Thamnophis rossmani Conant, 2000. Rossman's Gartersnake is the only herpetofaunal species endemic to Nayarit. Its distribution is restricted to the vicinity of the type locality, 1.4 km NW of the small settlement of San Cayetano, Nayarit, Mexico (Conant, 2000), which lies between the capital city of Tepic and the town of San Cayetano (ca. 10 km SE of Tepic). Douglas A. Rossman collected the holotype in 1969. Conant (2000) noted that suitable habitat for *T. rossmani* may have existed in this area before the region was disturbed for agriculture, and indicated that the localities he visited in 1959 were drastically altered; he also noted (p. 5) that *T. rossmani* "may be in grave danger, if not already extinct." Pictured here is an individual from Pantanal, in the municipality of Xalisco. Importantly, Nayarit's single state endemic is not found within a Natural Protected Area (Ponce-Campos and García-Aguayo, 2007), and occurs in an area likely to be overrun by urbanization. Wilson et al. (2013a) calculated its EVS as 18, placing it in the upper portion of the high vulnerability category. Its conservation status has been considered as Data Deficient by IUCN; this species is not listed by SEMARNAT. © Iván Ahumada-Carrillo

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

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Abstract: The herpetofauna of Nayarit, Mexico, is composed of 154 species, including 34 anurans, two salamanders, one crocodylian, 107 squamates, and 10 turtles. We detail the distribution of these species among the four physiographic regions we recognize. The number of species in these regions ranges from 34 in the Nayarit Islands to 110 in the Trans-Mexican Volcanic Belt. The species occupy from one to four regions ($\bar{x}$ = 2.2). The largest number of single-region species is found in the Sierra Madre Occidental. Approximately six of every 10 species are confined to one or two physiographic regions, which is of profound conservation significance. We developed a Coefficient of Biogeographic Resemblance (CBR) matrix in which the number of shared species ranges from 17 to 78. We used these data to construct a UPGMA dendrogram, which indicates that the montane regions of the state, the Sierra Madre Occidental and the Trans-Mexican Volcanic Belt, resemble one another most closely in herpetofaunal content, and in turn they most closely resemble the Coastal Plain in composition; the most distinctive region in the state is the Nayarit Islands. We placed the members of the herpetofauna in four distributional categories, of which the greatest number is composed of the country endemics (88), followed by the non-endemics (61), non-natives (four), and state endemics (one). We identified the principal environmental threats as habitat fragmentation resulting from agriculture and livestock raising, the construction of hydroelectric dams, acceleration of the tourist industry, and global climate change. We assessed the conservation status of the native species by utilizing the SEMARNAT, IUCN, and EVS systems, of which the EVS proved to be the most helpful. The number of species in the three EVS categories increased from low (42) to medium

(56), and decreased to high (47). Additionally, we employed the EVS ratings to assess how the species in the IUCN categories of DD, NE, and LC might be evaluated more accurately. We also used a scheme for determining Relative Herpetofaunal Priority (RHP), a simple means for ascertaining the rank order of a regional herpetofauna dependent on the number of state and national endemic species, as well as the number of EVS species evaluated with high vulnerability. Using these two measures, we found the Trans-Mexican Volcanic Belt to occupy rank order one in both cases, followed by the Sierra Madre Occidental, the Coastal Plain, and the Nayarit Islands. We also discuss the ability of the state's six protected areas to protect the members of the herpetofauna. Based on our analyses, we present a set of conclusions and recommendations for the future protection of the Nayarit herpetofauna.

Key Words: Anurans, caudates, crocodylians, environmental threats, physiographic regions, natural protected areas, protection recommendations, squamates, turtles

Resumen: La herpetofauna de Nayarit, México, está compuesta de 154 especies, incluyendo 34 anuros, dos salamandras, un cocodrilo, 107 lagartijas y serpiente, y 10 tortugas. Detallamos la distribución de las especies entre cuatro regiones fisiográficas reconocidas en este estudio. El número de especies en estas regiones varía de 34 en las Islas de Nayarit a 110 en la Faja Volcánica Transmexicana. Las especies ocupan de una a cuatro regiones ($\bar{x}$ = 2.2). El mayor número de especies presentes en una sola región se encuentra en la Sierra Madre Occidental. Aproximadamente seis de cada 10 especies están confinadas a una o dos regiones fisiográficas, lo cual tiene una importancia de conservación profunda. Desarrollamos una matriz con un coeficiente de similitud biogeográfica (CSB) en el cual el número de especies compartidas varía de 17 a 78. Utilizamos estos datos en la construcción de un dendrograma de UPGMA, el cual indica que las regions montañosas del estado, la Sierra Madre Occidental y la Faja Volcánica Transmexicana, son las regions que más se aproximan en su contenido en relación con la herpetofauna, posteriormente la Planicie Costera se aproxima en su composición; la region más característica en el estado es la de las Islas de Nayarit. Ubicamos los miembros de la herptofauna de Nayarit en cuatro categorías de distribución, en las cuales el número mayor está compuesto de especies endémicas al país (88), seguidas de las no endémicas (61), no nativas (cuatro), y las endémicas al estado (una). Identificamos las principales amenazas ambientales para la herpetofauna de Nayarit, las cuales incluyen la fragmentación del hábitat como resultado de actividades agrícolas y ganaderas, la construcción de presas, la aceleración de la industria turística, y el cambio climático global. Evaluamos el estatus de conservación de las especies nativas utilizando los sistemas de SEMARNAT, UICN, y de EVS; de estos, el EVS fue el sistema más útil. El número de especies en las tres categorías del EVS aumentó de la categoría baja (42) a la media (56) y luego disminuyó en la categoría de vulnerabilidad alta (47). Adicionalmente, empleamos las evaluaciones del EVS para determinar cómo las especies en las categorías de Datos Insuficientes, No Evaluadas, y de Preocupación Menor de la UICN podrían evaluarse de una forma más precisa. También usamos un esquema para determinar la Prioridad Herpetofaunística Relativa (PHR), una medida simple para estimar el orden de rango de una herpetofuna regional que depende del número de especies endémicas al país y al estado, así como el número de especies con un valor de EVS alto. Usando estas dos medidas encontramos que la Faja Volcánica Transmexicana ocupa un orden de rango de uno en ambos casos, seguido de la Sierra Madre Occidental, la Planicie Costera, y las Islas de Nayarit con ambas medidas. También discutimos la capacidad de las seis áreas naturales protegidas para salvaguardar los miembros de la herpetofauna. Basado en nuestros análisis, presentamos un numero de conclusiones y recomendaciones para la futura protección de la herpetofauna de Nayarit.

Palabras Claves: Amenazas ambientales, anuros, áreas protegidas, caudados, cocodrilos, lagartijas y serpiente, recomendaciones para protección, regiones fisiográficas, tortugas

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The variety of life-forms on Earth remains largely unknown to science. The species discovered and studied well enough to assess, notably the vertebrate animals and flowering plants, are declining in number at an accelerating rate—due almost entirely to human activity.

— E. O. Wilson (2016)

INTRODUCTION

Nayarit, one of nine states in Mexico that border the Gulf of California and/or the Pacific Ocean, is bounded to the northwest by Sinaloa, to the north by Durango, narrowly to the northeast by Zacatecas, and to the east and south by Jalisco. A prominent group of islands, the Islas Marías, lie to the west, with smaller islands closer to the coast (www.wikipedia.org; accessed 2 March 2016). The state lies just south of the Tropic of Cancer.

With an area of 27,815 km^2, Nayarit is the 9th smallest state in Mexico. In 2010 its population was 1,084,979, ranking it 28th in size among the 31 states in the country (www.wikipedia.org; accessed 2 March 2016).

Nayarit is located at the junction of three prominent physiographic segments of Mexico: (1) the Coastal Plain, the lowland region extending from Sonora to Chiapas, (2) the Sierra Madre Occidental, the montane region lying between the United States–Mexico border and the Río Grande de Santiago (the largest river in the state, forming the border between Nayarit and Jalisco), and (3) the Trans-Mexican Volcanic Belt, another montane region traversing Mexico from southern Nayarit and Jalisco in the west to central Veracruz in the east (Fig. 1). The Trans-Mexican Volcanic Belt, as its name suggests, is the region containing the prominent volcanoes of Mexico, which are the highest mountains in the country. Two volcanoes are located in Nayarit, Ceboruco and Sangangüey, with the former located in the southeastern part of the state and reaching an elevation of 2,280 m, and the latter in the south-central portion and attaining an elevation of 2,353 m; the highest elevation in the state, however, is Cerro el Vigía (2,760 m) in the south-southeastern region of the state (www.wikipedia.org; accessed 7 March 2016).

Until recently, information on the herpetofauna of Nayarit has been fragmentary and limited in scope, consisting largely of a collection of reports. Luja et al. (2014), however, provided a checklist of the amphibians of the state, and a checklist of the remainder of the herpetofauna soon will be available (Woolrich-Piña et al*., In Press*). These two studies have provided the majority of the information available on the makeup of the herpetofauna of the state, including the citations of previously published works.

The purpose of this paper is to document the composition, physiographic distribution, and conservation status of members of the Nayarit herpetofauna. It follows the general format of earlier papers on Michoacán (Alvarado-Díaz et al., 2013), Oaxaca (Mata-Silva et al., 2015), Chiapas (Johnson et al., 2015a), and Tamaulipas (Terán-Juárez et al., 2016).

MATERIALS AND METHODS

Our Taxonomic Position

We adopted the same taxonomic position as explained in papers published by some of us (Johnson, et al., 2015a, b; Mata-Silva et al., 2015; Terán-Juárez et al., 2016). These papers can be consulted for the details of our position.

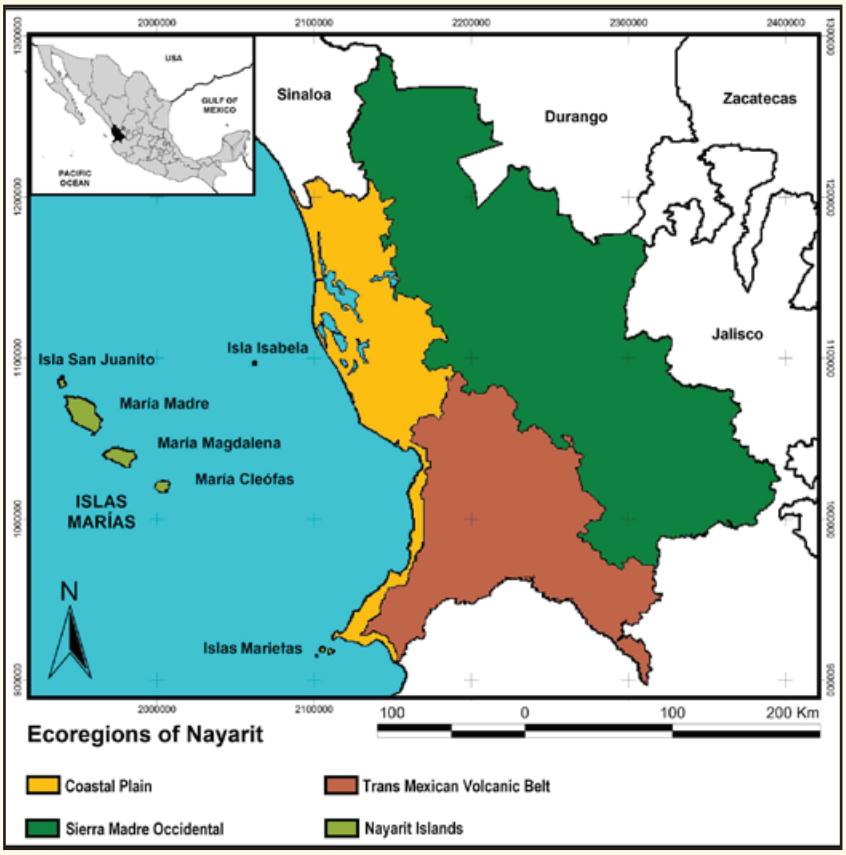

Fig. 1. Physiographic regions of Nayarit, Mexico, slightly modified from Woolrich-Piña (*In Press*). Abbreviations are as follows: CP = Coastal Plain; SMO = Sierra Madre Occidental; TMV = Trans-Mexican Volcanic Belt; and NI = Nayarit Islands.

Updating the Herpetofaunal List

The herpetofaunal list adopted here is based on the checklists of Luja et al. (2014) and Woolrich-Piña et al. (*In Press*). Here, however, we dropped the species *Craugastor hobartsmithi* from the amphibian list, based on the information in Streicher et al. (2014) and from J. Streicher (pers. comm.). From the list in Woolrich-Piña et al. (*In Press*), we deleted *Coleonyx fasciatus*, *Lampropeltis webbi*, and *Crotalus stejnegeri* because of the lack of proper documentation, and added *Thamnophis nigronuchalis* on the basis of a specimen from the state in the collection of the California Academy of Sciences (see below). In addition, Luja and Grünwald (2015) reported a number of significant locality records for the state. Our names for the taxa we deal with are based on the Taxonomic List in the *Mesoamerican Herpetology* website (www.mesoamericanherpetology.com; accessed 5 June 2016).

System for Determining Distributional Status

We used the system developed by Alvarado-Diaz et al. (2013) to determine the distributional status of members of the Michoacán herpetofauna; Mata-Silva et al. (2015), Johnson et al. (2015a), and Terán-Juárez (2016) also used this system. This system is composed of the following four categories: SE = endemic to Nayarit; CE = endemic to Mexico; NE = not endemic to Mexico; and NN = non-native in Mexico.

Systems for Determining Conservation Status

To evaluate the conservation status of the herpetofauna of Nayarit, we used the same systems (i.e., SEMARNAT, IUCN, and EVS) as Alvarado-Díaz et al. (2013), Mata-Silva et al. (2015), and Johnson et al. (2015a). These papers can be consulted for descriptions of these three systems.

PHYSIOGRAPHY AND CLIMATE

Physiographic Regions

More than one scheme exists for the classification of the physiography of Nayarit. Luja et al. (2014) recognized five regions, including the Sierra Madre Occidental, the Sinaloa and Sonora hills and canyons, the Transvolcanic belt hills and sierras, the Jalisco/Nayarit hills and coastal plain, and the Nayarit and Sinaloa plain. Woolrich et al. (*In Press*) also recognized five regions, but of a different configuration than those adopted by Luja et al. (2014); these are the Sierra Madre Occidental, the Transmexican Volcanic Belt, the Sierra Madre del Sur, the Coastal Plain, and the Nayarit islands. We chose, however, to recognize four physiographic regions, as described below. We argue that the Sierra Madre del Sur does not extend into Nayarit, but rather is restricted to a region south of the Balsas Depression (Campbell, 1999).

Coastal Plain (CP).—This region (Figs. 1, 2) occupies a narrow margin along the Pacific boundary of the state that widens toward the north; it comprises about 4,460 km^2, or about 17.0% of its land surface. Its origin is related to marine transgressions that occurred during the Quaternary, starting in the late Pleistocene to Holocene. The Coastal Plain is characterized by the presence of two geomorphological environments: (1) the coastal plain is composed of accumulated sediments and isolated lithological structures; and (2) eroded low hills that are extensions of the Sierra Madre Occidental and the Trans-Mexican Volcanic Belt onto the plain. Within the plain of accumulated sediments are three geomorphological landscapes identified by deltaic plains of the Santiago, San Pedro, and Acaponeta rivers: (1) a set of bars or ridges parallel to the beach; (2) a system of marshes and coastal lagoons; and (3) isolated and modeled structures embedded in the deltaic plain. This region contains four widespread types of vegetation (natural, introduced, water bodies, and modified areas with bare land) and 10 groups of cover and land use. Mangrove is regarded as natural vegetation associated with marshes, and is represented by *Avicenia germinans*, *Conocapus erectus*, *Laguncularia racemosa*, and *Rhizophora mangle*, as well as halophytic vegetation (with species such as *Cenchrus echinatus*, *Ipomoea pescaprea*, *Sesuvium portulacastrum*, *Sesuvium* sp., and *Uniola pittieri*). Tropical deciduous forest is represented by tree species of the genera *Bursera*, *Cyrtocarpa*, *Ficus*, and *Psidium* and thorny scrub (with representative species such as *Caesalpinia bonduc*, *Ehretia tinifolia*, *Hibiscus pernanbucensis*, *Prosopis juliflora*,

Fig. 2. Coastal Plain. Lowland thorn forest at km 109 on highway 15 from Tepic, Nayarit, to Mazatlán, Sinaloa, Municipio de Rosamorada, elevation 38 m. © Jesús Loc-Barragán

Stegnosperma cubense, and *Tournefortia densijhra*); this vegetation is connected to the deltaic plain located in the outlets of the Santiago, San Pedro, and Acaponeta rivers. Palmar vegetation (*Orbignya guacoyule*) and semi-deciduous tropical forest (with dominant tree species of the genera *Acacia*, *Ayenia*, *Bursera*, *Calliandra*, *Ficus*, and *Salvia*) are linked to the deltaic plain. Introduced vegetation refers to agricultural crops in the deltaic plain and on the beach ridges. Water bodies are represented by systems of lagoons and marshes, and as bare land beaches and coastal dunes with creeping species such as *Ipomoea pescapre*, *Sesuvium portulacastrum*, and Combtop Muhly Grass, *Muhlenbergia pectinata* (González-García Sancho et al., 2009).

Sierra Madre Occidental (SMO).—Within the state, the Sierra Madre Occidental (Figs. 1, 3, 4) region occupies an area of ca. 13,928 km^2 (53.2% of entire state) extending from southern Durango and southeastern Sinaloa to the canyon formed by the Río Santiago to northern Tequila, in Jalisco. Elongated plateaus with north to south orientation formed by the Sierra de Huajicori in the north, the Sierra del Nayar in the middle, and the Sierra la Yesca in the south characterize this region. The Sierra la Yesca is formed by a system of four mountain chains (Sierra Alica, Sierra Pajaritos, Sierra Berbeñón, and Sierra Pinavete), with parallel canyons and valleys (e.g., Cañón de Puente de Camotlán and Valle de Huajimic). The highest elevation is ca. 2,760 m, at Cerro el Vigía. The vegetation types are grouped into three broad categories: Madrense, Madrense-xeric, and Tropical. The Madrense area (Brown et al, 1995, 1998; Felger et al, 1997), found at elevations above 2,200 m in northeastern Nayarit, is characterized by pine forest and pine-oak associations, with dominant species like *Pinus arizonica*. The shrub layer contains *Arctostaphylos pungens*, *Juniperus deppeana*, and *Quercus striatula*. *Pinus cooperi* sometimes is present, or is replaced by *P. leiophylla* (Gonzalez-Elizondo et al., 2007). Tree diversity on the slopes is more complex, and is combined with oaks, mainly *Q. sideroxyla*. Associations of *P. oocarpa* and *Q. subspathulata*, with *Befaria mexicana*, are found at the Sinaloan border; species such as *Arbutus tessellate*, *P. devoniana*, *P. herrerae*, *P. maximinoi*, and *Quercus* spp. are found at elevations of ca. 2,000 m. *Pinus oocarpa*, *Q. praineana*, and *Q. resinosa* are abundant along the boundaries with the state of Jalisco. Among the woody elements of pine-oak forest are *Acacia pennatula*, *Agarista mexicana*, *Clethra rosei*, *Comarostaphylis glaucescens*, and *Dodonaea viscosa* (Carrillo-Reyes et al., 2003). Patches of cloud forest are found in this Madrense area (Huajicoeri), characterized by trees such as *Carpinus caroliniana*, *Cornus disciflora*, *Magnolia pacifica*, and *Ostrya virginiana*, among others. The lower tree layer (10–17 m in height) is represented mostly by *Clethra rosei*, *Clusia salvinii*, *Quercus castanea*, and *Saurauia serrata* (Baab et al., 2010). The Madrense-xeric area, which represents a smaller area in the state, is located on the eastern

Anaxyrus kelloggi (Taylor, 1938). The Little Mexican Toad is a Mexican endemic distributed from "central Sonora south along the coastal plain to Nayarit, Mexico" (Frost, 2015). This individual came from Pajaritos, in the Marismas Nacionales, in the municipality of Tecuala. Wilson et al. (2013b) calculated its EVS as 14, placing it at the lower limit of the high vulnerability category. Its conservation status has been considered as Least Concern by IUCN; this species is not listed by SEMARNAT. © Jesús Loc-Barragán

Fig. 3. Sierra Madre Occidental. Vista of the Sierra Madre Occidental as seen from the road from Picachos to San Andrés Milpillas, Municipio de Huajicori, elevation 1,656 m. © Jesús Loc-Barragán

Fig. 4. Sierra Madre Occidental. Pine forest at Puente Camotlán, Municipio de Yesca, elevation 2,010 m. © Jesús Loc-Barragán

slopes and characterized by scrub grassland, desert scrub, and xeric thorn forest (primarily *Cercocarpus montanus*, *Comarostaphylis* sp., *Garrya* sp., *Juniperus* sp., and *Quercus* sp.). A tropical portion occurs in the lower regions, on cliffs and in canyons of the western slopes. Deciduous and subcaducifolious forests also are present, with vegetation composed of *Acacia* sp., *Acuminata* sp., *Bursera* spp., *Crescentia* sp., *Enterolobium* sp., *Havardia* spp., *Lysiloma* spp., *Pennatula* sp., *Pilosocereus* sp., *Pithecellobium* spp., *Plumeria* sp., *Pseudobombax* sp., *Sapindus* sp., *Sapium* spp., *Sebastiania* sp., *Stenocereus* spp., and *Tabebuia* spp., among several others.

Trans-Mexican Volcanic Belt (TMV).—The Trans-Mexican Volcanic Belt (Figs. 1, 5, 6) is characterized as a mass of volcanic rock resulting from successive volcanic episodes of the late Miocene and Pliocene. In Nayarit, this region is equivalent in stature with that of the Sierra Madre Occidental, and covers an area of ca. 7,521 km^2 (28.7% of entire state). The highest elevations in this region are on Sangangüey and Ceboruco volcanoes, both reaching nearly 2,300 m. The vegetation in this region is composed of pine, oak-pine, and oak forests, as well as grassland (*Acaena elongata*, *Ageratina glabrata*, *A. mairetiana*, *Cestrum thyrsoideum*, *Pinus* spp., *Quercus* spp., *Roldana albonervia, R. angulifolia*, and *Satureja macrostema*).

Fig. 5. Trans-Mexican Volcanic Belt. Vista along road from Tepic to San Blas, in the Municipio de San Blas, elevation 302 m.
© Jesús Loc-Barragán

Fig. 6. Trans-Mexican Volcanic Belt. Lava field along road from Tepic, Nayarit, to Guadalajara, Jalisco, Municipio de Jala, elevation 924 m.
© Jesús Loc-Barragán

Incilius mazatlanensis (Taylor, 1940). The Sinaloa Toad is a Mexican endemic distributed from "northern Sonora and southwestern Chihuahua to Colima, along the Pacific coastal plain, Mexico; [also] reported in the Pacific drainage of Durango, Mexico, at relatively low elevations" (Frost, 2015). This individual was encountered at San Rafael, in the municipality of El Nayar. Wilson et al. (2013b) calculated its EVS as 12, placing it in the upper portion of the medium vulnerability category. Its conservation status has been considered as Least Concern by IUCN; this species is not listed by SEMARNAT. © Jesús Loc-Barragán

Incilius occidentalis (Camerano, 1879). The Pine Toad is a Mexican endemic distributed from "the mountains of northern Durango southward over much of the Mexican Plateau and the Transvolcanic Belt" (Lemos-Espinal and Dixon, 2013: 39). This individual was encountered at Puente de Camotlán, in the municipality of La Yesca. Wilson et al. (2013b) calculated its EVS as 11, placing it in the lower portion of the medium vulnerability category. Its conservation status has been considered as Least Concern by IUCN; this species is not listed by SEMARNAT. © Jesús Loc-Barragán

Nayarit Islands (NI).—This region is comprised of the Islas Marías, the Islas Marietas, and Isla Isabela (Figs. 1, 7, 8). The Marías Archipielago (María Madre, María Magdalena, María Cleofas, and San Juanito) consists of an area of ca. 260 km^2 (1.0% of entire state); the area of the Islas Marietas is ca. 0.7 km^2, and that of Isla Isabel ca. 1 km^2. The total area of all these islands is ca. 262 km^2. Their origin dates back to volcanic and tectonic events in the late Miocene to Pleistocene. The relief on these islands tends to be uniform, but is abrupt on Isla María Madre and María Cleofas, which range in elevation from sea level to almost 680 m and 470 m, respectively. On other islands, elevations reach up to ca. 70 m. Five types of vegetation that vary in composition are found in this region: (1) semideciduous tropical forest (*Ateleia insularis*, *Bursera simaruba*, *Cardioptera ameliae*, *Ceiba aesculifolia*, *Cedrela odorata*, *Cordia* sp., *Crataeva tapia*, *Dendropanax insulare*, *Ficus* spp., *Hylocereus undatus*, *Jacaratia mexicana*, *Pachycereus pectenaboriginum*, *Selenicereus vagans*, *Stenocereus standlyii*, and *Trichilia hirta*); (2) tropical dry forest (*Acacia cochiacantha*, *Ateleia standleyiana*, *Bromelia plumieri*, *Bunchosia palmeri*, *Cordia* sp., *Croton roxannae*, *Lysiloma microphyllum*, *Plumeria rubra*, *Prosopis juliflora*, and *Thevetia ovata*) and some cacti (*Acanthocereus occidentalis*, *Hylocereus purpusii*, *Nopalea karwinkiana*, *Pachycereus pecten-aboriginum*, *Selenicereus vagans,* and *Stenocereus standleyi*); (3) thorny scrub bushes (*Acacia cochiacantha*, *Plumeria rubra*, *Prosopis laevigata*, and *Randia thurberi*); (4) coastal dunes (*Abronia maritima*, *Batis maritima*, *Caesalpinia bonduc*, *Canavalia maritima*, *Ipomoea pescaprea*, and *Pectis arenaria*); and (5) mangrove (*Avicenia germinans*, *Conocarpus erecta*, and *Rhizophora mangle*).

Fig. 7. Nayarit Islands. Vista on Isla María Cleofas, Islas Marías, Nayarit. elevation 176 m. © Emmanuel Miramontes

Fig. 8. Nayarit Islands. Interior of forest on Isla María Cleofas, Islas Marías, Nayarit. elevation 158 m. © Emmanuel Miramonte

Craugastor augusti (Dugès, 1879). The Common Barking Frog is distributed from "Arizona to Texas in the United States, and in Mexico from Sonora to Oaxaca, and from Chihuahua, Coahuila, Nuevo León, and Tamaulipas to Puebla" (Lemos-Espinal and Dixon, 2013: 42). This individual was encountered at Puente de Camotlán, in the municipality of La Yesca. Wilson et al. (2013b) determined its EVS as 8, placing it in the upper portion of the low vulnerability category. Its conservation status has been assessed as Least Concern by IUCN; this species is not listed by SEMARNAT. © Jesús Loc-Barragán

Craugastor occidentalis (Taylor, 1941). Taylor's Barking Frog is distributed from "western Michoacán, Colima, and northeastern Jalisco west and north to southern Zacatecas and southern Sinaloa, Mexico" (Frost, 2015). This individual was found at Rancho La Noria, in the municipality of Tepic. Wilson et al. (2013b) determined its EVS as 13, placing it at the upper limit of the medium vulnerability category. Its conservation status has been assessed as Data Deficient by IUCN; this species is not listed by SEMARNAT. © Jesús Loc-Barragán

Climate

Temperature.—We assembled a table with the monthly minimum, mean, and maximum temperatures for one locality in each of the four physiographic regions in the state (Table 1). The elevation of these localities ranges from 5 m on the Islas Marías to 1,131 m in the Sierra Madre Occidental.

Mean annual temperature (MAT) declines with increased elevation. With regard to the Nayarit Islands, on Isla Madre María (elev. 5 m), in the Islas Marías, the MAT is 26.0°C. At Tecuala (10 m), on the Coastal Plain, which is located along the western periphery of the state, the MAT is 25.1°C. At Huajimic (1,131 m), in the Sierra Madre Occidental, located in the northeastern, eastern, and southeastern portions of Nayarit, the MAT is 21.1°C. At Tepic (935 m), in the central portion of the state and within the Trans-Mexican Volcanic Belt, the MAT is 21.3°C. The annual monthly minimum temperature is 10.7–18.7°C lower than the annual monthly maximum temperature. Mean monthly temperatures peak at some point during the months from June to August.

Precipitation.—In Nayarit, precipitation is highest from June to October, during the rainy season, and lowest from November to May, during the dry season (Table 2). The data in this table indicate that 91.0–93.3% of the yearly precipitation falls during the rainy season. Depending on the location, the month with the least amount of precipitation is March or April, and that with the most is July, August, or September. The annual rainfall ranges from 743.0 mm in the Sierra Madre Occidental to 1,441.4 in the Nayarit Islands, with the higher value 1.9 times larger than the lower one. Otherwise, the annual rainfall is below 1,000 mm in only one area, the Sierra Madre Occidental.

Table 1. Monthly minimum, mean (in parentheses), maximum, and annual temperature data (in °C) for the physiographic regions of Nayarit, Mexico. Localities and their elevation for each of the regions are as follows: Coastal Plain—Tecuala (10 m); Sierra Madre Occidental—Huajimic (1,131 m); Trans-Mexican Volcanic Belt—Tepic (935 m); and Nayarit Islands—Tres Marías Islands, María Madre (5 m). Data from: www.smn.cna.gob.mx; accessed 19 February 2016.

Physiographic Region	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Coastal Plain	36.3 (21.2) 10.0	37.5 (21.3) 5.3	34.6 (22.0) 9.3	36.6 (24.0) 7.8	38.7 (26.2) 11.2	38.4 (28.2) 14.0	37.7 (28.4) 16.5	37.8 (28.1) 16.4	36.7 (27.8) 14.7	36.0 (27.3) 13.4	34.5 (24.7) 10.9	32.6 (22.1) 10.0	32.4 (25.1) 17.8
Sierra Madre Occidental	27.6 (17.0) 6.4	28.7 (17.5) 6.3	30.8 (19.2) 7.6	32.8 (21.1) 9.3	34.3 (23.2) 12.2	32.9 (24.8) 16.6	30. 0 (23.7) 17.4	29.9 (23.6) 17.4	30.0 (23.6) 17.2	30.1 (22.1) 14.1	29.8 (19.5) 9.2	27.6 (17.3) 7.1	30.4 (21.1) 11.7
Trans-Mexican Volcanic Belt	25.9 (17.8) 9.8	26.8 (18.3) 9.8	28.1 (19.0) 10.0	29.8 (20.7) 11.7	31.0 (22.5) 14.1	30.0 (23.8) 17.7	29.1 (24.0) 18.9	29.0 (23.8) 18.7	28.7 (23.7) 18.7	28.8 (22.7) 16.7	27.9 (20.3) 12.8	26.5 (18.9) 11.3	28.5 (21.3) 14.2
Nayarit Islands	31.8 (22.1) 16.2	31.4 (22.1) 15.9	33.9 (22.6) 16.3	38.9 (24.0) 17.8	36.2 (26.3) 20.8	35.7 (28.8) 24.3	36.7 (29.3) 24.7	36.3 (29.4) 24.8	37.2 (29.2) 24.7	39.8 (28.8) 23.9	33.8 (26.2) 20.6	31.9 (23.4) 17.8	31.4 (26.0) 20.7

COMPOSITION OF THE HERPETOFAUNA

The herpetofauna of Nayarit is composed of 154 species, including 34 anurans, two salamanders, one crocodylian, 107 squamates, and 10 turtles (Table 3). Thus, the herpetofauna consists of 36 amphibians (23.4% of the total) and 118 of the remainder of the herpetofauna (76.6%). These numbers compare with the 30 species of amphibians documented by Parra-Olea et al. (2014) and the 88 species in the remainder of the herpetofauna listed by Flores-Villela and García-Vázquez (2014). The discrepancy of 36 species between our figures and those of Parra-Olea et al. (2014) and Flores-Villela and García-Vázquez (2014) for the total herpetofauna is significant, somewhat more substantially for crocodylians, squamates, and turtles than for amphibians.

Craugastor pygmaeus (Taylor, 1937). The Pygmy Robber Frog is distributed from "southern Sinaloa, western Nayarit, western Jalisco, to southern Michoacán and México (state) in Mexico, south and east along the Pacific slope to Guatemala; Veracruz, Tabasco, and eastern Oaxaca, Mexico, on the Atlantic slope" (Frost, 2015). This individual came from Carrillo Puerto, in the municipality of Compostela. Wilson et al. (2013b) ascertained its EVS as 9, placing it at the upper limit of the low vulnerability category. Its conservation status has been established as Vulnerable by IUCN; this species is not listed by SEMARNAT. © Jesús Loc-Barragán

Eleutherodactylus pallidus (Duellman, 1958). The Pale Chirping Frog is a Mexican endemic ranging from Durango to Jalisco. This individual was found at Cora, in the municipality of San Blas. Wilson et al. (2013b) ascertained its EVS as 17, placing it in the middle portion of the high vulnerability category. Its conservation status has been established as Least Concern by IUCN; this species is not listed by SEMARNAT. © Jesús Loc-Barragán

Table 2. Monthly and annual precipitation data (in mm.) for the physiographic regions of Nayarit, Mexico. Localities and their elevation for each of the regions are as follows: Coastal Plain—Tecuala (10 m); Sierra Madre Occidental—La Yesca (1,357 m); Trans-Mexican Volcanic Belt—Tepic (935 m); and Nayarit Islands—Tres Marías Islands (0 m). The shaded area indicates the months of the rainy season. Data from: www.smn.cna.gob.mx; accessed 19 February 2016.

Physiographic Region	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Coastal Plain	14.3	7.2	4.2	0.3	3.1	74.0	245.1	261.5	267.8	69.9	31.3	27.2	1,005.6
Sierra Madre Occidental	13.9	7.2	1.5	2.5	14.4	126.2	212.5	178.1	119.4	42.1	13.7	11.5	743.0
Trans-Mexican Volcanic Belt	29.5	10.1	7.4	9.1	8.9	169.7	378.6	285.6	221.5	72.9	17.5	29.1	1,239.9
Nayarit Islands	21.1	13.4	6.2	1.0	19.1	132.1	339.9	389.7	358.8	123.8	12.8	23.5	1,441.4

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

Orders	Families	Genera	Species
Anura	8	19	34
Caudata	2	2	2
Subtotals	**10**	**21**	**36**
Crocodylia	1	1	1
Squamata	20	59	107
Testudines	5	8	10
Subtotals	**26**	**68**	**118**
Totals	**36**	**89**	**154**

Families

The Nayarit herpetofauna includes representatives of 36 families, 10 of amphibians (eight of anurans and two of salamanders) and 26 of the remainder of the herpetofauna (one crocodylian, 20 squamates, and five turtle families). This number of total families is 63.2% of the total number of herpetofaunal families in Mexico (57). Caecilians have not been recorded from Nayarit, but one species (*Dermophis oaxacae*) has been reported on the basis of a photograph of a specimen from Puerto Vallarta, Jalisco (http://naturalista.conabio.gob.mx/observations/219418), which lies just to the south of the southern border of the state. About seven-tenths of the amphibian species are assigned to four families, i.e., Bufonidae, Craugastoridae, Hylidae, and Ranidae, and 65.0% of the remainder of the herpetofauna is allocated to five families, i.e., Phrynosomatidae, Colubridae, Dipsadidae, Natricidae, and Viperidae (Table 4).

Genera

The amphibians of Nayarit are classified in 21 genera, of which 19 contain anurans and two contain salamanders. The remainder of the herpetofauna is grouped in 68 genera, of which 59 are squamates, eight are turtles, and one a crocodylian (Table 3). The total number of genera in Nayarit is 89, 42.0% of the total of 210 known from Mexico (Wilson et al., 2013a, b). The most speciose genera of amphibians in Nayarit are *Craugastor* (four species) and *Lithobates* (six), and *Sceloporus* (15), *Plestiodon* (four), *Tantilla* (four), *Leptodeira* (four), *Thamnophis* (eight), and *Crotalus* (six) among the rest of the herpetofauna.

Agalychnis dacnicolor (Cope, 1864). The Mexican Leaf Frog is a Mexican endemic distributed from "southern Sonora to the Isthmus of Tehuantepec, México, including the Balsas Basin" (Duellman, 2001: 87). This individual was encountered at El Famoso, in the municipality of Santiago Ixcuintla. Wilson et al. (2013b) ascertained its EVS as 13, placing it at the upper limit of the medium vulnerability category. Its conservation status has been established as Least Concern by IUCN; this species is not listed by SEMARNAT. © Jesús Loc-Barragán

Diaglena spatulata (Günther, 1882). The Mexican Shovel-headed Frog is a Mexican endemic distributed from "southern Sinaloa to the Isthmus of Tehuantepec, Oaxaca, México; this species also occurs in the Balsas Basin in Michoacán (Duellman, 2001: 636, 637). This individual was encountered at Alta Vista, in the municipality of Compostela. Wilson et al. (2013b) calculated its EVS as 13, placing it at the upper limit of the medium vulnerability category. Its conservation status has been judged as Least Concern by IUCN; this species is not listed by SEMARNAT. © Guillermo Woolrich-Piña

Table 4. Distribution of the amphibians, crocodylians, squamates, and turtles in Nayarit, Mexico, by physiographic region. Abbreviations are as follows: CP = Coastal Plain; SMO = Sierra Madre Occidental; TMV = Trans-Mexican Volcanic Belt; and NI = Nayarit Islands. * = species endemic to Mexico; ** = species endemic to Nayarit; and *** = non-native species. See text for descriptions of these regions.

Taxa	Physiographic Regions of Nayarit				Number of Regions Occupied
	CP	SMO	TMV	NI	
Anura (34 species)					
Bufonidae (5 species)					
*Anaxyrus kelloggi**	+	+			2
*Incilius marmoreus**	+				1
*Incilius mazatlanensis**	+	+	+	+	4
*Incilius occidentalis**		+	+		2
Rhinella marina	+	+	+		3
Craugastoridae (4 species)					
Craugastor augusti	+	+	+		3
*Craugastor occidentalis**	+	+	+		3
Craugastor pygmaeus	+		+		2
*Craugastor vocalis**	+	+	+		3
Eleutherodactylidae (3 species)					
*Eleutherodactylus nitidus**	+	+	+		3
*Eleutherodactylus pallidus**	+	+	+	+	4
*Eleutherodactylus teretistes**	+	+	+		3
Hylidae (10 species)					
*Agalychnis dacnicolor**	+	+	+		3
*Diaglena spatulata**	+				1
Dryophytes arenicolor		+	+		2
*Dryophytes eximius**		+	+		2
*Exerodonta smaragdina**	+	+	+		3
*Plectrohyla bistincta**		+	+		2
Smilisca baudinii	+	+	+	+	4
Smilisca fodiens	+	+	+		3
*Tlalocohyla smithii**	+	+	+		3
Trachycephalus typhonius	+		+		2
Leptodactylidae (1 species)					
Leptodactylus melanonotus	+	+	+		3
Microhylidae (3 species)					
Gastrophryne mazatlanensis	+				1
Hypopachus ustus	+	+	+		3
Hypopachus variolosus	+	+	+	+	4
Ranidae (6 species)					
*Lithobates catesbeianus****	+	+	+		3
Lithobates forreri	+		+		2
*Lithobates magnaocularis**	+	+	+		3
*Lithobates megapoda**	+		+		2
*Lithobates psilonota**		+	+		2
*Lithobates pustulosus**	+	+	+		3
Scaphiopodidae (2 species)					
Scaphiopus couchii	+	+			2
Spea multiplicata		+	+		2
Caudata (2 species)					

Ambystomatidae (1 species)					
*Ambystoma rosaceum**		+			1
Plethodontidae (1 species)					
*Isthmura bellii**		+	+		2
Crocodylia (1 species)					
Crocodylidae (1 species)					
Crocodylus acutus	+			+	2
Squamata (107 species)					
Anguidae (3 species)					
*Barisia imbricata**			+		1
Elgaria kingii	+	+	+		3
Gerrhonotus liocephalus		+	+		2
Corytophanidae (1 species)					
Basiliscus vittatus	+		+		2
Dactyloidae (1 species)					
*Norops nebulosus**	+	+	+	+	4
Eublepharidae (1 species)					
Coleonyx elegans	+				1
Gekkonidae (2 species)					
*Gehyra mutilata****	+	+	+		3
*Hemidactylus frenatus****	+			+	2
Helodermatidae (1 species)					
*Heloderma horridum**	+	+	+		3
Iguanidae (2 species)					
*Ctenosaura pectinata**	+	+	+	+	4
Iguana iguana	+		+	+	3
Mabuyidae (1 species)					
Mabuya brachypoda	+			+	2
Phrynosomatidae (18 species)					
*Phrynosoma orbiculare**		+	+		2
*Sceloporus albiventris**		+	+		2
*Sceloporus asper**			+		1
Sceloporus clarkii	+	+	+	+	4
*Sceloporus dugesi**		+	+		2
Sceloporus grammicus		+			1
*Sceloporus heterolepis**		+			1
*Sceloporus horridus**	+	+	+		3
Sceloporus jarrovii		+			1
Sceloporus melanorhinus	+		+		2
*Sceloporus nelsoni**	+	+	+		3
Sceloporus poinsettii		+			1
*Sceloporus scalaris**		+	+		2
*Sceloporus torquatus**		+	+		2
*Sceloporus unicanthalis**		+	+		2
*Sceloporus utiformis**	+	+	+		3
*Urosaurus bicarinatus**	+	+	+		3
Urosaurus ornatus	+	+		+	3
Phyllodactylidae (2 species)					
*Phyllodactylus lanei**	+	+	+	+	4
Phyllodactylus tuberculosus	+	+	+	+	4
Scincidae (4 species)					
*Plestiodon brevirostris**	+		+		2

Plestiodon callicephalus	+	+	+		3
*Plestiodon lynxe**	+	+	+		3
*Plestiodon parvulus**	+		+		2
Teiidae (4 species)					
*Aspidoscelis communis**	+			+	2
*Aspidoscelis costata**	+	+	+		3
*Aspidoscelis lineattissima**	+		+	+	3
*Holcosus sinister**	+		+		2
Boidae (1 species)					
Boa sigma	+	+	+	+	4
Colubridae (26 species)					
Drymarchon melanurus	+		+	+	3
Drymobius margaritiferus	+		+		2
Gyalopion quadrangulare	+	+			2
*Lampropeltis mexicana**		+			1
*Lampropeltis polyzona**	+	+	+	+	4
*Leptophis diplotropis**	+	+	+	+	4
Masticophis bilineatus	+	+	+		3
Masticophis mentovarius	+	+	+	+	4
*Mastigodryas cliftoni**			+		1
Mastigodryas melanolomus	+		+	+	3
Oxybelis aeneus	+	+	+	+	4
*Pituophis deppei**		+			1
*Pseudoficimia frontalis**	+				1
Rhinocheilus lecontei	+				1
*Salvadora bairdi**		+	+		2
Salvadora grahamiae		+			1
*Salvadora mexicana**	+	+	+		3
Senticolis triaspis	+		+		2
*Sonora mutabilis**		+	+		2
*Sympholis lippiens**	+	+	+		3
*Tantilla bocourti**		+	+	+	3
*Tantilla calamarina**	+		+		2
*Tantilla ceboruca**			+		1
Tantilla yaquia		+	+		2
*Trimorphodon paucimaculatus**	+		+		2
*Trimorphodon tau**		+	+		2
Dipsadidae (17 species)					
*Coniophanes lateritius**	+				1
Diadophis punctatus	+		+		2
*Enulius oligostichus**	+		+		2
*Geophis dugesii**			+		1
*Hypsiglena affinis**		+			1
*Hypsiglena torquata**	+	+	+	+	4
Imantodes gemmistratus	+		+	+	3
Leptodeira maculata	+	+	+		3
*Leptodeira punctata**	+	+	+		3
Leptodeira septentrionalis	+		+		2
*Leptodeira splendida**			+		1
*Manolepis putnami**	+	+	+		3
*Rhadinaea hesperia**		+	+		2
*Rhadinaea taeniata**		+			1

Sibon nebulatus	+				1
*Tropidodipsas annulifera**	+			+	2
*Tropidodipsas philippi**	+				1
Elapidae (4 species)					
Hydrophis platurus	+			+	2
Micruroides euryxanthus	+		+		2
*Micrurus distans**	+	+	+		3
*Micrurus promimans**	+	+	+		3
Leptotyphlopidae (1 species)					
Rena humilis		+	+		2
Loxocemidae (1 species)					
Loxocemus bicolor	+				1
Natricidae (9 species)					
*Storeria storerioides**		+			1
Thamnophis cyrtopsis		+			1
Thamnophis eques		+	+		2
*Thamnophis errans**		+			1
*Thamnophis melanogaster**		+	+		2
*Thamnophis nigronuchalis**		+			1
*Thamnophis pulchrilatus**		+			1
*Thamnophis rossmani***			+		1
*Thamnophis validus**	+	+	+		3
Typhlopidae (1 species)					
*Indotyphlops braminus****				+	1
Viperidae (7 species)					
Agkistrodon bilineatus	+		+	+	3
*Crotalus armstrongi**			+		1
*Crotalus basiliscus**	+	+	+		3
*Crotalus campbelli**			+		1
Crotalus lepidus		+			1
Crotalus molossus		+	+		2
Crotalus pricei		+			1
Testudines (10 species)					
Cheloniidae (3 species)					
Chelonia mydas	+			+	2
Eretmochelys imbricata	+			+	2
Lepidochelys olivacea	+			+	2
Dermochelyidae (1 species)					
Dermochelys coriacea	+			+	2
Emydidae (2 species)					
*Terrapene nelsoni**		+	+		2
*Trachemys ornata**	+				1
Geoemydidae (1 species)					
Rhinoclemmys pulcherrima		+	+		2
Kinosternidae (3 species)					
*Kinosternon chimalhuaca**	+				1
Kinosternon hirtipes	+	+	+		3
*Kinosternon integrum**	+	+	+		3

Smilisca fodiens (Boulenger, 1882). The Burrowing Treefrog is distributed from "south-central Arizona in the United States southward through western Sonora and the coastal regions of Sinaloa, and thence into the foothills of the Pacific slopes of the Sierra Madre Occidental in Nayarit and southward onto the Mexican Plateau in Jalisco" (Duellman, 2001: 628). This individual was encountered at Atotonilco, in the municipality of Tecuala. Wilson et al. (2013b) determined its EVS as 8, placing it in the upper portion of the low vulnerability category. Its conservation status has been established as Least Concern by IUCN; this species is not listed by SEMARNAT. © Jesús Loc-Barragán

Species

Presently, the herpetofauna of Nayarit is composed of 154 species, including 34 anurans, two salamanders, one crocodylian, 107 squamates, and 10 turtles (Table 3). Wilson et al. (2013b) recorded 378 native amphibian species for all of Mexico; that number currently is 388 (J. Johnson, unpublished). Thus, 9.5% of this fauna is known from Nayarit. Wilson et al. (2013a) reported 849 native species of crocodylians, squamates, and turtles from Mexico; the current number is 881 (J. Johnson, unpublished), so 13.4% of these species now are recorded from Nayarit. In total, the native herpetofauna of Nayarit comprises 11.8% of that of Mexico (1,269 species). In discussing the amphibian fauna of Nayarit, Luja et al. (2014) compared it to that of the surrounding states. They noted that Parra-Olea et al. (2014) reported 36 species from Sinaloa, one more than the number of native species in Nayarit, although in our experience those numbers seem underestimated. Valdes et al. (2013) reported 33 species from Durango, three fewer than are known from Nayarit, despite the former state being twice the size of the latter. Parra-Olea et al. (2014) recorded 13 amphibian species from Zacatecas, almost one-third fewer than known from Nayarit, even though the former state is 2.7 times the size of the latter. Finally, Luja et al. (2014) noted that Parra-Olea et al. (2014) reported 43 amphibian species from Jalisco, which has 2.8 times the area of Nayarit, according to numbers in Luja et al. (2014). Thus, the area/species numbers for the states on the periphery of Nayarit are as follows: Sinaloa, 1,593.5; Durango, 3,736.9; Zacatecas, 5,791.1; and Jalisco, 1,827.6. The number for Nayarit is 772.6, which is much lower (i.e., more species per unit area) than the corresponding numbers for the peripheral states. The number for Nayarit also is lower than the corresponding one for Michoacán (1,085.2; Alvarado-Díaz et al., 2013), but higher than that for Oaxaca (629.2; Mata-Silva et al., 2015) and Chiapas (685.1; Johnson et al., 2015a). With respect to the remainder of the herpetofauna represented in adjacent states, Valdez-Lares et al. (2013) reported 118 species from Durango, which is the same as the number reported here for Nayarit. Flores-Villela and García-Vazquez (2014) listed the species numbers for the following adjacent states: Sinaloa, 108; Zacatecas, 64; and Jalisco, 100. The area/species figures for the remainder of the herpetofauna for the states adjacent to Nayarit are as follows: Sinaloa,

531.2; Durango, 1,045.1; Zacatecas, 1,176.3; and Jalisco, 785.9. The figure for Nayarit is 235.7, which as for the amphibians is significantly lower than for those for the adjacent states. The Nayarit figure also is lower than that for Michoacán (364.0; Alvarado-Díaz, 2013), Oaxaca (320.0; Mata-Silva et al., 2015) and Chiapas (328.7; Johnson et al., 2015a). In general, therefore, the area/species figures for both groups of animals are lower than those for all of the peripheral states. Additionally, the figure for amphibians also is lower than that for Michoacán, and the remainder of the herpetofauna for Michoacán, Oaxaca, and Chiapas, but higher for amphibians in Nayarit than in Oaxaca and Chiapas. Thus, even though Nayarit is one of the smallest states in Mexico, its herpetofauna is sizeable when compared to that in the adjacent states and others to the south.

Tlalocohyla smithii (Boulenger, 1902). The Dwarf Mexican Treefrog is a Mexican endemic and is found along the "Pacific lowlands of Mexico from extreme southwestern Chihuahua and extreme southeastern Sonora south to southern Oaxaca and in the Balsas Depression from Michoacán to México and Puebla" (Frost, 2015). This individual was encountered at Carrillo Puerto, in the municipality of Compostela. Wilson et al. (2013b) ascertained its EVS as 11, placing it in the lower portion of the medium vulnerability category. Its conservation status has been judged as Least Concern by IUCN; this species is not listed by SEMARNAT. © Jesús Loc-Barragán

COMMENTS ON THE SPECIES LIST

A few species in the list of the herpetofauna of Nayarit require some commentary, as follows:

Boa sigma. The phylogenetic systematics of the genus *Boa* continues to be elucidated. Card et al. (*In Press*) recognized three broadly-occurring clades at the species level, including *B. sigma*, distributed from within 80 km of the Arizona–Sonora border to the Isthmus of Tehuantepec, including the Islas Marías of Nayarit. The name *sigma* is resurrected and elevated to species level from its original status as a subspecies of *Boa constrictor* described from the Islas Marías, even though Card et al. (*In Press*) had no molecular data from these islands to substantiate the conspecificity of the insular and mainland western Mexican population. For the present, we accept these authors' conclusions and recognize *B. sigma* as occurring in Nayarit.

Salvadora grahamiae. This species is known to be distributed from "southern Arizona to central Texas, in the United States, and in Mexico southward into Tamaulipas, Nuevo León, Coahuila, and Chihuahua. On the Atlantic versant, it occurs as far south as Querétaro, Hidalgo, and northern Veracruz" (Lemos-Espinal and Dixon, 2013). It also is recorded in Durango (Valdez-Lares et al., 2013). We are able to confirm the presence of this species in

Nayarit on the basis of a specimen in the Muséum National d'Histoire Naturelle (MNHN-RA-1898.251; https://science.mnhn.fr/institution/mnhn/collection/ra/item/1898.251?listIndex=6) collected on 9 June 1898 in the "Sierra de Mayarit [sic], partie occidentale." The western part of the Sierra de Nayarit is in northeastern Nayarit within the Sierra Madre Occidental.

Thamnophis nigronuchalis. Most of the information available on the distribution of this species does not indicate its occurrence in Nayarit (Rossman et al., 1996; IUCN Red List, accessed 31 May 2016; Reptile Database, accessed 31 May 2016). A record substantiating the occurrence of this species in Nayarit, however, is available at the Integrated Digitized Biocollections website (https://www.idigbio.org/portal/records/7bc0d600-31aa-45fb-8a8b-9084d7ca4776). The record is based on a single specimen (CAS 169660) collected from "along Arroyo Santa Rosa, west of Santa Teresa, Mesa del Nayar, Municipio de El Nayar" by D. B. Breedlove on 5 October 1979 at an elevation of 2,095 m. The habitat is described as a "rocky ridge with *Pinus*, *Quercus* & *Arbutus* dissected by a grassy spring-filled valley." The coordinates for this locality are 22.50031443814296 N and -104.77022766069274 W. We accept this species as part of the Nayarit herpetofauna based on this specimen record.

Crotalus armstrongi. Bryson et al. (2014) provided a review of the *Ctrotalus triseriatus* species group. The scale counts for specimens from southern Nayarit and adjacent Jalisco fell within the range of *C. armstrongi*, but these authors commented that animals from this area likely are geographically isolated from this species and from *C. campbelli* by the low-elevation Río Ameca drainage. Consequently, Bryson et al. (2014: 491) tentatively assigned specimens from the mountains of southern Nayarit and adjacent Jalisco to *C. armstrongi*, indicating that, "future genetic studies are needed to clarify the relationships of snakes from that area to *C. campbelli* and other *C. armstrongi*." For the purposes of this paper, we are including *C. armstrongi* as part of the herpetofauna of Nayarit.

Hypopachus ustus (Cope, 1866). The Two-spaded Narrow-mouthed Toad is distributed from "central Sinaloa, the Balsas Depression, and central Veracruz to Chiapas (Mexico), Guatemala, and El Salvador on the Pacific versant" (Frost, 2015). This individual came from La Puntilla, in the Marismas Nacionales, in the municipality of Tecuala. Wilson et al. (2013b) ascertained its EVS as 7, placing it in the middle portion of the low vulnerability category. Its conservation status has been judged as Least Concern by IUCN, and as a species of special protection by SEMARNAT. © Jesús Loc-Barragán

Crotalus pricei. The occurrence of this rattlesnake species in Nayarit is not entirely well established. Klauber (1952) discussed a specimen from the Sierra de Nayarit (MNHN 98-254) that he tentatively allocated to *C. pricei* based on features that distinguish it from *C. triseriatus*. Campbell and Lamar (2004: 573) mapped the distribution of this species as encompassing extreme northern Nayarit (Map 103), but also included a sentence in the Distribution section of the species account (p. 572) stating that, "it has been suggested that *C. pricei* may occur in eastern Sinaloa and northern Nayarit, but no specimens have been collected there." This sentence also is found in Campbell and Lamar (1989), but no dot was included on their distribution map. Apparently the species has been collected in northern Nayarit, as indicated in the map in Campbell and Lamar (2004), but perhaps the authors did not modify the statement in the section on distribution. For the purposes of this paper, we accept that this rattlesnake is recorded from the state.

Crotalus stejnegeri. Campbell and Lamar (2004: 586) indicated that this species is distributed in the "western portion of the Sierra Madre Occidental in western Durango and southeastern Sinaloa, Mexico," and that it "has been collected within a few kilometers of the Nayarit border and almost certainly occurs in the northern part of that state." A sight record now is available from coordinates 22.872680°N, 105.098862°W (WGS 84), elev. 1,384 m, places this locality in the northeastern portion of the state, at an elevation 184 m higher than previously recorded (500–1,200 m: Campbell and Lamar, 2004). No voucher photograph is available, however, so we declined to include this species in our list.

Lithobates magnaocularis (Frost and Bagnara, 1974). The Northwest Mexico Leopard Frog is a Mexican endemic distributed from "east-central Sonora along the western foothills of the Sierra Madre Occidental, including extreme southwestern Chihuahua, and low-elevation western versant Durango, through Sinaloa and Nayarit to central Jalisco, Mexico" (Frost, 2015). This individual was found in Sierra Vallejo, at Mazatán, in the municipality of Compostela. Wilson et al. (2013b) calculated its EVS as 12, placing it in the upper portion of the medium vulnerability category. Its conservation status has been evaluated as Least Concern by IUCN; this species is not listed by SEMARNAT.
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Lithobates pustulosus (Boulenger, 1883). The Cascade Frog is a Mexican endemic that occurs "from southern Sinaloa through Nayarit to Jalisco, Colima, and Michoacán" (Frost, 2015). This individual was encountered at Marquezado, in the municipality of Ahuacatlán. Wilson et al. (2013b) calculated its EVS as 9, placing it at the upper limit of the low vulnerability category. Its conservation status has been considered as Least Concern by IUCN, and as a species of special protection by SEMARNAT. © Jesús Loc-Barragán

Elgaria kingii Gray, 1838. The Madrean Alligator Lizard is distributed from southeastern Arizona and southwestern New Mexico southward in the Sierra Madre Occidental to Jalisco (Stebbins, 2003). This individual was encountered at La Curva, in the municipality of Xalisco. Wilson et al. (2013a) calculated its EVS as 10, placing it at the lower limit of the medium vulnerability category. Its conservation status has been considered as Least Concern by IUCN, and as a species of special protection by SEMARNAT. © Jesús Loc-Barragán

PATTERNS OF PHYSIOGRAPHIC DISTRIBUTION

We used a system of four regions (see Fig. 1) to examine the physiographic distribution of members of the herpetofauna of Nayarit. We document the distribution of species among these regions in Table 4, and summarize this information in Table 5.

The total number of species among the four regions ranges from 34 in the Nayarit Islands to 110 in the Trans-Mexican Volcanic Belt (TMV). The total numbers in the other two regions are 102 in the Coastal Plain (CP) and 99 in the Sierra Madre Occidental (SMO). Thus, in three of the four regions the total number is close to or exceeds 100.

Norops nebulosus (Wiegmann, 1834). The Clouded Anole is a Mexican endemic distributed from "Sinaloa to the Isthmus of Tehuantepec on the Pacific coast, extending to the states of Morelos, Puebla, and Durango" (translation ours; Santiago-Pérez et al., 2012: 136). This individual was encountered at Puente de Camotlán, in the municipality of La Yesca. Wilson et al. (2013a) determined its EVS as 13, placing it at the upper limit of the medium vulnerability category. Its conservation status has been assessed as Least Concern by IUCN; this species is not listed by SEMARNAT. © Jesús Loc-Barragán

Ctenosaura pectinata (Wiegmann, 1834). The Western Spiny-tailed Iguana is a Mexican endemic distributed from "Sinaloa to Oaxaca," Mexico (translation ours; Santiago-Pérez et al., 2012: 112). This individual was encountered at Juan Escutia, in the municipality of San Pedro Lagunillas. Wilson et al. (2013a) calculated its EVS as 15, placing it in the lower portion of the high vulnerability category. Its conservation status has not been evaluated by IUCN; this lizard is listed as a threatened species by SEMARNAT. © Jesús Loc-Barragán

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

Families	Number of Species	Distributional Occurrence			
		CP	SMO	TMV	NI
Bufonidae	5	4	4	3	1
Craugastoridae	4	4	3	4	—
Eleutherodactylidae	3	3	3	3	1
Hylidae	10	7	8	9	1
Leptodactylidae	1	1	1	1	—
Microhylidae	3	3	2	2	1
Ranidae	6	5	4	6	—
Scaphiopodidae	2	1	2	1	—
Subtotals	**34**	**28**	**27**	**29**	**4**
Ambystomatidae	1	—	1	—	—
Plethodontidae	1	—	1	1	—
Subtotals	**2**	**—**	**2**	**1**	**—**
Totals	**36**	**28**	**29**	**30**	**4**
Crocodylidae	1	1	—	—	1
Subtotals	**1**	**1**	**—**	**—**	**1**
Anguidae	3	1	2	3	—
Corytophanidae	1	1	—	1	—
Dactyloidae	1	1	1	1	1
Eublepharidae	1	1	—	—	—
Gekkonidae	2	2	1	1	1
Helodermatidae	1	1	1	1	—
Iguanidae	2	2	1	2	2
Mabuyidae	1	1	—	—	1
Phrynosomatidae	18	7	16	13	2
Phyllodactylidae	2	2	2	2	2
Scincidae	4	4	2	4	—
Teiidae	4	4	1	3	2
Subtotals	**40**	**27**	**27**	**31**	**11**
Boidae	1	1	1	1	1
Colubridae	26	16	16	20	7
Dipsadidae	17	12	7	11	3
Elapidae	4	4	2	3	1
Leptotyphlopidae	1	—	1	1	—
Loxocemidae	1	1	—	—	—
Natricidae	9	1	8	4	—
Typhlopidae	1	—	—	—	1
Viperidae	7	2	4	5	1
Subtotals	**67**	**37**	**39**	**45**	**14**
Cheloniidae	3	3	—	—	3
Dermochelyidae	1	1	—	—	1
Emydidae	2	1	1	1	—
Geoemydidae	1	—	1	1	—
Kinosternidae	3	3	2	2	—
Subtotals	**10**	**8**	**4**	**4**	**4**
Totals	**118**	**73**	**70**	**80**	**30**
Sum Totals	**154**	**101**	**99**	**110**	**34**

Sceloporus albiventris Smith, 1939. The White-bellied Rough Lizard is a Mexican endemic distributed along the Pacific coastal regions from southwestern Chihuahua and adjacent Sonora to northwestern Jalisco (Lemos Espinal and Smith, 2007). This individual was found at Mazatán, in the Marismas Nacionales, in the municipality of Tecuala. Wilson et al. (2013a) calculated its EVS as 16, placing it in the middle portion of the high vulnerability category. Its conservation status has not been evaluated by IUCN, and this species is not listed by SEMARNAT. © Jesús Loc-Barragán

Sceloporus clarkii Baird and Girard, 1852. Clark's Spiny Lizard ranges from central Arizona and southwestern New Mexico southward through Sonora and western Chihuahua to Jalisco, Mexico (Stebbins, 2003; Lemos-Espinal and Smith, 2007). This individual came from La Puntilla, in the Marismas Nacionales, in the municipality of Tecuala. Wilson et al. (2013a) calculated its EVS as 10, placing it at the lower limit of the medium vulnerability category. Its conservation status has been evaluated as Least Concern by IUCN; this species is not listed by SEMARNAT. © Jesús Loc-Barragán

The highest numbers of species of most herpetofaunal groups are found in the Trans-Mexican Volcanic Belt (TMV), including the amphibians (30 of 36 species), the lizards (31 of 40), and the snakes (45 of 67). Collectively, the TMV species in these three groups amount to 106 of 143 species (74.1%). As expected, the single crocodylian is restricted to lowland regions (the CP and NI regions) and the majority of the turtles (8 of 10 species) are found in the Coastal Plain, especially as four of them are sea turtles. Among the amphibians, the two salamanders found in the state are restricted to the two montane regions (SMO and TMV). The anurans are distributed fairly evenly among the three mainland regions, with 28 species in the CP, 27 in the SMO, and 29 in the TMV. The same is the case with the lizards (27, 27, and 31, respectively), as well as with the snakes (37, 39, and 45, respectively).

Sceloporus dugesii Bocourt, 1873. Duges' Spiny Lizard is a Mexican endemic distributed from "southern Nayarit to Colima, on the Pacific versant, and across the Transvolcanic Belt in Jalisco, Michoacán, Guanajuato, San Luis Potosí, and Querétaro" (Lemos-Espinal and Dixon, 2013: 126). These individuals were encountered at Puente de Camotlán, in the municipality of La Yesca. Wilson et al. (2013a) calculated its EVS as 13, placing it at the upper limit of the medium vulnerability category. Its conservation status has been considered as Least Concern by IUCN; this species is not listed by SEMARNAT. © Jesús Loc-Barragán

Sceloporus heterolepis Boulenger, 1895. The Southern Odd-scaled Lizard is a Mexican endemic that ranges from Durango southward to Michoacán (Reptile Database, accessed 15 April 2016). This individual came from Puente de Camotlán, Sierra de la Yesca, in the municipality of La Yesca. Wilson et al. (2013a) ascertained its EVS as 14, placing it at the lower limit of the high vulnerability category. Its conservation status has been judged as Least Concern by IUCN; this species is not listed by SEMARNAT. © Jesús Loc-Barragán

As noted above, 34 herpetofaunal species are recorded from the Nayarit Islands region. As expected, only a few (four species) are amphibians, and all are anurans. The single crocodylian and the four sea turtles are known from this region. Twenty-five of the 34 species are squamates, including 11 species of lizards and 14 of snakes.

Members of the herpetofauna of Nayarit occupy from one to four regions (Table 4), as follows: one (39 of 154 species; 25.3%); two (55; 35.7%); three (45; 29.2%); and four (15; 9.7%). The average regional occupancy figure is 2.2.

The most widely distributed species are the anurans *Eleutherodactylus pallidus*, *Hypopachus variolosus*, *Incilius mazatlanensis*, and *Smilisca baudinii*, the lizards *Ctenosaura pectinata*, *Norops nebulosus*, *Phyllodactylus lanei*, *P. tuberculosus*, and *Sceloporus clarkii*, and the snakes *Boa sigma*, *Hypsiglena torquata*, *Lampropeltis polyzona*, *Leptophis diplotropis*, *Masticophis mentovarius*, and *Oxybelis aeneus*. Interestingly, eight of these 15 species are Mexican endemics.

Sceloporus utiformis Cope, 1864. Cope's Large-scaled Spiny Lizard is a Mexican endemic distributed "along the Pacific coast from Sinaloa to Guerrero" (Santiago-Pérez, 2012: 132). This individual came from El Filo, in the municipality of Tecuala. Wilson et al. (2013a) ascertained its EVS as 15, placing it in the lower portion of the high vulnerability category. Its conservation status has been determined as Least Concern by IUCN; this species is not listed by SEMARNAT. © Jesús Loc-Barragán

Urosaurus bicarinatus (Duméril, 1856). The Tropical Tree Lizard is a Mexican endemic that ranges from "southeastern Sonora and southwestern Chihuahua to Chiapas" (Lemos-Espinal et al., 2015). This individual was found at Tepic, in the municipality of Tepic. Wilson et al. (2013a) ascertained its EVS as 12, placing it in the upper portion of the medium vulnerability category. Its conservation status has been judged as Least Concern by IUCN; this species is not listed by SEMARNAT. © Jesús Loc-Barragán

Of conservation significance is that 94 of 154 species (61.0%) occur in only one or two physiographic regions, and only 15 species (9.7%) are found in all four regions. This proportion is higher than that seen for the state of Chiapas (53.0%; Johnson et al., 2015a), Oaxaca (59.0%; Mata-Silva et al., 2015), or Tamaulipas (60.3%; Terán-Juárez et al., 2016).

The number of species occupying a single region ranges from one (in the NI), through nine (in the TMV) and 13 (in the CP), to 17 (in the SMO). The Sierra Madre Occidental region is of greatest conservation significance, given that it contains the highest number of single-region species. These 17 species are as follows:

*Ambystoma rosaceum**
Sceloporus grammicus
Sceloporus poinsettii
*Sceloporus heterolepis**
Sceloporus jarrovii
*Lampropeltis mexicana**
*Pituophis deppei**
Salvadora grahamiae
*Hypsiglena affinis**
*Rhadinaea taeniata**
*Storeria storerioides**
Thamnophis cyrtopsis
*Thamnophis errans**
*Thamnophis nigronuchalis**
*Thamnophis pulchrilatus**
Crotalus lepidus
Crotalus pricei

Plestiodon lynxe (Wiegmann, 1834). The Oak Forest Skink is a Mexican endemic distributed from southern San Luis Potosí, Guanajuato, Querétaro, Hidalgo, and the mountains of western Veracruz, with isolated populations also in southern Durango, southwestern Zacatecas, southeastern Nayarit, and Jalisco (Webb, 1968; Ponce Campos and Romero-Contreras, 2006; Canseco-Márquez et al., 2007; Lemos-Espinal and Dixon, 2013). This individual was encountered at Puente de Camotlán, in the municipality of La Yesca. Wilson et al. (2013a) determined its EVS as 10, placing it at the lower limit of the medium vulnerability category. Its conservation status has been judged as Least Concern by IUCN, and as a species of special protection by SEMARNAT. © Jesús Loc-Barragán

As expected, most of these species (12 of 17) are country endemics. The distribution of the remainder extends into the southwestern United States.

The distribution of 13 species is limited to the Coastal Plain, as follows:

*Incilius marmoreus**
*Diaglena spatulata**
Gastrophryne mazatlanensis
Coleonyx elegans
Sceloporus poinsettii
*Pseudoficimia frontalis**
Rhinocheilus lecontei
*Coniophanes lateritius**
Sibon nebulatus
*Tropidodipsas philippi**
Loxocemus bicolor
*Trachemys ornata**
*Kinosternon chimalhuaca**

Most of these species are non-endemics, and less than one-half are country endemics.

The distribution of the following nine species is limited to the Trans-Mexican Volcanic Belt:

*Barisia imbricata**
*Sceloporus asper**
*Mastigodryas cliftoni**
*Tantilla ceboruca**
*Geophis dugesii**
*Leptodeira splendida**
*Thamnophis rossmani***
*Crotalus armstrongi**
*Crotalus campbelli**

Aspidoscelis communis (Cope, 1878). The Colima Giant Whiptail is a Mexican endemic distributed from southern Nayarit to Jalisco, Michoacán, and Guerrero (Ponce-Campos et al., 2007). This individual was found at Puerto Balleto, Isla María Madre, Las Islas Marías. Wilson et al. (2013a) ascertained its EVS as 14, placing it at the lower end of the high vulnerability category. Its conservation status is determined as Least Concern by the IUCN, and as a species of special protection by SEMARNAT. © Juan Cruzado Cortés

Interestingly, all of these species are endemic to Mexico, including the single species (*Thamnophis rossmani*) endemic to Nayarit.

Only a single species, the non-native *Indotyphlops braminus*, is limited to the Nayarit Islands.

We constructed a Coefficient of Biogeographic Resemblance (CBR) matrix for examining the herpetofaunal relationships among the four physiographic regions in Nayarit (Table 6). The number of shared species ranges from 17 to 78, with the lowest value between the Nayarit Islands and the Sierra Madre Occidental and the highest one between the Sierra Madre Occidental and the Trans-Mexican Volcanic Belt. The mean number of shared species is 46.7. In general, the higher the number of species in the two regions being compared, the higher the number of shared species; however, there are exceptions. In fact, the highest number of shared species is 78, but this number is shared between the most speciose region (TMV) and the third most speciose (SMO).

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

	Costal Plain	Sierra Madre Occidental	Trans-Mexican Volcanic Belt	Nayarit Islands
Coastal Plain	**101**	56	75	32
Sierra Madre Occidental	0.56	**99**	78	17
Trans-Mexican Volcanic Belt	0.71	0.75	**110**	22
Nayarit Islands	0.47	0.26	0.31	**34**

The CBR data in Table 6 demonstrate values ranging from 0.26 to 0.75. The lowest value is that between the Sierra Madre Occidental and the Nayarit Islands. These two regions lie at opposite extremes in the state (Fig. 1). The highest value is that between the Sierra Madre Occidental and the Trans-Mexican Volcanic Belt, montane and contiguous areas in the south-central portion of the state. The overall CBR values among the four physiographic regions are as follows, arranged from the highest to lowest value (species numbers in parentheses):

Sierra Madre Occidental (99)—0.75—Trans-Mexican Volcanic Belt (110)

Coastal Plain (101)—0.71—Trans-Mexican Volcanic Belt (110)

Coastal Plain (101)—0.47—Nayarit Islands (34)

Based on the data in Table 6, we assembled a UPGMA dendrogram to illustrate the herpetofaunal resemblance patterns among the four physiographical regions, in a hierarchical fashion (Fig. 9). The UPGMA dendrogram (Fig 2) indicates that two Nayarit regions, the Sierra Madre Occidental (SMO) and the Trans-Mexican Volcanic Belt (TMV), share the highest herpetofaunal resemblance (.75 level). Both of these regions are largely montane and are in broad contact with each other in the southern portion of the state. This pair of regions is not overly distinguished (.64 level) from the Coastal Plain (CP), and both border the CP region on their western peripheries. The CP region contains many species that are restricted to the Pacific coastal plain, which extends in one or both directions outside of Nayarit, or with lower elevational areas of the adjacent montane regions. The most distinctive physiographic region comprises the Nayarit Islands (NI; .35 level). Also as expected, the NI region shares its greatest herpetological resemblance with the CP region (.47 level; Table 6), because of their geographic proximity and the apparent higher dispersal abilities of lowland forms even though there is a random dispersal pattern associated with particular mainland species, as indicated by the .35 resemblance factor between the mainland regions as a group, and the NI region.

Aspidoscelis costata (Cope, 1878). The Western Mexico Whiptail is a Mexican endemic distributed from "northeastern Sonora…southward through the coastal plains of southwestern Sonora, including southwestern Chihuahua to Guerrero, Morelos, and Mexico" (Lemos Espinal et al., 2015: 277). This individual was found in Sierra Vallejo, at Mazatán, in the municipality of Compostela. Wilson et al. (2013a) calculated its EVS as 11, placing it in the lower portion of the medium vulnerability category. Its conservation status has been placed as Least Concern by IUCN, and as a species of special protection by SEMARNAT. © Jesús Loc-Barragán

Holcosus sinister (Smith and Lauge, 1946). This teiid is a Mexican endemic distributed from coastal Nayarit to Michoacán and in the Trans-Mexican Volcanic Belt from Jalisco to Puebla. This individual was encountered at Alta Vista, in the Sierra Vallejo, in the municipality of Compostela. We ascertained its EVS as 13, placing it at the upper limit of the medium vulnerability category. Its conservation status has not been assessed by IUCN, and this species is not listed by SEMARNAT. © Jesús Loc-Barragán

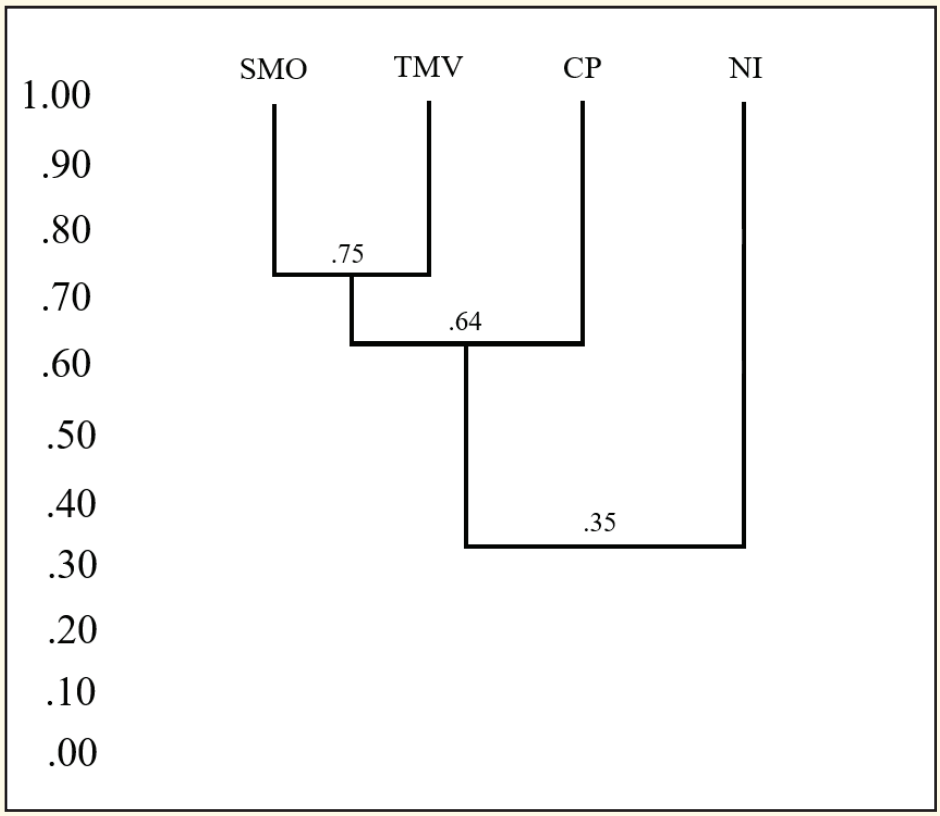

Fig. 9. A UPGMA generated dendrogram illustrating the similarity relationships of species richness among the herpetofaunas of the four physiographic regions of Nayarit (based on data in Table 6). See Table 4 for explanation of abbreviations. We calculated the similarity values using Duellman's (1990) Coefficient of Biogeographic Resemblance (CBR).

Drymarchon melanurus (Duméril, Bibron, & Duméril, 1854). The Black-tailed Cribo occurs from south-central Texas, United States, on the Atlantic versant and from southern Sonora, Mexico, on the Pacific versant to northern Venezuela and northwestern Peru; it also occurs on the Islas Tres Marías, Nayarit, Mexico, and on the Islas de la Bahía and Isla del Tigre, Honduras (McCranie, 2011). This individual was encountered at Tecuala, in the municipality of Tecuala. Wilson et al. (2013a) assessed its EVS as 6, placing it in the middle portion of the low vulnerability category. Its conservation status has been judged as Least Concern by IUCN; this species is not listed by SEMARNAT.

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DISTRIBUTION STATUS CATEGORIZATIONS

We used the same classification developed by Alvarado-Díaz et al. (2013), and also used by Mata-Silva et al. (2015), Johnson et al. (2015a), and Terán-Juárez et al. (2016) to categorize the distributional status of the members of the Nayarit herpetofauna. We placed these data in Table 7, and summarize them in Table 8.

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

Taxa	Distributional Status	Environmental Vulnerability Category (Score)	IUCN Categorization	SEMARNAT Status
*Anaxyrus kelloggi**	CE	H (14)	LC	NS
*Incilius marmoreus**	CE	M (11)	LC	NS
*Incilius mazatlanensis**	CE	M (12)	LC	NS
*Incilius occidentalis**	CE	M (11)	LC	NS
Rhinella marina	NE	L (3)	LC	NS
Craugastor augusti	NE	L (8)	LC	NS
*Craugastor occidentalis**	CE	M (13)	DD	NS
Craugastor pygmaeus	NE	L (9)	VU	NS
*Craugastor vocalis**	CE	M (13)	LC	NS
*Eleutherodactylus nitidus**	CE	M (12)	LC	NS
*Eleutherodactylus pallidus**	CE	H (17)	DD	Pr
*Eleutherodactylus teretistes**	CE	H (16)	DD	Pr
*Agalychnis dacnicolor**	CE	M (13)	LC	NS
*Diaglena spatulata**	CE	M (13)	LC	NS
Dryophytes arenicolor	NE	L (7)	LC	NS
*Dryophytes eximius**	CE	M (10)	LC	NS
*Exerodonta smaragdina**	CE	M (12)	LC	Pr
*Plectrohyla bistincta**	CE	L (9)	LC	Pr
Smilisca baudinii	NE	L (3)	LC	NS
Smilisca fodiens	NE	L (8)	LC	NS
*Tlalocohyla smithii**	CE	M (11)	LC	NS
Trachycephalus typhonius	NE	L (4)	LC	NS
Leptodactylus melanonotus	NE	L (6)	LC	NS
Gastrophryne mazatlanensis	NE	L (8)	NE	NS
Hypopachus ustus	NE	L (7)	LC	Pr
Hypopachus variolosus	NE	L (4)	LC	NS
*Lithobates catesbeianus***	NN	M (10)	LC	NS
Lithobates forreri	NE	L (3)	LC	Pr
*Lithobates magnaocularis**	CE	M (12)	LC	NS
*Lithobates megapoda**	CE	H (14)	VU	Pr
*Lithobates psilonota**	CE	H (14)	DD	NS
*Lithobates pustulosus**	CE	L (9)	LC	Pr
Scaphiopus couchii	NE	L (3)	LC	NS
Spea multiplicata	NE	L (6)	LC	NS
*Ambystoma rosaceum**	CE	H (14)	LC	Pr

*Isthmura bellii**	CE	M (12)	VU	A
Crocodylus acutus	NE	H (14)	VU	Pr
*Barisia imbricata**	CE	H (14)	LC	Pr
Elgaria kingii	NE	M (10)	LC	Pr
Gerrhonotus liocephalus	NE	L (6)	LC	Pr
Basiliscus vittatus	NE	L (7)	NE	NS
*Norops nebulosus**	CE	M (13)	LC	NS
Coleonyx elegans	NE	L (9)	NE	A
*Gehyra mutilata****	NN	—	—	—
*Hemidactylus frenatus****	NN	—	—	—
*Heloderma horridum**	CE	H (14)	LC	A
*Ctenosaura pectinata**	CE	H (15)	NE	A
Iguana iguana	NE	M (12)	NE	Pr
Mabuya brachypoda	NE	L (6)	NE	NS
*Phrynosoma orbiculare**	CE	M (12)	LC	A
*Sceloporus albiventris**	CE	H (16)	NE	NS
*Sceloporus asper**	CE	H (14)	LC	Pr
Sceloporus clarkii	NE	M (10)	LC	NS
*Sceloporus dugesi**	CE	M (13)	LC	NS
Sceloporus grammicus	NE	L (9)	LC	Pr
*Sceloporus heterolepis**	CE	H (14)	LC	NS
*Sceloporus horridus**	CE	M (11)	LC	NS
Sceloporus jarrovii	NE	M (11)	LC	NS
Sceloporus melanorhinus	NE	L (9)	LC	NS
*Sceloporus nelsoni**	CE	M (13)	LC	NS
Sceloporus poinsettii	NE	M (12)	LC	NS
*Sceloporus scalaris**	CE	M (12)	LC	NS
*Sceloporus torquatus**	CE	M (11)	LC	NS
*Sceloporus unicanthalis**	CE	H (16)	NE	NS
*Sceloporus utiformis**	CE	H (15)	LC	NS
*Urosaurus bicarinatus**	CE	M (12)	LC	NS
Urosaurus ornatus	NE	M (10)	LC	NS
*Phyllodactylus lanei**	CE	H (15)	LC	NS
Phyllodactylus tuberculosus	NE	L (8)	NE	NS
*Plestiodon brevirostris**	CE	M (11)	LC	NS
Plestiodon callicephalus	NE	M (12)	LC	NS
*Plestiodon lynxe**	CE	M (10)	LC	Pr
*Plestiodon parvulus**	CE	H (15)	DD	NS
*Aspidoscelis communis**	CE	H (14)	LC	Pr
*Aspidoscelis costata**	CE	M (11)	LC	Pr
*Aspidoscelis lineattissima**	CE	H (14)	LC	Pr
*Holcosus sinister**	CE	M (13)	NE	NS
Boa sigma	CE	H (15)	NE	NS
Drymarchon melanurus	NE	L (6)	LC	NS
Drymobius margaritiferus	NE	L (6)	NE	NS
Gyalopion quadrangulare	NE	M (11)	LC	Pr
*Lampropeltis mexicana**	CE	H (15)	LC	A
*Lampropeltis polyzona**	CE	M (11)	NE	NS
*Leptophis diplotropis**	CE	H (14)	LC	A
Masticophis bilineatus	NE	M (11)	LC	NS
Masticophis mentovarius	NE	L (6)	NE	A
*Mastigodryas cliftoni**	CE	H (14)	NE	NS

Mastigodryas melanolomus	NE	L (6)	LC	NS
Oxybelis aeneus	NE	L (5)	NE	NS
*Pituophis deppei**	CE	H (14)	LC	A
*Pseudoficimia frontalis**	CE	M (13)	LC	NS
Rhinocheilus lecontei	NE	L (8)	LC	NS
*Salvadora bairdi**	CE	H (15)	LC	Pr
Salvadora grahamiae	NE	M (10)	LC	NS
*Salvadora mexicana**	CE	H (15)	LC	Pr
Senticolis triaspis	NE	L (6)	LC	NS
*Sonora mutabilis**	CE	H (14)	LC	NS
*Sympholis lippiens**	CE	H (14)	NE	NS
*Tantilla bocourti**	CE	L (9)	LC	NS
*Tantilla calamarina**	CE	M (12)	LC	Pr
*Tantilla ceboruca**	CE	H (16)	NE	NS
Tantilla yaquia	NE	M (10)	LC	NS
*Trimorphodon paucimaculatus**	CE	H (15)	NE	NS
*Trimorphodon tau**	CE	M (13)	LC	NS
*Coniophanes lateritius**	CE	M (13)	DD	NS
Diadophis punctatus	NE	L (4)	LC	NS
*Enulius oligostichus**	CE	H (15)	DD	Pr
*Geophis dugesii**	CE	M (13)	LC	NS
*Hypsiglena affinis**	CE	H (14)	NE	NS
*Hypsiglena torquata**	CE	L (8)	LC	Pr
Imantodes gemmistratus	NE	L (6)	NE	Pr
Leptodeira maculata	NE	L (7)	LC	Pr
*Leptodeira punctata**	CE	H (17)	LC	NS
Leptodeira septentrionalis	NE	L (8)	NE	NS
*Leptodeira splendida**	CE	H (14)	LC	NS
*Manolepis putnami**	CE	M (13)	LC	NS
*Rhadinaea hesperia**	CE	M (10)	LC	Pr
*Rhadinaea taeniata**	CE	M (13)	LC	NS
Sibon nebulatus	NE	L (5)	NE	NS
*Tropidodipsas annulifera**	CE	M (13)	LC	Pr
*Tropidodipsas philippi**	CE	H (14)	LC	Pr
Hydrophis platurus	NE	—	LC	NS
Micruroides euryxanthus	NE	H (15)	LC	A
*Micrurus distans**	CE	H (14)	LC	Pr
*Micrurus proximans**	CE	H (18)	LC	Pr
Rena humilis	NE	L (8)	LC	NS
Loxocemus bicolor	NE	M (10)	NE	Pr
*Storeria storerioides**	CE	M (11)	LC	NS
Thamnophis cyrtopsis	NE	L (7)	LC	NS
Thamnophis eques	NE	L (8)	LC	A
*Thamnophis errans**	CE	H (16)	LC	NS
*Thamnophis melanogaster**	CE	H (15)	EN	A
*Thamnophis nigronuchalis**	CE	M (12)	DD	Pr
*Thamnophis pulchrilatus**	CE	H (15)	LC	NS
*Thamnophis rossmani***	SE	H (18)	DD	NS
*Thamnophis validus**	CE	M (12)	LC	NS
*Indotyphlops braminus****	NN	—	—	—
Agkistrodon bilineatus	NE	M (11)	NT	Pr
*Crotalus armstrongi**	CE	H (18)	NE	NS

*Crotalus basiliscus**	CE	H (16)	LC	Pr
*Crotalus campbelli**	CE	H (17)	NE	NS
Crotalus lepidus	NE	M (12)	LC	Pr
Crotalus molossus	NE	L (8)	LC	Pr
Crotalus pricei	NE	H (14)	LC	Pr
Chelonia mydas	NE	—	EN	P
Eretmochelys imbricata	NE	—	CR	P
Lepidochelys olivacea	NE	—	VU	P
Dermochelys coriacea	NE	—	VU	P
*Terrapene nelsoni**	CE	H (18)	DD	Pr
*Trachemys ornata**	CE	H (19)	VU	Pr
Rhinoclemmys pulcherrima	NE	L (8)	NE	A
*Kinosternon chimalhuaca**	CE	H (16)	LC	NS
Kinosternon hirtipes	NE	M (10)	LC	Pr
*Kinosternon integrum**	CE	M (11)	LC	Pr

In the studies indicated above, the largest number of species in a given state fell into the non-endemic distributional category. This, however, is not the case with the state of Nayarit (Table 8). Of 154 species, 61 (39.6%) are non-endemic, but this number is exceeded by the number of country endemics, 88 (57.1%). Beyond this peculiarity, only a single state endemic is recorded in Nayarit (*Thamnophis rossmani*). Also unusual is that there are more non-native species (4) in the state (*Lithobates catesbeianus*, *Gehyra mutilata*, *Hemidactylus frenatus*, and *Indotyphlops braminus*) than state endemics.

The non-endemic species are comprised of 14 anurans, one crocodylian, 14 lizards, 26 snakes, and six turtles. The country endemics amount to 19 anurans, two salamanders, 24 lizards, 39 snakes, and four turtles. The single state endemic is a snake. The non-native species consist of one anuran, two lizards, and one snake.

Interestingly, the 89 state and country endemics in Nayarit constitute 57.1% of the total herpetofauna, which is significantly higher than the comparable proportions seen in Chiapas (17.6%; Johnson et al., 2015a) and Tamaulipas (32.1%; Terán Juárez et al., 2016), but similar to those obtained for Oaxaca (58.1%; Mata-Silva et al., 2015) and Michoacán (63.7%; Alvarado-Díaz et al., 2013). The number of endemic species in Nayarit is 11.6% of the 768 species currently known to be endemic to Mexico (J. Johnson, unpublished).

To determine how the species allocated to the four distributional status categories are distributed among the four physiographic regions, we fabricated Table 9. The data in this table demonstrate that the largest number of species in three of the four regions consists of country endemics. Only in the Nayarit Islands are there more non-endemics than country endemics (19 vs. 13). The numbers of species in these two categories are close to one another in the Coastal Plain (47 non-endemics vs. 51 country endemics), but only about one-half and six-tenths in the Sierra Madre Occidental and the Trans-Mexican Volcanic Belt regions, respectively.

Of the 34 species in the Nayarit Islands region, 32 also are found in the Coastal Plain region (Tables 4, 6). Only two non-native species (*Hemidactylus frenatus* and *Indotyphlops braminus*) are found on the islands but not recorded from the Coastal Plain. Of the 20 non-endemics, two are anurans (*Hypopachus variolosus* and *Smilisca baudinii*), one is a crocodylian (*Crocodylus acutus*), five are lizards (*Iguana iguana*, *Mabuya brachypoda*, *Phyllodactylus tuberculosus*, *Sceloporus clarkii*, and *Urosaurus ornatus*), seven are snakes (*Agkistrodon bilineatus*, *Drymarchon melanurus*, *Hydrophis platurus*, *Imantodes gemmistratus*, *Masticophis mentovarius*, *Mastigodryas melanolomus*, and *Oxybelis aeneus*), and four are sea turtles (*Chelonia mydas*, *Dermochelys coriacea*, *Eretmochelys imbricata*, and *Lepidochelys olivacea*). Of the 12 country endemics, two are anurans (*Eleutherodactylus pallidus* and *Incilius mazatlanensis*), five are lizards (*Aspidoscelis communis*, *A. lineatissima*, *Ctenosaura pectinata*, *Norops nebulosus*, and *Phyllodactylus lanei*,), and six are snakes (*Boa sigma*, *Hypsiglena torquata*, *Lampropeltis polyzona*, *Leptophis diplotropis*, *Tantilla bocourti*, and *Tropidodipsas annulifera*).

Lampropeltis polyzona Cope, 1860. This milksnake is a Mexican endemic ranging from southern Sonora and southwestern Chihuahua southward to Guerrero, thence eastward to Veracruz (Ruane et al., 2014). This individual was found on the highway between Acaponeta and Huajicori, at La Mariquita, in the municipality of Acaponeta. Wilson et al. (2013a) calculated its EVS as 11, placing it in the lower portion of the medium vulnerability category. Its conservation status has not been assessed by IUCN, and this species is not listed by SEMARNAT.
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Leptophis diplotropis (Günther, 1872). The Pacific Coast Parrot Snake is a Mexican endemic distributed from "southeastern Chihuahua and southern Sonora along the Pacific versant to Oaxaca" [as well as both Atlantic and Pacific Chiapas], Mexico (Santiago-Pérez et al., 2012: 168). This individual was found on the highway between Novillero and Cuautla, at Novillero, in the municipality of Tecuala. Wilson et al. (2013a) calculated its EVS as 14, placing it at the lower limit of the high vulnerability category. Its conservation status has been reported as Least Concern by IUCN, and as threatened by SEMARNAT.
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Table 8. Summary of the distributional status of herpetofaunal families in Nayarit, Mexico.

Families	Number of Species	Distributional Status			
		Non-endemic (NE)	Country Endemic (CE)	State Endemic (SE)	Non-native (NN)
Bufonidae	5	1	4	—	—
Craugastoridae	4	2	2	—	—
Eleutherodactylidae	3	—	3	—	—
Hylidae	10	4	6	—	—
Leptodactylidae	1	1	—	—	—
Microhylidae	3	3	—	—	—
Ranidae	6	1	4	—	1
Scaphiopodidae	2	2	—	—	—
Subtotals	**34**	**14**	**19**	**—**	**1**
Ambystomatidae	1	—	1	—	—
Plethodontidae	1	—	1	—	—
Subtotals	**2**	**—**	**2**	**—**	**—**
Totals	**36**	**14**	**21**	**—**	**1**
Crocodylidae	1	1	—	—	—
Subtotals	**1**	**1**	**—**	**—**	**—**
Anguidae	3	2	1	—	—
Corytophanidae	1	1	—	—	—
Dactyloidae	1	—	1	—	—
Eublepharidae	1	1	—	—	—
Gekkonidae	2	—	—	—	2
Helodermatidae	1	—	1	—	—
Iguanidae	2	1	1	—	—
Mabuyidae	1	1	—	—	—
Phrynosomatidae	18	6	12	—	—
Phyllodactylidae	2	1	1	—	—
Scincidae	4	1	3	—	—
Teiidae	4	—	4	—	—
Subtotals	**40**	**14**	**24**	**—**	**2**
Boidae	1	—	1	—	—
Colubridae	26	11	15	—	—
Dipsadidae	17	5	12	—	—
Elapidae	4	2	2	—	—
Leptotyphlopidae	1	1	—	—	—
Loxocemidae	1	1	—	—	—
Natricidae	9	2	6	1	—
Typhlopidae	1	—	—	—	1
Viperidae	7	4	3	—	—
Subtotals	**67**	**26**	**39**	**1**	**1**
Cheloniidae	3	3	—	—	—
Dermochelyidae	1	1	—	—	—
Emydidae	2	—	2	—	—
Geoemydidae	1	1	—	—	—
Kinosternidae	3	1	2	—	—
Subtotals	**10**	**6**	**4**	**—**	**—**
Totals	**118**	**47**	**67**	**1**	**3**
Sum Totals	**154**	**61**	**88**	**1**	**4**

Table 9. Number of herpetofaunal species in four distributional categories among the four physiographic regions of Nayarit, Mexico.

Physiographic Regions	Distributional Status Categories				Totals
	Non-endemics	Country Endemics	State Endemics	Non-natives	
Coastal Plain	47	51	—	3	101
Sierra Madre Occidental	34	63	—	2	99
Trans-Mexican Volcanic Belt	39	68	1	2	110
Nayarit Islands	19	13	—	2	34
State Totals	**61**	**88**	**1**	**4**	—

Interestingly, the species numbers for the three mainland physiographic regions are close to one another (Tables 5, 6). They range from 99 in the Sierra Madre Occidental and 101 in the Coastal Plain regions, to 110 in the Trans-Mexican Volcanic Belt region. The number of species shared between regions and the number not shared, respectively, are as follows:

Coastal Plain (101)—56 and 45—Sierra Madre Occidental (99)

Sierra Madre Occidental (99)—78 and 32—Trans-Mexican Volcanic Belt (110)

Trans-Mexican Volcanic Belt (110)—75 and 35—Coastal Plain (101)

Rhinocheilus lecontei Baird and Girard, 1853. The Long-nosed Snake is broadly distributed from Idaho, Utah, Colorado, and Kansas, in the United States, into Baja California, Sonora, Chihuahua, San Luis Potosí, Tamaulipas, Nayarit, and Jalisco in Mexico (Hammerson et al., 2007b; Lemos-Espinal and Dixon, 2013). This individual came from Tecuala, in the municipality of Tecuala. Wilson et al. (2013a) calculated its EVS as 8, placing it in the upper portion of the low vulnerability category. Its conservation status has been determined as Least Concern by IUCN; this species is not listed by SEMARNAT. © Jesús Loc-Barragán

Leptodeira maculata (Hallowell, 1861). The Southwestern Cat-eyed Snake ranges from Tamaulipas to the Isthmus of Tehuantepec, on the Atlantic versant, and from Sinaloa on the Pacific into southwestern Guatemala (Lemos-Espinal and Dixon, 2013; Johnson et al., 2015b). This juvenile individual was found in the Marismas Nacionales, in the municipality of Tecuala. Wilson et al. (2013a) determined its EVS as 7, placing it in the middle portion of the low vulnerability category. Its conservation status has been judged as Least Concern by IUCN, and as a species of special protection by SEMARNAT. © Jesús Loc-Barragán

We determined the distribution of the shared species among the four distributional status categories and placed them in Table 10. The data in this table indicate that in all three comparisons the majority of the species shared are country endemics as opposed to non-endemics. The number of non-natives in each of the three regions is the same (i.e., two). The single state endemic is restricted to the Trans-Mexican Volcanic Belt and, thus, is not shared. The proportion of the country endemics in each of the pairs is as follows: CP-SMO—62.5%; SMO-TMV—66.7%; and TMV-CP—56.0%. Given these proportions of shared species, it will be easier to protect the country endemics found in Nayarit than if the proportions were smaller (see discussion below).

Table 10. Number of shared species in four distributional status categories among three mainland physiographic regions of Nayarit, Mexico.

Physiographic Regions	Distributional Status Categories				
	Total Species Shared	Non-endemics	Country Endemics	State Endemics	Non-natives
Coastal Plain—Sierra Madre Occidental	56	19	35	—	2
Sierra Madre Occidental—Trans-Mexican Volcanic Belt	78	24	52	—	2
Trans-Mexican Volcanic Belt—Coastal Plain	75	31	42	—	2

PRINCIPAL ENVIRONMENTAL THREATS

Currently, the herpetofauna of Nayarit faces four serious threats, of which three are closely linked to human activities and one a byproduct of expanding human society. The first is related to habitat fragmentation, tied to changes in land use for agriculture and livestock activities. This environmental degradation principally is occurring in the north, near the border with Sinaloa, where the growing of various crops such as beans, corn, and sorghum is intensifying. Also, in the central and southern portions of the state, areas devoted for sugarcane cultivation continues to increase. Livestock activity focuses primarily on cattle, goats, and pigs.

Leptodeira punctata (Peters, 1866). The Western Cat-eyed Snake is a Mexican endemic found along the Pacific lowlands from Sinaloa to Jalisco (Duellman, 1958). This individual was encountered at El Ahuaje, in the Marismas Nacionales, in the municipality of Acaponeta. Wilson et al. (2013a) calculated its EVS as 17, placing it in the middle portion of the high vulnerability category. Its conservation status has been considered as Least Concern by IUCN; this species is not listed by SEMARNAT. © Jesús Loc-Barragán

Manolepis putnami (Jan, 1863). The Thin-scaled Snake is a Mexican endemic found along the Pacific coast from Nayarit to the Isthmus of Tehuantepec region of southwestern Chiapas (Ponce-Campos and García-Aguayo, 2007; Johnson et al., 2015a). This individual came from Sierra Vallejo from Mazatán, in the municipality of Compostela. Wilson et al. (2013a) determined its EVS as 13, placing it at the upper limit of the medium vulnerability category. Its conservation status has been judged as Least Concern by IUCN; this species is not listed by SEMARNAT. © Jesús Loc-Barragán

A second threat exists with the construction project of a hydroelectric dam in the town of Ruíz located in the Sierra Madre Occidental. This megaproject undertaken by the Comisión Federal de Electricidad (CFE, a Mexican governmental agency) is intended to flood a vast area (ca. 10,000 ha; Excelsior, 2014), which would affect the habitats utilized by the resident organisms. Among the most affected groups would be the freshwater turtles and crocodiles, because of their aquatic habits. Nonetheless, all groups inhabiting this region would be affected to varying degrees.

Rhadinaea hesperia Bailey, 1940. The Western Graceful Brownsnake is a Mexican endemic distributed on "Pacific slopes from southwestern Chihuahua…to Guerrero, following large river valleys inland to reach Zacatecas, Morelos and possibly Guanajuato (Lemos-Espinal and Smith, 2007). This individual was found at Carrillo Puerto, in the municipality of Compostela. Wilson et al. (2013b) calculated its EVS as 10, placing it at the lower limit of the medium vulnerability category. Its conservation status has been considered as Least Concern by IUCN, and as a species of special protection by SEMARNAT. © Jesús Loc-Barragán

Tropidodipsas annulifera Boulenger, 1894. The Western Snail-eating Snake is a Mexican endemic distributed in western Mexico from Sinaloa to Guerrero, including the Las Marias Islands (Wallach et al., 2014). This individual came from Carrillo Puerto, in the municipality of Compostela. Wilson et al. (2013a) ascertained its EVS as 13, placing it at the upper limit of the medium vulnerability category. Its conservation status has been judged as Least Concern by IUCN, and as a species of special protection by SEMARNAT. © Jesús Loc-Barragán

Accelerated development in the marsh areas of the southwestern region by the tourist industry represents the third threat. In the municipalities of Bahía de Banderas and San Blas, the occupation and invasion of mangroves and beaches by the hotel industry jeopardizes populations of iguanas, crocodiles, and sea turtles, mainly by restricting access to the nesting areas of these organisms. Although access to the islands is restricted because of the requirement of special permits from the Secretaría del Medio Ambiente y Recursos Naturales (SEMARNAT) and Secretaría de Marina (SEMAR), tourism has negatively impacted these sites, primarily on Isla Isabel and the Islas Marietas, because their access for short periods of time is not regulated properly.

The fourth serious threat is related to global climate change. The gradual increase in environmental temperatures directly influences the biological activities of the herpetofauna, which will increase the amount of time these organisms spend in their shelters to avoid temperatures that might compromise their physiological processes, and, consequently, their survival. This cascade effect, therefore, might reduce their time for social interactions and reproductive purposes, feeding periods, home ranges, and movement rates, eventually reducing population sizes, and possibly leading to local extirpations (Sinervo et al., 2010).

Tropidodipsas philippii (Jan, 1863). Phillippi's Snail-eating Snake is a Mexican endemic ranging in western Mexico from Sinaloa to western Oaxaca (Wallach et al., 2014). This individual was found at Carrillo Puerto, in the municipality of Compostela. Wilson et al. (2013a) calculated its EVS as 14, placing it at the lower limit of the high vulnerability category. Its conservation status has been judged as Least Concern by IUCN, and as a species of special protection by SEMARNAT. © Jesús Loc-Barragán

CONSERVATION STATUS

We employed the same three systems as Alvarado-Díaz et al. (2013), Mata-Silva et al. (2015), Johnson et al. (2015a), and Terán-Juárez et al. (2016) to assess the conservation status of the herpetofaunal makeup of Nayarit. Except where updates were necessary, we drew the data for the IUCN and EVS systems from Wilson et al. (2013a, b), and those for the SEMARNAT system from SEMARNAT (2010).

The SEMARNAT System

People working on the Mexican herpetofauna frequently use the SEMARNAT system of conservation assessment, presumably because it is a product of the Mexican national Secretaría de Medio Ambiente y Recursos Naturales. We included the ratings available for members of the herpetofauna of Nayarit based on this system in Table 7 and summarize them in Table 11 (excluding the four non-native species).

The data in Table 11 indicate that of the 150 native species known from Nayarit, 89 (59.3%) are not evaluated using the SEMARNAT system (SEMARNAT, 2010). This proportion is the second highest among the state-level herpetofaunas some of us have examined, including Michoacán (46.2%; Alvarado-Díaz et al., 2013), Oaxaca (52.3%; Mata-Silva et al., 2015), Chiapas (58.0%; Johnson et al., 2015a), and Tamaulipas (59.2%; Terán-Juárez et al., 2016).

Table 11. SEMARNAT categorizations for herpetofaunal species in Nayarit, Mexico, arranged by families. Non-native species are not included.

Families	Number of Species	SEMARNAT Categorizations			
		Endangered (P)	Threatened (A)	Special protection (Pr)	No status (NS)
Bufonidae	5	—	—	—	5
Craugastoridae	4	—	—	—	4
Eleutherodactylidae	3	—	—	2	1
Hylidae	10	—	—	2	8
Leptodactylidae	1	—	—	—	1
Microhylidae	3	—	—	1	2
Ranidae	5	—	—	3	2
Scaphiopodidae	2	—	—	—	2
Subtotals	**33**	**—**	**—**	**8**	**25**
Ambystomatidae	1	—	—	1	—
Plethodontidae	1	—	1	—	—
Subtotals	**2**	**—**	**1**	**1**	**—**
Totals	**35**	**—**	**1**	**9**	**25**
Crocodylidae	1	—	—	1	—
Subtotals	**1**	**—**	**—**	**1**	**—**
Anguidae	3	—	—	3	—
Corytophanidae	1	—	—	—	1
Dactyloidae	1	—	—	—	1
Eublepharidae	1	—	1	—	—
Helodermatidae	1	—	1	—	—
Iguanidae	2	—	1	1	—
Mabuyidae	1	—	—	—	1
Phrynosomatidae	18	—	1	2	15
Phyllodactylidae	2	—	—	—	2
Scincidae	4	—	—	1	3
Teiidae	4	—	—	3	1
Subtotals	**38**		**4**	**10**	**24**
Boidae	1	—	—	—	1
Colubridae	26	—	4	4	18
Dipsadidae	17	—	—	7	10
Elapidae	4	—	1	2	1
Leptotyphlopidae	1	—	—	—	1
Loxocemidae	1	—	—	1	—
Natricidae	9	—	2	1	6
Viperidae	7	—	—	5	2
Subtotals	**66**	**—**	**7**	**20**	**39**
Cheloniidae	3	3	—	—	—
Dermochelyidae	1	1	—	—	—
Emydidae	2	—	—	2	—
Geoemydidae	1	—	1	—	—
Kinosternidae	3	—	—	2	1
Subtotals	**10**	**4**	**1**	**4**	**1**
Totals	**115**	**4**	**12**	**35**	**64**
Sum Totals	**150**	**4**	**13**	**44**	**89**

The SEMARNAT system consists of three categories, i.e., endangered (P), threatened (A), and of special protection (Pr). The data in Table 11 demonstrate that only four species (2.7%) are allocated to the P category, 13 (8.7%) to the A category, and 44 (29.3%) to the Pr category.

Given that almost one of every six species occurring in Nayarit has not been evaluated by the SEMARNAT system, we found no significant value in using it to ascertain the conservation status of the members of the herpetofauna of this state. Of the four species placed in the endangered (P) category, all are sea turtles. Of the 13 allocated to the threatened (A) category, one each is a plethodontid salamander, a eublepharid lizard, a helodermatid lizard, an iguanid lizard, a phrynosomatid lizard, an elapid snake, and a geoemydid turtle, two are natricid snakes, and four are colubrid snakes.

The IUCN System

The IUCN system of conservation assessment is used on a global basis, but has been found wanting with respect to its use with the Mesoamerican herpetofauna (Wilson et al., 2013a, b; Johnson et al., 2015b). Johnson et al. (2015b) provided a critique of this system, finding it expensive and time-consuming, incapable of remaining current with advances in herpetofaunal systematics, and over reliant on the DD and LC categories. The same problems have been found to apply at the state level by Alvarado-Díaz et al. (2013), Mata-Silva et al. (2015), Johnson et al. (2015a) and Terán-Juárez et al. (2016). We found the same situation for the state of Nayarit, but in a more exaggerated way. The IUCN evaluations are available for 122 (81.9%) of the 149 native members of the herpetofauna.

Only 10 species (6.7% of total) have been placed into one of the three threat categories (CR, EN, or VU). One is allocated to the CR category, two to the EN category, and seven to the VU category (Tables 7, 12). The single CR species is *Eretmochelys imbricata*. The two EN species are *Thamnophis melanogaster* and *Chelonia mydas*; the snake is a country endemic, and the sea turtle is oceanic and pantropical. The seven VU species are *Craugastor pygmaeus*, *Lithobates megapoda*, *Isthmura bellii*, *Crocodylus acutus*, *Dermochelys coriacea*, *Lepidochelys olivacea*, and *Trachemys ornata*. Only three of these species (the ranid, plethodontid, and emydid species) are country endemics, and the remainder are non-endemics.

Micrurus proximans Smith and Chrapliwy, 1958. The Nayarit Coralsnake is a Mexican endemic distributed "along the Pacific coast of Nayarit to Jalisco, Mexico (Campbell and Lamar, 2004: 188). This individual was encountered in the Sierra Vallejo at Mazatán, in the municipality of Compostela. Wilson et al. (2013a) determined its EVS as 18, placing it in the middle portion of the high vulnerability category. Its conservation status has been judged as Least Concern by IUCN, and as a species of special protection by SEMARNAT.

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Table 12. IUCN Red List categorizations for herpetofaunal families in Nayarit, Mexico. Non-native species are excluded. The shaded columns to the left are the "threat categories," and those to the right the categories for which too little information on conservation status exists to allow the taxa to be placed in any other IUCN category, or they have not been evaluated.

Families	Number of Species	IUCN Red List categorizations						
		Critically Endangered	Endangered	Vulnerable	Near Threatened	Least Concern	Data Deficient	Not Evaluated
Bufonidae	5	—	—	—	—	5	—	—
Craugastoridae	4	—	—	1	—	2	1	—
Eleutherodactylidae	3	—	—	—	—	1	2	—
Hylidae	10	—	—	—	—	10	—	—
Leptodactylidae	1	—	—	—	—	1	—	—
Microhylidae	3	—	—	—	—	2	—	1
Ranidae	5	—	—	1	—	3	1	—
Scaphiopodidae	2	—	—	—	—	2	—	—
Subtotals	**33**	**—**	**—**	**2**	**—**	**26**	**4**	**1**
Ambystomatidae	1	—	—	—	—	1	—	—
Plethodontidae	1	—	—	1	—	—	—	—
Subtotals	**2**	**—**	**—**	**1**	**—**	**1**	**—**	**—**
Totals	**35**	**—**	**—**	**3**	**—**	**27**	**4**	**1**
Crocodylidae	1	—	—	1	—	—	—	—
Subtotals	**1**	**—**	**—**	**1**	**—**	**—**	**—**	**—**
Anguidae	3	—	—	—	—	3	—	
Corytophanidae	1	—	—	—	—	—	—	1
Dactyloidae	1	—	—	—	—	1	—	
Eublepharidae	1	—	—	—	—	—	—	1
Helodermatidae	1	—	—	—	—	1	—	
Iguanidae	2	—	—	—	—	—	—	2
Mabuyidae	1	—	—	—	—	—	—	1
Phrynosomatidae	18	—	—	—	—	16	—	2
Phyllodactylidae	2	—	—	—	—	1	—	1
Scincidae	4	—	—	—	—	3	1	—
Teiidae	4	—	—	—	—	3		1
Subtotals	**38**	**—**	**—**	**—**	**—**	**28**	**1**	**9**
Boidae	1	—	—	—	—	—	—	1
Colubridae	26	—	—	—	—	18	—	8
Dipsadidae	17	—	—	—	—	11	2	4
Elapidae	3	—	—	—	—	3	—	—
Leptotyphlopidae	1	—	—	—	—	1	—	—
Loxocemidae	1	—	—	—	—	—	—	1
Natricidae	9	—	1	—	—	6	2	—
Viperidae	7	—	—	—	1	4	—	2
Subtotals	**65**	**—**	**1**	**—**	**1**	**43**	**4**	**16**
Cheloniidae	3	1	1	1	—	—	—	—
Dermochelyidae	1	—	—	1	—	—	—	—
Emydidae	2	—	—	1	—	—	1	—
Geoemydidae	1	—	—	—	—	—	—	1
Kinosternidae	3	—	—	—	—	3	—	—
Subtotals	**10**	**1**	**1**	**3**	**—**	**3**	**1**	**1**
Totals	**114**	**1**	**2**	**4**	**1**	**74**	**6**	**26**
Sum Totals	**149**	**1**	**2**	**7**	**1**	**101**	**10**	**27**
Category Totals	**149**	**10**			**102**		**37**	

The remainder of the species are allocated as follows (Table 12): NT = 1 (0.7%); LC = 101 (67.8%); DD = 10 (6.7%); NE = 27 (18.1%). The percentage of LC species in Nayarit is higher than for the state of Tamaulipas (61.5%: Terán-Juárez et al., 2016), and significantly higher than for Oaxaca (39.3%; Mata-Silva et al., 2015) and Chiapas (37.4%; Johnson et al., 2015a).

We assembled the values for the six IUCN categories plus that for the NE species in Table 12 into three summary categories; the results are as follows: CR+EN+VU = 10 (6.7%); NT+LC = 102 (68.5%); and DD+NE = 37 (24.8%). These proportional figures are more comparable to those for Michoacán (CR+EN+VU = 12.7%; NT+LC = 61.8%; and DD+NE = 25.5%; Alvarado-Díaz et al., 2013) and Tamaulipas (CR+EN+VU = 12.8%; NT+LC = 65.4%; and DD+NE = 21.8%; Terán-Juárez et al., 2016) than they are to those for Oaxaca (CR+EN+VU = 23.2%; NT+LC = 43.2%; and DD+NE = 33.6%; Mata-Silva et al., 2015) and Chiapas (CR+EN+VU = 20.2%; NT+LC = 42.3%; and DD+NE = 37.4%; Johnson et al. 2015a), respectively.

As Wilson et al. (2013a, b), Alvarado-Díaz et al. (2013), Mata-Silva et al. (2015), Johnson et al. (2015a), and Terán-Juárez et al. (2016) have demonstrated, users of the IUCN methodology have placed an overwhelming proportion of any assemblage of Mexican species in the LC category. As noted above, almost seven of every 10 species in Nayarit has been allocated to this category (Table 12). Based on the criteria for allocation in the IUCN system, it would appear that there is relatively little concern for the survivability of the Nayarit herpetofauna.

In addition to the species allocated to the LC category, slightly more than one in four herpetofaunal species has been allocated to the DD category or has not been evaluated by the IUCN methodology (37; 24.8%). Below, we evaluated how these 37 species might be placed in the IUCN system.

The EVS System

Wilson and McCranie (1992) developed the Environmental Vulnerability Score (EVS) system of conservation assessment and used it for the Honduran herpetofauna (McCranie and Wilson, 2002; Wilson and McCranie, 2004), and since then it has proved useful in dealing with the conservation evaluation of the Mesoamerican herpetofauna.

Rena humilis Baird and Girard, 1853. The Western Threadsnake is distributed throughout the southwestern United States on into northwestern Mexico as far south as Colima (Hammerson, et al., 2007a). This individual came from Alta Vista, in the Sierra de Vallejo, in the municipality of Compostela. Wilson et al. (2013b) calculated its EVS as 8, placing it in the upper portion of the low vulnerability category. Its conservation status has been considered as Least Concern by IUCN; this species is not listed by SEMARNAT. © Jesús Loc-Barragán

We consider this system to have several advantages over those of SEMARNAT and the IUCN (see discussions in Mata-Silva et al. [2015] and Johnson et al. [2015b]).

As in previous papers where one or more of us have used this system in discussing the conservation requirements of several Mexican states (Chiapas, Johnson et al., 2015a; Michoacán, Alvarado-Díaz et al., 2015; Oaxaca, Mata-Silva et al., 2015; and Tamaulipas, Terán-Juárez et al., 2016), herein we use it to evaluate the conservation status of the herpetofauna of Nayarit (Tables 7, 13). The EVS values range from 3 to 19, one less than the entire theoretical range (3–20) for the measure, as no species in Nayarit was assessed a score of 20. The most frequent values (for 10 or more species) are six (10 species), eight (11), 10 (11), 11 (15), 12 (15), 13 (15), 14 (20), and 15 (13). We provided these eight scores for a total of 110 species, 75.3% of the 146 species for which the EVS can be calculated. At the lower end of the EVS range, we applied a score of 3 (the lowest score theoretically possible) to four species, all anurans, including the bufonid *Rhinella marina*, the hylid *Smilisca baudinii*, the ranid *Lithobates forreri*, and the scaphiopodid *Scaphiopus couchii*. These values were accorded these species because all are widely distributed, both geographically and ecologically, and utilize the most widespread reproductive mode. At the other extreme, only a single species was given a score of 19, the emydid turtle *Trachemys ornata*. This turtle is relatively narrowly distributed geographically and ecologically, and is subject to intense human pressure.

As typical of studies using the EVS measure, we divided the resulting scores into three categories, low (EVS 3–9), medium (10–13), and high (14–19) (Table 13). The scores increase from low to medium, but then decrease to high. We have seen this general pattern in studies on Chiapas (Johnson et al., 2015a) and Tamaulipas (Terán-Juárez et al., 2016), but not in studies on Michoacán (Alvarado-Díaz et al., 2013) and Oaxaca (Mata-Silva et al., 2015), where the numbers increased from low through medium to high. The principal reason for the pattern seen in Chiapas and Tamaulipas is the relatively large proportion of non-endemic species found in the herpetofaunas of these states (81.2 and 65.2%, respectively). In Nayarit, however, there are fewer non-endemics than country and state endemics (61 vs. 88), so the reason for the pattern likely has to do with there only being one state endemic (i.e., *Thamnophis rossmani*).

Thamnophis validus (Kennicott, 1860). The Mexican Pacific Lowlands Gartersnake is a Mexican endemic ranging in disjunct populations along the Pacific coast from southern Sonora to Central Guerrero, as well as in southern Baja California Sur (Rossman et al., 1996). This individual is from the Pantanal, in the municipality of Tepic. Wilson et al. (2013a) determined its EVS as 12, placing it in the upper portion of the medium vulnerability category. Its conservation status has been judged as Least Concern by IUCN; this species is not listed by SEMARNAT. © Jesús Loc-Barragán

Table 13. Environmental Vulnerability Scores (EVS) for herpetofaunal species in Nayarit, Mexico, arranged by family. Shaded area to the left encompasses low vulnerability scores, and the one to the right high vulnerability scores. Non-native and marine species are excluded.

Families	Number of Species	Environmental Vulnerability Scores																
		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Bufonidae	5	1	—	—	—	—	—	—	—	2	1	—	1	—	—	—	—	—
Craugastoridae	4	—	—	—	—	—	1	1	—	—	—	2	—	—	—	—	—	—
Eleutherodactylidae	3	—	—	—	—	—	—	—	—	—	1	—	—	—	1	1	—	—
Hylidae	10	1	1	—	—	1	1	1	1	1	1	2	—	—	—	—	—	—
Leptodactylidae	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—
Microhylidae	3	—	1	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—
Ranidae	6	1	—	—	—	—	—	1	1	—	1	—	2	—	—	—	—	—
Scaphiopodidae	2	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotals	**34**	**4**	**2**	**—**	**2**	**2**	**3**	**3**	**2**	**3**	**4**	**4**	**3**	**—**	**1**	**1**	**—**	**—**
Ambystomatidae	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—
Plethodontidae	1	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—
Subtotals	**2**	—	—	—	—	—	—	—	—	—	**1**	—	**1**	—	—	—	—	—
Totals	**36**	**4**	**2**	**—**	**2**	**2**	**3**	**3**	**2**	**3**	**5**	**4**	**4**	**—**	**1**	**1**	**—**	**—**
Crocodylidae	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—
Subtotals	**1**	—	—	—	—	—	—	—	—	—	—	—	**1**	—	—	—	—	—
Anguidae	3	—	—	—	1	—	—	—	1	—	—	—	1	—	—	—	—	—
Corytophanidae	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—
Dactyloidae	1	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Eublepharidae	1	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—
Helodermatidae	1	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—
Iguanidae	2	—	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—
Mabuyidae	1	—	—	—	1	—	—	—	—	—	—	—		—	—	—	—	—
Phrynosomatidae	18	—	—	—	—	—	—	2	2	3	4	2	2	1	2	—	—	—
Phyllodactylidae	2	—	—	—	—	—	1	—	—	—	—	—	—	1	—	—	—	—
Scincidae	4	—	—	—	—	—	—	—	1	1	1	—	—	1	—	—	—	—
Teiidae	4	—	—	—	—	—	—	—	—	1	—	1	2	—	—	—	—	—
Subtotals	**38**	**—**	**—**	**—**	**2**	**1**	**1**	**3**	**4**	**6**	**6**	**4**	**5**	**4**	**2**	**—**	**—**	**—**
Boidae	1	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—
Colubridae	26	—	—	1	5	—	1	1	2	3	1	2	5	4	1	—	—	—
Dipsadidae	17	—	1	1	1	1	2	—	1	—	—	5	3	1	—	1	—	—
Elapidae	3	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	1	—
Leptotyphlopidae	1	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—
Loxocemidae	1	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—
Natricidae	9	—	—	—	—	1	1	—	—	1	2	—	—	2	1	—	1	—
Viperidae	7	—	—	—	—	—	1	—	—	1	1	—	1	—	1	1	—	—
Subtotals	**65**	**—**	**1**	**2**	**6**	**2**	**6**	**1**	**4**	**5**	**4**	**7**	**10**	**9**	**3**	**2**	**2**	**—**
Emydidae	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1
Geoemydidae	1	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—
Kinosternidae	3	—	—	—	—	—	—	—	1	1	—	—	—	—	1	—	—	—
Subtotals	**6**	**—**	**—**	**—**	**—**	**—**	**1**	**—**	**1**	**1**	**—**	**—**	**—**	**—**	**1**	**—**	**1**	**1**
Totals	**110**	**—**	**1**	**2**	**8**	**3**	**8**	**4**	**9**	**12**	**10**	**11**	**16**	**13**	**7**	**2**	**3**	**1**
Sum Totals	**146**	**4**	**3**	**2**	**10**	**5**	**11**	**7**	**11**	**15**	**15**	**15**	**20**	**13**	**8**	**3**	**3**	**1**
Sum Totals%	**—**	**2.7**	**2.0**	**1.3**	**6.7**	**3.4**	**7.4**	**4.7**	**7.5**	**10.1**	**9.4**	**10.1**	**13.4**	**8.9**	**5.4**	**3.4**	**2.7**	**—**
Category Totals	**146**	**42**							**56**				**48**					

As in the aforementioned studies, we compared the EVS and IUCN categorizations for the Nayarit herpetofauna (Table 14). The data in this table indicate that only 14.3% (7 of 49) of the high vulnerability species are allocated to any of the IUCN threat categories (CR, EN, and VU); interestingly, none of these species is allocated to the CR category. This proportion is significantly less than the figure for the Chiapan (42.0%; Johnson et al., 2015a) or the Oaxacan herpetofaunas (37.4%; Mata-Silva et al., 2015), as well as for the Tamaulipan herpetofauna (26.5%; Terán-Juárez et al., 2016). The fully assessed IUCN categorizations include the threat categories and the NT, LC, and DD categories, with the LC category placed at the other extreme from the threat categories. With the Nayarit herpetofauna, 101 species are allocated to the LC category, which is 2.4 times the number of low vulnerability species (42). This value is greater than those found for the Oaxacan (1.7 times; Mata-Silva et al., 2015), Chiapan (1.3 times; Johnson et al., 2015a), and Tamaulipan (2.1 times; Terán-Juárez et al., 2016) herpetofaunas. Thus, in Nayarit, the results of the application of the IUCN and EVS systems are more at odds with one another than for the states of Oaxaca, Chiapas, and Tamaulipas.

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

EVS	IUCN Categories							Totals
	Critically Endangered	Endangered	Vulnerable	Near Threatened	Least Concern	Data Deficient	Not Evaluated	
3	—	—	—	—	4	—	—	4
4	—	—	—	—	3	—	—	3
5	—	—	—	—	—	—	2	2
6	—	—	—	—	6	—	4	10
7	—	—	—	—	4	—	1	5
8	—	—	—	—	7	—	4	11
9	—	—	1	—	5	—	1	7
10	—	—		—	9	—	1	10
11	—	—		1	12	—	1	14
12	—	—	1	—	12	1	1	15
13	—	—		—	12	2	1	15
14	—	—	2	—	15	1	3	21
15	—	1	—	—	7	2	3	13
16	—	—	—	—	3	1	3	7
17	—	—	—	—	1	1	1	3
18	—	—	—	—	1	2	1	4
19	—	—	1	—	—	—	—	1
Totals	**—**	**1**	**5**	**1**	**101**	**10**	**27**	**145**

Ten species (6.9% of the number of species to which both the IUCN and EVS systems can be applied; Table 15) are allocated to the DD category. This fairly low number would appear to indicate that the herpetofauna of Nayarit is reasonably well understood and in relatively good shape with respect to conservation status. Perusal of the data in Table 15 indicates that nine of the 10 species are country endemics, including three anurans (*Craugastor occidentalis*, *Eleutherodactylus pallidus*, *E. teretistes,* and *Lithobates psilonota*), one lizard (*Plestiodon parvulus*), three snakes (*Coniophanes lateritius*, *Enulius oligostichus*, and *Thamnophis nigronuchalis*), and one turtle (*Terrapene nelsoni*), and that one is the single state endemic (*Thamnophis rossmani*). All of the EVS values of these 10 species are relatively high, ranging from 12 (one species) through 13 (two species), 14 (one species), 15 (two species), 16 (one species), and 17 (one species) to 18 (two species), with all but three falling into the high vulnerability category. The exceptions are *C. occidentalis*, *C. lateritius*, and *T. nigronuchalis*, species with relatively broad ecological distributions (Table 15). Arguably, all of the high vulnerability species should be placed among the threat categories and the two medium vulnerability species in the NT category. For these 10 species to continue languishing in the

Data Deficient category marginalizes their conservation status, as found in previous studies (Howard and Bickford, 2014; Johnson et al., 2015a; Mata-Silva et al., 2015; Nori and Loyola, 2015; Terán-Juárez et al., 2016).

Table 15. Environmental Vulnerability Scores for members of the herpetofauna of Nayarit, Mexico, allocated to the IUCN Data Deficient category. * = country endemic; ** = state endemic.

Taxa	Environmental Vulnerability Score			
	Geographic Distribution	Ecological Distribution	Reproductive Mode/ Degree of Persecution	Total Score
*Craugastor occidentalis**	5	4	4	13
*Eleutherodactylus pallidus**	5	8	4	17
*Eleutherodactylus teretistes**	5	7	4	16
*Lithobates psilonota**	5	8	1	14
*Plestiodon parvulus**	5	7	3	15
*Coniophanes lateritius**	5	5	3	13
*Enulius oligostichus**	5	7	3	15
*Thamnophis nigronuchalis**	5	3	4	12
*Thamnophis rossmani***	6	8	4	18
*Terrapene nelsoni**	5	7	6	18

About the same proportion of species in Nayarit (18.1%) are placed in the NE category as in Tamaulipas (18.5%; Terán-Juárez et al., 2016). To examine the reasons why the 27 species in Nayarit were assessed in this category, we placed their EVS values in Table 16. Thirteen of the 27 species are country endemics (48.1%), but the reason why they have not been evaluated by the IUCN is not apparent. The EVS scores for the 27 species ranges from 5 to 18, as follows: low (5, two species; 6, four species; 7, one species; 8, four species; and 9, one species); medium (10, one species; 11, one species; 12, one species; and 13, one species); and high (14, three species; 15, three species; 16, three species; 17, one species; and 18, one species). If and when the IUCN evaluates these taxa, we suggest that the 12 low vulnerability species should be placed in the LC category, the four medium vulnerability species in the NT category, and the 11 high vulnerability species in one of the three threat categories.

The IUCN has placed a large proportion of the herpetofaunal species in Nayarit in the LC category (101 of 149 species; 67.8%). Although over two-thirds of the species in Nayarit have been allocated to this category, the herpetofauna is not in comparatively good shape, as also has been found with other state studies (Mata-Silva et al., 2015; Johnson et al., 2015a; Terán-Juárez et al., 2016). We placed these 101 species along with their EVS scores in Table 17. As with other studies, the EVS of these species (3–18) entails almost the entire range of scores allocated in the state (3–19). When placed into the three categories of vulnerability, the numbers and proportions are as follows: low—29 (28.7); medium—45 (44.6%); high—27 (26.7%). Obviously, this compendium of species runs nearly the entire gamut of types from broadly distributed generalist species such as *Lithobates forreri*, *Scaphiopus couchii*, *Rhinella marina*, and *Smilisca baudinii*, to country endemics of relatively limited distribution such as *Leptodeira punctata* and *Micrurus proximans*. Of the 101 species, 62 (61.4%) are country endemics, which, given the rate of conversion of natural habitats to human-engineered habitats in Mexico and the general ill-feeling humans have for these creatures, does not appear to support their allocation to the LC category. In terms of geographic distribution, the allocation of the 101 species to the five applicable levels, from more restricted to less restricted, is as follows: 5 (62; 61.4%); 4 (four; 4.0%); 3 (one; 1.0%); 2 (23; 22.8%); and 1(11; 10.9%). The country endemics fall into level 5, therefore, the largest proportion of these species consists of species limited in distribution to Mexico. With respect to ecological distribution, the placement of the 101 species to the eight applicable levels, from more restricted to less restricted, is as follows: 8 (five; 5.0%); 7 (seven; 6.9%); 6 (19; 18.8%); 5 (22; 21.8%); 4 (15; 14.9%); 3 (13; 12.9%); 2 (six; 5.9%); and 1 (14; 13.9%). Consequently, the majority of the species (69; 68.3%) occupy from three to six vegetational formations.

Table 16. Environmental Vulnerability Scores for members of the herpetofauna of Nayarit, Mexico, currently not evaluated (NE) by the IUCN. Non-native taxa are not included. * = species endemic to Mexico.

Taxa	Environmental Vulnerability Score			
	Geographic Distribution	Ecological Distribution	Reproductive Mode/Degree of Persecution	Total Score
Gastrophryne mazatlanensis	2	5	1	8
Basiliscus vittatus	1	3	3	7
Coleonyx elegans	2	3	4	9
*Ctenosaura pectinata**	5	4	6	15
Iguana iguana	3	3	6	12
Mabuya brachypoda	1	2	3	6
*Sceloporus albiventris**	5	8	3	16
*Sceloporus unicanthalis**	5	8	3	16
Phyllodactylus tuberculosus	1	4	3	8
*Holcosus sinister**	5	5	3	13
*Boa sigma**	5	4	6	15
Drymobius margaritiferus	1	1	6	6
*Lampropeltis polyzona**	5	1	5	11
Masticophis mentovarius	1	1	4	6
*Mastigodryas cliftoni**	5	6	3	14
Oxybelis aeneus	1	1	3	5
*Sympholis lippiens**	5	6	3	14
*Tantilla ceboruca**	6	8	2	16
*Trimorphodon paucimaculatus**	5	6	4	15
*Hypsiglena affinis**	5	7	2	14
Imantodes gemmistratus	1	3	2	6
Leptodeira septentrionalis	2	2	4	8
Sibon nebulatus	1	2	2	5
Loxocemus bicolor	1	5	4	10
*Crotalus armstrongi**	5	8	5	18
*Crotalus campbelli**	5	7	5	17
Rhinoclemmys pulcherrima	1	4	3	8

Based on our EVS analysis of the 101 species allocated by the IUCN to the LC category, it seems best to leave the 74 low and medium vulnerability species in that category, or perhaps to place at least some of them in the NT category, but the high vulnerability species (27) should be allocated to one of the three threat categories. These 27 species and their respective EVS calculations are as follows (* = endemic to Mexico):

*Anaxyrus kelloggi** (5+8+1 = 14)
*Ambystoma rosaceum** (5+8+1 = 14)
*Barisia imbricata** (5+6+3 = 14)
*Heloderma horridum** (5+4+5 = 14)
*Sceloporus asper** (5+6+3 = 14)
*Sceloporus heterolepis** (5+6+3 = 14)
*Sceloporus utiformis** (5+7+3 = 15)
*Phyllodactylus lanei** (5+7+3 = 15)
*Aspidoscelis communis** (5+6+3 = 14)
*Aspidoscelis lineatissima** (5+6+3 = 14)
*Lampropeltis mexicana** (5+7+3 = 15)
*Leptophis diplotropis** (5+5+4 = 14)
*Pituophis deppei** (5+5+4 = 14)
*Salvadora bairdi** (5+6+4 = 15)
*Salvadora mexicana** (5+6+4 = 15)
*Sonora mutabilis** (5+6+3 = 14)
*Leptodeira punctata** (5+8+4 = 17)
*Leptodeira splendida** (5+5+4 = 14)
*Tropidodipsas philippi** (5+5+4 = 14)
Micruroides euryxanthus (4+6+5 = 15)
*Micrurus distans** (5+4+5 = 14)
*Micrurus proximans** (5+8+5 = 18)
*Thamnophis errans** (5+7+4 = 16)
*Thamnophis pulchrilatus** (5+6+4 = 15)
*Crotalus basiliscus** (5+6+5 = 16)
Crotalus pricei (2+7+5 = 14)
*Kinosternon chimalhuaca** (5+8+3 = 16)

Perusal of this list of species indicates that all but two (*M. euryxanthus* and *C. pricei*) are country endemics. For the remaining 25 species, we suggest assigning the two species with EVS scores of 17 and 18 to the CR category, the 10 with EVS scores of 15 and 16 to the EN category, and the 15 with EVS scores of 14 to the VU category.

Agkistrodon bilineatus Günther, 1863. The Common Cantil "primarily occurs in the coastal portion of nine states from Sonora to Chiapas, as well as in Morelos (Porras et al., 2013: 61);" its distribution continues along southern Guatemala and into western El Salvador, as well as extreme western Honduras. This individual was encountered at San Rafael, in the municipality of El Nayar. Porras et al. (2013) calculated its EVS as 13, placing it at the upper limit of the medium vulnerability category. Its conservation status has been evaluated as Near Threatened by IUCN, and as a species of special protection by SEMARNAT. © Jesús Loc-Barragán

Table 17. Environmental Vulnerability Scores for members of the herpetofauna of Nayarit, Mexico, assigned to the IUCN Least Concern category. Non-native and marine taxa are not included. * = species endemic to Mexico.

Taxa	Environmental Vulnerability Score			
	Geographic Distribution	Ecological Distribution	Reproductive Mode/ Degree of Persecution	Total Score
*Anaxyrus kelloggi**	5	8	1	14
*Incilius marmoreus**	5	5	1	11
*Incilius mazatlanensis**	5	6	1	12
*Incilius occidentalis**	5	5	1	11
Rhinella marina	1	1	1	3
Craugastor augusti	2	2	4	8
*Craugastor vocalis**	5	4	4	13
*Eleutherodactylus nitidus**	5	3	4	12
*Agalychnis dacnicolor**	5	5	3	13
*Diaglena spatulata**	5	7	1	13
Dryophytes arenicolor	2	4	1	7
*Dryophytes eximius**	5	4	1	10
*Exerodonta smaragdina**	5	6	1	12
*Plectrohyla bistincta**	5	3	1	9
Smilisca baudinii	1	1	1	3
Smilisca fodiens	2	5	1	8
*Tlalocohyla smithii**	5	5	1	11
Trachycephalus typhonius	1	2	1	4
Leptodactylus melanonotus	1	3	2	6
Hypopachus ustus	2	4	1	7
Hypopachus variolosus	2	1	1	4
Lithobates forreri	1	1	1	3
*Lithobates magnaocularis**	5	6	1	12
*Lithobates pustulosus**	5	3	1	9
Scaphiopus couchii	1	1	1	3
Spea multiplicata	1	4	1	6
*Ambystoma rosaceum**	5	8	1	14
*Barisia imbricata**	5	6	3	14
Elgaria kingii	2	5	3	10
Gerrhonotus liocephalus	2	1	3	6
*Norops nebulosus**	5	5	3	13
*Heloderma horridum**	5	4	5	14
*Phrynosoma orbiculare**	5	4	3	12
*Sceloporus asper**	5	6	3	14
Sceloporus clarkii	2	5	3	10
*Sceloporus dugesi**	5	5	3	13
Sceloporus grammicus	2	4	3	9
*Sceloporus heterolepis**	5	6	3	14
*Sceloporus horridus**	5	3	3	11
Sceloporus jarrovii	2	6	3	11
Sceloporus melanorhinus	2	4	3	9
*Sceloporus nelsoni**	5	5	3	13
Sceloporus poinsettii	4	5	3	12
*Sceloporus scalaris**	5	4	3	12

*Sceloporus torquatus**	5	3	3	11
*Sceloporus utiformis**	5	7	3	15
*Urosaurus bicarinatus**	5	4	3	12
Urosaurus ornatus	2	5	3	10
*Phyllodactylus lanei**	5	7	3	15
*Plestiodon brevirostris**	5	3	3	11
Plestiodon callicephalus	2	7	3	12
*Plestiodon lynxe**	5	2	3	10
*Aspidoscelis communis**	5	6	3	14
*Aspidoscelis costata**	5	3	3	11
*Aspidoscelis lineattissima**	5	6	3	14
Drymarchon melanurus	1	1	4	6
Gyalopion quadrangulare	3	6	2	11
*Lampropeltis mexicana**	5	7	3	15
*Leptophis diplotropis**	5	5	4	14
Masticophis bilineatus	2	5	4	11
Mastigodryas melanolomus	1	1	4	6
*Pituophis deppei**	5	5	4	14
*Pseudoficimia frontalis**	5	5	3	13
Rhinocheilus lecontei	1	3	4	8
*Salvadora bairdi**	5	6	4	15
Salvadora grahamiae	4	2	4	10
*Salvadora mexicana**	5	6	4	15
Senticolis triaspis	2	1	3	6
*Sonora mutabilis**	5	6	3	14
*Tantilla bocourti**	5	2	2	9
*Tantilla calamarina**	5	5	2	12
Tantilla yaquia	2	6	2	10
*Trimorphodon tau**	5	4	4	13
Diadophis punctatus	1	1	2	4
*Geophis dugesii**	5	6	2	13
*Hypsiglena torquata**	5	1	2	8
Leptodeira maculata	2	1	4	7
*Leptodeira punctata**	5	8	4	17
*Leptodeira splendida**	5	5	4	14
*Manolepis putnami**	5	5	3	13
*Rhadinaea hesperia**	5	3	2	10
*Rhadinaea taeniata**	5	6	2	13
*Tropidodipsas annulifera**	5	4	4	13
*Tropidodipsas philippi**	5	5	4	14
Micruroides euryxanthus	4	6	5	15
*Micrurus distans**	5	4	5	14
*Micrurus promimans**	5	8	5	18
Rena humilis	4	3	1	8
*Storeria storerioides**	5	4	2	11
Thamnophis cyrtopsis	2	1	4	7
Thamnophis eques	2	2	4	8
*Thamnophis errans**	5	7	4	16
*Thamnophis pulchrilatus**	5	6	4	15
*Thamnophis validus**	5	3	4	12

*Crotalus basiliscus**	5	6	5	16
Crotalus lepidus	2	5	5	12
Crotalus molossus	2	1	5	8
Crotalus pricei	2	7	5	14
*Kinosternon chimalhuaca**	5	8	3	16
Kinosternon hirtipes	2	5	3	10
*Kinosternon integrum**	5	3	3	11

RELATIVE HERPETOFAUNAL PRIORITY

Johnson et al. (2015a) developed the concept of Relative Herpetofaunal Priority (RHP) as a simple device to measure the relative importance of a herpetofauna recorded in an area of conservation interest, e.g., the physiographic regions found in a larger area, such as a state in Mexico. For this study, the RHP is calculated and ranked in one way as the absolute number of state and country endemics found in particular physiographic regions, with higher cumulative numbers given a proportionally higher ranking. In another way, higher rankings are given to regions with proportionally higher absolute numbers of high EVS category species. We constructed two tables to ascertain the RHP for the four physiographic regions of Nayarit, one for the endemicity values (Table 18) and the other for the high vulnerability EVS values (Table 19).

The data in Table 18 demonstrate that the highest value of 69 species is seen in the Trans-Mexican Volcanic Belt in the southern portion of the state. Thus, its RHP rank is one. Following closely behind is the value of 63 for the Sierra Madre Occidental in the eastern region of the state, providing a rank of two. The third rank is allocated to the Coastal Plain, with a figure of 51 species. Finally, the fourth rank, as expected, is provided to the Nayarit Islands, where the number is 13.

In Table 19, the highest number of high category species (35) is recorded in the Trans-Mexican Volcanic Belt, so it is accorded rank one. The next highest number (30) is found in the Sierra Madre Occidental, which is given rank two. The third highest number (26) is located on the Coastal Plain, so it occupies rank three. The fourth rank, again as expected, is given to the Nayarit Islands, on which eight high category species are found.

The rankings for the two RHP measures resemble one another and are arranged in the following order: Trans-Mexican Volcanic Belt, Sierra Madre Occidental, Coastal Plain, and Nayarit Islands. The proportional values of endemic species for the four regions are as follows: TMV = 61.8% (68 of 110 species); SMO = 62.6% (62 of 99); CP = 49.5% (50 of 101); and NI = 35.3% (12 of 34). For the high vulnerability species, they are as follows: TMV = 32.4% (35 of 108); SMO = 31.3% (30 of 96); CP = 27.7% (26 of 94); and NI = 29.6% (8 of 27).

The two RHP measures, when used in combination, allow for a fundamental determination of the relative conservation significance of the herpetofaunas of the physiographic regions of Nayarit. Two regions in the state, the Trans-Mexican Volcanic Belt and the Sierra Madre Occidental, are of comparable importance in securing protection for the endemic herpetofauna, as well as for the high vulnerability species. The next step is to ascertain how well the existing protected areas of the state match up with the realities of the composition and distribution of the resident herpetofauna.

Table 18. Number of herpetofaunal species of four distributional categories among the four physiographic regions of Nayarit. Rank determined by adding state and country endemics.

Physiographic Regions	Non-endemics	Country Endemics	State Endemics	Non-natives	Totals	Rank Order
Coastal Plain	47	51	—	3	101	3
Sierra Madre Occidental	34	63	—	2	99	2
Trans-Mexican Volcanic Belt	39	68	1	2	110	1
Nayarit Islands	19	13	—	2	34	4

Table 19. Number of herpetofaunal species in the three EVS categories among the four physiographic regions of Nayarit, Mexico. Rank determined by the relative number of high EVS species. Marine and non-native species are excluded.

Physiographic Regions	Low	Medium	High	Totals	Rank Order
Coastal Plain	31	37	26	94	3
Sierra Madre Occidental	25	41	30	96	2
Trans-Mexican Volcanic Belt	34	39	35	108	1
Nayarit Islands	11	8	8	27	4

PROTECTED AREAS IN NAYARIT

Six natural protected areas (NPAs) are found in Nayarit; five are decreed and one is in process by the Mexican Federal Government (Table 20).

The Biosphere Reserve Marismas Nacionales was established on 12 May 2010, and is the most recently designated area in Nayarit. This reserve is located in the northwestern sector of the state, in the municipalities of Santiago Ixcuintla, Tuxpan, Rosamorada, Tecuala, and Acaponeta. It contains nearly 133,000 ha of marshes and mangroves, which are some of the most important wetlands systems in Mexico, as they preserve 20% of the existing mangroves in the country. The herpetofauna of Marismas Nacionales consists of 55 species, including 17 anurans, representing 50.0% of the anurans distributed in the state, and 38 species of the remaining herpetofauna, equivalent to 32.2% of this diversity in Nayarit. The remaining herpetofauna comprises one crocodylian, 31 squamates (14 lizards, 17 snakes) and six turtles (Table 21). This area contains 23 Mexican endemic species, representing 25.8% of the overall endemism for the state, and two introduced species (Table 22).

The Biosphere Reserve Archipelago Islas Marías was declared on 27 November 2000. This reserve is composed of four islands: María Madre, María Magdalena, María Cleofas, and San Juanito, as well as their respective surrounding territories. The Islas Marías are areas of rugged topography with elevations ranging from sea level to 620 m, and contain a broad representation of ecosystems, among which are the pelagic marine environment, coasts, reefs, mangroves, and deciduous forest. The herpetofaunal component consists of four anurans, one crocodylian, 24 squamates (10 lizards, 14 snakes) and three turtles (Table 21). These 32 species represent 20.8% of the herpetofauna of Nayarit. The Islas Marías contain more non-endemic than endemic species (17 and 11, respectively, Table 22), and the latter species represent only 12.4% of the endemics found in Nayarit.

Isla Isabel was declared a National Park on 8 December 1980, in order to preserve its natural resources for the development of scientific research and to preserve its scenic beauty and recreational activities, benefiting nearby coastal communities. This site presents a pelagic marine environment, coasts, and deciduous forest. The herpetofauna on this island is poorly represented, with only one anuran (*Incilius mazatlanensis*) and nine squamates (*Aspidoscelis costata*, *Ctenosaura pectinata*, *Iguana iguana*, *Hemidactylus frenatus*, *Phyllodactylus lanei*, *P. tuberculosus*, *Sceloporus clarkii*, *Indotyphlops braminus*, and *Lampropeltis polyzona*; Table 21), including two non-native species (Table 22).

The Islas Marietas constitute a National Park located in the municipality of Bahía de Banderas, in waters under federal jurisdiction. The park, which was decreed in 2005, is located near the shore, 6 km SW of the peninsula known as Punta de Mita. Access to these islands is only by sea from any point of the bay (from Puerto Vallarta, in Jalisco, and Nuevo Vallarta, La Cruz de Huanacaxtle, Bucerías, and Punta de Mita, in Nayarit). Only one type of vegetation (grassland) is present. Like Isla Isabel, the herpetofauna is poorly represented, with only nine squamates (six lizards and three snakes), including *Aspidoscelis lineattissima*, *Ctenosaura pectinata*, *Iguana iguana*, *Mabuya brachypoda*, *Norops nebulosus*, *Phyllodactylus lanei*, *Hypsiglena torquata*, *Hydrophis platurus*, and *Masticophis mentovarius*, as well as two turtles (*Eretmochelys imbricata* and *Lepidochelys olivacea*). Thus far, no amphibians have been reported from these islands (Table 21). The Islas Marietas contain 4.6% of the endemism for Nayarit (Table 22). On 9 May 2016, the Comisión Nacional de Areas Naturales Protegidas officially closed the beach Playa del Amor to tourism due to the negative impact caused by a high number of visitors. This area is an important habitat for many marine species, and the beach also is a reproductive site for *E. imbricata* and *L. olivacea* (CONANP, 2016).

Table 20. Characteristics of Natural Protected Areas in Nayarit, Mexico. Abbreviations in Facilities available as follows: A = administrative services; R = park guards; S = systems of pathways; and V = facilities for visitors.

Name	Category	Date of Decree	Area (ha)	Municipalities	Jurisdiction	Physiographic Regions	Facilities Available	Occupied by landowners	Herpetofaunal Survey Completed	Management Plan Available
Marismas Nacionales	Biosphere Reserve	May 12, 2010	133,000	Santiago Ixcuintla, Tuxpan, Rosamorada, Tecuala and Acaponeta	Mexican Federal Goverment	Coastal Plain	A, S, V	Yes	Yes	Yes
Islas Marías	Biosphere Reserve	November 27, 2000	26,000	San Blas	Mexican Federal Goverment	Nayarit Islands	A	Not	Yes	Yes
Isla Isabel	National Park	December 8, 1980	70	San Blas	Mexican Federal Goverment	Nayarit Islands	A, R, S, V	Not	Yes	Yes
Islas Marietas	National Park	2005	79	Bahía de Banderas	Mexican Federal Goverment	Nayarit Islands	A, R, S, V	Not	Yes	Yes
Sierra de Vallejo-Río Ameca	Biosphere Reserve	in the process of decree	261,443	Bahía de Banderas and Compostela	Mexican Federal Goverment	Trans Mexican Volcanic Belt	A, S, V	Yes	Yes	Not
Sierra de San Juan	Biosphere Reserve	December 13, 2008	20053	Tepic, Xalisco and San Blas	Nayarit Goverment	Trans Mexican Volcanic Belt	A, R, S, V	Yes	Yes	Yes

The Biosphere Reserve Sierra de Vallejo-Río Ameca is being established, and is considered by the Comisión Nacional para el Uso y Aprovechamiento de la Biodiversidad (CONABIO) as a priority region for conservation of its natural resources, including plant and animal diversity and water supplies available to the inhabitants of the region. With an area of ca. 261,443 ha, this reserve is located in the municipalities of Atenguillo, Cuautla, Pets, Mixtlán, Puerto Vallarta, and San Sebastian, in Jalisco, as well as in the municipalities of Bahía de Banderas and Compostela, in Nayarit (Diario Oficial de la Federación, November 27, 2012). The vegetation is represented by semi-deciduous tropical forest, cloud forest, oak forest, pine forest, and mixed pine-oak forest. The herpetofauna in the Biosphere Reserve Sierra de Vallejo-Río Ameca represents 46.8% of the total herpetofauna reported for Nayarit, and is composed of 21 anurans (61.8% of the anurans distributed in the state), 48 squamates (23 lizards, 25 snakes) and three turtles (Table 21), 46.8% of the remainder of the state's herpetofauna; 49.4% of the endemic species (44) in Nayarit are found in this area (Table 22).

The Biosphere Reserve Sierra de San Juan was decreed by the government of Nayarit on 31 December 2008. This reserve is located in the Trans-Mexican Volcanic Belt physiographic region, in the Volcanic Belt West Subprovince (also known as Tepic-Chapala Graben). The latter consists of four areas, of which one is the volcanic region of Nayarit, including the Sierra de San Juan. It covers an area of ca. 20,053 ha, with elevations ranging from 980 to 2,240 m, and includes the municipalities of Tepic, Xalisco, and San Blas in Nayarit. Its limits to the north are the ejidos La Yerba, El Trapichillo, Venustiano Carranza, and Ahuacate, to the south Adolfo Lopez Mateos, Brotherhood of Chocolón, and Malinal, to the east the cities of Tepic and Xalisco and ejidos Los Fresnos, Molino Menchaca, Testerazo, Aquiles Serdan, and Emiliano Zapata, and to the west the ejidos Tepozal, Cuarenteño, Jalcocotán, La Yerba, and the community of San Juan Bautista. Six vegetation types are found in this reserve, including semi-deciduous tropical forest, cloud

forest, oak forest, pine forest, mixed pine-oak forest, and secondary scrub. The herpetofauna of Sierra de San Juan is composed of 19 anurans (55.9% of the anurans found in the state), as well as 52 squamates (24 lizards and 28 snakes) and two turtles (Table 21), constituting 45.8% of the remainder of the herpetofauna. This reserve is particularly important because it contains 50.6% of the endemic species in the state (Table 22).

Future efforts at conservation in Nayarit require the provision of protection for the 42 of 150 native species not protected currently in any of the established NPAs, including 28 of the country and state endemic species and 14 of the non-endemic species.

Table 21. Distribution of amphibians and reptiles in the six Natural Protected Areas of Nayarit, Mexico. Abbreviations are as follows: * = species endemic to Mexico; ** = species endemic to Nayarit; and *** = non-native species.

Taxa	Natural Protected Area					
	Marismas Nacionales	Islas Marías	Isla Isabel	Islas Marietas	Sierra de Vallejo-Río Ameca	Sierra de San Juan
Anura (31 species)						
Bufonidae (5 species)						
*Anaxyrus kelloggi**	+					
*Incilius marmoreus**	+				+	
*Incilius mazatlanensis**	+	+	+		+	
*Incilius occidentalis**						+
Rhinella marina	+				+	+
Craugastoridae (4 species)						
Craugastor augusti					+	+
*Craugastor occidentalis**	+				+	+
Craugastor pygmaeus					+	+
*Craugastor vocalis**						+
Eleutherodactylidae (3 species)						
*Eleutherodactylus nitidus**					+	+
*Eleutherodactylus pallidus**	+	+			+	+
*Eleutherodactylus teretistes**					+	
Hylidae (9 species)						
*Agalychnis dacnicolor**	+				+	+
*Diaglena spatulata**					+	
*Dryophytes eximius**					+	+
*Exerodonta smaragdina**						+
Plectrohyla cf. *bistincta**						+
Smilisca baudinii	+	+			+	+
Smilisca fodiens	+				+	+
*Tlalocohyla smithii**	+				+	+
Trachycephalus typhonius	+					
Leptodactylidae (1 species)						
Leptodactylus melanonotus	+				+	+
Microhylidae (3 species)						
Gastrophryne mazatlanensis	+					
Hypopachus ustus	+					

Hypopachus variolosus	+	+				
Ranidae (5 species)						
Lithobates forreri	+				+	+
*Lithobates magnaocularis**					+	
*Lithobates megapoda**					+	
*Lithobates psilonota**					+	+
*Lithobates pustulosus**					+	+
Scaphiopodidae (1 species)						
Scaphiopus couchii	+					
Crocodylia (1 species)						
Crocodylidae (1 species)						
Crocodylus acutus	+	+				
Squamata (69 species)						
Anguidae (2 species)						
Elgaria kingii						+
Gerrhonotus liocephalus					+	+
Corytophanidae (1 species)						
Basiliscus vittatus					+	
Dactyloidae (1 species)						
*Norops nebulosus**	+	+			+	+
Gekkonidae (2 species)						
*Gehyra mutilata****	+				+	+
*Hemidactylus frenatus****	+		+		+	+
Helodermatidae (1 species)						
*Heloderma horridum**	+				+	+
Iguanidae (2 species)						
*Ctenosaura pectinata**	+	+	+	+	+	+
Iguana iguana	+		+	+	+	+
Mabuyidae (1 species)						
Mabuya brachypoda				+		
Phrynosomatidae (12 species)						
*Sceloporus albiventris**					+	+
*Sceloporus asper**						+
Sceloporus clarkii	+		+		+	+
*Sceloporus horridus**					+	+
Sceloporus jarrovii						
Sceloporus melanorhinus	+				+	+
*Sceloporus nelsoni**	+				+	+
*Sceloporus torquatus**						+
*Sceloporus unicanthalis**						+
*Sceloporus utiformis**					+	+
*Urosaurus bicarinatus**					+	+
Urosaurus ornatus		+				

Phyllodactylidae (2 species)						
*Phyllodactylus lanei**	+		+	+	+	+
Phyllodactylus tuberculosus	+	+	+		+	+
Scincidae (2 species)						
Plestiodon callicephalus	+				+	
*Plestiodon parvulus**					+	+
Teiidae (4 species)						
*Aspidoscelis communis**	+	+			+	+
*Aspidoscelis costata**	+		+		+	+
*Aspidoscelis lineattissima**				+	+	
*Holcosus sinister**					+	+
Boidae (1 species)						
*Boa sigma**	+	+			+	+
Colubridae (14 species)						
Drymarchon melanurus	+	+			+	+
Drymobius margaritiferus	+				+	+
*Lampropeltis polyzona**	+	+	+		+	+
*Leptophis diplotropis**	+	+			+	+
Masticophis mentovarius	+	+		+	+	+
Mastigodryas melanolomus		+			+	+
Oxybelis aeneus	+	+			+	+
Rhinocheilus lecontei	+					
*Salvadora mexicana**					+	
Senticolis triaspis					+	+
*Sympholis lippiens**						+
*Tantilla bocourti**		+				
*Tantilla calamarina**		+				
*Trimorphodon paucimaculatus**	+				+	+
Dipsadidae (13 species)						
*Geophis dugesii**						+
*Hypsiglena torquata**	+	+		+	+	+
Imantodes gemmistratus		+			+	
Leptodeira maculata	+				+	+
*Leptodeira punctata**	+					
Leptodeira septentrionalis					+	+
*Leptodeira splendida**					+	+
*Manolepis putnami**					+	
*Rhadinaea hesperia**					+	+
*Rhadinaea taeniata**						+
Sibon nebulatus		+				+
*Tropidodipsas annulifera**					+	
*Tropidodipsas philippi**					+	

Elapidae (3 species)						
Hydrophis platurus	+	+		+		
Micruroides euryxanthus						+
*Micrurus proximans**					+	+
Leptotyphlopidae (1 species)						
Rena humilis	+				+	+
Natricidae (2 species)						
*Storeria storerioides**						+
*Thamnophis validus**	+				+	+
Typhlopidae (1 species)						
*Indotyphlops braminus****			+			
Viperidae (4 species)						
Agkistrodon bilineatus	+	+			+	+
*Crotalus armstrongi**						+
*Crotalus basiliscus**	+				+	+
*Crotalus campbelli**						+
Testudines (7 species)						
Cheloniidae (3 species)						
Chelonia mydas	+	+				
Eretmochelys imbricata	+	+		+		
Lepidochelys olivacea	+	+		+		
Dermochelyidae (1 species)						
Dermochelys coriacea	+	+				
Emydidae (1 species)						
*Trachemys ornata**	+				+	
Geoemydidae (1 species)						
Rhinoclemmys pulcherrima					+	+
Kinosternidae (1 species)						
*Kinosternon integrum**	+				+	+

Table 22. Summary of the distributional status of herpetofaunal species in protected areas in Nayarit, Mexico. Totals = total number of species recorded in all of the listed protected areas.

Protected Areas	Number of Species	Distributional Status			
		Non-endemic (NE)	Country Endemic (CE)	State Endemic (SE)	Non-native (NN)
Marismas Nacionales	55	30	23	—	2
Islas Marías	28	17	11	—	—
Isla Isabel	10	3	5	—	2
Islas Marietas	10	6	4	—	—
Sierra de Vallejo-Río Ameca	72	26	44	—	2
Sierra de San Juan	73	26	45	—	2
Totals	108	46	59	—	3

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

A. The herpetofauna of Nayarit presently consists of 154 species, including 34 anurans, two salamanders, one crocodylian, 107 squamates, and 10 turtles. The total represents 12.1% of the 1,269 species currently recorded from Mexico.

B. The number of herpetofaunal species distributed among the four physiographic regions we recognize in Nayarit ranges from 34 in the Nayarit Islands to 110 in the Trans-Mexican Volcanic Belt.

C. The species shared between physiographic regions range from 17 between the Sierra Madre Occidental and the Nayarit Islands, to 78 between the Sierra Madre Occidental and the Trans-Mexican Volcanic Belt. The CBR values range from 0.26 between the Sierra Madre Occidental and the Nayarit Islands to 0.75 between the Sierra Madre Occidental and the Trans-Mexican Volcanic Belt. Our UPGMA analysis indicates that the montane regions of the state, the Sierra Madre Occidental and the Trans-Mexican Volcanic Belt, resemble one another most closely in herpetofaunal makeup, and, in turn, these most closely resemble the Coastal Plain in composition; the most distinctive region in the state is the Nayarit Islands.

D. Unlike the situation reported for Chiapas, Michoacán, Oaxaca, and Tamaulipas, where the largest number of species lies in the non-endemic distributional category, in Nayarit that position is occupied by the country endemic species (88 species; 57.1% of the total number). Unlike the other states, however, a single state endemic is known from Nayarit. Together, therefore, 89 species are restricted in distribution to Mexico (57.8% of the total herpetofauna). This figure is slightly lower than that for all of Mexico (60.4%; 767/1,269), but it is substantially higher than the comparable figures for Chiapas and Tamaulipas (17.6% and 32.1%, respectively), inasmuch as the geographic position of Nayarit is relatively distant from the nearest point of the United States in southern Texas and that of Central America in western Guatemala.

E. The distributional status of the members of the herpetofauna of Nayarit is as follows (in the order of the size of the categories): country endemics (88; 57.1% of 154 species); non-endemic species (61; 39.6%); non-native species (4; 2.6%); and state endemics (1; 0.6%).

F. The principal environmental threats include habitat fragmentation, the building of hydroelectric dams, increasing development of the tourist industry, and global climate change.

G. We used the SEMARNAT, IUCN, and EVS systems to evaluate the conservation status of the members of the herpetofauna of Nayarit. We ascertained that the SEMARNAT system is of limited value, since only 41.3% of the native species have been assessed. Otherwise, only four species are allocated to the endangered category (P), 13 to the threatened category (A), and 44 to the special protection category (Pr).

H. The IUCN system is widely used, but has been criticized for several reasons in a number of papers dealing with portions of the Mesoamerican herpetofauna (Alvarado-Díaz et al., 2013; Wilson et al., 2013a, b; Mata-Silva et al., 2015; Johnson et al., 2015a, b). Johnson et al. (2015a: 324) summarized these reasons as follows: "(1) irrespective of the area in Mesoamerica examined, a sizable portion of the species involved have not been evaluated (we placed them in the NE category); (2) because the species are too poorly known to be placed into one of the fully-assessed categories, a considerable portion are allocated to the DD category; and (3) because the largest group of species is placed in the LC category, which generally includes a sizable number of species we believe should be placed in one of the three threat categories or the NT category." With reference to the herpetofauna of Nayarit, the category, number, and percentage of the 150 native species are as follows: CR (1, 0.7%); EN (two, 1.3%); VU (seven, 4.7%); NT (one, 0.7%); LC (101, 67.3%); DD (10, 6.7%); and NE (27, 18.1%).

I. As in similar studies, we found the EVS system to be most useful in assessing the conservation status of the members of the herpetofauna of Nayarit. We determined the individual EVS for these species and partitioned them in low, medium, and high categories of vulnerability, the number of species in these categories increased from low (42, 28.8%) to medium (56, 38.4%) and then again decreased to high (48, 32.9%). We agree with the conclusions of the earlier studies that the EVS system provides an easily usable and rapidly and inexpensively employable method for ascertaining how scarce funds to support conservation efforts should be allocated in instances ranging from single species to entire native terrestrial herpetofaunas.

Rhinoclemmys pulcherrima (Gray, 1855). The Painted Wood Turtle ranges along "the Pacific versant of Mexico from Sonora to Colima, in Guerrero, and from eastern Oaxaca, Mexico, to central Costa Rica" (Savage, 2002: 768–769). This individual was found at Alta Vista, in the Sierra Vallejo, in the municipality of Compostela. Wilson et al. (2013a) ascertained its EVS as 8, placing it in the upper portion of the low vulnerability category. Its conservation status has not been assessed by IUCN; this species is listed as threatened by SEMARNAT.
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Kinosternon integrum Le Conte, 1854. The Mexican Mud Turtle is a Mexican endemic ranging along the Pacific coastal lowlands from central Sonora to the Río Verde in Oaxaca, and is also widespread throughout the central and southern portion of the Mexican Plateau (Lemos-Espinal and Dixon, 2013). This individual came from La Puntilla, in the Marismas Nacionales, in the municipality of Tecuala. Wilson et al. (2013b) calculated its EVS as 11, placing it in the lower portion of the medium vulnerability category. Its conservation status has been considered as Least Concern by IUCN, and as a species of special concern by SEMARNAT.
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J. A comparison of the IUCN and EVS categorizations demonstrates that only approximately 15% of the high vulnerability species are placed in the IUCN threat categories, and that about two and one-half times the number of low vulnerability species are allocated to the LC category. As documented in other studies, these two systems of conservation evaluation are in serious disagreement with one another and provide highly disparate views of the conservation status of the members of the herpetofauna of Nayarit.

K. An assessment of the species placed in the DD, NE, and LC categories by the IUCN, as compared to their respective EVS values, indicates that many species in Nayarit have been incorrectly placed within the IUCN categories and should be re-categorized in the interests of a more realistic evaluation of their survival prospects.

L. We used the Relative Herpetofaunal Priority (RHP) measure to determine the conservation significance of the four regional herpetofaunas in Nayarit. One means of determining the RHP involves adding the country and state endemics; by using this method, we found the conservation importance of the regional herpetofaunas to be most significant for the Trans-Mexican Volcanic Belt, next most for the Sierra Madre Occidental, then the Coastal Plain, and least for the Nayarit Islands. The other method of calculating the RHP is based on the number of high vulnerability species, and by employing this means we found the following ranking, from high to low: Trans-Mexican Volcanic Belt, Sierra Madre Occidental, Coastal Plain, and Nayarit Islands. Thus, both RHP measures illustrate the following conservation significance of the physiographic regions: Trans-Mexican Volcanic Belt, Sierra Madre Occidental, Coastal Plain, and Nayarit Islands.

M. Six natural protected areas, five existing and another being established, are represented in Nayarit.

N. Herpetofaunal surveys conducted in the NPAs demonstrate the presence of a collective number of 108 species (70.1% of the total herpetofauna). The two most important of the six NPAs are the Biosphere Reserve Sierra de Vallejo-Río Ameca, still not dedicated formally, which contains 44 country endemics, 26 non-endemics, and two non-native species, and the Biosphere Reserve Sierra de San Juan, with 45 country endemics, 26 non-endemics, and two non-natives.

O. Future conservation activities should include the establishment of areas that would protect the 42 species not currently found in any of the current or planned NPAs.

Recommendations

A. A series of surveys in unexplored sites within the Sierra Madre Occidental adjacent to Jalisco, Zacatecas, Durango, and Sinaloa are of significant importance, because other species found in these states likely will be encountered in Nayarit. We suspect that these surveys would increase the geographic distribution of many species, as well as the species richness for Nayarit. We hope this information will help promote the establishment of additional protected areas, since they are lacking in this physiographic region.

B. We also emphasize the need to devote greater attention to sites facing the greatest potential anthropogenic impact by conducting frequent monitoring studies that would reveal pattern changes in different populations, especially for species assigned with a high category of risk by any of the systems used to assess their conservation status (NOM-ECOL-059-SEMARNAT 2010, IUCN, EVS).

C. Finally, we underscore the need for all professionals concerned with the conservation of natural resources to increase their efforts to make the people of Nayarit aware of the importance of the sustainable maintenance of these organisms and their interactions within their ecosystems. Environmental education plans in the state should focus primarily on people who are in direct or frequent contact with natural environments. Additionally, government agencies should develop and monitor projects that are in tune with the conservation of the natural environments, and protection strategies for the currently established NPAs should be fully implemented as rapidly as possible.

We should forever bear in mind that the beautiful world our species inherited took the biosphere 3.8 billion years to build. The intricacy of its species we know only in part, and the way they work together to create a sustainable balance we have only recently begun to grasp. Like it or not, and prepared or not, we are the mind and stewards of the living world. We have come a very long way through the barbaric period in which we still live, and now I believe we've learned enough to adopt a transcendent moral precept concerning the rest of life. It is simple and easy to say: Do no further harm to the biosphere. —E. O. Wilson (2016)

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Paulino Ponce-Campos is a biologist who graduated from the Universidad Autónoma de Guadalajara (1988–1992). He obtained his Master's degree, with a thesis on ecology, at the Centro Universitario de Ciencias Biológicas y Agropecuarias of the Universidad de Guadalajara (1999–2003). Paulino has participated in various proposals and conservation projects at the national and international levels, and has authored several scientific papers in peer-reviewed journals, as well as a number of book chapters. Since 1985 he has specialized in the herpetology of western Mexico, and since 1990 has devoted himself to investigating human-crocodile conflicts for all three native crocodilian species in throughout their respective ranges. He also has lectured in various states of Mexico and the United States, and has collaborated on several studies on crocodiles, including population genetics, ecology, physiology, conservation status, and distribution. Currently, he is the director of a nonprofit research organization focused on conservation. Additionally, he has participated in reviews of the NOM-ECOL-059-SEMARNAT, as well as the IUCN Red List of Threatened Species, and presently is a member of the Crocodile Specialist Group of CONABIO, IUCN, and CITES. Paulino has visited and worked with several researchers in the United States.

Jesús Loc-Barragán is a biologist who graduated from the Universidad Autónoma de Nayarit. His bachelor's thesis focused on the herpetofauna and mammalian fauna associated with the cloud forest of the Biosphere Reserve Sierra de Vallejo, Nayarit, mentored by Juan Pablo Ramírez-Silva and Guillermo A. Woolrich-Piña. He has collaborated on various projects focused on the conservation, ecology, and distribution of amphibians and reptiles in Nayarit, and has participated in national and international conferences. Among his contributions are several co-authored papers published or submitted to peer-reviewed journals. Jesús currently works as an independent nature researcher and photographer.

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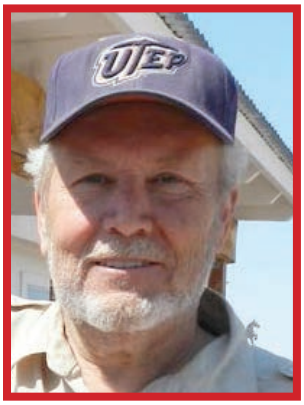
Vicente Mata-Silva is a herpetologist from Río Grande, Oaxaca, Mexico. His interests include ecology, conservation, geographic distribution, and the monitoring of herpetofauna in Mexico and the southwestern United States. His bachelor's thesis at the Universidad Nacional Autónoma de México (UNAM) compared herpetofaunal richness in Puebla, Mexico, in habitats with different degrees of human-related disturbance. Vicente's master's thesis focused primarily on the diet of two syntopic whiptail lizard species, one unisexual and the other bisexual, in the Trans-Pecos region of the Chihuahuan Desert. His dissertation was on the ecology of the rock rattlesnake, *Crotalus lepidus*, in the northern Chihuahuan Desert. To date, Vicente has authored or co-authored over 80 peer-reviewed scientific publications. Currently, he is a research fellow and lecturer at the University of Texas at El Paso, where his work focuses on the ecology of rattlesnake populations in a Chihuahuan Desert habitat. He also is the Distribution Notes Section Editor for the journal *Mesoamerican Herpetology*.



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

Elí García-Padilla is a herpetologist primarily focused on the study of the ecology and natural history of the Mexican herpetofauna. His research efforts have centered on the Mexican states of Baja California, Tamaulipas, Chiapas, and Oaxaca. His first experience in the field was researching the ecology of the insular endemic populations of the rattlesnakes *Crotalus catalinensis*, *C. pyrrhus*, and *C. tortugensis* in the Gulf of California. For his bachelor's degree he presented a thesis on the ecology of *Crotalus pyrrhus* (previously recognized as *C. muertensis*) on Isla El Muerto, Baja California, Mexico. To date, he has authored or co-authored 52 peer-reviewed scientific publications. Currently, he is employed as a formal Curator of Reptiles from Mexico in the electronic platform "Naturalista" of the Comisión Nacional para el Uso y Conocimiento de la Biodiversidad (CONABIO; www.naturalista.mx). One of his main passions is environmental education, and for several years he has been working on a variety of projects that include the use of audiovisual media as a powerful tool to reach large audiences and to promote the importance of the knowledge, protection, and conservation of the Mexican biodiversity. Elí's interests include wildlife and conservation photography, and his art has been published in several recognized scientific, artistic, and educational books, magazines, and websites.

Larry David Wilson is a herpetologist with lengthy experience in Mesoamerica. He has authored or co-authored over 335 peer-reviewed papers and books on herpetology, including two papers published in 2013 entitled "A conservation reassessment of the amphibians of Mexico based on the EVS measure" and "A conservation reassessment of the reptiles of Mexico based on the EVS measure," one in 2014 entitled "Snakes of the genus *Tantilla* (Squamata: Colubridae) in Mexico: taxonomy, distribution, and conservation," four in 2015 entitled "A conservation reassessment of the Central American herpetofauna based on the EVS measure," "The herpetofauna of Oaxaca, Mexico: composition, physiographic distribution, and conservation status," "The herpetofauna of Chiapas, Mexico: compostion, distribution, and conservation," and "A checklist and key to the snakes of the *Tantilla* clade (Squamata: Colubridae), with comments on taxonomy, distribution, and conservation," and one in 2016 entitled "The herpetofauna of Tamaulipas: composition, distribution, and conservation." Larry is the senior editor of *Conservation of Mesoamerican Amphibians and Reptiles* and the co-author of seven of its chapters. His other books include *The Snakes of Honduras*, *Middle American Herpetology*, *The Amphibians of Honduras*, *Amphibians & Reptiles of the Bay Islands and Cayos Cochinos, Honduras*, *The Amphibians and Reptiles of the Honduran Mosquitia*, and *Guide to the Amphibians & Reptiles of Cusuco National Park, Honduras*. To date, he has authored or co-authored the descriptions of 70 currently recognized herpetofaunal species, and seven species have been named in his honor, including the anuran *Craugastor lauraster*, the lizard *Norops wilsoni*, and the snakes *Oxybelis wilsoni*, *Myriopholis wilsoni*, and *Cerrophidion wilsoni*. Currently, Larry is an Associate Editor and Co-chair of the Taxonomic Board for the journal *Mesoamerican Herpetology*.