and are characterized by *Hilaria mutica* and *Sporobolus airoides* and other grasses, such as *Bouteloua gracilis* and *Panicum obtusum*. The most common woody species are *Prosopis glandulosa*, *Koeberlinia spinosa*, *Flourensia cernua*, *Acacia constricta*, and *Condalia ericoides*.

Bolsón de Mapimí (BDM). Located in the central part of the state, this subprovince (Fig. 9) consists of an elongated band with a northwest to southeast orientation. Structurally, the topoforms in the sierras are oriented from northwest to southeast and west to east, and contain anticlines with carbonite rocks that developed in the Cretaceous. A panoramic view reveals a steep relief that often is associated with plateaus, hills, slopes, and ravines. The hills are steep and branched, and often are associated with slopes. Plains and ravines are found throughout the south-central portion of this subprovince, and the slopes of the broadest hillsides take up much of the terrain in the north-central part of this region. The plains in this region developed on alluvial soil in desert areas with a saline presence, which was deposited in rocky ground that can flood. The least distributed topoforms are plateaus related to basalt flows, which gradually transformed into hills, and the scenery is dominated by "malpaís" and dunes (INEGI 1999).

This subprovince represents 12.4% of the state's surface, and it is located southeast of the Sierras Plegadas del Norte and Llanuras y Sierras Volcánicas subprovinces. It extends over the territory of Aquiles Serdán, Delicias, López, Meoqui, and San Francisco de Conchos, and parts of the municipalities of Ahumada, Aldama, Allende, Buenaventura, Camargo, Coronado, La Cruz, Chihuahua, Hidalgo de Parral, Jiménez, Julimes, Matamoros, Rosales, Satevó, Saucillo, and Valle de Zaragoza. The land primarily is composed of alluvial plains and lowlands, but also contains steep and folded mountains and steep and branched hills. The average elevation is 1,200 m. The terrain is characterized by the presence of acid basaltic rocks and limestone hills. Northeast of Hidalgo del Parral, the morphology of the rocks resembles that of a plateau (INEGI 2003).

The vascular flora of central Chihuahua primarily is composed of eight biological forms: herbs, inerms, shrubs, trees, vines, crassicaules, thorny shrubs, rosetophyllous shrubs, and parasites. Herbaceous species predominate over the remainder of the area. In scrub communities with plains and hills, the more densely occurring species are *Larrea tridentata*, *Acacia neovernicosa*, *Flourensia cernua*, *Parthenium confertum*, and *Parthenium incanum* (Estrada-Castillón and Villarreal-Quintanilla 2010).

Moreno-Contreras et al. (2021) worked in the riverine area of Meoqui, where the vegetation consists of gallery forest and includes trees such as cottonwood *Populus* sp., willow *Salix* sp., and ash *Fraxinus* sp., as well as cattail *Typha* sp., with Bulrush (*Schoenoplectus americanus*) in low places and along the edge of the river, and desert thickets of mesquite *Prosopis* sp. and agave *Agave* sp. are present in the drier open areas.

Llanuras y Sierras Volcánicas (LSV). The topoforms in the sierras (Fig. 10) are oriented in a northwest to southeast direction and consist of anticlinal products of carbonated sequences of folding that date back to the Cretaceous. Part of its appearance consists of steep and branched hills and plateaus that in some associations contain distinctive ravines and slopes. Slopes are the most abundant, especially because of their relationship with hills, and the plains occur on alluvial grounds on rocky or granular terrain, as well as dunes with salinity where flooding is common (INEGI 1999).

No. 5. *Anaxyrus woodhousii* (Girard, 1854). Woodhouse's Toad is found in the "Western USA (excluding Great Basin and Pacific Coast) and northern Mexico (northeastern Sonora to north-eastern Coahuila south to eastern Durango)" (Frost 2023). This individual was photographed along a road on a rainy night near Santa Eulalia, Chihuahua. Wilson et al. (2013b) determined its EVS as 10, placing it at the lower limit of the medium vulnerability category. The IUCN indicated its conservation status as Least Concern, and this species is not listed by SEMARNAT. *Photo by Ramón Isaac Miramontes Cinco*.

No. 6. *Incilius mazatlanensis* (Taylor, 1940). The distribution of the Sinaloa Toad extends from "Northern Sonora from the municipality of Imuris and southwestern Chihuahua (Río Fuerte drainage) to Colima, along the Pacific coastal plain, Mexico; reported on the Pacific drainage of Durango and Jalisco, Mexico; reported in the Pacific drainage of Durango and Jalisco, Mexico; Isla Maria Madre, Nayarit, Mexico" (Frost 2023). This individual was photographed in lowland deciduous forest in Guapalaina, in the municipality of Urique, Chihuahua. Wilson et al. (2013b) determined its EVS as 12, placing it in the upper portion of the medium vulnerability category. The IUCN determined its conservation status as Least Concern, and this species is not listed by SEMARNAT. *Photo by Javier Cruz-Nieto*.

No. 7. *Dryophytes arenicolor* (Cope, 1886). The distribution of the Canyon Treefrog "extends from the mountains of southern Colorado, western New Mexico, and southern Arizona, in the United States, southward to Guerrero and northern Oaxaca in Mexico; isolated populations, however, are found in the Big Bend area of Texas, adjacent Coahuila, and in San Luis Potosí" (Lemos-Espinal and Dixon 2013: 52–53). This individual was photographed in pine forest at Monterde, in the municipality of Guazapares, Chihuahua. Wilson et al. (2013b) calculated its EVS as 7, placing it in the middle portion of the low vulnerability category. The IUCN assessed its conservation status as Least Concern, and this species is not listed by SEMARNAT. *Photo by Eric Centenero-Alcalá*.

No. 8. *Dryophytes wrightorum* (Taylor, 1939). The Mountain Treefrog occurs at "discontinuous distributions generally above 2,000 m in the Mogollon Rim of central Arizona and west-central New Mexico, the Huachuca Mountains area (at elevations down to about 1,400 m) in southeastern Arizona, and Peloncillo Mountains of Hidalgo County, New Mexico, and southward in grama grasslands and pine-oak parklands in the Sierra Madre Occidental and south to, but not including, the state of México, Mexico" (Frost 2023). This individual was photographed in pine forest at Guachochi, Chihuahua. Wilson et al. (2013b) assessed its EVS as 9, placing it at the upper limit of the low vulnerability category. The IUCN assessed its conservation status as Least Concern, and this species is not listed by SEMARNAT. *Photo by Eric Centenero-Alcalá*.

Table 1. Monthly minimum, mean (in parentheses ± SD), maximum, and annual temperature data (in °C) for the nine physiographic regions of Chihuahua, Mexico. Data were obtained from Normales Climatológicas 1950–2010 CONAGUA-SMN.

Physiographic region	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Llanuras y Médanos del Norte	-0.9 (10.9 ± 3.0) 15.8	0.5 (12.9 ± 2.6) 18.4	3.1 (16.0 ± 2.7) 21.8	6.5 (19.9 ± 2.5) 25.8	10.3 (23.8 ± 2.6) 30.0	14.7 (27.9 ± 2.9) 34.2	16.7 (28.0 ± 2.8) 33.0	15.9 (27.0 ± 2.7) 31.9	13.4 (25.0 ± 2.3) 29.7	7.8 (20.2 ± 2.6) 25.4	1.9 (14.1 ± 2.6) 19.8	-0.8 (11.0 ± 2.7) 15.9	7.5 (19.8 ± 2.7) 25.3
Sierras Plegadas del Norte	-0.6 (8.9 ± 5.5) 17.7	1.0 (11.3 ± 1.8) 20.5	4.8 (15.2 ± 1.9) 24.7	9.3 (19.9 ± 1.8) 29.6	13.7 (24.0 ± 1.6) 33.5	17.8 (27.9 ± 1.7) 36.9	18.5 (27.8 ± 1.6) 35.6	17.9 (26.9 ± 1.5) 34.6	14.7 (23.8 ± 2.0) 32.3	9.8 (19.3 ± 1.6) 27.8	3.4 (13.3 ± 1.9) 22.4	-1.6 (9.4 ± 1.7) 18.3	6.9 (18.4 ± 2.6) 27.2
Bolsón de Mapimí	0.5 (10.9 ± 1.8) 20.0	2.7 (14.6 ± 1.8) 22.6	5.6 (16.5 ± 1.6) 26.5	9.7 (19.7 ± 1.8) 30.3	14.4 (22.3 ± 1.5) 33.7	18.0 (24.5 ± 1.6) 35.7	18.1 (23.7 ± 1.7) 33.7	17.4 (22.7 ± 5.3) 32.7	15.2 (21.3 ± 1.7) 30.8	10.32 (18.7 ± 1.7) 28.5	4.2 (15.2 ± 1.7) 24.0	1.4 (12.6 ± 1.6) 20.6	5.7 (17.8 ±1.7) 28.1
Llanuras y Sierras Volcánicas	-1.4 (8.3 ± 1.6) 18.1	0.7 (10.8 ± 2.2) 20.9	3.4 (14.2 ± 1.7) 25.0	7.0 (19.3 ± 1.7) 29.6	11.1 (23.5 ± 1.5) 33.9	15.6 (27.9 ± 2.2) 37.4	16.9 (26.3 ± 2.7) 36.4	16.0 (25.5 ± 2.7) 34.8	13.3 (22.7 ± 2.0) 32.1	7.7 (19.0 ± 1.4) 28.4	2.6 (12.4 ± 1.6) 22.8	-0.8 (8.6 ± 1.7) 18.1	8.0 (19.5 ± 1.6) 28.4
Sierras y Cañadas del Norte	-7.9 (4.9 ± 1.4) 13.7	-6.6 (6.1 ± 1.7) 15.0	-4.8 (8.4 ± 1.5) 18.3	-1.5 (11.8 ± 1.5) 21.7	1.9 (15.1 ± 1.2) 24.0	6.5 (19.2 ± 1.5) 27.7	10 (19.5 ± 1.1) 25.8	9.2 (18.7 ± 1.0) 25.4	6.5 (16.9 ± 1.3) 24.5	0.2 (12.8 ± 1.3) 22.6	-4.7 (8 ± 1.8) 17.9	-7.5 (5.2 ± 1.5) 14.1	-0.9 (12.2 ± 1.7) 21.0
Sierras y Llanuras Tarahumaras	-4.7 (6.7 ± 1.5) 15.5	-3.4 (8.3 ± 1.5) 17.6	-1.2 (10.9 ± 1.5) 20.4	1.9 (14.3 ± 1.5) 24.1	4.7 (18.1 ± 2.0) 28.0	9.9 (22.0 ± 1.5) 31.4	12.4 (21.4 ± 1.6) 28.8	11.6 (20.5 ± 1.3) 27.8	9.0 (18.8 ± 4.2) 26.4	3.1 (15.0 ± 1.2) 24.0	-2.1 (10.2 ± 1.4) 19.8	-4.5 (8.7 ± 1.6) 16.3	0.8 (14.7 ± 6.4) 24.2
Sierras y Llanuras de Durango	0.2 (9.4 ± 2.3) 18.6	1.5 (11.2 ± 1.8) 20.9	4.7 (14.3 ± 1.5) 24.0	8.0 (17.8 ± 1.5) 27.6	11.8 (21.4 ± 1.5) 31.1	15.9 (24.9 ± 1.4) 33.8	16.1 (23.9 ± 1.4) 31.5	15.4 (23.0 ± 1.3) 30.4	13.8 (21.2 ± 1.4) 28.6	9.4 (18.0 ± 1.6) 26.6	3.6 (13.1 ± 1.7) 22.7	0.7 (10.2 ± 1.8) 19.7	8.4 (17.4 ± 1.6) 26.3
Gran Meseta y Cañones Chihuahuenses	-0.1 (12.5 ± 1.6) 21.6	0.7 (13.9 ± 1.7) 23.4	2.7 (16.1 ± 1.6) 25.8	5.1 (19.1 ± 1.5) 29.0	9.3 (22.4 ± 1.5) 32.4	13.0 (25.7 ± 1.5) 34.6	14.3 (24.7 ± 1.4) 31.8	13.7 (24.1 ± 1.3) 31.0	12.6 (23.1 ± 2,1) 30.4	6.5 (19.8 ± 1.5) 28.4	3.0 (15.3 ± 1.6) 25.2	-1.9 (13.5 ± 1.6) 22.0	5.4 (19.4 ± 2.8) 28.1
Gran meseta y Cañones Duranguenses	-1.7 (8.7 ± 1.3) 19.2	-2.0 (9.2 ± 1.7) 20.4	-0.4 (11.1 ± 1.8) 22.6	1.9 (13.7 ± 1.5) 25.5	4.4 (16.2 ± 1.0) 28.0	8.8 (19.1 ± 1.7) 29.4	10.5 (18.9 ± 1.0) 27.3	10.4 (18.9 ± 1.0) 27.5	9.5 (18.2 ± 1.3) 27.0	4.9 (15.5 ± 1.2) 26.1	0.2 (11.6 ± 1.8) 22.9	-1.0 (9.7 ± 1.3) 20.3	3.8 (14.2 ± 1.4) 24.7

This subprovince comprises 13.2% of the state's surface area, is located in the southeastern portion of the state, and includes the municipalities of Manuel Benavides and portions of Camargo, La Cruz, Jiménez, Julimes, Ojinaga, and Saucillo. The relief is characterized by plains, slopes, and flattened surfaces that sometimes are interrupted by mountains, hills, or plateaus. The mountains generally are composed of volcanic rock, but small mountain ranges also occur, while the plains are alluvial and those with salinity sometimes are flooded (INEGI 2003).

González and Sosa (2003) identified nine vegetational groups in the natural protected area of Cañón de Santa Elena, based on elevation and botanical composition. At the lowest elevations, level 1 (600–900 m), the vegetation primarily is composed of *Larrea tridentata*, *Jatropha dioica*, and *Prosopis glandulosa*; in level 5 (1,300–1,600 m) it contains *Vachellia constricta*, *Viguiera stenoloba*, and *Mimosa wherryana*; and in level 9 (2,300–2,400 m) it consists of *Muhlenbergia monticola*, *Pinus cembroides*, *Quercus grisea*, and *Bouteloua gracilis*.

Climate

Temperature. In Table 1, we provide the monthly minimum, maximum, and mean annual temperatures for each of the nine physiographic regions recognized in Chihuahua. The highest mean annual temperature is in the Llanuras y Médanos del Norte at 19.8 °C, and the lowest is in the Sierras y Cañadas del Norte, at 12.2 °C. The mean monthly temperatures generally are highest in June and lowest in January. The differences between the monthly minimum and maximum temperatures in the nine regions range from 17.8 °C to 22.7 °C.

Precipitation. The precipitation regime (Figs. 11–12) in the nine physiographic regions of Chihuahua typically consists of a 5-month "rainy" season that extends from June to October, and a 7-month "dry" season that lasts from November to May (Table 2). The mean monthly rainfall generally is highest in July or August. The mean annual precipitation ranges from 196.8 mm in the Llanuras y Sierras Volcánicas to 922.3 mm in the Gran Meseta y Cañones Duranguenses.

Composition of the Herpetofauna

Families. The species of herpetofauna in Chihuahua are classified into 34 families, including eight families of anurans, two of caudates, 19 of squamates, and five of turtles (Table 3). No families of caecilians or crocodylians are represented within the state. The total of 34 families makes up 56.7% of the 60 families represented in all of Mexico (J. Johnson, unpublished data, 27 May 2023). Among the 10 families of amphibians represented in Chihuahua (Table 4), 50.0% (20) of the 40 species are allocated to the families Bufonidae (11 species) and Ranidae (nine species). Among the 24 families of reptiles, 79.5% (116) of the 146 species are assigned to the families Phrynosomatidae (23 species), Scincidae (seven species), Teiidae (nine species), Colubridae (40 species), Dipsadidae (10 species), Natricidae (11 species), Viperidae (11 species), and Kinosternidae (five species).

Fig. 11. A scene from the rainy season during the month of August in the municipality of Ahumada, Chihuahua. Sierra Candelaria is seen in the background. *Photo by Ana Gatica-Colima*.

Fig. 12. The snowy season in December at Rancho El Uno in Cerro de la Cal, a Biosphere Reserve located in Janos, Chihuahua. *Photo by Laura I. Heredia-González*.

Genera. Eighty-two genera of amphibians and reptiles are represented in Chihuahua, including 14 genera of anurans, two of salamanders, 59 of squamates, and seven of turtles (Table 3). These 82 genera constitute 38.0% of the 216 genera known from Mexico (J. Johnson, unpublished data, 27 May 2023). Among the anurans and salamanders (Table 4), the most speciose genera are *Anaxyrus* (six species), *Lithobates* (nine species), and *Ambystoma* (four species). Among the reptiles (Table 4), the most speciose genera are *Phrynosoma* (four species), *Sceloporus* (11 species), *Plestiodon* (seven species), *Aspidoscelis* (nine species), *Lampropeltis* (four species), *Masticophis* (four species), *Salvadora* (four species), *Tantilla* (six species), *Rena* (four species), *Thamnophis* (nine species), *Crotalus* (nine species), and *Kinosternon* (five species).

Species. The herpetofauna of Chihuahua is composed of 186 species, including 35 species of anurans, five of salamanders, 133 of squamates, and 13 of turtles (Table 3). Of these 186 species, 183 are native to the state and three are non-native. Presently, the numbers of native species in these groups in Mexico are 272, 161, 913, and 51, respectively (J. Johnson, unpublished data, 27 May 2023). The 183 native species in Chihuahua constitute 13.0% of the 1,403 native species in all of Mexico (J. Johnson, unpublished data, 27 May 2023).

Patterns of Physiographic Distribution

We recognize nine physiographic regions in Chihuahua (Fig. 1). We document the distributions of the members of the herpetofauna among these nine regions in Table 4, and summarize the data in Table 5.

The numbers of species in the nine physiographic regions range from 58 in the Sierras y Llanuras de Durango to 128 in the Gran Meseta y Cañones Chihuahuenses. The values for the remaining seven regions, in ascending order are: 59 (Gran Meseta y Cañones Duranguenses); 61 (Sierras y Llanuras Tarahumaras); 64 (Sierras Plegadas del Norte); 75 (Llanuras y Sierras Volcánicas); 78 (Sierras y Cañadas del Norte); 80 (Bolsón de Mapimí); and 81 (Llanuras y Médanos del Norte). The mean figure for regional occupancy in Chihuahua is 76.0, or 40.9% of the state's total.

As expected, the greatest absolute and relative numbers of species are found among amphibians (30; 23.4%) and squamates (98; 76.6%) in the Gran Meseta y Cañones Chihuahuenses. Conversely, turtles are most prominently represented in the Llanuras y Médanos del Norte at nine species (11.1% of the regional total of 81).

Members of the herpetofauna of Chihuahua inhabit from one to nine physiographic regions (Table 4), as follows: one (42 of 186; 22.6%); two (32; 17.2%); three (27; 14.5%); four (28; 15.1%); five (16; 8.6%); six (12;

No. 9. *Lithobates berlandieri* (Baird, 1859). The distribution of the Rio Grande Leopard Frog "extends from New Mexico and Texas, in the United States, southward in Mexico through eastern Chihuahua, Coahuila, Nuevo León, Tamaulipas, Querétaro, and Hidalgo. It also occurs throughout the lowlands of Veracruz, except for the southern portion of the state and along the Transvolcanic Belt to Colima. Additionally, an isolated population is present in western Chihuahua and an introduced population in extreme northwestern Sonora" (Lemos-Espinal and Dixon 2013: 67–68). This individual was photographed in a creek at San Carlos canyon, a Natural Protected Area in Cañón de Santa Elena, in the municipality of Manuel Benavides, Chihuahua. Wilson et al. (2013b) determined its EVS as 7, placing it in the middle portion of the low vulnerability category. The IUCN established its conservation status as Least Concern, and this species is not listed by SEMARNAT. *Photo by Ana B. Gatica-Colima*.

No. 10. *Lithobates catesbeianus* (Shaw, 1802). The distribution of the American Bullfrog "extends from southeastern Canada and throughout most of the eastern and midwestern United States, although it has been introduced into several areas in the western part of the country. In Mexico, it occurs in the northeastern coastal plain" (Lemos-Espinal and Dixon 2013: 68–69). This individual was photographed in the San Pedro River wetland, located in Meoqui, Chihuahua. Wilson et al. (2013b) calculated its EVS as 10, placing it at the lower limit of the medium vulnerability category. The conservation status of this frog was determined as Least Concern by IUCN, and this species is not listed by SEMARNAT. *Photo by Leonardo Hernández-Escudero*.

No. 11. *Lithobates cora* (Pérez-Ramos and Luja-Molina, 2022). The Náayari Leopard Frog (as indicated in the original publication) occurs from "extreme southwestern Chihuahua, west-central Sonora, through Sinaloa, Nayarit, and Colima, Mexico, sea level to 1,250 m elevation; presumably penetrating into the barrancas of western Durango" (Frost 2023). This individual was photographed in lowland deciduous forest at Guapalaina, in the municipality of Urique, Chihuahua. The EVS of this frog was calculated as 13, placing it at the upper limit of the medium vulnerability category. The IUCN has not determined its conservation status, and this species is not listed by SEMARNAT. *Photo by Javier Cruz-Nieto*.

No. 12. *Lithobates tarahumarae* (Boulenger, 1917). Previously, the Tarahumara Frog was known to occur "in extreme southern Arizona (USA, although now extinct there), south through the Sierra Madre Occidental of eastern Sonora, western Chihuahua, and eastern Sinaloa, likely in adjacent western Durango and northern Jalisco, Mexico; southwestern Aguascalientes" (Frost 2023). This individual was photographed in a river in the Sierra Tutuaca, in the municipality of Madera, Chihuahua. Wilson et al. (2013b) determined its EVS as 8, placing it in the upper portion of the low vulnerability category. The IUCN ascertained its conservation status as Vulnerable, but this species is not listed by SEMARNAT. *Photo by Juan Cruzado-Cortés*.

Table 2. Monthly minimum, mean (in parentheses ± SD), maximum, and annual precipitation data (in mm) for nine physiographic regions of Chihuahua, Mexico. Data were obtained from: SMN (s/f) Servicio Meteorológico Nacional, Normales Climatológicas por Estado Chihuahua: https://smn.conagua.gob.mx/es/informacion-climatologica-por-estado?estado=chih (Accessed 24 November 2023). The shaded area indicates the months of the rainy season.

Physiographic region	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Llanuras y Médanos del Norte	0 (12.7 ± 5.3) 62.1	0 (9.6 ± 11.9) 52.3	0 (22.0 ± 11.2) 55.2	0 (6.7 ± 12.4) 67.0	0 (6.6 ± 12.2) 65.1	0 (14.7 ± 20.0) 80.7	4.9 (66.0 ± 42.2) 182.6	6.7 (62.6 ± 38.5) 150.4	0.5 (40.7 ± 32.9) 125.7	0 (22.2 ± 6.7) 119.7	0 (10.5 ± 12.3) 50.7	0 (13.5 ± 17.5) 76.1	3.6 (262.6 ± 9.5) 519.1
Sierras Plegadas del Norte	0.9 (9.2 ± 9.3) 39.1	1.3 (8.0 ± 8.4) 47.2	2.6 (7.9 ± 8.6) 46.5	4.1 (9.8 ± 11.1) 59.6	5.2 (14.6 ± 11.1) 47.1	5.9 (26.5 ± 28.9) 110.3	6.9 (50.6 ± 36.1) 174.7	6.8 (50.6 ± 29.1) 125.2	3.1 (41.6 ± 37.8) 173.4	3.5 (22.9 ± 22.5) 107.0	1.8 (10.3 ± 10.9) 55.9	0.7 (10.4 ± 14.1) 71.9	3.6 (241.6 ± 7.7) 442.7
Bolsón de Mapimí	0 (8.4 ± 14.1) 67.2	0 (12.4 ± 7.0) 31.2	0 (2.6 ± 5.6) 26.9	0 (7.7 ± 15.1) 68.4	0 (12.5 ± 15.9) 61.9	0 (12.5 ± 31.6) 125.4	1.1 (31.2 ± 48.6) 238.1	3.7 (65.4 ± 50.7) 260.4	0.3 (67.3 ± 55.7) 236.4	0 (22.0 ± 25.1) 96.4	0 (6.8 ± 12.1) 67.1	0 (8.2 ± 11.5) 43.9	4.5 (253.3 ± 10.3) 596.8
Llanuras y Sierras Volcánicas	0 (4.7 ± 8.6) 34.3	0 (4.1 ± 9.1) 33.7	0 (3.1 ± 6.5) 24	0 (4.6 ± 8.0) 31.2	0 (9.0 ± 9.7) 35.3	0 (21.4 ± 27.4) 88.7	0.5 (38.3 ± 38.0) 144.5	1.4 (42.5 ± 42.6) 177.7	0.3 (42.4 ± 46.5) 107.7	0 (21.5 ± 26.5) 105.1	0.7 (6.4 ± 11.3) 44	13.3 (6.5 ± 11.5) 50.5	1.1 (196.8 ± 11.0) 427
Sierras y Cañadas del Norte	0 (28.2 ± 24.0) 101.1	0 (30.5 ± 15.6) 87.5	0 (12.2 ± 12.4) 87.8	0 (8.1 ± 10.7) 61.3	0.5 (7.3 ± 9.5) 61.4	25.9 (33.2 ± 33.6) 137.7	10.5 (103.5 ± 68.9) 263.8	0 (92.3 ± 59.0) 260.4	0 (46.3 ± 39.1) 161.6	0 (26.1 ± 27.7) 138.6	0 (16.7 ± 14.4) 79.4	0 (24.9 ± 23.6) 122.0	9.2 (605.9 ± 221.3) 847.0
Sierras y Llanuras Tarahumaras	0 (17.8 ± 25.3) 103.1	0 (7.1 ± 15.3) 90.3	0 (4.8 ± 8.6) 36.8	0 (15.5 ± 10.5) 50.4	0 (6.0 ± 11.6) 57.7	0 (28.2 ± 30.0) 137.8	0 (98.0 ± 74.2) 399.5	0 (97.0 ± 69.9) 320.38	0 (62.4 ± 55.5) 246.3	0 (24.2 ± 30.8) 143.1	0 (8.5 ± 16.2) 90.6	0 (12.4 ± 22.0) 123.5	0 (353.9 ± 163.3) 390.2
Sierras y Llanuras de Durango	0 (9.7 ± 14.7) 55	0 (6.4 ± 11.1) 39.8	0 (4.7 ± 9.4) 38.4	0 (6.1 ± 11.8) 48.5	0 (11.7 ± 18.4) 76.4	0.5 (43.0 ± 41.4) 154.0	22.0 (106.4 ± 45.7) 206.6	21.7 (120.9 ± 67.9) 269.5	4.0 (111.7 ± 88.7) 339.7	0 (25.1 ± 30.9) 100.4	0 (9.4 ± 13.3) 50.0	0.5 (10.2 ± 16.1) 239	9.4 (350.2 ± 15.7) 608.1
Gran Meseta y Cañones Chihuahuenses	0 (40.2 ± 51.3) 189.4	0 (27.2 ± 34.3) 130.9	0 (12.2 ± 23.0) 112.0	0 (11.9 ± 27.3) 143.0	0.0 (10.4 ± 25.4) 131.2	0.1 (59.0 ± 64.3) 280.3	6.7 (169.1 ± 100.8) 459.9	36.6 (151.7 ± 87.2) 405.6	2.5 (77.6 ± 54.2) 234.5	0 (42.9 ± 61.0) 210.5	0 (21.4 ± 26.8) 103.7	0.7 (40.8 ± 47.4) 184.8	10.1 (609.1 ± 1416.4)
Gran Meseta y Cañones Duranguenses	0.3 (52.5 ± 52.1) 169.1	0 (31.8 ± 35.5) 120.0	0 (23.6 ± 41.7) 149.7	0 (17.6 ± 28.0) 120.0	0.1 (19.6 ± 26.8) 109.3	0 (105.9 ± 73.4) 258.6	91.4 (255.4 ± 104.7) 514.3	70.1 (229.5 ± 90.6) 474.7	32 (152.1 ± 67.9) 269.4	0 (64.5 ± 56.9) 162.1	0 (30.3 ± 38.1) 115.1	0.4 (64.1 ± 63.2) 196.2	29.6 (922.3 ± 34.4) 1502.1

6.5%); seven (nine; 4.8%); eight (nine; 4.8%); and nine (11; 5.9%). The most broadly distributed species, i.e., those inhabiting all nine physiographic regions, consist of one anuran (*Lithobates pustulosus**), nine squamates (*Phrynosoma cornutum*, *Sceloporus poinsettii*, *Urosaurus ornatus*, *Aspidoscelis exsanguis*, *Masticophis flagellum*, *Salvadora deserticola*, *Thamnophis cyrtopsis*, *T. eques*, and *Crotalus lepidus*), and one turtle (*Kinosternon hirtipes*). With one exception (the Mexican endemic *Lithobates pustulosus*), the remaining species also range northward in the USA.

Of the 186 species that comprise the herpetofauna of Chihuahua, 74 (or 39.8%) occupy one or two physiographic regions, which is of considerable conservation significance. The mean regional occupancy is 3.7. The number of species occupying a single physiographic region ranges from none in one of the nine regions (GMCD) to 28 in the GMCC region. The remaining six regions have single-digit numbers of single-region species, including the LMN (one), SPN (one), BDM (four), LSV (five), SCN (one), and SLD (two).

The physiographic region of greatest conservation importance is the Gran Meseta y Cañones Chihuahuenses, since it contains the largest number of species (128, including 27 anurans, three salamanders, 39 lizards, 53 snakes, and six turtles), the largest number of single-region species (28 species, including eight anurans, three lizards, 15 snakes, and two turtles), the largest number of country endemics (57), and the single state endemic (*Plestiodon multilineatus*).

The 28 single-region species that are restricted to the Gran Meseta y Cañones Chihuahuenses (* = endemic to Mexico, ** = endemic to Chihuahua, and *** = non-native to Chihuahua) are as follows:

*Agalychnis dacnicolor**
Agkistrodon bilineatus
*Crotalus basiliscus**
*Eleutherodactylus interorbitalis**
Gastrophryne mazatlanensis
*Gopherus evgoodei**
*Heloderma horridum**
Holbrookia elegans
Hypopachus variolosus
Imantodes gemmistratus
*Lampropeltis polyzona**
*Leptophis diplotropis**
*Lithobates cora**
*Lithobates lemosespinali**
Micruroides euryxanthus
*Micrurus distans**
Oxybelis microphthalmus
*Phyllodactylus saxatilis**
*Rena dugesii**
*Rhadinaea hesperia**
Rhinella horribilis
Rhinoclemmys pulcherrima
*Sympholis lippiens**
Tantilla yaquia
*Thamnophis validus**
*Tlalocohyla smithi**

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

Order	Families	Genera	Species
Anura	8	14	35
Caudata	2	2	5
Subtotal	**10**	**16**	**40**
Squamata	19	59	133
Testudines	5	7	13
Subtotal	**24**	**66**	**146**
Total	**34**	**82**	**186**

*Trimorphodon tau**
*Tropidodipsas repleta**

Of these 28 single-region species, 18 (64.3%) are country endemics and 10 are non-endemics (35.7%).

The distribution of the following five species in Chihuahua is limited to the Llanuras y Sierras Volcánicas:

Agkistrodon laticinctus
Lampropeltis alterna
Nerodia erythrogaster
Pantherophis bairdi
Tantilla cucullata

All five of these species are non-endemics.

The following four species only occupy the Bolsón de Mapimí region in Chihuahua:

Ambystoma mavortium
*Indotyphlops braminus****
Rena segrega
*Uma paraphygas**

Two of these species are non-endemics, one is a country endemic, and one is a non-native.

The following two species are found only in the Sierras y Llanuras de Durango region in Chihuahua:

*Ambystoma velasci**
Salvadora lineata

One of these species is a country endemic and the other is a non-endemic.

Only a single species is restricted to each of the following three physiographic regions in Chihuahua. These three regions and the species involved are as follows:

Llanuras y Médanos del Norte—*Incilius alvarius*
Sierras Plegadas del Norte—*Eleutherodactylus marnockii*
Sierras y Cañadas del Norte—*Heloderma suspectum*

Each of these three species is a non-endemic.

Finally, no species are limited to the GMCD region in Chihuahua.

To determine the herpetofaunal relationships among the nine physiographic regions we recognize, we constructed a Coefficient of Biogeographic Resemblance (CBR) matrix (Table 6). As noted above, the number of species per physiographic region ranges from 58 in the SLD to 128 in the GMCC. The number of shared species ranges from 14 between the SPN and GMCD regions to 72 between the SCN and GMCC regions. The range and mean of the shared species numbers for each of the nine regions, arranged according to the increasing mean number, are as follows (mean number in parentheses followed by range, then by total regional number in parentheses):

GMCD — (27.6) 14–59 (59)
SCN — (42.6) 29–72 (78)
SLD — (37.4) 22–42 (58)
BDM — (44.5) 20–62 (80)
SPN — (38.9) 14–58 (64)
LMN — (45.6) 23–62 (81)
SLT — (40.1) 27–53 (61)
GMCC — (46.1) 27–72 (128)
LSV — (41.6) 17–61 (75)

Notably, with one exception, as the total regional number increases, so does the mean number of shared species.

The CBR data in Table 6 demonstrate a range of values from 0.23 to 0.83. The lowest value is that between the SPN and the GMCD, while the highest value is that between the SPN and the LSV. The highest CBR value for each of the nine regions is as follows:

LMN (81) — 0.77 — BDM (80)
SLT (61) — 0.76 — SCN (78)
SPN (64) — 0.83 — LSV (75)
GMCC (128) — 0.70 —SCN (78)
BDM (80) — 0.81 — SPN (64)
SLD (58) — 0.66 — SLT (61)
LSV (75) — 0.83 — SPN (64)
GMCD (59) — 0.63 — GMCC (128)
SCN (78) — 0.76 — SLT (61)

For the nine regions, the strongest relationships involve only six of the other regions (SPN, BDM, LSV, SCN, SLT, and GMCC). The SPN, SCN, and SLT are involved in two of these relationships, whereas the other three (BDM, LSV, and GMCC) are involved only once.

Based on the data in Table 6, we constructed a UPGMA dendrogram to conveniently illustrate the overall herpetofaunal resemblances among the nine physiographic regions in Chihuahua in a hierarchial fashion (Fig. 13). The dendrogram indicates that the nine physiographic regions are divided into two principal groups separated at the 0.40 level, one containing the GMCC and GMCD regions and the other containing the remaining seven regions. The GMCC and GMCD regions are located adjacent to one another in southwestern Chihuahua (Fig. 1), with the smaller GMCD region situated to the south of the GMCC region. The other seven regions are partitioned into two groups separated at the 0.53 level. One group comprises the SCN, SLT, and SLD regions, which are located in a swath lying to the east of the GMCC–GMCD pair that extends from the west-central portion of the state adjacent to the border of Sonora southeastward to the south-central portion adjacent to the border of Durango (Fig. 1). The SCN and SLT regions are separated at the 0.76 level and lie

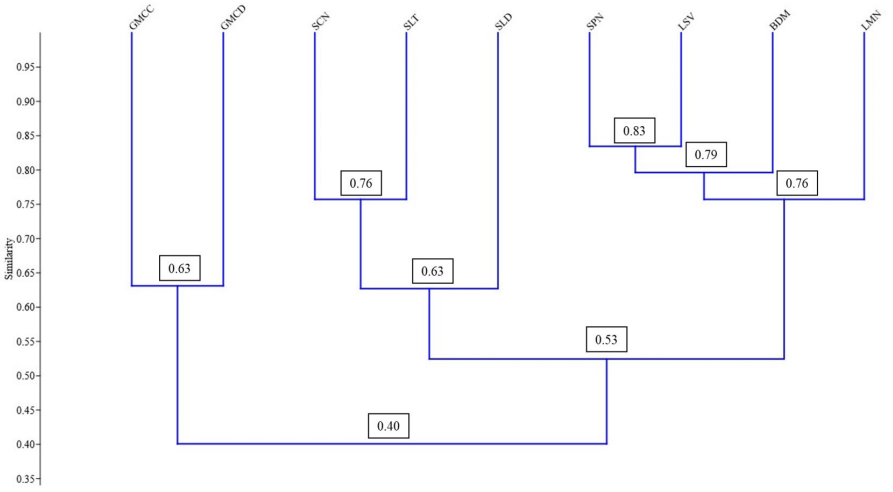


Fig. 13. UPGMA-generated dendrogram showing the similarity relationships of species richness among the herpetofaunal components of the nine physiographic provinces of Chihuahua (based on the data in Table 6; Sokal and Michener 1958). The similarity values were calculated using the Coefficient of Biogeographic Resemblance (CBR) of Duellman (1990).

adjacent to one another, with the SCN and SLT regions separated from the SLD region at the 0.63 level. Finally, the remaining four regions (LMN, SDM, LSV, and SPN) are joined to one another at the 0.76 level; these four regions are situated in a group occupying roughly the eastern half of the state (Fig. 1) and are comprised of two swaths (LMN–BDM and SPN–LSV), the latter lying to the east of the former. The two most closely related regions (at the 0.83 level) are the SPN and LSV regions that lie adjacent to one another along the borders of Texas and Coahuila. These two regions are connected to the BDM region, which is adjacent to both these regions, at the 0.79 level. Finally, as noted above, these three regions are connected to the LMN region, located in the northwestern section of the state adjacent to the border of New Mexico, at the 0.76 level.

Distribution Status Categorizations

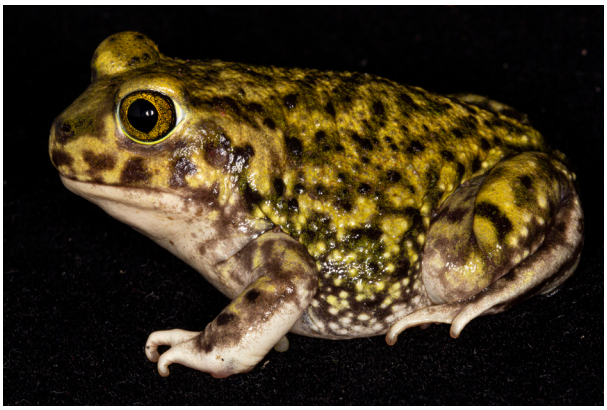
To categorize the distributional status of members of the Chihuahua herpetofauna, we used the system in Alvarado-Díaz et al. (2013) and the other MCS entries (see above). We indicate our assignment of the four distributional categories of non-endemic, country endemic, state endemic, and non-native species in Table 7 and summarize the data in Table 8.

The number and proportion of species in each of these four categories are as follows: non-endemic, 121 of 186 (65.1%); country endemics, 61 (32.8%); non-natives, three (1.6%); and state endemics, one (0.5%). Accordingly, the Chihuahua herpetofauna resembles the other faunas dealt with in the MCS that have more non-native species than in any other category, and in this case, all the other categories combined (121 vs. 65). The number of non-endemic species exceeds that of the country endemic species in Oaxaca (Mata-Silva et al. 2015, 2021), Chiapas (Johnson et al. 2015a), Nuevo León (Nevárez-de los Reyes et al. 2016), the Mexican Yucatan Peninsula (González-Sánchez et al. 2017), Coahuila (Lazcano et al. 2019), Veracruz (Torres-Hernández et al. 2021), Tabasco (Barragán-Vázquez et al. 2022), and the Baja California Peninsula (Peralta-García et al. 2023). In the other states dealt with thus far in the MCS, the number of country endemics is greater than that of the non-endemic species in Michoacán (Alvarado-Díaz et al. 2013), Nayarit (Woolrich-Piña et al. 2016), Jalisco (Cruz Sáenz et al. 2017), Puebla (Woolrich-Piña et al. 2017), Hidalgo (Ramírez-Bautista et al. 2020), Querétaro (Cruz-Elizalde et al. 2022), and Guanajuato (Leyte-Manrique et al. 2022).

As indicated above, in some entries of the MCS the number of country endemics is greater than the number of non-endemic species, whereas in others the reverse is the case. Thus, the ratios of country endemics to non-endemic species vary considerably, from 0.53 in Jalisco to 0.95 in Baja California. The ratios in which the number of non-endemics exceeds that of the country endemics range from 1.12 in Oaxaca to 127.0 in the Mexican Yucatan Peninsula. The figure for Chihuahua is 1.9 (121/65). As noted by Leyte-Manrique et al. (2022: 147), "the nature of this ratio depends on how close the state in question is to either the United States or Central America. This ratio also depends upon the size of these aspects of a given herpetofauna as to whether the ratio will be more or less than one." In the case of Chihuahua, we would expect the ratio to be greater than one since this state shares a relatively long border with the USA. Leyte-Manrique et al. (2022) quoted Torres-Hernández et al. (2021), who stated: "In the case of the three MCS states that border the USA, the ratios are 3.22 (100/31 in Coahuila; Lazcano et al. 2019), 2.44 (95/39 in Nuevo León; Nevárez-de los Reyes et al. 2016), and 2.32 (130/56 in Tamaulipas; Terán-Juárez et al. 2016)." As noted above, the ratio for Chihuahua is 1.9 (121/65), which is most similar to the ratio for Tamaulipas (i.e., 119/49=2.4; Terán-Juárez et al. 2016).

Interestingly, only one state endemic species is known to occur in Chihuahua, i.e., *Plestiodon multilineatus* (McCranie and Wilson 1987). This skink inhabits pine forests at elevations from 2,246 to 2,615 m in the Sierra Madre Occidental (Tanner 1988).

The three non-native species recorded from Chihuahua (Table 7) are the anuran *Lithobates catesbeianus*, the gecko



No. 13. *Scaphiopus couchii* Baird, 1854. The distribution of Couch's Spadefoot "extends from southeastern California to southeastern Colorado and southwestern Oklahoma, in the United States, southward in Mexico to northern Nayarit, Zacatecas, San Luis Potosí, and northern Veracruz" (Lemos-Espinal and Dixon 2013: 75–76). This individual was photographed in scrub vegetation near the city of Chihuahua, Chihuahua. Wilson et al. (2013b) established its EVS as 3, placing it at the lower limit of the low vulnerability category. Its IUCN status has been calculated as Least Concern, and this species is not listed by SEMARNAT. *Photo by Eric Centenero-Alcalá*.

No. 14. *Spea bombifrons* (Cope, 1863). The Plains Spadefoot is distributed from "southern Alberta and southwestern Saskatchewan (Canda) southward through Montana, North Dakota, … Nebraska and eastern Colorado to southeastern Utah, northeastern and southeastern Arizona, central Missouri, Oklahoma and western and South Texas (USA) to Chihuahua and Tamaulipas (Mexico)" (Frost 2023). This individual was photographed in sand dune vegetation containing an aromatic shrub (*Poliomintha incana*) and Sand Sagebrush (*Artemisa filifolia*) at Rancho Zorro Plateado in the city of Juárez, Chihuahua. Wilson et al. (2013b) calculated its EVS as 10, placing it at the lower limit of the medium vulnerability category. The IUCN rated this species as Least Concern, and this species is not listed by SEMARNAT. *Photo by Jesús M. Martínez-Calderas.*

No. 15. *Spea multiplicata* (Cope, 1863). The distribution of the Mexican Spadefoot "extends from southeastern Utah and southern Colorado through western Oklahoma, Arizona and New Mexico, in the United States, southward into Mexico to northern Sonora and throughout the Chihuahuan Desert to the Transvolcanic Belt; it also occurs in mountainous regions from the Sierra Madre Occidental of central Chihuahua southward to Oaxaca" (Lemos-Espinal and Dixon 2013: 76–77). This individual was photographed in a sand dune environment (médanos) near Rancho El Lobo, in the city of Juárez, Chihuahua. Wilson et al. (2013b) determined its EVS as 6, placing it in the middle of the low vulnerability category. The IUCN has established its conservation status as Least Concern, and this species is not listed by SEMARNAT. *Photo by Eric Centenero-Alcalá*.

No. 16. *Ambystoma rosaceum* Taylor, 1941. The Tarahumara Salamander occurs at "high elevations in the Sierra Madre Occidental from the region of Aguascalientes and western Zacatecas north through montane Nayarit, Durango and montane Sinaloa to northern Chihuahua (vicinity of Casas Grandes) and northern Sonora (Sierra Pinitos, Sierra de los Ajos, Sierra El Tigre, and Sierra San Luis in the north), Mexico" (Frost 2023). This larval individual was photographed in pine forest vegetation at Monterde, in the municipality of Guazapares, Chihuahua. Wilson et al. (2013b) ascertained its EVS as 14, placing it at the lower limit of the high vulnerability category. The IUCN conservation status of this salamander has been assessed at Least Concern, and this species was placed in the Special Protection category by SEMARNAT. *Photo by Eric Centenero-Alcalá*.

Table 4. Distribution of the amphibians, squamates, and turtles of Chihuahua, Mexico, by physiographic region (= sub physiographic provinces). Abbreviations: Sierra y Llanuras del Norte - Llanuras y Médanos del Norte (LMN), Sierras Plegadas del Norte (SPN), Bolsón de Mapimí (BDM), Llanuras y Sierras Volcánicas (LSV); Sierra Madre Occidental - Sierras y Cañadas del Norte (SCN), Sierras y Llanuras Tarahumaras (SLT), Gran Meseta y Cañones Chihuahuenses (GMCC), Sierras y Llanuras de Durango (SLD), and Gran Meseta y Cañones Duranguenses (GMCD). See text for descriptions of these regions. * = species endemic to Mexico; ** = species endemic to Chihuahua; and *** = non-native species.

Taxon	Physiographic region									Number of regions occupied
	Sierra y Llanuras del Norte				Sierra Madre Occidental					
	LMN	SPN	BDM	LSV	SCN	SLT	GMCC	SLD	GMCD	
Amphibia (40 species)										
Anura (35 species)										
Bufonidae (11 species)										
Anaxyrus cognatus	+	+	+	+	+	+		+		7
Anaxyrus debilis	+	+	+	+						4
Anaxyrus mexicanus *	+				+	+	+	+	+	6
Anaxyrus punctatus	+	+	+	+	+	+	+	+		8
Anaxyrus speciosus	+		+	+	+		+			5
Anaxyrus woodhousii	+	+	+	+	+	+	+	+		8
Incilius alvarius	+									1
Incilius mazatlanensis *							+		+	2
Incilius mccoyi *					+		+		+	3
Incilius occidentalis *					+		+			2
Rhinella horribilis							+			1
Craugastoridae (2 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
Craugastor augusti					+	+	+			3
Craugastor tarahumaraensis *					+		+	+		3
Eleutherodactylidae (2 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
Eleutherodactylus interorbitalis *							+			1
Eleutherodactylus marnockii		+								1
Hylidae (4 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
Dryophytes arenicolor	+			+	+	+	+	+	+	7
Dryophytes wrightorum					+	+	+			3
Smilisca baudinii					+		+			2
Tlalocohyla smithii *							+			1
Microhylidae (3 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
Gastrophryne mazatlanensis							+			1
Gastrophryne olivacea	+	+	+	+						4
Hypopachus variolosus							+			1
Phyllomedusidae (1 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
Agalychnis dacnicolor *							+			1
Ranidae (9 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
Lithobates berlandieri	+	+	+	+			+	+	+	7
Lithobates catesbeianus ***	+			+						2
Lithobates chiricahuensis	+		+		+	+	+	+		6
*Lithobates cora**							+			1
Lithobates lemosespinali *							+			1
Lithobates magnaocularis *					+	+	+			3
Lithobates pustulosus *	+	+	+	+	+	+	+	+	+	9
Lithobates tarahumarae					+		+		+	3
Lithobates yavapaiensis					+		+			2
Scaphiopodidae (3 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
Scaphiopus couchii	+	+	+	+				+		5
Spea bombifrons	+		+	+						3
Spea multiplicata	+	+	+	+	+	+	+	+		8
Caudata (5 species)										
Ambystomatidae (4 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
Ambystoma mavortium			+							1
Ambystoma rosaceum *			+		+	+	+		+	5
Ambystoma silvense *					+	+	+	+		4
Ambystoma velasci *								+		1

Table 4 (continued). Distribution of the amphibians, squamates, and turtles of Chihuahua, Mexico, by physiographic region (= sub physiographic provinces). Abbreviations: Sierra y Llanuras del Norte - Llanuras y Médanos del Norte (LMN), Sierras Plegadas del Norte (SPN), Bolsón de Mapimí (BDM), Llanuras y Sierras Volcánicas (LSV); Sierra Madre Occidental - Sierras y Cañadas del Norte (SCN), Sierras y Llanuras Tarahumaras (SLT), Gran Meseta y Cañones Chihuahuenses (GMCC), Sierras y Llanuras de Durango (SLD), and Gran Meseta y Cañones Duranguenses (GMCD). See text for descriptions of these regions. * = species endemic to Mexico; ** = species endemic to Chihuahua; and *** = non-native species.

Taxon	Physiographic region									Number of regions occupied
	Sierra y Llanuras del Norte				Sierra Madre Occidental					
	LMN	SPN	BDM	LSV	SCN	SLT	GMCC	SLD	GMCD	
Reptilia (146 species)										
Squamata (133 species)										
Squamata/Lacertilia (53 species)										
Anguidae (5 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
Barisia ciliaris *							+	+		2
Barisia imbricata *					+	+	+			3
Barisia levicollis *					+	+	+			3
Elgaria kingii			+		+	+	+		+	5
Gerrhonotus infernalis	+			+	+		+	+		5
Anolidae (1 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
Norops nebulosus *							+		+	2
Crotaphytidae (2 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
Crotaphytus collaris	+	+	+	+						4
Gambelia wislizenii	+	+	+	+						4
Eublepharidae (1 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
Coleonyx brevis		+	+	+						3
Gekkonidae (1 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
Hemidactylus turcicus ***		+	+	+						3
Helodermatidae (2 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
Heloderma horridum *							+			1
Heloderma suspectum					+					1
Iguanidae (1 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
Ctenosaura macrolopha *							+		+	2
Phrynosomatidae (23 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
Cophosaurus texanus	+	+	+	+				+		5
Holbrookia approximans *	+	+	+	+	+	+	+	+		8
Holbrookia elegans							+			1
Holbrookia maculata	+	+	+	+	+	+	+	+		8
Phrynosoma cornutum	+	+	+	+	+	+	+	+	+	9
Phrynosoma hernandesi	+		+		+	+	+	+		6
Phrynosoma modestum	+	+	+	+		+				5
Phrynosoma orbiculare *					+	+	+		+	4
Sceloporus albiventris *							+	+	+	3
Sceloporus clarkii	+				+		+	+	+	5
Sceloporus cowlesi	+	+	+	+						4
Sceloporus jarrovii	+		+		+	+	+	+	+	7
Sceloporus lemosespinali *					+	+	+		+	4
Sceloporus magister	+	+	+	+						4
Sceloporus merriami		+		+						2
Sceloporus nelsoni *							+		+	2
Sceloporus poinsettii	+	+	+	+	+	+	+	+	+	9
Sceloporus slevini			+		+	+	+	+	+	6
Sceloporus virgatus	+				+	+	+			4
Uma paraphygas *			+							1
Urosaurus bicarinatus *							+	+	+	3
Urosaurus ornatus	+	+	+	+	+	+	+	+	+	9
Uta stansburiana	+	+	+	+	+	+	+	+		8
Phyllodactylidae (1 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
*Phyllodactylus saxatilis**							+			1
Scincidae (7 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
Plestiodon bilineatus *		+			+		+	+		4

Table 4 (continued). Distribution of the amphibians, squamates, and turtles of Chihuahua, Mexico, by physiographic region (= sub physiographic provinces). Abbreviations: Sierra y Llanuras del Norte - Llanuras y Médanos del Norte (LMN), Sierras Plegadas del Norte (SPN), Bolsón de Mapimí (BDM), Llanuras y Sierras Volcánicas (LSV); Sierra Madre Occidental - Sierras y Cañadas del Norte (SCN), Sierras y Llanuras Tarahumaras (SLT), Gran Meseta y Cañones Chihuahuenses (GMCC), Sierras y Llanuras de Durango (SLD), and Gran Meseta y Cañones Duranguenses (GMCD). See text for descriptions of these regions. * = species endemic to Mexico; ** = species endemic to Chihuahua; and *** = non-native species.

Taxon	Physiographic region									Number of regions occupied
	Sierra y Llanuras del Norte				Sierra Madre Occidental					
	LMN	SPN	BDM	LSV	SCN	SLT	GMCC	SLD	GMCD	
Plestiodon multivirgatus	+				+		+		+	4
Plestiodon obsoletus	+	+	+	+		+		+		6
Plestiodon parviauriculatus *					+		+		+	3
Plestiodon tetragrammus		+	+	+	+	+	+		+	7
Teiidae (9 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
Aspidoscelis costatus *							+		+	2
Aspidoscelis exsanguis	+	+	+	+	+	+	+	+	+	9
Aspidoscelis gularis		+	+	+	+	+	+	+		7
Aspidoscelis inornata	+	+	+	+		+	+		+	7
Aspidoscelis marmorata	+	+	+	+		+	+			6
Aspidoscelis neomexicanus	+		+							2
Aspidoscelis sonorae	+				+					2
Aspidoscelis tesselata	+	+	+	+		+	+	+		7
Aspidoscelis uniparens	+	+	+	+	+	+	+	+		8
Squamata/Serpentes (80 species)										
Boidae (1 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
Boa sigma *							+		+	2
Colubridae (40 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
Arizona elegans	+	+	+	+				+		5
Bogertophis subocularis		+	+	+						3
Conopsis nasus *					+		+		+	3
Drymarchon melanurus							+		+	2
Drymobius margaritiferus							+		+	2
Gyalopion canum	+		+							2
Gyalopion quadrangulare							+		+	2
Lampropeltis alterna				+						1
Lampropeltis knoblochi					+	+	+	+		4
Lampropeltis polyzona *							+			1
Lampropeltis splendida	+	+		+				+		4
Leptophis diplotropis *							+			1
Masticophis bilineatus	+				+		+		+	4
Masticophis flagellum	+	+	+	+	+	+	+	+	+	9
Masticophis mentovarius				+			+		+	3
Masticophis taeniatus	+	+	+	+	+	+	+	+		8
Mastigodryas cliftoni *							+		+	2
Opheodrys vernalis					+		+		+	3
Oxybelis microphthalmus							+			1
Pantherophis bairdi				+						1
Pantherophis emoryi	+	+	+	+				+		5
Pituophis catenifer	+	+	+	+	+	+	+	+		8
Pituophis deppei *			+				+			2
Rhinocheilus lecontei	+	+	+	+						4
Salvadora bairdi *					+		+			2
Salvadora deserticola	+	+	+	+	+	+	+	+	+	9
Salvadora grahamiae	+		+	+	+	+		+		6
Salvadora lineata								+		1
Senticolis triaspis	+				+		+		+	4
Sonora aemula *							+		+	2
Sonora semiannulata	+	+	+	+		+				5
Sympholis lippiens *							+			1
Tantilla atriceps		+	+	+						3

Table 4 (continued). Distribution of the amphibians, squamates, and turtles of Chihuahua, Mexico, by physiographic region (= sub physiographic provinces). Abbreviations: Sierra y Llanuras del Norte - Llanuras y Médanos del Norte (LMN), Sierras Plegadas del Norte (SPN), Bolsón de Mapimí (BDM), Llanuras y Sierras Volcánicas (LSV); Sierra Madre Occidental - Sierras y Cañadas del Norte (SCN), Sierras y Llanuras Tarahumaras (SLT), Gran Meseta y Cañones Chihuahuenses (GMCC), Sierras y Llanuras de Durango (SLD), and Gran Meseta y Cañones Duranguenses (GMCD). See text for descriptions of these regions. * = species endemic to Mexico; ** = species endemic to Chihuahua; and *** = non-native species.

Taxon	Physiographic region									Number of regions occupied
	Sierra y Llanuras del Norte				Sierra Madre Occidental					
	LMN	SPN	BDM	LSV	SCN	SLT	GMCC	SLD	GMCD	
Tantilla nigriceps	+	+	+				+			4
Tantilla wilcoxi					+	+	+	+		4
Tantilla yaquia							+			1
Trimorphodon tau *							+			1
Trimorphodon vilkinsonii	+	+	+							3
Dipsadidae (10 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
Diadophis punctatus	+			+	+		+		+	5
Geophis dugesii *							+		+	2
Heteredon kennerlyi	+	+	+	+	+	+				6
Hypsiglena chlorophaea	+	+	+	+		+		+		6
Hypsiglena jani		+	+	+				+		4
Imantodes gemmistratus							+			1
Leptodeira splendida *							+		+	2
Rhadinaea hesperia *							+			1
Rhadinaea laureata *							+		+	2
Tropidodipsas repleta *							+			1
Elapidae (2 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
Micruroides euryxanthus							+			1
Micrurus distans *							+			1
Leptotyphlopidae (4 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
Rena dugesii *							+			1
Rena dulcis	+			+				+		3
Rena humilis	+		+	+			+			4
Rena segrega			+							1
Natricidae (11 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
Nerodia erythrogaster				+						1
Storeria storerioides *					+		+		+	3
Thamnophis cyrtopsis	+	+	+	+	+	+	+	+	+	9
Thamnophis elegans			+		+	+	+		+	5
Thamnophis eques	+	+	+	+	+	+	+	+	+	9
Thamnophis errans *					+	+	+	+	+	5
Thamnophis marcianus	+	+	+	+		+		+		6
Thamnophis melanogaster *					+		+			2
Thamnophis sirtalis	+		+		+	+	+		+	6
Thamnophis unilabialis *					+		+	+	+	4
Thamnophis validus *							+			1
Typhlopidae (1 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
Indotyphlops braminus ***			+							1
Viperidae (11 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
Agkistrodon bilineatus							+			1
Agkistrodon laticinctus				+						1
Crotalus atrox	+	+	+	+	+			+		6
Crotalus basiliscus *							+			1
Crotalus lepidus	+	+	+	+	+	+	+	+	+	9
Crotalus molossus					+	+	+	+	+	5
Crotalus ornatus	+	+	+	+						4
Crotalus pricei					+	+	+		+	4
Crotalus scutulatus	+	+	+	+	+	+		+		7
Crotalus viridis	+	+								2
Crotalus willardi					+	+	+		+	4
Testudines (13 species)										

Table 4 (continued). Distribution of the amphibians, squamates, and turtles of Chihuahua, Mexico, by physiographic region (= sub physiographic provinces). Abbreviations: Sierra y Llanuras del Norte - Llanuras y Médanos del Norte (LMN), Sierras Plegadas del Norte (SPN), Bolsón de Mapimí (BDM), Llanuras y Sierras Volcánicas (LSV); Sierra Madre Occidental - Sierras y Cañadas del Norte (SCN), Sierras y Llanuras Tarahumaras (SLT), Gran Meseta y Cañones Chihuahuenses (GMCC), Sierras y Llanuras de Durango (SLD), and Gran Meseta y Cañones Duranguenses (GMCD). See text for descriptions of these regions. * = species endemic to Mexico; ** = species endemic to Chihuahua; and *** = non-native species.

Taxon	Physiographic region									Number of regions occupied
	Sierra y Llanuras del Norte				Sierra Madre Occidental					
	LMN	SPN	BDM	LSV	SCN	SLT	GMCC	SLD	GMCD	
Terrapene nelsoni *	+						+		+	3
Terrapene ornata	+	+	+	+						4
Trachemys gaigeae	+	+	+							3
Geoemydidae (1 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
Rhinoclemmys pulcherrima							+			1
Kinosternidae (5 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
Kinosternon durangoense *			+	+						2
Kinosternon flavescens	+	+		+						3
Kinosternon hirtipes	+	+	+	+	+	+	+	+	+	9
Kinosternon integrum *	+						+			2
Kinosternon sonoriense	+				+	+	+			4
Testudinidae (2 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
Gopherus evgoodei *							+			1
Gopherus flavomarginatus *			+	+						2
Trionychidae (1 species)	**LMN**	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**	
Apalone spinifera	+	+	+	+						4
Total (186 species)										

Hemidactylus turcicus, and the blindsnake *Indotyphlops braminus*. The blindsnake *I. braminus* is one of the most widespread non-native species in Mexico, as it has been recorded in all 16 previous MCS entries. González-Sánchez et al. (2021) also indicated this snake is one of the most widespread of the introduced herpetofaunal taxa in Mesoamerica (Mexico and Central America), as it has been recorded in six of the eight countries in this region, and this blindsnake also occurs in northwestern Costa Rica (Wallach 2020a; Solórzano 2022).

Wilson et al. (2017) developed a system for categorizing the distribution of the non-endemic species of the Mesoamerican herpetofauna, including those of Mexico. As expected, the categorization of the non-endemic species in Chihuahua (Table 9) demonstrates that most of them (108 of 121 or 89.3%) are placed in the MXUS category. This situation was expected given that Chihuahua is one of the six Mexican states along the Mexico–USA border, as well as the one with the longest border. The next most common categorization is USCA (six, or 5.0%), which also was expected since Chihuahua lies at the opposite end of the country of Mexico from any of the countries in Central America. The MXSA and MXCA species each amount to three (2.5%). Finally, a single USSA species is represented (0.8%). Thus, all but six of the non-endemic species have distributional ranges that extend northward into the USA, and in a few cases all the way to South America.

Herpetofaunal Comparisons in Adjacent Mexican States

As indicated above, the northern border of Chihuahua is part of the border between Mexico and the USA. The rest of Chihuahua's border is contiguous with parts of the Mexican states of Sonora, Sinaloa, Durango, and Coahuila. The herpetofauna of Coahuila was examined in the Mexican Conservation Series (Lazcano et al. 2019), and the herpetofauna of Durango, Sinaloa, and Sonora were dealt with by Lemos-Espinal et al. (2018a, 2019b, 2020).

In Table 10 we compare the herpetofauna of Chihuahua to those of the five bordering Mexican states, which indicates the total number of herpetofaunal species, the number of endemic species (both state and country, as applicable), the number of non-native species, and the percentage of endemism (calculated as the number of endemic species [state and country endemics] divided by the number of native species times 100).

The size of the herpetofauna in each of these five states ranges from 143 in Coahuila to 200 in Sonora (Table 10). The number of non-endemic species ranges from 73 in Sinaloa to 125 in Sonora. The number of endemic species ranges from 40 in Coahuila to 82 in Sinaloa. In most of these five states the number of non-endemic species is higher than the number of endemic species, except for Sinaloa. The ratios of endemic species to non-endemic species for the five states are as follows: Sonora (68/125 = 0.54); Chihuahua (62/121 = 0.51); Coahuila (40/100 = 0.40); Durango (72/81 = 0.89); and Sinaloa (82/73 = 1.12). Evidently, the lower ratios are those for Coahuila, Chihuahua, and Sonora, all states that share a border with the USA; the higher ratios are those for Durango and Sinaloa, states that do not border the USA. The percentage of endemism in the five states ranges from 28.6 in Coahuila to 52.9 in Sinaloa, with a mean value of 39.4. Finally, the number of non-native species ranges from three to seven. Three of the five states harbor three non-native species (Chihuahua,

Table 5. Distributional summary of the herpetofaunal families in Chihuahua, Mexico, by physiographic region. See Table 4 for an explanation of the abbreviations.

Family	Number of species	Distributional occurrence								
		LMN	SPN	BDM	LSV	SCN	SLT	GMCC	SLD	GMCD
Bufonidae	11	7	4	5	5	7	4	8	4	3
Craugastoridae	2	—	—	—	—	2	1	2	1	—
Eleutherodactylidae	2	—	1	—	—	—	—	1	—	—
Hylidae	4	1	—	—	1	3	2	4	1	1
Microhylidae	3	1	1	1	1	—	—	2	—	—
Phyllomedusidae	1	—	—	—	—	—	—	1	—	—
Ranidae	9	4	2	3	3	5	3	8	3	3
Scaphiopodidae	3	3	2	3	3	1	1	1	2	—
Subtotal	**35**	**16**	**10**	**12**	**13**	**18**	**11**	**27**	**11**	**7**
Ambystomatidae	4	—	—	2	—	2	2	2	2	1
Plethodontidae	1	—	—	—	—	1	—	1	—	—
Subtotal	**5**	**—**	**—**	**2**	**—**	**3**	**2**	**3**	**2**	**1**
Amphibians total	**40**	**16**	**10**	**14**	**13**	**21**	**13**	**30**	**13**	**8**
Anguidae	5	1	—	1	1	4	3	5	2	1
Anolidae	1	—	—	—	—	—	—	1	—	1
Crotaphytidae	2	2	2	2	2	—	—	—	—	—
Eublepharidae	1	—	1	1	1	—	—	—	—	—
Gekkonidae	1	—	1	1	1	—	—	—	—	—
Helodermatidae	2	—	—	—	—	1	—	1	—	—
Iguanidae	1	—	—	—	—	—	—	1	—	1
Phrynosomatidae	23	14	11	14	11	13	13	17	13	11
Phyllodactylidae	1	—	—	—	—	—	—	1	—	—
Scincidae	7	2	3	2	2	6	3	6	2	4
Teiidae	9	7	6	7	6	4	6	7	4	3
Subtotal	**53**	**26**	**24**	**28**	**24**	**28**	**25**	**39**	**21**	**21**
Boidae	1	—	—	—	—	—	—	1	—	1
Colubridae	40	16	14	16	17	12	8	26	11	12
Dipsadidae	10	3	3	3	4	2	2	7	2	4
Elapidae	2	—	—	—	—	—	—	2	—	—
Leptotyphlopidae	4	2	—	2	2	—	—	2	1	—
Natricidae	11	4	3	5	4	8	6	9	5	7
Typhlopidae	1	—	—	1	—	—	—	—	—	—
Viperidae	11	5	5	4	5	6	5	6	4	4
Subtotal	**80**	**30**	**25**	**31**	**32**	**28**	**21**	**53**	**23**	**28**
Emydidae	4	4	2	3	1	—	—	1	—	1
Geoemydidae	1	—	—	—	—	—	—	1	—	—
Kinosternidae	5	4	2	2	3	2	2	3	1	1
Testudinidae	2	—	—	1	1	—	—	1	—	—
Trionychidae	1	1	1	1	1	—	—	—	—	—
Subtotal	**13**	**9**	**5**	**7**	**6**	**2**	**2**	**6**	**1**	**2**
Reptiles total	**146**	**65**	**54**	**66**	**62**	**58**	**48**	**98**	**45**	**51**
Sum total	**186**	**81**	**64**	**80**	**75**	**78**	**61**	**128**	**58**	**59**

No. 17. *Barisia ciliaris* (Smith, 1942). The distribution of the Sierra Alligator Lizard "extends along the Sierra Madre Oriental, from Nuevo León and southeastern Coahuila southward to at least Guanajuato, and northward along the Sierra Madre Occidental to extreme southern Chihuahua" (Lemos-Espinal and Dixon 2013: 96–97). This individual was photographed in pine-oak forest at 25 km E of Guachochi on highway 23, in the municipality of Balleza, Chihuahua. Wilson et al. (2013a) determined its EVS as 15, placing it in the lower portion of the high vulnerability category. The IUCN has not evaluated its conservation status, and this species is not listed by SEMARNAT. *Photo by Antonio Esaú Valdenegro Brito*.

No. 18. *Barisia levicollis* Stejneger, 1890. The Chihuahuan Alligator Lizard is distributed in Chihuahua (Lemos-Espinal and Smith 2007), and it also might occur in eastern Sonora (Rorabaugh and Lemos-Espinal 2016). This individual was photographed in a remnant patch of pine forest at La Mesa de Cristo Rey, in the municipality of Guerrero, Chihuahua. Wilson et al. (2013a) calculated its EVS as 15, placing it in the lower portion of the high vulnerability category. The IUCN has evaluated its conservation status as Data Deficient, and it was noted as a species of Special Protection by SEMARNAT. *Photo by José Eduardo Gámez López*.

No. 19. *Elgaria kingii* Gray, 1838. The Madrean Alligator Lizard "lives in and adjacent to mountains of eastern Arizona, southwestern New Mexico, and in the Sierra Madre in eastern Sonora and western Chihuahua … to Jalisco" (Lemos-Espinal and Smith 2007). This individual was photographed in pine forest at Divisadero, in the municipality of Urique, Chihuahua. Wilson et al. (2013a) determined the EVS of this anguid as 10, placing it at the lower limit of the medium vulnerability category. The IUCN has judged its conservation status as Least Concern, and it was placed in the Special Protection category by SEMARNAT. *Photo by Eric Centenero-Alcalá*.

No. 20. *Gerrhonotus infernalis* Baird, 1859. The Texas Alligator Lizard occurs from "central Texas west to the Big Bend area, and west of the Sierra Madre Oriental to southern San Luis Potosí and perhaps extreme southeastern Durango. Its distribution in Mexico is limited to the Chihuahuan Desert and Sierra Madre Oriental biotic provinces…" (Lemos-Espinal et al. 2018). This adult individual was photographed in pine-oak forest at Sierra Rica, in the municipality of Manuel Benavides, Chihuahua. Wilson et al. (2013a) assessed its EVS as 13, placing it at the upper limit of the medium vulnerability category. The IUCN evaluated its conservation status as Least Concern, and this species is not listed by SEMARNAT. *Photo by José Candelario Hernández Álvarez*.

Table 6. Pair-wise comparison matrix of the Coefficient of Biogeographic Resemblance (CBR) data of herpetofaunal relationships for the nine physiographic regions in Chihuahua, 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 abbreviations. See Fig. 11 for the UPGMA dendrogram produced from the CBR data.

	Physiographic region								
	LMN	**SPN**	**BDM**	**LSV**	**SCN**	**SLT**	**GMCC**	**SLD**	**GMCD**
LMN	**81**	54	62	59	41	40	44	42	23
SPN	0.74	**64**	58	58	29	33	29	36	14
BDM	0.77	0.81	**80**	61	36	42	38	39	20
LSV	0.76	0.83	0.79	**75**	31	35	33	39	17
SCN	0.52	0.41	0.46	0.41	**78**	53	72	40	39
SLT	0.56	0.53	0.60	0.51	0.76	**61**	52	39	27
GMCC	0.42	0.30	0.37	0.33	0.70	0.55	**128**	42	59
SLD	0.60	0.59	0.57	0.59	0.59	0.66	0.45	**58**	22
GMCD	0.33	0.23	0.29	0.25	0.57	0.45	0.63	0.38	**59**

Coahuila, and Durango), one supports four species (Sinaloa), and one contains seven species (Sonora). The total number of non-native species in these five states is nine, which includes two anurans (*Lithobates catesbeianus* in Chihuahua, Coahuila, Durango, Sinaloa, and Sonora, and *L. berlandieri* in Sonora), four lizards (*Gehyra mutilata* in Sinaloa, *Hemidactylus frenatus* in Sinaloa and Sonora, *H. turcicus* in Chihuahua, Coahuila, Durango, and Sonora, and *Sauromalus hispidus* in Sonora), one snake (*Indotyphlops braminus* in Chihuahua, Durango, Sinaloa, and Sonora), and two turtles (*Trachemys scripta* in Coahuila and *Apalone spinifera* in Sonora). The most widespread of these nine non-native species are *Lithobates catesbeianus* (five states), and *Hemidactylus turcicus* and *Indotyphlops braminus* (four states each).

Principal Environmental Threats

In each entry of the Mexican Conservation Series (see description above) we concluded that the inclusion of species within the state's system of protected areas is an important step toward assuring the safety of the herpetofauna from anthropogenic threats. In doing so, several assumptions were made. A major assumption is that the system of natural protected areas (NPAs) is so extensive and well protected that the perpetuity of the herpetofauna is guaranteed. This assumption is based on the premise that the integrity of the NPAs is protected from direct impacts by human action for the long term (e.g., land conversion), and also that these areas will somehow remain unimpacted by over-arching global environmental threats such as climate change and water pollution. Thus, even given that the maintenance of sufficiently inclusive NPAs is an important first step in the direction of long-term support for the herpetofaunal populations, broad-scale studies of the impact of humanity on the nine "planetary boundaries" indicate that our species has exceeded the "safe operating space" within the last few years (Richardson et al. 2023).

A summary piece based this paper indicated that:

> *"back in 2009 researchers published the first report on exceeding the boundaries of Earth's 'safe operating space.' In 2015, there was an update, which concluded that the Earth had crossed the line beyond safety on at least four of nine boundaries* (*i.e., climate change, land use, biodiversity, and nutrient flows*). *Now, the researchers have provided an even more disturbing update assessing the planet's health* (*Earth beyond six of nine planetary boundaries*), *in which fresh water and forests were added to the list. Only three boundaries, stratospheric ozone levels, air pollution, and ocean acidification are still inside the safety zone, and the two latter areas are edging up to the boundary. The researchers noted: Currently, anthropogenic perturbations of the global environment are primarily addressed as if they were separate issues, e.g., climate change, biodiversity loss, or pollution. This approach, however, ignores these perturbations' nonlinear interaction and resulting aggregate effects on the overall state of Earth's system. Planetary boundaries bring a scientific understanding of anthropogenic global environmental impacts into a framework that calls for considering the state of Earth's system as a whole."*

Whereas this last conclusion appears "earth-shaking" (no pun intended), this conclusion is so elementary that it might be characterized as "environmental science 101," to use the vernacular. Johnson et al. (2017) put it this way:

> *"All life on planet Earth* (*i.e., the biosphere*) *exists at the intersections among the three abiotic spheres, i.e., the atmosphere, hydrosphere, and lithosphere, and is dependent on their interplay for continued existence over time. These four spheres are all interrelated in a huge variety of ways, in a planet-wide system of energy flow and the cycling of materials referred to as the ecosystem."*

Again, this idea is fundamental to the study of environmental science and should not be considered as new to the above-cited study of planetary boundaries. Nevertheless, the speed at which these planet-wide changes are occurring should give any person who reaches conclusions based on demonstrable evidence pause. The first report discussed above appeared in 2009, the second in 2015, and the third in 2023…a span of 14 years. Therefore, one of the most important questions facing all of humanity at this juncture is how much more time needs to be poorly used to the point that the remaining planetary boundaries will be breached.

Table 7. Distributional and conservation status measures for members of the herpetofauna of Chihuahua, Mexico. Distributional status: SE = endemic to state of Chihuahua; CE = endemic to country of Mexico; NE = not endemic to state or country; and NN = non-native. The numbers suffixed to the NE category signify the distributional categories developed by Wilson et al. (2017) and implemented in the taxonomic list at the *Mesoamerican Herpetology* website (http://mesoamericanherpetology.com), as follows: 3 = species distributed only in Mexico and the United States; 6 = species ranging from Mexico to South America; 7 = species ranging from the United States to Central America; and 8 = species ranging from the United States to South America. 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 categorizations: CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least Concern; DD = Data Deficient; NE = Not Evaluated. SEMARNAT Status: A = Threatened; P = Endangered; Pr = Special Protection; and NS = No Status. * = Endemic to Mexico; ** = Endemic to Chihuahua; *** = Non-native. See text for explanations of the EVS, IUCN, and SEMARNAT rating systems.

Taxon	Distributional status	Environmental Vulnerability Category (score)	IUCN categorization	SEMARNAT status
Anaxyrus cognatus	NE3	L (9)	LC	NS
Anaxyrus debilis	NE3	L (7)	LC	Pr
*Anaxyrus mexicanus**	CE	M (13)	LC	NS
Anaxyrus punctatus	NE3	L (5)	LC	NS
Anaxyrus speciosus	NE3	M (12)	LC	NS
Anaxyrus woodhousii	NE3	M (10)	LC	NS
Incilius alvarius	NE3	M (11)	LC	NS
*Incilius mazatlanensis**	CE	M (12)	LC	NS
*Incilius mccoyi**	CE	H (14)	LC	NS
*Incilius occidentalis **	CE	M (11)	LC	NS
Rhinella horribilis	NE7	L (3)	NE	NS
Craugastor augusti	NE3	L (8)	LC	NS
*Craugastor tarahumaraensis**	CE	H (17)	LC	Pr
*Eleutherodactylus interorbitalis**	CE	H (15)	LC	Pr
Eleutherodactylus marnockii	NE3	M (11)	LC	NS
Dryophytes arenicolor	NE3	L (7)	LC	NS
Dryophytes wrightorum	NE3	L (9)	LC	NS
Smilisca baudinii	NE7	L (3)	LC	NS
*Tlalocohyla smithi**	CE	M (11)	LC	NS
Gastrophryne mazatlanensis	NE3	L (8)	LC	NS
Gastrophryne olivacea	NE3	L (9)	LC	Pr
Hypopachus variolosus	NE7	L (4)	LC	NS
*Agalychnis dacnicolor**	CE	M (13)	LC	NS
Lithobates berlandieri	NE3	L (7)	LC	Pr
*Lithobates catesbeianus****	NN	—	—	—
Lithobates chiricahuensis	NE3	M (11)	VU	A
*Lithobates cora**	CE	M (13)	LC	NS
*Lithobates lemosespinali**	CE	H (14)	DD	NS
*Lithobates magnaocularis**	CE	M (12)	LC	NS
*Lithobates pustulosus**	CE	L (9)	LC	Pr
Lithobates tarahumarae	NE3	L (8)	VU	NS
Lithobates yavapaiensis	NE3	M (12)	LC	Pr
Scaphiopus couchii	NE3	L (3)	LC	NS
Spea bombifrons	NE3	M (10)	LC	NS
Spea multiplicata	NE3	L (6)	LC	NS
Ambystoma mavortium	NE3	M (10)	LC	NS
*Ambystoma rosaceum**	CE	H (14)	LC	Pr
*Ambystoma silvense**	CE	H (14)	DD	NS
*Ambystoma velasci**	CE	M (10)	LC	Pr
*Isthmura sierraoccidentalis**	CE	H (17)	VU	NS
*Barisia ciliaris**	CE	H (15)	LC	NS
*Barisia imbricata **	CE	H (14)	LC	Pr
*Barisia levicollis**	CE	H (15)	DD	Pr
Elgaria kingii	NE3	M (10)	LC	Pr
Gerrhonotus infernalis	NE3	M (13)	LC	NS
*Norops nebulosus**	CE	M (13)	LC	NS
Crotaphytus collaris	NE3	M (13)	LC	A
Gambelia wislizenii	NE3	M (13)	LC	Pr
Coleonyx brevis	NE3	H (14)	LC	Pr
*Hemidactylus turcicus****	NN	—	LC	—
*Heloderma horridum**	CE	M (11)	LC	A
Heloderma suspectum	NE3	H (15)	NT	A
*Ctenosaura macrolopha**	CE	H (19)	LC	NS
Cophosaurus texanus	NE3	H (14)	LC	A
*Holbrookia approximans**	CE	H (14)	NE	NS
Holbrookia elegans	NE3	M (13)	LC	NS
Holbrookia maculata	NE3	M (10)	LC	NS
Phrynosoma cornutum	NE3	M (11)	LC	NS
Phrynosoma hernandesi	NE3	M (13)	LC	NS

Table 7 (continued). Distributional and conservation status measures for members of the herpetofauna of Chihuahua, Mexico. Distributional status: SE = endemic to state of Chihuahua; CE = endemic to country of Mexico; NE = not endemic to state or country; and NN = non-native. The numbers suffixed to the NE category signify the distributional categories developed by Wilson et al. (2017) and implemented in the taxonomic list at the *Mesoamerican Herpetology* website (http://mesoamericanherpetology.com), as follows: 3 = species distributed only in Mexico and the United States; 6 = species ranging from Mexico to South America; 7 = species ranging from the United States to Central America; and 8 = species ranging from the United States to South America. 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 categorizations: CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least Concern; DD = Data Deficient; NE = Not Evaluated. SEMARNAT Status: A = Threatened; P = Endangered; Pr = Special Protection; and NS = No Status. * = Endemic to Mexico; ** = Endemic to Chihuahua; *** = Non-native. See text for explanations of the EVS, IUCN, and SEMARNAT rating systems.

Taxon	Distributional status	Environmental Vulnerability Category (score)	IUCN categorization	SEMARNAT status
Phrynosoma modestum	NE3	M (12)	LC	NS
*Phrynosoma orbiculare**	CE	M (12)	LC	A
*Sceloporus albiventris**	CE	H (16)	NE	NS
Sceloporus clarkii	NE3	M (10)	LC	NS
Sceloporus cowlesi	NE3	M (13)	NE	NS
Sceloporus jarrovii	NE3	M (11)	LC	NS
*Sceloporus lemosespinali**	CE	H (16)	DD	NS
Sceloporus magister	NE3	L (9)	LC	NS
Sceloporus merriami	NE3	M (13)	LC	NS
*Sceloporus nelsoni**	CE	M (13)	LC	NS
Sceloporus poinsettii	NE3	M (12)	LC	NS
Sceloporus slevini	NE3	M (11)	LC	NS
Sceloporus virgatus	NE3	H (15)	LC	NS
*Uma paraphygas**	CE	H (17)	NT	P
*Urosaurus bicarinatus**	CE	M (12)	LC	NS
Urosaurus ornatus	NE3	M (10)	LC	NS
Uta stansburiana	NE3	L (7)	LC	A
*Phyllodactylus saxatilis**	CE	H (16)	NE	NS
*Plestiodon bilineatus**	CE	M (13)	NE	NS
Plestiodon callicephalus	NE3	M (12)	LC	NS
*Plestiodon multilineatus***	SE	H (16)	DD	Pr
Plestiodon multivirgatus	NE3	H (14)	LC	Pr
Plestiodon obsoletus	NE3	M (11)	LC	NS
*Plestiodon parviauriculatus**	CE	H (15)	DD	Pr
Plestiodon tetragrammus	NE3	M (12)	LC	NS
*Aspidoscelis costata**	CE	M (11)	LC	Pr
Aspidoscelis exsanguis	NE3	H (14)	LC	NS
Aspidoscelis gularis	NE3	L (9)	LC	NS
Aspidoscelis inornata	NE3	H (14)	LC	NS
Aspidoscelis marmorata	NE3	H (14)	NE	NS
Aspidoscelis neomexicanus	NE3	H (15)	LC	Pr
Aspidoscelis sonorae	NE3	M (13)	LC	NS
Aspidoscelis tesselata	NE3	H (14)	LC	NS
Aspidoscelis uniparens	NE3	H (15)	LC	NS
*Boa sigma**	CE	H (15)	NE	NS
Arizona elegans	NE3	L (5)	LC	NS
Bogertophis subocularis	NE3	H (14)	LC	NS
*Conopsis nasus**	CE	M (11)	LC	NS
Drymarchon melanurus	NE6	L (6)	LC	NS
Drymobius margaritiferus	NE8	L (6)	LC	NS
Gyalopion canum	NE3	L (9)	LC	NS
Gyalopion quadrangulare	NE3	M (11)	LC	Pr
Lampropeltis alterna	NE3	H (14)	LC	A
Lampropeltis knoblochi	NE3	M (10)	LC	NS
*Lampropeltis polyzona**	CE	L (7)	LC	NS
Lampropeltis splendida	NE3	M (12)	LC	NS
*Leptophis diplotropis**	CE	H (14)	LC	A
Masticophis bilineatus	NE3	M (11)	LC	NS
Masticophis flagellum	NE3	L (8)	LC	A
Masticophis mentovarius	NE6	L (6)	LC	A
Masticophis taeniatus	NE3	M (10)	LC	NS
*Mastigodryas cliftoni**	CE	H (14)	DD	NS
Opheodrys vernalis	NE3	H (14)	LC	NS
Oxybelis microphthalmus	NE3	M (11)	NE	NS
Pantherophis bairdi	NE3	H (15)	LC	NS
Pantherophis emoryi	NE3	M (13)	LC	NS
Pituophis catenifer	NE3	L (9)	LC	NS
*Pituophis deppei**	CE	H (14)	LC	A
Rhinocheilus lecontei	NE3	L (8)	LC	NS

Table 7 (continued). Distributional and conservation status measures for members of the herpetofauna of Chihuahua, Mexico. Distributional status: SE = endemic to state of Chihuahua; CE = endemic to country of Mexico; NE = not endemic to state or country; and NN = non-native. The numbers suffixed to the NE category signify the distributional categories developed by Wilson et al. (2017) and implemented in the taxonomic list at the *Mesoamerican Herpetology* website (http://mesoamericanherpetology.com), as follows: 3 = species distributed only in Mexico and the United States; 6 = species ranging from Mexico to South America; 7 = species ranging from the United States to Central America; and 8 = species ranging from the United States to South America. 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 categorizations: CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least Concern; DD = Data Deficient; NE = Not Evaluated. SEMARNAT Status: A = Threatened; P = Endangered; Pr = Special Protection; and NS = No Status. * = Endemic to Mexico; ** = Endemic to Chihuahua; *** = Non-native. See text for explanations of the EVS, IUCN, and SEMARNAT rating systems.

Taxon	Distributional status	Environmental Vulnerability Category (score)	IUCN categorization	SEMARNAT status
*Salvadora bairdi**	CE	H (15)	LC	Pr
Salvadora deserticola	NE3	H (14)	NE	NS
Salvadora grahamiae	NE3	M (10)	LC	NS
Salvadora lineata	NE3	M (11)	NE	NS
Senticolis triaspis	NE7	L (6)	LC	NS
*Sonora aemula**	CE	H (16)	NT	Pr
Sonora semiannulata	NE3	L (5)	LC	NS
*Sympholis lippiens**	CE	H (14)	DD	NS
Tantilla atriceps	NE3	M (11)	LC	A
Tantilla cucullata	NE3	M (12)	LC	NS
Tantilla hobartsmithi	NE3	M (11)	LC	NS
Tantilla nigriceps	NE3	M (11)	LC	NS
Tantilla wilcoxi	NE3	M (10)	LC	NS
Tantilla yaquia	NE3	M (10)	LC	NS
*Trimorphodon tau**	CE	M (13)	LC	NS
Trimorphodon vilkinsonii	NE3	H (15)	LC	A
Diadophis punctatus	NE3	L (4)	LC	NS
*Geophis dugesii**	CE	M (13)	LC	NS
Heterodon kennerlyi	NE3	M (11)	LC	NS
Hypsiglena chlorophaea	NE3	L (8)	LC	Pr
Hypsiglena jani	NE3	L (6)	LC	Pr
Imantodes gemmistratus	NE6	L (6)	LC	Pr
*Leptodeira splendida**	CE	H (14)	LC	NS
*Rhadinaea hesperia**	CE	M (10)	LC	Pr
*Rhadinaea laureata**	CE	M (12)	LC	NS
*Tropidodipsas repleta**	CE	H (17)	DD	NS
Micruroides euryxanthus	NE3	H (15)	LC	A
*Micrurus distans**	CE	H (14)	LC	Pr
*Rena dugesii**	CE	H (14)	NE	NS
Rena dulcis	NE3	M (13)	LC	NS
Rena humilis	NE3	L (8)	LC	NS
Rena segrega	NE3	L (8)	NE	NS
Nerodia erythrogaster	NE3	M (11)	LC	A
*Storeria storerioides**	CE	M (11)	LC	NS
Thamnophis cyrtopsis	NE7	L (7)	LC	A
Thamnophis elegans	NE3	H (14)	LC	A
Thamnophis eques	NE3	L (8)	LC	A
*Thamnophis errans**	CE	H (16)	LC	NS
Thamnophis marcianus	NE7	M (10)	LC	A
*Thamnophis melanogaster**	CE	H (15)	EN	A
Thamnophis sirtalis	NE3	H (14)	LC	Pr
*Thamnophis unilabialis**	CE	H (16)	NE	NS
*Thamnophis validus**	CE	M (12)	NE	NS
*Virgotyphlops braminus****	NN	—	LC	—
Agkistrodon bilineatus	NE4	M (11)	NT	Pr
Agkistrodon laticinctus	NE3	H (15)	LC	NS
Crotalus atrox	NE3	L (9)	LC	Pr
*Crotalus basiliscus**	CE	H (16)	LC	Pr
Crotalus lepidus	NE3	M (12)	LC	Pr
Crotalus molossus	NE3	L (8)	LC	Pr
Crotalus ornatus	NE3	M (13)	NE	NS
Crotalus pricei	NE3	H (14)	LC	Pr
Crotalus scutulatus	NE3	M (11)	LC	Pr
Crotalus viridis	NE3	M (12)	LC	Pr
Crotalus willardi	NE3	M (13)	LC	Pr
Chrysemys picta	NE3	H (14)	LC	A
*Terrapene nelsoni**	CE	H (18)	DD	Pr
Terrapene ornata	NE3	H (15)	NT	Pr
Trachemys gaigeae	NE3	H (18)	VU	NS

Table 7 (continued). Distributional and conservation status measures for members of the herpetofauna of Chihuahua, Mexico. Distributional status: SE = endemic to state of Chihuahua; CE = endemic to country of Mexico; NE = not endemic to state or country; and NN = non-native. The numbers suffixed to the NE category signify the distributional categories developed by Wilson et al. (2017) and implemented in the taxonomic list at the *Mesoamerican Herpetology* website (http://mesoamericanherpetology.com), as follows: 3 = species distributed only in Mexico and the United States; 6 = species ranging from Mexico to South America; 7 = species ranging from the United States to Central America; and 8 = species ranging from the United States to South America. 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 categorizations: CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least Concern; DD = Data Deficient; NE = Not Evaluated. SEMARNAT Status: A = Threatened; P = Endangered; Pr = Special Protection; and NS = No Status. * = Endemic to Mexico; ** = Endemic to Chihuahua; *** = Non-native. See text for explanations of the EVS, IUCN, and SEMARNAT rating systems.

Taxon	Distributional status	Environmental Vulnerability Category (score)	IUCN categorization	SEMARNAT status
Rhinoclemmys pulcherrima	NE4	L (8)	NE	A
*Kinosternon durangoense**	CE	H (16)	DD	NS
Kinosternon flavescens	NE3	M (12)	LC	NS
Kinosternon hirtipes	NE3	M (10)	LC	Pr
*Kinosternon integrum**	CE	M (11)	LC	Pr
Kinosternon sonoriense	NE3	H (14)	NT	P
*Gopherus evgoodei**	CE	H (18)	VU	NS
*Gopherus flavomarginatus**	CE	H (19)	CR	P
Apalone spinifera	NE3	H (15)	LC	Pr

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

Family	Number of species	Distributional status			
		Non-endemic (NE)	Country Endemic (CE)	State Endemic (SE)	Non-native (NN)
Bufonidae	11	7	4	—	—
Craugastoridae	2	1	1	—	—
Eleutherodactylidae	2	1	1	—	—
Hylidae	4	3	1	—	—
Microhylidae	3	3	—	—	—
Phyllomedusidae	1	—	1	—	—
Ranidae	9	4	4	—	1
Scaphiopodidae	3	3	—	—	—
Subtotal	35	22	12	—	1
Ambystomatidae	4	1	3	—	—
Plethodontidae	1	—	1	—	—
Subtotal	**5**	**1**	**4**	**—**	**—**
Total	**40**	**23**	**16**	**—**	**1**
Anguidae	5	2	3	—	—
Anolidae	1	—	1	—	—
Crotaphytidae	2	2	—	—	—
Eublepharidae	1	1	—	—	—
Gekkonidae	1	—	—	—	1
Helodermatidae	2	1	1	—	—
Iguanidae	1	—	1	—	—
Phrynosomatidae	23	16	7	—	—
Phyllodactylidae	1	—	1	—	—
Scincidae	7	4	2	1	—
Teiidae	9	8	1	—	—
Subtotal	**53**	**34**	**17**	**1**	**1**
Boidae	1	—	1	—	—
Colubridae	40	31	9	—	—
Dipsadidae	10	5	5	—	—
Elapidae	2	1	1	—	—
Leptotyphlopidae	4	3	1	—	—
Natricidae	11	6	5	—	—
Typhlopidae	1	—	—	—	1
Viperidae	11	10	1	—	—
Subtotal	**80**	**56**	**23**	**—**	**1**
Emydidae	4	3	1	—	—
Geoemydidae	1	1	—	—	—
Kinosternidae	5	3	2	—	—
Testudinidae	2	—	2	—	—
Trionychidae	1	1	—	—	—
Subtotal	**13**	**8**	**5**	**—**	**—**
Total	**146**	**98**	**45**	**1**	**2**
Sum total	**186**	**121**	**61**	**1**	**3**

No. 21. *Crotaphytus collaris* (Say, 1823). The Eastern Collared Lizard is distributed 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, where it has been recorded in the western half of the state" (Lemos-Espinal and Dixon 2013: 104–105). This individual was photographed at Charco de Peña, in the municipality of Julimes, Chihuahua, where it was in the shade while perched on a large rock. Wilson et al. (2013a) calculated the EVS of this species as 13, placing it at the upper limit of the medium vulnerability category. The IUCN determined its conservation status as Least Concern, but it was assessed as Threatened by SEMARNAT. *Photo by Ana B. Gatica-Colima*.

No. 22. *Gambelia wislizenii* (Baird and Girard, 1852). The Longnose Leopard Lizard "is widely distributed in western North America, ranging from Oregon and Idaho through the Great Basin and deserts of the southwestern United States southward into northern Mexico… In Mexico, *G. wislizenii* occurs west of the Sierra Madre Occidental in northeastern Baja California…and in western Sonora…This lizard is also known from Isla Tiburón…East of the Sierra Madre Occidental, *G. wislizenii* ranges into northern Chihuahua, and in apparently disjunct populations further south through the southern half of Coahuila and adjacent regions of southeastern Chihuahua and northwestern Durango…" (Heimes 2022: 54). This individual was photographed under the cover of mesquite, east of Rancho El Lobo, in Juárez, Chihuahua. Wilson et al. (2013a) determined the EVS of this lizard as 13, placing it at the upper limit of the medium vulnerability category. The IUCN ascertained its conservation status as Least Concern, and it is regarded as a species of Special Protection by SEMARNAT. *Photo by Ana B. Gatica-Colima*.

No. 23. *Ctenosaura macrolopha* Smith, 1972. The Sonoran Spiny-tailed Iguana is distributed in "Sonora and adjacent areas of Chihuahua and Sinaloa" (Heimes 2022: 146). This juvenile was photographed on a rock on the side of a dirt road traversing a steep hill. The surrounding vegetation consisted of lowland forest with mosses and grasses near the small town of Batopilas, Chihuahua. Wilson et al. (2013a) judged its EVS as 19, placing it in the upper portion of the high vulnerability category. The IUCN has not determined its conservation status, and this species is not listed by SEMARNAT. *Photo by Jesús M. Martínez-Calderas*.

No. 24. *Cophosaurus texanus* Troschel, 1852. The distribution of the Greater Earless Lizard "extends from southeastern Arizona to western Texas, in the United States, and in Mexico from northeastern Sonora southward through eastern Chihuahua and into San Luis Potosí" (Lemos-Espinal and Dixon 2013: 117–118). This individual was photographed in scrub vegetation alongside a road to Bismark mine, in Ascensión, Chihuahua. Wilson et al. (2013a) calculated the EVS of this species as 14, placing it at the lower limit of the high vulnerability category. The IUCN has assessed its conservation status as Least Concern, but this species is considered as Threatened by SEMARNAT. *Photo by Eric Centenero-Alcalá*.

Table 9. Summary of the distributional categories of the herpetofaunal families in Chihuahua, Mexico, that contain non-endemic species. The categorizations are as follows: MXUS = species distributed only in Mexico and the United States (except for a few perhaps found in Canada); MXCA = species found only in Mexico and Central America; MXSA = species ranging from Mexico to South America; USCA = species ranging from the United States to Central America (except for a few perhaps found in the Antilles); and USSA = species ranging from the United States to South America.

Family	Number of non-endemic species	Distributional status				
		MXUS Species (3)	MXCA Species (4)	MXSA Species (6)	USCA Species (7)	USSA Species (8)
Bufonidae	7	6	—	—	1	—
Craugastoridae	1	1	—	—	—	—
Eleutherodactylidae	1	1	—	—	—	—
Hylidae	3	2	—	—	1	—
Microhylidae	3	2	—	—	1	—
Ranidae	5	4	1	—	—	—
Scaphiopodidae	3	3	—	—	—	—
Subtotal	**23**	**19**	**1**	**—**	**3**	**—**
Ambystomatidae	1	1	—	—	—	—
Subtotal	**1**	**1**	**—**	**—**	**—**	**—**
Total	**24**	**20**	**1**	**—**	**3**	**—**
Anguidae	2	2	—	—	—	—
Crotaphytidae	2	2	—	—	—	—
Eublepharidae	1	1	—	—	—	—
Helodermatidae	1	1	—	—	—	—
Phrynosomatidae	16	16	—	—	—	—
Scincidae	4	4	—	—	—	—
Teiidae	7	7	—	—	—	—
Subtotal	**33**	**33**	**—**	—	—	—
Colubridae	31	27	—	2	1	1
Dipsadidae	5	4	—	1	—	—
Elapidae	1	1	—	—	—	—
Leptotyphlopidae	3	3	—	—	—	—
Natricidae	6	4	—	—	2	—
Viperidae	10	9	1	—	—	—
Subtotal	**56**	**48**	**1**	**3**	**3**	**1**
Emydidae	3	3	—	—	—	—
Geoemydidae	1	—	1	—	—	—
Kinosternidae	3	3	—	—	—	—
Trionychidae	1	1	—	—	—	—
Subtotal	**8**	**7**	1	**—**	—	—
Total	**97**	**88**	**2**	**3**	**3**	**1**
Sum total	**121**	**108**	**3**	**3**	**6**	**1**

Accordingly, it is important to understand that the protection of organismic populations through the erection and maintenance of NPAs is only a relatively small part of what humans need to do to help maintain the biosphere as a functional component of a sustainable world, but this action is something that conservation biologists can do to help protect the biosphere. In the context of this paper, we identify the major threats to the herpetofauna of Chihuahua, as follows: land conversion and habitat loss; improper management of water quality and quantity; invasive species; climate change; fires and illegal logging; illegal trade; infectious diseases and parasites; on and off-road activities; mining; solid waste pollution; consumption of amphibians and reptiles; agriculture and livestock grazing; fear and/or confusion; and miscellaneous threats.

Land conversion and habitat loss (Figs. 14–16)

The inhabitants of the Raramuri communities of Ejido Arroyo de La Cabeza, Comunidad Laguna, Ejido Panalachi, and Ejido Sisoguichi, in the municipality of Bocoyna, recognize deforestation and clandestine logging as major environmental problems, in addition to the erosion of lands (WWF 2008).

Ceballos et al. (2010) demonstrated a large decline in the abundance of vertebrates across all taxonomic groups (mammals, native and migratory birds, and reptiles). The

Table 10. Comparison of the numbers of endemic, non-endemic, and non-native species, and the percentage of endemism for Chihuahua, Mexico, and the surrounding Mexican states. The percentage of endemism is calculated as the number of endemic species/total native herpetofauna. Data in the table are from this study for Chihuahua, Lemos-Espinal et al. (2019) for Sonora, Lemos-Espinal et al. (2020) for Sinaloa, Lemos-Espinal et al. (2018) for Durango, and Lazcano et al. (2019) for Coahuila, along with the calculations pertaining to the percentage of endemism.

State	Total herpetofauna	Endemic species	% of endemism	Non-endemic species	Non-native species
Chihuahua	183	59	32.2	121	3
Sonora	200	68	35.2	125	7
Sinaloa	159	82	52.9	73	4
Durango	156	72	47.1	81	3
Coahuila	143	40	28	100	3

Fig. 14. The removal of vegetation from the arid lands of northern Chihuahua exposes an increasing amount of soil erosion, and dust storms occur in Ascensión, Chihuahua. *Photo by Ana Gatica-Colima*.

Fig. 15. The logging of trees creates an environmental problem even at a low scale, as it transforms the landscape and habitat of vertebrates. *Photo by Ana Gatica-Colima*.

55,000 ha Prairie Dog colony complex has declined by 73% since 1988. It has become increasingly fragmented, and densities have shown a precipitous decline over the years, from an average of 25/ha in 1988 to 2/ha in 2004.

The PMARP (2012), a master plan by the regional alliance for the conservation of grasslands in the Chihuahuan Desert, identified 10 major problems or necessities for conserving the Chihuahuan Desert grasslands in the states of Zacatecas and Chihuahua, one of which is land use conversion. In particular, these problems are significant in Chihuahua, as it is one of the states in this ecoregion that has been impacted by a large scale of illegal changes in land conversion.

Munguia-Vega et al. (2013) studied the localized extinction of an arboreal desert lizard (*Urosaurus nigricaudus*) caused by fragmentation, suggesting that limited dispersal, coupled with an inability to use a homogeneous and hostile matrix without vegetation and shade, could result in frequent time-delayed extinctions of small ectotherms in highly fragmented desert landscapes, particularly when considering an increase in the risk of overheating and a reduction in dispersal potential induced by global warming. Lavín-Murcio et al. (2014) selected *Ambystoma rosaceum*, *Craugastor tarahumarensis*, *Crotalus viridis*, and *Gopherus flavomarginatus* as targets for immediate action to avoid their disappearance in Chihuahua, pointing out the destruction of habitats as one of the more harmful threats to amphibians and reptiles.

The grassland areas of the Chihuahuan Desert Ecoregion are undergoing a large-scale transformation, principally due to expanding agriculture, urbanization, energy development, and desertification (Pool et al. 2014).

The results of a geospatial analysis of land use and water in the peri-urban area of Ciudad Cuauhtémoc, Chihuahua, indicate that the processes of changes in land use and vegetation cover occur within a context of high competition for water among the various users (Díaz-Cervantes et al. 2014).

Importantly, we need to conserve the natural habitats in the Sierra de Juárez, Juárez, Chihuahua, because of the potential risk and threats to biodiversity. The construction of the "Camino Real" road and increasing urban development are present in the Sierra de Juárez (Gatica-Colima et al. 2014a; Fernández-López and Lavín-Murcio 2016).

Clarke-Crespo et al. (2017) used a multi-objective method to assess the quality of grasslands in the northern

No. 25. *Holbrookia maculata* Girard, 1851. The Lesser Earless Lizard "inhabits much of the Great Plains of North America, ranging from South Dakota south to central and western Texas, thence westward into Arizona, New Mexico and northern Chihuahua" (Heimes 2022: 188). This individual was photographed in sand dunes (médanos) at Rancho El Lobo, in Juárez, Chihuahua. Wilson et al. (2013a) determined its EVS as 10, placing it at the lower limit of the medium vulnerability category. The IUCN determined its conservation status as Least Concern, and this species is not listed by SEMARNAT. *Photo by Eric Centenero-Alcalá*.

No. 26. *Phrynosoma cornutum* (Harlan, 1824). The distribution of the Texas Horned Lizard "extends from Kansas southwestward to southeastern Arizona, then southward through all of northern Mexico east of the Sierra Madre Occidental to Durango, and eastward through all of Coahuila and Nuevo León, Tamaulipas, and disparate localities in San Luis Potosí" (Lemos-Espinal and Dixon 2013: 119–120). This adult individual was photographed in loam-gravel substrate associated with a downhill slope containing microphyllous desert scrub vegetation (with *Larrea tridentata* and *Opuntia leptocaulis*), from where it fled to seek refuge. This location lies south of Sierra Samalayuca, in Juárez, Chihuahua. Wilson et al. (2013a) established its EVS as 11, placing it in the middle of the medium vulnerability category. The IUCN assessed its conservation status as Least Concern, and this species is not listed by SEMARNAT. *Photo by Jesús M. Martínez-Calderas*.

No. 27. *Phrynosoma hernandesi* Girard, 1858. The Greater Short-horned Lizard "ranges from central Utah and southwestern Colorado southward to northeastern Sonora and adjacent northwestern Chihuahua" (Heimes 2022: 218). This individual was photographed in grassland habitat in Namiquipa, Chihuahua, and the disturbance caused it to start squirting blood from the ducts in its eyes. Wilson et al. (2013a) determined its EVS as 13, placing it at the upper limit of the medium vulnerability category. The IUCN judged its conservation status as Least Concern, and this species is not listed by SEMARNAT. *Photo by Sebastian Ochoa Rodríguez*.

No. 28. *Phrynosoma modestum* Girard, 1852. The distribution of the Round-tailed Horned Lizard "extends from southeastern Arizona to western Texas and southeastern Colorado, in the United States, southward in Mexico through Chihuahua, east of the Sierra Madre Occidental (except for the northwestern portion) to San Luis Potosí…" (Lemos-Espinal and Dixon 2013: 121). This individual was photographed in rocky substrate along the side of a dirt road to El Marro Canyon, an ecological park in Chihuahua. Wilson et al. (2013a) calculated its EVS as 12, placing it in the middle portion of the medium vulnerability category. The IUCN has assessed the conservation status of this lizard as Least Concern, and this species is not listed by SEMARNAT. *Photo by Ana B. Gatica-Colima*.

Fig. 16. The removal of the natural vegetation can produce land erosion, Bocoyna, Chihuahua. Chihuahua. *Photo by Ana Gatica-Colima*.

Chihuahuan Desert, and demonstrated that the values of the 14-patch metrics confirmed that these grasslands are undergoing intense fragmentation in the Chihuahuan Desert landscape, and also that the grassland ecosystems are in a highly vulnerable state.

Reyes-Gómez et al. (2020) diagnosed three aquifers in the Chihuahuan Desert, the Tabalaopa Aldama (TA), San Diego (SD), and Laguna de Hormigas (LH), and concluded that the types of land use change identified for a 19-year period (1993–2012) show a significant loss of primary and secondary vegetation cover represented by desert scrub and grassland (480.24 km^2 in total; 11.7% in the TA aquifer, 12.1% in the SD aquifer, and 76.2% in the Laguna de Hormigas LH aquifer). These losses in vegetation cover produced significant increases in the agricultural frontier (356.9 km^2 in total; 0.15% in TA, 14.9% in SD and 85% in LH), and in the urban sprawl (54.93 km^2 in total; 8% in SD, 92% in TA and 0% in LH). The largest area of primary and secondary vegetation cover transformed to urban use occurred in the southwestern portion of the TA aquifer, in the neighborhoods in the southern periphery of the city of Chihuahua, and showed little representation in the SD and LH aquifers.

The Ramsar site along Río San Pedro-Meoqui, Chihuahua (No. 2047) is an area that suffers consistent anthropogenic disturbances, such as the extraction of stone material from the riverbed, as recorded in 2015 (see Loredo-Varela and Hernández-Escudero 2021).

Improper management of water quality and quantity (Figs. 17–18)

An overexploitation of aquifers occurs in Chihuahua (Chávez-Rodríguez et al. 2007). In a study of the aquifer conditions in the Laguna Bustillos Basin (Chihuahua, Mexico) in recent decades (1991–2012), Alatorre et al. (2019) noted that the least favorable conditions for furrow irrigation were in Mennonite properties.

About 90% of the surface water and 84% of the pumped groundwater are used for irrigation in the state of Chihuahua (CONAGUA 2020).

More recently, Renteria-Villalobos et al. (2022) evaluated the impact of climate variability on the sustainability of the transboundary water supply in Chihuahua, Mexico. They sampled three reservoirs (Boquilla, Francisco I. Madero, and Granero), and concluded that climate variability and temperature increases will amplify the cycles of supply and demand, which will undermine sustainability, mitigation, and management strategies.

The residents of the Raramuri communities in Ejido Arroyo de La Cabeza, Comunidad Laguna, and Ejido Sisoguichi, in the municipality of Bocoyna, recognize water pollution as a principal environmental problem (WWF 2008).

Gutierrez et al. (2008) suggested that human activities associated with the Conchos River (wastewater discharges and waste products from agriculture and industrial activities) are the source of arsenic (As) contamination in the San Pedro River. Gutierrez et al. (2009) also found that sediments from the Río Conchos Basin in northern Mexico contained arsenic levels that exceeded the guideline value (22 mg kg^{-1}) for agricultural soils.

According to Gallo-Reynoso et al. (2020), before entering Pegüis Canyon, the waters of the Conchos River flow through vast agricultural and urban areas in the central part of the state of Chihuahua, where numerous dams divert water to irrigation channels and the river receives urban and agricultural wastewater.

Ríos-Arana et al. (2007) commented that the high conductivity values measured in September and October might reflect reduced flows in the Río Bravo at the end of the irrigation season.

The Raramuri communities Ejido Arroyo de La Cabeza, Comunidad Laguna, and Ejido Sisogichi from the municipality of Bocoyna, also recognize reduced flow in rivers and water scarcity as principal environmental problems (WWF 2008).

Between the first visit to a section of the Río Florido near the Aguila Dam, Coronado, in August of 2000, and a second in June of 2013, Gatica-Colima (2017) noticed that the flow of the river was less than in previous years. The local people indicated that the water was being managed upstream.

Invasive species (Fig. 19)

The Mediterranean Gecko (*Hemidactylus turcicus*) was reported from Camargo, Chihuahua (Lemos-Espinal and Smith 2007), and later from Juárez, Chihuahua (Gatica-Colima et al. 2009). This species is well established and often seen on the walls of buildings at the Universidad Autónoma de Ciudad Juárez campus (AGC, pers. obs.).

In Chihuahua, the American Bullfrog (*Lithobates catesbeianus*) has been reported from the municipalities of Ascensión, Janos, Juárez, and Nuevo Casas Grandes

Fig. 17. The constant irrigation of crops in the desert drives the excessive extraction of subterranean water. *Photo by Ana Gatica-Colima.*

Fig. 18. The reduction of water levels in the Janos reservoir reveals the demand for water over the years. *Photo by Ana Gatica-Colima.*

(Lemos-Espinal and Smith 2007). This species also appears to have an established population in Presa Rosetilla, in the municipality of Saucillo (Gatica-Colima et al. 2014b), and Carbajal-Márquez et al. (2014) reported it from the Río Chuviscar. There is evidence of *L. catesbeianus* preying on the Green Toad (*Anaxyrus debilis*) and on a species of gartersnake (*Thamnophis*) (Fig. 19) in the municipality of Janos in northwestern Chihuahua (Ramos-Guerra and Gatica-Colima 2014). According to the NOM-059-SEMARNAT-2010, *A. debilis* is categorized as a species of Special Protection. Additionally, a population of *L. catesbeianus* from southeastern Texas ($n = 45$) was found to have a component parasite community consisting of three nematode species, six trematodes, and a single acanthocephalan, with a prevalence of 93% (Yoder and Gomez 2007).

Mendoza-Almeralla et al. (2015) undertook a review of chytridiomycosis in amphibians from Mexico and recognized the introduction and displacement of the American Bullfrog as an important factor for spreading the causative pathogen *Batrachochytrium dendrobatidis* (Bd). Although *Bd* has not been detected in Chihuahuan amphibians, Hernández-Martínez et al. (2019) provided the first records of *Bd* in anurans from the Nazas-Aguanaval basin in the states of Coahuila and Durango. They reported detecting *Bd* in *Lithobates berlandieri* and *L. catesbeianus*, as well as in *Anaxyrus cognatus*, *A. debilis*, *A. punctatus*, and *Gastrophryne olivacea*, all of which are found in Chihuahua. Importantly, a survey needs to be conducted in southern Chihuahua to see if this pathogen can be detected in anurans from the state.

In their review of the introduced herpetofauna of Mexico and Central America, González-Sánchez et al. (2021) listed two invasive species for Chihuahua, i.e., the Mediterranean Gecko (*Hemidactylus turcicus*) and the American Bullfrog (*Lithobates catesbeianus*). Another invasive species in Chihuahua is *Indotyphlops* [formerly in the genus *Virgotyphlops*] *braminus* (Cruz Elizalde et al. 2022). Initially, Carbajal-Márquez et al. (2015) reported this species as a new state record, as this exotic snake was found in a garden in the city of Chihuahua. According to Wallach (2020b), Chihuahua is the 26th place in Mexico where this species has been recorded as of 2015, as it was first recorded from Guerrero in 1891.

Other vertebrates are considered as potential threats to the environment and/or to amphibians and reptiles in Chihuahua, as noted below. In southern Chihuahua,

near the Águila Dam, in the municipality of Coronado, we encountered a large carapace of the Mexican Plateau Slider (*Trachemys gaigeae*). We observed large fish in the water, but there were no turtles basking on the logs, as we had seen in prior years (Gatica-Colima et al. 2017). The invasive fish species that we recorded from the Río Florido is the Common Carp (*Cyprinus carpio*) (https://www.naturalista.mx/observations/56386114). According to the Global Invasive Species Database (2013), *C. carpio* stirs up the sediments on the bottom in search of food, altering the habitat of native fish and other aquatic species. The rapid invasion of *C. carpio* was determined to be in a high-risk category, with an invasiveness value of 0.85 (CONABIO 2017).

According to Torres-Olave et al. (2018), Wild Boars (*Sus scrofa*) use the six main habitat types in Chihuahua, as follows: microphyll desert scrub (24,376.71 km^2); rosetophyllous desert scrub (7,036.95 km^2); natural grasslands (6,360.0 km^2); halophytic grassland (4,017.75 km^2); pine-oak forest (2,172 km^2); and annual seasonal agriculture (1,946.84 km^2). Although no studies have documented the threats of this species in Chihuahua, in the NPA of Sierra La Laguna in the state of Baja California Sur, Breceda et al. (2009) indicated that Wild Boars are known to have consumed a Desert Night Lizard (*Xantusia vigilis*) among other food items. Lastly, Soto-Cruz et al. (2014) documented the first record of the Monk Parakeet (*Myiopsitta monachus*) in the state of Chihuahua, and recorded active nests in the cities of Chihuahua and Delicias. The authors recommended follow-up population studies to assess the possible risks for the ecosystems in the region.

Climate change (Figs. 20–21)

Regarding this subject, Lara-Reséndiz et al. (2015) used data from field, laboratory, and modeling approaches for *Phrynosoma cornutum* and *P. modestum* at three contrasting sites in the Mexican Chihuahuan Desert (Mapimí, Durango; and Janos and Samalayuca, Chihuahua). The thermoregulatory indices suggested that both species thermoregulate effectively despite living in habitats of low thermal quality. Based on their measurements, if the air temperature rises, as predicted by climate models, the extinction model projects that *P. cornutum* will become locally extinct at 6% of the sites and *P. modestum* at 32% of the sites by the year 2050.

At the Sevilleta National Wildlife Refuge and Long-Term Ecological Research (LTER), New Mexico, USA, a short-term study of the influence of rainfall on microhabitat use by the Chihuahuan Spotted Whiptail (*Aspidoscelis exsanguis*) was conducted within Pinyon Pine (*Pinus edulis*) and One-seed Juniper (*Juniperus monosperma*) forest. The study showed that rainfall can influence lizard microhabitat use more than temperature in a Piñon Pine/Juniper woodland, and that the trees provide important refugia. The loss of Piñon Pine and Juniper trees from prolonged drought threatens to limit the amount of shade available for lizards in the future (Mason et al. 2016).

Fig. 19. Remains of a gartersnake (*Thamnophis* sp.) extracted from the stomach of an American Bullfrog (*Lithobates catesbeianus*), collected in Janos, Chihuahua, reveals the impact of this invasive species on native reptile fauna. *Photo by Ana Gatica-Colima.*

Aburto-Oropeza et al. (2018) noted that the effects of climate change will devastate biodiversity in the USA–Mexico border region, and suggested that by carefully selecting new montane preserves adjacent to desert and tropical forest habitats, and by implementing global controls on atmospheric carbon dioxide emissions, extinctions might be reduced to fewer than 11% of the species and to a single reptile family.

According to Pineda-Martínez (2020), the values from detection indexes associated with intense to extreme rainfall demonstrated a positive trend in the last decade. These trends are associated with an increase in sea surface temperature. The spatial distribution of these trends was positive in the SMO region and showed a negative anomaly in the core zone of the monsoon, but with an increase toward northern Mexico.

Lazcano et al. (2023) reported that on 18 September 2022, northwest of Juárez, they found what they considered to be a strange death for a Prairie Rattlesnake (*Crotalus viridis*). The authors noted that a strong rainstorm occurred between 1600 and 1900 h, which accumulated 9.8 mm of rain, followed by a heavy hailstorm between 1700 and 1715 h, which apparently caused its death. Further, they noted that climate change undoubtedly will enhance the occurrence of large hailstones, as warmer air containing more water vapor will enter the atmosphere, and that powerful storms with powerful updrafts will occur more frequently.

The Raramuri community of Ejido Panalachi, in the municipality of Bocoyna, recognizes fires as a principal environmental problem (WWF 2008). CONAFOR (2010) reported data for the 2009 average number of forest fires by state, and Chihuahua ranked 4th with 842, and 10th regarding the size of the area affected, with 10,703.87 ha.

Alva-Alvarez et al. (2018) evaluated the interaction between fires and landscape during the 2000–2010 period in Madera, Chihuahua, and identified 388 fire polygons covering 8,277 ha. On average 35 fires occur per year, with an annual fire rate of 9% and an average burn area of

Fig. 20. Climate change. Different rainfall patterns in recent years, such as reduced precipitation, have been causing extreme drought in the Rio Bravo/Rio Grande, Manuel Benavides, Chihuahua/Brewster Co. Texas. *Photo by Ana Gatica-Colima*.

Fig. 21. The removal of the natural vegetation cover for agricultural purposes triggers the burning of dry matter, a relatively new but common practice that generates air pollution. Ahumada, Chihuahua. *Photo by Ana Gatica-Colima*.

20.60 ha. The authors concluded that the burning of forests in Madera fragments landscapes with less connectivity.

According to the UNDRR (2021) the National Forestry Commission reported that 212,000 ha in all 32 states of Mexico were affected by forest fires in the year 2021; one of the most affected states was Chihuahua. Burning the vegetation cover that had been removed for agricultural purposes is a common practice in Chihuahua, and logging at a low scale is another environmental problem.

Bonello (2019) provided a warning about the increasing amount of illegal wood being extracted from Chihuahua. Lastly, Guerrero et al. (2000) noted that some populations of plant and animal species, including reptiles, have been depleted as the result of habitat loss in the Sierra Madre Occidental.

Illegal trade (Figs. 22–23)

Some reptile species for sale in pet stores in Juárez, Chihuahua, included the Spiny Softshell Turtle *Apalone spinifera* and the Ornate Box Turtle *Terrapene ornata* according to a study conducted between April 1997 and July 1999, and both species are protected by law (Gatica-Colima and Bojorquez-Rangel 1999).

The herpetofaunal diversity of the Mexican Chihuahuan Desert Ecoregion (CDE) is among the highest in all the desert ecoregions. The CDE herpetofauna is composed of 29 species of amphibians and 131 species of reptiles. Approximately 63% (n = 82) of the 131 estimated reptile species found in the Mexican portion of the CDE (Cotera et al. 2001) are subject to some level of trade.

Fitzgerald et al. (2004) recorded rattlesnakes and Bolson Tortoises (*Gopherus flavomarginatus*) as reptiles that are subject to trade in the Chihuahuan Desert Ecoregion of Mexico. Garza-Almanza et al. (2010) listed 41 species of fauna that have been seized in Chihuahua, including the following reptiles: *Apalone spinifera*, *Boa constrictor*, *Crotalus durissus*, *Gopherus flavomarginatus*, *Heloderma suspectum*, *Iguana iguana*, *Kinosternon integrum*, *Kinosternon leucostomum*, *Masticophis flagellum*, *Python regius* (an introduced species), *Terrapene ornata*, and *Trachemys scripta*, all

Fig. 22. An increasing amount of illegal commerce is being detected in the region. Here, some anurans (Bufonidae) are being sold in a local market in northern Chihuahua. The demand for wildlife might be triggered by new beliefs from an increasing population of migrants along the border region. *Photo by Ramón I. Miramontes-Cinco*.

Fig. 23. Rattlesnake carcasses are sold at different prices (from 100 to 450 pesos) in a local market in northern Chihuahua. *Photo by Ramón I. Miramontes-Cinco.*

Fig. 24. Argasid ticks, one in the corner of the right eye (bottom left) and another in the first third of the body (can you find it?) of a Prairie Rattlesnake (*Crotalus viridis*) in Janos, Chihuahua. *Photo by Eduardo F. Macias-Rodríguez.*

of which except *P. regius* in a risk category according to SEMARNAT (2010).

Infectious diseases and parasites (Figs. 24–25)

Goldberg and Bursey (1991) found various helminth parasites in the lungs and gastrointestinal tracts of three species of toads from Arizona (USA): *Anaxyrus alvarius, Anaxyrus cognatus,* and *Scaphiopus couchii*. Although these helminths were found in anurans from the USA, these species of amphibians are abundant in Chihuahua after rains, primarily in the Sierras y Llanuras del Norte (SLN) province.

Gatica-Colima et al. (2014c) reported the first member of the tick family Argasidae associated with the Prairie Rattlesnake (*Crotalus viridis*) from Janos (LMN subprovince), Chihuahua, as well as the second record of an argasid tick on a snake from Mexico.

On a cattle ranch located in Jeff Davis and Presidio counties, Texas, Christensen et al. (2020) tracked the development of a previously undescribed disease, Carapacial Shell Disease Process (CSDP), in the Yellow Mud Turtle (*Kinosternon flavescens*) over a 13-year period. By using permanent artificial water sources, a filamentous alga (*Arnoldiella chelonum*) invaded and damaged the non-living portion of the shell of this species. Subsequently, the authors examined 475 dry and fluid preserved *K. flavescens* that were collected in 121 counties in Texas, and 73 (60.3%) demonstrated the presence of this disease. Records of this disease have been found in the five Texas counties that border Chihuahua. In Chihuahua, this turtle is distributed in the SPN and LSV subprovinces.

Fig. 25. At least 10 blood sucking mosquitoes (Diptera) are seen on the body of a Black-tailed Rattlesnake (*Crotalus molossus*) in the municipality of Guerrero, Chihuahua. *Photo by Sara G. Sáenz-González.*

No. 29. *Sceloporus jarrovii* Cope, 1875. Yarrow's Spiny Lizard is distributed from "southeastern Arizona and southwestern New Mexico through the Sierra Madre Occidental of Chihuahua, Sonora, Sinaloa and Durango southward to southern Zacatecas and Aguascalientes" (Heimes 2022: 327). This lizard was photographed on a rock in pine forest at Monterde, in the municipality of Guazapares, Chihuahua. Wilson et al. (2013a) determined its EVS as 11, placing it in the middle portion of the medium vulnerability category. The IUCN has not determined its conservation status, and this species is not listed by SEMARNAT. *Photo by Eric Centenero-Alcalá*.

No. 30. *Sceloporus lemosespinali* Lara-Góngora, 2004. The Western Graphic Lizard "occurs in the Sierra Madre Occidental and associated mountain ranges of Chihuahua and Sonora, ranging southward into northern Durango and Sinaloa" (Heimes 2022: 128). This individual was photographed on dry bark in a pine forest near Creel, in the municipality of Bocoyna, Chihuahua. Wilson et al. (2013a) calculated its EVS as 16, placing it in the middle portion of the high vulnerability category. The IUCN evaluated its conservation status as Data Deficient, and this species is not listed by SEMARNAT. *Photo by Antonio Esaú Valdenegro-Brito*.

No. 31. *Sceloporus magister* Hallowell, 1854. The Desert Spiny Lizard "occurs in the Sonoran Desert from southwestern Arizona through western Sonora, including Isla Tiburón in the Gulf of California, southward to northwestern Sinaloa" (Heimes 2022: 338). This adult individual, which lacks the tip of its tail, was photographed in a sand dune under Sand Sagebrush (*Artemisa filifolia*), near Ojo de la Punta in the Samalayuca Dune Fields, Juárez, Chihuahua. Wilson et al. (2013a) calculated its EVS as 9, placing it at the upper limit of the low vulnerability category. The IUCN determined its conservation status as Least Concern, but this species is not listed by SEMARNAT. *Photo by Jesús M. Martínez-Calderas.*

No. 32. *Sceloporus merriami* Stejneger, 1904. The Canyon Lizard "ranges widely from the Big Bend region of southwestern Texas southward through eastern Chihuahua and Coahuila to extreme northeastern Durango and west-central Nuevo León, but its distribution is highly discontinuous" (Heimes 2022: 343). This individual was photographed in a rocky outcrop at Angulo canyon, a Natural Protected Area (Cañón de Santa Elena) in the municipality of Manuel Benavides, Chihuahua. Wilson et al. (2013a) determined its EVS as 13, placing it at the upper limit of the medium vulnerability category. The IUCN evaluated its conservation status as Least Concern, and this species is not listed by SEMARNAT. *Photo by Daisy Marina Cuevas Ortalejo.*

Fig. 26. Road-killed snakes often are seen on the roads in Chihuahua. Here, a dead adult Prairie Rattlesnake (*Crotalus viridis*) was found in a Type C road in Janos, Chihuahua. *Photo by Ana Gatica-Colima.*

Fig. 27. Chihuahua is one of Mexico's leading states for mining activities, and the tailings often contaminate water resources. Pictured here is an abandoned mine at Bustillos, in the municipality of Aquiles Serdán, Chihuahua. *Photo by Ana Gatica-Colima.*

On and off-road activities (Fig. 26)

The number and species of reptiles killed by vehicles on roads is likely underestimated, not only because of their relatively small size and removal by scavengers, but also because they are often flattened beyond recognition. Traffic on roads also causes noise pollution, interfering with the vocal communication of certain animals. Frogs living along noisy roads are known to increase the amplitude or pitch of their calls. Roads also can rapidly cause genetic effects, thereby raising conservation concerns about rare and threatened species, as documented in a review by Dean et al. (2019). Lazcano et al. (2009a,b, 2019) documented other impacts of roads on snake populations.

The Ramsar area along the Río San Pedro-Meoqui, Chihuahua (No. 2047) is subject to constant anthropogenic disturbances, including extreme sports practices with Off-Road Vehicles (ORV) as recorded in 2009 (see Loredo-Varela and Hernández-Escudero 2021).

The establishment of factories that manufacture recreational vehicles and power sports engines for aquatic, snow, and all-terrain vehicles keeps increasing in Juárez, Chihuahua. Off-Road Vehicles (ORV) and racing activities have increased in northern Chihuahua, sometimes in natural landscapes that have not been assigned for recreational use, and they can potentially affect the flora and fauna of this region. A critical evaluation of this situation is required to document the impact caused by these activities.

In a conservation study conducted by Hans-Werner et al. (2017), the authors found reduced gene flow in a population of an important reptilian predator, the Western Diamond-backed Rattlesnake (*Crotalus atrox*), along Interstate 10 in the Sonoran Desert of southern Arizona. To reverse the trend, the authors recommended designing eco-passages to re-establish population connectivity.

Fig. 28. Discarded tires sometimes are a threat to reptiles. Here, a Whiptail Lizard (*Aspidoscelis* sp.) was found dead inside of a discarded tractor tire in Ascensión, Chihuahua. *Photo by Sandra I. Ramos Guerra.*

Fig. 29. Recent observations of individual rattlesnakes and their venom indicate that they are being used in spiritual drinks. Here, a rattlesnake has been added to a bottle of Sotol, an alcoholic drink available in the northern states of Mexico. *Photo by Ana Gatica-Colima.*

Mining (Fig. 27)

In 2020, the primary minerals produced by municipalities in the state of Chihuahua were dolomite in the city of Chihuahua, silver in Guadalupe y Calvo and Chínipas, iron in Camargo, gypsum in Guadalupe, kaolin in the city of Chihuahua, zinc and lead in Santa Barbara, copper in Urique, and gold in Ocampo and Madera (INEGI 2022).

Sasaki et al. (2015) noted that structural alterations in terrestrial habitats, and concomitant changes in the availability of resources and microclimate, have had stronger effects on amphibian and reptile communities than metal pollution caused by century-long smelting operations. Other environmental impacts of mining are discussed by Gutiérrez-Ruiz et al. (2007), Gavilán García et al. (2017), and Guzmán-Martínez et al. (2023).

Mayani-Parás et al. (2019) produced ecological niche models for 179 amphibian and reptile species endemic to Mexico and examined the impact of habitat loss and mining activities. The lowest and highest values for the percentage of distribution loss for some endemic herpetofauna in Chihuahua are as follows: for amphibians, *Ambystoma rosaceum* (10.09, 14.34) and *A. velasci* (75.11, 75.83); and for reptiles, *Crotalus basiliscus* (25.93, 29.63) and *Salvadora bairdi* (60.54, 61.80).

Solid waste pollution (Fig. 28)

Gatica-Colima et al. (2016) found a dead adult Texas Horned Lizard (*Phrynosoma cornutum*) entangled in a discarded plastic crate in an illegal dump site in Ciudad Juárez, Chihuahua. Later, a live one was found inside a tire, and nine others were found dead in other tires. A subsequent survey demonstrated a relationship between the mortality of *P. cornutum* and discarded tires, and the authors commented that it could lead to local population extinction.

The Ramsar site of Río San Pedro-Meoqui, Chihuahua (No. 2047) is an area that suffers constant anthropogenic disturbances, such as garbage disposal recorded in 2018 (see Loredo-Varela and Hernández-Escudero 2021). Recently, Dong-Min and Ding-Qi (2022) reviewed microplastics and their effects on amphibians and reptiles, focusing on the toxicity of bisphenol A (BPA) to tadpoles, the toxic effects caused by direct contact or ingestion, and the detection of microplastics in the natural environment of amphibians. In addition, reptiles can become entangled in plastics and might ingest large pieces of this material.

Consumption of amphibians and reptiles (Fig. 29)

Gatica-Colima and Jiménez-Castro (2009) studied the uses of rattlesnakes by local people, and reported that

in the Chihuahuan Desert, and primarily in Chihuahua, people consume rattlesnakes as food and for medicinal purposes.

An alcoholic drink called "sotol" is produced in the state of Chihuahua, particularly in the desert and mountainous municipalities that gave rise to the product's name and the historical tradition for its process in artisan factories (Diario Oficial de la Federación 2002). Recently, the addition of rattlesnakes (whole individuals or their venom) to Sotol has been increasing (Fig. 23). An evaluation is needed to confirm the attributes of this drink with rattlesnake products, especially when using endangered species.

Agriculture and livestock grazing (Figs. 30–34)

According to the Secretariat of the Convention of Biological Diversity SCBD (2008), the homogenization of farming landscapes with the elimination of natural areas, including hedgerows, woodlots and wetlands, to achieve larger scale production units for large-scale mechanized production also has led to declines in biodiversity and ecological services. This is only one way that agriculture can reduce biodiversity.

From 2002–2014 there was a tendency for extending the anthropic origin for annual and perennial agriculture in Mexico. Extensive zones of negative changes in the desert regions of Sonora and Chihuahua have been noted, with reductions in the xerophytic shrubs (INEGI 2021c).

Pérez-Espejo (2008) commented on the difficulty of quantifying biodiversity loss due to cattle. An estimate of the role of livestock among the threats and losses of biodiversity was based on the emission of greenhouse gases, soil erosion, and water pollution.

The PMARP (2012) identified a total of 10 major problems or necessities for a regional alliance for conserving grasslands of the Chihuahuan Desert in the states of Zacatecas and Chihuahua, one of which is the animal load adjustment (i.e., the amount of livestock that grassland ideally can support).

The use of chemicals in agricultural and livestock areas also are a constant threat to wildlife, particularly for groups such as amphibians due to the continuous interchange of gases through their skin (Siliceo-Cantero 2021).

Fear and/or confusion

Saucedo-Sánchez de Tagle (2007) attempted to bring Rarámuri students closer to classifying fauna based on their conception of the universe, where animals and diverse beings are grouped around the celestial region of the Tarahumaran cosmos. In this study, the author identified the chameleon (*wilókare*) as capable of curing certain diseases by placing it on the part of the body with an ailment, and allowing the reptile to "suck the bad blood." Subsequently, Alonso-Castro (2014) documented the use of ethnozoology for medicinal purposes in Mexican Traditional Medicine (MTM), and mentioned *Anolis carolinensis* as the "chameleon" that was used by the Tarahumaras. Caution must be taken when referring to a given species in MTM, as the information provided usually is based on common names. According to Conant and Collins (1991), the Green Anole (*Anolis carolinensis*) was reported as an isolated record from Tamaulipas, Mexico, where presumably it was introduced.

According to a survey by Gatica and Jiménez-Castro (2009), some people indicated they might kill rattlesnakes 48.93% (n = 23), while another 31.91% (n = 15) may not. About one-half of the people that kill them do so because of fear or precaution (n = 19), whereas, others consume them (10.52%), and there is also a combination of fear and consumption 31.57% (n = 12).

Fear is the principal enemy of conservation, and thus the need for more education.

Miscellaneous threats

The Priority Terrestrial Region (RTP) project is circumscribed in the Priority Regions Program for the Conservation of Biodiversity of the National Commission for the Knowledge and Use of Biodiversity (Comisión Nacional para el Conocimiento y Uso de la Biodiversidad—CONABIO), and this commission identifies ecological areas with physical and biotic characteristics that favor biodiversity. Twenty-one (13.81%) of the 152 national RTP's are recognized in Chihuahua. In Appendix 1, we compiled the principal environmental problems in the state RTPs (Arriaga et al. 2000) that are associated with the physiographic provinces in Chihuahua.

Conservation Status

In this study, we used the three systems of conservation assessment employed in all the other entries in the MCS (see above), i.e., the systems of SEMARNAT (2010), the IUCN Red List (http://www.iucnredlist.org), and the EVS (Wilson et al. 2013a,b). The assessments from these three systems were updated as necessary to reflect the most current information.

The SEMARNAT System

Torres-Hernández et al. (2021: 117) indicated that "the SEMARNAT system for assessing conservation status was developed and implemented by the Secretaría de Medio Ambiente y Recursos Naturales of the federal government of Mexico (SEMARNAT 2010, 2019)." We provide the status ratings for the native herpetofaunal species in Chihuahua in Table 7, and summarize the data in Table 11. Three evaluation categories are established in the SEMARNAT system: Endangered (P), Threatened (A), and Under Special Protection (Pr) for species considered under threat. In addition, we allocated the species that were not assessed to a "No Status" (NS) category (Tables 7 and 11).

As with all the previous MCS studies, we found that the SEMARNAT system, by design, has been applied to relatively few of the native members of the herpetofauna (Table 11). In the case of Chihuahua, only 68 of the 183 native species (37.2%) have been evaluated, with three species allocated to the Endangered (P) category, 23 to the Threatened (A) category, and 42 to the Special Protection

Fig. 30. The use of different agricultural products has been increasing in various areas of Chihuahua, such as extensive fields of corn in the arid lands of the state. *Photo by Ana Gatica-Colima.*

Fig. 31. Extensive cotton fields have been increasing in Mennonite communities in several municipalities of Chihuahua, thereby transforming the natural habitats. *Photo by Ana Gatica-Colima.*

Fig. 32. In recent years, the planting of pecans and walnuts has increased in the state of Chihuahua. Pictured here is a field of pecans in Meoqui. *Photo by Ana Gatica-Colima.*

Fig. 33. Traditionally, Chihuahua has been a cattle-producing state. Here, a herd of cows roams free in the municipality of Casas Grandes, Chihuahua. *Photo by Ana Gatica-Colima.*

Fig. 34. Cattle guards or grids are structures that prevent livestock from crossing enclosed properties. Recent observations reveal, however, that cattle guards also serve as traps for reptiles and other vertebrates. Here, we encountered and rescued four Texas Horned Lizards (*Phrynosoma cornutum*) from under the shade of a grid. *Photo by Ana Gatica-Colima*.

No. 33. *Sceloporus poinsettii* Baird and Girard, 1852. The distribution of the Crevice Spiny Lizard "extends from central New Mexico and central Texas, in the United States, southward in Mexico to northern Jalisco, west of the Sierra Madre Occidental; in Chihuahua, it ranges westward to the Pacific slopes of the Sierra Madre Occidental and eastward to the western slopes of the Sierra Madre Oriental in the states of Nuevo León and northern and north-central San Luis Potosí" (Lemos-Espinal and Dixon 2013: 133–134). This individual was photographed on a rock with lichens at Sierra El Capulín, in Ascensión, Chihuahua. Wilson et al. (2013a) assessed its EVS as 12, placing it in the middle of the medium vulnerability category. The IUCN judged the conservation status of this lizard as Least Concern, and this species is not listed by SEMARNAT. *Photo by Eduardo Francisco Macias-Rodríguez.*

No. 34. *Sceloporus virgatus* Smith, 1938. The Striped Plateau Lizard "occurs in the Sierra Madre Occidental and associated mountains of western Chihuahua and eastern Sonora, possibly ranging southward into the northern part of Durango" (Heimes 2022: 401). This individual was photographed on dry pine leaves in pine forest at Monterde, in the municipality of Guazapares, Chihuahua. Wilson et al. (2013a) determined its EVS as 15, placing it in the lower portion of the high vulnerability category. The IUCN evaluated its conservation status as Least Concern, and this species is not listed by SEMARNAT. *Photo by Eric Centenero-Alcalá.*

No. 35. *Urosaurus ornatus* (Baird and Girard, 1852). The Ornate Tree Lizard is distributed from "extreme southwestern Wyoming and central Texas southward to western and northern Mexico. In Mexico, it occurs on the Pacific side from the Rio Colorado valley of northeastern Baja California through all of Sonora (including Isla Tiburón and some smaller islands in the Sea of Cortés) and Sinaloa southward to Nayarit" (Heimes 2022: 421). This individual was photographed as it was climbing a mesquite tree near El Paradero, in the municipality of Ojinaga, Chihuahua. Wilson et al. (2013a) calculated its EVS as 10, placing it at the lower limit of the medium vulnerability category. The IUCN determined its conservation status as Least Concern, and this species is not listed by SEMARNAT. *Photo by Cesar Daniel Munóz-Rivas.*

No. 36. *Uta stansburiana* (Baird and Girard, 1852). The Common Side-blotched Lizard is "widely distributed in desert regions of the western United States and northern Mexico, ranging from central Washington southeast to western Texas, and south to Baja California, Sonora and the Mexican Plateau…On the Mexican Plateau, the range extends from northern and eastern Chihuahua southeast through western and southern Coahuila to adjacent west-central Nuevo León, and south to northeastern Durango and extreme northern Zacatecas…" (Heimes 2022: 429). This adult male was photographed in sandy soil near San Gerónimo ranch, north of Sierra Samalayuca, Juárez, Chihuahua. Wilson et al. (2013a) calculated its EVS as 7, placing it in the middle portion of the low vulnerability category. The IUCN evaluated its conservation status as Least Concern, and this species is not listed by SEMARNAT. *Photo by Ana B. Gatica-Colima.*

Table 11. SEMARNAT categorizations for the herpetofaunal species in Chihuahua, Mexico, arranged by families. Non-native species are excluded.

Family	Number of species	SEMARNAT categorization			
		Endangered (P)	Threatened (A)	Special Protection (Pr)	No Status (NS)
Bufonidae	11	—	—	1	10
Craugastoridae	2	—	—	1	1
Eleutherodactylidae	2	—	—	1	1
Hylidae	4	—	—	—	4
Microhylidae	3	—	—	1	2
Phyllomedusidae	1	—	—	—	1
Ranidae	8	—	1	3	4
Scaphiopodidae	3	—	—	—	3
Subtotal	**34**	**—**	**1**	**7**	**26**
Ambystomatidae	4	—	—	2	2
Plethodontidae	1	—	—	—	1
Subtotal	**5**	**—**	**—**	**2**	**3**
Amphibia total	**39**	**—**	**1**	**9**	**29**
Anguidae	5	—	—	3	2
Anolidae	1	—	—	—	1
Crotaphytidae	2	—	1	1	—
Eublepharidae	1	—	—	1	—
Helodermatidae	2	—	2	—	—
Iguanidae	1	—	—	—	1
Phrynosomatidae	23	1	3	—	19
Phyllodactylidae	1	—	—	—	1
Scincidae	7	—	—	3	4
Teiidae	9	—	—	2	7
Subtotal	**52**	**1**	**6**	**10**	**35**
Boidae	1	—	—	—	1
Colubridae	40	—	7	3	30
Dipsadidae	10	—	—	4	6
Elapidae	2	—	1	1	—
Leptotyphlopidae	4	—	—	—	4
Natricidae	11	—	6	1	4
Viperidae	11	—	—	9	2
Subtotal	**79**	**—**	**14**	**18**	**47**
Emydidae	4	—	1	2	1
Geoemydidae	1	—	1	—	—
Kinosternidae	5	1	—	2	2
Testudinidae	2	1	—	—	1
Trionychidae	1	—	—	1	—
Subtotal	**13**	**2**	**2**	**5**	**4**
Reptiles total	**144**	**3**	**22**	**33**	**86**
Sum total	**183**	**3**	**23**	**42**	**115**

(Pr) category. Most species (115, or 62.8%) remain unassessed.

Of the three species allocated to the Endangered category, one is a country endemic lizard (*Uma paraphygas*), one is a non-endemic turtle (*Kinosternon sonoriense*), and one is a country endemic turtle (*Gopherus flavomarginatus*). Of the 23 species placed in the Threatened (A) category, one is a non-endemic frog (*Lithobates chiricahuensis*), four are non-endemic lizards (*Crotaphytus collaris*, *Heloderma suspectum*, *Cophosaurus texanus*, and *Uta stansburiana*), two are country endemic lizards (*Heloderma horridum* and *Phrynosoma orbiculare*), 11 are non-endemic snakes (*Lampropeltis alterna*, *Masticophis flagellum*, *M. mentovarius*, *Tantilla atriceps*, *Trimorphodon vilkinsonii*, *Micruroides euryxanthus*, *Nerodia erythrogaster*, *Thamnophis cyrtopsis, T. elegans*, *T. eques*, and *T. marcianus*), three are country endemic snakes (*Leptophis diplotropis*, *Pituophis deppei*, and *Thamnophis melanogaster*), and two are non-endemic turtles (*Chrysemys picta* and *Rhinoclemmys pulcherrima*). Forty-two species are placed in the Special Protection (Pr) category, including seven anurans, two salamanders, 10 lizards, 18 snakes, and five turtles (Table 11).

Given that only slightly more than one-third of the native species of amphibians and reptiles have been assessed by the SEMARNAT system, this system is of little use in assessing the conservation status of the herpetofauna of Chihuahua, although the system does deal with the threatened species identified by SEMARNAT.

The IUCN System

The IUCN system of conservation assessment has a global reach and is the most widely-used system in Mexican herpetology. In our estimation, however, this system has several drawbacks, as identified in earlier entries in the MCS. Nonetheless, we would be remiss if we did not examine its application to the herpetofauna of Chihuahua.

The IUCN system of conservation assessment encompasses six categories, including three so-called "threat" categories of Critically Endangered (CR),

Endangered (EN), and Vulnerable (VU); two categories of so-called "lesser risk," i.e., Near Threatened (NT) and Least Concern (LC); and one category called Data Deficient (DD) for species for which too little information exists to allow for assignment to another category. Finally, we use a category of Not Evaluated (NE) for species that have not been assessed using the IUCN system. Two additional categories exist for species considered to be either Extinct (EX) or Extinct in the Wild (EW), but these categories seldom apply to herpetofaunal species.

We provide the data on the IUCN categorizations in Table 7, and a summary of the data in Table 12. The data in Table 12 show that only seven species are allocated to the "threat categories" of CR, EN, and VU. The single CR species is the country endemic *Gopherus flavomarginatus**. The single EN species is the country endemic *Thamnophis melanogaster**. The five VU species are the anurans *Lithobates chiricahuensis* and *L. tarahumarae*, the salamander *Isthmura sierraoccidentalis**, and the turtles *Trachemys gaigeae* and *Gopherus evgoodei**. Two of these VU species are country endemics (indicated by the asterisks). Of the 148 species of "lesser risk," most (142, or 95.9%) are allocated to the Least Concern (LC) category. An additional 11 species are assigned to the Data Deficient (DD) category, which leaves 17 species unassessed, so we assigned them to the Not Evaluated (NE) category.

Of the 148 "lesser risk" species, 39 are country endemics (26.4%), and the remainder are non-endemics (Table 7). The 11 Data Deficient (DD) species are as follows: *Lithobates lemosespinali**, *Ambystoma silvense**, *Barisia levicollis**, *Sceloporus lemosespinali**, *Plestiodon multilineatus***, *P. parviauriculatus**, *Mastigodryas cliftoni**, *Sympholis lippiens**, *Tropidodipsas repleta**, *Terrapene nelsoni**, and *Kinosternon durangoense**. All 11 species are country endemics, except for *Plestiodon multilineatus*, which is the single Chihuahua state endemic species. The species not evaluated by the IUCN include one anuran, six lizards, nine snakes, and one turtle. Of these 17 species, eight (47.1%) are country endemics (Table 7).

The 142 species allocated to the Least Concern (LC) category constitute 77.6% of the 183 native members of the Chihuahua herpetofauna. Of these 142 species, 38 (26.8%) are country endemics, and the remainder are non-endemics. As found in the previous MCS entries, most of the native species in Chihuahua (slightly more than three-quarters) have been placed in the Least Concern (LC) category. We consider the LC category to be overused by the IUCN, which creates a false impression that, from a conservation perspective, the native herpetofauna generally is in better shape than reported in the MCS studies. Since this pattern consistently has been observed in these studies, we apply the EVS system below.

The EVS System

The Environmental Vulnerability Score (EVS) system of conservation assessment originally was developed for use with the herpetofauna of Honduras (Wilson and McCranie 2004), because the herpetofauna was not sufficiently well understood to apply the criteria used in the IUCN system at that time. Subsequently, the EVS system has been applied to the entire Mexican and Central American herpetofauna (Wilson et al. 2013a,b; Johnson et al. 2015a), as well as in all the previous MCS entries (see above). In addition, this system is being used more frequently in other conservation studies on the herpetofauna of Mexico, including those by Julio Lemos-Espinal and his co-authors.

In this entry, we determined the EVS values for the 183 native members of the herpetofauna of Chihuahua. We present these values in Table 7 and summarize them in Table 13. The EVS values range from 3 to 19, one less than the total theoretical range of values (3–20). The most frequent values (i.e., those associated with 10 or more species) are: 8 (11 species), 10 (16 species), 11 (25 species) 12 (17 species), 13 (20 species), 14 (29 species), and 15 (17 species). Notably, we collectively applied these seven values to 135 (73.8%) of the 183 native species in Chihuahua. The lowest score of 3 was calculated for only three anuran species (*Rhinella horribilis*, *Smilisca baudinii*, and *Scaphiopus couchii*). The highest value of 19 was applied to only two species, one a lizard (*Ctenosaura macrolopha**) and a turtle (*Gopherus flavomarginatus**).

As in all other MCS studies, we grouped the EVS values into three categories of low (3–9), medium (10–13), and high (14–19) vulnerability. Based on this categorization, the resulting EVS values for the native members of the Chihuahua herpetofauna increase from low vulnerability (41 species) to medium vulnerability (78 species), and then decrease with high vulnerability (64 species). This pattern of an increase from low to medium and a decrease from medium to high is similar to the patterns in many of the MCS studies (e.g., Barragán-Vázquez et al. 2022 and Leyte-Manrique et al. 2022).

To demonstrate how the IUCN ratings relate to those for the EVS, we compared the categorizations for these two systems in Table 14. Only seven (10.9%) of the 64 high vulnerability species are allocated to the three IUCN "threat categories" (CR, EN, and VU). At the other extreme, 41 of the low vulnerability species (by EVS) account for only 28.9% of the 142 LC species (by IUCN). Consequently, as seen in many of the other MCS studies, the conservation evaluations provided by the IUCN and EVS systems do not correlate well with one another.

As shown in previous MCS studies, the primary reason for the poor correspondence between the IUCN and EVS systems of conservation evaluation is the sizable number of species placed in the IUCN's DD, NE, and LC categories. In the case of the Chihuahuan herpetofauna, these categorizations involve 170 (92.9%) of the 183 native species. Of these 170 species, 11 are allocated to the DD category (Table 15). One of these species is an anuran, one is a salamander, four are lizards, three are snakes, and two are turtles. All 11 are endemic species, including 10 country endemics and one state endemic; their EVS values range from 14 to 18, all high vulnerability values. Unless the conservation status of these species is reassessed as additional information accumulates, then for all intents

Table 12. IUCN Red List categorizations for the herpetofaunal families in Chihuahua, Mexico. Non-native species are excluded. The shaded columns to the left are the "threat categories," and those to the right are the categories for which insufficient information on conservation status is available to place the taxa in another IUCN category, or they have not been evaluated.

Family	Number of species	IUCN Red List categorization						
		Critically Endangered	Endangered	Vulnerable	Near Threatened	Least Concern	Data Deficient	Not Evaluated
Bufonidae	11	—	—	—	—	10	—	1
Craugastoridae	2	—	—	—	—	2	—	—
Eleutherodactylidae	2	—	—	—	—	2	—	—
Hylidae	4	—	—	—	—	4	—	—
Microhylidae	3	—	—	—	—	3	—	—
Phyllomedusidae	1	—	—	—	—	1	—	—
Ranidae	8	—	—	2	—	5	1	—
Scaphiopodidae	3	—	—	—	—	3	—	—
Subtotal	**34**	—	—	**2**	**—**	**30**	**1**	**1**
Ambystomatidae	4	—	—	—	—	3	1	—
Plethodontidae	1	—	—	1	—	—	—	—
Subtotal	**5**	—	—	**1**	—	**3**	**1**	—
Amphibia total	**39**	—	—	**3**	**—**	**33**	**2**	**1**
Anguidae	5	—	—	—	—	4	1	—
Anolidae	1	—	—	—	—	1	—	—
Crotaphytidae	2	—	—	—	—	2	—	—
Eublepharidae	1	—	—	—	—	1	—	—
Helodermatidae	2	—	—	—	1	1	—	—
Iguanidae	1	—	—	—	—	1	—	—
Phrynosomatidae	23	—	—	—	1	18	1	3
Phyllodactylidae	1	—	—	—	—	—	—	1
Scincidae	7	—	—	—	—	4	2	1
Teiidae	9	—	—	—	—	8	—	1
Subtotal	**52**	**—**	—	**—**	**2**	**40**	**4**	**6**
Boidae	1	—	—	—	—	—	—	1
Colubridae	40	—	—	—	1	34	2	3
Dipsadidae	10	—	—	—	—	9	1	—
Elapidae	2	—	—	—	—	2	—	—
Leptotyphlopidae	4	—	—	—	—	2	—	2
Natricidae	11	—	1	—	—	8	—	2
Viperidae	11	—	—	—	1	9	—	1
Subtotal	**79**	—	**1**	**—**	**2**	**64**	**3**	**9**
Emydidae	4	—	—	1	1	1	1	—
Geoemydidae	1	—	—	—	—	—	—	1
Kinosternidae	5	—	—	—	1	3	1	—
Testudinidae	2	1	—	1	—	—	—	—
Trionychidae	1	—	—	—	—	1	—	—
Subtotal	**13**	**1**	**—**	**2**	**2**	**5**	**2**	**1**
Reptiles total	**144**	**1**	**1**	**2**	**6**	**109**	**9**	**16**
Sum total	**183**	**1**	**1**	**5**	**6**	**142**	**11**	**17**
Category total	**183**	**7**			**148**		**28**	

and purposes these species are ignored. In our opinion, the four species with an EVS of 14 (*Lithobates lemosespinali**, *Ambystoma silvense**, *Mastigodryas cliftoni**, and *Sympholis lippiens**) should be placed in the IUCN VU category, the five species with an EVS of 15 or 16 (*Barisia levicollis**, *Sceloporus lemosespinali**, *Plestiodon multilineatus*** [the single Chihuahua state endemic], *P. parviauriculatus**, and *Kinosternon durangoense**) should be allocated to the EN category, and the two species with an EVS of 17 or 18 (*Tropidodipsas repleta** and *Terrapene nelsoni**) should be relegated to the CR category.

Seventeen species remain unevaluated by the IUCN (Table 16). One species is an anuran, six are lizards, nine are snakes, and one is a turtle. Eight species are country endemics, and the remaining nine are non-endemics. Their EVS values range from 3 to 16, with three in the low vulnerability category, six in the medium vulnerability category, and eight in the high vulnerability category. The three species with an EVS of 3 to 8 should be placed in the LC category, the six with EVS of 11 to 13 in the NT category, the four species with EVS of 14 in the VU category, and the four species with an EVS of 15 or 16 in the EN category.

The IUCN placed the largest number of species that comprise the Chihuahuan herpetofauna in the LC category (Table 17). The 142 LC species includes 30 anurans, three salamanders, 40 lizards, 64 snakes, and five turtles. Thirty-four (23.9%) of these 142 species are country endemics and 108 (76.1%) are non-endemics. Their EVS values range from 3 to 19, with 37 falling within the low vulnerability category, 69 in the medium vulnerability category, and 36 in the high vulnerability category. Fifty-three species have an EVS ranging from 3 to 10 and can be placed in the LC category, the 54 with an EVS from 11 to 13 can be allocated to the NT category, the 21 with an EVS of 14

Table 13. Environmental Vulnerability Scores (EVS) for the herpetofaunal species in Chihuahua, Mexico, arranged by family. The shaded area on the left encompasses low vulnerability scores, and the one on the right includes the high vulnerability scores. Non-native species are excluded.

Family	Number of species	Environmental Vulnerability Score																
		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Bufonidae	11	1	—	1	—	1	—	1	1	2	2	1	1	—	—	—	—	—
Craugastoridae	2	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1	—	—
Eleutherodactylidae	2	—	—	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—
Hylidae	4	1	—	—	—	1	—	1	—	1	—	—	—	—	—	—	—	—
Microhylidae	3	—	1	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—
Phyllomedusidae	1	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Ranidae	8	—	—	—	—	1	1	1	—	1	2	1	1	—	—	—	—	—
Scaphiopodidae	3	1	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—
Subtotal	**34**	**3**	**1**	**1**	**1**	**3**	**3**	**4**	**2**	**5**	**4**	**3**	**2**	**1**	**—**	**1**	—	—
Ambystomatidae	4	—	—	—	—	—	—	—	2	—	—	—	2	—	—	—	—	—
Plethodontidae	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—
Subtotal	**5**	—	—	—	—	—	—	—	**2**	—	**—**	—	**2**	**—**	**—**	**1**	**—**	**—**
Amphibia total	**39**	**3**	**1**	**1**	**1**	**3**	**3**	**4**	**4**	**5**	**4**	**3**	**4**	**1**	**—**	**2**	—	—
Anguidae	5	—	—	—	—	—	—	—	1	—	—	1	1	2	—	—	—	—
Anolidae	1	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Crotaphytidae	2	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—
Eublepharidae	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—
Helodermatidae	2	—	—	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—
Iguanidae	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Phrynosomatidae	23	—	—	—	—	1	—	1	3	3	4	5	2	1	2	1	—	—
Phyllodactylidae	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—
Scincidae	7	—	—	—	—	—	—	—	—	1	2	1	1	1	1	—	—	—
Teiidae	9	—	—	—	—	—	—	1	—	1	—	1	4	2	—	—	—	—
Subtotal	**52**	—	—	**—**	**—**	**1**	**—**	**2**	**4**	**6**	**6**	**11**	**9**	**7**	**4**	**1**	**—**	**1**
Boidae	1	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—
Colubridae	40	—		2	4	1	2	2	5	8	2	2	8	3	1	—	—	—
Dipsadidae	10	—	1	—	2	—	1	—	1	1	1	1	1	—	—	1	—	—
Elapidae	2	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—
Leptotyphlopidae	4	—	—	—	—	—	2	—	—	—	—	1	1	—	—	—	—	—
Natricidae	11	—	—	—	—	1	1	—	1	2	1	—	2	1	2	—	—	—
Viperidae	11	—	—	—	—	—	1	1	—	2	2	2	1	1	1	—	—	—
Subtotal	**79**	—	**1**	**2**	**6**	**2**	**7**	**3**	**7**	**13**	**6**	**6**	**14**	**7**	**4**	**1**	**—**	**—**
Emydidae	4	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	2	—
Geoemydidae	1	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—
Kinosternidae	5	—	—	—	—	—	—	—	1	1	1	—	1	—	1	—	—	—
Testudinidae	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1
Trionychidae	1	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—
Subtotal	**13**	—	—	—	—	—	**1**	**—**	**1**	**1**	**1**	**—**	**2**	**2**	**1**	**—**	**3**	**1**
Reptiles total	**144**	—	**1**	**2**	**6**	**3**	**8**	**5**	**12**	**20**	**13**	**17**	**25**	**16**	**9**	**2**	**3**	**2**
Sum total	**183**	**3**	**2**	**3**	**7**	**6**	**11**	**9**	**16**	**25**	**17**	**20**	**29**	**17**	**9**	**4**	**3**	**2**
Category total	**183**	**41**							**78**				**64**					

No. 37. *Plestiodon bilineatus* (Tanner, 1958). The Two-lined Short-nosed Skink "occurs in the Sierra Madre Occidental from southern Chihuahua to northern Jalisco" (Lemos-Espinal et al. 2019: 150–151). This individual was photographed on dry leaves in pine forest at Monterde, in the municipality of Guazapares, Chihuahua. Wilson et al. (2013a) determined its EVS as 13, placing it at the upper limit of the medium vulnerability category. The IUCN has not determined its conservation status, and this species is not listed by SEMARNAT. *Photo by Eric Centenero-Alcalá.*

No. 38. *Aspidoscelis exsanguis* (Lowe, 1956). The Chihuahuan Spotted Whiptail occupies "Most of New Mexico, western Texas, northeastern Sonora and most of Chihuahua east of the Sierra Madre Occidental" (Lemos-Espinal et al. 2013: 84). This adult individual was photographed on a small hill with oak trees, near Cueva de las Monas, municipality of Chihuahua, Chihuahua. Wilson et al. (2013a) determined its EVS as 14, placing it at the lower limit of the high vulnerability category. The IUCN calculated its conservation status as Least Concern, and this species is not listed by SEMARNAT. *Photo by Ana B. Gatica-Colima.*

No. 39. *Aspidoscelis marmoratus* (Baird and Girard, 1852). The Marbled Whiptail occupies "Parts of New Mexico and western Texas south through northern and eastern Chihuahua to northeastern Durango, southern Coahuila, and western and southern Nuevo León" (Lemos-Espinal et al. 2018b: 137). This individual was photographed in sandy soil containing sand dune vegetation near the microwave tower station at Ascensión, Chihuahua. Wilson et al. (2013a) calculated its EVS as 14, placing it at the lower limit of the high vulnerability category. The IUCN has not judged its conservation status, and this species is not listed by SEMARNAT. *Photo by Sandra I. Ramos-Guerra.*

No. 40. *Aspidoscelis tesselatus* (Say, in James, 1823). The Checkered Whiptail "is distributed from central New Mexico southward into western Texas and eastern Chihuahua…along the Río Bravo and Río Conchos" (Lemos-Espinal et al. 2007: 360–361). This individual was photographed in sandy soil on the bank of a dry creek at Ojinaga, Chihuahua. Wilson et al. (2013a) judged its EVS as 14, placing it at the lower limit of the high vulnerability category. The IUCN has not determined its conservation status, and this species is not listed by SEMARNAT. *Photo by Eduardo F. Macias-Rodríguez.*

Table 14. Comparison of Environmental Vulnerability Scores (EVS) and IUCN categorizations for members of the herpetofauna of Chihuahua, Mexico. Non-native species are excluded. The shaded area at the top encompasses the low vulnerability category scores, and the one at the bottom includes the high vulnerability category scores.

EVS	IUCN categorization							Total
	Critically Endangered	Endangered	Vulnerable	Near Threatened	Least Concern	Data Deficient	Not Evaluated	
3	—	—	—	—	2	—	1	3
4	—	—	—	—	2	—	—	2
5	—	—	—	—	3	—	—	3
6	—	—	—	—	7	—	—	7
7	—	—	—	—	6	—	—	6
8	—	—	1	—	8	—	2	11
9	—	—	—	—	9	—	—	9
10	—	—	—	—	16	—	—	16
11	—	—	1	1	21	—	2	25
12	—	—	—	—	16	—	1	17
13	—	—	—	—	17	—	3	20
14	—	—	—	1	20	4	4	29
15	—	1	—	2	11	2	1	17
16	—	—	—	1	2	3	3	9
17	—	—	1	1	1	1	—	4
18	—	—	2	—	—	1	—	3
19	1	—	—	—	1	—	—	2
Total	**1**	**1**	**5**	**6**	**142**	**11**	**17**	**183**

Table 15. Environmental Vulnerability Scores (EVS) for members of the herpetofauna of Chihuahua, Mexico that are allocated to the IUCN Data Deficient category. * = country endemic. ** = Chihuahua endemic.

Species	Environmental Vulnerability Score (EVS)			
	Geographic distribution	Ecological distribution	Reproductive mode/Degree of persecution	Total score
*Lithobates lemosespinali**	5	8	1	14
*Ambystoma silvense**	5	8	1	14
*Barisia levicollis**	5	7	3	15
*Sceloporus lemosespinali**	5	8	3	16
*Plestiodon multilineatus***	5	8	3	16
*Plestiodon parviauriculatus**	5	7	3	15
*Mastigodryas cliftoni**	5	6	3	14
*Sympholis lippiens**	5	6	3	14
*Tropidodipsas repleta**	5	8	4	17
*Terrapene nelsoni**	5	7	6	18
*Kinosternon durangoense**	5	8	3	16

Table 16. Environmental Vulnerability Scores (EVS) for members of the herpetofauna of Chihuahua, Mexico that are currently not evaluated (NE) by the IUCN. Non-native taxa are excluded. * = country endemic.

Species	Environmental Vulnerability Score (EVS)			
	Geographic distribution	Ecological distribution	Reproductive mode/Degree of persecution	Total score
Rhinella horribilis	1	1	1	3
*Holbrookia approximans**	5	6	3	14
*Sceloporus albiventris**	5	8	3	16
Sceloporus cowlesi	4	6	3	13
*Phyllodactylus saxatilis**	5	8	3	16
*Plestiodon bilineatus**	5	5	3	13
Aspidoscelis marmorata	4	7	3	14
*Boa sigma**	5	4	6	15
Oxybelis microphthalmus	2	6	3	11
Salvadora deserticola	4	6	4	14
Salvadora lineata	2	5	4	11
*Rena dugesii**	5	8	1	14
Rena segrega	2	5	1	8
*Thamnophis unilabialis**	5	7	4	16
*Thamnophis validus**	5	3	4	12
Crotalus ornatus	4	4	5	13
Rhinoclemmys pulcherrima	1	4	3	8

Table 17. Environmental Vulnerability Scores (EVS) for members of the herpetofauna of Chihuahua, Mexico that are assigned to the IUCN Least Concern (LC) category. Non-native taxa are excluded. * = country endemic.

Species	Environmental Vulnerability Score (EVS)			
	Geographic distribution	Ecological distribution	Reproductive mode/ Degree of persecution	Total score
Anaxyrus cognatus	3	5	1	9
Anaxyrus debilis	1	5	1	7
*Anaxyrus mexicanus**	5	7	1	13
Anaxyrus punctatus	1	3	1	5
Anaxyrus speciosus	4	7	1	12
Anaxyrus woodhousii	3	6	1	10
Incilius alvarius	4	6	1	11
*Incilius mazatlanensis**	5	6	1	12
*Incilius mccoyi**	5	8	1	14
*Incilius occidentalis**	5	5	1	11
Craugastor augusti	2	2	4	8
*Craugastor tarahumaraensis**	5	8	4	17
*Eleutherodactylus interorbitalis**	5	6	4	15
Eleutherodactylus marnockii	3	4	4	11
Dryophytes arenicolor	2	4	1	7
Dryophytes wrightorum	2	6	1	9
Smilisca baudinii	1	1	1	3
*Tlalocohyla smithi**	5	5	1	11
Gastrophryne mazatlanensis	2	5	1	8
Gastrophryne olivacea	3	5	1	9
Hypopachus variolosus	2	1	1	4
*Agalychnis dacnicolor**	5	5	3	13
Lithobates berlandieri	4	2	1	7
*Lithobates cora**	5	7	1	13
*Lithobates magnaocularis**	5	6	1	12
*Lithobates pustulosus**	5	3	1	9
Lithobates yavapaiensis	4	7	1	12
Scaphiopus couchii	1	1	1	3
Spea bombifrons	3	6	1	10
Spea multiplicata	1	4	1	6
Ambystoma mavortium	3	6	1	10
*Ambystoma rosaceum**	5	8	1	14
*Ambystoma velasci**	5	4	1	10
Barisia ciliaris	5	7	3	15
Barisia imbricata	5	6	3	14
Elgaria kingii	2	5	3	10
Gerrhonotus infernalis	5	5	3	13
*Norops nebulosus**	5	5	3	13
Crotaphytus collaris	3	7	3	13
Gambelia wislizenii	3	7	3	13
Coleonyx brevis	4	6	4	14
*Heloderma horridum**	2	4	5	11
Ctenosaura macrolopha	5	8	6	19
Cophosaurus texanus	4	7	3	14
Holbrookia elegans	4	6	3	13
Holbrookia maculata	1	6	3	10
Phrynosoma cornutum	1	7	3	11
Phrynosoma hernandesi	3	7	3	13
Phrynosoma modestum	4	5	3	12
*Phrynosoma orbiculare**	5	4	3	12
Sceloporus clarkii	2	5	3	10
Sceloporus jarrovii	2	6	3	11
Sceloporus magister	1	5	3	9
Sceloporus merriami	4	6	3	13
*Sceloporus nelsoni**	5	5	3	13
Sceloporus poinsettii	4	5	3	12
Sceloporus slevini	2	6	3	11
Sceloporus virgatus	4	8	3	15
*Urosaurus bicarinatus**	5	4	3	12
Urosaurus ornatus	2	5	3	10
Uta stansburiana	3	1	3	7
Plestiodon callicephalus	2	7	3	12
Plestiodon multivirgatus	3	8	3	14
Plestiodon obsoletus	3	5	3	11
Plestiodon tetragrammus	4	5	3	12

Table 17 (continued). Environmental Vulnerability Scores (EVS) for members of the herpetofauna of Chihuahua, Mexico that are assigned to the IUCN Least Concern (LC) category. Non-native taxa are excluded. * = country endemic.

Species	Environmental Vulnerability Score (EVS)			
	Geographic distribution	Ecological distribution	Reproductive mode/ Degree of persecution	Total score
Aspidoscelis exsanguis	4	7	3	14
Aspidoscelis gularis	2	4	3	9
Aspidoscelis inornata	4	7	3	14
Aspidoscelis neomexicanus	4	8	3	15
Aspidoscelis sonorae	4	6	3	13
Aspidoscelis tesselata	4	7	3	14
Aspidoscelis uniparens	4	8	3	15
Arizona elegans	1	1	3	5
Bogertophis subocularis	4	7	3	14
*Conopsis nasus**	5	4	2	11
Drymarchon melanurus	1	1	4	6
Drymarchon margaritiferus	1	1	4	6
Gyalopion canum	4	3	2	9
Gyalopion quadrangulare	3	6	2	11
Lampropeltis alterna	4	7	3	14
Lampropeltis knoblochi	2	5	3	10
*Lampropeltis polyzona**	1	1	5	7
Lampropeltis splendida	4	5	3	12
*Leptophis diplotropis**	5	5	4	14
Masticophis bilineatus	2	5	4	11
Masticophis flagellum	1	3	4	8
Masticophis mentovarius	1	1	4	6
Masticophis taeniatus	1	5	4	10
Opheodrys vernalis	3	8	3	14
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 bairdi**	5	6	4	15
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 cucullata	4	6	2	12
Tantilla hobartsmithi	3	6	2	11
Tantilla nigriceps	3	6	2	11
Tantilla wilcoxi	2	6	2	10
Tantilla yaquia	2	6	2	10
*Trimorphodon tau**	5	4	4	13
Trimorphodon vilkinsonii	4	7	4	15
Diadophis punctatus	1	1	2	4
*Geophis dugesii**	5	6	2	13
Heterodon kennerlyi	3	4	4	11
Hypsiglena chlorophaea	1	5	2	8
Hypsiglena jani	1	3	2	6
Imantodes gemmistratus	1	3	2	6
*Leptodeira splendida**	5	5	4	14
*Rhadinaea hesperia**	5	3	2	10
*Rhadinaea laureata**	5	5	2	12
Micruroides euryxanthus	4	6	5	15
*Micrurus distans**	5	4	5	14
Rena dulcis	4	8	1	13
Rena humilis	4	3	1	8
Nerodia erythrogaster	3	4	4	11
*Storeria storerioides**	5	4	2	11
Thamnophis cyrtopsis	2	1	4	7
Thamnophis elegans	3	7	4	14
Thamnophis eques	2	2	4	8
*Thamnophis errans**	5	7	4	16
Thamnophis marcianus	1	5	4	10
Thamnophis sirtalis	3	7	4	14
Agkistrodon laticinctus	3	6	5	14
Crotalus atrox	1	3	5	9
*Crotalus basiliscus**	5	6	5	16

Table 17 (continued). Environmental Vulnerability Scores (EVS) for members of the herpetofauna of Chihuahua, Mexico that are assigned to the IUCN Least Concern (LC) category. Non-native taxa are excluded. * = country endemic.

Species	Environmental Vulnerability Score (EVS)			
	Geographic distribution	Ecological distribution	Reproductive mode/ Degree of persecution	Total score
Crotalus molossus	2	1	5	8
Crotalus pricei	2	7	5	14
Crotalus scutulatus	2	4	5	11
Crotalus viridis	1	6	5	12
Crotalus willardi	2	6	5	13
Chrysemys picta	3	8	3	14
Kinosternon flavescens	3	6	3	12
Kinosternon hirtipes	2	5	3	10
*Kinosternon integrum**	5	3	3	11
Apalone spinifera	3	6	6	15

and can be relegated to the VU category, the 12 species with an EVS of 15 or 16 can go in the EN category, and the two species with an EVS of 17 or 19 should be in the CR category.

Relative Herpetofaunal Priority

Johnson et al. (2015a) introduced the concept of Relative Herpetofaunal Priority (RHP) in an MCS study on the herpetofauna of the Mexican state of Chiapas. This device involves a simple means of determining the relative conservation significance of the herpetofauna of any geographical entity (e.g., a physiographic region, municipality, or state), and comprises two moieties: (1) ascertaining the proportion of country endemic species (and, in certain cases, state endemic species); and (2) determining the absolute number of high EVS category species in each regional herpetofauna. We provide the data for these two approaches in Tables 18 and 19.

The relative numbers of country and state endemics range from three in the Sierras Plegadas del Norte to 57 in the Gran Meseta y Cañones Chihuahuenses (Table 18). The average number of endemic species in the nine physiographic regions is 16.4. Thus, three of the nine regions have values above this mean, including the Sierras y Cañadas del Norte (with 23 endemics), Gran Meseta y Cañones Duranguenses (26), and the Gran Meseta y Cañones Chihuahuenses (57). Interestingly, these three regions are the only ones in the state that house the single state endemic (*Plestiodon multilineatus***).

Using the other RHP measure (i.e., relative number of high vulnerability species), from a conservation perspective the Gran Meseta y Cañones Chihuahuenses is the most significant region (Table 19). The number of high EVS species in each region ranges from 11 to 46, with a mean of 21.1. Four of the nine regions have values above this mean, including the Bolsón de Mapimí (with 22 high EVS species), Sierras y Cañadas del Norte (25), Gran Meseta y Cañones Chihuahuenses (46), and the Gran Meseta y Cañones Duranguenses (22).

The comparable ranks indicated based on the two RHP measures (endemic species rank on left and high EVS species rank on the right) are as follows (see Tables 18 and 19):

Gran Meseta y Cañones Chihuahuenses (1—1)
Gran Meseta y Cañones Duranguenses (2—3)
Sierras y Cañadas de Norte (3—2)
Sierras y Llanuras de Durango (4—8)
Sierra y Llanuras Tarahumaras (5—5)
Bolsón de Mapimí (6—3)
Llanuras y Médanos del Norte (7—4)
Llanuras y Sierras Volcánicas (8—6)
Sierras Plegadas del Norte (9—7)

There is little agreement in the respective ranges for the two RHP measures, except that Gran Meseta y Cañones Chihuahuenses occupies the 1st rank with both measures and Sierra y Llanuras Tarahumaras the 5th rank.

The 58 endemic species in the Gran Meseta y Cañones Chihuahuenses include 12 anurans, three salamanders, 17 lizards, 23 snakes, and three turtles. This region also harbors the following 49 high-vulnerability species:

*Ambystoma rosaceum** (14)
*Ambystoma silvense** (14)
Aspidoscelis exsanguis (14)
Aspidoscelis inornata (14)
Aspidoscelis marmorata (14)
Aspidoscelis tesselata (14)
Aspidoscelis uniparens (15)
*Barisia ciliaris** (15)
*Barisia imbricata** (14)
*Barisia levicollis** (15)
*Boa sigma** (15)
*Craugastor tarahumaraensis** (17)
*Crotalus basiliscus** (16)
Crotalus pricei (14)
*Ctenosaura macrolopha** (19)
*Eleutherodactylus interorbitalis** (15)
*Gopherus evgoodei** (18)
*Holbrookia approximans** (14)
*Incilius mccoyi** (14)
*Isthmura sierraoccidentalis** (17)
Kinosternon sonoriense (14)
Lampropeltis alterna (14)
*Leptodeira splendida** (14)
*Leptophis diplotropis** (14)
*Lithobates lemosespinali** (14)
*Mastigodryas cliftoni** (14)
Micruroides euryxanthus (15)
*Micrurus distans** (14)
Opheodrys vernalis (14)
*Phyllodactylus saxatilis** (16)

*Pituophis deppei** (14)
*Plestiodon multilineatus*** (16)
Plestiodon multivirgatus (14)
*Plestiodon parviauriculatus** (15)
*Rena dugesii** (14)
*Salvadora bairdi** (15)
Salvadora deserticola (14)
*Sceloporus albiventris** (16)
*Sceloporus lemosespinali** (16)
Sceloporus virgatus (15)
*Sonora aemula** (16)
*Sympholis lippiens** (14)
*Terrapene nelsoni** (18)
Thamnophis elegans (14)
*Thamnophis errans** (16)
*Thamnophis melanogaster** (15)
Thamnophis sirtalis (14)
*Thamnophis unilabialis** (16)
*Tropidodipsas repleta** (17)

These 49 species include four anurans, three salamanders, 17 lizards, 22 snakes, and three turtles. Thirty-four (69.4%) of these species are endemic to Mexico (33 species) or to the state of Chihuahua (one species). Their EVS values range from 14 to 19.

The 26 endemic species in the Gran Meseta y Cañones Duranguenses include four anurans, one salamander, 10 lizards, 10 snakes, and one turtle. This region also supports the following 22 high EVS species:

*Ambystoma rosaceum** (14)
Aspidoscelis exsanguis (14)
Aspidoscelis inornata (14)
*Boa sigma** (15)
Crotalus pricei (14)
*Ctenosaura macrolopha** (19)
*Incilius mccoyi** (14)
*Leptodeira splendida** (14)
*Mastigodryas cliftoni** (14)
Opheodrys vernalis (14)
*Plestiodon multilineatus*** (16)
Plestiodon multivirgatus (14)
*Plestiodon parviauriculatus** (15)
Salvadora deserticola (14)
*Sceloporus albiventris** (16)
*Sceloporus lemosespinali** (16)
*Sonora aemula** (16)
*Terrapene nelsoni** (18)
Thamnophis elegans (14)
*Thamnophis errans** (16)
Thamnophis sirtalis (14)
*Thamnophis unilabialis** (16)

These 22 species include one anuran, one salamander, eight lizards, 11 snakes, and one turtle. Thirteen (59.1%) of these species are endemic to Mexico and one (4.5%) is endemic to Chihuahua. Their EVS values range from 14 to 19.

The 23 endemic species in the Sierras y Cañadas del Norte include six anurans, three salamanders, eight lizards, and six snakes. This region also contains the following 26 high EVS species:

*Ambystoma rosaceum** (14)
*Ambystoma silvense** (14)
Aspidoscelis exsanguis (14)
Aspidoscelis uniparens (15)
*Barisia imbricata** (14)
*Barisia levicollis** (15)
*Craugastor tarahumaraensis** (17)

Table 18. Number of herpetofaunal species in the four distributional status categories among the nine physiographic regions of Chihuahua, Mexico. Rank is based on the number of country and state endemics. The numbers in parentheses in the rank order column represent the sum of the country endemic and state endemic numbers.

Physiographic region	Distributional category				Total	Rank order
	Non-endemics	Country endemics	State endemics	Non-natives		
Llanuras y Médanos del Norte LMN	75	5	—	1	81	7 (5)
Sierras Plegadas del Norte SPN	60	3	—	1	64	9 (3)
Bolsón de Mapimí BDM	71	7	—	2	80	6 (7)
Llanuras y Sierras Volcánicas LSV	69	4	—	2	75	8 (4)
Sierras y Cañadas del Norte SCN	56	22	1	—	79	3 (23)
Sierras y Llanuras Tarahumaras SLT	50	11	—	—	61	5 (11)
Gran Meseta y Cañones Chihuahuenses GMCC	71	56	1	—	128	1 (57)
Sierras y Llanuras de Durango SLD	46	12	—	—	58	4 (12)
Gran Meseta y Cañones Duranguenses GMCD	33	25	1	—	59	2 (26)

Table 19. Number of herpetofaunal species in the three EVS categories in nine physiographic regions in Chihuahua, Mexico. Rank is determined by the relative number of high EVS species. Non-native species are excluded.

Physiographic region	Low	Medium	High	Total	Rank order
Llanuras y Médanos del Norte LMN	24	37	18	79	4
Sierras Plegadas del Norte SPN	21	28	13	62	7
Bolsón de Mapimí BDM	24	31	22	77	3
Llanuras y Sierras Volcánicas LSV	25	31	16	72	6
Sierras y Cañada del Norte SCN	19	34	25	78	2
Sierras y Llanuras Tarahumaras SLT	16	27	17	60	5
Gran Meseta y Cañones Chihuahuenses GMCC	28	53	46	127	1
Sierras y Llanuras de Durango SLD	18	28	11	57	8
Gran Meseta y Cañones Duranguenses GMCD	13	24	22	59	3

No. 41. *Arizona elegans Kennicott*, 1859. The distribution of the Glossy Snake "extends from central California, southern Nevada, southern Utah, southwestern and eastern Colorado, and southeastern Nebraska southward through southern California, Arizona, New Mexico, Kansas, Oklahoma, and Texas, in the United States, and in Mexico in northern Baja California, Sinaloa, Aguascalientes, and in the Chihuahuan Desert, including western San Luis Potosí" (Lemos-Espinal and Dixon, 2013: 170–171). This juvenile was photographed in sandy soil in a somewhat stable sand dune at Médanos de Samalayuca, in Juárez, Chihuahua. Wilson et al. (2013a) ascertained its EVS as 5, placing it in the lower portion of the low vulnerability category. The IUCN designated its conservation status as Least Concern, but this species is not listed by SEMARNAT. *Photo by Rubén F. Alvídrez Heredia.*

No. 42. *Lampropeltis knoblochi* Taylor, 1940. The Chihuahuan Mountain Kingsnake "appears to be limited to the Sierra Madre Occidental of Sonora, Chihuahua, Sinaloa, and Durango, and Madrean Sky Islands in southeastern Arizona and southwestern New Mexico…" (Lemos-Espinal et al. 2013: 103). This individual was photographed on a rock with moss and lichens near Cascada de Basaseachi National Park, where there is pine-oak and gallery forest vegetation, in the municipality of Ocampo, Chihuahua. Wilson et al. (2013a) calculated its EVS as 10, placing it at the lower limit of the medium vulnerability category. The IUCN has not determined its conservation status, and this species is not listed by SEMARNAT. *Photo by Ramón Isaac Miramontes Cinco.*

No. 43. *Leptophis diplotropis* (Günther, 1872). The Pacific Coast Parrot Snake is found at "low altitudes on Pacific slopes from southern Sonora and southwestern Chihuahua (canyons of the Sierra Tarahumara) to the Isthmus of Tehuantepec, extending some distance up the Río Santiago valley" (Lemos-Espinal et al. 2013: 105). This individual was photographed in low deciduous forest at Urique, Chihuahua. Wilson et al. (2013a) determined its EVS as 14, placing it at the lower limit of the high vulnerability category. The IUCN assessed its conservation status as Least Concern, but this species is listed as Threatened by SEMARNAT. *Photo by Sebastián Ochoa Rodríguez.*

No. 44. *Masticophis flagellum* (Shaw, 1802). The distribution of the Coachwhip "extends across the southern half of the United States, and in Mexico southward through Baja California, west of the Sierra Madre Occidental to southern Sinaloa, and east of the Sierra Madre Occidental to northern Jalisco and Querétaro" (Lemos-Espinal and Dixon 2013: 199–200). This individual was photographed in a crop field on the old road to the city of Meoqui, Chihuahua. Wilson et al. (2013a) calculated its EVS as 8, placing it in the upper portion of the low vulnerability category. The IUCN determined its conservation status as Least Concern, but this species is considered as Threatened by SEMARNAT. *Photo by Leonardo Hernández Escudero.*

Crotalus pricei (14)
Heloderma suspectum (15)
*Holbrookia approximans** (14)
*Incilius mccoyi** (14)
*Isthmura sierraoccidentalis** (17)
Kinosternon sonoriense (14)
Opheodrys vernalis (14)
*Plestiodon multilineatus*** (16)
Plestiodon multivirgatus (14)
*Plestiodon parviauriculatus** (15)
*Salvadora bairdi** (15)
Salvadora deserticola (14)
*Sceloporus lemosespinali** (16)
Sceloporus virgatus (15)
Thamnophis elegans (14)
*Thamnophis errans** (16)
*Thamnophis melanogaster** (15)
Thamnophis sirtalis (14)
*Thamnophis unilabialis** (16)

These 26 species include two anurans, three salamanders, 11 lizards, nine snakes, and one turtle. Fourteen (53.8%) of these species are country endemics and one (3.8%) is a state endemic. Their EVS values range from 14 to 17.

Twelve endemic species inhabit the Sierras y Llanuras de Durango, including three anurans, two salamanders, five lizards, and two snakes. This region also harbors the following 12 high EVS species:

*Ambystoma silvense** (14)
Aspidoscelis exsanguis (14)
Aspidoscelis tesselata (14)
Aspidoscelis uniparens (15)
*Barisia ciliaris** (15)
Cophosaurus texanus (14)
*Craugastor tarahumaraensis** (17)
*Holbrookia approximans** (14)
Salvadora deserticola (14)
*Sceloporus albiventris** (16)
*Thamnophis errans** (16)
*Thamnophis unilabialis** (16)

These 12 species include one anuran, one salamander, seven lizards, and three snakes. Seven (58.3%) of these species are country endemics. Their EVS values range from 14 to 17.

Eleven endemic species occur in the Sierras y Llanuras Tarahumaras, including three anurans, two salamanders, five lizards, and one snake. This region also contains the following 18 high EVS species:

*Ambystoma rosaceum** (14)
Aspidoscelis marmorata (14)
*Ambystoma silvense** (14)
Aspidoscelis tesselata (14)
*Barisia imbricata** (14)
Aspidoscelis uniparens (15)
*Barisia levicollis** (15)
Salvadora deserticola (14)
*Holbrookia approximans** (14)
Thamnophis elegans (14)
*Sceloporus lemosespinali** (16)
*Thamnophis errans** (16)
Sceloporus virgatus (15)
Thamnophis sirtalis (14)
Aspidoscelis exsanguis (14)
Crotalus pricei (14)
Aspidoscelis inornata (14)
Kinosternon sonoriense (14)

These 18 species include two salamanders, 10 lizards, five snakes, and one turtle. Seven (38.9%) of these are country endemics. Their EVS values range from 14 to 16.

The Bolsón de Mapimí region houses seven endemic species, including one anuran, one salamander, two lizards, one snake, and two turtles. This region also contains the following 21 high EVS species:

*Ambystoma rosaceum** (14)
Apalone spinifera (15)
Aspidoscelis exsanguis (14)
Aspidoscelis inornata (14)
Aspidoscelis marmorata (14)
Aspidoscelis tesselata (14)
Aspidoscelis uniparens (15)
Bogertophis subocularis (14)
Chrysemys picta (14)
Cophosaurus texanus (14)
*Gopherus flavomarginatus** (19)
*Holbrookia approximans** (14)
*Kinosternon durangoense** (16)
*Pituophis deppei** (14)
Salvadora deserticola (14)
Terrapene ornata (15)
Thamnophis elegans (14)
Thamnophis sirtalis (14)
Trachemys gaigeae (18)
Trimorphodon vilkinsonii (15)
*Uma paraphygas** (17)

These 21 species include one salamander, eight lizards, six snakes, and six turtles. Six (28.6%) of these species are country endemics. Their EVS values range from 14 to 19.

The Llanuras y Médanos del Norte harbors five country endemics, including two anurans, one lizard, and two turtles. This region also contains the following 18 high EVS species:

Apalone spinifera (15)
Aspidoscelis exsanguis (14)
Aspidoscelis inornata (14)
Aspidoscelis marmorata (14)
Aspidoscelis tesselata (14)
Aspidoscelis uniparens (15)
Chrysemys picta (14)
Cophosaurus texanus (14)
*Holbrookia approximans** (14)
Kinosternon sonoriense (14)
Plestiodon multivirgatus (14)
Salvadora deserticola (14)
Sceloporus virgatus (15)
*Terrapene nelsoni** (18)
Terrapene ornata (15)

Thamnophis sirtalis (14)
Trachemys gaigeae (18)
Trimorphodon vilkinsonii (15)

These 18 species comprise nine lizards, three snakes, and six turtles. Only two are country endemics. Their EVS values range from 14 to 18.

The Llanuras y Sierras Volcánicas harbors four country endemics, including one anuran, one lizard, and two turtles. This region also contains the following 17 high EVS species:

Agkistrodon laticinctus (15)
Apalone spinifera (15)
Aspidoscelis exsanguis (14)
Aspidoscelis inornata (14)
Aspidoscelis marmorata (14)
Aspidoscelis tesselata (14)
Aspidoscelis uniparens (15)
Bogertophis subocularis (14)
Coleonyx brevis (14)
Cophosaurus texanus (14)
*Gopherus flavomarginatus** (19)
*Holbrookia approximans** (14)
Kinosternon durangoense (16)
Lampropeltis alterna (14)
Pantherophis bairdi (15)
Salvadora deserticola (14)
Terrapene ornata (15)

These 17 species consist of eight lizards, five snakes, and four turtles. Only two of these species are country endemics. Their EVS values range from 14 to 19.

The Sierras Plegadas del Norte harbors three country endemics, including one anuran and two lizards. This region also supports the following 14 high EVS species:

Apalone spinifera (15)
Aspidoscelis exsanguis (14)
Aspidoscelis inornata (14)
Aspidoscelis marmorata (14)
Aspidoscelis tesselata (14)
Aspidoscelis uniparens (15)
Bogertophis subocularis (14)
Coleonyx brevis (14)
Cophosaurus texanus (14)
*Holbrookia approximans** (14)
Salvadora deserticola (14)
Terrapene ornata (15)
Trachemys gaigeae (18)
Trimorphodon vilkinsonii (15)

These 14 species comprise eight lizards, three snakes, and three turtles. Only one of these species is a country endemic. Their EVS values range from 14 to 18.

Of the 183 native herpetofaunal species of herpetofauna in Chihuahua, 62 are endemics (33.9%) and 64 (35.0%) are high EVS species. Their numbers in the nine physiographic regions we recognize range from 12 to 49. These allocations are important for developing management plans in the protected areas of Chihuahua, as we discuss in the following section

Natural Protected Areas in Chihuahua

Biodiversity decline is one of the most significant global environmental problems affecting our planet. This problem is so extensive that biologists have described it as the sixth great extinction (Kolbert 2014). As with all global environmental problems, biodiversity decline is characterized by the following features: (1) insofar as we know, this is a worldwide problem that affects all components of the biosphere; (2) even though the decline is thought to be extensive, the actual extent is currently unknown and might never be known; (3) the problem is considered to be the result of the impact of an uncontrolled human population acting on limited supplies of resources, thereby producing widespread pollution; (4) the problem is expected to continue exacerbating until a currently incompletely understood tipping point is reached, forecasting an expected biospheric collapse; and (5) the basis for the problem is in the widespread affliction of humans by "a social disease termed anthropocentrism, for which the symptoms arise from denying the reality of natural law" (Leyte-Manrique et al. 2022: 167; also see Wilson and Lazcano 2019).

Conservation biologists are faced with attempting to control the short- and long-term manifestations of biodiversity decline. These biologists, however, are trying to fight this global environmental problem with primitive weapons that are in short supply.

The most basic problem conservation biologists face is a lack of knowledge of the true global extent of biodiversity, not even to the nearest order of magnitude (Wilson 2002). Thus, conservation biologists depend upon systematic biologists, who are attempting, with limited resources, to answer a fundamental question…Just how many species of organisms presently occupy our planet? Without an answer to this seemingly simple question, it is impossible to produce a suitable answer to more complex questions such as…How are all the world's creatures organized into ecosystems? Which of these ecosystems are most endangered by the actions of human beings? How close is humanity to bringing the biosphere (known and unknown) to the tipping point of biospheric collapse? Which organisms (known or unknown) lie on the cusp of that tipping point? As noted by Wilson (2002: 21), "the biospheric membrane that covers Earth, and you and me…is a miracle we have been given…" It is also "our tragedy, because a large part of it is being lost forever before we learn what it is and the best means by which it can be savored and used."

So, from the statements in the earlier part of this section, it should be evident that conservation biologists are able to make only minimal inroads in finding answers to these elemental questions about the natural world. One of the tools these biologists can use is to establish natural protected areas in an effort to provide some level of protection, hopefully for perpetuity, to particular groups of organisms occupying particular portions of ecosystems. Amphibians and reptiles are rarely the target organisms of such efforts, so in this paper it is important to assess the level of protection that the herpetofauna of Chihuahua presently has. For this reason, we present a summary of the known information on the natural protected areas of this state in Table 20.

Eleven natural protected areas (NPAs) occur in Chihuahua (Table 20). Two of these areas are biosphere reserves (Janos and Mapimi), two are national parks (Cascada de Bassascachic and Cumbres de Majalca), six are Flora and Fauna Protected Areas (Papigochic, Tutuaca, Cerro Mohinora, Médanos de Samalayuca, Campo Verde, and Cañon de Santa Elena), and one is a National Monument (Río Bravo del Norte). All 11 of these NPAs are under federal or national/federal jurisdiction.

These 11 NPAs protect portions of the following physiographic regions in Chihuahua: Bolsón de Mapimí (BDM), Gran Meseta y Cañones Chihuahuenses (GMCC), Gran Meseta y Cañones Duranguenses (GMCD), Llanuras y Médanos del Norte (LMN), Llanuras y Sierras Volcánicas (LSV), Sierras y Cañadas del Norte (SCN), Sierras y Llanuras Tarahumaras (SLT), and Sierras Plegadas del Norte (SPN). The only physiographic region with no representation in the protected area system in Chihuahua is the Sierras y Llanuras de Durango (SLD).

These NPAs were established from 1937 to 2015, with seven decreed during the present century (2001–2015). They range in area from 2,175 to 526,482.43 ha, with an average area of 181,076.06 ha (= 1,810.76 km^2 or 699.14 mi^2).

Only two of the 11 NPAs are unoccupied by landowners. Seven of these NPAs involve ejidos (which are communally held and collectively farmed land) and private ownership, one includes ejidos and rural communities, and one encompasses ejidos, private ownership, and national territory.

Of considerable significance is that all 11 of the NPAs have available management programs. In addition, and even more significantly, is that 10 of the 11 have completed herpetofaunal surveys.

Based on these surveys and other information, we were able to determine the herpetofaunal species found within the 11 NPAs (summarized in Table 21). Of the 40 species of amphibians in Chihuahua, 26 (65.0%) have been recorded in one or more of the NPAs, including 24 of 35 anuran species (68.6%) and two of five salamander species (40.0%). Of the 146 species of reptiles in the state, 99 (67.8%) have been recorded in one or more of the NPAs, including 90 of 133 squamates (67.7%) and nine of 13 turtles (69.2%). For the total herpetofauna of 186 species, 125 species (67.2%) are known from the compendium of 11 NPAs. Consequently, 61 species (32.8%) still have not been recorded from any of these NPAs. Of the 125 species of amphibians and reptiles presently recorded from the NPAs in the state of Chihuahua, 94 (75.2%) are non-endemic species, 28 (22.4%) are country endemics, one (0.8%) is a state endemic, and two (1.6%) are non-natives (Table 22).

The number of species recorded for each of the 11 NPAs ranges from 20 to 71 (Table 21). The lowest number is for Fauna and Flora Protected Area (FFPA) Campo Verde, which is the only NPA in Chihuahua for which no herpetofaunal survey is available. The highest number is from National Park Cascada de Bassascachic, which interestingly is one of the smallest NPAs in the state at 5,802.85 ha, but it also is one of the two NPAs that is not occupied by landowners (Table 20). The largest of the NPAs in Chihuahua, Biosphere Reserve Janos, is known to support 50 species of amphibians and reptiles.

Table 20. Characteristics of the Natural Protected Areas (NPAs) in Chihuahua, Mexico. Abbreviations for the category types of NPAs are: FFPA = Flora and Fauna Protected Area; NP = National Park; BR = Biosphere Reserve; and NM = Natural Monument. Abbreviations for services available in facilities are: A = administrative services; R = park guards; S = system of pathways; and V = facilities for visitors. Data were obtained from: Biosphere Reserves in Latin America and the Caribbean (https://en.unesco.org/biosphere/lac; Accessed: 19 March 2024).

Name	Category	Date of decree	Area (ha)	Municipalities of Chihuahua	Jurisdiction	Physiographic regions	Facilities available (A, R, S, V)	Occupied by landowners	Herpetofaunal survey completed	Management program available
Papigochic	FFPA	29 January 2003	222,763.85	Guerrero, Bocoyna, Ocampo and Temósachic	Federal	SCN, GMCC and SLT	A, R	Ejidos and private ownership	Yes	Yes
Tutuaca	FFPA	27 December 2001	436,985.67	Temósachic, Guerrero, Matachi, Madera, Moris and Ocampo	Federal	SCN, GMCC and SLT	A, R	Ejidos and rural communities	Yes	Yes
Cerro Mohinora	FFPA	10 July 2015	9,126.36	Guadalupe y Calvo	Federal	GMCD	A, R	Ejidos and private ownership	Yes	Yes
Cascada de Bassaseachic	National Park	2 February 1981	5,802.85	Ocampo	Federal	GMCC	A, R	Not occupied	Yes	Yes
Cumbres de Majalca	National Park	1 September 1939	4,701.28	Chihuahua and Riva Palacio	Federal	SLT	A, R	Ejidos, public and private ownership	Yes	Yes
Janos	Biosphere Reserve	7 June 1937	526,482.43	Janos	Federal	LMN and SCN	A, R, S, V	Ejidos and private ownership	Yes	Yes
Médanos de Samalayuca	FFPA	5 June 2009	56,134.38	Juárez and Guadalupe DB	Federal	LMN and SPN	A, R, S, V	Ejidos and private ownership	Yes	Yes
Campo Verde	FFPA	29 January 22003	108,067.47	Madera and Casas Grandes	Federal	SCN	A, R	Ejidos and private ownership	No	No
Cañón de Santa Elena	FFPA	7 November 1994	277,209.72	Manuel Benavides and Ojinaga	National/ Federal	LSV	A, R, S, V	Ejidos, private ownership and national territory	Yes	Yes
Mapimi	Biosphere Reserve*	27 November 2000	342,387.99	Jiménez	Federal	BDM	A, R, S, V	Ejidos and small private ownership	Yes	Yes

* The Mapimí Biosphere Reserve was the first biosphere reserve in Mexico, designated in 1977 by the "Man and Biosphere" (MAB) program of UNESCO.

Table 21. Distribution of herpetofaunal species in the Natural Protected Areas of Chihuahua, Mexico. Abbreviations are as follows: * = species endemic to Mexico; ** = species endemic to Chihuahua; and *** = non-native species. The numbers for the Natural Protected Areas are: 1 = Papigochic, 2 = Tutuaca, 3 = Mohinora, 4 = Bassaseachic, 5 = Cumbres de Majalca, 6 = Janos, 7 = Médanos de Samalayuca, 8 = Campo Verde, 9 = Cañón de Santa Elena, 10 = Mapimí, and 11 = Rio Bravo.

Taxon	Natural Protected Area										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Amphibia (26 species)											
Anura (24 species)											
Bufonidae (10 species)	1	2	3	4	5	6	7	8	9	10	11
Anaxyrus cognatus	+	+		+	+	+	+		+	+	
Anaxyrus debilis				+		+	+		+	+	+
Anaxyrus mexicanus *		+						+			
Anaxyrus punctatus	+	+	+	+	+	+	+	+	+	+	+
Anaxyrus speciosus											
Anaxyrus woodhousii		+	+	+	+	+	+	+			
Incilius alvarius				+		+	+	+			
Incilius mazatlanensis *		+	+					+			
Incilius mccoyi *				+							
Incilius occidentalis	+							+			
Craugastoridae (2 species)	1	2	3	4	5	6	7	8	9	10	11
Craugastor augusti				+		+					
Craugastor tarahumaraensis *	+	+	+								
Hylidae (2 species)	1	2	3	4	5	6	7	8	9	10	11
Dryophytes arenicolor	+	+	+	+	+	+		+	+		
Dryophytes wrightorum	+	+	+	+	+			+			
Microhylidae (1 species)	1	2	3	4	5	6	7	8	9	10	11
Gastrophryne olivacea		+	+	+	+				+	+	
Ranidae (6 species)	1	2	3	4	5	6	7	8	9	10	11
Lithobates berlandieri	+		+	+			+		+		+
Lithobates catesbeianus ***						+	+	+	+		
Lithobates chiricahuensis			+			+		+	+		
Lithobates lemosespinali *								+			
Lithobates tarahumarae			+	+	+			+	+		
Lithobates yavapaiensis				+					+		
Scaphiopodidae (3 species)	1	2	3	4	5	6	7	8	9	10	11
Scaphiopus couchii				+		+	+		+	+	+
Spea bombifrons				+		+	+				
Spea multiplicata						+	+			+	
Caudata (2 species)											
Ambystomatidae (2 species)	1	2	3	4	5	6	7	8	9	10	11
Ambystoma rosaceum *	+	+	+			+		+			
Ambystoma velasci *	+	+	+		+			+			
Reptilia (99 species)											
Squamata (90 species)											
Anguidae (4 species)	1	2	3	4	5	6	7	8	9	10	11
Barisia imbricata	+							+			
Barisia levicollis *	+	+									
Elgaria kingii		+	+	+	+						
Gerrhonotus infernalis									+		
Crotaphytidae (2 species)	1	2	3	4	5	6	7	8	9	10	11
Crotaphytus collaris				+	+	+	+		+	+	+
Gambelia wislizenii				+			+		+	+	+
Eublepharidae (1 species)	1	2	3	4	5	6	7	8	9	10	11
Coleonyx brevis				+			+		+	+	+
Gekkonidae (1 species)	1	2	3	4	5	6	7	8	9	10	11
*Hemidactylus turcicus****											+
Iguanidae (1 species)	1	2	3	4	5	6	7	8	9	10	11
Ctenosaura macrolopha *			+								
Phrynosomatidae (19 species)	1	2	3	4	5	6	7	8	9	10	11
Cophosaurus texanus				+	+	+	+		+	+	+
Holbrookia approximans *							+				
Holbrookia maculata				+	+	+	+		+	+	
Phrynosoma cornutum	+	+		+	+	+	+		+	+	+
Phrynosoma hernandesi			+	+	+						
Phrynosoma modestum				+		+	+		+	+	+
Phrynosoma orbiculare *	+		+	+				+			
Sceloporus clarkii			+								
Sceloporus cowlesi							+				
Sceloporus jarrovii	+	+	+	+	+						

Table 21 (continued). Distribution of herpetofaunal species in the Natural Protected Areas of Chihuahua, Mexico. Abbreviations are as follows: * = species endemic to Mexico; ** = species endemic to Chihuahua; and *** = non-native species. The numbers for the Natural Protected Areas are: 1 = Papigochic, 2 = Tutuaca, 3 = Mohinora, 4 = Bassaseachic, 5 = Cumbres de Majalca, 6 = Janos, 7 = Médanos de Samalayuca, 8 = Campo Verde, 9 = Cañón de Santa Elena, 10 = Mapimí, and 11 = Rio Bravo.

Taxon	Natural Protected Area										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Sceloporus magister				+		+	+		+	+	+
Sceloporus merriami									+		+
Sceloporus poinsettii			+	+	+	+	+		+	+	
Sceloporus slevini				+							
Sceloporus virgatus				+							
Uma paraphygas *									+	+	
Urosaurus ornatus				+	+	+	+		+		
Uta stansburiana				+		+	+		+	+	
Scincidae (5 species)	1	2	3	4	5	6	7	8	9	10	11
Plestiodon bilineatus *			+								
Plestiodon multilineatus **	+	+						+			
Plestiodon obsoletus				+		+	+		+	+	
Plestiodon parviauriculatus *		+	+					+			
Plestiodon tetragrammus				+							
Teiidae (7 species)	1	2	3	4	5	6	7	8	9	10	11
Aspidoscelis costatus *			+								
Aspidoscelis exsanguis				+	+	+	+				
Aspidoscelis gularis									+		+
Aspidoscelis inornata				+		+	+		+	+	
Aspidoscelis marmorata							+		+	+	+
Aspidoscelis tesselata							+		+		
Aspidoscelis uniparens				+	+	+	+				
Colubridae (25 species)	1	2	3	4	5	6	7	8	9	10	11
Arizona elegans				+		+	+		+	+	
Bogertophis subocularis									+	+	
Drymarchon melanurus			+								
Gyalopion canum				+		+	+				
Lampropeltis knoblochi				+	+						
Lampropeltis splendida							+				
Masticophis bilineatus				+							
Masticophis flagellum			+	+	+		+		+	+	+
Masticophis taeniatus					+	+	+		+	+	
Opheodrys vernalis				+							
Pantherophis bairdi									+		
Pantherophis emoryi							+				
Pituophis catenifer				+	+	+	+		+	+	
Pituophis deppei *	+								+		
Rhinocheilus lecontei				+		+	+		+	+	
Salvadora bairdi *									+		
Salvadora deserticola				+		+	+		+		+
Salvadora grahamiae				+		+					
Senticolis triaspis			+								
Sonora semiannulata				+		+	+		+	+	
Tantilla atriceps				+			+				
Tantilla hobartsmithi							+				
Tantilla nigriceps				+		+					
Tantilla wilcoxi			+	+	+						
Trimorphodon tau *				+							
Dipsadidae (6) species	1	2	3	4	5	6	7	8	9	10	11
Diadophis punctatus			+	+		+	+		+	+	
Geophis dugesii *			+								
Heteredon kennerlyi				+		+	+		+	+	
Hypsiglena chlorophaea				+							
Hypsiglena jani						+	+		+		
Leptodeira splendida *			+								
Leptotyphlopidae (2 species)	1	2	3	4	5	6	7	8	9	10	11
Rena dulcis				+		+	+				
Rena humilis				+		+	+		+	+	
Natricidae (9 species)	1	2	3	4	5	6	7	8	9	10	11
Storeria storerioides *			+	+							
Thamnophis cyrtopsis	+	+	+	+	+	+	+		+		+
Thamnophis elegans			+								
Thamnophis eques	+		+	+							
Thamnophis errans *	+			+				+			

Table 21. Distribution of herpetofaunal species in the Natural Protected Areas of Chihuahua, Mexico. Abbreviations are as follows: * = species endemic to Mexico; ** = species endemic to Chihuahua; and *** = non-native species. The numbers for the Natural Protected Areas are: 1 = Papigochic, 2 = Tutuaca, 3 = Mohinora, 4 = Bassaseachic, 5 = Cumbres de Majalca, 6 = Janos, 7 = Médanos de Samalayuca, 8 = Campo Verde, 9 = Cañón de Santa Elena, 10 = Mapimí, and 11 = Rio Bravo.

Taxon	Natural Protected Area										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Thamnophis melanogaster *								+			
Thamnophis sirtalis						+	+				
Thamnophis unilabialis *	+		+	+							
Viperidae (8 species)	1	2	3	4	5	6	7	8	9	10	11
Crotalus atrox						+	+		+	+	+
Crotalus lepidus	+	+	+	+	+	+	+		+	+	
Crotalus molossus	+	+	+	+	+	+					
Crotalus ornatus							+		+	+	
Crotalus pricei	+	+	+	+							
Crotalus scutulatus				+	+	+	+		+	+	
Crotalus viridis						+	+		+		
Crotalus willardi	+	+	+	+							
Testudines (9 species)											
Emydidae (2 species)	1	2	3	4	5	6	7	8	9	10	11
Terrapene ornata					+	+	+				
Trachemys gaigeae									+		
Kinosternidae (5 species)	1	2	3	4	5	6	7	8	9	10	11
Kinosternon durangoense *										+	
Kinosternon flavescens						+			+		+
Kinosternon hirtipes	+	+		+	+				+		
Kinosternon integrum *		+									
Kinosternon sonoriense				+							
Testudinidae (1 species)	1	2	3	4	5	6	7	8	9	10	11
Gopherus flavomarginatus *										+	
Trionychidae (1 species)	1	2	3	4	5	6	7	8	9	10	11
Apalone spinifera											+
Total (125 species)	**25**	**24**	**38**	**71**	**31**	**50**	**55**	**20**	**55**	**37**	**22**

In general, about two-thirds of the state's herpetofauna has been recorded within the state's NPAs, leaving about one-third unrecorded and unprotected. The one-third, or 61 species, still not recorded from any NPA include the following 11 anurans:

*Agalychnis dacnicolor**
*Eleutherodactylus interorbitalis**
Eleutherodactylus marnockii
Gastrophryne mazatlanensis
Hypopachus variolosus
Lithobates cora
*Lithobates magnaocularis**
*Lithobates pustulosus**
Rhinella horribilis
Smilisca baudinii
*Tlalocohyla smithi**

These unprotected species also include the following three salamanders:

Ambystoma mavortium
*Isthmura sierraoccidentalis**
*Ambystoma silvense**

The following 43 squamates are also included among the unprotected species:

Agkistrodon bilineatus
Agkistrodon laticinctus
Aspidoscelis neomexicanus
Aspidoscelis sonorae
*Barisia ciliaris**
*Boa sigma**
*Conopsis nasus**
*Crotalus basiliscus**
Drymobius margaritiferus
Gyalopion quadrangulare
*Heloderma horridum**
Heloderma suspectum
Holbrookia elegans
Imantodes gemmistratus
*Indotyphlops braminus***
Lampropeltis alterna
Lampropeltis polyzona
*Leptophis diplotropis**
Masticophis mentovarius
*Mastigodryas cliftoni**
Micruroides euryxanthus
*Micrurus distans**
Nerodia erythrogaster
*Norops nebulosus**
Oxybelis microphthalmus
*Phyllodactylus saxatilis**
Plestiodon callicephalus
Plestiodon multivirgatus
*Rena dugesii**
Rena segrega
*Rhadinaea hesperia**
*Rhadinaea laureata**
Salvadora lineata
Sceloporus albiventris
*Sceloporus nelsoni**
*Sonora aemula**

No. 45. *Masticophis taeniatus* (Hallowell, 1852). The Striped Whipsnake "is distributed from Idaho and Washington in the northwestern United States through the Great Basin and Chihuahuan Desert south to the Mexican Plateau. In Mexico, it is known from Chihuahua, Coahuila, Durango, Zacatecas, Aguascalientes and northeastern Jalisco" (Heimes 2016: 111). This individual was photographed in pine forest at Teseachi ranch, in Bachíniva, Chihuahua. Wilson et al. (2013a) determined its EVS as 10, placing it at the lower limit of the medium vulnerability category. The IUCN indicated its conservation status as Least Concern, and this species is not listed by SEMARNAT. *Photo by Sara G. Sáenz González.*

No. 46. *Pituophis catenifer* (Blainville, 1835). The distribution of the Gopher Snake "extends from southwestern Canada to the Great Lakes region of the United States, and southward to include most of northern Mexico" (Lemos-Espinal and Dixon 2013: 207–208). This adult was photographed on the road to Rancho El Berrendo, in Ascensión, Chihuahua. Wilson et al. (2013a) calculated its EVS as 9, placing it at the upper limit of the low vulnerability category. The IUCN determined its conservation status as Least Concern, and this species is not listed by SEMARNAT. *Photo by Ana B. Gatica-Colima.*

No. 47. *Salvadora deserticola* Schmidt, 1940. The Big Bend Patch-nosed Snake "ranges from southeastern Arizona, southwestern New Mexico and the Big Bend in Texas southward into northern Mexico. In Mexico, this species occurs west of the Sierra Madre Occidental from eastern Sonora and adjacent southwestern Chihuahua south to northern Nayarit, and east of the Sierra Madre Occidental through most of Chihuahua" (Heimes 2016: 146). This individual was photographed in the plains near a small creek, north of Sierra El Capulín in Ascension, Chihuahua. Wilson et al. (2013a) estimated its EVS as 14, placing it at the lower limit of the high vulnerability category. The IUCN has not calculated its conservation status, and this species is not listed by SEMARNAT. *Photo by Eduardo F. Macias-Rodríguez.*

No. 48. *Diadophis punctatus* (Linnaeus, 1766). The Ring-necked Snake occurs "from southeastern Canada through the eastern and southern United States south into central Mexico" (Heimes 2016: 227). This adult was photographed among the reddish rocks characteristic of this area, where the vegetation consists of a mixture of microphyllous and rosetophyllous scrub with patches of grassland, at Cerro Colorado in the Sierra Nombre de Dios, in the municipality of Chihuahua, Chihuahua. Wilson et al. (2013a) calculated its EVS as 4, placing it in the lower portion of the low vulnerability category. The IUCN determined its status as Least Concern, and this species is not listed by SEMARNAT. *Photo by Ramón Isaac Miramontes-Cinco.*

*Sympholis lippiens**
Tantilla cucullata
Tantilla yaquia
*Thamnophis validus**
Trimorphodon vilkinsonii
*Tropidodipsas repleta**
*Urosaurus bicarinatus**

Finally, the following four turtle species have not been recorded from the NPAs in Chihuahua:

Chrysemys picta
*Gopherus evgoodei**
Rhinoclemmys pulcherrima
*Terrapene nelsoni**

Of these 61 species, 32 are non-endemics, 28 are country endemics, and one is a non-native. Naturally, it is not desirable for the non-native species to be established in the system of NPAs, but given the widespread nature of *Indotyphlops braminus* in Mexico and elsewhere, it seems likely that eventually it will be found in one or more of the NPAs in Chihuahua.

We also need to mention that four areas have been set aside voluntarily for conservation (ADVC) in Chihuahua: El Quemado with 1,896.68 ha; Reserva Ecológica Presa El Caldillo with 68.32 ha; Dulce Amparo de Aguila with 1,356.14 ha; and Potrero de la Lumbre with 5,453.20 ha (INEGI 2022). Recently, three more ADVC areas have been set aside: in Bocoyna, Ejido San Ignacio de Arareco (3,917.87 ha); Area ribereña Ejido Bocoyna (3,070.39 ha) and Ejido Panalachi (4,100.08 ha).

Conclusions and Recommendations

Conclusions

A. Currently, the herpetofauna of Chihuahua consists of 186 species, including 35 anurans, five salamanders, 133 squamates (53 lizards and 80 snakes), and 13 turtles.
B. The numbers of herpetofaunal species from the nine physiographic regions in Chihuahua range from 58 in the Sierras y Llanuras de Durango (SLD) to 128 in the Gran Meseta y Cañones Chihuahuenses (GMCC).
C. The numbers of species shared among the nine physiographic regions range from 14 between the SPN and the GMCD to 72 between the SCN and the GMCC. The Coefficient of Biogeographic Resemblance (CBR) ranges from a low of 0.23 between the Sierras Plegadas del Norte (SPN) and the Gran Meseta y Cañones Duranguenses (GMCD) to 0.83 between the Sierras Plegadas del Norte (SPN) and the Llanuras y Sierras Volcánicas (LSV). The UPGMA dendrogram demonstrates that the closest relationships among the nine physiographic regions involve regions that are physically adjacent to one another in a series of swaths of two to three regions, generally oriented in a northwestern to southeastern direction and situated from the southwestern to the northeastern sectors of the state.
D. The level of endemism of the herpetofauna in Chihuahua is relatively limited (62/186, or 33.3%), with 61 species comprising the country endemics and one species constituting a state endemic. The country endemics include 12 of 35 anurans (34.3%), four of five salamanders (80.0%), 17 of 53 lizards (32.1%), 23 of 80 snakes (28.8%), and five of 13 species (38.5%). A single lizard species (*Plestiodon multilineatus***) constitutes the only state endemic species.
E. The distributional status of the 186 members of the herpetofauna of Chihuahua is as follows (in order of decreasing species numbers): non-endemics (121, 65.1%); country endemics (61, 32.8%); non-natives (three, 1.6%); and state endemics (one, 0.5%).
F. The 121 non-endemic species are allocated to the following distributional categories (in order of decreasing species numbers): MXUS species (109, 90.1%); USCA species (six, 5.0%); MXSA species (three, 2.5%); MXCA species (two, 1.7%); and USSA (one, 0.8%).
G. The principal environmental threats to the herpetofauna of Chihuahua are as follows:

Table 22. Summary of the distributional status of herpetofaunal species in protected areas in Chihuahua, Mexico. Total = total number of species recorded in the compendium of the listed protected areas.

Protected area	Number of species	Distributional status			
		Non-endemic (NE)	Country Endemic (CE)	State Endemic (SE)	Non-native (NN)
Papigochic	25	14	10	1	—
Tutuaca	24	15	8	1	—
Mohinora	39	25	14	—	—
Bassaseachic	71	64	7	—	—
Cumbres de Majalca	31	29	2	—	—
Janos	50	48	1	—	1
Médanos de Samalayuca	55	53	1	—	1
Campo Verde	20	8	11	1	—
Cañón de Santa Elena	55	51	3	—	1
Mapimí	37	34	3	—	—
Rio Bravo	22	21	—	—	1
Total	**125**	**94**	**28**	**1**	**2**

No. 49. *Heterodon kennerlyi* Kennicott, 1861. The Mexican Hog-nosed Snake "ranges from the western parts of Arizona, New Mexico and Texas south into Mexico. In Mexico, this species occurs in northern Sonora, Chihuahua, Durango, Coahuila, Zacatecas, Aguascalientes, San Luis Potosí, Nuevo León, and Tamaulipas" (Heimes 2016: 252). This individual was photographed on a rocky dirt road south of Cerro de la Cal, at Rancho El Uno, a Biosphere Reserve in Janos, Chihuahua. The IUCN has not determined its conservation status, and this species is not listed by SEMARNAT. *Photo by Eduardo F. Macias-Rodríguez.*

No. 50. *Thamnophis cyrtopsis* (Kennicott, 1861). The Black-necked Gartersnake "ranges from the southwestern United States through much of Mexico (but is absent in the Baja California Peninsula, coastal area and Yucatán Peninsula)" (Heimes 2016: 360). This individual was photographed in coniferous forest at San Juanito, in the municipality of Bocoyna, Chihuahua. Wilson et al. (2013a) ascertained its EVS as 7, placing it in the middle of the low vulnerability category. The IUCN judged its conservation status as Least Concern, but this species is listed as Threatened by SEMARNAT. *Photo by Daniele Gualdoni.*

No. 51. *Thamnophis eques* (Reuss, 1834). The Mexican Gartersnake "ranges continuously from Arizona southward through much of the Mexican Plateau to western Veracruz; an isolated population reported from Oaxaca" (Heimes, 2016: 364). This individual was photographed on a rock in oak forest at Cumbres de Majalca, a National Park in the state of Chihuahua, Chihuahua. Wilson et al. (2013a) determined its EVS as 8, placing it in the upper portion of the low vulnerability category. The IUCN determined its conservation status as Least Concern, but this species is considered as Threatened by SEMARNAT. *Photo by Sara G. Sáenz González.*

No. 52. *Thamnophis marcianus* (Baird and Girard, 1853). The Checkered Gartersnake "is continuously distributed across much of the southwestern United States and northern Mexico. It also occurs in several disjunct population from southern Mexico southward to northern Costa Rica" (Heimes, 2016: 372). This individual was photographed along a watering hole west of Rancho La Escondida, Nuevo Casas Grandes, Chihuahua. Wilson et al. (2013a) calculated its EVS as 10, placing it at the lower limit of the medium vulnerability category. The IUCN determined its conservation status as Least Concern, but this species is considered Threatened by SEMARNAT. *Photo by Alicia Santiesteban Martínez.*

land conversion and habitat loss; improper management of water quality and quantity; invasive species; climate change; fires and illegal logging; illegal trade; infectious diseases and parasites; on and off-road activities; mining; solid waste pollution; consumption of amphibians and reptiles; agriculture and livestock grazing; fear and/or confusion; and miscellaneous threats.

H. The percentage of endemism in Chihuahua (33.3) falls within the values for the surrounding Mexican states of Coahuila, Durango, Sinaloa, and Sonora (28.6–52.9%).

I. We evaluated the conservation status of the herpetofauna of Chihuahua using the SEMARNAT, IUCN, and EVS systems. As with all prior MCS studies, the SEMARNAT system was determined to be of minimal use, since only 68 of 183 native species (37.2%) have been assessed using this system. Of these 68 species, three are allocated to the Endangered (P) category, 23 to the Threatened (A) category, and 42 to the Special Protection (Pr) category. Most species (115, or 62.8%) remain unevaluated.

J. The application of the IUCN conservation system by category and proportions of the 183 native species in Chihuahua is as follows: CR (one species; 0.5%); EN (one; 0.5%); VU (five; 2.7%); NT (six; 3.3%); LC (142; 77.6%); DD (11; 6.0%); and NE (17; 9.3%).

K. The application of the EVS system of conservation assessment to the 183 native species of Chihuahua demonstrates that the categorial values increase from low vulnerability scores (41; 22.4%) to medium scores (78; 42.6%), and then decrease to high scores (64; 35.0%).

L. A comparison of the IUCN and EVS conservation status categorizations demonstrates that only seven of the 64 high vulnerability species (10.9%) are placed in the three IUCN "threat categories." At the other extreme, only 41 of the low vulnerability species (28.9%) are accounted for among the 142 LC species. As demonstrated in all other MCS studies, the correlation of the results from the application of the IUCN and EVS systems to the Chihuahua herpetofauna is relatively poor.

M. An examination of the 170 out of 183 native species of the Chihuahuan herpetofauna that have been allocated to the IUCN DD, NE, and LC categories indicates that many of these species have been assessed improperly when compared to their respective EVS values, so we demonstrated how these 170 species should be re-assigned in the IUCN system to better indicate their prospects for survival in perpetuity.

N. The Relative Herpetofauna Priority measure was used to determine the conservation significance of the nine regional herpetofaunas in Chihuahua. This analysis indicates the most significant herpetofauna, based on country and state endemic species numbers, is found in the Gran Meseta y Cañones Chihuahuenses. The rank order of the remaining eight regions is as follows: Gran Meseta y Cañones Duranguenses, Sierra y Cañadas del Norte, Sierras y Llanuras de Durango, Sierras y Llanuras Tarahumaras, Bolsón de Mapimí, Llanuras y Médanos del Norte, Llanuras y Sierras Volcánicas, and Sierras Plegadas del Norte. Using the other RHP measure (number of high vulnerability species), the most significant region also is the Gran Meseta y Cañones Chihuahuenses. The rank order of the other eight regions by this measure is as follows: Sierras y Cañadas de Norte, Bolsón de Mapimí, Gran Meseta y Cañones Duranguenses, Llanuras y Médanos del Norte, Sierras y Llanuras Tarahumaras, Llanuras y Sierras Volcánicas, Sierras Plegadas del Norte, and Sierras y Llanuras de Durango.

O. Eleven natural protected areas (NPAs) are established in Chihuahua, including two biosphere reserves, two national parks, six flora and fauna protected areas, and one national monument. All these areas have federal or national/federal status. These NPAs are distributed among all the physiographic areas in the state except for one. All but two of the NPAs are occupied by landowners, but all 11 have management programs and all but one have completed their herpetofaunal surveys.

P. Of the state total of 186 species, 125 have been recorded in one or more of the NPAs, leaving 61 species still not recorded. These 61 species include 11 anurans, three salamanders, 43 squamates, and four turtles. One of the squamates is a non-native species, so it is not desired as a component of the NPA herpetofaunas.

Recommendations

A. This study demonstrated that of the 186 species that comprise the Chihuahuan herpetofauna, 125 have been recorded from one or more of the 11 natural protected areas in the state. This situation is relatively desirable, but it still means that 61 species (32.8%) are not represented among these NPAs.

B. Herpetofaunal surveys have been completed in 10 of the 11 NPAs. The number of herpetofaunal species known in each of these NPAs ranges from 20 to 71.

C. What is known about the composition of the herpetofauna of the state's NPAs can serve as a springboard for attempts to document the presence of the 61 species currently not reported from any of the NPAs. Such a study should be the first goal for the state's conservation herpetologists.

D. Once reasonably complete herpetofaunal surveys are available for the existing NPAs, then it will be possible to determine if any species from the state remain unaccounted for in these NPAs, and allow for the establishment of additional NPAs.

E. Once the entire herpetofauna of Chihuahua is

considered protected within the NPAs, then monitoring programs can be established for the ongoing assessment of the health of the state's amphibian and reptiles.

F. Accordingly, these steps need to be undertaken in advance of the rate at which the herpetofaunal populations in Chihuahua are threatened by human encroachment.

"To cope with the crises of biodiversity loss, climate change, overpopulation, and threats to the provision of life's essentials, far more is needed than scientific reports that are too often largely ignored. To rescue the human enterprise in the long run, requires strong action in the short run directed toward saving biodiversity and bringing the human enterprise within sustainable limits." Chapter 13 in *Life: A Journey through Science and Politics* by Paul R. Ehrlich (2023)

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No. 53. *Crotalus atrox* Baird and Girard, 1853. The distribution of the Western Diamond-backed Rattlesnake "extends from Arkansas and north-central Oklahoma westward to southeastern California and southward through parts of Arizona, New Mexico, and much of Texas. In Mexico, this species ranges from northeastern Baja California through Sonora and northern Sinaloa, across most of Chihuahua except for the Sierra Madre Occidental, throughout Coahuila, Nuevo León, and Tamaulipas, and in the northeastern parts of Durango and Zacatecas. It also occurs in Hidalgo and Querétaro, and in parts of central and eastern San Luis Potosí, as well as in extreme northern Veracruz…" (Lemos-Espinal and Dixon 2013: 249–250). This adult was photographed in a sand dune with some vegetation, including mesquite, at Rancho Zorro Plateado, in Juárez, Chihuahua. Wilson et al. (2013a) judged its EVS as 9, placing it at the upper limit of the low vulnerability category. The IUCN determined its conservation status as Least Concern, but this species is listed as subject to Special Protection by SEMARNAT. *Photo by Jesús M. Martínez-Calderas.*

No. 54. *Crotalus lepidus* (Kennicott, 1861). The distribution of the Rock Rattlesnake "extends 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: 250–251). This snake was photographed on dry leaves in pine forest at National Park Cascadas de Basaseachi, in the municipality of Ocampo, Chihuahua. Wilson et al. (2013a) determined its EVS as 12, placing it in the middle portion of medium vulnerability category. The IUCN designated its conservation status as Least Concern, but this species is listed as subject to Special Protection by SEMARNAT. *Photo by Sara G. Sáenz González.*

No. 55. *Crotalus molossus* (Baird and Girard, 1853). The distribution of the Black-tailed Rattlesnake "extends from northwestern Arizona and western New Mexico, in the United States, and in Sonora, Mexico including Isla Tiburón in the Sea of Cortés (Gulf of California), southward throughout the Sierra Madre Occidental to central Oaxaca, and throughout the Mexican plateau to southern Coahuila and Nuevo León. In San Luis Potosí it has been recorded in several localities…" (Lemos-Espinal and Dixon 2013: 252–253). This snake was photographed along a dry tree trunk in oak forest, on pieces of dry bark, at Rancho Teseachi, in the municipality of Bachíniva, Chihuahua. The IUCN determined its conservation status as Least Concern, and this species is listed as subject to Special Protection by SEMARNAT. *Photo by Sara G. Sáenz-González.*

No. 56. *Crotalus pricei* Van Denburgh, 1895. The distribution of the Twin-spotted Rattlesnake "extends 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: 254–255). This snake was photographed on a rock in pine forest at Monterde, in the municipality of Guazapares, Chihuahua. The IUCN assessed its conservation status as Least Concern, and this species is listed as subject to Special Protection by SEMARNAT. *Photo by Eric Centenero-Alcalá.*

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No. 57. *Crotalus scutulatus* (Kennicott, 1861). The distribution of the Mohave Rattlesnake "extends from southern California, southern Nevada, and southwestern Utah southward through southern Arizona, New Mexico, and western Texas, in the United States, and in Mexico from northern Sonora and east of the Sierra Madre Occidental to Puebla and central Veracruz. The entire Chihuahuan Desert is a major portion of its distribution, especially western of Nuevo León and Tamaulipas. In San Luis Potosí it has been recorded in the west-central parts of the state" (Lemos-Espinal and Dixon 2013: 254–255). This individual was photographed on the ground with scrub vegetation, south of Sierra El Capulín in Ascensión, Chihuahua. The IUCN evaluated its conservation status as Least Concern, and this species is listed as subject to Special Protection by SEMARNAT. *Photo by Eduardo F. Macias-Rodríguez.*

No. 58. *Crotalus viridis* (Rafinesque, 1818). The Prairie Rattlesnake "ranges from Alberta, Canada, southward over much of the Great Plains southward to northern Mexico. In Mexico, this species is known from extreme northwestern Chihuahua and northern Coahuila and has been reported from extreme northeastern Sonora…" (Heimes 2016: 487). This individual was photographed on sandy soil at Rancho Zorro Plateado in the Natural Protected Area Médanos de Samalayuca, in Juárez, Chihuahua. Wilson et al. (2013a) calculated its EVS as 12, placing it in the middle of the medium vulnerability category. The IUCN assessed its conservation status as Least Concern, and this species is listed as subject to Special Protection by SEMARNAT. *Photo by Alejandro García-Palacios.*

No. 59. *Crotalus willardi* Meek, 1906. The Ridge-nosed Rattlesnake ranges from "extreme southeastern Arizona and southwestern New Mexico southward through the Sierra Madre Occidental and associated mountains" (Heimes 2016: 495). This individual was photographed on dry pine leaves in pine forest at Divisadero, in the municipality of Urique, Chihuahua. Wilson et al. (2013a) designated its EVS as 13, placing it at the upper limit of the medium vulnerability category. The IUCN judged its conservation status as Least Concern, and this species is listed as subject to Special Protection by SEMARNAT. *Photo by Eric Centenero-Alcalá.*

No. 60. *Terrapene ornata* (Agassiz, 1857). The Ornate Box Turtles occupies "the central and southern Great Plains of the United States, extending southwestward into southeastern Arizona and southeastward into southwestern Louisiana. It occurs in northwestern northern and eastern Chihuahua…" (Lemos-Espinal and Smith 2007: 298–299). This individual was photographed in the grasslands of Rancho El Uno, Reserva de la Biosfera de Janos, Janos, Chihuahua. Wilson et al. (2013a) calculated its EVS as 15, placing it in the lower portion of the high vulnerability category. The IUCN determined its conservation status as Near Threatened, and this species is listed as subject to Special Protection by SEMARNAT. *Photo by Eduardo F. Macias-Rodríguez.*

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No. 61. *Trachemys gaigeae* (Hartweg, 1939). The Big Bend Slider occurs "in the Río Bravo in central New Mexico southward to (but not including) Coahuila, and in the Río Conchos, as well as in lakes and permanent ponds adjacent to the rivers" (Lemos-Espinal and Smith, 2007: 299–300). Once it was captured, this individual was photographed in a stream in the municipality of Coronado, Chihuahua. Wilson et al. (2013a) calculated its EVS as 18, placing it in the upper portion of the high vulnerability category. The IUCN judged its conservation status as Vulnerable, but this species is not listed by SEMARNAT. *Photo by Ana B. Gatica-Colima.*

No. 62. *Kinosternon flavescens* (Agassiz, 1857). The Yellow Mud Turtle is distributed in "the Mississippi and other Gulf drainages southward from NE Nebraska through Kansas, Oklahoma, Texas, and extreme southeastern Arizona to northern and Gulf Coastal Mexico. Isolated population occur in the northern part of the range in the United States" (Legler and Vogt 2013). This individual was photographed in a small rain pond in September, near El Bosque, Rancho El Uno, at Reserva de la Biosfera de Janos, in the municipality of Janos, Chihuahua. Wilson et al. (2013a) determined its EVS as 12, placing it in the middle of the medium vulnerability category. The IUCN evaluated its conservation status as Least Concern, and this species is not listed by SEMARNAT. *Photo by Ana Gatica-Colima.*

No. 63. *Apalone spiniferus* (Lesueur, 1827). The distribution of the Spiny Soft-shelled Turtle "extends from southeastern Canada and throughout much of the eastern and central United States, with scattered introduced and relictual populations in the western part of the country. In Mexico, this species occurs in Baja California and Sonora (introduced populations), along the main rivers from Chihuahua to Tamaulipas, and in San Luis Potosí; a relictual population also occurs in the Río Balsas of Guerrero" (Lemos-Espinal and Dixon 2013: 88–89). This individual was photographed on a discarded tire in a water channel in the municipality of Guadalupe, Chihuahua. Wilson et al. (2013a) designated its EVS as 15, placing it in the lower portion of the high vulnerability category. The IUCN determined its conservation status as Least Concern, and this species is listed as subject to Special Protection by SEMARNAT. *Photo by Ana Gatica-Colima.*

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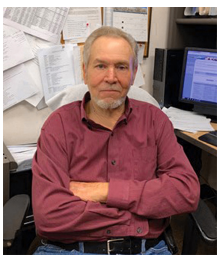
Ana Bertha Gatica-Colima was born in Tijuana, Baja California, Mexico, and is a biologist with an M.S. in Management of Arid Zones from the Universidad Autónoma de Baja California, and a Ph.D. in Natural Resources from the Universidad Autónoma de Chihuahua. She was awarded a Diploma in Herpetology by the Sociedad Herpetológica Mexicana AC, and is a founding teacher of the Biology Program at the Universidad Autónoma de Ciudad Juárez. She is a researcher responsible for the Animal Ecology and Biodiversity Laboratory, where the scientific collection is maintained. This collection contains specimens of vertebrates mostly from the Chihuahuan Desert in the state of Chihuahua, Mexico. Ana has taught undergraduate students (in courses on chordate biology, fieldwork biology, and management of arid zones), and has been working with reptiles and amphibians for about 30 years. Her main interests are rattlesnakes of the genus *Crotalus* from the Sonoran and Chihuahuan deserts, although she also has worked with other colleagues on various aspects of vertebrate research. Ana has directed about 100 theses (undergraduate and graduate students), and has received grants for several projects, including three from CONABIO. She has participated in revising amphibian and reptile species proposals to be included, excluded, or have their categories changed in the SEMARNAT Norm. About 45 of her publications have appeared in refereed journals, and she has participated in national and international academic meetings. Ana is an active member of the Sociedad Herpetológica Mexicana AC, the Society for the Study of Amphibians and Reptiles, and the Southwestern Association of Naturalists. She also likes hiking and taking photos for Naturalista.

Louis W. Porras graduated with a degree in Biology in 1971 from what today is known as Miami-Dade College (Miami, Florida, USA). Over his career he has authored or co-authored over 60 academic publications, including the descriptions of two new species, and two taxa have been named in his honor. Louis developed an interest in herpetology at an early age in his native Costa Rica. His passion for the field led him to travel to many remote areas, including throughout the Bahamas, the United States, Mesoamerica, and parts of South America. In 1968 he worked at the Houston Zoological Gardens, and from 1982 to 1984 at Utah's Hogle Zoo. In 1976 he attended the inaugural meeting of the International Herpetological Symposium (IHS), and later served the group as Vice-President and President. In 1993, along with Gordon W. Schuett, he helped launch the journal *Herpetological Natural History,* and for IHS' 20th anniversary, in recognition of his contributions, three former Presidents dedicated the book *Advances in Herpetoculture* in his honor. Louis' career in publishing began in 1995, when as a member of Canyonlands Publishing Group he helped publish *Fauna* magazine. In 2002 he founded Eagle Mountain Publishing, LC, which has published such herpetological titles as *Biology of the Vipers* (2002), *Biology of the Boas and Pythons* (2007), *Amphibians, Reptiles, and Turtles in Kansas* (2010), *Conservation of Mesoamerican Amphibians and Reptiles* (2010), and *Amphibians and Reptiles of San Luis Potosí* (2013). From 2014 to 2018 he was the Publisher and Managing Editor of the journal *Mesoamerican Herpetology*, and more recently he was the Publisher and Co-editor of the book *Advances in Coralsnake Biology: with an Emphasis on South America*.

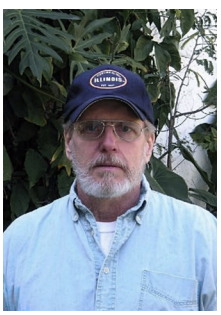
Vicente Mata-Silva is a herpetologist originally from Río Grande, Oaxaca, Mexico. His interests include the ecology, conservation, natural history, and biogeography of the herpetofaunas of Mexico, Central America, and the southwestern United States. He received his B.S. degree from the Universidad Nacional Autónoma de México (UNAM), and his M.S. and Ph.D. degrees from the University of Texas at El Paso (UTEP). Vicente is an Associate Professor of Instruction of Biological Sciences at UTEP in the Ecology and Evolutionary Biology Program, and Director of UTEP's 41,200-acre Indio Mountains Research Station, located in the Chihuahuan Desert of Trans-Pecos, Texas. To date, Vicente has authored or co-authored over 190 peer-reviewed scientific publications. He also was the Distribution Notes Section Editor for the journal *Mesoamerican Herpetology.*

Dominic L. DeSantis is an Assistant Professor of Biology at Georgia College and State University, Milledgeville, Georgia, USA, in the Department of Biological and Environmental Sciences. Dominic's research interests broadly include the behavioral ecology, conservation biology, and natural history of herpetofauna. In addition to ongoing collaborative projects associated with the Mesoamerican Research Group, much of Dominic's current research focuses on using novel animal-borne sensor technologies to study the behavior of snakes in the field. While completing his Ph.D. at the University of Texas at El Paso, Dominic accompanied Vicente Mata-Silva, Elí García-Padilla, and Larry David Wilson on survey and collecting expeditions to Oaxaca in 2015, 2016, and 2017, and is a co-author on numerous natural history publications produced from those visits, including an invited book chapter on the conservation outlook for herpetofauna in the Sierra Madre del Sur of Oaxaca.

Arturo Rocha is a Ph.D. student in the Ecology and Evolutionary Biology program at the University of Texas at El Paso. His interests include the study of biogeography, physiology, and ecology of amphibians and reptiles in the southwestern United States and Mexico. A graduate of the University of Texas at El Paso, his thesis centered on the spatial ecology of the Trans-Pecos Rat Snake (*Bogertophis subocularis*) in the northern Chihuahuan Desert. To date, he has authored or co-authored over 20 peer-reviewed scientific publications.



Jerry D. Johnson is a retired 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 was the Director of the 41,200-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 the Geographic Distribution section of *Herpetological Review*. Jerry has authored or co-authored over 130 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 was a renowned herpetologist with lengthy experience in Mesoamerica who passed away from leukemia on 28 April 2024. He was born in Taylorsville, Illinois, USA, and received his university education at the University of Illinois at Champaign-Urbana (B.S. degree) and at Louisiana State University in Baton Rouge (M.S. and Ph.D. degrees). He authored or co-authored 488 peer-reviewed papers and books on herpetology. Larry was the senior editor of *Conservation of Mesoamerican Amphibians and Reptiles* (2010) and a co-author of seven of its chapters. His other books include *The Snakes of Honduras* (1985), *Middle American Herpetology* (1988), *The Amphibians of Honduras* (2002), *Amphibians & Reptiles of the Bay Islands and Cayos Cochinos, Honduras* (2005), *The Amphibians and Reptiles of the Honduran Mosquitia* (2006), and *Guide to the Amphibians & Reptiles of Cusuco National Park, Honduras* (2008). He was also the co-author of 16 entries in the Mexican Conservation series, which dealt with the herpetofauna of the states of Michoacán, Oaxaca, Chiapas, Tamaulipas, Nayarit, Nuevo León, Jalisco, Puebla Coahuila, Hidalgo, Veracruz, Querétaro, Tabasco, Guanajuato, and the Baja California Peninsula, as well as the tri-state Mexican Yucatan Peninsula. In addition, he was a co-author of several significant publications on the development and extensive application of the EVS measure and on conservation issues related to the Mexican and Central American herpetofaunas. He authored or co-authored the descriptions of 76 currently recognized herpetofaunal species, and six species have been named in his honor, including the anuran *Craugastor lauraster*, the lizard *Norops wilsoni*, as well as coccidian parasite *Isospora wilsoni.* In 2005 he was designated a Distinguished Scholar in the Field of Herpetology at the Kendall Campus of Miami-Dade College by the then-campus president Dr. Wasim Shomar. Larry also served as a Co-chair of the Taxonomic Board for the website Mesoamerican Herpetology.

Appendix 1. Priority Terrestrial Regions (Regiones Terrestres Prioritarias or RTPs) found within the physiographic provinces of Chihuahua and their principal environmental problems. Numbers refer to those provided for the RTPs by CONABIO (Arriaga et al. 2000).

Sierra y Llanuras del Norte (SLN)

- Médanos de Samalayuca (48). Changes in land use (irrigation by using wells); the effects of tourism due to the use of off-road vehicles that disturb the ecological balance of the dunes; and contamination by garbage.
- Cañón de Santa Elena (49). Overgrazing, indiscriminate illegal hunting, low productivity, and high pressure on natural reserves due to the extraction of firewood and the use of fauna for food.
- El Berrendo (50). Overgrazing, desertification, and poaching.
- Laguna Jaco (51). Salt mines have highly impacted the area.
- Mapimí (52). Cattle and horse farming; the collection of the Candelilla Shrub (*Euphorbia antisyphilitica*); rain fed crops, and the effects of tourism in the Silence Zone; the extraction of salt from ephemeral lagoons, as well as minerals such as dolomite, zinc, copper, and silver; the depletion of the aquifer due to the use of water for irrigation and the use of "abrevaderos" (= watering holes); an increase in deer hunting; and growth of the urban frontier in the region of La Comarca Lagunera.
- Cuchillas de la Zarca (53). In the lower zone, rain fed crops extend into higher areas of grassland and open oak forest, which are less suitable for agriculture.

Sierra Madre Occidental (SMO)

- Guadalupe y Calvo-Mohinora (26). Certain types of crops threaten the ecological integrity of the region.
- Barranca Sinforosa (27). Illegal logging in forested areas; and the extraction and trafficking of medicinal plants, birds, and mammals.
- Rocahuachi-Nanaruchi (28). In the short term, problems occur due to highway construction and the deposition of minerals.
- Lago Los Mexicanos (29). In this region, poaching affects species with a commercial value. The lake also is being desiccated, so deforestation and changes in groundwater levels occur; the lake also is being contaminated by agrochemicals, solid waste, and urban sewage.
- Alta Tarahumara-Barrancas (30). This region is being impacted by forestry activities. For example, there has been a reduction in the number of strawberry trees (*Arbutus* sp.), as well as changes in the community structure of Lumholtz's Pine (*Pinus lumholtzii*), locally known as "Pino Triste," and oaks (*Quercus* sp.). This area needs restoration.
- Sierra Álamos-El Cuchujaqui (31). This area suffers from overgrazing, the excessive logging of Croton trees (*Croton* sp.), which are used for fence posts, and accelerated opening of paddocks and buffel grass prairie in the shrublands and jungles. Furthermore, birds such as the Military Macaw (*Ara militaris*), the Thick-billed Parrot (*Rhynchopsitta pachyrhyncha*), the Black-throated Magpie Jay (*Calocitta colliei*), the West-Mexican Chachalaca (*Ortalis poliocephala*), and reptiles such as the Gila Monster (*Heloderma suspectum*) and *Gopherus* sp. are collected and sold illegally.
- Cañón de Chínipas (32). The construction of a highway to Creel and a tourist project (FONATUR [= The National Fund for Tourism Development]) can lead to additional environmental problems.
- Bassaseachic (33). The clearing of land and tourist developments are affecting the higher elevations, but environmental problems also are evident in the lower elevations.
- Babicora (34). There is an accelerated process of using the "influence area" of the lagoon for agricultural activities.
- Cuenca del río Chico-Sirupa (35). Incipient progressive forest extraction that can degrade the ecosystems of the region.
- Yécora-El Reparo (36). The major environmental problems in this region are the cutting of pine forest and mining. More recently, the illegal cutting of oak trees for charcoal production has been increasing, even though it is a low-quality product.
- Bavispe-El Tigre (44). From a conservation perspective, this isolated mountain range has remained relatively untouched. Nonetheless, illegal hunting, moderate logging activities, and open-pit mining have been documented in this region.

Sierra y Llanuras del Norte (SLN) and Sierra Madre Occidental (SMO)

- Sierra San Luis-Janos (45). In this region, the introduced and invasive Bufflegrass (*Cenchrus ciliaris*) is an important environmental consideration.
- Pastizales del Norte del Rio Santa Maria (46). Environmental problems include structural changes resulting from overgrazing in yucca, mesquite, and prickly pear shrub communities.
- Sierra del Nido-Pastizales de Flores Magón (47). Poaching and the accidental introduction of exotic wildlife are the principal threats. Deforestation is also an important environmental problem.

Addendum: Entidades federativas de México por superficie, población y densidad. Available: https://es.wikipedia.org/wiki/A:Entidades_federativas_de_M%C3%A9xico_por_superficie,_poblaci%C3%B3n_y_densidad [Accessed: 12 August 2024].