Ambystoma flavipiperatum Dixon, 1963. The Yellow-peppered Salamander (*Ajolote de Chapala*) is one of two species of amphibians endemic to Jalisco. Its known distribution "is restricted to the Sierra de Quila in the municipality of Tecolotlán" (Cortés-Vázquez et al., 2016), and its elevation ranges from 1,494 to 2,400 m (IUCN SSC Amphibian Specialist Group, 2016). The holotype and three paratypes all were collected within an 11-mile (17.7 km) radius of the community of Santa Cruz, indicated in the original description to be located "approximately 26 miles [41.8 km] southwest of Guadalajara at an elevation of 4,900 feet [1,494 m]" (Dixon, 1963). Subsequently, this species has been reported from "60 km to the west-southwest of the type locality at 3 km south of Quila El Grande, Jalisco" (Frost, 2016). The larval and neotenic stages of this salamander occur in streams in pine-oak forest (Rosas-Espinosa et al., 2013; Cortés-Vázquez et al., 2016). These streams are "slow moving and not very deep" and have "a lot of organic matter in decomposition (oak leaves and pine needles) on the bottom" (Rosas-Espinosa et al., 2013). The adult stage lives underground in the vicinity of these streams, especially in burrows constructed by Buller's Pocket Gophers (*Pappogeomys bulleri*), locally known as *tuzas* (Santiago Pérez et al., 2012). The hypodigm of this species was assembled from a locality 26 miles (41.8 km) southwest of Tapalpa, Jalisco, in "desert shrub and dense thorn forest along temporary streams" (Rosas-Espinosa et al., 2013). This individual was found in Área de Protección de Flora y Fauna "Sierra de Quila," in the municipality of Tecolotlán, Jalisco. Wilson et al. (2013b) determined its EVS to be 14, placing it at the lower limit of the high vulnerability category, and currently this species is judged as Endangered by the IUCN and as a species of special protection (Pr) by SEMARNAT. Cortés-Vázquez et al. (2016) reported the finding of a leucistic individual of this species.

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

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Abstract: The herpetofauna of Jalisco, Mexico, is comprised of 223 species, including 47 anurans, four salamanders, one caecilian, one crocodylian, 158 squamates, and 12 turtles. We document the distribution of these species among the seven physiographic regions we recognize. The number of species in these regions ranges from 38 in the Sierra de Coalcomán and the Tepalcatepec Depression to 116 in the Trans-Mexican Volcanic Belt. The species occupy from one to seven regions ($\bar{x}$ = 2.6). The number of species shared between physiographic regions ranges from 19 between the Pacific Coastal Plain and the Tepalcatepec Depression to 69 between the Trans-Mexican Volcanic Belt and the Central Plateau, with the Coefficient of Biogeographic Resemblance (CBR) values ranging from 0.21 to 0.68. The greatest number of single-region species (33) is restricted to the Pacific Coastal Plain. About 61% of the species in Jalisco are confined to one or two physiographic regions, which is of great conservation significance. We developed a CBR matrix in which the number of shared species ranges from 19 to 69. We utilized these data to build a UPGMA dendrogram, which indicates that two distinct clusters of multiple pairwise groupings united at a CBR level of 0.41 are present, as well as an outlier consisting of the Pacific Coastal Plain region (PC) joined to the other six regions at a CBR level of 0.35. None of the seven regions illustrate high resemblance patterns; the highest CBR value (0.68) is that between the Tepalcatepec Depression (TD) and Sierra de Coalcomán (SC) regions, which lie adjacent to one another in the southeastern sector of the state. The next highest resemblance (0.66) is that between the Trans-Mexican Volcanic Belt (TV) and the Central Plateau (CP) regions, which share a lengthy border in the central portion of the state. This pair of regions is next most closely related to the Sierra Madre Occidental (SO) region, with a value of 0.60; both TV and CP lie adjacent to the Sierra Madre Occidental in north-central Jalisco. The last region, the Sierras Jaliscienses (SJ), joins the SO-TV-CP group at a level of 0.54. Against expectations, the TD region shares little resemblance (0.28) to the PC region, even though these two regions share a connection through the Río Balsas Basin in southern Michoacán. The most distinctive herpetofaunal assemblage is located within the Pacific Coastal Plain, which contains the most single-region species (33) and the highest number of

country endemics (15). We allocated the members of the herpetofauna to four distributional categories, of which the largest number is comprised of the country endemic species (142), followed by the non-endemics (75), the non-natives (4), and the state endemics (2). We identified the principal environmental threats as climate change, population growth, habitat fragmentation due to excessive urban development, agricultural expansion, logging, soil erosion, soil compaction, desertification, air and water pollution, unregulated dumping of waste, open pit mining, illegal hunting, and commercial trade. We evaluated the conservation status of the native species by using the SEMARNAT, IUCN, and EVS systems, of which the EVS proved to be the most helpful. The number of species in the three EVS categories increased from low (51) through medium (74), to high (88). In addition, we utilized the EVS rankings to evaluate how the species in the IUCN categories of NE and LC might be assessed more accurately. We also utilized a means for determining Relative Herpetofaunal Priority (RHP), a simple scheme for ascertaining the rank order of a physiographic regional herpetofauna dependent on the number of state and national endemic species, in addition to the number of high vulnerability EVS species. By employing these two measures, we determined the Trans-Mexican Volcanic Belt to occupy rank number one in both cases. We discuss the impact of global environmental issues on Jalisco, as well as the ability of the state's 20 protected areas to provide sanctuary for the members of the herpetofauna. Based on our analysis, we developed a set of conclusions and recommendations for the perpetual protection of the herpetofauna of Jalisco.

Key Words: Anurans, caecilians, caudates, crocodylians, physiographic regions, protected areas, protection recommendations, squamates, turtles

Resumen: La herpetofauna de Jalisco, México, está compuesta por 223 especies, incluyendo 47 anuros, cuatro salamandras, una cecilia, un crocodilio, 158 escamosos y 12 tortugas. Documentamos la distribución de estas especies entre las siete regiones fisiográficas aquí reconocidas. El número de especies en estas regiones va de 38 en la Sierra de Coalcomán y la Depresión de Tepaltepec a 116 en el Eje Volcánico Transversal. Las especies ocupan de una a siete regiones ($\bar{x} = 2.6$). El número de especies compartido entre las regiones fisiográficas va de 19 entre la Planicie Costera del Pacífico y la Depresión de Tepalcatepec a 69 entre el Eje Volcanico Transversal y la Altiplanicie Central, con valores del Coeficiente de Similitud Biogeográfica (CBR) con un rango de 0.21 a 0.68. El mayor número de especies (33) restringidas a una sola región se encontró en la Planicie Costera del Pacífico. Aproximadamente 61% de las especies en Jalisco se distribuyen en una o dos regiones fisiográficas, lo cual significa gran importancia en terminos de la conservación. Desarrollamos una matriz de CBR en el cual el número de especies compartidas va de 19 a 69. Utilizamos estos datos para construir un dendrograma de UPGMA, el cual muestra dos grupos principales que se unen con un valor de CBR de 0.41, y están aunados a un grupo aislado consistente en la Planicie Costera del Pacífico (PC), misma que se une a las otras seis regiones con un valor de CBR de 0.35. Ninguna de las siete regiones muestra patrones de alta similitud; el valor más alto de CBR (0.68) es entre la Depresión de Tepaltepec (TD) y la Sierra de Coalcomán (SC), las cuales se encuentran contiguas en el sureste del estado. La siguiente similitud más alta (0.66) fue entre el Eje Volcanico Transversal (TV) y la Altiplanicie Central (CP), las cuales comparten una larga frontera en la porción central del estado. Estas dos regiones son más similares a la Sierra Madre Occidental (SO), con un valor de 0.60; con ambas regiones (TV y CP) adyacentes a la Sierra Madre Occidental en la parte norte-centro de Jalisco. La última región, las Sierras Jalicienses (SJ), se une al grupo SO-TV-CP a un nivel de 0.54. Contrario a lo esperado, la región TD presenta una baja similitud (0.28) con la región PC, a pesar de que estas dos regiones están conectadas por la cuenca del Río Balsas en el sur de Michoacán. El ensamblaje herpetofaunístico más distinto está ubicado en la Planicie Costera del Pacífico, el cual comprende la región con el mayor número de especies únicas (33) y el número más alto de especies endémicas al país (15). Asignamos los miembros de la herpetofauna a cuatro categorías de distribución, de los cuales el número más grande está compuesto por las especies endémicas al país (142), seguido de las especies no endémicas (75), las no

nativas (4), y las endémicas para el estado (2). Identificamos las principales amenazas ambientales como el cambio climático global, crecimiento de la población humana, fragmentación del hábitat debido al excesivo desarrollo urbano, expansión agrícola, tala, erosión y compactación del suelo, desertificación, contaminación del aire y agua, depósito de residuos no regulado, minería a cielo abierto, caza y comercio ilegal de organismos. Evaluamos el estatus de conservación de las especies nativas con los sistemas de SEMARNAT, UICN y EVS, de los cuales el último sistema resultó ser el más informativo. El número de especies en las tres categorías del EVS aumentó de la categoria baja (51) a la mediana (74), y disminuyó en la categoría alta (88). Adicionalmente, utilizamos los rangos del EVS para evaluar cómo las especies en las categorías de No Evaluadas y de Preocupación Menor de la UICN podrían ser mejor evaluadas. También determinamos la Prioridad Herpetofaunística Relativa (RHP), un esquema básico para determinar el rango de relevancia de una región fisiográfica en función del número de especies endémicas al país y al estado, aunado al número de especies con un valor de EVS de alta vulnerabilidad. Utilizando estas dos medidas, determinamos que el Eje Volcanico Transversal ocupa el rango uno en ambos casos. Discutimos el impacto de los problemas ambientales globales en Jalisco, así como también la capacidad de las 20 áreas naturales protegidas del estado para proporcionar un santuario a los miembros de la herpetofauna. Basado en nuestro análisis, desarrollamos un conjunto de conclusiones y recomendaciones para la protección perpetua de la herpetofauna de Jalisco.

Palabras Claves: Anuros, áreas protegidas, caudados, cecilios, crocodilios, escamosos, recomendaciones de protección, regiones fisiográficas, tortugas

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We can survive our rude infancy and grow into responsible caring adults—without losing our innocence, playfulness or sense of wonder. But first we need to see ourselves from different angles, in many mirrors, as a very young species, both blessed and cursed by our prowess. Instead of ignoring or plundering nature, we need to refine our natural place in it.

—Diane Ackerman (2014)

INTRODUCTION

This paper is the sixth in a series dealing with the composition, distribution, and conservation status of the herpetofauna of various states in Mexico published in *Mesoamerican Herpetology*, which collectively we refer to as the Mexican Conservation Series (MCS). Previous papers have dealt with the herpetofaunas of Oaxaca (Mata-Silva et al., 2015), Chiapas (Johnson et al., 2015a), Tamaulipas (Terán-Juárez et al., 2016), Nayarit (Woolrich-Piña et al., 2016), and Nuevo León (Nevárez-de los Reyes et al., 2016). The MCS grew from an earlier paper published in *Amphibian & Reptile Conservation* on the herpetofauna of Michoacán (Alvarado-Diáz et al., 2013).

This paper deals with the herpetofauna of Jalisco, a curiously shaped state that borders on the Pacific Ocean and extends inland to intercalate among portions of the Sierra Madre Occidental, the Central Plateau, and the Tepalcatepec Depression. Each of these regions is joined to a segment of the Trans-Mexican Volcanic Belt in the west-central portion of the state.

To the north Jalisco is bordered by Nayarit, Zacatecas, and Aguascalientes, to the east by Guanajuato, and to the south by Colima and Michoacán. The state is situated entirely to the south of the Tropic of Cancer and, thus lies completely within the tropics. With an area of 78,304 km^2, Jalisco is the 7th largest state in Mexico, and also is the 11th most densely populated, at 100 people/km^2 (www.wikipedia.org; accessed 11 December 2016).

Given that a significant portion of the physiographic diversity of Mexico is found in Jalisco and the location of the state lies south of the Tropic of Cancer, its herpetofaunal species richness might be expected to be higher than that of states to the north of this latitudinal parallel, and lower than that of the highly speciose states in southern Mexico. We compared species richness values for the state of Sonora, the second-largest state in Mexico and which borders the United States, and for the state of Oaxaca, in the southern extreme of the country, with that of Jalisco, which lies in the west-central region. The species richness for Sonora is 185,430/194 = 955.8 (Rorabaugh and Lemos-Espinal, 2016), that of Oaxaca is 93,757/442 = 212.1 (Mata-Silva et al., 2015), and that of Jalisco is 75,588/222 = 340.5 (see below). Thus, as expected, the herpetofaunal species richness for Jalisco is intermediate between the comparable values for Sonora to the north and Oaxaca to the south, but more closely allied to that of Oaxaca than to Sonora.

As with previous MCS studies, the purpose of this paper is to document the composition of the herpetofauna of Jalisco, discuss its physiographic distribution, and evaluate its conservation status. We follow the general format of the other studies.

MATERIALS AND METHODS

Our Taxonomic Position

Our taxonomic position is the same as explained in earlier MCS works (Johnson, et al., 2015a; Mata-Silva et al., 2015; Terán-Juárez et al., 2016; Woolrich-Piña et al., 2016; Nevárez-de los Reyes et al., 2016). Johnson et al. (2015b) presented details of this position.

Updating the Herpetofaunal List

Cruz-Sáenz et al. (2009) and Chávez-Ávila et al. (2015) updated the herpetofaunal list for Jalisco, documenting the presence of 200 species, including 45 anurans, four salamanders, one crocodylian, 138 squamates, and 12 turtles.

Additional noteworthy information on the herpetofauna of Jalisco is found in Smith and Grant (1958), Duellman and Wellman (1960), Grant and Smith (1960), Tanner and Robinson (1960), Dixon (1963, 1965, 1968), Hensley and Lannom (1966), Trueb (1969), Medica et al. (1975), Campbell (1978), Pérez-Ramos (1987), Méndez-de la Cruz and Casas-Andreu (1992), Ramírez-Bautista and Smith (1992), Ramírez-Bautista (1994), Flores-Villela et al. (1995), Berry et al. (1997), Wake (1998), Riojas-López and Mellink (2006), Webb (2006), Mulcahy (2007), Ponce-Campos et al. (2007a, b), Reyna-Bustos et al. (2007), Reyes-Velasco et al. (2008), Reyes-Velasco and Mulcahy (2010), Reyes-Velasco et al. (2012), Carbajal-Márquez et al. (2013), Rodríguez-Canseco and Quiroz (2013), Rodríguez-Canseco et al. (2013), Barragán-Ramírez et al. (2014), Bryson et al. (2014), Grummer and Bryson (2014), Carbajal-Márquez et al. (2015), Casas-Andreu et al. (2015), Cruz-Sáenz et al. (2015), Meza-Lázaro and Nieto-Montes de Oca (2015), Reyes-Velasco et al. (2015), Ahumada-Carrillo et al. (2016), Carbajal-Márquez et al. (2016), Flores-Guerrero and Sánchez-González (2016), and Grünwald et al. (2016).

The names of the taxa in this paper are based on the Taxonomic List in the *Mesoamerican Herpetology* website (www.mesoamericanherpetology.com; accessed 12 February 2017).

System for Determining Distributional Status

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

Incilius marmoreus (Wiegmann, 1833). The Marbled Toad is a Mexican endemic distributed "from northern Sinaloa to Chiapas along the Pacific Coastal Plain; an isolated population in the region of the city of Veracruz on the Atlantic coast...; and reported for Hidalgo, Mexico…" but with no specific locality (Frost, 2016). This individual came from Yelapa, in the municipality of Cabo Corrientes. 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 this species is not listed by SEMARNAT. © Cheryl Harleston

Eleutherodactylus angustidigitorum (Taylor, 1940). The Patzcuaro Peeping Frog is a Mexican endemic that ranged historically from "Tuxpan, Jalisco, east through northern Michoacán and México (state) to the D.F., Mexico" (Frost, 2016), but now is restricted to northwestern and central Michoacán, and some localities in Jalisco (Santos-Barrera and Canseco-Márquez, 2004; Rosas-Espinoza et al., 2013). This individual was found in Sierra del Tigre, in the municipality of Valle de Juárez. Wilson et al. (2013b) determined its EVS as 17, placing it in the middle portion of the high vulnerability category. Its conservation status has been judged as Vulnerable by the IUCN, and this anuran is considered as a species of special protection (Pr) by SEMARNAT. © Francisco Javier Muñoz-Nolasco

Systems for Determining Conservation Status

To evaluate the conservation status of the Jalisco herpetofauna, we utilized the same systems (i.e., SEMARNAT, IUCN, and EVS) as Alvarado-Díaz et al. (2013), Mata-Silva et al. (2015), Johnson et al. (2015a), Terán-Juárez et al. (2016), Woolrich-Piña et al. (2016), and Nevárez-de los Reyes et al. (2016). Descriptions of these three systems are available in Alvarado-Díaz et al. (2013) and Johnson et al. (2015b).

PHYSIOGRAPHY AND CLIMATE

Physiographic Regions

Different schemes of physiographic regionalization have been used for the state of Jalisco, of which the most utilized has been that of INEGI (1981), and includes four provinces: Sierra Madre Occidental, Neo-volcanic Axis, Sierra Madre del Sur, and Central Plateau. Chávez-Ávila et al. (2015) used this scheme in their book on the herpetofauna of this state. In this study, however, we chose to recognize seven regions in order to examine the distributional patterns of the herpetofauna across the state at a finer scale. The physiographic regions proposed herein are an adaptation of the North American Terrestrial Regions–Level III (CEC, 2009), in accordance with the physiographic and biotic delimitations of other studies (Demant, 1978; Cervantes-Zamora et al., 1990; Olson et al., 2001; Olson and Dinerstein, 2002; Alvarado-Díaz et al., 2013; Espinosa et al., 2016; Woolrich-Piña et al., 2016).

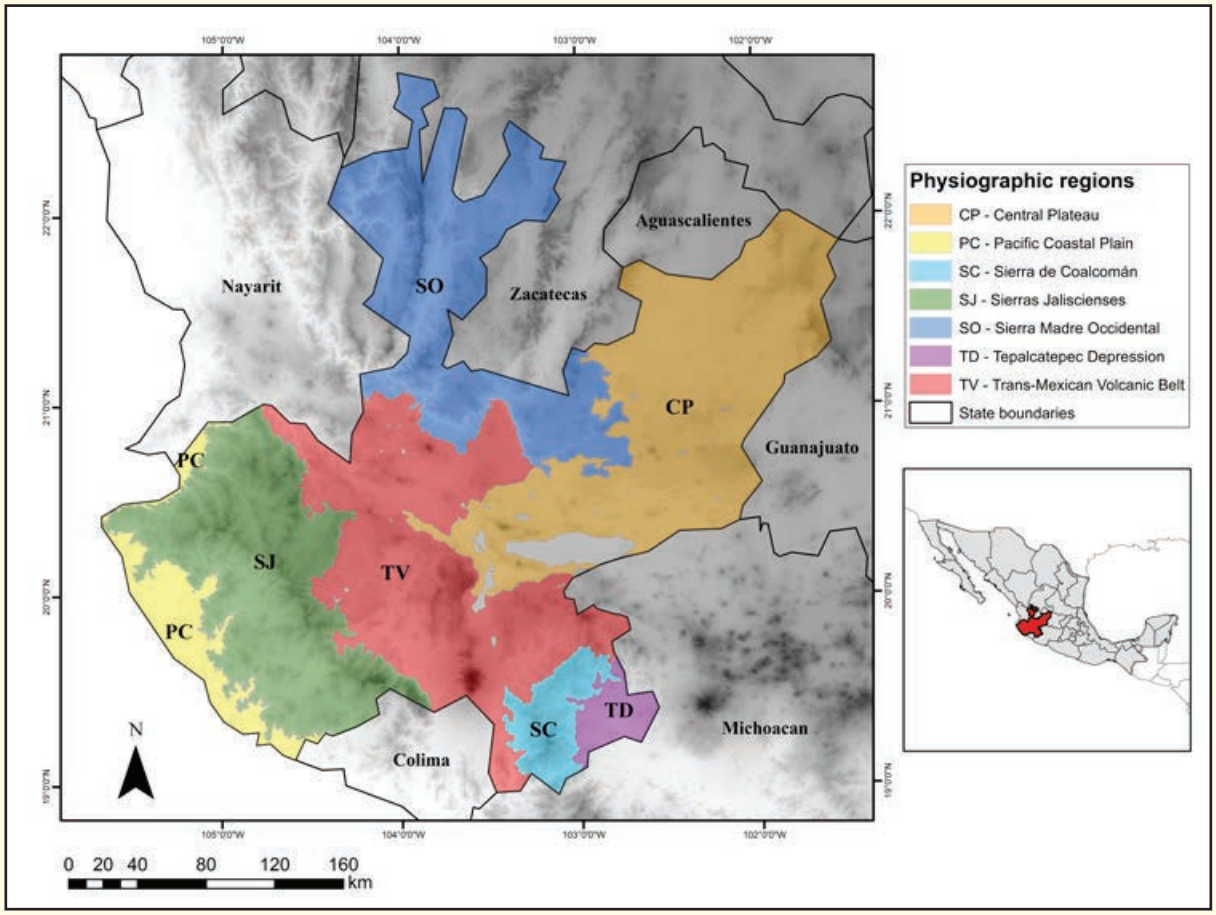

Fig. 1. Physiographic regions of Jalisco, Mexico. Abbreviations are as follows: PC = Pacific Coastal Plain; SJ = Sierras Jaliscienses; TV = Trans-Mexican Volcanic Belt; SC = Sierra de Coalcomán; TD = Tepalcatepec Depression; CP = Central Plateau; and SO = Sierra Madre Occidental.

These regions (Fig. 1) primarily were defined on the physiographic provinces of Mexico proposed by Cervantes-Zamora et al. (1990). In the most conflictive regions, however, it was necessary to define limits based on information from other studies. For the Trans-Mexican Volcanic Axis, we based our concept upon the work of Demant (1978); for the Sierras Jaliscienses and the Sierra de Coalcomán, we used the limits of Espinosa et al. (2016), and for the Pacific Coastal Plain we considered only the coastal lands below 200 m in elevation. Finally, we revised the resulting physiographic regions so that they correspond to those in studies for Michoacán and Nayarit (Alvarado-Díaz et al., 2013; Woolrich-Piña et al., 2016, respectively). The regions proposed here are as follows:

Pacific Coastal Plain (PC).—This region (Figs. 2–3) is comprised of the portion of the Pacific slope of the state that ranges in elevation from sea level to 200 m, but excludes the foothills of the adjacent Sierras Jaliscienses. It encompasses an area of 3818.5 km^2, and extends from the Bahía de Banderas, in the municipality of Puerto Vallarta, southward through parts of the municipalities of Cabo Corrientes, Tomatlán, La Huerta, Villa Purificación, and Casimiro Castillo. The region is crossed by a number of rivers and streams, of which the most important are the Mascota, San Nicolás, Cuixmala, Purificación, and Cihuatlán rivers. The main vegetation types are tropical deciduous forest, semideciduous forest, riparian vegetation, mangrove, xerophilous scrub, palm grove, reedbed, manzanillera (*Hippomane mancinella* community), coastal dune vegetation, agricultural areas, and induced grassland (García and Ceballos, 1994).

Fig. 2. *Pacific Coastal Plain*. Coastal dunes at Bahía de Tehualmixtle, in the municipality of Cabo Corrientes. A broad carpet of halophilous vegetation covers much of the dunes. © Francisco Javier Muñoz-Nolasco

Fig. 3. *Pacific Coastal Plain.* Panoramic view of vegetation, composed of tropical deciduous forest, at Reserva de la Biósfera Chamela-Cuixmala, in the municipality of La Huerta. The photo was taken in 2010. © Elí García-Padilla

Sierra Madre Occidental (SO).—This region (Figs. 4–6) is the third most extensive in the state, with an area of 15,712.44 km^2, and is represented by Cretaceous stratified limestones with shales, Tertiary igneous rocks, and Quaternary alluvial soils filling small valleys (INEGI, 1981). Its elevational range extends from 560 m in the canyons between the municipalities of Hostotipaquillo and Tequila to 2,300 m in the portion of Colotlán adjacent to the state of Zacatecas. The region extends from the Barranca del Río Santiago and part of the Río Verde basin, to the northern region of Jalisco. These ravines act as a biological corridor between the floristic elements of the Pacific coast and the temperate zones of the interior of the state, and represent a barrier between Nearctic and Neotropical elements (Rzedowski, 2006; Morrone, 2001). The lower elevation areas in these ravines contain communities of tropical deciduous forest; areas of moderate elevation and temperate conditions with greater humidity contain oak forest (*Quercus* spp.) and cloud forest, whereas toward the northernmost part of the region xerophilous scrubs and grasslands occur, as well as coniferous forest in the highlands.

Sierras Jaliscienses (SJ).—What we refer to as Sierras Jaliscienses (Figs. 7–9) is equivalent to the northernmost part of the Sierra Madre del Sur, according to INEGI (1981), or to the "Jalisciense" portion of it, *sensu* Espinosa et al. (2016). We opted to distinguish the two portions of the Sierra Madre del Sur present in Jalisco ("Jalisciense" and "Michoacana"), given that some authors have proposed to restrict the Sierra Madre del Sur to the mountain mass found south to the Río Balsas (Duellman, 1965; Campbell, 1999; Campbell and Lamar, 2004), whereas others argue that both the geomorphological and biotic similarities among these mountain ranges in Jalisco support their inclusion as part of the Sierra Madre del Sur (Cuevas-Guzman et al., 2010; Espinosa et al., 2016). In any case, these highlands constitute clearly defined massifs and can be differentiated from the other regions in the state.

Fig. 4. *Sierra Madre Occidental.* Oak forest on Sierra de San Esteban, near Huaxtla, municipality of Zapopan, at an elevation of 1,394 m. © Daniel Cruz-Sáenz

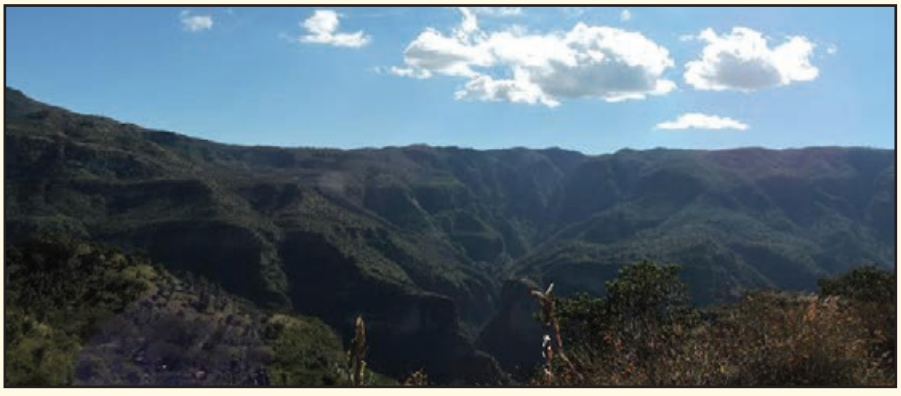

Fig. 5. *Sierra Madre Occidental.* General view of the intricate relief of the Sierra Madre Occidental, near San Andrés Cohamiata, municipality of Mezquitic, at an elevation ca. 1,950 m. © Rosario Aceves-Iñiguez

Fig. 6. *Sierra Madre Occidental*. Tropical dry forest at Barranca Río Santiago, municipality of Guadalajara, at an elevation of 1,105 m. © Daniel Cruz-Sáenz

Fig. 7. *Sierras Jalisciences*. Maple forest (*Acer saccharum*) in the municipality of Talpa de Allende, at an elevation of 1,780 m. This image illustrates one of few remnant patches of maple forest in Mexico. Arborescent ferns (*Cyathea* spp.), orchids, and bromeliads are representative elements of this community. © Francisco Javier Muñoz-Nolasco

Fig. 8. *Sierras Jalisciences*. View of semideciduous tropical forest at El Tuito, municipality of Cabo Corrientes, at an elevation ca. 800 m. On the Pacific coast, this vegetation occurs in mosaics of tropical deciduous forest and other communities, depending on differences in topography and exposure (Rzedowski, 2006). © Francisco Javier Muñoz-Nolasco

Fig. 9. *Sierras Jaliscienses*. View of oak forest and tropical semideciduous forest in Sierra de Cuale, near Llanitos Grandes, municipality of Cabo Corrientes, at an elevation of 1,385 m. © Erika Sugey García-Mata

The Sierras Jaliscienses region covers an area of around 15,070.3 km^2 of the foothills and highlands lying east of the Pacific Coastal Plain and west of the Trans-Mexican Volcanic Belt, from El Tuito and the Sierra del Cuale, in the municipalities of Cabo Corrientes, San Sebastian del Oeste, Talpa de Allende, and Mascota, to the Sierra de Cacoma and the Sierra de Manantlán. This region contains the oldest metamorphic outcrops in the state, which date from the Jurassic (INEGI, 1981). Its elevational range extends from less than 500 m in many areas near the Pacific Coastal Plain up to 2,890 m in the Cerro Las Capillas, in the municipality of Cuautitlán de García Barragán. The vegetation primarily is composed of coniferous and oak forests, as well as significant portions of tropical deciduous

and semideciduous forests. Furthermore, this region harbors most of the fragments of montane cloud forest found in Jalisco (Cuevas-Guzman et al., 2010), including two of only five remnant patches of maple forest (*Acer saccharum*) in Mexico, one in Talpa de Allende and the other in the Sierra de Manantlán (Vargas-Rodríguez and Platt, 2012). Other floristic elements characteristic of this region are the arborescent ferns (*Cyathea* spp.), the podocarp *Podocarpus reichei*, and the state endemic fir *Abies jaliscana*.

Trans-Mexican Volcanic Belt (TV).—This region (Figs. 10–11), which is bordered by the Sierra Madre Occidental to the north, the Sierras Jaliscienses to the west, the Central Plateau to the east, and the Sierra de Coalcomán to the southeast is the second largest in the state, with a total surface area of 18,733.2 km^2. The region consists primarily of volcanic elements. Its origin can be traced back to the Tertiary, when volcanic flows and pyroclastic products covered the sedimentary and intrusive igneous rocks of the Cretaceous, whereas the most recent sandstone,

Fig. 10. *Trans-Mexican Volcanic Belt*. Pine and pine-oak forest at Piedras Blancas, Sierra de Quila, municipality of Tecolotlán, at an elevation of 2,285 m. © Erika Sugey García-Mata

Fig. 11. *Trans-Mexican Volcanic Belt*. Volcán Nevado de Colima, with an elevation of 4,227 m, is the highest mountain in the state. Coniferous forest is widespread on the slopes, but at the top is replaced by high mountain grasslands. © Luis Enrique Sánchez-Ramos

conglomerate, alluvial deposits, and some basalts date back to the Quaternary (INEGI, 1981). The highest mountains in the state are found in this region: Volcán Nevado de Colima (4,227 m), the portion of Volcán de Fuego de Colima located in Jalisco (3,825 m), and Volcán de Tequila (2,920 m). The major vegetation types are oak forest, pine forest, and tropical deciduous forest, with small patches of cloud forest found on Volcán de Tequila, Nevado de Colima, and Volcán de Fuego. The slopes of Volcán de Tequila contain communities of *Juniperus flaccida*, and a community of *Cupressus lusitanica* is found at the top (Reynoso Dueñas, 2010). Volcán Nevado de Colima also hosts fir forest (*Abies colimensis*), and a high mountain grassland is present at elevations above 4,000 m.

Sierra de Coalcomán (SC).—The Sierra de Coalcomán (Figs. 12–13) corresponds to the "Michoacana" portion of the Sierra Madre del Sur, *sensu* Espinosa et al. (2016), lying in the southern portion of the state and occupying parts of the municipalities of Pihuamo, Tecalitlán, Jilotlán de los Dolores, Tamazula de Gordiano, Santa María del Oro, Quitupan, and Valle de Juárez. This relatively small area of 2,714.9 km^2 is geologically complex, as reflected by the presence of intrusive and extrusive igneous rocks, ancient sedimentary rocks of marine and continental origin, and metamorphic rocks (INEGI, 1981). Its elevational range extends from 600 m in some parts of the municipality of Pihuamo to 2,655 m in the municipality of Tecalitlán. Pine and pine-oak forests dominate the moderate to high elevation mountain areas, whereas tropical deciduous forest occurs on low elevation hills and some mountainous places with limestone outcrops.

Central Plateau (CP).—We define the Central Plateau (Figs. 14–16) as the area extending from the northeastern extreme of the state, in the Los Altos Region, to the environs of Lago de Chapala and Laguna de Sayula, bordering most of the Barranca del Río Verde and the eastern margin of the Trans-Mexican Volcanic Belt. This region is the most extensive in the state, with a surface area of 20,702.8 km^2. Elevations in this region extend from 1,320 m at the westernmost tip in the municipalities of Cocula and San Martín Hidalgo, to 2,800 m in the Sierra Alta of Lagos de Moreno, and 2,950 m at Cerro Viejo, south of the metropolitan area of Guadalajara. The oldest outcrops correspond to rocks of the Triassic, and are found east of Lagos de Moreno. Tertiary deposits are represented by extrusive and intrusive igneous rocks and continental sedimentary rocks, whereas Quaternary deposits, consisting of alluvial soils, fill the wide valleys throughout the region (INEGI, 1981). The vegetation of this region is represented by tropical deciduous forest, thorn forest, xerophilous scrub, grassland, and pine-oak forest. Aquatic and subaquatic vegetation also is represented in the numerous wetlands in this region, as well as around Lago de Chapala and Laguna de Sayula. The latter, due to its endorheic basin condition, similarly favors the presence of halophilous vegetation.

Fig. 12. *Sierra de Coalcomán*. View of relatively undisturbed pine forest in Sierra Tecalitlán, Las Palomas, municipality of Tecalitlán, at an elevation of 1,950 m. © Daniel Cruz-Sáenz

Fig. 13. *Sierra de Coalcomán*. Vista showing pine forest near La Jabalina, municipality of Pihuamo, at an elevation of 1,830 m.
© Daniel Cruz-Sáenz

Fig. 14. *Central Plateau*. Laguna de Villa Corona, seen from the tropical deciduous forest of the Atotonilco el Bajo hills, municipality of Villa Corona, at an elevation of 1,420 m. This wetland is an important refuge for local fauna, particularly amphibians and migratory birds.
© Francisco Javier Muñoz-Nolasco

Tepalcatepec Depression (TD).—The Tepalcatepec Depression (Fig. 17) is an extensive intermontane valley that represents a topographical discontinuity of the Balsas Depression caused by the lifting of the Sierra de Coalcomán and the Trans-Mexican Volcanic Belt. In Jalisco, this region consists of an area of only 1,551.9 km^2. Vertisols predominate in this region, the product of the weathering of the underlying andesites, tuffs, and granites (Garduño-Monroy, 2005). The valley ranges in elevation from 400 m in the Jilotlán de los Dolores portion adjoining the town of Tepalcatepec, Michoacán, up to 1,500 m in the northernmost extreme of the municipality of Santa María del Oro. The major vegetation type is tropical deciduous forest (INEGI, 1981).

Fig. 15. *Central Plateau*. View of Lago de Chapala and the Sierra de la Cuesta from the 19th century ruins on Isla de Mezcala (or Isla del Presidio), municipality of Mezcala, at an elevation of 1,555 m. This lake is the largest in Mexico, with a total surface area of 1,161 km^2 (Hansen and Van Afferden, 2004). © Francisco Javier Muñoz-Nolasco

Fig. 16. *Central Plateau*. Desert scrub at San Juan de los Lagos, municipality of Ojuelos de Jalisco, at an elevation of 2,657 m. © Erika Sugey García-Mata

Fig. 17. *Tepalcatepec Depression.* Panoramic view from El Pajal, near Huapala, municipality of Jilotlán de los Dolores, at an elevation ca. 1,350 m. This region, the smallest in the state, is covered mostly by tropical deciduous forest, although temperate elements also are present in the surrounding mountains. © Aníbal Doñán

Climate

The geographical context of Jalisco, together with the influence of marine and lacustrine water bodies, determines the existence of contrasting climatic conditions throughout the state. In the northern and northeastern portion, corresponding to the Sierra Madre Occidental and the Central Plateau, there are variants of semi-dry climates; temperate climates prevail in the highlands; semi-warm climates can be found in central Jalisco and around the Lago de Chapala, and warm climates along the coast (INEGI, 1981).

Temperature.—We constructed a table containing the monthly minimum, mean, and maximum temperatures for one locality in each of the seven physiographic regions we recognize in Jalisco (Table 1). The elevations of these localities range from 5 m on the Pacific Coastal Plain at La Huerta to 2,060 m in the Trans-Mexican Volcanic Belt at Tapalpa.

Table 1. Monthly minimum, mean (in parentheses), maximum, and annual temperature data (in °C) for the physiographic regions of Jalisco, Mexico. Localities and their elevation for each of the regions are as follows: Pacific Coastal Plain—La Huerta (Apazulco; 5 m); Sierra Madre Occidental—Mezquitic (Bocas; 1,352 m); Sierras Jaliscienses—Cuautitlán de García Barragán (Manantlán; 1,450 m); Trans-Mexican Volcanic Belt—Tapalpa (2,060 m); Sierra de Coalcomán—Tecalitlán (1,140 m); Central Plateau—Lagos de Moreno (Paso del Cuarenta II; 1,998 m), and Tepalcatepec Depression—Jilotlán de los Dolores (Los Olivos; 420 m). Data (1981–2010) from Ruiz-Corral et al. (2012).

Physiographic Region	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Pacific Coastal Plain	14.9 (23.3) 31.7	14.1 (23.1) 32.1	14.5 (23.3) 32.1	16.0 (24.4) 32.8	19.1 (26.5) 33.9	22.6 (28.4) 34.1	23.0 (28.4) 33.7	23.2 (28.4) 33.7	22.7 (27.8) 32.9	22.0 (27.6) 33.2	19.2 (26.0) 31.7	16.4 (24.0) 31.7	19.0 (25.9) 32.9
Sierra Madre Occidental	3.4 (14.6) 25.8	4.4 (16.3) 28.1	5.9 (18.4) 30.9	9.7 (21.7) 33.8	13.6 (24.7) 35.8	17.4 (26.1) 34.8	16.8 (24.0) 31.2	16.2 (23.4) 30.5	15.6 (22.9) 30.3	11.6 (21.0) 30.4	5.9 (17.4) 28.9	4.0 (15.2) 26.5	10.4 (20.5) 30.6
Sierras Jaliscienses	4.7 (15.0) 25.2	4.9 (16.0) 27.1	6.2 (17.6) 29.1	8.9 (20.1) 31.3	11.9 (21.8) 31.7	14.8 (22.0) 29.1	14.9 (20.3) 25.6	14.8 (20.2) 25.7	14.4 (20.0) 25.7	12.1 (18.9) 25.7	8.6 (17.2) 25.9	6.7 (15.8) 24.9	10.2 (18.7) 27.3
Trans-Mexican Volcanic Belt	4.2 (12.7) 21.2	4.4 (13.7) 23.0	5.2 (15.2) 25.2	7.2 (17.2) 27.2	9.4 (18.8) 28.1	12.2 (18.6) 25.1	11.9 (17.3) 22.7	11.8 (17.4) 22.9	11.8 (17.2) 22.7	9.6 (16.3) 23.0	6.6 (14.7) 22.8	5.0 (13.2) 21.4	8.3 (16.0) 23.8
Sierra de Coalcomán	9.1 (18.5) 27.8	8.9 (19.0) 29.2	9.6 (20.2) 30.8	11.4 (21.8) 32.2	14.2 (23.2) 32.2	18.0 (24.4) 30.8	17.8 (23.6) 29.3	17.7 (23.5) 29.3	17.6 (23.5) 29.3	16.5 (23.0) 29.4	14.4 (21.9) 29.4	11.2 (19.9) 28.6	13.9 (21.9) 29.9
Central Plateau	2.7 (13.2) 23.8	3.9 (14.6) 25.4	4.7 (16.1) 27.6	7.4 (18.5) 29.7	10.4 (20.7) 31.0	13.9 (21.6) 29.3	13.7 (20.2) 26.6	13.9 (20.2) 26.4	13.4 (19.5) 25.6	10.1 (17.9) 25.8	5.9 (15.5) 25.1	3.1 (13.5) 23.9	8.6 (17.6) 26.7
Tepalcatepec Depression	16.5 (24.1) 31.8	17.2 (25.5) 33.9	18.5 (27.1) 35.7	19.9 (28.8) 37.8	22.1 (30.1) 38.2	23.3 (29.6) 35.9	22.0 (27.5) 33.0	22.0 (27.5) 32.9	22.0 (27.5) 32.9	21.1 (27.0) 32.9	19.4 (26.3) 33.1	17.6 (25.0) 32.4	20.1 (27.1) 34.2

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). These individuals are from Yelapa, in the municipality of Cabo Corrientes. 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 the IUCN, and this species is not listed by SEMARNAT. © Cheryl Harleston

Lithobates megapoda (Taylor, 1942). The Big-footed Leopard Frog is a Mexican endemic that ranges from "southern Nayarit and western Jalisco east to northern Michoacán, and southern Guanajuato" (Frost, 2016). This individual is from the Presa Las Rucias, near the facilities of the Centro Universitario de Tonalá of the Universidad de Guadalajara, in the municipality of Tonalá. Wilson et al. (2013b) gauged its EVS as 14, placing it at the lower limit of the high vulnerability category. Its conservation status has been established as Vulnerable by IUCN, and this frog is regarded as a species of special protection (Pr) by SEMERNAT. © Francisco Javier Muñoz-Nolasco

At La Huerta (elev. 5 m), in the southern portion of the Pacific Coastal Plain, the mean annual temperature (MAT) is 25.9°C (Table 1). The next highest elevation is for Jilotlán de los Dolores at 420 m in the Tepalcatepec Depression; its MAT is 27.1°C. Located in the Sierra de Coalcomán of southeastern Jalisco, the town of Tecalitlán (at 1,140 m) presents an MAT of 21.9°C. Mezquitic, at 1,352 m, which lies in the "middle finger" of the three-fingered northern "hand" of the state in the Sierra Madre Occidental, has an MAT of 20.5°C. The MAT at Manantlán, located at 1,450 m in the northern portion of the Sierras Jaliscienses, is 18.7°C. At Lagos de Moreno, located at 1,998 m in the northeastern sector of the Central Plateau, the MAT is 17.6°C. Finally, the MAT is 16.0°C at Tapalpa (2,060 m) in the southern portion of the Trans-Mexican Volcanic Belt (Table 1).

The minimum annual temperature ranges from 8.3°C in the Trans-Mexican Volcanic Belt locality to 20.1°C in the Tepalcatepec Depression locality (Table 1). The maximum annual temperature ranges from 23.8°C to 34.2°C in the same two localities (Table 1). The minimum annual temperature is 13.9–20.2°C lower than the maximum annual temperature among the seven physiographic regions of the state (Table 1). Mean monthly temperatures peak at some point from May to August and reach a nadir at some point, usually in January (Table 1).

Precipitation.—Precipitation in Jalisco 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 Table 2 indicate that 80.2–94.9% ($\bar{x}$ = 88.4%) of the annual precipitation falls during the rainy season. The month with the least amount of precipitation, depending on the location, is December, March, or April, and usually March or April (Table 2). The month with the greatest amount of precipitation, again depending on the locality, is September or July, and in all but one instance, in July (Table 2). The annual rainfall ranges from 551.9 mm in the Central Plateau to 1,998.8 in the Sierras Jaliscienses, with the larger value 3.6 times greater than the smaller one (Table 2).

Table 2. Monthly and annual precipitation data (in mm) for the physiographic regions of Jalisco, Mexico. Localities and their elevation for each of the regions are as follows: Pacific Coastal Plain—La Huerta (Apazulco; 5 m); Sierra Madre Occidental—Mezquitic (Bocas; 1,352 m); Sierras Jaliscienses—Cuautitlán de García Barragán (Manantlán; 1,450 m); Trans-Mexican Volcanic Belt—Tapalpa (2,060 m); Sierra de Coalcomán—Tecalitlán (1,140 m); Central Plateau—Lagos de Moreno (Paso del Cuarenta II; 1,998 m), and Tepalcatepec Depression—Jilotlán de los Dolores (Los Olivos; 420 m). Data (1981–2010) from Ruiz-Corral et al. (2012).

Physiographic Region	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Pacific Coastal Plain	35.5	7.2	1.1	1.6	7.6	98.2	137.9	175.2	223.6	104.2	23.3	11.5	826.9
Sierra Madre Occidental	20.9	9.7	1.5	1.8	14.5	93.2	146.0	140.6	84.4	35.7	7.7	10.3	566.4
Sierras Jaliscienses	23.5	10.0	6.6	1.0	21.8	187.2	291.1	231.0	198.6	84.7	32.7	12.7	1100.8
Trans-Mexican Volcanic Belt	44.5	17.4	5.0	10.9	40.5	163.1	184.3	117.9	128.6	101.3	32.2	21.6	867.2
Sierra de Coalcomán	39.7	2.9	2.4	0.4	21.7	179.2	185.4	175.6	133.4	87.8	25.2	10.3	863.9
Central Plateau	16.0	5.5	6.3	10.6	25.0	89.4	141.3	115.0	93.0	37.5	7.8	4.5	551.9
Tepalcatepec Depression	9.7	1.7	1.0	0.5	19.8	119.4	180.2	132.6	123.1	61.1	16.4	5.1	670.6

COMPOSITION OF THE HERPETOFAUNA

Families

The herpetofauna of Jalisco is apportioned among 40 families, including 11 of amphibians (eight anuran, two salamander, and one caecilian), one of crocodylians, 23 of squamates, and five of turtles (Table 3). The total number of families represents 67.8% of the 59 families occurring in Mexico (J. Johnson, unpublished). Compared to the herpetofauna of the recently surveyed state to the north, i.e., Nayarit (Woolrich-Piña et al., 2016), three more families are present in Jalisco, including one caecilian (Dermophiidae) and two squamate (Sphenomorphidae and Xantusiidae) families. Table 3 in the Woolrich-Piña et al. (2016) paper, however, contains an inaccuracy, claiming the occurrence of 20 families in Nayarit; the number actually is 21 (see table 4 in that paper). Alvarado-Díaz et al. (2013) examined the herpetofauna of Michoacán and reported the representation of 38 families, two fewer than for Jalisco. A comparison of the summary data in tables 3 and 4 in that paper and this one reveals that the difference is not due simply to the "dropping out" of two families that are represented in Jalisco and not in Michoacán. The monospecific anuran family Rhinophrynidae is not represented in Jalisco, but it occurs in Michoacán. The squamate family Bipedidae is represented by one species in Michoacán, but none in Jalisco. The family Corytophanidae is represented by one species in Jalisco but none in Michoacán. The snake family Xenodontidae, recognized by Alvarado-Díaz et al. (2013) and in which they placed two species (*Conophis vittatus* and *Manolepis putnami*) is not recognized here; these two species occur in Jalisco, and we placed them in the family Dipsadidae. Representatives of the turtle family Emydidae are reported for Jalisco, but not in Michoacán.

The most speciose amphibian families in Jalisco are the Bufonidae (with eight species), Craugastoridae (five), Eleutherodactylidae (eight), Hylidae (12), and Ranidae (nine), which amounts to 80.8% of this group of 52 species (Tables 3, 4). The most sizable families among the remainder of the herpetofauna are the Phrynosomatidae (28 species), Scincidae (six), Teiidae (six), Colubridae (34), Dipsadidae (29), Elapidae (six), Natricidae (10), and Viperidae (12), amounting to 78.0% of a total of 168 species in this group (Tables 3, 4).

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

Orders	Families	Genera	Species
Anura	8	18	47
Caudata	2	2	4
Gymnophiona	1	1	1
Subtotals	**11**	**21**	**52**
Crocodylia	1	1	1
Squamata	23	70	158
Testudines	5	8	12
Subtotals	**29**	**79**	**171**
Totals	**40**	**100**	**223**

Table 4. Distribution of the amphibians, crocodylians, squamates, and turtles in Jalisco, Mexico, by physiographic region. Abbreviations are as follows: PC = Pacific Coastal Plain; SO = Sierra Madre Occidental; SJ = Sierras Jaliscienses; TV = Trans-Mexican Volcanic Belt; SC = Sierra de Coalcomán; CP = Central Plateau; and TD = Tepalcatepec Depression. * = species endemic to Mexico; ** = species endemic to Jalisco; and *** = non-native species. See text for descriptions of these regions.

Taxa	Physiographic Regions of Jalisco							Number of Regions Occupied
	PC	SO	SJ	TV	SC	CP	TD	
Anura (47 species)								
Bufonidae (8 species)								
*Anaxyrus compactilis**		+		+		+		3
Anaxyrus debilis		+				+		2
Anaxyrus punctatus		+				+		2
*Incilius marmoreus**	+							1
*Incilius mazatlanensis**	+							1
*Incilius occidentalis**		+	+	+		+		4
*Incilius perplexus**							+	1
Rhinella horribilis	+	+	+	+	+			5
Craugastoridae (5 species)								
Craugastor augusti		+	+	+	+	+	+	6
*Craugastor hobartsmithi**	+		+	+				3
*Craugastor occidentalis**	+	+	+	+	+	+	+	7
Craugastor pygmaeus	+		+	+				3
*Craugastor vocalis**	+		+	+	+		+	5
Eleutherodactylidae (8 species)								
*Eleutherodactylus angustidigitorum**				+				1
*Eleutherodactylus grunwaldi**			+					1
*Eleutherodactylus modestus**	+		+					2
*Eleutherodactylus nitidus**	+	+	+	+	+	+	+	7
*Eleutherodactylus nivicolimae**				+	+			2
*Eleutherodactylus pallidus**	+	+						2
*Eleutherodactylus verrucipes**						+		1
*Eleutherodactylus wixarika***		+						1
Hylidae (12 species)								
*Agalychnis dacnicolor**	+	+	+	+				4
*Dendropsophus sartori**	+							1
*Diaglena spatulata**	+							1
Dryophytes arenicolor		+	+	+	+	+	+	6
*Dryophytes eximius**		+	+	+	+	+	+	6
*Exerodonta smaragdina**		+	+	+	+	+	+	6
*Sarcohyla bistincta**		+	+	+	+	+	+	6
Smilisca baudinii	+	+	+		+		+	5
*Smilisca dentata**						+		1

Table 4 (continued)

Taxa	Physiographic Regions of Jalisco							Number of Regions Occupied
	PC	SO	SJ	TV	SC	CP	TD	
Smilisca fodiens	+	+	+	+	+	+	+	7
*Tlalocohyla smithii**	+	+	+	+	+		+	6
Trachycephalus typhonius	+							1
Leptodactylidae (2 species)								
Leptodactylus fragilis				+				1
Leptodactylus melanonotus	+	+		+		+		4
Microhylidae (2 species)								
Hypopachus ustus	+	+	+					3
Hypopachus variolosus	+	+	+	+	+	+	+	7
Ranidae (9 species)								
Lithobates forreri	+		+	+				3
*Lithobates magnaocularis**	+							1
*Lithobates megapoda**		+	+	+	+	+	+	6
*Lithobates montezumae**				+		+	+	3
*Lithobates neovolcanicus**		+	+	+		+		4
*Lithobates psilonota**		+	+	+		+		4
*Lithobates pustulosus**		+	+					2
*Lithobates spectabilis**						+		1
*Lithobates zweifeli**				+				1
Scaphiopodidae (1 species)								
Spea multiplicata		+		+		+		3
Caudata (4 species)								
Ambystomatidae (3 species)								
*Ambystoma flavipiperatum***						+		1
*Ambystoma rosaceum**		+						1
*Ambystoma velasci**		+	+	+		+		4
Plethodontidae (1 species)								
*Isthmura bellii**		+		+		+		3
Gymnophiona (1 species)								
Dermophiidae (1 species)								
*Dermophis oaxacae**	+		+					2
Crocodylia (1 species)								
Crocodylidae (1 species)								
Crocodylus acutus	+							1
Squamata (158 species)								
Anguidae (4 species)								
*Barisia ciliaris**		+				+		2
*Barisia imbricata**			+	+				2

Table 4 (continued)

Taxa	Physiographic Regions of Jalisco							Number of Regions Occupied
	PC	SO	SJ	TV	SC	CP	TD	
Elgaria kingii		+	+	+		+		4
Gerrhonotus liocephalus	+					+		2
Corytophanidae (1 species)								
Basiliscus vittatus	+							1
Dactyloidae (1 species)								
*Norops nebulosus**	+	+	+	+	+	+	+	7
Eublepharidae (1 species)								
Coleonyx elegans	+							1
Gekkonidae (3 species)								
*Gehyra mutilata****	+			+				2
*Hemidactylus frenatus****	+		+					2
*Hemidactylus turcicus****						+		1
Helodermatidae (1 species)								
*Heloderma horridum**	+	+	+	+				4
Iguanidae (3 species)								
*Ctenosaura clarki**							+	1
*Ctenosaura pectinata**	+	+	+	+		+		5
Iguana iguana	+							1
Mabuyidae (1 species)								
Marisora brachypoda	+		+					2
Phrynosomatidae (30 species)								
Holbrookia approximans						+		1
Phrynosoma asio	+							1
*Phrynosoma orbiculare**		+		+		+		3
*Sceloporus aeneus**				+		+		2
*Sceloporus albiventris**	+	+						2
*Sceloporus asper**		+	+	+				3
*Sceloporus aurantius**		+				+		2
*Sceloporus brownorum**		+						1
*Sceloporus bulleri**			+	+				2
Sceloporus clarkii		+		+				2
*Sceloporus dugesi**			+	+		+		3
*Sceloporus goldmani**						+		1
Sceloporus grammicus		+		+		+		3
*Sceloporus heterolepis**			+	+	+	+	+	5
*Sceloporus horridus**		+	+	+	+	+	+	6
*Sceloporus insignis**				+	+			2
Sceloporus jarrovii		+						1

Table 4 (continued)

Taxa	Physiographic Regions of Jalisco							Number of Regions Occupied
	PC	SO	SJ	TV	SC	CP	TD	
Sceloporus melanorhinus	+							1
*Sceloporus minor**						+		1
*Sceloporus nelsoni**		+		+				2
Sceloporus poinsettii			+					1
*Sceloporus pyrocephalus**	+		+		+			3
*Sceloporus scalaris**			+	+				2
*Sceloporus shannonorum**		+						1
*Sceloporus spinosus**						+		1
*Sceloporus torquatus**				+		+		2
*Sceloporus unicanthalis**		+		+		+		3
*Sceloporus utiformis**	+	+	+	+	+	+	+	7
*Urosaurus bicarinatus**	+	+	+	+	+	+		6
*Urosaurus gadovi**							+	1
Phyllodactylidae (1 species)								
*Phyllodactylus lanei**	+	+	+					3
Scincidae (6 species)								
*Plestiodon bilineatus**		+						1
*Plestiodon callicephalus**		+		+		+		3
*Plestiodon dugesii**				+		+		2
*Plestiodon indubitus**			+	+	+			3
*Plestiodon lynxe**				+		+		2
*Plestiodon parvulus**	+							1
Sphenomorphidae (1 species)								
Scincella assata	+		+					2
Teiidae (6 species)								
*Aspidoscelis communis**	+						+	2
*Aspidoscelis costata**				+		+		2
Aspidoscelis deppii				+				1
Aspidoscelis gularis						+		1
*Aspidoscelis lineattissima**	+	+	+					3
*Holcosus sinister**	+							1
Xantusiidae (1 species)								
*Xantusia sanchezi**		+		+				2
Boidae (1 species)								
Boa sigma	+	+	+	+				4
Colubridae (34 species)								
*Conopsis biserialis**			+	+				2
*Conopsis lineata**			+	+				2

Table 4 (continued)

Taxa	Physiographic Regions of Jalisco							Number of Regions Occupied
	PC	SO	SJ	TV	SC	CP	TD	
*Conopsis nasus**				+		+		2
Drymarchon melanurus	+		+	+				3
Drymobius margaritiferus	+	+	+					3
Ficimia publia	+							1
Gyalopion canum						+		1
*Lampropeltis mexicana**		+					+	2
*Lampropeltis polyzona**	+	+	+	+		+		5
*Lampropeltis ruthveni**			+	+		+		3
*Leptophis diplotropis**	+	+	+	+			+	5
Masticophis bilineatus	+	+	+	+	+	+		6
Masticophis flagellum		+				+		2
Masticophis mentovarius	+	+	+	+	+	+	+	7
Masticophis taeniatus		+				+		2
*Mastigodryas cliftoni**		+					+	2
Mastigodryas melanolomus	+		+					2
Oxybelis aeneus	+		+	+				3
*Pituophis deppei**		+	+	+	+	+	+	6
*Pseudoficimia frontalis**	+		+	+		+		4
*Salvadora bairdi**		+	+	+		+		4
*Salvadora mexicana**	+	+	+				+	4
Senticolis triaspis	+	+	+	+	+	+	+	7
*Sonora mutabilis**		+		+	+	+		4
*Symphimus leucostomus**	+							1
*Sympholis lippiens**				+				1
*Tantilla bocourti**		+	+	+		+		4
*Tantilla calamarina**	+		+		+		+	4
*Tantilla cascadae**					+			1
*Tantilla ceboruca**				+				1
Tantilla wilcoxi						+		1
*Trimorphodon biscutatus**	+		+					2
*Trimorphodon paucimaculatus**	+		+	+	+		+	5
*Trimorphodon tau**		+	+	+	+	+	+	6
Dipsadidae (31 species)								
Clelia scytalina	+			+				2
*Coniophanes lateritius**	+		+	+		+		4
*Conophis vittatus**	+		+				+	3
Diadophis punctatus		+		+		+		3
*Dipsas gaigeae**	+							1

Table 4 (continued)

Taxa	Physiographic Regions of Jalisco							Number of Regions Occupied
	PC	SO	SJ	TV	SC	CP	TD	
Enulius flavitorques	+		+					2
*Enulius oligostichus**				+				1
*Geophis bicolor**			+	+				2
*Geophis dugesii**		+		+		+		3
*Geophis nigrocinctus**			+					1
*Geophis petersii**			+	+				2
*Geophis sieboldi**					+			1
*Geophis tarascae**				+				1
Heterodon kennerlyi						+		1
*Hypsiglena affinis**		+		+		+		3
Hypsiglena jani						+		1
*Hypsiglena torquata**	+		+					2
Imantodes gemmistratus	+							1
Leptodeira maculata	+	+	+					3
*Leptodeira punctata**						+		1
Leptodeira septentrionalis	+		+	+				3
*Leptodeira splendida**		+	+	+	+	+	+	6
*Leptodeira uribei**	+							1
*Manolepis putnami**	+		+	+				3
*Pseudoleptodeira latifasciata**	+							1
*Rhadinaea hesperia**	+	+	+	+	+	+	+	7
*Rhadinaea laureata**		+		+		+		3
*Rhadinaea taeniata**			+	+		+		3
Sibon nebulatus	+							1
*Tropidodipsas annulifera**	+		+	+		+		4
*Tropidodipsas philippi**	+		+					2
Elapidae (6 species)								
Hydrophis platurus	+							1
Micruroides euryxanthus		+						1
Micrurus browni						+		1
*Micrurus distans**	+	+		+		+		4
*Micrurus laticollaris**			+	+				2
*Micrurus proximans**	+							1
Leptotyphlopidae (2 species)								
*Rena bressoni**							+	1
Rena humilis	+		+	+	+	+		5
Loxocemidae (1 species)								
Loxocemus bicolor	+							1

Table 4 (continued)

Taxa	Physiographic Regions of Jalisco							Number of Regions Occupied
	PC	SO	SJ	TV	SC	CP	TD	
Natricidae (10 species)								
*Adelophis copei**				+				1
*Storeria storerioides**			+	+		+		3
Thamnophis cyrtopsis		+	+	+		+		4
Thamnophis eques		+		+		+		3
*Thamnophis errans**		+						1
*Thamnophis melanogaster**		+		+		+		3
*Thamnophis pulchrilatus**		+						1
*Thamnophis scalaris**				+				1
*Thamnophis scaliger**				+		+		2
*Thamnophis validus**	+							1
Typhlopidae (1 species)								
*Indotyphlops braminus****	+		+	+		+		4
Viperidae (12 species)								
Agkistrodon bilineatus	+	+	+					3
*Crotalus aquilus**				+		+		2
*Crotalus armstrongi**				+				1
*Crotalus basiliscus**	+	+	+	+	+		+	6
*Crotalus campbelli**			+					1
*Crotalus lannomi**			+					1
Crotalus lepidus		+		+				2
Crotalus molossus		+		+		+	+	4
*Crotalus polystictus**				+		+		2
Crotalus pricei		+						1
*Crotalus pusillus**				+				1
Crotalus scutulatus		+				+		2
Testudines (12 species)								
Cheloniidae (4 species)								
Caretta caretta	+							1
Chelonia mydas	+							1
Eretmochelys imbricata	+							1
Lepidochelys olivacea	+							1
Dermochelyidae (1 species)								
Dermochelys coriacea	+							1
Emydidae (2 species)								
*Terrapene nelsoni**				+				1
*Trachemys ornata**	+							1
Geoemydidae (2 species)								

Table 4 (continued)

Taxa	Physiographic Regions of Jalisco							Number of Regions Occupied
	PC	SO	SJ	TV	SC	CP	TD	
Rhinoclemmys pulcherrima	+							1
*Rhinoclemmys rubida**	+		+					2
Kinosternidae (3 species)								
*Kinosternon chimalhuaca**	+							1
Kinosternon hirtipes		+				+		2
*Kinosternon integrum**	+	+	+	+	+	+		6

Genera

The herpetofauna of Jalisco is represented by100 genera, encompassing 18 of anurans, two of salamanders, one of caecilians, one of crocodylians, 70 of squamates, and eight of turtles (Table 3). The total number of genera is 46.3% of the 216 that occur in all of Mexico (Duellman et al., 2016; J. Johnson, unpublished). The total number of 100 genera is 11 more than reported for Nayarit (Woolrich-Piña et al., 2016) and four more than documented for Michoacán (Alvarado-Díaz et al., 2013). The amphibians are allocated to 21 genera, including 18 of anurans, two of salamanders, and one of caecilians; the remainder of the herpetofauna comprises 79 genera (Table 3).

The most speciose amphibian genera in Jalisco are *Incilius* (four species), *Craugastor* (five), *Eleutherodactylus* (eight), and *Lithobates* (nine). In the remainder of the herpetofauna the largest genera are *Sceloporus* (23 species), *Plestiodon* (six), *Aspidoscelis* (five), *Masticophis* (four), *Tantilla* (five), *Geophis* (five), *Leptodeira* (five), *Micrurus* (four), *Thamnophis* (eight), and *Crotalus* (11).

Species

At the present time, the herpetofauna of Jalisco is comprised of 223 species, including 47 anurans, four salamanders, one caecilian, one crocodylian, 158 squamates, and 12 turtles (Tables 3, 4). These figures include 219 native species and four non-native ones (three lizards and one snake; Table 4). The number of amphibian species in Mexico presently is 388 (J. Johnson, unpublished); therefore, the number occurring in Jalisco represents 13.4% of the country total. The number for the remainder of the Mexican herpetofauna is 881, thus the number of species in Jalisco represents 19.4% of the country total. The 219 native species represents 17.3% of the total of 1,269 native species for all of Mexico (J. Johnson, unpublished), and compares to 150 native species in Nayarit (Woolrich-Piña et al., 2016) and 212 in Michoacán (Alvarado-Díaz et al., 2013).

COMMENTS ON THE SPECIES LIST

Rhinocheilus lecontei. In the species distribution section of the species account in the Catalogue of American Amphibians and Reptiles, Medica (1975) included this species in Jalisco; however, the exact locality remains unknown (Medica, 1980). Frost (1978) reported this species in southern Zacatecas, and because of the close proximity of this record to the southern border of that state, he expected its presence in Jalisco as well. This species also is found in the bordering states of Nayarit, Aguascalientes, and San Luis Potosí (Heimes, 2016; Woolrich-Piña et al., 2016). Nonetheless, because of the lack of a vouchered specimen or a documented photographic image, we did not include this species in our list.

Epictia bakewelli. This species of threadsnake has been reported from the state of Jalisco (Smith and Taylor, 1945; Uetz et al., 2016). Wallach (2016) stated, however, that he was unaware of the existence of any voucher specimens or citation in the primary literature that would substantiate such a claim, so we did not include this species as part of the herpetofauna of Jalisco.

Isthmura bellii (Gray, 1850). Bell's Salamander is a Mexican endemic occurring from "southern Tamaulipas, Tlaxcala, Hidalgo and the Sierra Madre del Sur of Guerrero, Mexico, and west and north to southern Nayarit and southern Zacatecas" (Frost, 2016). This individual was found in the Sierra del Tigre, in the municipality of Valle de Juárez. Wilson et al. (2013b) established its EVS as 12, placing it in the upper portion of the medium vulnerability category. Its conservation status has been judged as Vulnerable by the IUCN, and this salamander is considered as threatened (A) by SEMARNAT. © Francisco Javier Muñoz-Nolasco

Barisia imbricata (Wiegmann, 1828). The Imbricate Alligator Lizard is a Mexican endemic inhabiting the mountains of the Trans-Mexican Volcanic Belt and the Sierra Madre Occidental in the states of México, Distrito Federal, Querétaro, Hidalgo, Jalisco, Puebla, Michoacán, Morelos, and Tlaxcala; in addition, isolated populations have been recorded in Oaxaca and Veracruz (Ramírez-Bautista et al., 2014). This individual was found in Sierra del Tigre, in the municipality of Mazamitla. Wilson et al. (2013a) determined its EVS as 14, placing it at the lower limit of the high vulnerability category. Its conservation status is judged as Least Concern by the IUCN, and this anguid is regarded as a species of special protection (Pr) by SEMARNAT. © Francisco Javier Muñoz-Nolasco

PATTERNS OF PHYSIOGRAPHIC DISTRIBUTION

We utilized a system of seven physiographic regions (Fig. 1) to analyze the patterns of distribution of members of the Jalisco herpetofauna. We document the distribution of these species in Table 4 and summarize these data in Table 5.

Table 5. Summary of distribution occurrence of herpetofaunal families in Jalisco, Mexico, by physiographic province. Abbreviations are as follows: PC = Pacific Coastal Plain; SO = Sierra Madre Occidental; SJ = Sierra Jaliscienses; TV = Trans-Mexican Volcanic Belt; SC = Sierra de Coalcomán; CP = Central Plateau; and TD = Tepalcatepec Depression.

Families	Number of Species	Distributional Occurrence						
		PC	SO	SJ	TV	SC	CP	TD
Bufonidae	8	3	5	2	3	1	4	1
Craugastoridae	5	4	2	5	5	3	2	3
Eleutherodactylidae	8	3	3	3	3	2	2	1
Hylidae	12	7	8	8	7	7	6	7
Leptodactylidae	2	1	1	—	2	—	1	—
Microhylidae	2	2	2	2	1	1	1	1
Ranidae	9	2	4	5	6	1	5	2
Scaphiopodidae	1	—	1	—	1	—	1	—
Subtotals	**47**	**22**	**26**	**25**	**28**	**15**	**22**	**15**
Ambystomatidae	3	—	2	1	1	—	2	—
Plethodontidae	1	—	1	—	1	—	1	—
Subtotals	**4**	**—**	**3**	**1**	**2**	**—**	**3**	**—**
Dermophiidae	1	1	—	1	—	—	—	—
Subtotals	**1**	**1**	**—**	**1**	**—**	**—**	**—**	**—**
Totals	**52**	**23**	**29**	**27**	**30**	**15**	**25**	**15**
Crocodylidae	1	1	—	—	—	—	—	—
Subtotals	**1**	**1**	**—**	**—**	**—**	**—**	**—**	**—**
Anguidae	4	1	2	2	2	—	3	—
Corytophanidae	1	1	—	—	—	—	—	—
Dactyloidae	1	1	1	1	1	1	1	1
Eublepharidae	1	1	—	—	—	—	—	—
Gekkonidae	3	2	—	1	1	—	1	—
Helodermatidae	1	1	1	1	1	—	—	—
Iguanidae	3	2	1	1	1	—	1	1
Mabuyidae	1	1	—	1	—	—	—	—
Phrynosomatidae	30	6	14	10	16	6	15	4
Phyllodactylidae	1	1	1	1	—	—	—	—
Scincidae	6	1	2	1	4	1	3	—
Sphenomorphidae	1	1	—	1	—	—	—	—
Teiidae	6	3	1	1	2	—	2	1
Xantusiidae	1	—	1	—	1	—	—	—

Subtotals	**60**	**22**	**24**	**21**	**29**	**8**	**26**	**7**
Boidae	1	1	1	1	1	—		
Colubridae	34	16	16	21	20	9	16	10
Dipsadidae	31	16	7	15	16	3	12	3
Elapidae	6	2	2	1	2	—	2	
Leptotyphlopidae	2	1	—	1	1	1	1	1
Loxocemidae	1	1	—	—	—	—	—	—
Natricidae	10	1	5	2	7	—	5	—
Typhlopidae	1	1	—	1	1	—	1	—
Viperidae	12	2	6	4	7	1	4	2
Subtotals	**98**	**41**	**37**	**46**	**55**	**14**	**41**	**16**
Cheloniidae	4	4	—	—	—	—	—	—
Dermochelyidae	1	1	—	—	—	—	—	—
Emydidae	2	1	—	—	1	—	—	—
Geoemydidae	2	2	—	1	—	—	—	—
Kinosternidae	3	2	2	1	1	1	2	—
Subtotals	**12**	**10**	**2**	**2**	**2**	**1**	**2**	**—**
Totals	**171**	**74**	**63**	**69**	**86**	**23**	**59**	**23**
Sum Totals	**223**	**97**	**92**	**96**	**116**	**38**	**84**	**38**

The total number of species in these seven regions ranges from a low of 38 in the Sierra de Coalcomán and Tepalcatepec Depression to a high of 116 in the Trans-Mexican Volcanic Belt (Table 5). The number of species in each of the other regions, in ascending order, is as follows: 84 (Central Plateau); 92 (Sierra Madre Occidental); 97 (Pacific Coastal Plain); and 97 (Sierra Jaliscienses). The lowest value of 38 in the Sierra de Coalcomán and the Tepalcatepec Depression is 32.8% of the highest one of 116 in the Trans-Mexican Volcanic Belt. The reason for this is because these two regions are the two smallest regions in Jalisco (Table 5). Interestingly, the least speciose regions in the state, the Sierra de Coalcomán and the Tepalcatepec Depression, both lie adjacent to the most speciose area, the Trans-Mexican Volcanic Belt.

As expected, the greatest absolute and relative numbers of the two largest component herpetofaunal groups are found in the Trans-Mexican Volcanic Belt, including 30 of 52 species of amphibians (57.7%) and 84 of 158 species of squamates (53.2%). As also expected, the majority of the turtle species are represented on the Pacific Coastal Plain (10 of 12 species [83.3%]); the only crocodylian in the state also is restricted to the Pacific Coastal Plain (Table 5). Only one or two species of turtles are found in the other physiographic regions of the state.

Members of the Jalisco herpetofauna occupy from one to seven of the seven physiographic regions, as follows: one (84 of 223 species; 37.7%); two (51; 22.9%); three (35: 15.7%); four (21; 9.4%); five (nine; 4.0%); six (15; 6.7%); and seven (nine; 4.0%). The most broadly distributed species (inhabiting all seven regions) are the anurans *Craugastor occidentalis*, *Eleutherodactylus nitidus*, *Smilisca fodiens*, and *Hypopachus variolosus*, the lizards *Norops nebulosus* and *Sceloporus utiformis*, and the snakes *Masticophis mentovarius*, *Senticolis triaspis*, and *Rhadinaea hesperia*. Three of these nine species occur broadly enough to be recorded in the southwestern Unites States, either in southern Arizona (*Smilisca fodiens* and *Senticolis triaspis*) or southern Texas (*Hypopachus variolosus*).

Of the 223 species comprising the Jalisco herpetofauna, 135 (60.5%) inhabit only one or two physiographic regions, which is of considerable conservation significance. The mean regional occupancy is 2.6, which is the same value reported for the herpetofauna of Nuevo León (Nevárez-de los Reyes et al., 2016).

The number of species found in a single region range from two (in the Sierra de Coalcomán) to 33 (in the Pacific Coastal Plain). The 33 single-region species in the Pacific Coastal Plain are as follows:

*Incilius marmoreus**
*Incilius mazatlanensis**
*Dendropsophus sartori**
*Diaglena spatulata**
Trachycephalus typhonius
*Lithobates magnaocularis**
Crocodylus acutus
Basiliscus vittatus
Coleonyx elegans
Iguana iguana
Phrynosoma asio
Sceloporus melanorhinus
*Plestiodon parvulus**
*Holcosus sinister**
Ficimia publia
*Symphimus leucostomus**
*Dipsas gaigeae**
Imantodes gemmistratus
*Leptodeira uribei**
*Pseudoleptodeira latifasciata**
Sibon nebulatus
Hydrophis platurus
*Micrurus proximans**
Loxocemus bicolor
*Thamnophis validus**
Caretta caretta
Chelonia mydas
Eretmochelys imbricata
Lepidochelys olivacea
Dermochelys coriacea
*Trachemys ornata**
Rhinoclemmys pulcherrima
*Kinosternon chimalhuaca**

Almost one-half of these 33 species (15) are country endemics; the remaining species either range to the south into Central America (12) or are marine in distribution (6).

The next largest group of single-region species is found in the Central Plateau and includes the following:

*Eleutherodactylus verrucipes**
*Smilisca dentata**
*Lithobates spectabilis**
*Ambystoma flavipiperatum***
*Hemidactylus turcicus****
Holbrookia approximans
*Sceloporus goldmani**
*Sceloporus minor**
*Sceloporus spinosus**
Aspidoscelis gularis
Gyalopion canum
Tantilla wilcoxi
Heterodon kennerlyi
Hypsiglena jani
*Leptodeira punctata**
Micrurus browni

Seven of these 16 species are country endemics and one is a state endemic. One is a non-native species. In contrast to the situation with the prior grouping, the remainder of these species, with one exception (*M. browni*), also occurs in the southern United States.

Thirteen species are restricted to the Trans-Mexican Volcanic Belt in Jalisco. These species are:

*Eleutherodactylus angustidigitorum**
Leptodactylus fragilis
*Lithobates zweifeli**
Aspidoscelis deppii
*Sympholis lippiens**
*Tantilla ceboruca**
*Enulius oligostichus**
*Geophis tarascae**
*Adelophis copei**
*Thamnophis scalaris**
*Crotalus armstrongi**
*Crotalus pusillus**
*Terrapene nelsoni**

Eleven of these 13 species are country endemics, whereas the other two are distributed to the south in Central America, as well as to the north in southern Texas in the case of *L. fragilis*.

Ten single-region species are found in the Sierra Madre Occidental, including the following:

*Eleutherodactylus wixarika*** *Plestiodon bilineatus**
*Ambystoma rosaceum** *Micruroides euryxanthus*
*Sceloporus brownorum** *Thamnophis errans**
Sceloporus jarrovii *Thamnophis pulchrilatus**
*Sceloporus shannonorum** *Crotalus pricei*

Six of these 10 species are country endemics and one is a state endemic; the remaining three species are distributed to the north in the southwestern United States.

Five single-region species occur in the Sierras Jaliscienses, including:

*Eleutherodactylus grunwaldi** *Crotalus campbelli**
Sceloporus poinsettii *Crotalus lannomi**
*Geophis nigrocinctus**

Four of these species are country endemics and the remaining one occurs also to the north in the United States.

Four species are limited to the Tepalcatepec Depression, including:

*Incilius perplexus** *Urosaurus gadovi**
*Ctenosaura clarki** *Rena bressoni**

All four of these species are country endemics.

Finally, two species are restricted to the Sierra de Coalcomán, including:

*Tantilla cascadae** *Geophis sieboldi**

Both species are country endemics.

Perusal of the above discussion shows that of the 83 single-region species found in Jalisco, 51 (61.4%) either are country or state endemics. Most of the remaining species also occur to the south in Central America or to the north in the United States, but a few occur in both areas. Interestingly enough, the Pacific Coastal Plain is the physiographic region of greatest conservation significance, given that it contains the greatest number of single-region species (33) and the highest number of country endemics (15). Alvarado-Díaz et al. (2013) also found this same result regarding the Pacific Coastal Plain physiographic region in Michoacán, by reporting 22 single-region species in this state. The Pacific Coastal Plain, however, does not contain the highest number of species (although it harbors 98 species, the second highest number); the highest number is in the Trans-Mexican Volcanic Belt, with 116 species.

We constructed a Coefficient of Biogeographic Resemblance (CBR) matrix for examining the herpetofaunal relationships among the seven physiographic regions of Jalisco (Table 6). The Trans-Mexican Volcanic Belt (TV) contains the most species richness (116 species), and the Sierra de Coalcomán (SC) and the Tepalcatepec Depression (TD) contain the fewest (38 species). The mean number of species richness for all regions is 81.7. The number of shared species between all regional pairs ranges from a high of 69 between the Central Plateau (CP) and the Trans-Mexican Volcanic belt (TV), to the lowest number of 19 between the Tepalcatepec Depression (TD) and the Pacific Coastal Plain (PC); the mean shared value of all the regions is 37.3.

Table 6. Pair-wise comparison matrix of Coefficient of Biogeographic Resemblance (CBR) data of herpetofaunal relationships for the seven physiographic regions in Jalisco, 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. Abbreviations are as follows: PC = Pacific Coastal Plain; SO = Sierra Madre Occidental; TV = Trans-Mexican Volcanic Belt; SC = Sierra de Coalcomán; CP = Central Plateau; and TD = Tepalcatepec Depression. See Fig. 3 for the UPGMA dendrogram produced from the CBR data.

	PC	SO	SJ	TV	SC	CP	TD
PC	**98**	33	57	39	21	20	19
SO	0.35	**92**	50	61	27	57	27
SJ	0.59	0.53	**96**	68	33	42	29
TV	0.36	0.59	0.64	**116**	32	69	27
SC	0.31	0.42	0.49	0.42	**38**	25	26
CP	0.21	0.61	0.44	0.66	0.38	**94**	22
TD	0.28	0.42	0.43	0.35	0.68	0.33	**38**

Elgaria kingii Gray, 1838. The Madrean Alligator Lizard is distributed in the "mountains of central Arizona and southwestern New Mexico southward through the Sierra Madre Occidental and adjacent ranges of eastern Sonora and western Chihuahua to Jalisco" (Rorabaugh and Lemos-Espinal, 2016). This individual is from the Cerro El Tepopote, adjacent to the Bosque La Primavera, in the municipality of Zapopan. Wilson et al. (2013a) reported its EVS as 10, placing it at the lower limit of the medium vulnerability category. Its conservation status has been assessed as Least Concern by the IUCN, and this lizard is considered as a species of special protection (Pr) by SEMARNAT.

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The CBR data in Table 6 demonstrate coefficient values ranging from a low of 0.21 between PC and CP, and a high of 0.68 between TD and SC. PC and CP sit at opposite extremes in distance from each other and in their environmental physiognomies (lowland vs. highland habitats), as well as being separated by the rugged Trans-Mexican Volcanic Belt (TV), whose herpetological relationships are placed most closely with CP (0.66). TD and SC are located directly adjacent to each other in the southeastern portion of the state and share some habitat types. As expected, the Sierra Madre Occidental (SO) and CP share a moderate resemblance value (0.61) because of their contiguous distribution (bridged through Zacatecas), and by containing similar habitats; the Sierras Jaliscienses (SJ) shares its highest resemblance value with TV (0.64) for the same ecological reasons. The overall CBR coefficient values among the seven physiographic regions are as follows, and arranged from highest to lowest values; the species numbers are in parentheses:

Tepalcatepec Depression (38)—0.68—Sierra de Coalcomán (38)

Trans-Mexican Volcanic Belt (116)—0.66—Central Plateau (94)

Trans-Mexican Volcanic Belt (116)—0.64—Sierras Jaliscienses (97)

Sierra Madre Occidental (92)—0.61—Central Plateau (94)

Sierras Jaliscienses (96)—0.59—Pacific Coastal Plain (98)

Trans-Mexican Volcanic Belt (116)—0.59—Sierra Madre Occidental (92)

Sierras Jaliscienses (96)—0.53—Sierra Madre Occidental (92)

Sierras Jaliscienses (96)—0.49—Sierra de Coalcomán (38)

Sierras Jaliscienses (96)—0.44—Central Plateau (94)

Sierras Jaliscienses (96)—0.43—Tepalcatepec Depression (38)

Sierra Madre Occidental (92)—0.42—Sierra de Coalcomán (38)

Sierra Madre Occidental (92)—0.61—Central Plateau (94)

Trans-Mexican Volcanic Belt (116)—0.42—Sierra de Coalcomán (38)

Central Plateau (94)—0.38—Sierra de Coalcomán (38)

Pacific Coastal Plain (98)—0.36—Trans-Mexican Volcanic Belt (116)

Pacific Coastal Plain (98)—0.35—Sierra Madre Occidental (92)

Trans-Mexican Volcanic Belt (116)—0.35—Tepalcatepec Depression (38)

Central Plateau (94)—0.33—Tepalcatepec Depression (38)

Pacific Coastal Plain (98)—0.31—Sierra de Coalcomán (38)

Pacific Coastal Plain (98)—0.28—Tepalcatepec Depression (38)

Pacific Coastal Plain (98)—0.21—Central Plateau (94)

Based on the data in Table 6, we assembled a UPGMA dendrogram (Fig. 18) to illustrate in a hierarchical fashion the herpetofaunal resemblance patterns among the seven physiographic regions of Jalisco (Fig. 1). The dendrogram indicates two separate clusters of multiple pairwise groupings, and an outlier consisting of PC, the most distinctive region. None of the seven groups show high resemblance patterns with other regions because the highest shared value is only 0.68 between SC and TD, which are two small regions in the state adjacent to each other in the southeastern portion on the Michoacán border; these two regions constitute one of the UPGMA-based clusters. The second cluster consists of four highland regions of varying elevations that include CP, TV, SO, and SJ. The highest resemblance value in that cluster is between TV and CP (0.66). SO shows a 0.60 resemblance value to the first two regions combined, and the outlier in the four-region cluster is SJ, with a resemblance value of 0.56 when compared to the other three regions combined. SJ is composed of lower slopes adjacent to TV on the northeast, and to the low elevations that characterizes PC on the southwest; their non-hierarchical physiographic relationships are reflected by higher CBR values: SJ—TV (0.64) and SJ—PC (0.59).

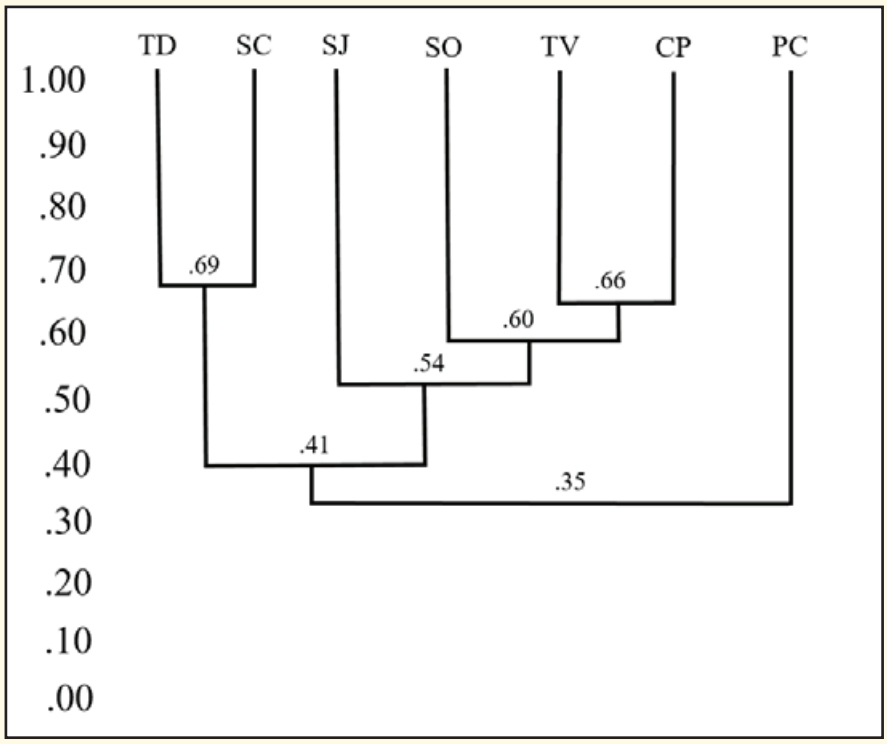

Fig. 18. A UPGMA generated dendrogram illustrating the similarity relationships of species richness among the herpetofana in the seven physiographic regions of Jalisco (based on data in Table 6; see Table 4 for explanation of abbreviations). We calculated the similarity values using Duellman's (1990) Coefficient of Biogeographic Resemblance (CBR).

Heloderma horridum (Wiegmann, 1829). The Mexican Beaded Lizard is a Mexican endemic occurring "primarily in dry forest habitats from southern Sinaloa southward to Oaxaca, including the states of Jalisco, Nayarit, Colima, Michoacán, and Guerrero, and inland into the states of México and Morelos" (Reiserer et al., 2013: 80). This individual was found at Yelapa, in the municipality of Cabo Corrientes. Its EVS was calculated as 5+4+5 = 14, reflecting its restriction to Mexico, its occurrence in five vegetation formations, and its status as a venomous species that is killed on sight. An EVS of 14 places this species at the lower limit of the high vulnerability category. Its conservation status has been determined to be Least Concern by the IUCN, but this species is regarded as threatened (A) by SEMARNAT. © Cheryl Harleston

We expected the hierarchical UPGMA pattern (Fig. 18) associated with PC to the cluster of the six other regions because of the region's low elevation and related habitat discrepancies, and by its small surface area within the state, even though contiguous geographic position and some shared ecological characteristics with other regions could have been anticipated to increase the faunal resemblance. Based on literature searches, there was one exception to our predetermined expectations. Many authorities consider PC to be part of a physiographic area extending at variable elevations from Sonora to the Pacific lowlands of Chiapas, or through Central American countries as far as the Colombian border (i.e., Flores-Villela and McCoy, 1993; Campbell, 1999; Morrone et al., 2003: Garcia, 2006; Wilson and Johnson, 2010; Johnson et al., 2010, 2015a, among others). With few exceptions, the ecosystems in that stretch usually are associated with subhumid to semihumid environments. Some researchers also consider portions of PC to be a segment of a dispersal corridor containing dry-adapted species, which include inland Pacific versant sections of the Balsas/Tepalcatepec Basins and Central Depression of Chiapas in Mexico, and in adjacent subhumid valleys of Guatemala (i.e., Stuart, 1954; Savage, 1982; Johnson, 1990; Wilson and McCranie, 1998; Garcia, 2006; Johnson et al. 2015a). Therefore, when starting our Jalisco study we anticipated that PC and TD would have a much higher non-hierarchical CBR value than 0.28, because the two regions contact each other in nearby Michoacán where the Río Balsas crosses the Pacific Coastal Plain and empties into the Pacific Ocean. The herpetofauna of the Tepalcatepec Depression in Jalisco has been poorly surveyed, with only a total of 38 species recorded (Table 4). Nineteen species are held in common between this region and the Pacific Coastal Plain, and they principally include those with a wide distribution in the state (i.e., inhabiting five, six, or seven of the seven regions; Table 4).

DISTRIBUTION STATUS CATEGORIZATIONS

We used the same system as Alvarado-Díaz et al. (2013), Mata-Silva et al. (2015), Johnson et al. (2015a), Terán-Juárez et al. (2016), Woolrich-Piña et al. (2016), and Nevárez-de los Reyes et al. (2016) for the herpetofaunas of Michoacán, Oaxaca, Chiapas, Tamaulipas, Nayarit, and Nuevo León, respectively, to characterize the distribution of the herpetofaunal species in Jalisco. The categories are non-endemic, country endemic, state endemic, and non-native. We placed these data in Table 7, and present a summary in Table 8.

As with the herpetofaunas of Michoacán (Alvarado-Díaz et al., 2013) and Nayarit (Woolrich-Piña et al., 2016), the largest number of species in Jalisco falls into the country endemic category, i.e., 142 of 223 species (63.7%) (Table 8); this proportion is even higher than those for Michoacán and Nayarit, which are 56.7% of 215 species and 57.1% of 154 species, respectively. In the case of the herpetofaunas of Oaxaca, Chiapas, Tamaulipas, and Nuevo León, the greatest proportion of species (41.4–81.2%) lies in the non-endemic category (Mata-Silva et al., 2015; Johnson et al., 2015a; Terán-Juárez et al., 2016; and Nevárez-de los Reyes et al., 2016).

The country endemic species in Jalisco consist of 31 anurans, three salamanders, one caecilian, 39 lizards, 63 snakes, and five turtles. The non-endemic species comprise 15 anurans, one crocodylian, 18 lizards, 34 snakes, and seven turtles (Table 8).

The proportion of non-endemic to country endemic species in Jalisco is 75/142 (52.8%) (Table 8). The corresponding figures for Michoacán and Nayarit are 70/122 (57.4%) and 61/88 (69.3%), respectively. The reason for the lower proportional value for Jalisco is that the number of non-endemic species is close to one-half of that of the country endemics.

The number of state endemics in Jalisco (two) is much closer to that in Nayarit (one) than in Michoacán (19). Interestingly, the two in Jalisco (Tables 7, 8) are an eleutherodactylid anuran (*Eleutherodactylus wixarika*) and an ambystomatid salamander (*Ambystoma flavipiperatum*), whereas the one in Nayarit (Woolrich-Piña et al., 2016) is a natricid snake (*Thamnophis rossmani*). The 19 Michoacán state endemics include a bufonid anuran (*Incilius pisinnus*), two eleutherodactylid anurans (*Eleutherodactylus angustidigitorum* and *E. rufescens*), a ranid anuran (*Lithobates dunni*), three ambystomatid salamanders (*Ambystoma amblycephalum*, *A. andersoni*, and *A. dumerilii*), an anguid lizard (*Barisia jonesi*), two phyllodactylid lizards (*Phyllodactylus duellmani* and *P. paucituberculatus*), one teiid lizard (*Aspidoscelis calidipes*), five dipsadid snakes (*Coniophanes michoacanensis*, *C. sarae*, *Geophis incomptus*, *G. maculiferus*, and *G. pyburni*), one leptotyphlopid snake (*Rena bressoni*), one natricid snake (*Thamnophis postremus*), and one viperid snake (*Crotalus tancitarensis*). Another snake (*Tantilla cascadae*) was considered a Michoacán state endemic by Alvarado-Díaz et al. (2013), but subsequently was reported from Jalisco by Cruz-Sáenz et al. (2015).

Table 7. Distributional and conservation status measures for members of the herpetofauna of Jalisco, Mexico. Distributional Status: SE = endemic to state of Jalisco; 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 compactilis**	CE	H (14)	LC	NS
Anaxyrus debilis	NE	L (7)	LC	Pr
Anaxyrus punctatus	NE	L (5)	LC	NS
*Incilius marmoreus**	CE	M (11)	LC	NS
*Incilius mazatlanensis**	CE	M (12)	LC	NS
*Incilius occidentalis**	CE	M (11)	LC	NS
*Incilius perplexus**	CE	M (11)	EN	NS
Rhinella horribilis	NE	L (3)	NE	NS
Craugastor augusti	NE	L (8)	LC	NS
*Craugastor hobartsmithi**	CE	H (15)	EN	NS
*Craugastor occidentalis**	CE	M (13)	DD	NS
Craugastor pygmaeus	NE	L (9)	VU	NS
*Craugastor vocalis**	CE	M (13)	LC	NS
*Eleutherodactylus angustidigitorum**	CE	H (17)	VU	Pr
*Eleutherodactylus grundwaldi**	CE	H (16)	NE	NS
*Eleutherodactylus modestus**	CE	H (16)	VU	Pr
*Eleutherodactylus nitidus**	CE	M (12)	LC	NS
*Eleutherodactylus nivicolimae**	CE	H (17)	VU	Pr
*Eleutherodactylus pallidus**	CE	H (17)	DD	Pr
*Eleutherodactylus verrucipes**	CE	H (16)	VU	Pr
*Eleutherodactylus wixarika***	SE	H (18)	NE	NS
*Agalychnis dacnicolor**	CE	M (13)	LC	NS
*Dendropsophus sartori**	CE	H (14)	LC	A
*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
*Sarcohyla bistincta**	CE	L (9)	LC	Pr
Smilisca baudinii	NE	L (3)	LC	NS
*Smilisca dentata**	CE	H (14)	EN	A
Smilisca fodiens	NE	L (8)	LC	NS
*Tlalocohyla smithii**	CE	M (11)	LC	NS
Trachycephalus typhonius	NE	L (4)	LC	NS

Table 7 (continued)

Taxa	Distributional Status	Environmental Vulnerability Category (Score)	IUCN Categorization	SEMARNAT Status
Leptodactylus fragilis	NE	L (5)	LC	NS
Leptodactylus melanonotus	NE	L (6)	LC	NS
Hypopachus ustus	NE	L (7)	LC	Pr
Hypopachus variolosus	NE	L (4)	LC	NS
Lithobates forreri	NE	L(3)	LC	Pr
*Lithobates magnaocularis**	CE	M (12)	LC	NS
*Lithobates megapoda**	CE	H (14)	VU	Pr
*Lithobates montezumae**	CE	M (13)	LC	Pr
*Lithobates neovolcanicus**	CE	M (13)	NT	A
*Lithobates psilonota**	CE	H (14)	DD	NS
*Lithobates pustulosus**	CE	L (9)	LC	Pr
*Lithobates spectabilis**	CE	M (12)	LC	NS
*Lithobates zweifeli**	CE	M (11)	LC	NS
Spea multiplicata	NE	L (6)	LC	NS
*Ambystoma flavipiperatum***	SE	H (14)	EN	Pr
*Ambystoma rosaceum**	CE	H (14)	LC	Pr
*Ambystoma velasci**	CE	M (10)	LC	Pr
*Isthmura bellii**	CE	M (12)	VU	A
*Dermophis oaxacae**	CE	M (12)	DD	Pr
Crocodylus acutus	NE	H (14)	VU	Pr
*Barisia ciliaris**	CE	H (15)	NE	NS
*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)	LC	NS
*Norops nebulosus**	CE	M (13)	LC	NS
Coleonyx elegans	NE	L (9)	LC	A
*Gehyra mutilata****	NN	—	—	—
*Hemidactylus frenatus****	NN	—	—	—
*Hemidactylus turcicus****	NN	—	—	—
*Heloderma horridum**	CE	H (14)	LC	A
*Ctenosaura clarki**	CE	H (15)	VU	NS
*Ctenosaura pectinata**	CE	H (15)	NE	A
Iguana iguana	NE	M (12)	NE	Pr
Marisora brachypoda	NE	L (6)	LC	NS
Holbrookia approximans	NE	H (14)	NE	NS
Phrynosoma asio	NE	M (11)	LC	Pr
*Phrynosoma orbiculare**	CE	M (12)	LC	A

Table 7 (continued)

Taxa	Distributional Status	Environmental Vulnerability Category (Score)	IUCN Categorization	SEMARNAT Status
*Sceloporus aeneus**	CE	M (13)	LC	NS
*Sceloporus albiventris**	CE	H (16)	NE	NS
*Sceloporus asper**	CE	H (14)	LC	Pr
*Sceloporus aurantius**	CE	H (16)	NE	NS
Sceloporus brownorum	CE	H (15)	NE	NS
*Sceloporus bulleri**	CE	H (15)	LC	NS
Sceloporus clarkii	NE	M (10)	LC	NS
*Sceloporus dugesi**	CE	M (13)	LC	NS
*Sceloporus goldmani**	CE	H (15)	EN	NS
Sceloporus grammicus	NE	L (9)	LC	Pr
*Sceloporus heterolepis**	CE	H (14)	LC	NS
*Sceloporus horridus**	CE	M (11)	LC	NS
*Sceloporus insignis**	CE	H (16)	LC	Pr
Sceloporus jarrovi	NE	M (11)	LC	NS
Sceloporus melanorhinus	NE	L (9)	LC	NS
*Sceloporus minor**	CE	M (13)	LC	NS
*Sceloporus nelsoni**	NE	M (12)	LC	NS
Sceloporus poinsettii	NE	M (12)	LC	NS
*Sceloporus pyrocephalus**	CE	M (12)	LC	NS
*Sceloporus scalaris**	CE	M (12)	LC	NS
*Sceloporus shannonorum**	CE	H (15)	NE	NS
*Sceloporus spinosus**	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 gadovi**	CE	M (12)	LC	NS
*Phyllodactylus lanei**	CE	H (15)	LC	NS
*Plestiodon bilineatus**	CE	M (13)	NE	NS
Plestiodon callicephalus	NE	M (12)	LC	NS
*Plestiodon dugesii**	CE	H (16)	VU	Pr
*Plestiodon indubitus**	CE	H (15)	NE	Pr
*Plestiodon lynxe**	CE	M (10)	LC	Pr
*Plestiodon parvulus**	CE	H (15)	DD	NS
Scincella assata	NE	L (7)	LC	NS
*Aspidoscelis communis**	CE	H (14)	LC	Pr
*Aspidoscelis costata**	CE	M (11)	LC	Pr
Aspidoscelis deppii	NE	L (8)	LC	NS

Table 7 (continued)

Taxa	Distributional Status	Environmental Vulnerability Category (Score)	IUCN Categorization	SEMARNAT Status
Aspidoscelis gularis	NE	L (9)	LC	NS
*Aspidoscelis lineattissima**	CE	H (14)	LC	Pr
*Holcosus sinister**	CE	M (13)	NE	NS
*Xantusia sanchezi**	CE	H (16)	LC	P
Boa sigma	NE	M (10)	NE	A
*Conopsis biserialis**	CE	M (13)	LC	A
*Conopsis lineata**	CE	M (13)	LC	NS
*Conopsis nasus**	CE	M (11)	LC	NS
Drymarchon melanurus	NE	L (6)	LC	NS
Drymobius margaritiferus	NE	L (6)	NE	NS
Ficimia publia	NE	L (9)	LC	NS
Gyalopion canum	NE	L (9)	LC	NS
*Lampropeltis mexicana**	CE	H (15)	LC	A
*Lampropeltis polyzona**	CE	M (11)	NE	NS
*Lampropeltis ruthveni**	CE	H (16)	NT	A
*Leptophis diplotropis**	CE	H (14)	LC	A
Masticophis bilineatus	NE	M (11)	LC	NS
Masticophis flagellum	NE	L (8)	LC	A
Masticophis mentovarius	NE	L (6)	LC	A
Masticophis taeniatus	NE	M (10)	LC	NS
*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
*Salvadora bairdi**	CE	H (15)	LC	Pr
*Salvadora mexicana**	CE	H (15)	LC	Pr
Senticolis triaspis	NE	L (6)	LC	NS
*Sonora mutabilis**	CE	H (14)	LC	NS
*Symphimus leucostomus**	CE	H (14)	LC	Pr
*Sympholis lippiens**	CE	H (14)	NE	NS
*Tantilla bocourti**	CE	L (9)	LC	NS
*Tantilla calamarina**	CE	M (12)	LC	Pr
*Tantilla cascadae**	CE	H (16)	DD	A
*Tantilla ceboruca**	CE	H (16)	NE	NS
Tantilla wilcoxi	NE	M (10)	LC	NS
*Trimorphodon biscutatus**	CE	L (7)	NE	NS
*Trimorphodon paucimaculatus**	CE	H (15)	NE	NS

Table 7 (continued)

Taxa	Distributional Status	Environmental Vulnerability Category (Score)	IUCN Categorization	SEMARNAT Status
*Trimorphodon tau**	CE	M (13)	LC	NS
Clelia scytalina	NE	M (13)	LC	NS
*Coniophanes lateritius**	CE	M (13)	DD	NS
*Conophis vittatus**	CE	M (11)	LC	NS
Diadophis punctatus	NE	L (4)	LC	NS
*Dipsas gaigeae**	CE	H (17)	LC	Pr
Enulius flavitorques	NE	L (5)	LC	NS
*Enulius oligostichus**	CE	H (15)	DD	Pr
*Geophis bicolor**	CE	H (15)	DD	Pr
*Geophis dugesii**	CE	M (13)	LC	NS
*Geophis nigrocinctus**	CE	H (15)	DD	Pr
*Geophis petersii**	CE	H (15)	DD	Pr
*Geophis sieboldi**	CE	M (13)	DD	Pr
*Geophis tarascae**	CE	H (15)	DD	Pr
Heterodon kennerlyi	NE	M (11)	NE	NS
*Hypsiglena affinis**	CE	H (14)	NE	NS
Hypsiglena jani	NE	L (6)	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
*Leptodeira uribei**	CE	H (17)	LC	NS
*Manolepis putnami**	CE	M (13)	LC	NS
*Pseudoleptodeira latifasciata**	CE	H (14)	LC	Pr
*Rhadinaea hesperia**	CE	M (10)	LC	Pr
*Rhadinaea laureata**	CE	M (12)	LC	NS
*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 browni	NE	L (8)	LC	Pr
*Micrurus distans**	CE	H (14)	LC	Pr
*Micrurus laticollaris**	CE	H (14)	LC	Pr
*Micrurus proximans**	CE	H (18)	LC	Pr

Table 7 (continued)

Taxa	Distributional Status	Environmental Vulnerability Category (Score)	IUCN Categorization	SEMARNAT Status
*Rena bressoni**	CE	H (14)	DD	Pr
Rena humilis	NE	L (8)	LC	NS
Loxocemus bicolor	NE	M (10)	LC	Pr
*Adelophis copei**	CE	H (15)	VU	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 pulchrilatus**	CE	H (15)	LC	NS
*Thamnophis scalaris**	CE	H (14)	LC	A
*Thamnophis scaliger**	CE	H (15)	VU	A
*Thamnophis validus**	CE	M (12)	LC	NS
*Indotyphlops braminus****	NN	—	—	—
Agkistrodon bilineatus	NE	M (11)	NT	Pr
*Crotalus aquilus**	CE	H (16)	LC	Pr
*Crotalus armstrongi**	CE	H (18)	NE	NS
*Crotalus basiliscus**	CE	H (18)	LC	NS
*Crotalus campbelli**	CE	H (17)	NE	Pr
*Crotalus lannomi**	CE	H (18)	DD	NS
Crotalus lepidus	NE	M (12)	LC	Pr
Crotalus molossus	NE	L (8)	LC	Pr
*Crotalus polystictus**	CE	H (16)	LC	Pr
Crotalus pricei	NE	H (14)	LC	Pr
*Crotalus pusillus**	CE	H (18)	EN	A
Crotalus scutulatus	NE	M (11)	LC	Pr
Caretta caretta	NE	—	VU	P
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
*Rhinoclemmys rubida**	CE	H (14)	NT	Pr
*Kinosternon chimalhuaca**	CE	H (16)	LC	NS
Kinosternon hirtipes	NE	M (10)	LC	Pr
*Kinosternon integrum**	CE	M (11)	LC	Pr

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

Families	Number of Species	Distributional Status			
		Non-endemic (NE)	Country Endemic (CE)	State Endemic (SE)	Non-native (NN)
Bufonidae	8	3	5	—	—
Craugastoridae	5	2	3	—	—
Eleutherodactylidae	8	—	7	1	—
Hylidae	12	4	8	—	—
Leptodactylidae	2	2	—	—	—
Microhylidae	2	2	—	—	—
Ranidae	9	1	8	—	—
Scaphiopodidae	1	1	—	—	—
Subtotals	**47**	**15**	**31**	**1**	**—**
Ambystomatidae	3	—	2	1	—
Plethodontidae	1	—	1	—	—
Subtotals	**4**	—	**3**	**1**	—
Dermophiidae	1	—	1	—	—
Subtotals	**1**	—	**1**	—	—
Totals	**52**	**15**	**35**	**2**	**—**
Crocodylidae	1	1	—	—	—
Subtotals	**1**	**1**	**—**	**—**	**—**
Anguidae	4	2	2	—	—
Corytophanidae	1	1	—	—	—
Dactyloidae	1	—	1	—	—
Eublepharidae	1	1	—	—	—
Gekkonidae	3	—	—	—	3
Helodermatidae	1	—	1	—	—
Iguanidae	3	1	2	—	—
Mabuyidae	1	1	—	—	—
Phrynosomatidae	30	8	22	—	—
Phyllodactylidae	1	—	1	—	—

Scincidae	6	1	5	—	—
Sphenomorphidae	1	1	—	—	—
Teiidae	6	2	4	—	—
Xantusiidae	1	—	1	—	—
Subtotals	**60**	**18**	**39**	**—**	**3**
Boidae	1	1	—	—	—
Colubridae	34	12	22	—	—
Dipsadidae	31	9	22	—	—
Elapidae	6	3	3	—	—
Leptotyphlopidae	2	1	1	—	—
Loxocemidae	1	1	—	—	—
Natricidae	10	2	8	—	—
Typhlopidae	1	—	—	—	1
Viperidae	12	5	7	—	—
Subtotals	**98**	**34**	**63**	**—**	**1**
Cheloniidae	4	4	—	—	—
Dermochelyidae	1	1	—	—	—
Emydidae	2	—	2	—	—
Geoemydidae	2	1	1	—	—
Kinosternidae	3	1	2	—	—
Subtotals	**12**	**7**	**5**	**—**	**—**
Totals	**171**	**60**	**107**	**—**	**4**
Sum Totals	**223**	**75**	**142**	**2**	**4**

The number of non-native species in Jalisco is four, including three gekkonid lizards (*Gehyra mutilata*, *Hemidactylus frenatus*, and *H. turcicus*) and one typhlopid snake (*Indotyphlops braminus*). In Nayarit, the total number of non-native species also is four, but one is a ranid anuran (*Lithobates catesbeianus*), two are gekkonid lizards (*G. mutilata* and *H. frenatus*), and one is a typhlopid snake (*I. braminus*). The number of non-native species in Michoacán is three, and except for *G. mutilata* these species are the same as in Nayarit.

The number of endemic species (both country and state endemics) in Jalisco (144) is 18.8% of the 768 known from all of Mexico (J. Johnson, unpublished). The number of non-endemic species (75) is 15.0% of the 501 such species from the entire country (J. Johnson, unpublished). The comparable figures for Nayarit are 11.6% (89 of 768 species) and 12.2% (61 of 501 species); for Michoacán, the figures are 18.5%, the same figure as for Jalisco, and 14.0% (70 of 501), which is close to the comparable figure for Jalisco (Alvarado-Díaz et al., 2013; Woolrich-Piña et al., 2016).

PRINCIPAL ENVIRONMENTAL THREATS

We organized our discussion of the principal environmental threats impacting the herpetofauna of Jalisco under the headings for each of the seven physiographic regions represented in the state.

Pacific Coastal Plain (PC). The landscape beauty of this region is one of the features that have made it the most frequented touristic area in the state. For the fauna and flora, however, this attention poses a risk, because of habitat fragmentation derived from the development of large resorts and roads, the destruction of mangroves and tropical forests, and the consequent pollution of the ocean. Another issue in this region that directly affects the herpetofauna is the illegal trade of sea turtle eggs and meat, together with the entanglement of turtles in fishing gear. Despite the numerous environmental threats, several natural protected areas are found in this region, of which one, the Reserva de la Biosfera de Chamela-Cuixmala, is the largest in Jalisco. These areas act as important refuges for the flora and fauna of this region. In addition, far more studies of the herpetofauna of the coast are available than for any other part of the state.

Sierra Madre Occidental (SO). In this region, the recent emergence of deforestation and forest fires due to the expansion of livestock activities, soil contamination due to agrochemicals, soil erosion, forestry, the encroachment of grasslands, road construction, and even the disappearance of species like the White-Tailed Deer (*Odocoileus virginianus*) and the Golden Eagle (*Aquila chrysaetos*) caused by hunting (Guzmán-Mejia and Anaya-Corona, 2007; Tetreault and Lucio, 2011) have become a major concern. Furthermore, the semi-dry climate of this area makes it susceptible to the effects of climate change, which are expected to modify the temperatures and water regimes (Amaya-Acuña, 2014). For squamates this is an important issue, as some projections indicate that by the year 2080, lizard extirpations and extinctions due to climate warming might reach drastic proportions (Sinervo et al., 2010).

Sierras Jaliscienses (SJ). The principal environmental threats in this region are population growth, the pollution of rivers and streams, monoculture, soil pollution by agrochemicals and improper trash handling, deforestation, and the erosion and compaction of soil by agricultural and livestock activities (Tetreault and Lucio, 2011). In the Sierra de Manantlán, the open pit mining of iron has devastated a significant amount of habitat because of the destructive extraction methods employed, which also are responsible for pollution of the hydrological system of the area (Tetreault and Lucio, 2011).

Central Plateau (CP). Desertification is the major threat, especially in the northeastern portion of this region. Along with the naturally arid conditions of this area, cattle raising poses a severe environmental pressure (Fig. 19) because the demand for water to supply the livestock is significant, considering the high hydric vulnerability of the region (Amaya-Acuña, 2014). These activities also are responsible for deforestation, forest fires (Fig. 20), erosion, and water pollution (Fig. 21), the latter due to fecal wastes from numerous chicken and pig farms. These problems are less accentuated in the southern part of the region, but present as well, together with the extensive use of agrochemicals.

Trans-Mexican Volcanic Belt (TV). This region contains the largest human settlements in the state. For this reason, anthropogenic disturbances such as urbanization, land use change, uncontrolled forest fires (Fig. 22), water demand, urban heat island effects, and air and water pollution entail serious threats to the environment. More importantly, the effects of these threats are not restricted only to urban areas, but also reach neighboring areas because the city of Guadalajara lies in close proximity to Barranca del Río Santiago and the southern portion of the Central Plateau. Several natural protected areas are present in this region, of which some are located near urban areas (Fig. 23). The latter of course help to reduce air pollution, but due to their proximity the most adverse pressure is on these areas.

Sierra de Coalcomán (SC). In this region, the pressure is twofold: the first is from illegal logging (Fig. 24), particularly for the extraction of pinewood; and the second, and heaviest, is from open pit iron mining (Fig. 25), in which the methods for extraction cause considerable habitat destruction and pollution.

Tepalcatepec Depression (TD). Deforestation, forest fires, erosion, and water pollution by agrochemicals and sewage are the main environmental threats to this small region; most of these pressures result from unsustainable agricultural activities (Núñez-Medero, 1996).

Fig. 19. *Overgrazing*. Extensive livestock farming on the Central Plateau at El Terrero, municipality of Tepatitlán de Morelos, at an elevation of 1,970 m. Much of the habitat in this area has been transformed into grazing lands. © Liliana Monserrath Mena-Preciado

Fig. 20. *Uncontrolled Fires*. Oak forest hours after a fire on the Central Plateau at Cerro de García, municipality of Jocotepec, at an elevation of 2,300 m. Recurrent induced fires in this area make ecological succession difficult to impossible. © Francisco Javier Muñoz-Nolasco

Fig. 21. *Water Pollution*. Gallery forest on the Central Plateau consisting of Montezuma Bald Cypress (*Taxodium mucronatum*) along a polluted stream at Rancho Anacaspiloya, municipality of San Miguel el Alto, at an elevation of 1,830 m. © Liliana Monserrath Mena-Preciado

Fig. 22. *Uncontrolled Fires*. The effects of a wildfire along the Trans-Mexican Volcanic Belt, at an elevation of 1,970 m. The fire occurred in oak-pine forest in a natural protected area, Bosque La Primavera, in the municipality of Zapopan. © Daniel Cruz-Sáenz

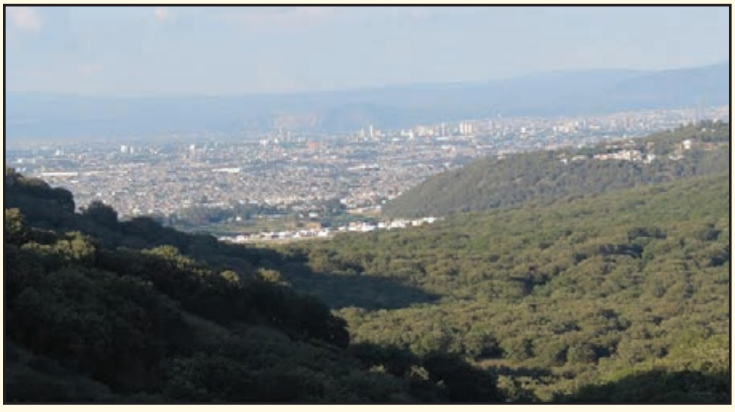

Fig. 23. *Urban Sprawl*. View of Bosque La Primavera, municipality of Zapopan, at an elevation of ca. 1,600 m. This natural protected area, in the Trans-Mexican Volcanic Belt, has been subjected to significant pressure due to the expansion of the city of Guadalajara. © Luis Enrique Sánchez-Ramos

Fig. 24. *Immoderate Logging.* Overexploitation of fir trees (*Abies* sp.) on Volcán Nevado de Colima, in the Trans-Mexican Volcanic Belt. The photo taken at El Floripondio, municipality of San Gabriel, at an elevation of 2,700 m. © Luis Enrique Sánchez-Ramos

Fig. 25. *Open Pit Mining.* Iron mining in the Sierra de Coalcomán, municipality of Pihuamo, at an elevation of 2,000 m. © Daniel Cruz-Sáenz

CONSERVATION STATUS

We used the same three systems as Alvarado-Díaz et al. (2013), Mata-Silva et al. (2015), Johnson et al. (2015a), Terán-Juárez et al. (2016), Woolrich-Piña et al. (2016), and Nevárez-de los Reyes et al. (2016) to examine the conservation status of the herpetofauna of Jalisco. Except in instances where updates were necessary, we used the same data for the SEMARNAT system from SEMARNAT (2010) and those for the IUCN and EVS systems from Wilson et al. (2013a, b).

The SEMARNAT System

The SEMARNAT system is a product of the Mexican national Secretaría de Medio Ambiente y Recursos Naturales, and often is used by Mexican herpetologists to evaluate the conservation status of members of the Mexican herpetofauna. We placed the ratings based on this system available for certain members of the Jaliscan herpetofauna (excluding the non-native species) in Table 7, and present a summary in Table 9.

Three categories comprise the SEMARNAT system, i.e., endangered (P), threatened (A), and under special protection (Pr). Previously, Alvarado-Díaz et al. (2013), Mata-Silva et al. (2015), Johnson et al. (2015a), Terán-Juárez et al. (2016), Woolrich-Piña et al. (2016), and Nevárez-de los Reyes et al. (2016) determined that many Mexican species remain uncategorized, so we follow these authors and place these taxa in a "no status" (NS) category.

Perusal of the data in Table 9 indicates that of the 219 native members of the herpetofauna of Jalisco, evaluations are not available for 119 species (54.3%), including 31 of 47 anurans (66.0%), 87 of 154 squamates (56.5%), and one of 12 turtles (8.3%). This proportion falls between those for the neighboring states of Michoacán (46.2%; Alvarado-Díaz et al., 2013) and Nayarit (59.3%; Woolrich-Piña et al., 2016). Percentages for the other states thus far examined in the MCS are as follows: Oaxaca (52.3%; Mata-Silva et al., 2015), Chiapas (58.0%; Johnson et al., 2015a), Tamaulipas (59.2%; Terán-Juárez et al., 2016), and Nuevo León (65.2%; Nevárez-de los Reyes et al., 2016). Thus, as with five of the six states surveyed thus far, more than one-half of the native species in Jalisco have not been assessed by the SEMARNAT system.

Table 9. SEMARNAT categorizations for herpetofaunal species in Jalisco, 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	8	—	—	1	7
Craugastoridae	5	—	—	—	5
Eleutherodactylidae	8	—	—	5	3
Hylidae	12	—	2	2	8
Leptodactylidae	2	—	—	—	2
Microhylidae	2	—	—	1	1
Ranidae	9	—	1	4	4
Scaphiopodidae	1	—	—	—	1
Subtotals	**47**	**—**	**3**	**13**	**31**
Ambystomatidae	3	—	—	3	—
Plethodontidae	1	—	1	—	—
Subtotals	**4**	**—**	**1**	**3**	**—**
Dermophiidae	1	—	—	1	—
Subtotals	**1**	**—**	**—**	**1**	**—**
Totals	**52**	**—**	**4**	**17**	**31**
Crocodylidae	1	—	—	1	—
Subtotals	**1**	**—**	**—**	**1**	**—**
Anguidae	4	—	—	3	1
Corytophanidae	1	—	—	—	1
Dactyloidae	1	—	—	—	1
Eublepharidae	1	—	1	—	—
Helodermatidae	1	—	1	—	—
Iguanidae	3	—	1	1	1
Mabuyidae	1	—	—	—	1
Phrynosomatidae	28	—	1	4	23

Phyllodactylidae	1	—	—	—	1
Scincidae	6	—	—	3	3
Sphenomorphidae	1	—	—	—	1
Teiidae	6	—	—	3	3
Xantusiidae	1	1	—	—	—
Subtotals	**55**	**1**	**4**	**14**	**36**
Boidae	1	—	1	—	—
Colubridae	34	—	8	4	22
Dipsadidae	29	—	—	13	16
Elapidae	6	—	1	4	1
Leptotyphlopidae	3	—	—	1	2
Loxocemidae	1	—	—	1	—
Natricidae	10	—	4	1	5
Viperidae	12	—	1	8	3
Subtotals	**96**	**—**	**15**	**32**	**49**
Cheloniidae	4	4	—	—	—
Dermochelyidae	1	1	—	—	—
Emydidae	2	—	—	2	—
Geoemydidae	2	—	1	1	—
Kinosternidae	3	—	—	2	1
Subtotals	**12**	**5**	**1**	**5**	**1**
Totals	**164**	**6**	**20**	**52**	**86**
Sum Totals	**216**	**6**	**24**	**69**	**117**

A total of 100 native species (45.7%) in Jalisco, however, are allocated to one of the three SEMARNAT categories (Table 9). Of these species, only six (2.7% of 219 native species) are placed in the most critical category (P or endangered). These six species include the five sea turtles occurring on the shores of Jalisco and the single xantusiid lizard in the state (*Xantusia sanchezi*, a country endemic). The next larger group, 24 species (11.0%), is allocated to the A or threatened category and includes three anurans, one salamander, 19 squamates, and one turtle. The largest group, 70 species (32.0%) is placed in the Pr (special protection) category, and includes 13 anurans, three salamanders, one caecilian, one crocodylian, 47 squamates, and five turtles.

The authors of all of the papers in the MCS have argued that a system that offers conservation status assessments for less than one-half of the species in any given state is not very useful in developing strategies for the perpetual protection of all of the members of a given herpetofauna. We adopt the same position here.

The IUCN System

Each paper in the MCS has examined the utility of the globally employed IUCN system of conservation assessment in reference to the portions of the Mexican herpetofauna included in those papers. This system also has been assessed in reference to the Mexican herpetofauna as a whole (Wilson et al., 2013a, b), as well as that of Central America (Johnson et al., 2015b). The deficiencies of this widely used system were summarized by Johnson et al. (2015b), as follows: "it [is] expensive and time-consuming, incapable of remaining current with advances in herpetofaunal systematics, and over reliant on the DD and LC categories" (Woolrich-Piña et al., 2016).

IUCN assessments have been rendered for 186 of the 219 native members (84.9%) of the Jaliscan herpetofauna (Table 10). This proportional figure compares with 86.8% for the herpetofauna of Michoacán (Alvarado-Díaz

et al., 2013) and 81.9% for the herpetofauna of Nayarit (Woolrich-Piña et al., 2016). Only 25 species (11.4%) are placed in one of the three IUCN threat categories (CR, EN, and VU); this proportion compares to 12.7% for Michoacán (Alvarado-Díaz et al., 2013) and 6.7% for Nayarit (Woolrich-Piña et al., 2016). One species is placed in the CR category, eight in the EN category, and 16 in the VU category. The single CR species is the sea turtle *Eretmochelys imbricata*, which is oceanic and pantropical (Table 7). The eight EN species include the anurans *Incilius perplexus**, *Craugastor hobartsmithi**, and *Smilisca dentata**, the salamander *Ambystoma flavipiperatum***, the lizard *Sceloporus goldmani**, the snakes *Thamnophis melanogaster** and *Crotalus pusillus**, and the sea turtle *Chelonia mydas*. With the exception of the sea turtle, the remaining five species are country or state endemics (Table 7). The 16 VU species include the anurans *Craugastor pygmaeus*, *Eleutherodactylus angustidigitorum**, *E. modestus**, *E. nivicolimae**, *E. verrucipes**, *Lithobates megapoda**, the salamander *Isthmura bellii**, the crocodylian *Crocodylus acutus*, the lizards *Ctenosaura clarki** and *Plestiodon dugesii**, the snakes *Adelophis copei** and *Thamnophis scaliger**, and the turtles *Caretta caretta*, *Lepidochelys olivacea*, *Dermochelys coriacea*, and *Trachemys ornata**. All but one of the six anurans are country endemics (*C. pygmaeus* is not), as are the salamanders, two lizards, two snakes, and one of the four turtles (*T. ornata*).

Table 10. IUCN Red List categorizations for herpetofaunal families in Jalisco, 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	8	—	1	—	—	6	—	1
Craugastoridae	5	—	1	1	—	2	1	—
Eleutherodactylidae	8	—	—	4	—	1	1	2
Hylidae	12	—	1	—	—	11	—	—
Leptodactylidae	2	—	—	—	—	2	—	—
Microhylidae	2	—	—	—	—	2	—	—
Ranidae	9	—	—	1	1	6	1	—
Scaphiopodidae	1	—	—	—	—	1	—	—
Subtotals	**47**	**—**	**3**	**6**	**1**	**31**	**3**	**3**
Ambystomatidae	3	—	1	—	—	2	—	—
Plethodontidae	1	—	—	1	—	—	—	—
Subtotals	**4**	**—**	**1**	**1**	**—**	**2**	**—**	**—**
Dermophiidae	1	—	—	—	—	—	1	—
Subtotals	**1**	**—**	**—**	**—**	**—**	**—**	**1**	**—**
Totals	**52**	**—**	**4**	**7**	**1**	**33**	**4**	**3**
Crocodylidae	1	—	—	1	—	—	—	—
Subtotals	**1**	**—**	**—**	**1**	**—**	**—**	**—**	**—**
Anguidae	4	—	—	—	—	3	—	1
Corytophanidae	1	—	—	—	—	1	—	—
Dactyloidae	1	—	—	—	—	1	—	—
Eublepharidae	1	—	—	—	—	1	—	—
Helodermatidae	1	—	—	—	—	1	—	—
Iguanidae	3	—	—	1	—	—	—	2

Mabuyidae	1	—	—	—	—	1	—	—
Phrynosomatidae	30	—	1	—	—	23	—	6
Phyllodactylidae	1	—	—	—	—	1	—	—
Scincidae	6	—	—	1	—	2	1	2
Sphenomorphidae	1	—	—	—	—	1	—	—
Teiidae	6	—	—	—	—	5	—	1
Xantusiidae	1					1		
Subtotals	**57**	**—**	**1**	**2**	**—**	**41**	**1**	**12**
Boidae	1	—	—	—	—	—	—	1
Colubridae	34	—	—	—	1	24	1	8
Dipsadidae	31	—	—	—	—	18	7	6
Elapidae	6	—	—	—	—	6	—	—
Leptotyphlopidae	2	—	—	—	—	1	1	—
Loxocemidae	1	—	—	—	—	1	—	—
Natricidae	10	—	1	2	—	7	—	
Viperidae	12	—	1	—	1	7	1	2
Subtotals	**97**	**—**	**2**	**2**	**2**	**64**	**10**	**17**
Cheloniidae	4	1	1	2	—	—	—	—
Dermochelyidae	1	—	—	1	—	—	—	—
Emydidae	2	—	—	1	—	—	1	—
Geoemydidae	2	—	—	—	1	—	—	1
Kinosternidae	3	—	—	—	—	3	—	—
Subtotals	**12**	**1**	**1**	**4**	**1**	**3**	**1**	**1**
Totals	**167**	**1**	**4**	**9**	**3**	**108**	**12**	**30**
Sum Totals	**219**	**1**	**8**	**16**	**4**	**141**	**16**	**33**
Category Totals	**219**	**25**			**145**		**49**	

The rest of the species are assessed as follows (Table 10): NT = 4 (1.8%); LC = 141 (64.4%); DD = 16 (7.3%); and NE = 33 (15.1%). The percentage of LC species in Jalisco is somewhat more than that for Michoacán (60.0%; Alvarado-Díaz et al., 2013), but somewhat less than that for Nayarit (67.8%; Woolrich-Piña et al., 2016).

We aggregated the values for the six IUCN categories and that for the NE species in Table 10 into three summary categories, as follows: CR+EN+VU = 25 (11.4%); NT+LC = 145 (66.2%); and DD+NE = 49 (22.4%). These proportional figures compare reasonably favorably with those for both Michoacán (CR+EN+VU = 10.7%; NT+LC = 61.8%; and DD+NE = 25.5%; Alvarado-Díaz et al., 2013) and Nayarit (CR+EN+VU = 6.7%; NT+LC = 68.5%; and DD+NE = 24.8%; Woolrich-Piña et al., 2016).

As amply demonstrated in other studies (Alvarado-Díaz et al., 2013; Mata-Silva et al., 2015; Johnson et al., 2015a; Terán-Juárez et al., 2016; Woolrich-Piña et al., 2016; Nevárez-de los Reyes et al., 2016), use of the IUCN system has allowed a large proportion of the species in the state herpetofaunal assemblages examined to be placed in the LC category. In the case of Jalisco, this proportion amounts to more than six of every 10 species, which on the surface might lead one to think that the herpetofauna of this state enjoys a reasonably good chance for survival in the future.

In addition to the species placed in the LC category, more than one of every five of the Jaliscan species has been allocated to the DD category or has not been evaluated in the IUCN system (49; 22.4%). Given that these 49 species have not been fully assessed by this system, below we estimate how they might be evaluated by using this means.

Ctenosaura pectinata (Wiegmann, 1834). The Mexican Spiny-tailed Iguana occurs from "southern Sinaloa…along the Pacific versant to western Chiapas" (Köhler, 2008). This individual came from the Reserva de la Biósfera Chamela-Cuixmala, in the municipality of La Huerta. Wilson et al. (2013a) determined its EVS as 15, placing it in the lower portion of the high vulnerability category. Its conservation status has not been assessed by the IUCN, and this species has been judged as threatened (A) by SEMARNAT. © Elí García-Padilla

Phrynosoma asio Cope, 1864. The Giant Horned Lizard ranges from Colima to Chiapas, Mexico, and western Guatemala, on the Pacific versant (Canseco-Márquez et al. (2013). This individual was found in the Reserva de la Biósfera Chamela-Cuixmala, in the municipality of La Huerta. Wilson et al. (2013a) judged its EVS as 11, placing it in the lower portion of the middle vulnerability category. Its conservation status has been determined as Least Concern by the IUCN, but this lizard has been considered as a species of special protection (Pr) by SEMARNAT. © Elí García-Padilla

The EVS System

In previous papers of the MCS, we noted that McCranie and Wilson (2002) and Wilson and McCranie (2004) introduced the Environmental Vulnerability Score (EVS) system of conservation assessment for use with the herpetofauna of Honduras. Subsequently, it has been used for several countries in Mesoamerica, including Guatemala (Acevedo et al., 2010), Honduras (Townsend and Wilson, 2010), Nicaragua (Sunyer and Köhler, 2010), Costa Rica (Sasa et al., 2010), Panama (Jaramillo et al., 2010), and Mexico (Wilson et al., 2013a, b). To date, it has been used to examine the conservation status of six states in Mexico, including Michoacán (Alvarado-Díaz et al., 2013), Oaxaca (Mata-Silva et al., 2015), Chiapas (Johnson et al., 2015a), Tamaulipas (Terán-Juárez et al., 2016), Nayarit (Woolrich-Piña et al., 2016), and Nuevo León (Nevárez-de los Reyes et al., 2016), as well as in the present one. Wilson et al. (2013a, b) and Johnson et al. (2015b) described the methodology for this system for Mexico and Central America, respectively. We put it to use to assess the conservation status of the herpetofauna of Jalisco and placed the EVS scores in Table 7, and present a summary in Table 11.

Table 11. Environmental Vulnerability Scores (EVS) for herpetofaunal species in Jalisco, 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	8	1	—	1	—	1	—	—	—	3	1	—	1	—	—	—	—	—
Craugastoridae	5	—	—	—	—	—	1	1	—	—	—	2	—	1	—	—	—	—
Eleutherodactylidae	8	—	—	—	—	—	—	—	—	—	1	—	—	—	3	3	1	—
Hylidae	12	1	1	—	—	1	1	1	1	1	1	2	2	—	—	—	—	—
Leptodactylidae	2	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—
Microhylidae	2	—	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—
Ranidae	9	1	—	—	—	—	—	1	—	1	2	2	2	—	—	—	—	—
Scaphiopodidae	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotals	**47**	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**1**	**5**	**5**	**6**	**5**	**1**	**3**	**3**	**1**	**—**
Ambystomatidae	3	—	—	—	—	—	—	—	1	—	—	—	2	—	—	—	—	—
Plethodontidae	1	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—
Subtotals	**4**	—	—	—	—	—	—	—	**1**	—	**1**	—	**2**	—	—	—	—	—
Dermophiidae	1	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—
Subtotals	**1**	—	—	—	—	—	—	—	—	—	**1**	—	—	—	—	—	—	—
Totals	**52**	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**5**	**7**	**6**	**7**	**1**	**3**	**3**	**1**	**—**
Crocodylidae	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—
Subtotals	**1**	—	—	—	—	—	—	—	—	—	—	—	**1**	—	—	—	—	—
Anguidae	4	—	—	—	1	—	—	—	1	—	—	—	1	1	—	—	—	—
Corytophanidae	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—
Dactyloidae	1	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Eublepharidae	1	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—
Helodermatidae	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—
Iguanidae	3	—	—	—	—	—	—	—	—	—	1	—	—	2	—	—	—	—
Mabuyidae	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—
Phrynosomatidae	30	—	—	—	—	—	—	2	1	4	8	3	3	5	4	—	—	—
Phyllodactylidae	1	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—

Scincidae	6	—	—	—	—	—	—	—	1	—	1	1	—	2	1	—	—	—
Sphenomorphidae	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—
Teiidae	6	—	—	—	—	—	1	1	—	1	—	1	2	—	—	—	—	—
Xantusiidae	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—
Subtotals	**57**	—	—	—	**2**	**2**	**1**	**4**	**3**	**5**	**10**	**6**	**7**	**11**	**6**	—	—	—
Boidae	1	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—
Colubridae	34	—	—	1	5	1	1	3	2	3	1	4	6	4	3	—	—	—
Dipsadidae	31	—	1	2	2	1	2	—	1	2	1	7	4	5	—	3	—	—
Elapidae	5	—	—	—	—	—	1	—	—	—	—	—	2	1	—	—	1	—
Leptotyphlopidae	2	—	—	—	—	—	1	—	—	—	—	—	1	—	—	—	—	—
Loxocemidae	1	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—
Natricidae	10	—	—	—	—	1	1	—	—	1	1	—	1	4	1	—	—	—
Viperidae	12	—	—	—	—	—	1	—	—	2	1	—	1	—	2	1	4	—
Subtotals	**96**	**—**	**1**	**3**	**7**	**3**	**7**	**3**	**5**	**8**	**4**	**11**	**15**	**14**	**6**	**4**	**5**	—
Emydidae	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1
Geoemydidae	2	—	—	—	—	—	1	—	—	—	—	—	1	—	—	—	—	—
Kinosternidae	3	—	—	—	—	—	—	—	1	1	—	—	—	—	1	—	—	—
Subtotals	**7**	—	—	—	—	—	**1**	**—**	**1**	**1**	—	—	**1**	—	**1**	—	**1**	**1**
Totals	**161**	**—**	**1**	**3**	**9**	**5**	**9**	**7**	**9**	**14**	**14**	**17**	**24**	**25**	**13**	**4**	**6**	**1**
Sum Totals	**213**	**3**	**3**	**5**	**11**	**8**	**11**	**10**	**11**	**19**	**21**	**23**	**31**	**26**	**16**	**7**	**7**	**1**
Category Totals	**213**	**51**							**74**				**88**					

The EVS values for the Jaliscan herpetofauna range from 3 to 19 (Table 11), one less than the complete theoretical range of 3–20. The most frequent values (for 10 or more species) are six (11 species), eight (11), nine (10), 10 (11), 11 (19), 12 (21), 13 (23), 14 (31), 15 (26), and 16 (17). We applied these 10 scores to 180 of the 213 species (84.5%) for which the EVS could be determined. The proportion for Jalisco is higher than the corresponding values for Nayarit (75.3%; Woolrich-Piña et al., 2016) and Michoacán (81.7%; Alvarado-Díaz et al., 2013).

At the lower end of the range of the EVS, we calculated a score of 3 (the lowest theoretically possible) for three species, the bufonid *Rhinella horribilis*, the hylid *Smilisca baudinii*, and the ranid *Lithobates forreri*, the same three species as for Nayarit (Woolrich-Piña et al., 2016) and for Michoacán (Alvarado-Díaz et al., 2013). As indicated earlier, these three species are provided this score because they "all are widely distributed, both geographically and ecologically, and utilize the most widespread reproductive mode" (Woolrich-Piña et al., 2016: 425). At the other end of the range, only a single species, the emydid turtle *Trachemys ornata*, is given an EVS of 19, the same species as for Nayarit, where it was noted to be "relatively narrowly distributed, both geographically and ecologically, and is subject to intense human pressure" (Woolrich-Piña et al., 2016: 425).

As with other studies that have used the EVS measure, we divided the scores in Table 11 into three categories, low (EVS 3–9), medium (10–13), and high (14–19). The scores increase from low (51 species) through medium (74) to high (88). This trend has been evident with work on the Michoacán herpetofauna (Alvarado-Díaz et al., 2013), but not with Nayarit (Woolrich-Piña et al., 2016), in which the numbers increased from the low to medium categories and then decreased to the high category. Perhaps the reason for the sharing of this trend (increase from low through medium to high) is the resemblance in the proportion of the country and state endemics relative to the entire herpetofaunas of Michoacán and Jalisco (66.0 and 64.5%, respectively) compared to that of Nayarit (57.8%).

As in previous MCS studies, we compared the IUCN and EVS categorizations for the herpetofauna of Jalisco (Table 12). Perusal of the data in this table indicates that only 21.6% of the high vulnerability species (19 of 88) are allocated to one of the IUCN threat categories (CR, EN, or VU). As with the Nayarit herpetofauna (Woolrich-Piña

et al., 2016), none of these species is placed in the CR category (actually, one species, the sea turtle *Eretmochelys imbricata* is allocated to the CR category [Table 7], but since the EVS measure is not applicable to marine species, this IUCN categorization does not appear in Table 12). This proportion, however, is somewhat higher than the comparable figure for Nayarit (14.3%; Woolrich-Piña et al., 2016). Contrariwise, the number of low vulnerability species is only 36.4% (51 of 140 species) of the LC species. In contrast, the number of LC species is 2.7 times the number of low vulnerability species (140 and 51, respectively; Table 12). This proportion is even higher than the comparable figure for Nayarit, which is 2.4 times (Woolrich-Piña et al., 2016). As in earlier studies, the results of the application of the IUCN and EVS systems to the herpetofauna of Nayarit are significantly at odds with one another.

Table 12. Comparison of Environmental Vulnerability Scores (EVS) and IUCN categorizations for members of the herpetofauna of Jalisco, 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	—	—	—	—	2	—	1	3
4	—	—	—	—	3	—	—	3
5	—	—	—	—	3	—	2	5
6	—	—	—	—	8	—	3	11
7	—	—	—	—	7	—	1	8
8	—	—	—	—	9	—	2	11
9	—	—	1	—	9	—	—	10
10	—	—	—	—	10	—	1	11
11	—	1	—	1	15	—	2	19
12	—	—	1	—	18	1	1	21
13	—	—	—	1	17	3	2	23
14	—	2	2	1	21	2	4	32
15	—	2	3	—	8	6	6	25
16	—	—	3	1	7	1	5	17
17	—	—	2	—	3	1	1	7
18	—	1	—	—	1	2	2	6
19	—	—	1	—	—	—	—	1
Totals	**—**	**6**	**13**	**4**	**141**	**16**	**33**	**213**

Sixteen species are allocated to the DD category (7.5% of 213 species for which EVS can be calculated; Table 13). This low percentage of DD species might indicate that the herpetofauna of Jalisco is fairly well known. Examination of the data in Table 13, however, demonstrates that all 16 are country endemics. Twelve of the 16 EVS (75.0%) values for these species fall into the high vulnerability category; the other four lie in the upper half of the medium vulnerability category (EVS of 12 and 13). These four medium vulnerability species are *Craugastor occidentalis*, *Dermophis oaxacae*, *Coniophanes lateritius*, and *Geophis sieboldi*, all of which are relatively broadly distributed ecologically (Table 13). It can be argued that all of the 12 high vulnerability species should be placed among the IUCN threat categories and the four medium vulnerability species in the NT category. Nonetheless, it is not instrumental to the understanding of the conservation needs of these species for them to remain in the DD category, as noted by other authors (Howard and Bickford, 2014; Johnson et al., 2015a; Mata-Silva et al., 2015; Nori and Loyola, 2015; Terán-Juárez et al., 2016; Woolrich-Piña et al., 2016).

Table 13. Environmental Vulnerability Scores (EVS) for members of the herpetofauna of Jalisco, Mexico, allocated to the IUCN Data Deficient category. * = country endemic.

Taxa	Environmental Vulnerability Score (EVS)			
	Geographic Distribution	Ecological Distribution	Reproductive Mode/ Degree of Persecution	Total Score
*Craugastor occidentalis**	5	4	4	13
*Eleutherodactylus pallidus**	5	8	4	17
*Lithobates psilonota**	5	8	1	14
*Dermophis oaxacae**	5	3	4	12
*Plestiodon parvulus**	5	7	3	15
*Tantilla cascadae**	6	8	2	16
*Coniophanes lateritius**	5	5	3	13
*Enulius oligostichus**	5	7	3	15
*Geophis bicolor**	5	8	2	15
*Geophis nigrocinctus**	5	8	2	15
*Geophis petersii**	5	8	2	15
*Geophis sieboldi**	5	6	2	13
*Geophis tarascae**	5	8	2	15
*Rena bressoni**	5	8	1	14
*Crotalus lannomi**	6	8	5	19
*Terrapene nelsoni**	5	7	6	18

A significant number of herpetofaunal species in Jalisco have not been evaluated by use of the IUCN criteria. As in earlier studies, we placed these species in an NE (not evaluated) category. Thirty-three such species are included, 15.1% of the 219 native species known from the state. In order to determine why these species have not been evaluated by the IUCN, we placed them in Table 14, along with the calculations for their EVS. These 33 species include three anurans, 11 lizards, 18 snakes, and one turtle. Interestingly, 21 of these species (63.6%) are endemic to Mexico. In light of their distributional status, it is regrettable that they have not been provided with an IUCN rating. Their EVS ratings, however, range from 3 to 18, with about one-half of the species (17) falling into the high vulnerability category (Table 14); these species should be placed in one of the threat categories. The nine low vulnerability species could remain in the LC category, but the seven medium vulnerability species could be placed in the NT category.

Table 14. Environmental Vulnerability Scores (EVS) for members of the herpetofauna of Jalisco, Mexico, currently not evaluated (NE) by the IUCN. Non-native taxa are not included.

Taxa	Environmental Vulnerability Score (EVS)			
	Geographic Distribution	Ecological Distribution	Reproductive Mode/ Degree of Persecution	Total Score
Rhinella horribilis	1	1	1	3
*Eleutherodactylus grunwaldi**	5	7	4	16
*Eleutherodactylus wixarika***	6	8	4	18
*Barisia ciliaris**	5	7	3	15
*Ctenosaura pectinata**	5	4	6	15
Iguana iguana	3	3	6	12
*Holbrookia approximans**	5	6	3	14
*Sceloporus albiventris**	5	8	3	16
*Sceloporus aurantius**	5	8	3	16
*Sceloporus shannonorum**	5	7	3	15
*Sceloporus unicanthalis**	5	8	3	16
*Plestiodon bilineatus**	5	5	3	13
*Plestiodon indubitus**	5	7	3	15
*Holcosus sinister**	5	5	3	13
Boa sigma	3	1	6	10
Drymobius margaritiferus	1	1	6	6
*Lampropeltis polyzona**	5	1	5	11
*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 biscutatus**	2	1	4	7
*Trimorphodon paucimaculatus**	5	6	4	15
Heterodon kennerlyi	3	4	4	11
*Hypsiglena affinis**	5	7	2	14
Hypsiglena jani	1	3	2	6
Imantodes gemmistratus	1	3	2	6
Leptodeira septentrionalis	2	2	4	8
Sibon nebulatus	1	2	2	5
*Epictia bakewelli**	5	4	1	10
*Crotalus armstrongi**	5	8	5	18
Crotalus campbelli	5	7	5	17
Rhinoclemmys pulcherrima	1	4	3	8

Sceloporus bulleri Boulenger, 1894. Buller's Spiny Lizard is a Mexican endemic distributed from Sinaloa and southwestern Durango (Frost et al., 2007), and in the Sierras Jaliscienses and Trans-Mexican Volcanic Belt in Jalisco. This individual was seen at the Reserva de la Biósfera Sierra de Manantlán, in the municipality of Cuautitlán de García Barragán. Wilson et al. (2013a) calculated its EVS as 15, placing it in the lower portion of the high vulnerability category. Its conservation status has been evaluated as Least Concern by the IUCN, but this lizard is not listed by SEMARNAT.
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Plestiodon dugesii (Thominot, 1883). Duges' Skink is a Mexican endemic occurring in the Trans-Mexican Volcanic Belt of Jalisco and Michoacán and the Central Plateau of Jalisco. This individual was encountered in the Sierra del Tigre, in the municipality of Mazamitla. Wilson et al. (2013a) ascertained its EVS as 12, placing it at the upper portion of the medium vulnerability category. Its conservation status is assessed as Vulnerable by the IUCN, and this skink is considered as a species of special protection (Pr) by SEMARNAT.
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Almost two-thirds of the native species (140 of 219 [63.9%]) in Jalisco are allocated to the LC category by the IUCN (Table 15). This proportion is similar to that of the Nayarit herpetofauna (101 of 149 species or 67.8%; Woolrich-Piña et al., 2016). As demonstrated in other MCS papers, this large proportion of LC species does not necessarily mean that the Jaliscan herpetofauna is well protected now and into the future. We placed the 140 Jalisco LC species, along with their EVS scores in Table 15 (one species, *Hydrophis platurus*, does not appear in this table because it is a marine species, for which the EVS measure does not apply). The EVS scores in this table range from 3 to 18, almost the span as for the entire herpetofauna (3–19). When allocated to the three categories of vulnerability, the values and proportions are as follows: low—41 (29.3%); medium—60 (42.9%); and high—39 (27.9%). As shown for the Nayarit herpetofauna, the species presently allocated to the LC category in Jalisco encompass the range from broadly distributed ecologically generalist species such as the anurans *Smilisca baudinii*, *Trachycephalus typhonius*, *Hypopachus variolosus*, and *Lithobates forreri* to relatively narrowly geographically and ecologically distributed species such as the snakes *Dipsas gaigeae*, *Leptodeira punctata*, *L. uribei*, and *Micrurus proximans*. Consequently, it is unlikely that such a broad range of species all deserve to occupy the lowest category of conservation concern, especially in light of the multiplicity of environmental effects that humans have placed on these species. Of the 140 LC species listed in Table 15, 87 (62.1%) are country endemics, and the remaining 53 are non-endemic to Mexico. With respect to geographic distribution, as a group the 140 LC species fall into five of the six subcategories (Wilson et al., 2013a, b), from more restricted to less restricted, as follows: 5 (85; 60.7%); 4 (six; 4.3%); 3 (one; 0.7%); 2 (29; 20.7%); and 1 (19; 13.6%). The proportions of these values are very close to the comparable figures for Nayarit (Woolrich-Piña et al., 2016). As with Nayarit, the largest percentage of species is comprised of Mexican endemics, inasmuch as level 5 includes these species. With reference to ecological distribution, the allocation of the 140 LC species to the eight levels, from more restricted to less restricted, is as follows: 8 (10; 7.1%); 7 (nine; 6.4%); 6 (27; 19.3%); 5 (31; 22.1%); 4 (23; 16.4%); 3 (17; 12.1%); 2 (eight; 5.7%); and 1 (15; 10.7%). Evidently, most of the 140 species (98; 70.0%) occupy from three to six vegetational formations, a similar proportion to that in Nayarit (Woolrich-Piña et al., 2016).

Table 15. Environmental Vulnerability Scores for members of the herpetofauna of Jalisco, Mexico, assigned to the IUCN Least Concern category. Non-native and marine taxa are not included.

Taxa	Environmental Vulnerability Score			
	Geographic Distribution	Ecological Distribution	Reproductive Mode/Degree of Persecution	Total Score
*Anaxyrus compactilis**	5	8	1	14
Anaxyrus debilis	1	5	1	7
Anaxyrus punctatus	1	3	1	5
*Incilius marmoreus**	5	5	1	11
*Incilius mazatlanensis**	5	6	1	12
*Incilius occidentalis**	5	5	1	11
Craugastor augusti	2	2	4	8
*Craugastor vocalis**	5	4	4	13
*Eleutherodactylus nitidus**	5	3	4	12
*Agalychnis dacnicolor**	5	5	3	13
*Dendropsophus sartori**	5	8	1	14
*Diaglena spatulata**	5	7	1	13
Dryophytes arenicolor	2	4	1	7
*Dryophytes eximius**	5	4	1	10
*Exerodonta smaragdina**	5	6	1	12
*Sarcohyla bistincta**	5	3	1	9

Table 15 (continued)

Taxa	Environmental Vulnerability Score			
	Geographic Distribution	Ecological Distribution	Reproductive Mode/Degree of Persecution	Total Score
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 fragilis	1	2	2	5
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 montezumae**	5	7	1	13
*Lithobates pustulosus**	5	3	1	9
*Lithobates spectabilis**	5	6	1	12
*Lithobates zweifeli**	5	5	1	11
Spea multiplicata	1	4	1	6
*Ambystoma rosaceum**	5	8	1	14
*Ambystoma velasci**	5	4	1	10
*Barisia imbricata**	5	6	3	14
Elgaria kingii	2	5	3	10
Gerrhonotus liocephalus	2	1	3	6
Basiliscus vittatus	1	3	3	7
*Norops nebulosus**	5	5	3	13
Coleonyx elegans	2	3	4	9
*Heloderma horridum**	5	4	5	14
Mabuya brachypoda	1	2	3	6
Phrynosoma asio	2	6	3	11
*Phrynosoma orbiculare**	5	4	3	12
*Sceloporus aeneus**	5	5	3	13
*Sceloporus asper**	5	6	3	14
*Sceloporus bulleri**	5	7	3	15
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 insignis**	5	8	3	16
Sceloporus jarrovii	2	6	3	11

Table 15 (continued)

Taxa	Environmental Vulnerability Score			
	Geographic Distribution	Ecological Distribution	Reproductive Mode/Degree of Persecution	Total Score
Sceloporus melanorhinus	2	4	3	9
*Sceloporus minor**	5	6	3	14
*Sceloporus nelsoni**	5	5	3	13
Sceloporus poinsettii	4	5	3	12
*Sceloporus pyrocephalus**	5	4	3	12
*Sceloporus scalaris**	5	4	3	12
*Sceloporus spinosus**	5	4	3	12
*Sceloporus torquatus**	5	3	3	11
*Sceloporus utiformis**	5	7	3	15
*Urosaurus bicarinatus**	5	4	3	12
*Urosaurus gadovi**	3	6	3	12
*Phyllodactylus lanei**	5	7	3	15
Plestiodon callicephalus	2	7	3	12
*Plestiodon lynxe**	5	2	3	10
Scincella assata	2	2	3	7
*Aspidoscelis communis**	5	6	3	14
*Aspidoscelis costata**	5	3	3	11
Aspidoscelis deppii	1	4	3	8
Aspidoscelis gularis	2	4	3	9
*Aspidoscelis lineattissima**	5	6	3	14
*Xantusia sanchezi**	5	8	3	16
*Conopsis biserialis**	5	6	2	13
*Conopsis lineata**	5	6	2	13
*Conopsis nasus**	5	4	2	11
Drymarchon melanurus	1	1	4	6
Ficimia publia	4	3	2	9
Gyalopion canum	4	3	2	9
*Lampropeltis mexicana**	5	7	3	15
*Leptophis diplotropis**	5	5	4	14
Masticophis bilineatus	2	5	4	11
Masticophis flagellum	1	3	4	8
Masticophis mentovarius	1	1	4	6
Masticophis taeniatus	1	5	4	10
Mastigodryas melanolomus	1	1	4	6
*Pituophis deppei**	5	5	4	14
*Pseudoficimia frontalis**	5	5	3	13
*Salvadora bairdi**	5	6	4	15

Table 15 (continued)

Taxa	Environmental Vulnerability Score			
	Geographic Distribution	Ecological Distribution	Reproductive Mode/Degree of Persecution	Total Score
*Salvadora mexicana**	5	6	4	15
Senticolis triaspis	2	1	3	6
*Sonora mutabilis**	5	6	3	14
*Symphimus leucostomus**	5	6	3	14
*Tantilla bocourti**	5	2	2	9
*Tantilla calamarina**	5	5	2	12
Tantilla wilcoxi	2	6	2	10
*Trimorphodon tau**	5	4	4	13
Clelia scytalina	4	5	4	13
*Conophis vittatus**	2	5	4	11
Diadophis punctatus	1	1	2	4
*Dipsas gaigeae**	5	8	4	17
Enulius flavitorques	1	1	3	5
*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
*Leptodeira uribei**	5	8	4	17
*Manolepis putnami**	5	5	3	13
*Pseudoleptodeira latifasciata**	5	5	4	14
*Rhadinaea hesperia**	5	3	2	10
*Rhadinaea laureata**	5	5	2	12
*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 browni	2	1	5	8
*Micrurus distans**	5	4	5	14
*Micrurus laticollaris**	5	4	5	14
*Micrurus proximans**	5	8	5	18
Rena humilis	4	3	1	8
Loxocemus bicolor	1	5	4	10
*Storeria storerioides**	5	4	2	11
Thamnophis cyrtopsis	2	1	4	7
Thamnophis eques	2	2	4	8
*Thamnophis errans**	5	7	4	16

Table 15 (continued)

Taxa	Environmental Vulnerability Score			
	Geographic Distribution	Ecological Distribution	Reproductive Mode/Degree of Persecution	Total Score
*Thamnophis pulchrilatus**	5	6	4	15
*Thamnophis scalaris**	5	5	4	14
*Thamnophis validus**	5	3	4	12
*Crotalus aquilus**	5	6	5	16
*Crotalus basiliscus**	5	6	5	16
Crotalus lepidus	2	5	5	12
Crotalus molossus	2	1	5	8
*Crotalus polystictus**	5	6	5	16
Crotalus pricei	2	7	5	14
Crotalus scutulatus	2	4	5	11
*Kinosternon chimalhuaca**	5	8	3	16
Kinosternon hirtipes	2	5	3	10
*Kinosternon integrum**	5	3	3	11

Given the results of our EVS analysis for the 140 LC species in Jalisco (Table 15), it appears logical to retain the 101 low and medium vulnerability species in the LC category or perhaps, in some cases, transfer them to the NT category. The 40 high vulnerability species, however, should be allocated to one of the three threat categories. These species and their respective EVS calculations are as follows (* = endemic to Mexico):

*Anaxyrus compactilis** (5+8+1 = 14)
*Dendropsophus sartori** (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 bulleri** (5+7+3 = 15)
*Sceloporus heterolepis** (5+6+3 = 14)
*Sceloporus insignis** (5+8+3 = 16)
*Sceloporus minor** (5+6+3 = 14)
*Sceloporus utiformis** (5+7+3 = 15)
*Phyllodactylus lanei** (5+7+3 = 15)
*Aspidoscelis communis** (5+6+3 = 14)
*Aspidoscelis lineattissima** (5+6+3 = 14)
*Xantusia sanchezi** (5+8+3 = 16)
*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)
*Symphimus leucostomus** (5+6+3 = 14)
*Dipsas gaigeae** (5+8+4 = 17)
*Leptodeira punctata** (5+8+4 = 17)
*Leptodeira splendida** (5+5+4 = 14)
*Leptodeira uribei** (5+8+4 = 17)
*Pseudoleptodeira latifasciata** (5+5+4 = 14)
*Tropidodipsas philippi** (5+5+4 = 14)
Micruroides euryxanthus (4+6+5 = 15)
*Micrurus distans** (5+4+5 = 14)
*Micrurus laticollaris** (5+4+5 = 14)
*Micrurus proximans** (5+8+5 = 18)
*Thamnophis errans** (5+7+4 = 16)
*Thamnophis pulchrilatus** (5+6+4 = 15)
*Thamnophis scalaris** (5+5+5 = 14)
*Crotalus aquilus** (5+6+5 = 16)
*Crotalus basiliscus** (5+6+5 = 16)
*Crotalus polystictus** (5+6+5 = 16)
Crotalus pricei (2+7+5 = 14)
*Kinosternon chimalhuaca** (5+8+3 = 16)

Of these 40 species, all but two (*Micruroides euryxanthus* and *Crotalus pricei*) are country endemics, and we recommend that the four species with EVS scores of 17 or 18 be transferred to the CR category, the 15 species with scores of 15 and 16 be placed in the EN category, and the 21 species with scores of 14 be allocated to the VU category.

Aspidoscelis communis (Cope, 1878). The Colima Giant Whiptail is a Mexican endemic ranging from southern Nayarit to Jalisco, Michoacán, and Guerrero (Ponce-Campos and García-Aguayo, 2007). This individual was seen at the Reserva de la Biósfera Chamela-Cuixmala, in the municipality of La Huerta. Wilson et al. (2013a) determined its EVS as 14, placing it at the lower limit of the high vulnerability category. Its conservation status is assessed as Least Concern by the IUCN, and this teiid is regarded as a species of special protection (Pr) by SEMARNAT. © Francisco Javier Muñoz-Nolasco

Xantusia sanchezi Bezy and Flores-Villela, 1999. Sanchez's Night Lizard is a Mexican endemic distributed from southwestern Zacatecas to central Jalisco. This individual was photographed at Huaxtla, in the municipality of Zapopan. Wilson et al. (2013a) calculated its EVS as 16, placing it in the middle of the high vulnerability category. Its conservation status has been evaluated as Least Concern by the IUCN, but this species is considered as endangered (P) by SEMARNAT. © Daniel Cruz-Sáenz

RELATIVE HERPETOFAUNAL PRIORITY

Johnson et al. (2015a) introduced the concept of Relative Herpetofaunal Priority (RHP), a simple measure of the relative importance of the herpetofaunal members reported for any geographical entity (e.g., the state of Chiapas, Mexico, as dealt with in Johnson et al., 2015a), as demonstrated by (1) the proportion of state and country endemics as compared with the entire physiographic regional herpetofauna, and by (2) the absolute number of high category EVS species in each regional herpetofauna.

We built two tables to determine the RHP for the Jalisco herpetofauna, one for the endemicity values (Table 16) and the other for the high category EVS values (Table 17). The data in Table 16 indicate that the amount of endemicity (86 country endemics of a total of 116 species [74.1%]) is highest in the Trans-Mexican Volcanic Belt, thus providing a rank of one for this region. The remainder of the regions (and the relative size of their respective herpetofaunal elements) in rank order from highest to lowest (2 to 7) are as follows: Sierras Jaliscienses (68 of 97 species, 70.1%); Central Plateau (62 of 94 species; 66.0%); Sierra Madre Occidental (59 of 92 species; 64.1%); Pacific Coastal Plain (52 of 98 species; 53.1%); Tepalcatepec Depression (30 of 38 species; 78.9%); and Sierra de Coalcomán (27 of 37 species; 73.0%).

Table 16. Numbers of herpetofaunal species of four distributional status categories among the seven physiographic regions of Jalisco. Rank determined by adding the state and country endemics.

Physiographic Regions	Distributional Status Categories				Totals	Rank Order
	Non-endemics	Country Endemics	State Endemics	Non-natives		
Pacific Coastal Plain	43	52	—	3	98	5
Sierra Madre Occidental	33	58	1	—	92	4
Sierra Jaliscienses	27	67	1	2	97	2
Trans-Mexican Volcanic Belt	28	86	—	2	116	1
Sierra de Coalcomán	10	27	—	—	37	7
Central Plateau	30	61	1	2	94	3
Tepalcatepec Depression	8	30	—	—	38	6

In Table 17, we placed the number of herpetofaunal species in each of the three EVS categories, i.e., low, medium, and high. Based on the total number of high category species, the most important physiographic region (occupying rank one) is the Trans-Mexican Volcanic Belt, with 44 high category EVS species of a total of 114 (38.6%). The other regions (and the number of their respective high category EVS values) are as follows: Sierra Madre Occidental (35; 38.0% of 92 species); Sierras Jaliscienses (31; 33.0% of 94); Pacific Coastal Plain (27; 30.3% of 89); Central Plateau (27: 29.3% of 92); Tepalcatepec Depression (14; 36.8% of 38); and Sierra de Coalcomán (12; 31.6% of 38).

Table 17. Number of herpetofaunal species in the three EVS categories among the seven physiographic regions of Jalisco, Mexico. Rank determined by the relative number of high EVS species. Marine and non-native species are excluded.

Physiographic Provinces	Low	Medium	High	Totals	Rank Order
Pacific Coastal Plain	31	31	27	89	4
Sierra Madre Occidental	24	33	35	92	2
Sierra Jaliscienses	27	36	31	94	3
Trans Mexican Volcanic Belt	24	46	44	114	1
Sierra de Coalcomán	10	16	12	38	6
Central Plateau	24	41	27	92	4
Tepalcatepec Depression	9	15	14	38	5

Salvadora mexicana (Duméril, Bibron, and Duméril, 1854). The Mexican Patch-nosed Snake is a Mexican endemic occurring in west-central Mexico from Nayarit southward to Oaxaca and eastward to Morelos, Guanajuato, and Puebla (Wallach et al., 2014). This individual was found at Chamela, in the municipality of La Huerta. 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 judged as Least Concern by the IUCN, and this snake is considered a species of special protection (Pr) by SEMARNAT. © Daniel Cruz-Sáenz

Trimorphodon biscutatus (Duméril, Bibron, and Duméril, 1854). The Western Lyre Snake is a Mexican endemic ranging in southwestern Mexico from Jalisco, Colima, and Michoacán through Puebla on to Guerrero, Oaxaca, and Chiapas (Wallach et al., 2014). This individual was found in the Reserva de la Biósfera Chamela-Cuixmala, in the municipality of La Huerta. Wilson et al. (2013a) determined its EVS as 7, placing it in the middle of the low vulnerability category. Its conservation status has not been determined by the IUCN, and this snake is not considered a distinct species by SEMARNAT. © Elí García-Padilla

The rankings provided by using these two RHP methods (country and state endemic numbers and high category EVS values, respectively) are not identical, but are similar to one another, as indicated below (note that two regions hold the rank of four with reference to the high category EVS values):

Trans-Mexican Volcanic Belt (1, 1)

Sierras Jaliscienses (2, 3)

Central Plateau (3, 4)

Sierra Madre Occidental (4, 2)

Pacific Coastal Plain (5, 4)

Tepalcatepec Depression (6, 5)

Sierra de Coalcomán (7, 6)

Given the results of this RHP analysis, obviously the physiographic region with the highest priority is the Trans-Mexican Volcanic Belt because it harbors the highest number of country endemics and of high category EVS species. The Sierras Jaliscienses is the next most important region, with the next largest number of country (and state) endemics and the third highest number of high category EVS species. This conclusion perhaps was expected, given that the Trans-Mexican Volcanic Belt is the region with the largest herpetofauna in the state and the Sierra Jaliscienses is one species away from being the region with the second largest herpetofauna. At the other extreme, the two lowest priority regions are the Tepalcatepec Depression and the Sierra de Coalcomán, which also are the regions with the lowest species number (38). We suggest that the RHP methodology is a simple, general means that can help decide how to allocate scarce conservation funds, but this measure is not intended to ignore the conservation needs of other physiographic regions.

Dipsas gaigeae (Oliver, 1937). Gaige's Snail-eater is a Mexican endemic ranging in western Mexico from southwestern Jalisco through Colima and into Michoacán (Wallach et al., 2014). This individual came from the Reserva de la Biósfera Chamela-Cuixmala, in the municipality of La Huerta. Wilson et al. (2013a) determined its EVS as 17, placing it in the middle portion of the high vulnerability category. Its conservation status has been evaluated as Least Concern by the IUCN, but this snake is regarded as a species of special protection (Pr) by SEMARNAT.
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GLOBAL ENVIRONMENTAL ISSUES AND PROTECTED AREAS IN JALISO

Human population growth continues apace. In assessing the trends of this growth, the Population Reference Bureau and its annual World Population Data Sheet (WPDS, 2016) are extremely helpful and should be required reading on a continuing basis for any and all conservation biologists. The current WPDS is the 2016 edition, and in any given year each new edition is released after mid-year. The most current edition indicates that global population has grown to 7.418 billion people, an increase of 0.082 billion people (82 million) from the mid-2015 level. The current natural increase per year, however, is 89,795,313, which results from a subtraction of 57,387,752 deaths from 147,183,065 births. This natural increase is scheduled to produce a total estimated global population of 9.869 billion (just shy of 10 billion) at mid-century (Population Reference Bureau World Population Data Sheet [PRB-WPDS], 2016).

As professional herpetologists and conservation biologists, these population growth trends are the most significant factor that will determine the fate of life on our planet. All other concerns more familiar to the world's people (e.g., national economic health, immigration policies, employment trends, gender equity, and religious freedom) are subsidiary in importance to the reality of human global population growth trends. This even is the case with global climate change, which in the best case scenario is about as close, as most political leaders come to a full appreciation of the fate awaiting all life on the planet based on the overarching problem of uncontrolled human population growth. Not only are these lesser problems subsidiary in importance to human overpopulation, but they all arise from and grow in intensity commensurate with the rate of human population growth. Consequently, they are symptoms of the global tragedy of unchecked human overpopulation. Attending to the symptoms of these problems alone does not solve them (Wilson and McCranie, 2003), and serves to provide a measure of mental relief that only allows them to become more severe with the passage of time.

Leptodeira uribei (Ramírez-Bautista and Smith, 1992). Uribe's Cat-eyed Snake is "distributed along the coastal plain in Michoacán, and northward through the lowlands to Jalisco and southward to Oaxaca (Alvarado-Díaz et al., 2013). This individual was found in the Reserva de la Biósfera Chamela-Cuixmala, in the municipality of La Huerta. 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 determined as Least Concern by the IUCN, but this snake is regarded as a species of special protection (Pr) by SEMARNAT. © Elí García-Padilla

Manolepis putnami (Jan, 1863). The Thin-scaled Snake is a Mexican endemic distributed 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 was found at El Tuito, in the municipality of Cabo Corrientes. 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 evaluated as Least Concern by the IUCN, but this snake is not listed by SEMARNAT. © Francisco Javier Muñoz-Nolasco

Micrurus distans (Kennicott, 1860). The West Mexican Coralsnake occurs from "east-central Sonora and southwestern Chihuahua south along the Pacific slope to the central coast of Guerrero" (Rorabaugh and Lemos-Espinal, 2016). This individual was found in the Reserva de la Biósfera Chamela-Cuixmala, in the municipality of La Huerta. Wilson et al. (2013a) determined its EVS as 14 at the lower limit of the high vulnerability category. Its conservation status is calculated as Least Concern by the IUCN, but this elapid is considered as a species of special protection (Pr) by SEMARNAT. © Elí García-Padilla

Interestingly, humans are the most curious species on the planet, and studying our own species is our most dedicated undertaking. This concentration of interest is the result of our physical and mental evolution; the physical evolution provided us with a bipedal posture and anterior appendages gifted with an opposable thumb, and the mental evolution has given us rationality. This marriage has allowed us achieve the appearance of a mastery over everything else on the planet, including the intricate intercoupling of the world's ecosystems. The operative word in that last phrase is "appearance," because what passes for mastery actually is an illusion created by a misunderstanding that our physical and mental characteristics allow us to sidestep the controls that exist over the world's creatures. Humans are the result of the same processes that have shaped all life on our planet, which is the reality; the rest is only an illusion, or perhaps better put, a delusion.

From a demographic standpoint, Mexico constitutes a portion of the less developed nations of the world, and is the tenth most populous nation (PRB-WPDS 2016). In Latin America, Mexico is second in population (with 129 million people) to Brazil (with 206 million) and is the most populous nation in Mesoamerica (with a regional population of 175 million) (PRB-WPDS 2016). Its capital, Mexico City, is the world's 12th largest city, with a population of 20,063,000, and Latin America's second largest city after São Paulo with 20,365,000 (worldatlas.com; accessed 18 November 2016). With a total fertility rate of 2.2 (0.3 points below the global rate), the population of Mexico is predicted to grow to about 164 million by mid-century. Its percentage of urban population is 79, the highest for Mesoamerica; that of Costa Rica is next at 77%. If the urban population was totally dependent on the rural population for food production (i.e., discounting the effect of food importation), then the ratio of the one to the other would be 79:21 (3.8). These figures compare favorably with those for the two countries in Northern America, i.e., Canada (at 82%) and the United States of America (at 81%). In this respect, Mexico is more like the more developed world, where the percentage of urbanization is 78%, than the less developed world, where the percentage is 49% (PRB-WPDS 2016).

The higher the percentage of urbanization in a country, the lower its percentage of ruralization. Naturally, the percentage of undisturbed land in any given country depends on the rate of population increase in both the urban and rural sectors. In Mexico, the percentage of terrestrial land under protected area status, based on 2014 figures, is 13, which is the second lowest figure for Mesoamerica, compared to 8% for El Salvador, the nation in this region in which land transformation has proceeded to the greatest degree. In this respect, Mexico is more like its neighbor to the north, the United States, with a figure of 14%. Apart from El Salvador, the percentage of land under protected area status ranges from 21 in Panama to 37 in Belize and Nicaragua (PRB-WPDS 2016).

Micruroides euryxanthus (Kennicott, 1860). The Sonoran Coralsnake inhabits "Arizona and southwestern New Mexico south through Sonora and southwestern Chihuahua to the vicinity of Mazatlán, Sinaloa" (Rorabaugh and Lemos-Espinal, 2016). This species also is known from the states of Nayarit (Woolrich-Piña et al., 2016) and Jalisco (Cruz-Sáenz et al., 2008). This individual was found at Techaluta de Montenegro, in the municipality of San Cristobal de la Barranca. Wilson et al. (2013a) calculated its EVS as 15, placing it in the lower portion of the high vulnerability category. Its conservation status has been judged as Least Concern by the IUCN, and this species is considered as threatened (A) by SEMARNAT. © Sergio Guerrero-Vázquez

Thamnophis cyrtopsis (Kennicott, 1860). The Black-necked Gartersnake is distributed from "southern Colorado and Utah, in the United States, southward to Guatemala. In Mexico, it occurs from Sonora to Oaxaca along the Sierra Madre Occidental and from Chihuahua southeastward through the Sierra Madre Oriental to eastern Oaxaca" (Lemos-Espinal and Dixon, 2013); this species also occurs in Chiapas (Johnson et al., 2015a). Wilson et al. (2013a) determined its EVS as 7, placing it in the middle of the low vulnerability category. Its conservation status has been determined as Least Concern by the IUCN, but this species is considered as threatened (A) by SEMARNAT.

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Thamnophis melanogaster (Peters, 1864). The Black-bellied Garternake is a Mexican endemic occurring from "southwestern Chihuahua and adjacent Sonora south-southeastward to the Valley of Mexico, western Querétaro, and southern San Luis Potosí" (Lemos-Espinal and Dixon, 2013). This individual came from the Presa Las Rucias, near the facilities of the Centro Universitario de Tonalá of the Universidad de Guadalajara, in the municipality of Tonalá. Wilson et al. (2013a) calculated its EVS as 15, placing it in the lower portion of the high vulnerability category. Its conservation status has been evaluated as Endangered by the IUCN, and this species is listed as threatened (A) by SEMARNAT.

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In order to assess the robustness of the state's system of protected areas, we gathered information on features we believe to be of value in such assessments, as used in previous papers of the MCS (Terán-Juárez et al., 2016; Woolrich-Piña et al., 2016; Nevárez-de los Reyes et al., 2016). We placed this information in Table 18, where we list 20 protected sites with a combined area of 7,149 km^2, or about 9.5% of the total area of the state. This figure is about 3.5% less than the average for the country, and thus an increase in the number of protected areas would appear favorable before the land is converted into anthropogenic habitats.

Besides considering the size of an area for protection, the amount of land represented within each of the seven physiographic regions we recognize in the state should be examined. Of the 20 protected areas in the state (Table 18), only four regions are represented, i.e., the Planicie Costera del Pacífico (Pacific Coastal Plain), the Sierras Jaliscienses, the Sierra Madre Occidental, and the Eje Neovolcánico (Trans-Mexican Volcanic Belt). Thus, one of the most important steps to improve the system of protected areas in the state is to add sizeable portions within the Central Plateau, Sierra de Coalcomán, and the Tepalcatepec Depression regions.

The 20 protected areas fall under municipal (three), state (eight), and national (nine) jurisdiction. The municipal areas include two Áreas de Protección Hidrológica and one entitled Formaciones Naturales de Interés Municipal; all are relatively small, ranging in size from 0.9 to about 16 km^2. As their category name indicates, these areas were established to protect water resources. The eight state areas include three Áreas de Protección Hidrológica, two Áreas de Protección de Flora y Fauna, one Área de Conservación Ecológica, and two Parques Estatales; these areas generally are larger than the municipal areas, ranging in size from about 2 to 231 km^2. The national areas include five Santuarios (linear coastal areas established for protection of sea turtles), two Reservas de la Biósfera, one Parque Nacional, and one Área de Protección de Recursos Naturales; these areas are the largest, ranging in size from 64.3 to 3,921 km^2. The establishment of additional protected areas in the Central Plateau, Sierra de Coalcomán, and the Tepalcatepec Depression, therefore, could be administered at the municipal, state, or national levels.

Only two of the 20 protected areas in Table 18 were established prior to 1980. The older of these two areas, Parque National Volcán Nevado de Colima, was established in 1936 and the Área de Protección de Recursos Naturales Cuenca Alimentadora del Distrito Nacional de Riego 043 was created in 1949. PN Volcán Nevado de Colima provides protection to the volcano (also known as Tzapotépetl), whose peak represents Jalisco's highest point, at 4,227 m (measurement taken from Google Earth; accessed 19 November 2016) and which is part of the Colima Volcanic Complex and also includes Volcán de Colima, at 3,820 m. The Colima Volcanic Complex is a system of overlapping stratovolcanoes that lies on the border of Jalisco and Colima, with most of the complex lying within Jalisco (www.wikipedia.org; accessed 19 November 2016). The remaining protected areas were decreed between 1980 and 2016.

Public support for any system of protected areas is enhanced by allowing people to visit these areas for enjoyment and to learn from them. For this to happen, facilities for administering and protecting these areas must be available for all people who work in and visit these areas. Within the existing system in Jalisco, however, only four of the 20 areas have been provided with all of these components (20.0%).

The ability of the protected areas system to provide actual protection to ecosystems often is hampered by the presence of landowners within the system. Of the 20 protected areas in Jalisco, 13 (65.0%) are occupied to some degree by landowners. Depending on the extent to which these landowners are transforming the landscape within these areas, steps should be taken to appropriately compensate these people for their properties so they can acquire equivalent properties elsewhere in the state, but outside the protected areas system.

One of the first steps for properly using the various elements in a protected areas system is to draw up management plans to guide the actions of their conservation managers. In Jalisco, however, management plans only have been drawn up for four of the 20 areas. Thus, management plans need to be produced for 80.0% of the state's protected areas, and should become one of the major administrative goals of the protected areas system.

Our principal interest in writing this paper has been to assess the conservation status of the members of the herpetofauna. A basic consideration in this sort of effort is to undertake reasonably complete herpetofaunal surveys to determine the efficacy of these areas to protect the members of the Jaliscan herpetofauna, and to determine where other areas should be established to protect the segment of the herpetofauna not yet represented in the protected areas system. The data in Table 18 indicate that only seven of the 20 areas (35.0%) have been subjected to complete herpetofaunal surveys. Thus, a future goal would involve completing surveys for the 13 remaining areas by knowledgeable field herpetologists.

Table 18. Characteristics of Natural Protected Areas in Jalisco, 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
La Primavera	Área de Protección de Flora y Fauna	6 March 1980	30,500	Tala, Zapopan, Tlajomulco de Zuñiga	State	Trans-Mexican Volcanic Belt	A, R, S, V	Yes	Yes	Yes
Estero El Salado	Área de Conservación Ecológica	27 July 2000	196	Puerto Vallarta	State	Pacific Coastal Plain	A, S, V	No	Yes	No
Sierra de Manantlán	Reserva de la Biósfera	23 March 1987	139,577	Autlán, Cuautitlán, Casimiro Castillo, Tolimán, Tuxcacuesco	National	Sierras Jaliscienses	A, S, V	Yes	No	Yes
Sierra de Quila	Área de Protección de Flora y Fauna	4 August 1982	15,192	Tecolotlán, Tenammaxtlán, San Martín Hidalgo, Cocula	State	Trans-Mexican Volcanic Belt	A, R, S, V	Yes	Yes	No
Volcán Nevado de Colima	Parque Nacional	5 September 1936	6,430	Tuxpan, Zapotitlán de Vadillo, San Gabriel, Zapotlán el Grande	National	Trans-Mexican Volcanic Belt	A, R, S, V	No	No	Yes
Bosque El Nixticuil-San Esteban-El Diente	Área de Protección Hidrológica	24 February 2007	1,591	Zapopan	Municipal	Trans-Mexican Volcanic Belt	S	No	No	No
Barranca del Río Santiago	Área de Protección Hidrológica	7 October 2004	17,729	Zapopan	State	Sierra Madre Occidental	S	Yes	Yes	No
Los Colomos	Área de Protección Hidrológica	24 June 2007	90	Guadalajara	Municipal	Trans-Mexican Volcanic Belt	A, R, S, V	No	Yes	No
Piedras Bola	Formaciones Naturales de Interés Municipal	30 December 1993	256	Ahualulco del Mercado	Municipal	Trans-Mexican Volcanic Belt	A, S	No	No	No
Sierra del Águila	Área de Protección Hidrológica	4 August 1982	20,746	Etzatlán, Ameca, Ahualulco del Mercado	State	Trans-Mexican Volcanic Belt	S	Yes	No	No

Cerro Viejo-Chupinaya-Los Sabinos	Área de Protección Hidrologica	29 October 1986	23,146	Chapala, Ixtlahuacán de los Membrillos, Jocotepec, Tlajomulco de Zuñiga	State	Central Plateau	S	Yes	No	No
Chamela-Cuixmala	Reserva de la Biósfera	29 October 1986	13,141	La Huerta	National	Pacific Coastal Plain	A, S, V	No	Yes	Yes
Playón de Mismaloya	Santuario	29 October 1986	69 km	La Huerta	National	Pacific Coastal Plain	None	Yes	No	No
Playa Teopa	Sancuario	29 October 1986	6 km	La Huerta	National	Pacific Coastal Plain	None	Yes	No	No
Playa Cuixmala	Sancuario	29 October 1986	6 km	La Huerta	National	Pacific Coastal Plain	None	Yes	No	No
Playa El Tecuán	Sancuario	29 October 1986	7 km	La Huerta	National	Pacific Coastal Plain	None	Yes	No	No
Islas de la Bahía de Chamela	Sancuario	13 June 2002	1,981	La Huerta	National	Pacific Coastal Plain	None	Yes	Yes	No
Bosque Mesófilo Nevado de Colima	Parque Estatal	11 July 2009	7,213	San Gabriel, Zapotitlán de Vadillo, Tuxpan, Zapotlán el Grande	State	Trans-Mexican Volcanic Belt	A, R, S, V	Yes	No	No
Cuenca Alimentadora del Distrito Nacional de Riego 043	Área de Protección de Recursos Naturales	3 August 1949	392,115	Ameca, Atenguillo, Bolaños, Hostotipaquillo, Ixtlahuacán del Río, Mezquitic, Puerto Vallarta, Tequila, Villa Guerrero, Villa Hidalgo	National	Sierra Madre Occidental, Sierras Jaliscienses, Trans-Mexican Volcanic Belt,	None	Yes	No	No
Bosque de Arce	Parque Estatal	30 January 2016	150	Talpa de Allende	State	Sierras Jaliscienses	None	No	No	No

In summarizing our analysis of the characteristics of the protected areas of Jalisco (Table 18), currently no area contains all of the features we deem necessary for a fully functioning natural protected area. One area that looks rather good on paper, however, is the Área de Protección de Flora y Fauna La Primavera, a 305 km^2 state-level entity located in the municipalities of Tala, Tlajomulco de Zúñiga, and Zapopan in the Trans-Mexican Volcanic Belt. This area was established to protect the flora and fauna of the so-called Bosque la Primavera, which encircles the caldera of the Sierra de Primavera volcano. Nonetheless, this area lies on the western periphery of the state capital, Guadalajara, and is subject to the usual array of environmental problems resulting from urban sprawl. Additionally, this area also has had a history impacted by political decisions since its initial establishment in 1934. That year, President Lázaro Cárdenas declared as a Forest Protection Zone approximately 10,000 km^2 surrounding the city of Guadalajara, which included the Bosque La Primavera. In 1963, the Forestry Commission of the State of Jalisco established Bosque La Primavera as a state park, a move supported the following year by the federal government. In 1970, however, state governmental officials terminated 36 years of protection and declared this area available for public use, including tourists, which set the stage for fragmentation and urbanization. Two years later, the region was designated as an "urban reserve" and urbanization followed immediately thereafter. In 1980, however, the region was reestablished as a Zona de Protección Forestal y Refugio de Fauna Silvestre. In 1992, an ecological center was established within the area by the University of Guadalajara for use in environmental education (www.wikipedia.org; accessed 8 December 2016). As expected, however, these positive steps did not bring an end to the anthropogenic impact on the Bosque La Primavera. The immediate areas around the adjacent capital have continued to grow at an alarming rate, leading to the expansion of housing developments, accompanied by damage due to the attempted establishment of geothermal facilities, extraction of material for use as fill, illegal hunting, unregulated deforestation, fires, overgrazing, and motorcycling (www.wikipedia.org; accessed 8 December 2016). Plans to address these numerous environmental issues were drawn up during a seminar entitled "La Primavera, conservando en colectivo" held in April of 2016. It remains to be seen how effective these plans will be.

Crotalus lepidus (Kennicott, 1861). The Rock Rattlesnake is distributed from southeastern Arizona, west-central and southern New Mexico, and much of southwestern Texas, in the United States, and in Mexico along the Sierra Madre Occidental from Chihuahua and Sonora southward to eastern Nayarit and Durango, and southward to western and central San Luis Potosí and westward to Zacatecas and Aguascalientes (Campbell and Lamar, 2004; Bryson et al., 2014), as well as northern Jalisco (Wallach et al., 2014). This individual was found at the Volcán de Tequila, in the municipality of Tequila. Wilson et al. (2013a) calculated its EVS as 12, placing it in the upper portion of the medium vulnerability category. Its conservation status has been evaluated as Least Concern by the IUCN, and this snake is listed as a species of special protection (Pr) by SEMARNAT. © Francisco Javier Muñoz-Nolasco

As anyone who has studied the design and implementation of protected areas knows, providing land with protected area status does not mean much if the protected areas only exist on paper (the so-called paper parks) or if these areas are beset with persistent environmental impacts, as in the example discussed above. Even though a system of such parks might look good on paper, this does not mean that the protected areas actually are protected, and that the ecosystems within these areas are allowed to function naturally. Protected areas have been established because, as their name implies, they require protection from encroachment by humans who desire to use the resources within these areas for their own support and enrichment; the use of this term, therefore, does not indicate that these areas actually are protected. In Mesoamerica, such encroachment typically takes the form of slash-and-burn transformation of natural vegetation into crop fields on which subsistence agriculture is practiced, but also can result from numerous other environmental "insults," as discussed above in the section entitled "Principal Environmental Problems."

As noted above, slightly more than one-third of the protected areas examined in Table 18 have received complete herpetofaunal surveys. To determine the extent of the representation of the Jalisco herpetofauna among the surveyed areas, however, we assembled the data from the available surveys, no matter their degree of completion, in Table 19 and summarize these data in Table 20. Herpetofaunal listings are included for 17 areas. The data in Table 20 indicate that a total of 155 species have been recorded from these areas, which represents 69.5% of the species recorded in the entire country. The highest number of species (83) is recorded from Reserva de la Biósfera Chamela-Cuixmala, with numbers of 50 or higher recorded from Área de Protección de Flora y Fauna Bosque La Primavera (50), Área de Protección de Flora y Fauna Sierra de Quila (67), Área de Protección Hidrológica Barranca del Río Santiago (50), and Formaciones Naturales de Interés Municipal Piedras Bola (55). The total of 155 species includes 95 country endemics (66.9% of 142 species), two state endemics (100% of two species), 56 non-endemics (74.7% of 75 species), and two non-natives (50.0% of four species). Since 153 native species have been recorded from 17 protected areas (69.9% of the 219 native species in the state), a major goal for herpetofaunal conservation should be the attempt to locate sustainable populations of the remaining 66 native species currently not known to inhabit any protected area, including 49 country endemics and 17 non-endemics.

Rhinoclemmys pulcherrima (Gray, 1855). The Painted Wood Turtle is distributed 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 encountered at El Tuito, in the municipality of Cabo Corrientes. Wilson et al. (2013a) calculated its EVS as 8, placing it in the upper portion of the low vulnerability category. Its conservation status has not been determined by the IUCN, but this species is listed as threatened (A) by SEMARNAT.
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Table 19. Distribution of herpetofaunal species in Natural Protected Areas of Jalisco, Mexico, based on herpetofaunal surveys. Abbreviations are as follows: * = species endemic to Mexico; ** = species endemic to Jalisco; and *** = non-native species.

	Natural Protected Areas																
Taxa	**La Primavera**	**Estero El Salado**	**Sierra de Manantlán**	**Sierra de Quila**	**Volcán Nevado de Colima**	**Bosque El Nixticuil-San Sebastian-El Diente**	**Barranca del Río Santiago**	**Los Colomos**	**Piedras Bola**	**Sierra de Aguila**	**Cerro Viejo-Chupinaya-Los Sabinos**	**Chamela-Cuitzmala**	**Playón de Mismaloya**	**Islas de la Bahía de Chamela**	**Bosque Mesófilo Nevado de Colima**	**Bosque de Arce**	**Cuenca Alimentadora del Distrito Nacional de Riego 043**
Anura (34 species)																	
Bufonidae (5 species)																	
*Anaxyrus compactilis**	+																
*Incilius marmoreus**				+							+	+					
*Incilius mazatlanensis**												+					
*Incilius occidentalis**	+		+	+			+		+								
Rhinella horribilis	+	+		+			+	+	+			+					+
Craugastoridae (4 species)																	
Craugastor augusti	+			+			+		+								+
*Craugastor hobartsmithi**	+			+			+		+		+	+					
*Craugastor occidentalis**	+			+			+	+	+		+						
Craugastor pygmaeus			+	+					+								
Eleutherodactylidae (4 species)																	
*Eleutherodactylus angustidigitorum**				+													
*Eleutherodactylus grundwaldi**			+													+	
*Eleutherodactylus modestus**		+					+					+					
*Eleutherodactylus nitidus**	+			+				+	+		+	+					+
Hylidae (11 species)																	

Table 19 (continued)

Taxa	Natural Protected Areas																
	La Primavera	Estero El Salado	Sierra de Manantlán	Sierra de Quila	Volcán Nevado de Colima	Bosque El Nixticuil-San Sebastian-El Diente	Barranca del Río Santiago	Los Colomos	Piedras Bola	Sierra de Aguila	Cerro Viejo-Chupinaya-Los Sabinos	Chamela-Cuitzmala	Playón de Mismaloya	Islas de la Bahía de Chamela	Bosque Mesófilo Nevado de Colima	Bosque de Arce	Cuenca Alimentadora del Distrito Nacional de Riego 043
*Agalychnis dacnicolor**	+			+					+			+					
*Dendrosophus sartori**												+					
*Diaglena spatulata**												+					
Dryophytes arenicolor	+						+		+		+						+
*Dryophytes eximius**	+			+			+		+		+						
*Exerodonta smaragdina**				+					+			+					
*Sarcohyla bistincta**			+	+					+		+						
Smilisca baudinii		+		+			+					+					
Smilisca fodiens							+		+			+					
*Tlalocohyla smithii**		+		+								+					
Trachycephalus typhonius												+					
Leptodactylidae (1 species)																	
Leptodactylus melanonotus	+			+					+			+					
Microhylidae (2 species)																	
Hypopachus ustus												+					
Hypopachus variolosus	+			+					+			+					
Ranidae (6 species)																	
Lithobates forreri		+		+			+		+		+	+					
*Lithobates magnaocularis**								+									
*Lithobates megapoda**	+										+						

Table 19 (continued)

	Natural Protected Areas																
Taxa	**La Primavera**	**Estero El Salado**	**Sierra de Manantlán**	**Sierra de Quila**	**Volcán Nevado de Colima**	**Bosque El Nixticuil-San Sebastian-El Diente**	**Barranca del Río Santiago**	**Los Colomos**	**Piedras Bola**	**Sierra de Aguila**	**Cerro Viejo-Chupinaya-Los Sabinos**	**Chamela-Cuitzmala**	**Playón de Mismaloya**	**Islas de la Bahía de Chamela**	**Bosque Mesófilo Nevado de Colima**	**Bosque de Arce**	**Cuenca Alimentadora del Distrito Nacional de Riego 043**
*Lithobates neovolcanicus**	+			+			+	+	+		+						
*Lithobates psilonota**	+			+													
*Lithobates pustulosus**			+														
Scaphiopodidae (1 species)																	
Spea multiplicata									+								
Caudata (3 species)																	
Ambystomatidae (2 species)																	
*Ambystoma flavipiperatum***				+													
*Ambystoma rosaceum**																	+
Plethodontidae (1 species)																	
*Isthmura bellii**	+		+	+							+						
Crocodylia (1 species)																	
Crocodylidae (1 species)																	
Crocodylus acutus		+										+					
Squamata (106 species)																	
Anguidae (3 species)																	
*Barisia imbricata**			+		+										+		
Elgaria kingii	+			+			+	+	+		+						+
Gerrhonotus liocephalus												+				+	
Corytophanidae (1 species)																	

Table 19 (continued)

Taxa	Natural Protected Areas																
	La Primavera	Estero El Salado	Sierra de Manantlán	Sierra de Quila	Volcán Nevado de Colima	Bosque El Nixticuil-San Sebastian-El Diente	Barranca del Río Santiago	Los Colomos	Piedras Bola	Sierra de Aguila	Cerro Viejo-Chupinaya-Los Sabinos	Chamela-Cuitzmala	Playón de Mismaloya	Islas de la Bahía de Chamela	Bosque Mesófilo Nevado de Colima	Bosque de Arce	Cuenca Alimentadora del Distrito Nacional de Riego 043
Basiliscus vittatus		+										+					
Dactyloidae (1 species)																	
*Norops nebulosus**	+	+	+	+		+	+	+	+		+	+		+			+
Eublepharidae (1 species)																	
Coleonyx elegans												+					
Gekkonidae (1 species)																	
*Hemidactylus frenatus****		+										+					
Helodermatidae (1 species)																	
*Heloderma horridum**		+		+			+		+			+	+				
Iguanidae (2 species)																	
*Ctenosaura pectinata**	+	+		+			+	+	+		+	+	+	+			
Iguana iguana		+						+				+	+	+			
Mabuyidae (1 species)																	
Marisora brachypoda												+					
Phrynosomatidae (17 species)																	
Phrynosoma asio												+					
*Sceloporus albiventris**	+																
*Sceloporus asper**			+	+												+	
*Sceloporus bulleri**			+	+													
Sceloporus clarkii							+										
*Sceloporus dugesi**				+													

Table 19 (continued)

Taxa	Natural Protected Areas																
	La Primavera	Estero El Salado	Sierra de Manantlán	Sierra de Quila	Volcán Nevado de Colima	Bosque El Nixticuil-San Sebastian-El Diente	Barranca del Río Santiago	Los Colomos	Piedras Bola	Sierra de Aguila	Cerro Viejo-Chupinaya-Los Sabinos	Chamela-Cuitzmala	Playón de Mismaloya	Islas de la Bahía de Chamela	Bosque Mesófilo Nevado de Colima	Bosque de Arce	Cuenca Alimentadora del Distrito Nacional de Riego 043
*Sceloporus heterolepis**	+			+					+								
*Sceloporus horridus**				+		+	+	+	+			+					
Sceloporus melanorhinus		+					+					+					
*Sceloporus nelsoni**							+										
Sceloporus poinsettii			+														
*Sceloporus pyrocephalus**												+					
*Sceloporus scalaris**	+			+													
*Sceloporus spinosus**	+			+		+			+								
*Sceloporus torquatus**	+		+	+		+	+		+								
*Sceloporus utiformis**		+		+			+		+			+					
*Urosaurus bicarinatus**		+		+			+		+	+		+					+
Phyllodactylidae (1 species)																	
*Phyllodactylus lanei**		+					+					+					
Scincidae (5 species)																	
*Plestiodon callicephalus**				+			+										
*Plestiodon dugesii**				+					+								
*Plestiodon indubitus**			+							+							
*Plestiodon lynxe**				+													
*Plestiodon parvulus**												+					
Sphenomorphidae (1 species)																	
Scincella assata												+					

Table 19 (continued)

Taxa	Natural Protected Areas																
	La Primavera	Estero El Salado	Sierra de Manantlán	Sierra de Quila	Volcán Nevado de Colima	Bosque El Nixticuil-San Sebastian-El Diente	Barranca del Río Santiago	Los Colomos	Piedras Bola	Sierra de Aguila	Cerro Viejo-Chupinaya-Los Sabinos	Chamela-Cuitzmala	Playón de Mismaloya	Islas de la Bahía de Chamela	Bosque Mesófilo Nevado de Colima	Bosque de Arce	Cuenca Alimentadora del Distrito Nacional de Riego 043
Teiidae (5 species)																	
*Aspidoscelis communis**				+			+		+			+					
Aspidoscelis deppii							+										
Aspidoscelis gularis	+			+		+	+	+	+								
*Aspidoscelis lineattissima**		+										+		+			
*Holcosus sinister**												+					
Xantusiidae (1 species)																	
*Xantusia sanchezi**							+										
Boidae (1 species)																	
Boa sigma		+		+			+		+			+		+			
Colubridae (23 species)																	
*Conopsis biserialis**			+														
*Conopsis nasus**				+													+
Drymarchon melanurus	+	+		+		+	+		+			+					
Drymobius margaritiferus		+										+					
*Lampropeltis polyzona**	+		+	+			+		+	+	+	+					
*Leptophis diplotropis**	+	+		+					+		+	+					
Masticophis bilineatus							+										
Masticophis flagellum							+			+	+						
Masticophis mentovarius	+	+		+			+	+	+			+					
Mastigodryas melanolomus												+					

Table 19 (continued)

Taxa	Natural Protected Areas																
	La Primavera	Estero El Salado	Sierra de Manantlán	Sierra de Quila	Volcán Nevado de Colima	Bosque El Nixticuil-San Sebastian-El Diente	Barranca del Río Santiago	Los Colomos	Piedras Bola	Sierra de Aguila	Cerro Viejo-Chupinaya-Los Sabinos	Chamela-Cuitzmala	Playón de Mismaloya	Islas de la Bahía de Chamela	Bosque Mesófilo Nevado de Colima	Bosque de Arce	Cuenca Alimentadora del Distrito Nacional de Riego 043
Oxybelis aeneus	+	+		+				+	+			+					
*Pituophis deppei**	+			+	+	+		+	+		+				+		
*Pseudoficimia frontalis**												+					
*Salvadora bairdi**	+																
*Salvadora mexicana**							+					+					
Senticolis triaspis	+			+			+					+					
*Sonora mutabilis**	+						+										
*Symphimus leucostomus**												+					
*Sympholis lippiens**	+																
*Tantilla bocourti**	+		+	+			+	+	+			+					
*Tantilla calamarina**												+					
*Trimorphodon biscutatus**							+			+	+	+					
*Trimorphodon tau**	+			+			+		+								
Dipsadidae (20 species)																	
Clelia scytalina												+					
*Coniophanes lateritius**							+										
*Conophis vittatus**												+		+			
Diadophis punctatus	+																
*Dipsas gaigeae**												+					
*Geophis bicolor**			+	+													
*Geophis dugesii**				+													
*Geophis petersii**			+														

Table 19 (continued)

Taxa	Natural Protected Areas																
	La Primavera	Estero El Salado	Sierra de Manantlán	Sierra de Quila	Volcán Nevado de Colima	Bosque El Nixticuil-San Sebastian-El Diente	Barranca del Río Santiago	Los Colomos	Piedras Bola	Sierra de Aguila	Cerro Viejo-Chupinaya-Los Sabinos	Chamela-Cuitzmala	Playón de Mismaloya	Islas de la Bahía de Chamela	Bosque Mesófilo Nevado de Colima	Bosque de Arce	Cuenca Alimentadora del Distrito Nacional de Riego 043
*Hypsiglena torquata**	+			+			+		+			+					
Imantodes gemmistratus							+					+					
Leptodeira maculata	+	+					+		+			+					
*Leptodeira splendida**	+			+					+								
*Leptodeira uribei**												+					
*Manolepis putnami**	+											+					
*Pseudoleptodeira latifasciata**												+					
*Rhadinaea hesperia**	+						+		+			+					
*Rhadinaea laureata**			+														
*Rhadinaea taeniata**			+	+					+								
Sibon nebulatus												+					+
*Tropidodipsas philippi**												+					
Elapidae (4 species)																	
Hydrophis platurus												+		+			
Micruroides euryxanthus							+										
*Micrurus distans**	+			+					+		+	+					
*Micrurus laticollaris**				+													
Leptotyphlopidae (1 species)																	
Rena humilis		+		+			+		+			+					
Loxocemidae (1 species)																	
Loxocemus bicolor												+					
Natricidae (5 species)																	

Table 19 (continued)

Taxa	Natural Protected Areas																
	La Primavera	Estero El Salado	Sierra de Manantlán	Sierra de Quila	Volcán Nevado de Colima	Bosque El Nixticuil-San Sebastian-El Diente	Barranca del Río Santiago	Los Colomos	Piedras Bola	Sierra de Aguila	Cerro Viejo-Chupinaya-Los Sabinos	Chamela-Cuitzmala	Playón de Mismaloya	Islas de la Bahía de Chamela	Bosque Mesófilo Nevado de Colima	Bosque de Arce	Cuenca Alimentadora del Distrito Nacional de Riego 043
*Storeria storerioides**	+		+	+					+								
Thamnophis cyrtopsis	+		+	+					+								
Thamnophis eques	+								+		+						
*Thamnophis melanogaster**	+																
*Thamnophis validus**		+										+					
Typhlopidae (1 species)																	
*Indotyphlops braminus****	+							+	+								
Viperidae (9 species)																	
Agkistrodon bilineatus			+	+					+			+					+
*Crotalus aquilus**																	+
*Crotalus armstrongi**			+	+					+								
*Crotalus basiliscus**	+		+	+			+		+		+	+	+				+
*Crotalus campbelli**																	+
*Crotalus lannomi**			+														
Crotalus lepidus																	+
Crotalus molossus																	+
*Crotalus pusillus**				+													
Testudines (11 species)																	
Cheloniidae (4 species)																	
Caretta caretta												+	+				
Chelonia mydas												+	+	+			
Eretmochelys imbricata												+	+	+			

Table 19 (continued)

	Natural Protected Areas																
Taxa	**La Primavera**	**Estero El Salado**	**Sierra de Manantlán**	**Sierra de Quila**	**Volcán Nevado de Colima**	**Bosque El Nixticuil-San Sebastian-El Diente**	**Barranca del Río Santiago**	**Los Colomos**	**Piedras Bola**	**Sierra de Aguila**	**Cerro Viejo-Chupinaya-Los Sabinos**	**Chamela-Cuitzmala**	**Playón de Mismaloya**	**Islas de la Bahía de Chamela**	**Bosque Mesófilo Nevado de Colima**	**Bosque de Arce**	**Cuenca Alimentadora del Distrito Nacional de Riego 043**
Lepidochelys olivacea												+	+	+			
Dermochelyidae (1 species)																	
Dermochelys coriacea												+	+	+			
Emydidae (1 species)																	
*Trachemys ornata**		+															
Geoemydidae (2 species)																	
Rhinoclemmys pulcherrima												+					
*Rhinoclemmys rubida**												+					
Kinosternidae (3 species)																	
*Kinosternon chimalhuaca**												+					
Kinosternon hirtipes								+									
*Kinosternon integrum**	+			+		+	+	+	+		+	+					
Totals (155)	**50**	**27**	**26**	**67**	**2**	**8**	**50**	**18**	**55**	**5**	**23**	**83**	**9**	**11**	**2**	**3**	**16**

The two most important of the protected areas in Jalisco, with respect to the number of herpetofaunal species represented, are the Reserva de la Biósfera Chamela-Cuixmala, with 83 recorded species, and the Área de Protección de Flora y Fauna Sierra de Quila, with 67 species. An examination of the data in Table 19 demonstrates that a combined number of 118 species is known (53.2% of the total), including 27 of 47 anurans (57.4%), two of four salamanders (50.0%), one of one crocodylians (100%), 79 of 157 squamates (50.3%), and nine of 12 turtles (75.0%). Slightly more than one-half of the state's species are recorded within one protected area located along the coastal region of southwestern Jalisco (www.wikipedia.org; accessed 9 December 2016) and another situated in a montane region located in the Trans-Mexican Volcanic Belt, at elevations of 1,350–2,560 m (Santiago-Pérez et al., 2012). These two protected areas, thus, contain 77.1% of the 153 native species recorded from all 17 protected areas listed in Table 20; consequently, these areas represent significantly important efforts toward the conservation of the Jaliscan herpetofauna.

Table 20. Summary of the distributional status of herpetofaunal species in protected areas in Jalisco, 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)
La Primavera	50	14	35	—	1
Estero El Salado	27	14	12	—	1
Sierra de Manantlán	26	5	21	1	—
Sierra de Quila	67	17	49	1	—
Volcán Nevado de Colima	2	—	2	—	—
Bosque El Nixticuil-San Sebastian-El Diente	8	2	6	—	—
Barranca del Río Santiago	50	21	29	—	—
Los Colomos	18	7	10	—	1
Piedras Bola	55	20	34	—	1
Sierra de Aguila	5	1	4	—	—
Cerro Viejo-Chupinaya-Los Sabinos	23	5	18	—	—
Chamela-Cuitzmala	83	38	44	—	1
Playón de Mismaloya	9	6	3	—	—
Islas de la Bahía de Chamela	11	7	4	—	—
Bosque Mesófilo Nevado de Colima	2	—	2	—	—
Bosque de Arce	3	1	1	1	—
Cuenca Alimentadora del Distrito Nacional de Riego 043	16	8	8	—	—
Totals	155	56	95	2	2

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

A. Presently, the herpetofauna of Jalisco is known to consist of 223 species, including 47 anurans, four salamanders, one caecilian, one crocodylian, 158 squamates, and 12 turtles.

B. The number of herpetofaunal species among the seven physiographic regions we recognize in Jalisco ranges from 38 in the Sierra de Coalcomán and the Tepalcatepec Depression to 116 in the Trans-Mexican Volcanic Belt.

C. The number of species shared between physiographic regions ranges from 19 between the Pacific Coastal Plain and the Tepalcatepec Depression to 69 between the Trans-Mexican Volcanic Belt and the Central Plateau. The CBR values range from 0.21 between the Pacific Coastal Plain and the Central Plateau to 0.68 between the Sierra de Coalcomán and the Tepalcatepec Depression. The UPGMA analysis indicates that there are two clusters of regions consisting of the Tepalcatepec Depression and the Sierra de Coalcomán linked to the Central Plateau, Trans-Mexico Volcanic Belt, and Sierra Madre Occidental, both in turn joined to the final group, the Pacific Coastal Plain. None of these regions connect at a CBR level higher than 0.68. Contrary to our expectations, the Tepalcatepec Depression region shares little resemblance (level of 0.28) to the PC region, even though these two subarid regions share a connection through the Río Balsas Basin in southern Michoacán.

D. A relatively high level of endemism characterizes the herpetofauna of Jalisco. Of 223 species recorded from the state, the distribution of 144 (64.6%) is limited to Mexico. The range of only two of these species, however, is restricted to Jalisco. The level of herpetofaunal endemism in Jalisco is somewhat above the level for all of Mexico (60.5%; 768/1,269).

E. The distributional status of the herpetofauna of Jalisco is as follows (in order of the size of the categories): country endemics (142; 63.7%); non-endemics (75; 33.6%); non-natives (4; 1.8%); state endemics (2; 0.9%).

F. The principal environmental threats in Jalisco are discussed in relation to the seven physiographic regions we recognize, and consist of excessive urban development, agricultural expansion, logging, soil erosion, soil compaction, desertification, air and water pollution, unregulated dumping of waste, open pit mining, illegal hunting, and commercial trade.

G. We utilized the SEMARNAT, IUCN, and EVS systems to evaluate the conservation status of the members of the Jalisco herpetofauna. As usual, the SEMARNAT system proved to be of limited importance, inasmuch as only 45.7% of the native members of the herpetofauna have been assessed. Of these 100 species, six are placed in the endangered category (P), 24 in the threatened category (A), and 70 species in the special protection category (Pr).

H. The IUCN system is the most broadly applied in herpetofaunal conservation studies, but has been criticized in several studies involving the Mesoamerican herpetofauna (Alvarado-Díaz et al., 2013; Wilson et al., 2013a, b; Mata-Silva et al., 2015; Johnson et al., 2015a, b; Terán-Juárez et al., 2016; Woolrich-Piña et al., 2016; Nevárez de los Reyes et al., 2016). 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 respect to the Jalisco herpetofauna, the category, number, and percentage of the 219 native species is as follows: CR (one, 0.5%); EN (eight, 3.7%); VU (16, 7.3%); NT (four, 1.8%); LC (141, 64.4%); DD (16, 7.3%); and NE (33, 15.1%).

I. The EVS system has addressed the deficiencies of the IUCN system in a number of publications (Wilson et al., 2013a, b; Mata-Silva et al., 2015; Johnson et al., 2015a, b; Terán-Juárez et al., 2016; Woolrich-Piña et al., 2016; Nevárez-de los Reyes et al., 2016). Once we determined the EVS values for the members of the Jalisco herpetofauna and partitioned them into low, medium, and high categories of vulnerability, we ascertained that the number of species in these categories increased from low (51; 23.9% of the 213 species for which the EVS can be calculated) through medium (74; 34.7%) to high (88; 41.3%). Once again, the EVS system has been shown to function as a means for utilizing scarce conservation funds that can be used to protect anywhere from a single species to an entire terrestrial herpetofauna.

J. We compared the IUCN and EVS conservation status categorizations and found that only 21.6% of the high vulnerability species are placed in one of the three IUCN threat categories (CR, EN, or VU). In addition, 2.7 times the number of LC species has been allocated to the low vulnerability category. As demonstrated in earlier studies, these two systems of conservation assessment are in significant disagreement with one another, providing highly divergent views of the conservation status of the herpetofauna of Jalisco.

K. An evaluation of the herpetofaunal species in Jalisco allocated to the DD, NE, and LC categories by the IUCN, as compared to their respective EVS values, demonstrates that many of these species are incorrectly allocated within the IUCN categories and that they should be reallocated to other categories to more realistically assess their prospects for survival.

L. We applied the Relative Herpetofauna Priority (RHP) measure to ascertain the conservation significance of the seven regional herpetofaunas in Jalisco. Based on this analysis, the most significant regional herpetofauna is that of the Trans-Mexican Volcanic Belt, because it contains the largest number of country endemics and high category EVS species.

M. Unregulated human population growth is at the root of all of the world's environmental problems, which will continue to exacerbate in detrimental impact with continued ignorance of the underlying problem.

N. Twenty protected areas are established in Jalisco, of which none includes all of the aspects we consider necessary for perpetual protection of the state's herpetofauna.

O. Available herpetofaunal surveys conducted in the state's system of protected areas indicate the presence of a combined total of 155 species, which represents 69.5% of the entire state herpetofauna (223 species). The two most important areas are the Reserva de la Biósfera Chamela-Cuixmala, with 83 species, and the Área de Protección de Flora y Fauna Sierra de Quila, with 67 species.

P. The principal goal of future herpetofaunal conservation efforts in Jalisco should involve the establishment of protected areas in which the remaining 66 native species can find perpetual refuge. In addition, extensive herpetofaunal surveys should be conducted in the less well-studied regions of the state, including the Sierra Madre Occidental, Sierra de Coalcomán, and the Tepalcatepec Depression.

Recommendations

A. Our goal in this paper is to evaluate the conservation status of the members of the herpetofauna of Jalisco. With this goal in mind, we emphasize that the fate of these creatures hinges on decisions made by people living in the vicinity of their habitats, and who transform these habitats into rural and urban living spaces for themselves. These living spaces spread at a rate commensurate with the growth of the human population. The limitless expansion of the human population is a function of the worldview held by almost all humans, in which the planet and its resources exist to serve the needs of our species in whatever fashion we desire. As conservation biologists, in our effort to suggest strategies for preserving the herpetofauna of Jalisco, we are faced with the same problems that impact conservation biologists at large, irrespective of the groups of organisms involved. Thus, the principal environmental threats in Jalisco we examined in this paper all originated from the same underlying problems created by humans.

B. In light of the centristic mode of thinking exhibited by humans everywhere, the principal strategy practiced by conservation biologists is to advocate for the establishment of sufficiently robust parcels of natural habitat that supports sustainable populations of the creatures they study. With regard to the herpetofauna of Jalisco, we demonstrated that about 70% of the state's native herpetofauna has been recorded within some 20 natural protected areas. One major goal, therefore, is to identify the areas inhabited by the remaining 30% of the herpetofauna, either in existing natural protected areas or in places where these areas should be established.

C. Subsidiary goals that need to be enacted are (1) to determine the sustainability of all herpetofaunal populations found in all of the natural protected areas, and to modify these areas to address the exiting problems of sustainability; and (2) to stress the need to address the deficiencies of the existing natural protected areas.

D. Herpetofaunal goals should be integrated with those established for other faunal and floral groups of organisms among all interested stakeholders, especially local people who reside in areas adjacent to the natural protected areas.

E. We underscore that our recommended goals need to be addressed as rapidly as possible, as the available remaining natural areas are being subjected to damage from unregulated human population growth and its accompanying environmental threats.

These days, startling though the thought is, we control our own legacy. We're not passive, we're not helpless. We are earth-movers. We can become Earth restorers and Earth guardians. We still have time and talent, and we have a great many choices. As I said at the beginning of this mental caravan, our mistakes are legion, but our imagination is immeasurable.

—Diane Ackerman (2014)

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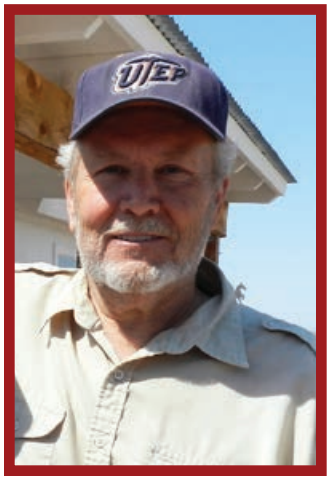

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Elí García-Padilla is a herpetologist primarily focused on the study of the ecology and natural history of the Mexican herpetofauna. His research efforts have centered on the Mexican states of Baja California, Tamaulipas, Chiapas, and Oaxaca. His first experience in the field was researching the ecology of insular populations of the rattlesnakes *Crotalus tortugensis* (= *C. atrox*), *C. muertensis* (= *C. pyrrhus*), and the endemic *C. catalinensis* in the Gulf of California. For his Bachelor's degree he presented a thesis on the ecology of *C. muertensis* (= *C. pyrrhus*) on Isla El Muerto, Baja California, Mexico. To date, he has authored or co-authored over 70 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 370 peer-reviewed papers and books on herpetology, including two papers published in 2013 entitled "A conservation reassessment of the amphibians of Mexico based on the EVS measure" and "A conservation reassessment of the reptiles of Mexico based on the EVS measure," one in 2014 entitled "Snakes of the genus *Tantilla* (Squamata: Colubridae) in Mexico: taxonomy, distribution, and conservation," four in 2015 entitled "A conservation reassessment of the Central American herpetofauna based on the EVS measure," "The herpetofauna of Oaxaca, Mexico: composition, physiographic distribution, and conservation status," "The herpetofauna of Chiapas, Mexico: composition, distribution, and conservation," and "A checklist and key to the snakes of the *Tantilla* clade (Squamata: Colubridae), with comments on taxonomy, distribution, and conservation," and two in 2016 entitled "The herpetofauna of Tamaulipas: composition, distribution, and conservation," and "The herpetofauna of Nuevo León: 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 71 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*.