Xenosaurus phalaroanthereon Nieto-Montes de Oca, Campbell, and Flores-Villela, 2001. This knob-scaled lizard is endemic to the state of Oaxaca, where it occurs in the Montañas y Valles del Centro and Sierra Madre del Sur physiographic provinces at elevations from 1,670 (García- Padilla and Mata-Silva, 2014) to 2,185 m. Individuals of this live-bearing species occupy the interior of crevices, usually singly, in small granite boulders located on hillsides covered with oak and pine-oak forest. Populations persist, however, at sites converted to agricultural use, such as cornfields (Lemos-Espinal and Smith, 2005). Its EVS is calculated as 16, which places it in the middle portion of the high vulnerability category (Wilson et al., 2013a), and its IUCN status is Data Deficient. This species is one of 10 members of the monogeneric family Xenosauridae, which is endemic to Mesoamerica. All but one of the species is endemic to Mexico.

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The herpetofauna of Oaxaca, Mexico: composition, physiographic distribution, and conservation status

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Abstract: The herpetofauna of Oaxaca is the largest of any state in Mexico, consisting of 106 anurans, 41 salamanders, two caecilians, three crocodylians, 271 squamates, and 19 turtles (total 442 species). We examined the distribution of these species among the 12 physiographic regions in the state. The number of species in these regions ranges from nine in the Depresión del Balsas to 216 in the Sierra Madre de Oaxaca. The species occupy from one to 10 of the 12 regions ($\bar{x} = 2.7$). The largest number of species (169) occurs in a single region, and of these the largest amount (67) is found in the Sierra Madre de Oaxaca. We constructed a Coefficient of Biogeographic Resemblance (CBR) matrix that demonstrates the number of shared species ranges from eight to 84. We used the data in this matrix to construct a greatest shared species diagram, which indicates that the two provinces with the two largest groups of species are connected to more provinces than any of the others, including one another. The CBR values range from 0.00 to 0.71, of which the highest values generally connect contiguous provinces. We constructed a UPGMA dendrogram for which the data indicate a geographic-based clustering of the provinces into southern, northern, west-central groups, as well as an outlier group containing only the Depresión del Balsas province. We placed these species in four distributional categories, and determined that the largest number consists of non-endemics (183), followed by country endemics (164), state endemics (93), and non-natives (2). We examined the conservation status of the native species by using the SEMARNAT, IUCN, and EVS systems. Of these three systems, the EVS provides the most useful conservation assessment for the herpetofauna of the state. The number of species in each of the three EVS categories increases from low (103), through medium (133), to high (199). We also used the EVS ratings to judge how species in the IUCN categories of DD, NE, and LC might be more accurately assessed. Based on our analyses we provide a set of conclusions, as well as recommendations for protecting the herpetofauna of Oaxaca for perpetuity.

Key Words: Anurans, salamanders, caecilians, crocodylians, squamates, turtles, physiographic regions, conservation status, protection recommendations

Resumen: La herpetofauna de Oaxaca es la más grande de cualquier estado en México. Esta consiste de 106 anuros, 41 salamandras, dos cecilias, tres cocodrílidos, 271 squamatos, y 19 tortugas (total 442 especies). Examinamos la distribución de estas especies entre las 12 regiones fisiográficas del estado. El número de especies en estas regiones va desde nueve en la Depresión del Balsas a 216 en la Sierra Madre

de Oaxaca. Las especies ocupan de una a 10 de las 12 regiones ($\bar{x}$ = 2.7). El mayor número de especies (169) ocurre en una sola región, y de estas especies el mayor número (67) se encuentra en la Sierra Madre de Oaxaca. Construimos una matriz de Coeficientes de Similitud Biogeográfica (CBR) que demuestra que el número de especies compartidas va de ocho a 84. Usamos los datos de esta matriz para construir un diagrama con el mayor número de especies compartidas, el cual indica que las dos provincias con los dos grupos más grandes de especies están más conectadas a otras provincias que las provincias restantes, e incluso entre estas. Los valores de CBR varían de 0.00 a 0.71, y los valores más altos en general conectan a las provincias contiguas. Construimos un dendrograma de UPGMA donde los datos revelan un agrupamiento de las provincias con base geográfica en grupos del sur, norte y centro-oeste, además de un grupo aislado que contiene solamente la provincia de la Depresión del Balsas. Colocamos estas especies en cuatro categorías de distribución y determinamos que el mayor número consiste de especies no endémicas (183), seguido por las endémicas al país (164), al estado (93), y las especies exóticas (2). Examinamos el estado de conservación de las especies nativas usando los sistemas de SEMARNAT, UICN, y EVS. De los tres sistemas, el EVS proporciona la evaluación más adecuada para la herpetofauna del estado. El incremento en número de especies en cada una de las tres categorías del EVS va de la baja (103), media (133), a alta (199) vulnerabilidad. También usamos los valores del EVS para determinar cómo las especies en las categorías de Datos Insuficientes, de Preocupación Menor y No evaluadas de la UICN podrían ser evaluadas de una forma más precisa. De acuerdo con nuestro análisis, proporcionamos un conjunto de conclusiones, además de recomendaciones para proteger la herpetofauna de Oaxaca para la perpetuidad.

Palabras Claves: Anuros, salamandras, cecilios, cocodrílidos, squamatos, tortugas, provincias fisiográficas, estatus de conservación, recomendaciones para protección

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The remainder of the century will be a bottleneck of growing human impact on the environment and diminishment of biodiversity. We bear all of the responsibility of bringing ourselves and as much as possible of the rest of life through the bottleneck into a sustainable Edenic existence. Our choice will be a profoundly moral one. Its fulfillment depends on knowledge still lacking and a sense of common decency still not felt.

— Wilson, E. O. 2014. *The Meaning of Human Existence*, p. 132.

INTRODUCTION

With a surface area of 93,757 km^2, Oaxaca is the fifth largest state in Mexico (wikipedia.org/wiki/List_of_Mexican_states_by_area). The state lies in the southern portion of the country, and to the north is bounded by the states of Veracruz and Puebla, to the west by Guerrero, and to the east by Chiapas. The eastern portion of the state comprises part of the Isthmus of Tehuantepec, and the southern portion borders the Pacific Ocean.

Oaxaca is legendary in terms of the overall diversity of its natural and social environments. In an article by David Ortega del Valle and Gustavo Sánchez Benítez entitled "Biodiversidad en Oaxaca, la mayor de México," which appeared in the newspaper *El Oriente* (posted 16 July 2012), the authors noted that Oaxaca shines as "the gold medal [*medalla de oro*] of Mexican biodiversity" (translation ours). This remarkable statement requires some explanation.

The physical setting of Oaxaca is highly complex, as the state harbors at least a dozen recognizable physiographic regions (García-Mendoza et al., 2004). Elevations in the state range from sea level to 3,759 m, with the highest peak (Cerro Nube Flan) located in the Sierra Madre del Sur (www.wikipedia.org/Oaxaca). Higher elevations in the country only are found in the states of Veracruz, Jalisco, and Michoacán, which lie in the Transverse Volcanic Axis and whose borders include either the Pacific Ocean or the Gulf of Mexico.

Given the location of Oaxaca at ca. 17°N latitude, well south of the Tropic of Cancer and thus within the tropics, the climate varies primarily with elevation—from low regions on the Pacific coastal plain to the highest peaks in the Sierra Madre del Sur. As a consequence, vegetation zones also vary widely. It follows, therefore, that animal diversity is extensive and sizable (García-Mendoza et al., 2004), and was noted by Ortega del Valle and Sánchez Benítez (2012) as the greatest in Mexico.

Oaxaca also is noteworthy as the most ethnically complex state in Mexico. Again, credit is given to the diverse topography of the region, which has led to the isolation of cultural groupings and the evolution of immense linguistic variation (de Ávila Blomberg, 2004).

Against this setting of monumental complexity of the natural and social environments of Oaxaca, within the megadiverse country of Mexico, our purpose for this paper is to examine the composition, distribution, and conservation status of the herpetofauna in the state.

MATERIALS AND METHODS

Updating the Herpetofaunal List

Casas-Andreu et al. (1996) and Casas-Andreu et al. (2004) provided major summaries of the herpetofauna of Oaxaca. We reviewed the major literature since 2004, and updated the relevant taxa based on the Taxonomic List available on the *Mesoamerican Herpetology* website (www.mesoamericanherpetology.com; accessed 22 February 2015).

System for Determining Distributional Status

We used the system developed by Alvarado Díaz et al. (2013) for the herpetofauna of Michoacán to determine the distributional status of members of the Oaxacan herpetofauna. This system consists of the following four categories: SE = endemic to Oaxaca; CE = endemic to Mexico; NE = not native to Mexico; and NN = non-endemic in Mexico.

Systems for Determining Conservation Status

Like Alvarado-Díaz et al. (2013), we applied the following three conservation assessment systems to members of the Oaxacan herpetofauna: SEMARNAT, IUCN, and EVS.

The Norma Oficial Mexicana NOM-059-SEMARNAT (www.semarnat.gob.mx) is a set of official regulations developed by the Secretaría de Medio Ambiente y Recursos Naturales, an arm of the Mexican federal government that deals with the environmental protection of native species of wildlife (flora and fauna), categories of risk that apply to them, with specifications for their inclusion, exclusion, or change in status, and a list of species at risk. The current version of these regulations was published 30 December 2010.

The IUCN system was developed and is administered by the International Union for the Conservation of Nature, a global organization headquartered in Gland, Switzerland (www.iucn.org). The IUCN system is used by biologists worldwide for conservation assessments, and frequently is employed to ascertain the conservation status of a broad range of organisms. The categories in this system are widely recognized and described in the Guidelines for Using the IUCN Red List Categories and Criteria (2010), and include the following: Extinct (EX), Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), Data Deficient (DD), and Not Evaluated (NE). Collectively, the Critically Endangered, Endangered, and Vulnerable categories are termed the "threat categories," to distinguish them from the others.

The EVS system initially was developed for use with the herpetofauna of Honduras, first with the amphibians (Wilson and McCranie, 1992; McCranie and Wilson, 2002) and then with the remainder of the herpetofauna (Wilson and McCranie, 2004). Subsequently, it was used in several chapters of Wilson et al. (2010), and Wilson

et al. (2013a, b) modified the system for use in Mexico. Herein we follow the modifications made by Wilson et al. (2013a, b), after applying the taxonomic changes occurring since that time. As noted by Alvarado Díaz et al. (2013: 133), "the EVS measure is not designed for use with marine species (e.g., marine turtles and sea snakes), and generally is not applied to non-native species."

PHYSIOGRAPHY AND CLIMATE

Physiographic Provinces

We used the classification system provided by Ortiz Pérez et al. (2004), which comprises 12 physiographic provinces (Fig. 1), to analyze the distribution of the Oaxacan herpetofauna. We used their numbering system for these provinces and the names in Spanish (with some modifications), and describe them briefly, as follows:

Depresión del Balsas.—This province constitutes an area of about 1,788 km^2, located in the extreme northwestern portion of the state (Fig. 1). It encompasses a part of the upper portion of the Río Balsas basin, one of the major river systems in Mexico, which empties into the Pacific Ocean at the southern terminus of the common border of the states of Guerrero and Michoacán. The mean elevation of this province is about 1,500 m (range 1,200–1,800 m).

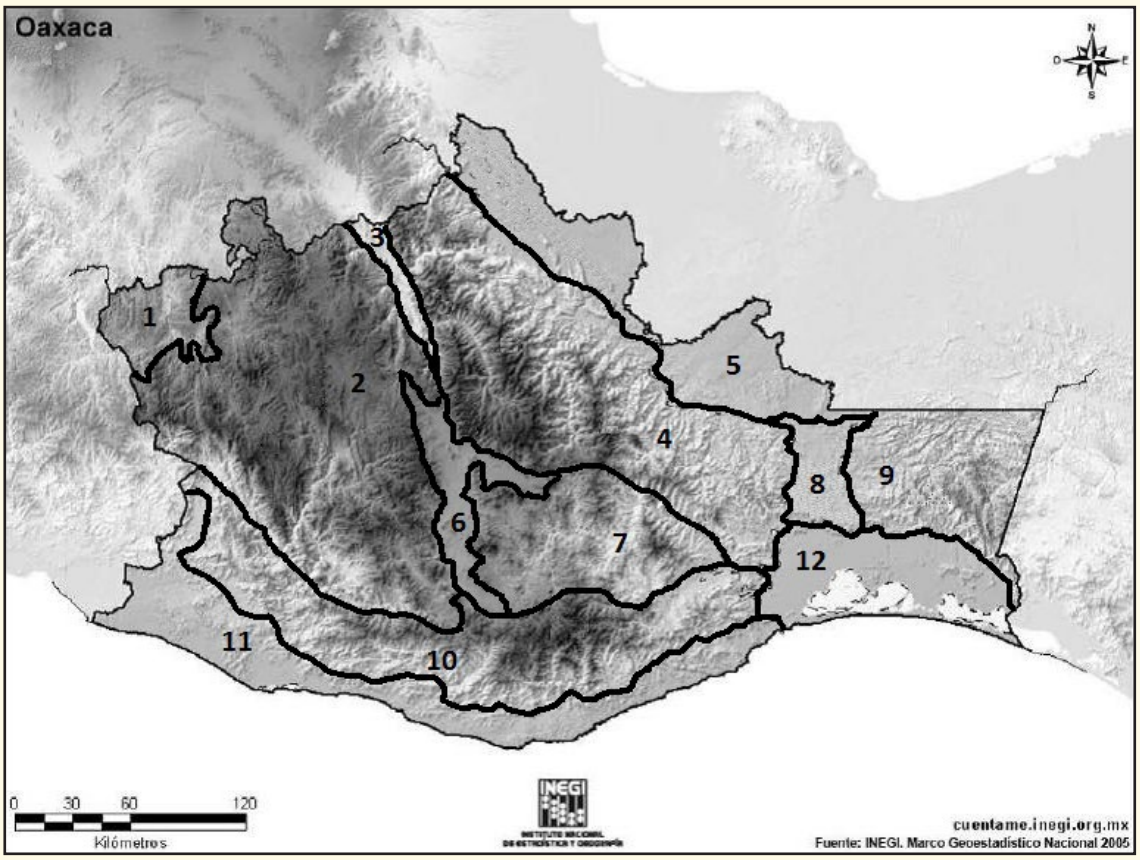

Fig. 1. Physiographic provinces in Oaxaca. The names of the numbered provinces and their abbreviations are as follows: 1 = Depresión del Balsas (DB); 2 = Montañas y Valles del Occidente (MVO); 3 = Fosa de Tehuacán (FT); 4 = Sierra Madre de Oaxaca (SMO); 5 = Planicie Costera del Golfo (PCG); 6 = Valles Centrales de Oaxaca (VCO); 7 = Montañas y Valles del Centro (MVC); 8 = Depresión Ístmica de Tehuantepec (DIT); 9 = Sierra Madre de Chiapas (SMC); 10 = Sierra Madre del Sur (SMS); 11 = Planicie Costera del Pacífico (PCP); and 12 = Planicie Costera de Tehuantepec (PCT).

Montañas y Valles del Occidente.—With an area of 21,263 km^2, this province is the largest in Oaxaca (Fig. 1). It comprises much of the northwestern sector of the state, except for the Depresión del Balsas, which bounds it to the

northwest. The province generally is referred to as the "Mixteca," to signify the region occupied by the Mixtec people, whose area of occupancy also extends into Puebla and Guerrero. In Oaxaca, this province consists of a series of linear ranges coursing in a NNW–SSE direction and separated by intermontane valleys. The maximum elevations (3,200–3,400 m) are found in the Sierra de Tlaxiaco, located in the southern portion of the province.

Fosa de Tehuacán.—This valley, the smallest of the 12 provinces with an area of about 1,134 km^2, is located between the northern portion of the Sierra Madre de Oaxaca province to the east and the northeastern portion of the Montañas y Valles del Occidente to the west (Fig. 1). Most of the valley lies at elevations below1,000 m, but toward the south elevations rise to slightly more than 1,400 m at the point where its watershed is divided from that of the Valles Centrales de Oaxaca province to the south.

Sierra Madre de Oaxaca.—This montane complex, the second largest of the 12 provinces of Oaxaca, constitutes an area of about 17,520 km^2 (Fig. 1). To the north it is bounded by the Planicie Costera del Golfo province, to the east by the Depresión Ístmica de Tehuantepec and the Planicie Costera de Tehuantepec provinces, and to the south by the Fosa de Tehuacán, Valles Centrales de Oaxaca, and the Montañas y Valles del Centro provinces. The mountains in this province generally trend from NNW to SSE, and more than 120 peaks reach elevations of at least 2,500 m.

Planicie Costera del Golfo.—This coastal plain, with an area of about 7,976 km^2, is bounded primarily to the south by the Sierra Madre de Oaxaca province and within Oaxaca comprises the upper portion of the extensive lowland region that bounds the Gulf of Mexico (Fig. 1). About 90% of this province consists of flat plains that lie at elevations below 400 m.

Valles Centrales de Oaxaca.—This interconnected set of valleys, which encompass an area of about 2,267 km^2, is surrounded by the major montane regions of the bulk of the state, i.e., the Sierra Madre de Oaxaca province to the north and east, the Montañas y Valles del Centro province to the east, the Sierra Madre del Sur province to the south, and the Montañas y Valles del Occidente province to the west (Fig. 1). About 60% of this province lies at elevations below 1,600 m, with the remainder comprising the foothills of the surrounding mountain ranges.

Montañas y Valles del Centro.—This region of mountains and intervening valleys, with an area of about 6,663 km^2, is located south of the Sierra de Oaxaca province, east of the Valles Centrales de Oaxaca province, and north of the Sierra Madre del Sur province (Fig. 1). The valleys lie at elevations below 1,400 m and the mountains peak at 2,800 m, in the case of Cerro Yautepec in the Sierra de Tehuantepec.

Depresión Ístmica de Tehuantepec.—This depressed structural block, with an area of about 2,114 km^2, lies between the Sierra Madre de Oaxaca province to the west and the Sierra Madre de Chiapas province to the east, with the Planicie Costera del Golfo province to the north and the Planicie Costera de Tehuantepec to the south (Fig. 1). It forms the more elevated portion of the relatively low Isthmus of Tehuantepec; Duellman (1960: 28) referred to this region as the "central ridges" of the isthmus. These ridges cap out at an elevation of about 400 m, in a range of hills that descends abruptly to the Planicie Costera de Tehuantepec.

Sierra Madre de Chiapas.—This province, with an area of about 5,816 km^2, is located east of the Depresión Ístmica de Tehuantepec province and north of the Planicie Costera de Tehuantepec (Fig. 1). It comprises the easternmost extension of the mountains of Nuclear Central America. Elevations in this province are lower than to the west of the isthmus, with only about 20% of the area lying above 1,000 m.

Sierra Madre del Sur.—This province is bounded to the south by the Planicie Costera del Pacífico province, to the east by the Planicie Costera de Tehuantepec, and to the north by the Montañas y Valles del Occidente, Valles Centrales de Oaxaca, Montañas y Valles del Centro, and the Sierra Madre de Oaxaca provinces (Fig. 1). Its area covers about 12,350 km^2, making it the third largest of the 12 provinces. This province encompasses the highest peak in Oaxaca, Cerro Nube Flan (elev. 3,750 m), located in the eastern sector.

Planicie Costera del Pacífico.—This province, bounded to the north by the Sierra Madre del Sur province, encompasses more than two-thirds of the entire Pacific coastal plain of Oaxaca; its area is about 9,262 km^2 (Fig. 1). This elongate plain consists of a western portion of gentle relief and an eastern area of rocky promontories interspersed with sandy beaches.

Planicie Costera de Tehuantepec.—With an area of about 4,299 km^2, this province comprises the remainder of the Pacific coastal plain of Oaxaca (Fig. 1). Several prominent lagoons lie along its southern edge, narrowly separated from the Pacific Ocean.

Climate

To examine temperature variation in Oaxaca, we constructed a table indicating the monthly minimum, mean, and maximum temperature values for a locality in each of the 12 physiographic regions in the state (Table 1). The elevations of these localities range from 23 m in the Planicie Costera de Tehuantepec to 2,564 m in the Sierra Madre del Sur.

Table 1. Monthly minimum, mean (in parentheses), maximum, and annual temperature data (in °C) for the physiographic provinces of Oaxaca, Mexico. Localities and their elevations for each of the provinces are as follows: Depresión del Balsas—San Jorge Nuchita (1,193 m); Montañas y Valles del Occidente—Huajuapan (1,585 m); Fosa de Tehuacán—San Juan Bautista Cuicatlán (603 m); Sierra Madre de Oaxaca—Ixtlán (2,014 m); Planicie Costera del Golfo—Tuxtepec (31 m); Valles Centrales de Oaxaca—Oaxaca (1,549 m); Montañas y Valles del Centro—Totolapa (922 m); Depresión Istmica de Tehuantepec—Matías Romero (211 m); Sierra Madre del Sur de Oaxaca y Chiapas—Santa María Chimalapa (274 m); Sierra Madre del Sur—San Miguel Suchixtepec (2,564 m); Planicie Costera del Pacífico—Puerto Escondido (67 m); and Planicie Costera de Tehuantepec—Juchitán (23 m). Data taken from www.climate-data.org.

Physiographic Province	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Annual
Depresión del Balsas	9.8 (19.3) 28.9	11.0 (20.9) 30.9	13.6 (23.4) 33.2	15.7 (24.9) 34.1	17.0 (25.4) 33.9	17.4 (24.4) 31.5	16.5 (23.3) 30.1	16.3 (23.2) 30.2	16.4 (22.8) 29.3	14.6 (22.0) 29.5	11.6 (20.5) 29.4	10.1 (19.4) 28.8	14.2 (22.5) 30.8
Montañas y Valles del Occidente	7.2 (17.2) 27.2	8.5 (18.7) 28.9	11.0 (20.9) 30.9	13.0 (22.4) 31.9	14.6 (23.2) 31.9	15.0 (22.3) 29.7	14.2 (21.4) 28.7	14.0 (21.5) 29.0	14.2 (21.1) 28.0	12.1 (20.0) 28.0	8.9 (18.4) 27.9	7.6 (17.3) 27.1	12.0 (20.4) 29.1
Fosa de Tehuacán	13.9 (21.3) 28.7	14.6 (22.6) 30.6	17.7 (25.5) 33.3	20.2 (27.9) 35.6	21.2 (28.5) 35.9	21.4 (27.8) 34.2	20.2 (26.1) 32.0	20.2 (26.3) 32.5	20.4 (26.1) 31.8	19.0 (24.9) 30.9	16.4 (22.9) 29.5	14.7 (21.7) 28.7	18.3 (25.1) 32.0
Sierra Madre de Oaxaca	6.1 (13.5) 21.0	7.1 (14.9) 22.8	8.9 (16.8) 24.7	9.5 (17.3) 25.1	10.8 (17.9) 25.0	10.8 (16.7) 22.7	10.4 (15.9) 21.5	10.2 (16.0) 21.8	10.5 (15.8) 21.2	8.9 (14.9) 21.0	7.1 (13.9) 20.8	7.0 (14.1) 21.2	9.0 (15.6) 22.4
Planicie Costera del Golfo	16.8 (21.4) 26.0	17.1 (22.3) 27.5	19.0 (24.4) 29.9	21.3 (27.2) 33.2	22.6 (28.4) 34.2	22.9 (28.0) 33.2	22.1 (26.6) 31.2	22.4 (27.2) 32.0	22.4 (26.7) 31.0	25.4 (21.2) 29.6	18.9 (23.2) 27.6	17.5 (21.9) 26.3	20.7 (24.9) 30.1
Valles Centrales de Oaxaca	8.4 (17.5) 26.6	9.6 (19.0) 28.4	11.8 (21.1) 30.5	13.7 (22.7) 31.7	14.8 (22.9) 31.1	15.3 (22.1) 28.9	14.5 (21.1) 27.7	14.4 (21.2) 28.0	14.7 (20.9) 27.1	12.8 (19.9) 27.0	10.2 (18.5) 26.9	8.8 (17.6) 26.5	12.4 (20.4) 28.4
Montañas y Valles del Centro	11.6 (20.0) 28.5	12.6 (21.2) 29.9	14.6 (23.1) 31.7	16.5 (24.9) 33.3	17.9 (25.6) 33.4	18.2 (24.7) 31.3	17.7 (24.0) 30.3	17.5 (24.1) 30.7	17.5 (23.6) 29.7	16.2 (22.8) 29.4	14.1 (21.5) 28.9	12.4 (20.4) 28.5	15.6 (23.0) 30.5
Depresión Ístmica de Tehuantepec	17.1 (22.3) 27.5	17.5 (23.1) 28.8	19.0 (24.7) 30.5	20.7 (26.5) 32.4	21.7 (27.5) 33.3	21.2 (26.5) 31.8	20.6 (25.6) 30.7	20.8 (25.9) 31.1	20.4 (25.2) 30.1	19.6 (24.4) 29.3	18.4 (23.4) 28.4	17.6 (22.6) 27.7	19.6 (25.0) 30.1
Sierra Madre del Sur de Oaxaca y Chiapas	16.6 (21.8) 27.1	17.2 (22.9) 28.7	18.8 (24.7) 30.6	20.5 (26.4) 32.4	21.5 (27.3) 33.2	21.3 (26.3) 31.4	20.9 (25.6) 30.4	21.1 (25.9) 30.8	21.0 (25.5) 30.1	19.8 (24.4) 29.0	18.2 (23.1) 28.1	17.2 (22.2) 27.3	19.5 (25.0) 30.0
Sierra Madre del Sur	6.5 (13.2) 19.9	6.8 (13.8) 20.8	7.4 (14.5) 21.6	8.2 (14.9) 21.7	8.9 (14.9) 21.0	9.1 (14.2) 19.4	8.8 (13.9) 19.1	8.8 (13.9) 19.1	8.7 (13.6) 18.5	8.2 (13.8) 19.4	7.3 (13.5) 19.8	6.9 (13.4) 20.0	8.0 (14.0) 20.0
Planicie Costera del Pacífico	18.0 (26.1) 34.2	18.1 (26.5) 34.9	19.0 (27.2) 35.4	20.0 (27.8) 35.7	21.6 (28.6) 35.7	21.8 (28.1) 34.5	21.6 (28.0) 34.5	21.5 (28.2) 35.0	21.7 (27.9) 34.1	20.7 (27.2) 33.8	19.3 (26.4) 33.6	18.1 (26.0) 34.0	20.1 (27.3) 34.6
Planicie Costera de Tehuantepec	19.9 (24.8) 29.8	20.2 (25.6) 31.0	21.7 (27.1) 32.5	23.5 (29.0) 34.5	24.4 (29.6) 34.9	23.9 (28.6) 33.3	23.7 (28.3) 33.0	23.8 (28.7) 33.6	23.3 (27.7) 32.2	22.8 (27.1) 31.5	21.6 (26.1) 30.7	20.5 (25.2) 30.0	22.4 (27.3) 32.3

The mean annual temperature (MAT) decreases with increased elevation, more or less following the normal lapse rate or vertical temperature gradient of 6.4°C/1,000 m (Glickman, 2000). Near the Pacific coast of the Isthmus of Tehuantepec at Juchitán (elev. 23 m), the MAT is 27.3°C, the same value as at Puerto Escondido in the Planicie Costera del Pacífico. At the other elevational extreme, in the central portion of the Sierra Madre del Sur at San Miguel Suchixtepec (2,564 m), the MAT is 14.0°C. This value is 2.3°C lower than expected if the actual lapse rate followed the exact theoretical lapse rate (2,564 – 23 = 2,541/1,000 = 2.541 × 6.4 = 16.3). The MAT generally decreases to 25°C at elevations from 200 to 600 m, thence to about 22°C at elevations ca. 1,200 m, to about 20°C at elevations ca. 1,500 m, to 15–16°C at elevations ca. 2,000 m, and finally to 14°C at elevations ca. 2,500 m. The annual monthly minimum temperature ranges from 9.4 to 17.1°C lower than the annual monthly maximum temperature. Across the year, mean monthly temperatures generally peak in May and decline gradually to their lowest level in January, with little variation from this pattern.

Precipitation in Oaxaca is highest during a six-month period called the rainy season and lowest during the six months of the dry season (Table 2). The data in this table indicate that 77.6–96.7% ($\bar{x}$ = 90.4) of the rainfall in the state occurs from May to October. Depending on the location, the month with the lowest amount of rainfall is December, January, or February, and that with the highest is June, July, August, or September. The annual precipitation ranges from 500 mm in the Fosa de Tehuacán to 2,348 mm in the Planicie Costera del Golfo. In addition to the Fosa de Tehuacán, the lowest values are found in Montañas y Valles del Centro (505 mm) and in the Valles Centrales de Oaxaca (676 mm), followed by the Montañas y Valles del Occidente (702 mm) and the Depresión del Balsas (762 mm). Higher values are found along the Pacific coastline (879 mm in the Planicie Costera de Tehuantepec and 946 mm in the Planicie Costera del Pacífico) and in the Sierra Madre de Oaxaca (951 mm). North of these coastal regions, in the Sierra Madre del Sur, the annual precipitation increases to 1,259 mm. In the Depresión Ístmica de Tehuantepec it increases to 1,450 mm, a value intermediate between that for the Planicie Costera de Tehuantepec (879 mm) and the rainiest region in the state, the Planicie Costera del Golfo (2,348 mm).

Eleutherodactylus syristes (Hoyt, 1965). The curiously-named Piping Peeping Frog is endemic to Oaxaca, with a distribution in the Sierra Madre del Sur and Montañas y Valles del Occidente physiographic provinces. Its EVS has been estimated at 16, placing it in the middle of the high vulnerability category. This frog is considered Endangered by the IUCN and a Special Protection species by SEMARNAT. Pictured here is an individual from San Agustín Loxicha, in the municipality of San Agustín Loxicha. © Alejandro Calzada-Arciniega

Table 2. Monthly and annual precipitation data (in mm.) for the physiographic provinces of Oaxaca, Mexico. Localities and their elevation for each of the provinces are as follows: Depresión del Balsas—San Jorge Nuchita (1,193 m); Montañas y Valles del Occidente—Huajuapan (1,585 m); Fosa de Tehuacán—San Juan Bautista Cuicatlán (603 m); Sierra Madre de Oaxaca—Ixtlán (2,014 m); Planicie Costera del Golfo—Tuxtepec (31 m); Valles Centrales de Oaxaca—Oaxaca (1,549 m); Montañas y Valles del Centro—Totolapa (922 m); Depresión Istmica de Tehuantepec—Matías Romero (211 m); Sierra Madre del Sur de Oaxaca y Chiapas—Santa María Chimalapa (274 m); Sierra Madre del Sur—San Miguel Suchixtepec (2,564 m); Planicie Costera del Pacífico—Puerto Escondido (67 m); and Planicie Costera de Tehuantepec—Juchitán (23 m). The shaded area indicates the months of the rainy season. Data taken from www.climate-data.org.

Physiographic Province	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Depresión del Balsas	4	3	6	28	75	156	132	145	161	45	6	1	762
Montañas y Valles del Occidente	6	4	8	20	76	155	113	103	149	52	13	3	702
Fosa de Tehuacán	3	3	5	12	33	104	113	84	101	30	8	4	500
Sierra Madre de Oaxaca	14	10	13	33	54	171	171	152	178	88	45	22	951
Planicie Costera del Golfo	37	41	38	36	91	402	516	377	448	225	81	56	2,348
Valles Centrales de Oaxaca	2	5	10	32	71	161	109	107	126	41	9	3	676
Montañas y Valles del Centro	2	3	6	21	54	113	83	81	101	32	7	2	505
Depresión Ístmica de Tehuantepec	25	20	23	21	56	212	292	287	295	142	47	30	1450
Sierra Madre del Sur de Oaxaca y Chiapas	107	56	34	39	80	273	302	351	462	284	154	116	2,258
Sierra Madre del Sur	5	21	18	39	124	258	204	232	238	93	19	8	1,259
Planicie Costera del Pacífico	3	7	2	8	65	163	138	249	217	83	8	3	946
Planicie Costera de Tehuantepec	4	4	3	6	55	201	132	160	237	58	14	5	879

COMPOSITION OF THE HERPETOFAUNA

The herpetofauna of Oaxaca is the largest of any state in Mexico (Flores-Villela and García-Vázquez, 2014; Parra-Olea et al., 2014; Ramírez González, et al. 2014). Parra-Olea et al. (2014) reported 140 species of amphibians from the state, and Flores-Villela and García-Vázquez (2014) 262 species of crocodylians, turtles, and squamates. González et al. (2014) stated the number of herpetofaunal species in the state as 378, the same number listed by Casas-Andreu et al. (2004), even though the former group of authors reported an anuran as new for the state. This number represented an increase of 19 species over the 359 reported by Casas-Andreu et al. (1996). The number we report here is 442 species (Table 3), an increase of 64 (16.9%) over the number recorded by Casas-Andreu et al. (2004).

Our use of the term "herpetofauna" in this paper includes the amphibians (anurans, salamanders, and caecilians), the crocodylians (alligators and crocodiles, *sensu lato*), turtles, and squamates (amphisbaenians, lizards, and snakes). We avoided using the term "reptile," given that its use to describe a class of vertebrate animals has become increasingly outmoded because its paraphyletic nature has been exposed over relatively recent time (see www.iflscience.com/plants-and-animals/there-s-no-such-thing-reptiles-any-more-and-here-s-why).

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

Orders	Families	Genera	Species
Anura	10	29	106
Caudata	1	4	41
Gymnophiona	1	1	2
Subtotals	**12**	**34**	**149**
Crocodylia	2	2	3
Squamata	28	107	271
Testudines	8	11	19
Subtotals	**38**	**120**	**293**
Totals	**50**	**154**	**442**

Families

The herpetofauna of Oaxaca contains representatives of 12 families of amphibians (in the orders Anura, Caudata, Gymnophiona), including 10 of anurans, one salamander, and one caecilian, as well as two families of crocodylians, 28 of squamates, and eight of turtles, for a total of 38 families (Table 3). By way of comparison, the total number of 50 families exceeds that for Honduras by two (Solís et al., 2014), a country about 1.2 times the size of Oaxaca. About two-thirds of Oaxaca's amphibians have been allocated to two families (Hylidae and Plethodontidae), and more than one-half of the remainder of the herpetofauna to four families (Dactyloidae, Phrynosomatidae, Colubridae, and Dipsadidae).

Pseudoeurycea boneti Alvarez and Martín, 1967. This large colorful salamander is a member of the *P. bellii* group of the large Mesoamerican endemic genus *Pseudoeurycea*; this species is found in the Sierra Madre de Oaxaca, Montañas y Valles del Occidente, and the Valles Centrales de Oaxaca physiographic provinces. Its EVS has been judged at 17, placing it in the middle of the high vulnerability category. This salamander has been assessed as Vulnerable by the IUCN, but has not been provided a status by SEMARNAT. The individual in this photo was encountered at Rancho Torres, Ixtlán de Juárez, in the municipality of Ixtlán de Juárez. © Alejandro Calzada-Arciniega

Genera

Oaxaca's amphibians have been categorized into 34 genera, of which 29 are anurans (Table 3). The remaining herpetofauna has been assigned to 120 genera, of which (107) are squamates (Table 3). The total number of genera (154) exceeds that for Honduras by three (Solís et al., 2014). The total number for Oaxaca is 73.3% of the 210 genera represented in Mexico (Wilson et al., 2013a, b). The most speciose genera are *Incilius* (11 species), *Craugastor* (12), *Plectrohyla* (20), *Bolitoglossa* (11), *Pseudoeurycea* (20), and *Thorius* (11) among the amphibians, and *Norops* (29), *Sceloporus* (26), *Tantilla* (10), *Geophis* (11), *Micrurus* (10), and *Thamnophis* (10) among the squamates.

Species

The herpetofauna of Oaxaca currently consists of 442 species, including 149 amphibians, three crocodylians, 271 squamates, and 19 turtles (Table 3). Wilson et al. (2013b) reported a total of 378 amphibian species for all of Mexico; the current number is 381 (J. Johnson, unpublished). Thus, 39.1% of this fauna resides in Oaxaca. Anurans comprise the most speciose group of amphibians in the state, with 106 species (71.1%), followed by salamanders (41 species; 27.5%). Three species of caecilians are recorded from Mexico (J. Johnson, unpublished), of which two are found in Oaxaca (Table 3). Similarly, the remainder of the herpetofauna is well represented in the state. Only three species of crocodylians occur in Mexico, and all three are found in Oaxaca (Table 3). The squamates, with 271 species, make up the bulk of the non-amphibian portion of the herpetofauna; this number represents 34.0% of the 798 species reported for Mexico by Wilson et al. (2013a). The current number of squamates is 817 (J. Johnson, unpublished), and thus their percentage of representation is 33.2%. Nineteen species of turtles are known from Oaxaca, which represents 39.6% of the 48 reported by Wilson et al. (2013a) and J. Johnson (unpublished). The total for the Oaxacan herpetofauna (442 species) is 35.4% of the 1,250 species now recorded for Mexico (J. Johnson, unpublished). The 442 species also represents 21.9% of the 2,018 species currently reported for Mesoamerica (Mexico and Central America; www.mesoamericanherpetology.com; accessed 18 February 2015).

PATTERNS OF PHYSIOGRAPHIC DISTRIBUTION

We used the system of 12 regions recognized by Ortiz Pérez et al. (2004; see Fig. 1) to examine the physiographic distribution of members of the Oaxacan herpetofauna. We indicate the distribution of species among these regions in Table 4, and present a summary in Table 5.

Table 4. Distribution of the herpetofauna of Oaxaca, Mexico, by physiographic province. Abbreviations: DB = Depresión del Balsas; MVO = Montañas y Valles del Occidente; FT = Fosa de Tehuacán; SMO = Sierra Madre de Oaxaca; PCG = Planicie Costera del Golfo; VCO = Valles Centrales de Oaxaca; MVC = Montañas y Valles del Centro; DIT = Depresión Ístmica de Tehuantepec; SMC = Sierra Madre de Chiapas; SMS = Sierra Madre del Sur; PCP = Planicie Costera del Pacífico; and PCT = Planicie Costera de Tehuantepec. * = species endemic to Mexico; ** = species endemic to Oaxaca; and *** = non-native species.

Taxa	Physiographic Regions of Oaxaca												Number of Regions Occupied
	DB	MVO	FT	SMO	PCG	VCO	MVC	DIT	SMC	SMS	PCP	PCT	
Anura (106 species)													
Bufonidae (12 species)													
Incilius canaliferus				+					+	+	+	+	5
Incilius coccifer				+			+	+	+	+	+	+	7
*Incilius cycladen**										+			1
*Incilius gemmifer**											+		1
Incilius macrocristatus									+				1
*Incilius marmoreus**				+		+	+		+	+	+	+	7
*Incilius occidentalis**	+	+	+	+		+	+			+			7
*Incilius perplexus**		+											1

*Incilius spiculatus***				+									1
Incilius tutelarius									+				1
Incilius valliceps			+	+	+			+	+				5
Rhinella marina			+	+	+			+	+	+	+		7
Centrolenidae (1 species)													
Hyalinobatrachium fleischmanni					+			+	+	+	+		5
Craugastoridae (14 species)													
Craugastor alfredi					+								1
Craugastor augusti			+	+		+	+	+		+			6
*Craugastor berkenbuschii**					+								1
*Craugastor decoratus**				+									1
Craugastor lineatus				+					+				2
Craugastor loki				+	+			+	+			+	5
*Craugastor mexicanus**		+	+	+		+				+			5
*Craugastor polymniae***				+									1
Craugastor pygmaeus				+					+	+			3
*Craugastor rhodopis**									+				1
*Craugastor rugulosus**	+								+	+	+	+	5
*Craugastor silvicola***												+	1
*Craugastor spatulatus**				+									1
*Craugastor uno**										+			1
Eleutherodactylidae (4 species)													
Eleutherodactylus leprus				+	+							+	3
*Eleutherodactylus nitidus**		+	+	+						+			4
Eleutherodactylus pipilans										+	+	+	3
*Eleutherodactylus syristes***		+								+			2
Hylidae (59 species)													
Agalychnis callidryas					+			+	+				3
*Agalychnis dacnicolor**										+	+	+	3
Agalychnis moreletii				+						+			2
Anotheca spinosa				+	+								2
*Bromeliohyla dendroscarta**				+									1
*Charadrahyla altipotens***		+								+			2
*Charadrahyla chaneque**									+				1
*Charadrahyla nephila***				+									1
Dendropsophus ebraccatus				+	+								2
Dendropsophus microcephalus				+	+			+	+				4
Dendropsophus robertmertensi												+	1
*Dendropsophus sartori**										+	+		2
*Diaglena spatulata**				+			+	+	+	+	+	+	7
*Duellmanohyla ignicolor***				+									1
Duellmanohyla schmidtorum									+			+	2
*Ecnomiohyla echinata***				+									1
*Ecnomiohyla miotympanum**		+		+		+							3
*Exerodonta abdivita***				+	+								2
*Exerodonta chimalapa**									+				1
*Exerodonta juanitae**										+			1
*Exerodonta melanomma**										+			1
*Exerodonta pinorum**										+			1
*Exerodonta sumichrasti**	+	+		+		+	+		+	+		+	8
*Exerodonta xera**		+	+	+									3
Hyla arenicolor	+	+	+	+									4
*Hyla euphorbiacea**		+		+		+							3
*Megastomatohyla mixe***				+									1
*Megastomatohyla pellita***										+			1
*Plectrohyla ameibothalame***		+											1
*Plectrohyla bistincta**	+	+	+	+		+	+						6
*Plectrohyla calthula***				+									1

*Plectrohyla calvicollina***				+									1
*Plectrohyla celata***				+									1
*Plectrohyla cembra***		+								+			2
*Plectrohyla crassa***				+		+	+						3
*Plectrohyla cyanomma***				+									1
*Plectrohyla cyclada***				+									1
*Plectrohyla ephemera***				+									1
Plectrohyla hartwegi									+				1
*Plectrohyla hazelae***				+						+			2
*Plectrohyla labedactyla***		+											1
Plectrohyla matudai									+				1
*Plectrohyla miahuatlanensis***										+			1
*Plectrohyla pentheter**		+		+						+			3
*Plectrohyla psarosema***				+									1
*Plectrohyla sabrina***				+									1
*Plectrohyla siopela**				+									1
*Plectrohyla thorectes**										+			1
*Ptychohyla acrochorda***				+									1
Ptychohyla euthysanota					+				+				2
*Ptychohyla leonhardschultzei**										+			1
*Ptychohyla zophodes***				+									1
Scinax staufferi				+	+			+	+	+	+	+	7
Smilisca baudinii		+	+	+	+		+	+	+	+	+	+	10
Smilisca cyanosticta				+					+				2
Tlalocohyla loquax				+	+			+	+				4
Tlalocohyla picta					+								1
*Tlalocohyla smithii**	+	+				+	+			+	+		6
Trachycephalus typhonius					+				+			+	3
Leptodactylidae (3 species)													
Engystomops pustulosus											+	+	2
Leptodactylus fragilis				+	+		+	+	+	+	+	+	8
Leptodactylus melanonotus				+	+			+	+	+	+	+	7
Microhylidae (3 species)													
Gastrophryne elegans					+								1
Hypopachus ustus		+		+	+	+	+	+	+	+	+	+	10
Hypopachus variolosus		+		+	+		+	+	+	+	+	+	9
Ranidae (8 species)													
Lithobates berlandieri		+	+	+	+	+	+	+	+	+		+	10
Lithobates brownorum					+								1
Lithobates forreri				+				+	+	+	+	+	6
Lithobates maculatus									+			+	2
*Lithobates sierramadrensis**										+			1
*Lithobates spectabilis**		+	+	+		+	+						5
Lithobates vaillanti									+			+	2
*Lithobates zweifeli**		+	+	+									3
Rhinophrynidae (1 species)													
Rhinophrynus dorsalis				+			+		+	+	+	+	6
Scaphiopodidae (1 species)													
Spea multiplicata	+	+	+	+									4
Caudata (41 species)													
Plethodontidae (41 species)													
*Bolitoglossa alberchi**									+				1
*Bolitoglossa chinanteca***				+									1
*Bolitoglossa macrinii***										+			1
*Bolitoglossa oaxacensis***		+								+			2
Bolitoglossa occidentalis									+				1
*Bolitoglossa platydactyla**					+			+	+				3
*Bolitoglossa riletti***		+											1

Bolitoglossa rufescens					+				+				2
*Bolitoglossa veracrucis**					+			+	+				3
*Bolitoglossa zapoteca***										+			1
*Ixalotriton parvus***									+				1
*Pseudoeurycea anitae***										+			1
*Pseudoeurycea aquatica***				+									1
*Pseudoeurycea aurantia***				+									1
*Pseudoeurycea boneti***		+		+		+							3
*Pseudoeurycea cochranae***		+		+									2
*Pseudoeurycea conanti***		+								+			2
*Pseudoeurycea juarezi***				+									1
*Pseudoeurycea maxima***		+											1
*Pseudoeurycea mixteca**		+											1
*Pseudoeurycea mystax***				+									1
*Pseudoeurycea obesa***				+									1
*Pseudoeurycea orchileucos***				+									1
*Pseudoeurycea papenfussi***				+									1
*Pseudoeurycea ruficauda***				+									1
*Pseudoeurycea saltator***				+									1
*Pseudoeurycea smithi***		+		+									2
*Pseudoeurycea unguidentis***				+									1
*Pseudoeurycea werleri**				+									1
*Thorius adelos***				+									1
*Thorius arboreus***				+									1
*Thorius aureus***				+									1
*Thorius boreas***				+									1
*Thorius insperatus***				+									1
*Thorius macdougalli***				+									1
*Thorius maxillabrochus**				+									1
*Thorius minutissimus***										+			1
*Thorius narisovalis***		+		+									2
*Thorius papaloae***				+									1
*Thorius pulmonaris***				+									1
*Thorius smithi***				+									1
Gymnophiona (2 species)													
Dermophiidae (2 species)													
Dermophis mexicanus									+			+	2
*Dermophis oaxacae**										+			1
Crocodylia (3 species)													
Alligatoridae (1 species)													
Caiman crocodilus											+	+	2
Crocodylidae (2 species)													
Crocodylus acutus											+	+	2
Crocodylus moreletii					+								1
Squamata (271 species)													
Anguidae (15 species)													
*Abronia bogerti**									+				1
*Abronia fuscolabialis**				+									1
*Abronia graminea**				+									1
*Abronia mitchelli**				+									1
*Abronia mixteca**		+											1
*Abronia oaxacae***		+		+			+			+			4
*Abronia ornelasi**									+				1
*Barisia imbricata**			+	+									2
*Barisia planifrons***				+									1
*Celestus enneagrammus**				+	+								2
Celestus rozellae								+	+			+	3
Gerrhonotus liocephalus		+		+		+	+		+				5

*Mesaspis gadovii**		+								+			2
*Mesaspis juarezi***				+									1
*Mesaspis viridiflava**				+									1
Corytophanidae (4 species)													
Basiliscus vittatus			+	+	+			+	+	+	+	+	8
Corytophanes hernandesii					+			+	+				3
Laemanctus longipes				+	+			+	+				4
Laemanctus serratus							+						1
Dactyloidae (27 species)													
*Norops barkeri**									+				1
Norops biporcatus									+				1
*Norops boulengerianus***							+			+		+	3
*Norops carliebi***		+	+	+									3
*Norops compressicauda**					+			+	+	+		+	4
*Norops cuprinus**									+			+	2
*Norops immaculogularis***											+		1
Norops laeviventris				+	+			+	+	+		+	6
Norops lemurinus					+							+	2
*Norops macrinii***										+	+		2
*Norops microlepidotus**		+											1
*Norops milleri**		+		+						+			3
*Norops nebuloides**		+								+			2
*Norops nebulosus**											+		1
Norops petersii				+					+			+	3
*Norops peucephilus***										+			1
*Norops pygmaeus**									+				1
*Norops quercorum***		+		+		+	+						4
Norops rodriguezii				+	+								2
*Norops rubiginosus**				+									1
*Norops sacamecatensis***				+			+						2
Norops sericeus				+	+								2
*Norops stevepoei***										+			1
*Norops subocularis**										+	+		2
Norops tropidonotus				+	+			+					3
Norops unilobatus									+		+	+	3
*Norops zapotecorum***										+			1
Eublepharidae (1 species)													
Coleonyx elegans		+		+	+		+	+	+	+	+	+	9
Gekkonidae (1 species)													
*Hemidactylus frenatus****			+	+		+				+	+	+	6
Gymnophthalmidae (1 species)													
Gymnophthalmus speciosus												+	1
Helodermatidae (1 species)													
Heloderma horridum										+	+	+	3
Iguanidae (5 species)													
Ctenosaura acanthura		+	+		+			+				+	5
*Ctenosaura oaxacana***							+		+	+	+	+	5
*Ctenosaura pectinata**										+	+	+	3
Ctenosaura similis							+			+		+	3
Iguana iguana		+	+		+					+	+	+	6
Mabuyidae (1 species)													
Marisora brachypoda				+			+		+	+	+	+	6
Phrynosomatidae (30 species)													
Phrynosoma asio							+			+	+	+	4
*Phrynosoma braconnieri**		+	+			+	+						4
*Phrynosoma taurus**		+	+										2
*Sceloporus aureolus**		+	+	+									3
*Sceloporus bicanthalis**				+									1
*Sceloporus cryptus**				+									1

*Sceloporus cupreus**		+		+		+							3
*Sceloporus edwardtaylori**				+			+			+	+	+	5
*Sceloporus formosus**		+		+		+	+			+			5
*Sceloporus gadoviae**		+	+										2
Sceloporus grammicus		+	+	+		+	+			+			6
*Sceloporus halli***							+						1
*Sceloporus horridus**		+	+	+									3
Sceloporus internasalis				+	+				+				3
*Sceloporus jalapae**		+	+			+							3
*Sceloporus macdougalli**											+	+	2
*Sceloporus megalepidurus**		+											1
Sceloporus melanorhinus				+						+	+	+	4
*Sceloporus ochoterenae**		+				+							2
*Sceloporus omiltemanus**		+								+			2
*Sceloporus salvini**				+									1
Sceloporus siniferus							+			+	+	+	4
*Sceloporus smithi**							+			+	+	+	4
*Sceloporus spinosus**		+		+		+	+						4
Sceloporus squamosus												+	1
*Sceloporus subpictus***		+				+							2
*Sceloporus tanneri***										+			1
Sceloporus teapensis				+	+			+	+				4
Sceloporus variabilis				+	+			+	+				4
*Urosaurus bicarinatus**		+	+				+			+	+	+	6
Phyllodactylidae (3 species)													
*Phyllodactylus bordai**		+	+										2
*Phyllodactylus muralis**							+		+	+	+	+	5
Phyllodactylus tuberculosus										+	+	+	3
Scincidae (3 species)													
*Plestiodon brevirostris**		+		+			+			+			4
*Plestiodon ochoterenae**		+								+			2
Plestiodon sumichrasti				+	+								2
Sphaerodactylidae (2 species)													
Sphaerodactylus continentalis								+	+	+	+	+	5
Sphaerodactylus glaucus								+	+	+	+	+	5
Sphenomorphidae (4 species)													
*Scincella gemmingeri**				+	+	+							3
*Scincella silvicola**		+	+	+									3
Sphenomorphus assatus				+				+		+	+	+	5
Sphenomorphus cherriei					+			+					2
Teiidae (8 species)													
*Aspidoscelis costata**		+					+						2
Aspidoscelis deppii					+		+	+	+	+	+	+	7
*Aspidoscelis guttata**							+			+	+	+	4
*Aspidoscelis mexicana**						+	+						2
Aspidoscelis motaguae						+	+	+					3
*Aspidoscelis parvisocia**		+	+										2
*Aspidoscelis sackii**		+	+	+		+	+						5
Holcosus undulates		+		+	+			+	+	+	+	+	8
Xantusiidae (9 species)													
*Lepidophyma cuicateca***			+										1
*Lepidophyma dontomasi**							+						1
Lepidophyma flavimaculatum					+			+					2
*Lepidophyma lineri***										+			1
*Lepidophyma lowei**				+									1
*Lepidophyma pajapanense**									+				1
*Lepidophyma radula**						+	+						2
Lepidophyma smithii							+			+	+	+	4

*Lepidophyma tuxtlae**				+	+			+	+				4
Xenosauridae (5 species)													
*Xenosaurus agrenon**		+								+			2
*Xenosaurus grandis**				+			+			+	+	+	5
*Xenosaurus phalaroanthereon***							+			+			2
Xenosaurus rackhami				+					+				2
*Xenosaurus rectocollaris**		+											1
Boidae (1 species)													
Boa imperator			+	+	+					+	+	+	6
Charinidae (1 species)													
*Exiliboa placata***				+									1
Colubridae (50 species)													
Coluber constrictor													?
*Conopsis acuta**		+		+		+							3
*Conopsis amphisticha**				+									1
*Conopsis lineata**		+	+	+		+							4
*Conopsis megalodon**			+	+		+							3
*Conopsis nasus**						+							1
Dendrophidion vinitor					+				+				2
Drymarchon melanurus		+	+	+	+				+	+	+	+	8
Drymobius chloroticus				+					+	+		+	4
Drymobius margaritiferus		+		+	+			+		+	+	+	7
*Ficimia olivacea**												+	1
Ficimia publia			+	+	+	+		+		+		+	7
*Ficimia ramirezi**									+				1
*Ficimia variegata**					+			+					2
*Geagras redimitus***												+	1
Lampropeltis abnorma						+		+				+	2
*Lampropeltis polyzona**		+	+	+	+		+			+	+		7
Leptophis ahaetulla								+					1
*Leptophis diplotropis**		+		+		+	+			+	+	+	7
Leptophis mexicanus				+	+			+		+		+	5
Masticophis mentovarius		+	+	+	+	+	+			+	+	+	9
Mastigodryas melanolomus				+	+					+	+	+	5
Oxybelis aeneus		+	+	+				+	+	+	+	+	8
Oxybelis fulgidus								+		+	+	+	4
Phrynonax poecilonotus				+	+			+	+			+	5
*Pituophis deppei**						+							1
Pituophis lineaticollis		+	+	+		+				+			5
Pseudelaphe flavirufa					+			+				+	3
*Salvadora bairdi**		+											1
*Salvadora intermedia**		+	+	+		+							4
*Salvadora lemniscata**						+	+		+	+	+	+	6
*Salvadora mexicana**										+	+		2
Senticolis triaspis		+	+	+	+	+	+			+	+	+	9
Spilotes pullatus				+	+			+					3
Stenorrhina degenhardtii				+	+			+	+			+	5
Stenorrhina freminvillii		+		+		+	+			+	+		6
*Symphimus leucostomus**										+	+	+	3
*Tantilla bocourti**		+				+							2
*Tantilla briggsi***					+								1
*Tantilla deppei**		+											1
*Tantilla flavilineata***		+				+							2
*Tantilla oaxacae***										+			1
Tantilla rubra		+		+	+			+		+		+	6
Tantilla schistosa				+								+	2
*Tantilla striata**				+			+		+	+		+	5
*Tantilla triseriata***							+			+			2

Tantilla vulcani									+			+	2
Tantillita brevissima												+	1
Trimorphodon biscutatus				+			+			+	+	+	5
*Trimorphodon tau**		+	+	+	+	+							5
Dipsadidae (55 species)													
*Adelphicos latifasciatum**									+				1
Adelphicos quadrivirgatum				+	+					+			3
Amastridium sapperi								+					1
*Chersodromus liebmanni**				+									1
Clelia scytalina					+			+				+	3
Coniophanes bipunctatus												+	1
Coniophanes fissidens					+			+	+	+		+	5
Coniophanes imperialis				+	+			+	+	+		+	6
Coniophanes piceivittis								+		+		+	3
Conophis lineatus								+				+	2
Conophis vittatus						+	+			+	+	+	5
*Cryophis hallbergi***				+									1
Enulius flavitorques					+		+		+	+		+	5
*Geophis anocularis**				+									1
*Geophis blanchardi**				+									1
Geophis carinosus				+									1
*Geophis dubius**		+		+									2
*Geophis duellmani**		+		+									2
*Geophis isthmicus**												+	1
*Geophis juarezi***				+									1
*Geophis laticinctus**				+									1
*Geophis omiltemanus**		+											1
*Geophis russatus**										+			1
*Geophis sallei**										+			1
*Hypsiglena torquata**		+											1
Imantodes cenchoa				+	+			+	+			+	5
Imantodes gemmistratus					+			+		+	+	+	5
Leptodeira frenata					+								1
Leptodeira maculata		+		+	+			+		+	+	+	7
Leptodeira nigrofasciata										+	+	+	3
Leptodeira septentrionalis		+		+	+	+	+	+		+		+	8
*Manolepis putnami**				+					+	+	+	+	5
Ninia diademata				+	+							+	3
Ninia sebae				+	+			+					3
Oxyrhophus petolarius				+	+								2
Pliocercus elapoides				+	+					+		+	4
*Pseudoleptodeira latifasciata**		+											1
*Rhadinaea bogertorum**				+									1
*Rhadinaea cuneata**				+									1
Rhadinaea decorata				+	+			+	+		+	+	6
*Rhadinaea fulvivittis**		+		+		+	+			+			5
*Rhadinaea hesperia**				+									1
*Rhadinaea macdougalli**				+					+				2
*Rhadinaea myersi**		+								+			2
*Rhadinaea taeniata**		+		+		+							3
*Rhadinella donaji***		+											1
Rhadinella godmani									+				1
Sibon dimidiatus				+	+								2
*Tantalophis discolor***		+		+									2
Tretanorhinus nigroluteus								+					1
Tropidodipsas fasciata							+			+		+	3
Tropidodipsas fischeri									+				1
*Tropidodipsas philippi**											+		1

Tropidodipsas sartorii				+	+				+			+	4
Xenodon rabdocephalus					+			+				+	3
Elapidae (11 species)													
Hydrophis platurus											+	+	2
*Micrurus bogerti**											+	+	2
Micrurus browni									+	+	+	+	4
Micrurus diastema				+	+			+					3
Micrurus elegans				+					+				2
*Micrurus ephippifer***		+		+			+			+		+	5
*Micrurus laticollaris**		+											1
Micrurus latifasciatus												+	1
*Micrurus nebularis***				+									1
Micrurus nigrocinctus												+	1
*Micrurus pachecogili**			+										1
Leptotyphlopidae (3 species)													
Epictia bakewelli												+	1
Epictia phenops				+			+		+	+	+	+	6
*Rena maxima**	+	+											2
Loxocemidae (1 species)													
Loxocemus bicolor									+	+	+	+	4
Natricidae (11 species)													
*Storeria storerioides**		+				+							2
*Thamnophis bogerti***		+		+									2
*Thamnophis chrysocephalus**		+		+		+				+			4
Thamnophis cyrtopsis		+	+	+		+				+			5
Thamnophis eques		+				+				+			3
*Thamnophis godmani**		+		+		+	+			+			5
*Thamnophis lineri***				+									1
Thamnophis marcianus									+			+	2
Thamnophis proximus											+	+	2
*Thamnophis scalaris**		+											1
*Thamnophis sumichrasti**		+											1
Sibynophiidae (1 species)													
Scaphiodontophis annulatus				+	+			+				+	4
Typhlopidae (2 species)													
Amerotyphlops tenuis									+				1
*Indotyphlops braminus****			+								+	+	3
Viperidae (15 species)													
Agkistrodon bilineatus		+									+	+	3
*Atropoides nummifer**				+					+			+	3
Atropoides olmec									+				1
*Bothriechis rowleyi**									+				1
Bothrops asper				+				+	+				3
Cerrophidion godmani									+				1
Crotalus atrox							+					+	2
*Crotalus culminatus**										+	+	+	3
*Crotalus intermedius**		+		+		+				+			4
Crotalus molossus		+	+	+									3
*Crotalus ravus**		+		+			+			+			4
Crotalus simus												+	1
*Mixcoatlus melanurus**		+											1
*Ophryacus undulatus**		+		+						+			3
*Porthidium dunni**										+	+	+	3
Testudines (19 species)													
Cheloniidae (3 species)													
Chelonia mydas											+	+	2
Eretmochelys imbricata											+	+	2
Lepidochelys olivacea											+	+	2
Chelydridae (1 species)													

Chelydra rossignonii					+				+				2
Dermatemyidae (1 species)													
Dermatemys mawii					+				+				2
Dermochelyidae (1 species)													
Dermochelys coriacea											+	+	2
Emydidae (2 species)													
Trachemys grayi											+	+	2
Trachemys ornata					+			+	+				3
Geoemydidae (3 species)													
Rhinoclemmys areolata					+							+	2
Rhinoclemmys pulcherrima										+	+	+	3
*Rhinoclemmys rubida**							+			+	+	+	4
Kinosternidae (5 species)													
*Kinosternon integrum**	+	+	+	+	+					+		+	7
*Kinosternon oaxacae**										+	+		2
Kinosternon scorpioides					+			+	+	+		+	5
Kinosternon acutum					+			+	+				3
Kinosternon leucostomum				+	+				+				3
Staurotypidae (3 species)													
Claudius angustatus					+			+	+				3
Staurotypus salvinii										+		+	2
Staurotypus triporcatus					+			+					2

Abronia oaxacae (Günther, 1885). The Oaxaca Arboreal Alligator Lizard is endemic to Oaxaca, where it occurs in the Sierra Madre de Oaxaca, Sierra Madre del Sur, Montañas y Valles del Occidente, and Montañas y Valles del Centro physiographic provinces. Its EVS has been estimated at 17, placing it in the middle of the high vulnerability category. This species has been judged as Vulnerable by the IUCN, and as threatened by SEMARNAT. This photo is of an individual from El Punto Ixtepeji, municipality of Santa Catarina Ixtepeji, in the Sierra de Juárez. © Vicente Mata-Silva

The total number of species among the 12 regions ranges from a low of nine in the Depresión del Balsas province to a high of 216 in the Sierra Madre de Oaxaca province. Aside from the Depresión del Balsas province, the total number of species is fewer than 100 in the Fosa de Tehuacán (52), the Valles Centrales de Oaxaca (57), the Montañas y Valles del Centro (69), the Depresión Ísthmica de Tehuantepec (75), and the Planicie Costera del Pacífico (93). Apart from the Sierra de Oaxaca province, the total number of species exceeds 100 in the Planicie Costera del Golfo (102), the Sierra Madre de Chiapas (103), the Montañas y Valles del Occidente (117), the Planicie Costera de Tehuantepec (143), and the Sierra Madre del Sur (154). Ramírez González et al. (2014: 679) noted that even though "Oaxaca contains more species of herpetofauna than any state in México…there are still areas of the state that are understudied." This appears to be the case with the Depresión del Balsas region, as the known herpetofaunal species in this province consists of seven anurans, one snake, and one turtle (Table 5), so this area of northwestern Oaxaca would seem to require additional survey work.

The Sierra Madre de Oaxaca (Table 5) contains the greatest number of species of anurans, salamanders, lizards, and snakes (a total of 216 of 417 species, 51.8%). Anurans are best represented in this range, with 62 of 106 species (58.5%); salamanders also are well represented, with 26 of 41 species (63.4%). Lizards are somewhat less well represented, with 52 of 120 species (43.3%), as are snakes, with 74 of 150 (49.3%). The next best-represented area in the state is the Sierra Madre del Sur, with a total of 147 species of anurans, salamanders, lizards, and snakes (35.3%). The province supporting the largest number of turtle species (Table 5) is the Planicie Costera de Tehuantepec, with 11 (57/9%), followed by the Planicie Costera del Golfo, with 10 (52.6%). Crocodylians are found only along the Planicie Costera de Tehuantepec, the Planice Costera del Pacífico, and the Planice Costera del Golfo.

Members of the Oaxacan herpetofauna occupy from one to 10 of the 12 physiographic regions (Table 4). The single exception is the snake *Coluber constrictor*, whose distribution in the state is uncertain. The specimen used to describe *Coluber oaxaca*, a synonym of *C. constrictor*, is assumed to have been collected in Oaxaca (Wilson, 1966), but no specimen with precise locality data is known (P. Campbell, pers. comm.).

Of the 441 species (except *C. constrictor*), 169 (38.3%) are limited to a single province. Among the remaining 272 species, 91 (20.7%) occupy two provinces, 64 (14.5%) three provinces, 34 (7.7%) four provinces, 37 (8.4%) five provinces, 18 (4.1%) six provinces, 14 (3.2%) seven provinces, 7 (1.6%) eight provinces, 4 (0.9%) nine provinces, and 3 (0.7%) 10 provinces. As expected, the species occupancy figures decrease gradually, except for a slight increase from four to five regions. The seven most broadly occurring species are *Smilisca baudinii*, *Hypopachus ustus*, and *Lithobates berlandieri* (10 regions) and *Hypopachus variolosus*, *Coleonyx elegans*, *Masticophis mentovarius*, and *Senticolis triaspis* (nine regions).

Mesaspis juarezi (Karges and Wright, 1987). The Sierra Juárez Alligator Lizard is a Oaxacan endemic, with a distribution restricted to the Sierra Madre de Oaxaca physiographic province. Its EVS is assessed at 15, placing it in the lower portion of the high vulnerability category. This species has been judged as Endangered by the IUCN, and as a species of Special Protection by SEMARNAT. This individual was found at La Cumbre, in the municipality of Santa Catarina Ixtepeji. © Elí García-Padilla

Table 5. Summary of distributional occurrence of herpetofaunal families in Oaxaca by physiographic province. See Table 4 for explanation of abbreviations.

Families	Number of Species	Distributional Occurrence											
		DB	MVO	FT	SMO	PCG	VCO	MVC	DIT	SMC	SMS	PCP	PCT
Bufonidae	12	1	2	3	7	2	2	3	3	7	6	5	3
Centrolenidae	1	—	—	—	—	1	—	—	1	1	1	1	—
Craugastoridae	14	1	1	2	8	3	2	1	2	5	5	1	3
Eleutherodactylidae	4	—	2	1	2	1	—	—	—	—	3	1	2
Hylidae	59	4	13	4	35	11	6	6	6	15	19	6	8
Leptodactylidae	3	—	—	—	2	2	—	1	2	2	2	3	3
Microhylidae	3	—	2	—	2	3	1	2	2	2	2	2	2
Ranidae	8	—	3	3	4	2	2	2	2	4	3	1	4
Rhinophrynidae	1	—	—	—	1	—	—	1	—	1	1	1	1
Scaphiopodidae	1	1	1	1	1	—	—	—	—	—	—	—	—
Subtotals	**106**	**7**	**24**	**14**	**62**	**25**	**13**	**16**	**18**	**28**	**42**	**21**	**26**
Plethodontidae	41	—	9	—	26	3	1	—	2	6	6	—	—
Subtotals	**41**		**9**		**26**	**3**	**1**		**2**	**6**	**6**		
Dermophiidae	2	—	—	—	—	—	—	—	—	1	1	—	1
Subtotals	**2**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**1**	**1**	**—**	**1**
Totals	**149**	**7**	**33**	**14**	**88**	**28**	**14**	**16**	**20**	**35**	**49**	**21**	**27**
Alligatoridae	1	—	—	—	—	—	—	—	—	—	—	1	1
Crocodylidae	2	—	—	—	—	1	—	—	—	—	—	1	1
Subtotals	**3**	**—**	**—**	**—**	**—**	**1**	**—**	**—**	**—**	**—**	**—**	**2**	**2**
Anguidae	15	—	4	1	10	1	1	2	1	4	2	—	1
Corytophanidae	4	—	—	1	2	3		1	3	3	1	1	1
Dactyloidae	27	—	5	1	10	6	1	3	3	8	10	5	7
Eublepharidae	1	—	1	—	1	1	—	1	1	1	1	1	1
Gekkonidae	1	—	—	1	1	—	1	—	—	—	1	1	1
Gymnophthalmidae	1	—	—	—	—	—	—	—	—	—	—	—	1
Helodermatidae	1	—	—	—	—	—	—	—	—	—	1	1	1
Iguanidae	5	—	2	2	—	2	—	2	1	1	4	3	5
Mabuyidae	1	—	—	—	1	—	—	1	—	1	1	1	1
Phrynosomatidae	30	—	15	8	14	3	8	10	2	3	10	7	8
Phyllodactylidae	3	—	1	1	—	—	—	1	—	1	2	2	2
Scincidae	3	—	2	—	2	1	—	1	—	—	2	—	—
Sphaerodactylidae	2	—	—	—	—	—	—	—	2	2	2	2	2
Sphenomorphidae	4	—	1	1	3	2	1	—	2	—	1	1	1
Teiidae	8	—	4	4	4	4	3	6	3	2	3	3	3
Xantusiidae	9	—	—	1	2	2	1	3	2	2	2	1	1
Xenosauridae	5	—	2	—	2	—	—	2	—	1	3	1	1
Subtotals	**120**	**—**	**37**	**21**	**52**	**25**	**16**	**33**	**20**	**29**	**46**	**30**	**37**
Boidae	1	—	—	1	1	1	—	—	—	—	1	1	1
Charinidae	1	—	—	—	1	—	—	—	—	—	—	—	—
Colubridae	50	—	18	11	26	17	17	9	13	10	22	14	25
Dipsadidae	55	—	12	—	29	18	4	5	14	11	17	7	21
Elapidae	11	—	2	1	4	1	—	1	1	2	2	3	6
Leptotyphlopidae	3	1	1	—	1	—	—	1	—	1	1	1	2
Loxocemidae	1	—	—	—	—	—	—	—	—	1	1	1	1
Natricidae	11	—	8	1	5	—	5	1	—	1	4	1	2
Sibynophiidae	1	—	—	—	1	1	—	—	1	—	—	—	1
Typhlopidae	2	—	—	1	—	—	—	—	—	1	—	1	1
Viperidae	15	—	5	1	6	—	1	2	1	5	5	3	6
Subtotals	**151**	**1**	**46**	**16**	**74**	**38**	**27**	**19**	**30**	**32**	**53**	**32**	**66**
Cheloniidae	3	—	—	—	—	—	—	—	—	—	—	3	3
Chelydridae	1	—	—	—	—	1	—	—	—	1	—	—	—

Dermatemydidae	1	—	—	—	—	1	—	—	—	1	—	—	—
Dermochelyidae	1	—	—	—	—	—	—	—	—	—	—	1	1
Emydidae	2	—	—	—	—	1	—	—	1	1	—	1	1
Geoemydidae	3	—	—	—	—	1	—	1	—	—	2	2	3
Kinosternidae	5	1	1	1	2	4	—	—	2	3	3	1	2
Staurotypidae	3	—	—	—	—	2	—	—	2	1	1	—	1
Subtotals	**19**	**1**	**1**	**1**	**2**	**10**	**—**	**1**	**5**	**7**	**6**	**8**	**11**
Totals	**293**	**2**	**84**	**38**	**128**	**74**	**43**	**53**	**55**	**68**	**105**	**72**	**116**
Sum Totals	**442**	**9**	**117**	**52**	**216**	**102**	**57**	**69**	**75**	**103**	**154**	**93**	**143**

Of considerable conservation significance is that 59.0% of the species in the state are confined to one or two of the 12 physiographic provinces. This is the case, as noted by Alvarado Díaz et al. (2013: 137), "inasmuch as the more restricted their distribution the more difficult it will be to provide species with effective protective measures." The mean occupancy figure for the herpetofauna is 2.7.

The numbers for single-region species found among the 12 physiographic provinces ranges from zero (only in the Depresión del Balsas) to 67 (in the Sierra Madre de Oaxaca). One-half of the regions contain single-digit numbers of species, including the Fosa de Tehuacán and the Valles Centrales de Oaxaca (each with two), the Montañas y Valles del Centro and the Depresión Ístmica de Tehuantepec (each with three), the Planicie Costera del Pacífico (with four), and the Planicie Costera del Golfo (with eight). The numbers for single-region species next increases to 13 for the Planicie Costera de Tehuantepec and then to 20 for the Montañas y Valles del Occidente. Two regions contain numbers in the 20s, the Sierra Madre del Sur, with 23, and the Sierra Madre de Chiapas, with 24. Finally, the highest number for single-region species is found in the Sierra Madre de Oaxaca, with 67.

The Sierra Madre de Oaxaca is the physiographic province of greatest conservation significance in the state, inasmuch as it contains the highest total number of species (216, including 62 anurans, 26 salamanders, 52 lizards, 74 snakes, and two turtles; Table 5), the highest number of single-region species (67, including 20 anurans, 22 salamanders, 11 lizards, and 14 snakes; Table 4), 103 country endemics (62.8% of total of 164; Table 8), and 25 state endemics (26.9% of total of 93; Table 8).

Ctenosaura oaxacana Köhler and Hasbun, 2001. The Oaxaca Spiny-tailed Iguana is endemic to Oaxaca, distributed in the Planicie Costera del Pacífico, Planicie Costera de Tehuantepec, Sierra Madre de Chiapas, Sierra Madre del Sur, and Montañas y Valles del Centro physiographic provinces. Its EVS has been estimated at 19, placing it in the upper portion of the high vulnerability category, the highest value assigned to any lizard in the state. The IUCN has assessed this species as Critically Endangered, and SEMARNAT considers it as threatened. This photo is of a juvenile from Nizanda, in the municipality of Ixtaltepec. © Leonardo Fernández-Badillo

The following 67 species are limited in distribution to the Sierra Madre de Oaxaca:

Incilius spiculatus
Craugastor decoratus
Craugastor polymniae
Craugastor spatulatus
Bromeliohyla dendroscarta
Charadrahyla nephila
Duellmanohyla ignicolor
Ecnomiohyla echinata
Megastomatodyla mixe
Plectrohyla calthula
Plectrohyla calvicollina
Plectrohyla celata
Plectrohyla cyanomma
Plectrohyla cyclada
Plectrohyla ephemera
Plectrohyla psarosema
Plectrohyla sabrina
Plectrohyla siopela
Ptychohyla acrochorda
Ptychohyla zophodes
Bolitoglossa chinenteca
Pseudoeurycea aquatica
Pseudoeurycea aurantia
Pseudoeurycea juarezi
Pseudoeurycea mystax
Pseudoeurycea obesa
Pseudoeurycea orchileucos
Pseudoeurycea papenfussi
Pseudoeurycea ruficauda
Pseudoeurycea saltator
Pseudoeurycea unguidentis
Pseudoeurycea werleri
Thorius adelos
Thorius arboreus
Thorius aureus
Thorius boreas
Thorius insperatus
Thorius macdougalli
Thorius maxillabrochus
Thorius papaloae
Thorius pulmonaris
Thorius smithi
Abronia fuscolabialis
Abronia graminea
Abronia mitchelli
Barisia planifrons
Mesaspis juarezi
Mesaspis viridiflava
Norops rubiginosus
Sceloporus bicanthalis
Sceloporus cryptus
Sceloporus salvini
Lepidophyma lowei
Exiliboa placata
Conopsis amphisticha
Chersodromus liebmanni
Cryophis hallbergi
Geophis anocularis
Geophis blanchardi
Geophis carinosus
Geophis juarezi
Geophis laticinctus
Rhadinaea bogertorum
Rhadinaea cuneata
Rhadinaea hesperia
Micrurus nebularis
Thamnophis lineri

Twenty-four single-region species are found in the Sierra Madre de Chiapas, as follows:

Incilius macrocristatus
Incilius tutelarius
Craugastor rhodopis
Charadrahyla chaneque
Exerodonta chimalapa
Plectrohyla hartwegi
Plectrohyla matudai
Norops barkeri
Norops biporcatus
Norops pygmaeus
Lepidophyma pajapanense
Ficimia ramirezi
Adelphicos latifasciatum
Rhadinella godmani

Bolitoglossa alberchi
Bolitoglossa occidentalis
Ixalotriton parvus
Abronia bogerti
Abronia ornelasi
Tropidodipsas fischeri
Amerotyphlops tenuis
Atropoides olmec
Bothriechis rowleyi
Cerrophidion godmani

The Sierra Madre del Sur is inhabited by 23 single-region species, as follows:

Incilius cycladen
Craugastor uno
Exerodonta juanitae
Exerodonta melanomma
Exerodonta pinorum
Megastomatohyla pellita
Plectrohyla miahuatlanensis
Plectrohyla thorectes
Ptychohyla leonhardschultzei
Lithobates sierramadrensis
Bolitoglossa macrinii
Bolitoglossa zapoteca
Pseudoeurycea anitae
Thorius minutissimus
Dermophis oaxacae
Norops peucephilus
Norops stevepoei
Norops zapotecorum
Sceloporus tanneri
Lepidophyma lineri
Tantilla oaxacae
Geophis russatus
Geophis sallei

The following 20 species are limited to the Montañas y Valles del Occidente region:

Incilius perplexus
Plectrohyla ameibothalame
Plectrohyla labedactyla
Bolitoglossa riletti
Pseudoeurycea maxima
Pseudoeurycea mixteca
Abronia mixteca
Norops microlepidotus
Sceloporus megalepidurus
Xenosaurus rectocollaris
Salvadora bairdi
Tantilla deppei
Geophis omiltemanus
Hypsiglena torquata
Pseudoleptodeira latifasciata
Rhadinella donaki
Micrurus laticollaris
Thamnophis scalaris
Thamnophis sumichrasti
Mixcoatlus melanurus

Thirteen species are restricted to the Planicie Costera de Tehuantepec within the state, as follows:

Craugastor silvicola
Dendropsophus robertmertensi
Gymnophthalmus speciosus
Sceloporus squamosus
Ficimia olivacea
Geagras redimitus
Tantillita brevissima
Coniophanes bipunctatus
Geophis isthmicus
Micrurus latifasciatus
Micrurus nigrocinctus
Epictia bakewelli
Crotalus simus

The following eight species are limited to the Planicie Costera del Golfo:

Craugastor alfredi
Craugastor berkenbuschii
Tlalocohyla picta
Gastrophryne elegans
Lithobates brownorum
Crocodylus moreletii
Tantilla briggsi
Leptodeira frenata

Four species are found only in the Planicie Costera del Pacífico in the state, as follows:

Incilius gemmifer *Norops nebulosus*
Norops immaculogularis *Tropidodipsas philippi*

Three species each are found exclusively in the two following regions:

Montañas y Valles del Centro
Laemanctus serratus *Lepidophyma dontomasi*
Sceloporus halli
Depresión Ístmica de Tehuantepec
Leptophis ahaetulla *Tretanorhinus nigroluteus*
Amastridium sapperi

Two species each are restricted to the two following regions:

Fossa de Tehuacán
Lepidophyma cuicateca *Micrurus pachecogili*
Valles Centrales de Oaxaca
Conopsis nasus *Pituophis deppei*

No species are limited to the Depresión del Balsas.

Thamnophis lineri Rossman and Burbrink, 2005. Liner's Garter Snake, a member of the *T. godmani* complex of southern Mexico (Rossman and Burbrink, 2005), is a Oaxacan endemic with a distribution restricted to the Sierra Madre de Oaxaca physiographic province. Its EVS has been estimated at 17, placing it in the middle of the high vulnerability category. It remains unevaluated by the IUCN, and has not been provided a status by SEMARNAT. This individual came from La Cumbre, in the municipality of Santa Catarina Ixtepeji.

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We constructed a Coefficient of Biogeographic Resemblance (CBR) matrix to examine the herpetofaunal relationships among the 12 physiographic provinces (Table 6). Based on the data on shared species numbers in this table, we constructed a greatest shared species diagram (Fig. 2). The number of shared species ranges from eight to 84, a broad range but one that is skewed by the very low number (eight) shared between the DB and MVO provinces. Thus, the mean number of shared species is 57.3. As expected, in most cases, the larger the herpetofaunas of the two areas compared the larger the number of species shared, although this number is dependent on the size of the smaller herpetofauna. Two provinces, the SMO and the SMS, are connected to more areas (four each) than the others, apparently resulting from a combination of the respective size of their herpetofaunas and the number of borders shared with other provinces. Nonetheless, even though these provinces are separated from one another except at their southern borders, they share 70 species, which is the greatest shared value for the SMO province but not the SMS, which is 84. Generally speaking, this value connects the northern portion of the map to its southern portion, except for the SMC province.

Table 6. Pair-wise comparison matrix of Coefficient of Biogeographic Resemblance (CBR) data of the native herpetofaunal relationships for the 12 physiographic regions in Oaxaca. Underlined values = number of species in each province; upper triangular matrix values = species in common between two provinces; 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 provinces, N_1 is the number of species in the first province, and N_2 is the number of species in the second province. See Table 4 for explanation of abbreviations, and Fig. 3 for the UPGMA dendrogram produced from the CBR data.

	DB	MVO	FT	SMO	PCG	VCO	MVC	DIT	SMC	SMS	PCP	PCT
DB	**9**	8	5	6	1	4	4	0	2	5	2	3
MVO	0.13	**117**	37	61	18	42	31	12	10	52	18	22
FT	0.16	0.44	**52**	39	15	20	13	9	7	22	13	15
SMO	0.05	0.37	0.29	**216**	61	40	41	42	51	70	37	58
PCG	0.02	0.16	0.19	0.38	**102**	8	11	57	48	36	23	47
VCO	0.12	0.48	0.37	0.29	0.10	**57**	29	6	6	26	11	13
MVC	0.10	0.33	0.21	0.29	0.13	0.46	**69**	12	20	52	32	39
DIT	0.00	0.13	0.14	0.29	0.64	0.09	0.17	**75**	45	35	24	45
SMC	0.04	0.09	0.09	0.32	0.47	0.08	0.23	0.51	**103**	42	33	57
SMS	0.06	0.38	0.21	0.38	0.28	0.25	0.47	0.31	0.33	**154**	73	84
PCP	0.04	0.17	0.18	0.24	0.24	0.15	0.40	0.29	0.34	0.59	**93**	84
PCT	0.04	0.17	0.15	0.32	0.38	0.13	0.37	0.41	0.46	0.57	0.71	**143**

The CBR data in Table 6 indicates values ranging from 0.00 to 0.71. The highest value (0.71) is between the Planicie Costera del Pacífico province (93 species) and the Planicie Costera de Tehuantepec province (143), based on a shared species number of 84. These two provinces are contiguous along the Pacific coastal region of the state, so the degree of resemblance is not surprising. The greatest degree of resemblance for the other 10 areas, arranged from the highest to lowest CBR value, are as follows (species numbers indicated parenthetically):

Planicie Costera del Golfo (102) – 0.64 – Depresión Ístmica de Tehuantepec (75)
Depresión Ístmica de Tehuantepec (75) – 0.64 – Planicie Costera del Golfo (102)
Sierra Madre del Sur (154) – 0.59 – Planicie Costera del Pacífico (93)
Sierra Madre de Chiapas (103) – 0.51 – Depresión Ístmica de Tehuantepec (75)
Montañas y Valles del Occidente (117) – 0.48 – Valles Centrales de Oaxaca (57)
Valles Centrales de Oaxaca (57) – 0.48 – Montañas y Valles del Occidente (117)
Montañas y Valles del Centro (69) – 0.47 – Sierra Madre del Sur (154)
Fosa de Tehuacán (52) – 0.44 – Montañas y Valles del Occidente (117)
Sierra Madre de Oaxaca (216) – 0.38 – Planicie Costera del Golfo (102) and Sierra Madre del Sur (154)
Depresión del Balsas (9) – 0.16 – Fosa de Tehuacán (52)

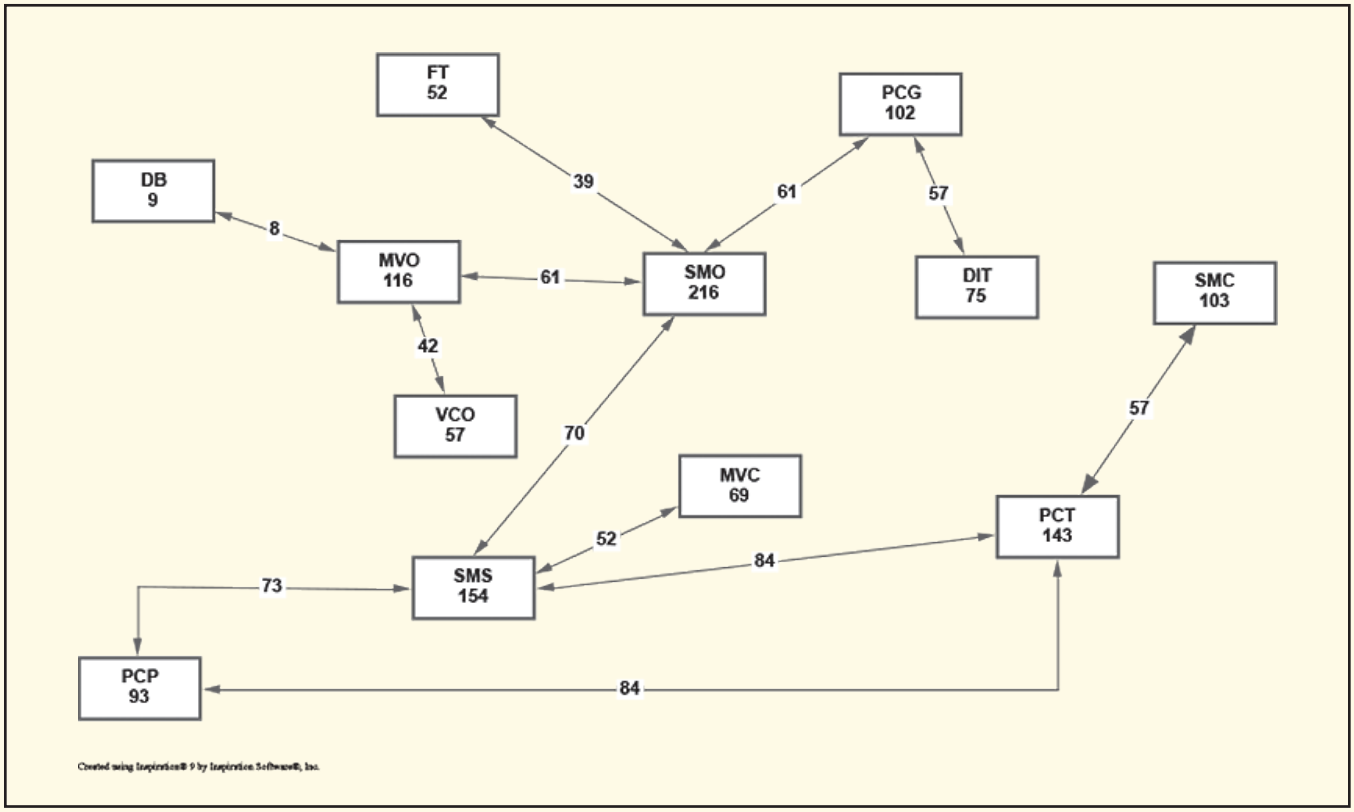

Fig. 2. Greatest shared species diagram of the 12 physiographic provinces in Oaxaca. See Fig. 1 for explanation of abbreviations. Numbers in boxes are for the number of species in each area, and numbers on arrows indicate the number of species shared between the areas connected, and represent the greatest shared value for each area. Position of boxes in diagram roughly reflects their geographic relationship in Oaxaca (compare with Fig. 1).

These province pairs are contiguous with one another, except for the Sierra Madre de Oaxaca–Sierra Madre del Sur pair, which are separated by the the Montañas y Valles del Centro province, and the Depresión del Balsas–Fosa de Tehuacán pair, which are separated by the Montañas y Valles del Occidente province. The most speciose provinces are the Sierra Madre de Oaxaca and the Sierra Madre del Sur, with 216 and 154 species, respectively. These two provinces have 70 species in common, one more than the total number in the intervening province; the CBR value for the intervening province would not be expected to be higher. With respect to the other pair, since few species are known from the Depresión del Balsas province (nine), the CBR values shared with the Montañas y Valles del Occidente province (117 species) are not expected to be higher than with the Fosa de Tehuacán (52 species), given the nature of the CBR algorithm. Nonetheless, the Depresión del Balsas shares eight species with the Montañas y Valles del Occidente province, with which it is contiguous, versus the five shared with the Fosa de Tehuacán province.

Based on the CBR data in Table 6, we constructed a UPGMA dendrogram to express the overall resemblances in species richness among the herpetofaunas of the 12 physiographic provinces of Oaxaca (Fig. 3). Numerous formulae can be used to calculate similarity coefficient values to construct UPGMA dendrograms (Lomolino et al., 2010), and different ones can depict dissimilar value levels on resultant trees. Therefore, results should not be used to specify distinct numerical levels as an overriding verity, but to show hierarchal relationships among the clusters of provinces. See Johnson et al. (2010) for a discussion of using similarity coefficients to build UPGMA dendrograms.

Clustering of provinces is evident on a geographic basis. Clusters include a southern group, including the MVC, SMS, PCP, and PCT provinces; a northern group, including the SMO, SMC, DIT, and PCG provinces; a west-central group, including the FT, MVO, and VCO provinces; and an outlier containing only the DB province. The northern and southern groups are slightly more similar to each other than either is to the west-central group. The

similarity among the clustered provinces and the four provincial groups is pointedly low, due to the high level of endemism found in several provinces, to edge effects, and also to the bias of using Duellman's (1990) CBR, because of the inequalities in number of species between the larger faunas and smaller ones (see Simpson, 1960). As an example, the two most closely related areas are the PCP and PCT provinces (with a similarity value of only .71), which in reality probably are part of the same region (Campbell, 1999), although the latter has more endemics (see above), harbors some species whose ranges end there, and the PCP contains 93 species as opposed to 143 in the PCT; and they share 84 species. The outlier status of the DB province probably is due to insufficient sampling, and when this province is better known it might turn out to be either associated with the west-central group or will be relegated to the biogeographic region categorized by Campbell (1999) as the Pacific lowlands from southern Sinaloa to western Chiapas (SC), which encompasses PCP and PCT provinces in Oaxaca as arranged herein.

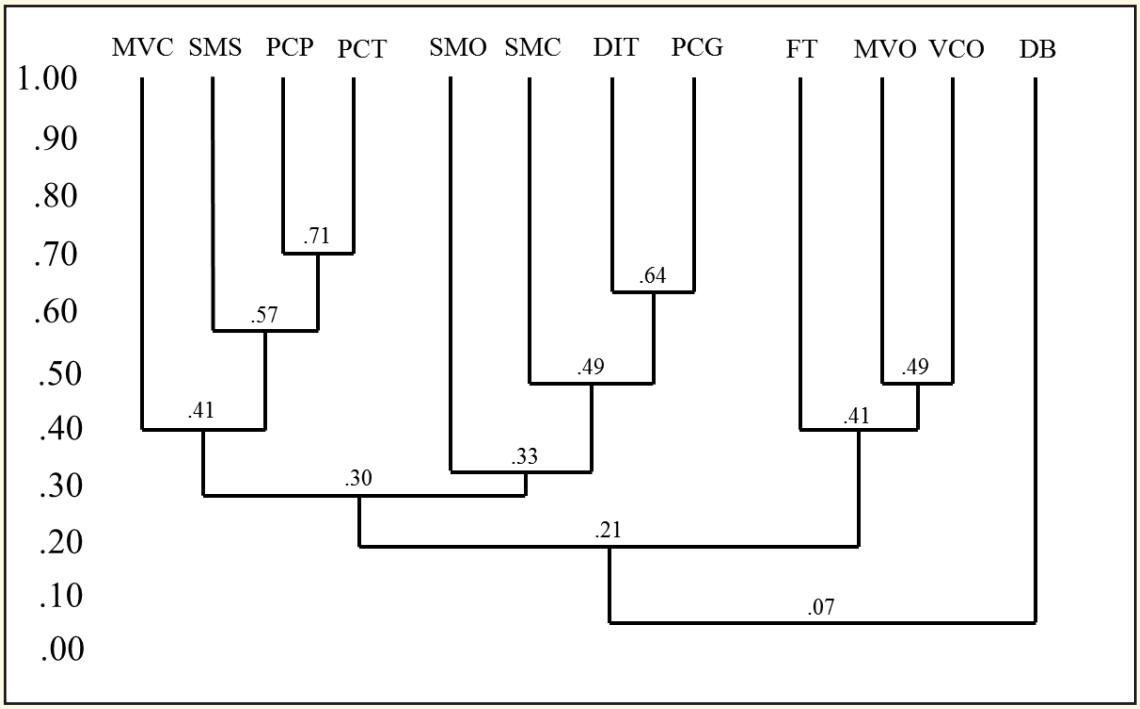

Fig. 3. A UPGMA generated dendrogram illustrating the similarity relationships of species richness among the herpetofaunas of the 12 physiographic provinces of Oaxaca (based on data in Table 6). See Table 4 for explanation of abbreviations. We calculated the similarity values using Duellman's (1990) Coefficient of Biogeographic Resemblance (CBR).

DISTRIBUTIONAL STATUS CATEGORIZATIONS

We used the same method as Alvarado Díaz et al. (2013) to categorize the distributional status of members of the Oaxacan herpetofauna. We placed these data in Table 7, and provide a summary in Table 8.

With respect to the entire herpetofauna (442 species), the largest number (183, 41.4%) are non-endemic species, followed by the country endemics (164, 37.1%), and the state endemics (93, 21.0%). Only two species (the gekkonid *Hemidactylus frenatus* and the typhlopid *Indotyphlops braminus*) are non-native to Oaxaca (0.5%).

The non-endemic species comprise 44 anurans (24.0% of 183), two salamanders (1.1%), one caecilian (0.5%), three crocodylians (1.6%), 41 lizards (22.4%), 76 snakes (41.5%), and 16 turtles (8.7%). The country endemics consist of 35 anurans (21.3% of 164 species), six salamanders (3.7%), one caecilian (0.6%), 59 lizards (36.0%), 60

snakes (36.6%), and three turtles (1.8%). The Oaxacan endemics constitute 27 anurans (29.0% of 93 species), 33 salamanders (35.5%), 19 lizards (20.4%), and 14 snakes (15.1%).

Of the 442 members of the Oaxacan herpetofauna, 257 are endemic to Mexico (including those endemic at the state level). Thus, 58.1% of the herpetofauna is endemic at the country or state levels. This number of endemic species represents 34.0% of the 756 endemic herpetofaunal species currently known from Mexico (J. Johnson, unpublished).

Table 7. Distributional and conservation status measures for members of the native herpetofauna of Oaxaca, Mexico. Distributional Status: SE = endemic to state of Oaxaca; 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
Incilius canaliferus	NE	L (8)	LC	NS
Incilius coccifer	NE	L (9)	LC	Pr
*Incilius cycladen**	CE	H (14)	VU	NS
*Incilius gemmifer**	CE	H (15)	EN	Pr
Incilius macrocristatus	NE	M (11)	VU	NS
*Incilius marmoreus**	CE	M (11)	LC	NS
*Incilius occidentalis**	CE	M (11)	LC	NS
*Incilius perplexus**	CE	M (11)	EN	NS
*Incilius spiculatus***	SE	M (13)	EN	NS
Incilius tutelarius	NE	M (10)	EN	NS
Incilius valliceps	NE	L (6)	LC	NS
Rhinella marina	NE	L (3)	LC	NS
Hyalinobatrachium fleischmanni	NE	M (10)	LC	NS
Craugastor alfredi	NE	M (11)	VU	NS
Craugastor augusti	NE	L (8)	LC	NS
*Craugastor berkenbuschii**	CE	H (14)	NT	Pr
*Craugastor decoratus**	CE	H (15)	VU	Pr
Craugastor lineatus	NE	H (15)	CR	Pr
Craugastor loki	NE	M (10)	LC	NS
*Craugastor mexicanus**	CE	H (16)	LC	NS
*Craugastor polymniae***	SE	H (18)	CR	Pr
Craugastor pygmaeus	NE	L (9)	VU	NS
*Craugastor rhodopis**	CE	H (14)	VU	NS
*Craugastor rugulosus**	CE	M (13)	LC	NS
*Craugastor silvicola***	SE	H (18)	EN	NS
*Craugastor spatulatus**	CE	H (16)	EN	Pr
*Craugastor uno**	CE	H (17)	EN	Pr
Eleutherodactylus leprus	NE	M (12)	VU	NS
*Eleutherodactylus nitidus**	CE	M (12)	LC	NS
Eleutherodactylus pipilans	NE	M (11)	LC	NS
*Eleutherodactylus syristes***	SE	H (16)	EN	Pr
Agalychnis callidryas	NE	M (11)	LC	NS
*Agalychnis dacnicolor**	CE	M (13)	LC	NS
Agalychnis moreletii	NE	L (7)	CR	NS
Anotheca spinosa	NE	H (14)	LC	NS
*Bromeliohyla dendroscarta**	CE	H (17)	CR	Pr
*Charadrahyla altipotens***	SE	M (12)	CR	Pr
*Charadrahyla chaneque**	CE	M (13)	EN	Pr
*Charadrahyla nephila***	SE	M (13)	VU	NS

Dendropsophus ebraccatus	NE	M (12)	LC	NS
Dendropsophus microcephalus	NE	L (7)	LC	NS
Dendropsophus robertmertensi	NE	L (9)	LC	NS
*Dendropsophus sartori**	CE	H (14)	LC	A
*Diaglena spatulata**	CE	M (13)	LC	NS
*Duellmanohyla ignicolor***	SE	H (14)	EN	Pr
Duellmanohyla schmidtorum	NE	L (8)	VU	Pr
*Ecnomiohyla echinata***	SE	H (19)	CR	Pr
*Ecnomiohyla miotympanum**	CE	L (9)	NT	NS
*Exerodonta abdivita***	SE	H (15)	DD	NS
*Exerodonta chimalapa**	CE	M (12)	EN	NS
*Exerodonta juanitae**	CE	H (14)	VU	A
*Exerodonta melanomma**	CE	M (11)	VU	Pr
*Exerodonta pinorum**	CE	M (13)	VU	Pr
*Exerodonta sumichrasti**	CE	L (9)	LC	NS
*Exerodonta xera**	CE	H (14)	VU	NS
Hyla arenicolor	NE	L (7)	LC	NS
*Hyla euphorbiacea**	CE	M (13)	NT	NS
*Megastomatohyla mixe***	SE	H (15)	CR	Pr
*Megastomatohyla pellita***	SE	H (14)	CR	NS
*Plectrohyla ameibothalame***	SE	H (15)	DD	NS
*Plectrohyla bistincta**	CE	L (9)	LC	Pr
*Plectrohyla calthula***	SE	H (14)	CR	NS
*Plectrohyla calvicollina***	SE	H (14)	CR	NS
*Plectrohyla celata***	SE	H (14)	CR	NS
*Plectrohyla cembra***	SE	H (14)	CR	A
*Plectrohyla crassa***	SE	H (14)	CR	Pr
*Plectrohyla cyanomma***	SE	H (14)	CR	A
*Plectrohyla cyclada***	SE	H (14)	EN	NS
*Plectrohyla ephemera***	SE	H (15)	CR	NS
Plectrohyla hartwegi	NE	M (10)	CR	Pr
*Plectrohyla hazelae***	SE	M (12)	CR	Pr
*Plectrohyla labedactyla***	SE	H (15)	DD	NS
Plectrohyla matudai	NE	M (11)	VU	NS
*Plectrohyla miahuatlanensis***	SE	H (15)	DD	NS
*Plectrohyla pentheter**	CE	M (13)	EN	NS
*Plectrohyla psarosema***	SE	H (15)	CR	NS
*Plectrohyla sabrina***	SE	H (14)	CR	A
*Plectrohyla siopela**	CE	H (15)	CR	NS
*Plectrohyla thorectes**	CE	M (13)	CR	Pr
*Ptychohyla acrochorda***	SE	H (14)	DD	NS
Ptychohyla euthysanota	NE	L (8)	NT	A
*Ptychohyla leonhardschultzei**	CE	M (12)	EN	Pr
*Ptychohyla zophodes***	SE	M (13)	DD	NS
Scinax staufferi	NE	L (4)	LC	NS
Smilisca baudinii	NE	L (3)	LC	NS
Smilisca cyanosticta	NE	M (12)	NT	NS
Tlalocohyla loquax	NE	L (7)	LC	NS
Tlalocohyla picta	NE	L (8)	LC	NS
*Tlalocohyla smithii**	CE	M (11)	LC	NS
Trachycephalus typhonius	NE	L (4)	LC	NS
Engystomops pustulosus	NE	L (7)	LC	NS
Leptodactylus fragilis	NE	L (5)	LC	NS
Leptodactylus melanonotus	NE	L (6)	LC	NS
Gastrophryne elegans	NE	L (8)	LC	Pr
Hypopachus ustus	NE	L (7)	LC	Pr
Hypopachus variolosus	NE	L (4)	LC	NS
Lithobates berlandieri	NE	L (7)	LC	Pr

Lithobates brownorum	NE	L (8)	NE	Pr
Lithobates forreri	NE	L (3)	LC	Pr
Lithobates maculatus	NE	L (5)	LC	NS
*Lithobates sierramadrensis**	CE	M (13)	VU	Pr
*Lithobates spectabilis**	CE	M (12)	LC	NS
Lithobates vaillanti	NE	L (9)	LC	NS
*Lithobates zweifeli**	CE	M (11)	LC	NS
Rhinophrynus dorsalis	NE	L (8)	LC	NS
Spea multiplicata	NE	L (6)	NE	NS
*Bolitoglossa alberchi**	CE	H (15)	LC	NS
*Bolitoglossa chinanteca***	SE	H (18)	NE	NS
*Bolitoglossa macrinii***	SE	H (15)	NT	Pr
*Bolitoglossa oaxacensis***	SE	H (17)	DD	NS
Bolitoglossa occidentalis	NE	M (11)	LC	Pr
*Bolitoglossa platydactyla**	CE	H (15)	NT	Pr
*Bolitoglossa riletti***	SE	H (16)	EN	Pr
Bolitoglossa rufescens	NE	L (9)	LC	Pr
*Bolitoglossa veracrucis**	CE	H (17)	EN	Pr
*Bolitoglossa zapoteca***	SE	H (18)	DD	NS
*Ixalotriton parvus***	SE	H (18)	CR	A
*Pseudoeurycea anitae***	SE	H (18)	CR	A
*Pseudoeurycea aquatica***	SE	H (18)	CR	NS
*Pseudoeurycea aurantia***	SE	H (18)	VU	NS
*Pseudoeurycea boneti***	SE	H (17)	VU	NS
*Pseudoeurycea cochranae***	SE	H (17)	EN	A
*Pseudoeurycea conanti***	SE	H (16)	EN	A
*Pseudoeurycea juarezi***	SE	H (17)	CR	A
*Pseudoeurycea maxima***	SE	H (17)	DD	NS
*Pseudoeurycea mixteca**	CE	H (17)	LC	NS
*Pseudoeurycea mystax***	SE	H (18)	EN	A
*Pseudoeurycea obesa***	SE	H (18)	DD	NS
*Pseudoeurycea orchileucos***	SE	H (18)	EN	NS
*Pseudoeurycea papenfussi***	SE	H (17)	NT	NS
*Pseudoeurycea ruficauda***	SE	H (18)	DD	NS
*Pseudoeurycea saltator***	SE	H (18)	CR	A
*Pseudoeurycea smithi***	SE	H (15)	CR	A
*Pseudoeurycea unguidentis***	SE	H (17)	CR	A
*Pseudoeurycea werleri**	CE	H (17)	EN	Pr
*Thorius adelos***	SE	H (18)	EN	NS
*Thorius arboreus***	SE	H (18)	EN	NS
*Thorius aureus***	SE	H (17)	CR	NS
*Thorius boreas***	SE	H (18)	EN	NS
*Thorius insperatus***	SE	H (18)	DD	NS
*Thorius macdougalli***	SE	H (16)	VU	Pr
*Thorius maxillobrochus**	CE	H (18)	NE	NS
*Thorius minutissimus***	SE	H (17)	CR	Pr
*Thorius narisovalis***	SE	H (17)	CR	Pr
*Thorius papaloae***	SE	H (17)	EN	NS
*Thorius pulmonaris***	SE	H (17)	EN	Pr
*Thorius smithi***	SE	H (17)	CR	NS
Dermophis mexicanus	NE	M (11)	VU	Pr
*Dermophis oaxacae**	CE	M (12)	DD	Pr
Caiman crocodilus	NE	H (16)	LC	Pr
Crocodylus acutus	NE	H (14)	VU	Pr
Crocodylus moreletii	NE	M (13)	LC	Pr
*Abronia bogerti**	CE	H (18)	DD	P
*Abronia fuscolabialis**	CE	H (18)	EN	A
*Abronia graminea**	CE	H (15)	EN	A

*Abronia mitchelli**	CE	H (18)	DD	Pr
*Abronia mixteca**	CE	H (18)	VU	A
*Abronia oaxacae***	SE	H (17)	VU	A
*Abronia ornelasi**	CE	H (18)	DD	P
*Barisia imbricata**	CE	H (14)	LC	Pr
*Barisia planifrons***	SE	H (15)	NE	NS
*Celestus enneagrammus**	CE	H (14)	LC	Pr
Celestus rozellae	NE	M (13)	NT	Pr
Gerrhonotus liocephalus	NE	L (6)	LC	Pr
*Mesaspis gadovii**	CE	H (14)	LC	Pr
*Mesaspis juarezi***	SE	H (15)	EN	Pr
*Mesaspis viridiflava**	CE	H (16)	LC	Pr
Basiliscus vittatus	NE	L (7)	NE	NS
Corytophanes hernandesii	NE	M (13)	NE	Pr
Laemanctus longipes	NE	L (9)	NE	Pr
Laemanctus serratus	NE	L (8)	LC	Pr
*Norops barkeri**	CE	H (15)	VU	Pr
Norops biporcatus	NE	M (10)	NE	Pr
*Norops boulengerianus***	SE	H (16)	DD	NS
*Norops carliebi***	SE	H (15)	LC	NS
*Norops compressicauda**	CE	H (15)	LC	NS
*Norops cuprinus**	CE	H (16)	LC	Pr
*Norops immaculogularis***	SE	H (16)	LC	NS
Norops laeviventris	NE	L (9)	NE	NS
Norops lemurinus	NE	L (8)	NE	NS
*Norops macrinii***	SE	H (16)	LC	Pr
*Norops microlepidotus**	CE	H (15)	LC	Pr
*Norops milleri**	CE	H (14)	DD	A
*Norops nebuloides**	CE	H (14)	LC	Pr
*Norops nebulosus**	CE	H (13)	LC	NS
Norops petersii	NE	L (9)	NE	NS
*Norops peucephilus***	SE	H (17)	NE	NS
*Norops rubiginosus**	CE	H (16)	DD	NS
*Norops pygmaeus**	CE	H (16)	EN	Pr
*Norops quercorum***	SE	H (16)	LC	NS
Norops rodriguezii	NE	M (10)	NE	NS
*Norops sacamecatensis***	SE	H (16)	LC	NS
Norops sericeus	NE	L (8)	NE	NS
*Norops stevepoei***	SE	H (14)	LC	NS
*Norops subocularis**	CE	H (15)	DD	Pr
Norops tropidonotus	NE	L (9)	NE	NS
Norops unilobatus	NE	L (7)	NE	NS
*Norops zapotecorum***	SE	H (15)	LC	NS
Coleonyx elegans	NE	L (9)	NE	A
Gymnophthalmus speciosus	NE	L (9)	NE	Pr
Heloderma horridum	NE	H (14)	LC	A
Ctenosaura acanthura	NE	M (12)	NE	Pr
*Ctenosaura oaxacana***	SE	H (19)	CR	A
*Ctenosaura pectinata**	CE	H (15)	NE	A
Ctenosaura similis	NE	L (8)	LC	A
Iguana iguana	NE	M (12)	NE	Pr
Marisora brachypoda	NE	L (6)	NE	NS
Phrynosoma asio	NE	M (11)	NE	Pr
*Phrynosoma braconnieri**	CE	H (15)	LC	Pr
*Phrynosoma taurus**	CE	M (12)	LC	A
*Sceloporus aureolus**	CE	H (15)	NE	NS
*Sceloporus bicanthalis**	CE	M (13)	LC	NS
*Sceloporus cryptus**	CE	H (14)	LC	Pr

*Sceloporus cupreus**	CE	H (16)	NE	NS
*Sceloporus edwardtaylori**	CE	H (14)	LC	NS
*Sceloporus formosus**	CE	H (15)	LC	NS
*Sceloporus gadoviae**	CE	M (11)	LC	NS
Sceloporus grammicus	NE	L (9)	LC	Pr
*Sceloporus halli***	SE	H (17)	DD	NS
*Sceloporus horridus**	CE	M (11)	LC	NS
Sceloporus internasalis	NE	M (11)	LC	NS
*Sceloporus jalapae**	CE	M (13)	LC	NS
*Sceloporus macdougalli**	CE	H (16)	LC	Pr
*Sceloporus megalepidurus**	CE	H (14)	VU	Pr
Sceloporus melanorhinus	NE	L (9)	LC	NS
*Sceloporus ochoterenae**	CE	M (12)	LC	NS
*Sceloporus omiltemanus**	CE	H (16)	NE	NS
*Sceloporus salvini**	CE	H (15)	DD	A
Sceloporus siniferus	NE	M (11)	LC	NS
*Sceloporus smithi**	CE	H (15)	LC	NS
*Sceloporus spinosus**	CE	M (12)	LC	NS
Sceloporus squamosus	NE	M (11)	NE	NS
*Sceloporus subpictus***	SE	H (16)	DD	A
*Sceloporus tanneri***	SE	H (16)	DD	A
Sceloporus teapensis	NE	M (13)	LC	NS
Sceloporus variabilis	NE	L (5)	NE	NS
*Urosaurus bicarinatus**	CE	M (12)	LC	NS
*Phyllodactylus bordai**	CE	M (13)	LC	Pr
*Phyllodactylus muralis**	CE	H (14)	LC	Pr
Phyllodactylus tuberculosus	NE	L (8)	NE	NS
*Plestiodon brevirostris**	CE	M (11)	LC	NS
*Plestiodon ochoterenae**	CE	M (13)	LC	Pr
Plestiodon sumichrasti	NE	M (12)	NE	NS
Sphaerodactylus continentalis	NE	M (10)	NE	NS
Sphaerodactylus glaucus	NE	M (12)	NE	Pr
*Scincella gemmingeri**	CE	M (10)	LC	Pr
*Scincella silvicola**	CE	M (12)	LC	A
Sphenomorphus assatus	NE	M (10)	NE	NS
Sphenomorphus cherriei	NE	M (12)	NE	NS
*Aspidoscelis costata**	CE	M (11)	LC	Pr
Aspidoscelis deppii	NE	L (8)	LC	NS
*Aspidoscelis guttata**	CE	M (12)	LC	NS
*Aspidoscelis mexicana**	CE	H (14)	LC	Pr
Aspidoscelis motaguae	NE	M (12)	LC	NS
*Aspidoscelis parvisocia**	CE	H (15)	LC	Pr
*Aspidoscelis sackii**	CE	H (14)	LC	NS
Holcosus undulatus	NE	L (7)	NE	NS
*Lepidophyma cuicateca***	SE	H (16)	NE	NS
*Lepidophyma dontomasi**	CE	H (14)	DD	A
Lepidophyma flavimaculatum	NE	L (8)	NE	Pr
*Lepidophyma lineri***	SE	H (15)	DD	NS
*Lepidophyma lowei**	CE	H (16)	DD	NS
*Lepidophyma pajapanense**	CE	M (13)	LC	Pr
*Lepidophyma radula**	CE	M (13)	DD	A
Lepidophyma smithii	NE	L (8)	NE	Pr
*Lepidophyma tuxtlae**	CE	M (11)	DD	A
*Xenosaurus agrenon**	CE	M (12)	NE	NS
*Xenosaurus grandis**	CE	L (9)	VU	Pr
*Xenosaurus phalaroanthereon***	SE	H (16)	DD	NS
Xenosaurus rackhami	NE	M (11)	NE	NS
*Xenosaurus rectocollaris**	CE	H (16)	LC	NS

Boa imperator	NE	M (10)	NE	NS
*Exiliboa plactaa***	SE	H (15)	VU	Pr
Coluber constrictor	NE	M (10)	LC	A
*Conopsis acuta**	CE	H (14)	NE	NS
*Conopsis amphisticha**	CE	H (15)	NT	NS
*Conopsis lineata**	CE	M (13)	LC	NS
*Conopsis megalodon**	CE	H (14)	LC	NS
*Conopsis nasus**	CE	M (11)	LC	NS
Dendrophidion vinitor	NE	M (13)	LC	NS
Drymarchon melanurus	NE	L (6)	LC	NS
Drymobius chloroticus	NE	L (8)	LC	NS
Drymobius margaritiferus	NE	L (6)	NE	NS
*Ficimia olivacea**	CE	L (9)	NE	NS
Ficimia publia	NE	L (9)	NE	NS
*Ficimia ramirezi**	CE	H (16)	DD	Pr
*Ficimia variegata**	CE	H (14)	DD	NS
*Geagras redimitus***	SE	H (14)	DD	Pr
Lampropeltis abnorma	NE	L (9)	NE	NS
*Lampropeltis polyzona**	CE	M (11)	NE	NS
Leptophis ahaetulla	NE	M (10)	NE	A
*Leptophis diplotropis**	CE	H (14)	LC	A
Leptophis mexicanus	NE	L (6)	LC	A
Masticophis mentovarius	NE	L (6)	NE	A
Mastigodryas melanolomus	NE	L (6)	LC	NS
Oxybelis aeneus	NE	L (5)	NE	NS
Oxybelis fulgidus	NE	L (9)	NE	NS
Phrynonax poecilonotus	NE	M (10)	LC	NS
*Pituophis deppei**	CE	H (14)	LC	A
Pituophis lineaticollis	NE	L (8)	LC	NS
Pseudelaphe flavirufa	NE	M (10)	LC	NS
*Salvadora bairdi**	CE	H (15)	LC	Pr
*Salvadora intermedia**	CE	H (16)	LC	Pr
*Salvadora lemniscata**	CE	H (15)	LC	Pr
*Salvadora mexicana**	CE	H (15)	LC	Pr
Senticolis triaspis	NE	L (6)	NE	NS
Spilotes pullatus	NE	L (6)	NE	NS
Stenorrhina degenhardtii	NE	L (9)	NE	NS
Stenorrhina freminvillii	NE	L (7)	NE	NS
*Symphimus leucostomus**	CE	H (14)	LC	Pr
*Tantilla bocourti**	CE	L (9)	LC	NS
*Tantilla briggsi***	SE	H (16)	DD	A
*Tantilla deppei**	CE	M (13)	LC	A
*Tantilla flavilineata***	SE	H (14)	EN	A
*Tantilla oaxacae***	SE	H (15)	DD	Pr
Tantilla rubra	NE	L (5)	LC	Pr
Tantilla schistosa	NE	L (8)	LC	NS
*Tantilla striata**	CE	H (14)	DD	NS
*Tantilla triseriata***	SE	M (13)	DD	NS
Tantilla vulcani	NE	M (12)	NE	NS
Tantillita brevissima	NE	L (9)	LC	Pr
Trimorphodon biscutatus	NE	L (7)	NE	NS
*Trimorphodon tau**	CE	M (13)	LC	NS
*Adelphicos latifasciatum**	CE	H (15)	DD	Pr
Adelphicos quadrivirgatum	NE	M (10)	DD	Pr
Amastridium sapperi	NE	M (10)	NE	NS
*Chersodromus liebmanni**	CE	M (12)	LC	Pr
Clelia scytalina	NE	M (13)	NE	NS
Coniophanes bipunctatus	NE	M (10)	NE	NS

Coniophanes fissidens	NE	L (7)	NE	NS
Coniophanes imperialis	NE	L (8)	LC	NS
Coniophanes piceivittis	NE	L (7)	LC	NS
Conophis lineatus	NE	L (9)	LC	NS
Conophis vittatus	NE	M (11)	LC	NS
*Cryophis hallbergi***	SE	H (14)	DD	A
Enulius flavitorques	NE	L (5)	NE	NS
*Geophis anocularis**	CE	H (16)	LC	Pr
*Geophis blanchardi**	CE	H (15)	DD	Pr
Geophis carinosus	NE	L (8)	LC	NS
*Geophis dubius**	CE	M (13)	LC	Pr
*Geophis duellmani**	CE	H (15)	LC	Pr
*Geophis isthmicus**	CE	H (16)	DD	Pr
*Geophis juarezi***	SE	H (16)	DD	NS
*Geophis laticinctus**	CE	M (11)	LC	Pr
*Geophis omiltemanus**	CE	H (15)	LC	Pr
*Geophis russatus**	CE	H (16)	DD	Pr
*Geophis sallei**	CE	H (15)	DD	Pr
*Hypsiglena torquata**	CE	L (8)	LC	Pr
Imantodes cenchoa	NE	L (6)	NE	Pr
Imantodes gemmistratus	NE	L (6)	NE	Pr
Leptodeira frenata	NE	M (12)	LC	NS
Leptodeira maculata	NE	L (7)	LC	Pr
Leptodeira nigrofasciata	NE	L (8)	LC	NS
Leptodeira septentrionalis	NE	L (8)	NE	NS
*Manolepis putnami**	CE	M (13)	LC	NS
Ninia diademata	NE	L (9)	LC	NS
Ninia sebae	NE	L (5)	NE	NS
Oxyrhophus petolarius	NE	H (14)	NE	NS
Pliocercus elapoides	NE	M (10)	LC	NS
*Pseudoleptodeira latifasciata**	CE	H (14)	LC	Pr
*Rhadinaea bogertorum**	CE	H (16)	DD	Pr
*Rhadinaea cuneata**	CE	H (15)	DD	Pr
Rhadinaea decorata	NE	L (9)	NE	NS
*Rhadinaea fulvivittis**	CE	M (11)	VU	NS
*Rhadinaea hesperia**	CE	M (10)	LC	Pr
*Rhadinaea macdougalli**	CE	M (12)	DD	Pr
*Rhadinaea myersi**	CE	M (12)	DD	Pr
*Rhadinaea taeniata**	CE	M (13)	LC	NS
*Rhadinella donaji***	SE	H (16)	NE	NS
Rhadinella godmani	NE	M (10)	NE	NS
Sibon dimidiatus	NE	M (10)	LC	NS
*Tantalophis discolor***	SE	H (14)	VU	A
Tretanorhinus nigroluteus	NE	M (10)	NE	NS
Tropidodipsas fasciata	NE	M (13)	NE	NS
Tropidodipsas fischeri	NE	M (11)	NE	NS
*Tropidodipsas philippi**	CE	H (14)	LC	Pr
Tropidodipsas sartorii	NE	L (9)	NE	Pr
Xenodon rabdocephalus	NE	M (13)	NE	NS
Hydrophis platurus	NE	—	LC	NS
*Micrurus bogerti**	CE	H (17)	DD	Pr
Micrurus browni	NE	L (8)	LC	Pr
Micrurus diastema	NE	L (8)	LC	Pr
Micrurus elegans	NE	M (13)	LC	Pr
*Micrurus ephippifer***	SE	H (15)	VU	Pr
*Micrurus laticollaris**	CE	H (14)	LC	Pr
Micrurus latifasciatus	NE	M (13)	LC	NS
*Micrurus nebularis**	CE	H (18)	DD	Pr

Micrurus nigrocinctus	NE	M (11)	NE	Pr
*Micrurus pachecogili**	CE	H (18)	DD	NS
*Epictia bakewelli**	CE	M (11)	NE	NS
Epictia phenops	NE	L (4)	NE	NS
*Rena maxima**	CE	M (11)	LC	NS
Loxocemus bicolor	NE	M (10)	NE	Pr
*Storeria storerioides**	CE	M (11)	LC	NS
*Thamnophis bogerti***	SE	H (16)	NE	NS
*Thamnophis chrysocephalus**	CE	H (14)	LC	A
Thamnophis cyrtopsis	NE	L (7)	LC	A
Thamnophis eques	NE	L (8)	LC	A
*Thamnophis godmani**	CE	H (14)	LC	A
*Thamnophis lineri***	SE	H (17)	NE	NS
Thamnophis marcianus	NE	M (10)	NE	A
Thamnophis proximus	NE	L (7)	NE	A
*Thamnophis scalaris**	CE	H (14)	LC	A
*Thamnophis sumichrasti**	CE	H (15)	LC	A
Scaphiodontophis annulatus	NE	M (11)	NE	NS
Amerotyphlops tenuis	NE	M (11)	LC	NS
Agkistrodon bilineatus	NE	M (11)	NT	Pr
*Atropoides nummifer**	CE	M (13)	LC	A
Atropoides olmec	NE	H (15)	LC	A
*Bothriechis rowleyi**	CE	H (16)	VU	Pr
Bothrops asper	NE	M (12)	NE	NS
Cerrophidion godmani	NE	M (11)	NE	NS
Crotalus atrox	NE	L (9)	LC	Pr
*Crotalus culminatus**	CE	H (15)	NE	NS
*Crotalus intermedius**	CE	H (15)	LC	A
Crotalus molossus	NE	L (8)	LC	Pr
*Crotalus ravus**	CE	H (14)	LC	A
Crotalus simus	NE	M (10)	NE	NS
*Mixcoatlus melanurus**	CE	H (17)	EN	NS
*Ophryacus undulatus**	CE	H (15)	VU	Pr
*Porthidium dunni**	CE	H (16)	LC	A
Chelonia mydas	NE	—	EN	P
Eretmochelys imbricata	NE	—	CR	P
Lepidochelys olivacea	NE	—	VU	P
Chelydra rossignonii	NE	H (17)	VU	NS
Dermatemys mawii	NE	H (17)	CR	P
Dermochelys coriacea	NE	—	CR	P
Trachemys grayi	NE	H (15)	NE	NS
Trachemys ornata	NE	M (13)	NE	NS
Rhinoclemmys areolata	NE	M (13)	NT	A
Rhinoclemmys pulcherrima	NE	L (8)	NE	A
*Rhinoclemmys rubida**	CE	H (14)	NT	Pr
Kinosternon acutus	NE	M (11)	NT	Pr
*Kinosternon integrum**	CE	H (15)	LC	Pr
Kinosternon leucostomus	NE	M (10)	NE	Pr
*Kinosternon oaxacae**	CE	H (14)	DD	Pr
Kinosternon scorpioides	NE	M (10)	NE	Pr
Claudius angustatus	NE	H (14)	NT	P
Staurotypus salvinii	NE	M (13)	NT	Pr
Staurotypus triporcatus	NE	H (14)	NT	A

Table 8. Summary of the distributional status of herpetofaunal families in Oaxaca (includes exotic species).

Families	Number of Species	Distributional Status			
		Non-endemic (NE)	Country Endemic (CE)	State Endemic (SE)	Non-native (NN)
Bufonidae	12	6	5	1	—
Centrolenidae	1	1	—	—	—
Craugastoridae	14	5	7	2	—
Eleutherodactylidae	4	2	1	1	—
Hylidae	59	17	19	23	—
Leptodactylidae	3	3	—	—	—
Microhylidae	3	3	—	—	—
Ranidae	8	5	3	—	—
Rhinophrynidae	1	1	—	—	—
Scaphiopodidae	1	1	—	—	—
Subtotals	**106**	**44**	**35**	**27**	**—**
Plethodontidae	41	2	6	33	—
Subtotals	**41**	**2**	**6**	**33**	**—**
Dermophiidae	2	1	1	—	—
Subtotals	**2**	**1**	**1**	**—**	**—**
Totals	**149**	**47**	**42**	**60**	**—**
Alligatoridae	1	1	—	—	—
Crocodylidae	2	2	—	—	—
Subtotals	**3**	**3**	**—**	**—**	**—**
Anguidae	15	2	10	3	—
Corytophanidae	4	4	—	—	—
Dactyloidae	27	8	10	9	—
Eublepharidae	1	1	—	—	—
Gekkonidae	1	—	—	—	1
Gymnophthalmidae	1	1	—	—	—
Helodermatidae	1	1	—	—	—
Iguanidae	5	3	1	1	—
Mabuyidae	1	1	—	—	—
Phrynosomatidae	30	8	19	3	—
Phyllodactylidae	3	1	2	—	—
Scincidae	3	1	2	—	—
Sphaerodactylidae	2	2	—	—	—
Sphenomorphidae	4	2	2	—	—
Teiidae	8	3	5	—	—
Xantusiidae	9	2	5	2	—
Xenosauridae	5	1	3	1	—
Subtotals	**120**	**41**	**59**	**19**	**1**
Boidae	1	1	—	—	—
Charinidae	1	—	—	1	—
Colubridae	50	25	20	5	—
Dipsadidae	55	29	22	4	—
Elapidae	11	6	4	1	—
Leptotyphlopidae	3	1	2	—	—
Loxocemidae	1	1	—	—	—
Natricidae	11	4	5	2	—
Sibynophiidae	1	1	—	—	—
Typhlopidae	2	1	—	—	1
Viperidae	15	7	8	—	—
Subtotals	**151**	**76**	**60**	**14**	**1**
Cheloniidae	3	3	—	—	—
Chelydridae	1	1	—	—	—
Dermatemydidae	1	1	—	—	—

Dermochelyidae	1	1	—	—	—
Emydidae	2	2	—	—	—
Geoemydidae	3	2	1	—	—
Kinosternidae	5	3	2	—	—
Staurotypidae	3	3	—	—	—
Subtotals	**19**	**16**	**3**	**—**	**—**
Totals	**293**	**136**	**122**	**33**	**2**
Sum Totals	**442**	**183**	**164**	**93**	**2**

Micrurus ephippifer (Cope, 1886). The Oaxacan Coral Snake is endemic to the state and is distributed in the Montañas y Valles del Occidente, Sierra Madre de Oaxaca, Montañas y Valles del Centro, Sierra Madre del Sur, and Planicie Costera de Tehuantepec physiographic provinces. Its EVS has been calculated at 15, placing it in the lower portion of the high vulnerability category. This species has been assessed as Vulnerable by the IUCN, and as a species of Special Protection by SEMARNAT. The individual in this photo was found in Nizanda, in the municipality of Asunción Ixtaltepec. © Leonardo Fernández-Badillo

CONSERVATION STATUS

We used the same systems as Alvarado Díaz et al. (2013) to assess the conservation status of the members of the Oaxacan herpetofauna. We drew the data for the IUCN and EVS systems from Wilson et al. (2013a, b), except where updates were necessary, and those for the SEMARNAT system from NOM-059 (2010).

The SEMARNAT System

The categories in the NOM-059 (2010) document are used widely in studies regarding the conservation status of the members of the Mexican herpetofauna. Similarly, we extracted the ratings from this document for members of the Oaxacan herpetofauna, which we list in Table 7 and provide a summary in Table 9.

The SEMARNAT system consists of three categories, and we placed the ones not listed in NOM-059 (2010) in a fourth category that we labeled NS—for "No Status."

We list 230 of the 440 species (52.3%) that comprise the native herpetofauna of Oaxaca as NS, indicating that less than one-half of the herpetofauna has been evaluated by means of this system. Of the remaining 210 species, only seven (1.6%) are placed in the P (= the endangered category), 60 (13.6%) in the A (= the threatened category), and 143 (32.5%) in the Pr (= the special protection category).

Given these results, the SEMARNAT system proves to be of little use in assessing the conservation status of the Oaxacan herpetofauna. Of the seven endangered (P) species, five are turtles (four marine and one freshwater species) and two are members of the anguid genus *Abronia*. The majority of the threatened (A) species are lizards and snakes, as well as hylid frogs and plethodontid salamanders.

Table 9. SEMARNAT categorization for herpetofaunal species in Oaxaca arranged by families. Non-native species are not included.

Families	Number of Species	SEMARNAT Categorization			
		Endangered (P)	Threatened (A)	Special Protection (Pr)	No Status (NS)
Bufonidae	12	—	—	2	10
Centrolenidae	1	—	—	—	1
Craugastoridae	14	—	—	6	8
Eleutherodactylidae	4	—	—	1	3
Hylidae	59	—	6	15	38
Leptodactylidae	3	—	—	—	3
Microhylidae	3	—	—	2	1
Ranidae	8	—	—	4	4
Rhinophrynidae	1	—	—	—	1
Scaphiopodidae	1	—	—	—	1
Subtotals	**106**	**—**	**6**	**30**	**70**
Plethodontidae	41	—	9	11	21
Subtotals	**41**	**—**	**9**	**11**	**21**
Dermophiidae	2	—	—	2	—
Subtotals	**2**	**—**	**—**	**2**	**—**
Totals	**149**	**—**	**15**	**43**	**91**
Alligatoridae	1	—	—	1	—
Crocodylidae	2	—	—	2	—
Subtotals	**3**	**—**	**—**	**3**	**—**
Anguidae	15	2	4	8	1
Corytophanidae	4	—	—	3	1
Dactyloidae	27	—	1	8	18

Eublepharidae	1	—	1	—	—
Gymnophthalmidae	1	—	—	1	—
Helodermatidae	1	—	1	—	—
Iguanidae	5	—	3	2	—
Mabuyidae	1	—	—	—	1
Phrynosomatidae	30	—	4	6	20
Phyllodactylidae	3	—	—	2	1
Scincidae	3	—	—	1	2
Sphaerodactylidae	2	—	—	1	1
Sphenomorphidae	4	—	1	1	2
Teiidae	8	—	—	3	5
Xantusiidae	9	—	3	3	3
Xenosauridae	5	—	—	1	4
Subtotals	**119**	**2**	**18**	**40**	**59**
Boidae	1	—	—	—	1
Charinidae	1	—	—	1	—
Colubridae	50	—	9	10	31
Dipsadidae	55	—	2	24	29
Elapidae	11	—	—	8	3
Leptotyphlopidae	3	—	—	—	3
Loxocemidae	1	—	—	1	—
Natricidae	11	—	8	—	3
Sibynophiidae	1	—	—	—	1
Typhlopidae	1	—	—	—	1
Viperidae	15	—	5	5	5
Subtotals	**150**	**—**	**24**	**49**	**77**
Cheloniidae	3	3	—	—	—
Chelydridae	1	—	—	—	1
Dermatemydidae	1	1	—	—	—
Dermochelyidae	1	1	—	—	—
Emydidae	2	—	—	—	2
Geoemydidae	3	—	2	1	—
Kinosternidae	5	—	—	5	—
Staurotypidae	3	—	1	2	—
Subtotals	**19**	**5**	**3**	**8**	**3**
Totals	**291**	**7**	**45**	**100**	**139**
Sum Totals	**440**	**7**	**60**	**143**	**230**

The IUCN System

After completion of the Global Amphibian Assessment in 2004 (Stuart et al., 2010) and the Mexican component of the Global Reptile Assessment in 2007 (natureserve.org/sites/default/files/projects/files/reptile_assessment_fact-sheet_low1_0), the IUCN assessment measure has been applied to the majority of the members of the Oaxacan herpetofauna (Tables 7, 10). A summary of these data (Table 10) indicates that 345 of 440 native species (78.4%) have been allocated to one of the eight IUCN categories; actually, only six of the eight categories have been applied to members of the Mexican herpetofauna, as the Extinct and Extinct in the Wild categories have not been used.

Table 10. IUCN Red List categorizations for herpetofaunal families in Oaxaca. 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	12	—	4	2	—	6	—	—
Centrolenidae	1	—	—	—	—	1	—	—
Craugastoridae	14	2	3	4	1	4	—	—
Eleutherodactylidae	4	—	1	1	—	2	—	—
Hylidae	59	19	6	7	4	17	6	—
Leptodactylidae	3	—	—	—	—	3	—	—
Microhylidae	3	—	—	—	—	3	—	—
Ranidae	8	—	—	1	—	6	—	1
Rhinophrynidae	1	—	—	—	—	—	—	1
Scaphiopodidae	1	—	—	—	—	—	—	1
Subtotals	**106**	**21**	**14**	**15**	**5**	**42**	**6**	**3**
Plethodontidae	41	11	12	3	3	4	6	2
Subtotals	**41**	**11**	**12**	**3**	**3**	**4**	**6**	**2**
Dermophiidae	2	—	—	1	—	—	1	—
Subtotals	**2**	**—**	**—**	**1**	**—**	**—**	**1**	**—**
Totals	**149**	**32**	**26**	**19**	**8**	**46**	**13**	**5**
Alligatoridae	1	—	—	—	—	1	—	—
Crocodylidae	2	—	—	1	—	1	—	—
Sustotals	**3**	**—**	**—**	**1**	**—**	**2**	**—**	**—**
Anguidae	15	—	3	2	1	5	3	1
Corytophanidae	4	—	—	—	—	1	—	3
Dactyloidae	27	—	1	1	—	12	4	9
Eublepharidae	1	—	—	—	—	—	—	1
Gymnophthalmidae	1	—	—	—	—	—	—	1
Helodermatidae	1	—	—	—	—	1	—	—
Iguanidae	5	1	—	—	—	1	—	3
Mabuyidae	1	—	—	—	—	—	—	1
Phrynosomatidae	30	—	—	1	—	19	4	6
Phyllodactylidae	4	—	—	—	—	2	—	1
Scincidae	3	—	—	—	—	2	—	1
Sphaerodactylidae	2	—	—	—	—	—	—	2
Sphenomorphidae	4	—	—	—	—	2	—	2
Teiidae	8	—	—	—	—	7	—	1
Xantusiidae	9	—	—	—	—	1	5	3
Xenosauridae	5	—	—	1	—	1	1	2
Subtotals	**119**	**1**	**4**	**5**	**1**	**54**	**17**	**37**
Boidae	1	—	—	—	—	—	—	1
Charinidae	1	—	—	1	—	—	—	—
Colubridae	50	—	1	—	1	25	7	16
Dipsadidae	55	—	—	2	—	23	12	18
Elapidae	11	—	—	1	—	6	3	1
Leptotyphlopidae	3	—	—	—	—	1	—	2

Loxocemidae	1	—	—	—	—	—	—	1
Natricidae	11	—	—	—	—	7	—	4
Sibynophiidae	1	—	—	—	—	—	—	1
Typhlopidae	1	—	—	—	—	1	—	—
Viperidae	15	—	1	2	1	7	—	4
Subtotals	**150**	**—**	**2**	**6**	**2**	**70**	**22**	**48**
Cheloniidae	3	1	1	1	—	—	—	—
Chelydridae	1	—	—	1	—	—	—	—
Dermatemydidae	1	1	—	—	—	—	—	—
Dermochelyidae	1	1	—	—	—	—	—	—
Emydidae	2	—	—	—	—	—	—	2
Geoemydidae	3	—	—	—	2	—	—	1
Kinosternidae	5	—	—	—	1	1	1	2
Staurotypidae	3	—	—	—	3	—	—	—
Subtotals	**19**	**3**	**1**	**2**	**6**	**1**	**1**	**5**
Totals	**291**	**4**	**7**	**14**	**9**	**127**	**40**	**90**
Sum Totals	**440**	**36**	**33**	**33**	**17**	**173**	**53**	**95**

The absolute and relative numbers of Oaxacan herpetofaunal species allocated to these six categories (Table 10) are as follows: CR = 36 (8.2%); EN = 33 (7.5%); VU = 33 (7.5%); NT = 17 (3.9%); LC = 173 (39.3%); and DD = 53 (12.0%). The three "threat categories" (CR, EN, and VU) amount to 102 species, 23.2% of the total native Oaxacan herpetofauna.

The DD species comprise 53 (12.0%) of the total number of native Oaxacan herpetofaunal species. As shown by Howard and Bickford (2014), who dealt only with amphibians, such species "are likely to be more threatened with extinction than their fully assessed counterparts." This remarkable and important result, supported by the application of predictive models, reflects what we expressed previously (Wilson et al., 2013a, b) in a more informal manner. Wilson et al. (2013b: 112) concluded that the DD species are "threat species in disguise," and Wilson et al. (2013a: 22) "that if a concerted effort to locate and assess the 118 DD [reptile] species were undertaken, that most or all of them would be shown to qualify for inclusion in one of the three IUCN threat categories." Howard and Bickford (2014: 837) characterized DD species as suffering a "silent extinction risk." The 53 DD species consist of six anurans, six salamanders, one caecilian, 17 lizards, 22 snakes, and one turtle (Table 10).

Typically, the largest number and proportion of species in the IUCN herpetofaunal assessments we studied have been allocated to the LC category. Based on their conservation reassessment of the Mexican herpetofauna, Wilson et al. (2013a, b) characterized this category as constituting "a dumping ground" (Wilson et al., 2013b: 112). Wilson et al. (2013a: 22) opined that, "A more discerning look at … the LC…species might demonstrate that many should be partitioned into other IUCN categories, rather than the LC."

One of the most significant problems with using the IUCN system is the delay in which it is applied to newly described taxa, as well as to taxa of broad distribution. Of the 440 native members of the Oaxacan herpetofauna, 95 (21.6%) have not been evaluated by the IUCN system.

The EVS System

The Environmental Vulnerability Score (EVS) was developed for use with the Honduran herpetofauna (Wilson and McCranie, 1992; McCranie and Wilson, 2002; Wilson and McCranie, 2004), initially for amphibians and later for the remainder of the herpetofauna. Various contributors in Wilson et al. (2010) also used this system for some countries in Central America, and Wilson et al. (2013a, b) employed it for use with the herpetofauna of Mexico. Alvarado Díaz et al. (2013) also used the Wilson et al. (2013a, b) scores to analyze the conservation status of the herpetofauna of the Mexican state of Michoacán.

The EVS system was designed to use information generally available to herpetologists conducting conventional fieldwork, so that preliminary assessments of conservation status can be made without waiting for longer-term, more expensive determinations of population conditions. Wilson et al. (2013a, b) discussed the advantages of this system over that used by the IUCN.

We applied the modified EVS system used by Wilson et al. (2013a, b) to the members of the Oaxacan herpetofauna, and indicate the results in Table 7 and summarize them in Table 11. The scores range from 3 to 19, which is almost the entire theoretical range for EVS values (3–20). The three most common scores are 14 (56 species), 15 (53), and 13 (39). The total number of species involved is 148 (34.0% of the 435 species for which the EVS can be calculated). We calculated an EVS of 3 for three species (*Rhinella marina*, *Smilisca baudinii*, and *Lithobates forreri*), all widely distributed, ecologically tolerant anurans, and an EVS of 19 for two (*Ecnomiohyla echinata* and *Ctenosaura oaxacana*, the former a hylid anuran and the latter an iguanid lizard; Table 7).

Table 11. Environmental Vulnerability Scores (EVS) for herpetofaunal species in Oaxaca, 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	12	1	—	—	1	—	1	1	1	4	—	1	1	1	—	—	—	—
Centrolenidae	1	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—
Craugastoridae	14	—	—	—	—	—	1	1	1	1	—	1	2	2	2	1	2	—
Eleutherodactylidae	4	—	—	—	—	—	—	—	—	1	2	—	—	—	1	—	—	—
Hylidae	59	1	2	—	—	4	3	4	2	4	5	9	15	8	—	1	—	1
Leptodactylidae	3	—	—	1	1	1	—	—	—	—	—	—	—	—	—	—	—	—
Microhylidae	3	—	1	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—
Ranidae	8	1	—	1	—	1	1	1	—	1	1	1	—	—	—	—	—	—
Rhinophrynidae	1	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—
Scaphiopodidae	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotals	**106**	**3**	**3**	**2**	**3**	**7**	**8**	**7**	**5**	**11**	**8**	**12**	**18**	**11**	**3**	**2**	**2**	**1**
Plethodontidae	41	—	—	—	—	—	—	1	—	1	—	—	—	4	3	16	16	—
Subtotals	**41**	—	—	—	—	—	—	**1**	**—**	**1**	**—**	**—**	**—**	**4**	**3**	**16**	**16**	**—**
Dermophiidae	2	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—
Subtotals	**2**	—	—	—	—	—	—	—	—	**1**	**1**	—	—	—	—	—	—	—
Totals	**149**	**3**	**3**	**2**	**3**	**7**	**8**	**8**	**5**	**13**	**9**	**12**	**18**	**15**	**6**	**18**	**18**	**1**
Alligatoridae	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—
Crocodylidae	2	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—
Subtotals	**3**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**1**	**1**	**—**	**1**	**—**	**—**	**—**
Anguidae	15	—	—	—	1	—	—	—	—	—	—	1	3	3	1	1	5	—
Corytophanidae	4	—	—	—	—	1	1	1	—	—	—	1	—	—	—	—	—	—
Dactyloidae	27	—	—	—	—	1	2	3	2	—	—	1	3	6	8	1	—	—
Eublepharidae	1	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—
Gymnophthalmidae	1	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—
Helodermatidae	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—
Iguanidae	5	—	—	—	—	—	1	—	—	—	2	—	—	1	—	—	—	1
Mabuyidae	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—
Phrynosomatidae	30	—	—	1	—	—	—	2	—	6	4	3	3	5	5	1	—	—
Phyllodactylidae	4	—	—	—	—	—	1	—	—	—	—	1	1	1	—	—	—	—
Scincidae	3	—	—	—	—	—	—	—		1	1	1			—	—	—	—

Sphaerodactylidae	2	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—
Sphenomorphidae	4	—	—	—	—	—	—	—	2	—	2	—	—	—	—	—	—	—
Teiidae	8	—	—	—	—	1	1	—	—	1	2	—	2	1	—	—	—	—
Xantusiidae	9	—	—	—	—	—	2	—	—	1	—	2	1	1	2	—	—	—
Xenosauridae	5	—	—	—	—	—	—	1	—	1	1	—	—	—	2	—	—	—
Subtotals	**120**	**—**	**—**	**1**	**2**	**3**	**8**	**9**	**5**	**10**	**13**	**10**	**14**	**18**	**18**	**3**	**5**	**1**
Boidae	1	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—
Charinidae	1	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—
Colubridae	50			2	7	2	3	7	4	2	1	5	9	5	3			
Dipsadidae	54	—	—	2	2	3	5	4	8	4	4	6	5	6	6	—	—	—
Elapidae	10	—	—	—	—	—	2	—	—	1	—	2	1	1	—	1	2	—
Leptotyphlopidae	3	—	1	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—
Loxocemidae	1	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—
Natricidae	11	—	—	—	—	2	1	—	1	1	—	—	3	1	1	1	—	—
Sibynophiidae	1	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—
Typhlopidae	1	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—
Viperidae	15	—	—	—	—	—	1	1	1	2	1	1	1	4	2	1	—	—
Subtotals	**149**	**—**	**1**	**4**	**9**	**7**	**12**	**12**	**16**	**14**	**6**	**14**	**19**	**18**	**12**	**3**	**2**	**—**
Chelydridae	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—
Dermatemydidae	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—
Emydidae	2	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—
Geoemydidae	3	—	—	—	—	—	1	—	—	—	—	1	1	—	—	—	—	—
Kinosternidae	5	—	—	—	—	—	—	—	2	1	—	—	1	1	—	—	—	—
Staurotypidae	3	—	—	—	—	—	—	—	—	—	—	1	2	—	—	—	—	—
Subtotals	**15**	**—**	**—**	**—**	**—**	**—**	**1**	**—**	**2**	**1**	**—**	**3**	**4**	**2**	**—**	**2**	**—**	**—**
Totals	**286**	**—**	**1**	**5**	**11**	**10**	**21**	**21**	**23**	**25**	**19**	**27**	**38**	**38**	**31**	**8**	**7**	**1**
Sum Totals	**435**	**3**	**4**	**7**	**14**	**17**	**29**	**29**	**28**	**38**	**28**	**39**	**56**	**53**	**37**	**26**	**25**	**2**
Sum Totals%	**—**	**0.7**	**0.9**	**1.6**	**3.2**	**3.9**	**6.7**	**6.7**	**6.4**	**8.7**	**6.4**	**9.0**	**12.9**	**12.2**	**8.5**	**6.0**	**5.7**	**0.5**
Category Totals	**435**	**Low = 103**							**Medium = 133**				**High = 199**					

We divided the range of EVS scores into three categories (Table 11): low (EVS of 3–9), medium (10–13), and high (14–19). As usual in such studies, the number of species allocated increases from the low category, through the medium, to the high, in this instance markedly so. For the Oaxacan herpetofauna, the numbers are, respectively, 103, 133, and 199, and comprise 23.6%, 30.6%, and 45.7% of the 435 species. Thus, the degree of conservation significance increases in the same direction. Contrary to our expectations, even though the herpetofauna of Oaxaca is the largest of any state in Mexico, the distribution of the EVS scores among all the species is somewhat more even than for the entire Mexican herpetofauna (Wilson et al., 2013b, Table 6). The scores for Mexico were as follows: low, 149 (12.3%); medium, 375 (30.9%); and high, 690 (56.8%). Consequently, the degree of correspondence between the size of the herpetofauna and its degree of conservation significance is less than we expected, but still significant enough for efforts directed at conserving the Oaxacan herpetofauna.

Following the scheme used by Wilson et al. (2013a, b), we compared the EVS and IUCN categorizations for the Oaxacan herpetofauna (Table 12). The data in this table indicate that only 37.4% (73 of 195) of the high vulnerability species are assessed in one of the IUCN threat categories. At the other extreme of the fully assessed IUCN categories (the LC category), 174 species comprise 1.7 times the number of species (101) in the low vulnerability category.

Table 12. Comparison of Environmental Vulnerability Scores (EVS) and IUCN categorizations for members of the Oaxacan herpetofauna. Shaded area at the top encompasses low vulnerability category scores, and the one at the bottom high vulnerability category scores. Non-native and marine species are excluded.

	IUCN categories							
EVS	**Critically Endangered**	**Endangered**	**Vulnerable**	**Near Threatened**	**Least Concern**	**Data Deficient**	**Not Evaluated**	**Totals**
3	—	—	—	—	3	—	—	3
4	—	—	—	—	3	—	1	4
5	—	—	—	—	3	—	4	7
6	—	—	—	—	6	—	8	14
7	1	—	—	—	9	—	7	17
8	—	—	1	—	19	—	8	28
9	—	—	2	—	13	—	13	28
10	1	1	—	—	9	1	15	27
11	—	1	6	2	19	1	9	38
12	2	2	1	—	12	3	8	28
13	1	3	3	3	21	3	5	39
14	8	3	7	3	24	8	2	55
15	6	3	5	1	19	12	5	51
16	—	5	2	—	13	12	5	37
17	8	7	3	—	1	4	2	25
18	5	7	2	—	—	9	2	25
19	2	—	—	—	—	—	—	2
Totals	**34**	**32**	**32**	**9**	**174**	**53**	**94**	**428**

The EVS for 53 DD species ranges from 10 to 18, as follows: 10, 1 species (1.9%); 11, 1 (1.9%); 12, 3 (5.7%); 13, 3 (5.7%); 14, 8 (15.1%); 15, 12 (22.6%); 16, 12 (22.6%); 17, 4 (7.5%); and 18, 9 (17.0%). The EVS for 45 of these species (84.9%) demonstrates high vulnerability, and the other eight medium vulnerability (Table 12).

To ascertain why the 53 DD species presently are placed in this IUCN category, we extracted their EVS calculations from the appendices in Wilson et al. (2013a, b) and indicate them in Table 13. Given the widespread use of the IUCN system, we tried to determine where these species logically might be placed if removed from the DD category. The principal reason they were placed in this category was because of their extremely limited geographic and ecological distributions. Of the 53 species, 30 (56.6%) presently are known only from the vicinity of their type localities (i.e., their geographic distribution score is 6; Table 13). Twenty-three species (43.4%) are known from beyond their type localities, but still are endemic to Mexico (Table 13). Twenty-eight species (52.8%) are limited to a single forest formation, and 17 (32.1%) are known from two (Table 13). In our opinion, any of these distributional features should be enough to place a species in one of the three IUCN threat categories. In combination, these features either should cement the species' placement in one of the three threat categories, or require their placement in a higher category. Four such combinations are 6/8; 6/7; 5/8; and 5/7. Respectively, the absolute and relative numbers for each are 20 (37.7); 8 (15.1%); 8 (15.1%); and 9 (17.0%). Our suggested IUCN allocations for these four categories are, respectively, CR, EN, VU, and NT. These allocations account for 45 of the 53 DD species (84.9%). The remaining eight species (15.1%) might be allocated to one of the threat categories (e.g., *Norops milleri* and *Lepidophyma dontomasi*) or either the NT or LC categories (the remaining six species).

Table 13. Environmental Vulnerability Scores for members of the Oaxacan herpetofauna allocated to the IUCN Data Deficient category.

Taxa	Environmental Vulnerability Score			
	Geographic Distribution	Ecological Distribution	Reproductive Mode/ Degree of Persecution	Total Score
*Exerodonta abdivita***	6	8	1	15
*Plectrohyla ameibothalame***	6	8	1	15
*Plectrohyla labedactyla***	6	8	1	15
*Plectrohyla miahuatlanensis***	6	8	1	15
*Ptychohyla acrochorda***	6	7	1	14
*Ptychohyla zophodes***	5	7	1	13
*Bolitoglossa oaxacensis***	5	8	4	17
*Bolitoglossa zapoteca***	6	8	4	18
*Pseudoeurycea maxima***	5	8	4	17
*Pseudoeurycea obesa***	6	8	4	18
*Pseudoeurycea ruficauda***	6	8	4	18
*Thorius insperatus***	6	8	4	18
*Dermophis oaxacae**	5	3	4	12
*Abronia bogerti**	6	8	4	18
*Abronia mitchelli**	6	8	4	18
*Abronia ornelasi**	6	8	4	18
*Norops boulengerianus***	5	8	3	16
*Norops milleri**	5	6	3	14
*Norops rubiginosus**	5	8	3	16
*Norops subocularis**	5	7	3	15
*Sceloporus halli***	6	8	3	17
*Sceloporus salvini**	5	7	3	15
*Sceloporus subpictus**	6	7	3	16
*Sceloporus tanneri***	6	7	3	16
*Lepidophyma dontomasi**	6	6	2	14
*Lepidophyma lineri***	5	8	2	15
*Lepidophyma lowei**	6	8	2	16
*Lepidophyma radula**	6	5	2	13
*Lepidophyma tuxtlae**	5	4	2	11
*Xenosaurus phalaroanthereon***	5	8	3	16
*Ficimia ramirezi**	6	8	2	16
*Ficimia variegata**	5	7	2	14
*Geagras redimitus***	5	7	2	14
*Tantilla briggsi***	6	8	2	16
*Tantilla oaxacae***	6	7	2	15
*Tantilla striata**	5	7	2	14
*Tantilla triseriata***	5	6	2	13
*Adelphicos latifasciatum**	6	7	2	15
Adelphicos quadrivirgatum	4	4	2	10
*Cryophis hallbergi**	5	7	2	14
*Geophis blanchardi**	5	8	2	15
*Geophis isthmicus**	6	8	2	16
*Geophis juarezi***	6	8	2	16
*Geophis russatus**	6	8	2	16
*Geophis sallei**	6	7	2	15
*Rhadinaea bogertorum**	6	8	2	16
*Rhadinaea cuneata**	6	7	2	15
*Rhadinaea macdougalli**	5	5	2	12
*Rhadinaea myersi**	5	5	2	12
*Micrurus bogerti**	5	7	5	17
*Micrurus nebularis***	5	8	5	18
*Micrurus pachecogili**	6	7	5	18
*Kinosternon oaxacae**	5	7	3	15

To determine why about one-fifth of the 440 native species in Oaxaca remain unassessed (i.e., allocated to the NE category), we placed the 94 species in Table 14, constructed in a fashion similar to Table 11. Perusal of these species indicates that many are non-endemic species with a distribution extending to Central America (see Köhler, 2008, 2011). In recent years, a few of these species have been described as new, resurrected, or elevated to species level, and thus have not been assessed by the IUCN. In total, however, the EVS of these NE species ranges from 4 to 19, close to the entire range for these values. The geographic distribution components of these scores ranges from 1 to 6, the ecological distribution components from 1 to 8, and the reproductive mode/degree of persecution components from 1 to 6 (i.e., the entire range possible for each of these three components). Of the 94 species, 76 (80.8%) are non-endemic, six (6.4%) are state endemics, and 12 (12.8%) are country endemics. Given that about 80% of the species are non-endemic to Mexico, it appears likely that these species eventually will be assessed an LC rating by the IUCN. In the future, however, the state and country endemics probably will be assigned to one of the three threat categories. Apparently, most of these species, i.e., the lizards and snakes (90 species), remain unassessed because they occur both in Mexico and Central America, and should be assessed when the final results of the Central American workshop on squamates that occurred in May of 2012 are published.

Table 14. Environmental Vulnerability Scores for members of the Oaxacan herpetofauna currently not evaluated (NE) by the IUCN.

Taxa	Environmental Vulnerability Score			
	Geographic Distribution	Ecological Distribution	Reproductive Mode/Degree of Persecution	Total Score
Lithobates brownorum	4	3	1	8
Spea multiplicata	1	4	1	6
*Bolitoglossa chinanteca***	6	8	4	18
*Thorius maxillobrochus**	6	8	4	18
*Barisia planifrons***	5	7	3	15
Basiliscus vittatus	1	3	3	7
Corytophanes hernandesii	4	6	3	13
Laemanctus longipes	1	5	3	9
Norops biporcatus	3	4	3	10
Norops laeviventris	3	3	3	9
Norops lemurinus	3	2	3	8
Norops petersii	2	4	3	9
*Norops peucephilus***	6	8	3	17
Norops rodriguezii	4	3	3	10
Norops sericeus	2	3	3	8
Norops tropidonotus	4	2	3	9
Norops unilobatus	1	3	3	7
Coleonyx elegans	2	3	4	9
Gymnophthalmus speciosus	3	3	3	9
Ctenosaura acanthura	2	4	6	12
*Ctenosaura pectinata**	5	4	6	15
Iguana iguana	3	3	6	12
Marisora brachypoda	1	2	3	6
Phrynosoma asio	2	6	3	11
*Sceloporus aureolus**	5	7	3	15
*Sceloporus cupreus**	5	8	3	16
*Sceloporus omiltemanus**	5	8	3	16
Sceloporus squamosus	3	5	3	11
Sceloporus variabilis	1	1	3	5
Phyllodactylus tuberculosus	1	4	3	8
Plestiodon sumichrasti	4	5	3	12
Sphaerodactylus continentalis	4	3	3	10
Sphaerodactylus glaucus	4	5	3	12
Sphenomorphus assatus	2	2	3	7
Sphenomorphus cherriei	3	2	3	8

Holcosus undulatus	2	2	3	7
*Lepidophyma cuicateca***	6	8	2	16
Lepidophyma flavimaculatum	1	5	2	8
Lepidophyma smithii	2	4	2	8
*Xenosaurus agrenon**	5	4	3	12
Xenosaurus rackhami	4	4	3	11
Boa imperator	3	1	6	10
*Conopsis acuta**	5	7	2	14
Drymobius margaritiferus	1	1	4	6
*Ficimia olivacea**	5	2	2	9
Ficimia publia	4	3	2	9
Lampropeltis abnorma	1	3	5	9
*Lampropeltis polyzona**	5	1	5	11
Leptophis ahaetulla	3	3	4	10
Masticophis mentovarius	1	1	4	6
Oxybelis aeneus	1	1	3	5
Oxybelis fulgidus	3	2	4	9
Senticolis triaspis	2	1	3	6
Spilotes pullatus	1	1	4	6
Stenorrhina degenhardtii	3	3	3	9
Stenorrhina freminvillii	1	2	4	7
Tantilla vulcani	4	6	2	12
Trimorphodon biscutatus	2	1	4	7
Amastridium sapperi	4	4	2	10
Clelia scytalina	4	5	4	13
Coniophanes bipunctatus	1	5	3	9
Coniophanes fissidens	1	3	3	7
Enulius flavitorques	1	1	3	5
Imantodes cenchoa	1	3	2	6
Imantodes gemmistratus	1	3	2	6
Leptodeira septentrionalis	2	2	4	8
Ninia sebae	1	1	2	4
Oxyrhophus petolarius	3	6	5	14
Rhadinaea decorata	1	6	2	9
*Rhadinella donaji***	6	8	2	16
Rhadinella godmani	3	5	2	10
Tretanorhinus nigroluteus	3	5	2	10
Tropidodipsas fasciata	5	4	4	13
Tropidodipsas fischeri	4	3	4	11
Tropidodipsas sartorii	2	2	5	9
Xenodon rabdocephalus	3	5	5	13
Micrurus nigrocinctus	3	3	5	11
*Epictia bakewelli**	5	5	1	11
Epictia phenops	2	1	1	4
Loxocemus bicolor	1	5	4	10
*Thamnophis bogerti**	5	7	4	16
*Thamnophis lineri***	5	8	4	17
Thamnophis marcianus	1	5	4	10
Thamnophis proximus	1	2	4	7
Scaphiodontophis annulatus	1	5	5	11
Bothrops asper	3	4	5	12
Cerrophidion godmani	3	3	5	11
*Crotalus culminatus**	5	5	5	15
Crotalus simus	3	2	5	10
Trachemys grayi	3	6	6	15
Trachemys ornata	5	8	6	19
Rhinoclemmys pulcherrima	1	4	3	8
Kinosternon leucostomus	3	4	3	10
Kinosternon scorpioides	3	4	3	10

Wilson et al. (2013b) indicated that a significant number of the DD species in Mexico actually should be placed in one of the threat categories or, perhaps, the Near Threatened (NT) category. To ascertain whether this applies to the LC species occurring in Oaxaca, we constructed Table 15 using the same design as for Tables 13 and 14, and listed the 174 LC species and their respective EVS values (except for *Hydrophis platurus*, a marine species whose EVS cannot be calculated). The EVS values in this table range from 3 to 17, which at the upper end is two points fewer than the highest score applied to a member of the Oaxacan herpetofauna. The absolute and relative numbers of EVS values in the LC category are as follows: 3 (3, 1.7%); 4 (3, 1.7%); 5 (3, 1.7%); 6 (6, 3.5%); 7 (9, 5.2%); 8 (19, 11.0%); 9 (13, 7.5%); 10 (8, 4.6%); 11 (22, 12.7%); 12 (12, 6.9%); 13 (20, 11.6%); 14 (23, 13.3%); 15 (18, 10.4%); 16 (13, 7.5%); and 17 (1, 0.6%). Given the three aforementioned categories of vulnerability, 56 species (32.4%) show low vulnerability, 62 (35.8%) medium vulnerability, and 55 (31.8%) high vulnerability. In our opinion, only the low vulnerability species deserve allocation to the LC category. All but four of these 56 species are non-endemics; the exceptions are *Exerodonta sumichrasti*, *Plectrohyla bistincta*, *Tantilla bocourti*, and *Hypsiglena torquata*, all country endemics with an EVS of 8 or 9, at the upper end of the low vulnerability category. The EVS of the remaining 84 country endemics ranges from 10 to 17 ($\bar{x}$ = 13.5). The EVS of the seven state endemics ranges from 14 to 16 (15.4). The 95 country and state endemics presently allocated to the LC category probably should be shifted to a higher category of endangerment (CR, EN, VU, or NT). Until that happens, the EVS can be used to gauge the level of attention that should be accorded the members of the Oaxacan herpetofauna.

Micrurus nebularis Roze, 1989. The distribution of the Ixtlán Coral Snake, until recently endemic to Oaxaca but now recorded in Puebla (Pavón et al., this issue), is restricted to the Sierra Madre de Oaxaca physiographic province. Its EVS has been assessed at 18, placing it in the upper portion of the high vulnerability category. This species has been judged as Data Deficient by the IUCN, and as a species of Special Protection by SEMARNAT. Pictured here is an individual from San Andres Pápalo, in the municipality of San Juan Tepeuxila.

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Table 15. Environmental Vulnerability Scores for members of the Oaxacan herpetofauna assigned to the IUCN Least Concern category.

Taxa	Environmental Vulnerability Score			
	Geographic Distribution	Ecological Distribution	Reproductive Mode/ Degree of Persecution	Total Score
Incilius canaliferus	4	3	1	8
Incilius coccifer	3	5	1	9
*Incilius marmoreus**	5	5	1	11
*Incilius occidentalis**	5	5	1	11
Incilius valliceps	3	2	1	6
Rhinella marina	1	1	1	3
Hyalinobatrachium fleischmanni	3	4	3	10
Craugastor augusti	2	2	4	8
Craugastor loki	2	4	4	10
*Craugastor mexicanus**	5	7	4	16
*Craugastor rugulosus**	5	4	4	13
*Eleutherodactylus nitidus**	5	3	4	12
Eleutherodactylus pipilans	2	5	4	11
Agalychnis callidryas	3	5	3	11
*Agalychnis dacnicolor**	5	5	3	13
Anotheca spinosa	3	6	5	14
Dendropsophus ebraccatus	3	6	3	12
Dendropsophus microcephalus	3	3	1	7
Dendropsophus robertmertensi	4	4	1	9
*Dendropsophus sartori**	5	8	1	14
*Diaglena spatulata**	5	7	1	13
*Exerodonta sumichrasti**	5	3	1	9
Hyla arenicolor	2	4	1	7
*Plectrohyla bistincta**	5	3	1	9
Scinax staufferi	2	1	1	4
Smilisca baudinii	1	1	1	3
Tlalocohyla loquax	3	3	1	7
Tlalocohyla picta	2	5	1	8
*Tlalocohyla smithii**	5	5	1	11
Trachycephalus typhonius	1	2	1	4
Engystomops pustulosus	3	2	2	7
Leptodactylus fragilis	1	2	2	5
Leptodactylus melanonotus	1	3	2	6
Gastrophryne elegans	2	5	1	8
Hypopachus ustus	2	4	1	7
Hypopachus variolosus	2	1	1	4
Lithobates berlandieri	4	2	1	7
Lithobates forreri	1	1	1	3
Lithobates maculatus	3	1	1	5
*Lithobates spectabilis**	5	6	1	12
Lithobates vaillanti	3	5	1	9
*Lithobates zweifeli**	5	5	1	11
Rhinophrynus dorsalis	2	5	1	8
*Bolitoglossa alberchi**	6	5	4	15
Bolitoglossa occidentalis	4	3	4	11
Bolitoglossa rufescens	1	4	4	9
*Pseudoeurycea mixteca**	5	8	4	17
Caiman crocodilus	3	7	6	16
Crocodylus moreletii	2	5	6	13
*Barisia imbricata**	5	6	3	14
*Celestus enneagrammus**	5	6	3	14

Gerrhonotus liocephalus	2	1	3	6
*Mesaspis gadovii**	5	6	3	14
*Mesaspis viridiflava**	5	8	3	16
Laemanctus serratus	2	3	3	8
*Norops carliebi***	5	7	3	15
*Norops compressicauda**	5	7	3	15
*Norops cuprinus**	6	7	3	16
*Norops immaculogularis***	5	8	3	16
*Norops macrinii***	5	8	3	16
*Norops microlepidotus**	5	7	3	15
*Norops nebuloides**	5	6	3	14
*Norops nebulosus**	5	5	3	13
*Norops quercorum***	5	8	3	16
*Norops sacamecatensis***	5	8	3	16
*Norops stevepoei***	5	6	3	14
*Norops zapotecorum***	6	6	3	15
Heloderma horridum	2	4	5	11
Ctenosaura similis	1	4	3	8
*Phrynosoma braconnieri**	5	7	3	15
*Phrynosoma taurus**	5	4	3	12
*Sceloporus bicanthalis**	5	5	3	13
*Sceloporus cryptus**	5	6	3	14
*Sceloporus edwardtaylori**	5	6	3	14
*Sceloporus formosus**	5	7	3	15
*Sceloporus gadoviae**	5	3	3	11
Sceloporus grammicus	2	4	3	9
*Sceloporus horridus**	5	3	3	11
Sceloporus internasalis	4	4	3	11
*Sceloporus jalapae**	5	5	3	13
*Sceloporus macdougalli**	5	8	3	16
Sceloporus melanorhinus	2	4	3	9
*Sceloporus ochoterenae**	5	4	3	12
Sceloporus siniferus	2	6	3	11
*Sceloporus smithi**	5	7	3	15
*Sceloporus spinosus**	5	4	3	12
Sceloporus teapensis	4	6	3	13
*Urosaurus bicarinatus**	5	4	3	12
*Phyllodactylus bordai**	5	5	3	13
*Phyllodactylus lanei**	5	7	3	15
*Phyllodactylus muralis**	5	6	3	14
*Plestiodon brevirostris**	5	3	3	11
*Plestiodon ochoterenae**	5	5	3	13
*Scincella gemmingeri**	5	3	3	11
*Scincella silvicola**	5	4	3	12
*Aspidoscelis costata**	5	3	3	11
Aspidoscelis deppii	1	4	3	8
*Aspidoscelis guttata**	5	4	3	12
*Aspidoscelis mexicana**	5	6	3	14
Aspidoscelis motaguae	4	5	3	12
*Aspidoscelis parvisocia**	5	7	3	15
*Aspidoscelis sackii**	5	6	3	14
*Lepidophyma pajapanense**	5	6	2	13
*Xenosaurus rectocollaris**	5	8	3	16
Coluber constrictor	1	6	3	10
*Conopsis lineata**	5	6	2	13
*Conopsis megalodon**	5	7	2	14
*Conopsis nasus**	5	4	2	11
Dendrophidion vinitor	3	7	3	13

Drymarchon melanurus	1	1	4	6
Drymobius chloroticus	1	3	4	8
*Leptophis diplotropis**	5	5	4	14
Leptophis mexicanus	1	1	4	6
Mastigodryas melanolomus	1	1	4	6
Phrynonax poecilonotus	3	4	3	10
*Pituophis deppei**	5	5	4	14
Pituophis lineaticollis	2	2	4	8
Pseudelaphe flavirufa	2	4	4	10
*Salvadora bairdi**	5	6	4	15
*Salvadora intermedia**	5	7	4	16
*Salvadora lemniscata**	5	6	4	15
*Salvadora mexicana**	5	6	4	15
*Symphimus leucostomus**	5	6	3	14
*Tantilla bocourti**	5	2	2	9
Tantilla rubra	2	1	2	5
Tantilla schistosa	3	3	2	8
Tantillita brevissima	4	3	2	9
*Trimorphodon tau**	5	4	4	13
*Chersodromus liebmanni**	5	5	2	12
Coniophanes imperialis	2	3	3	8
Coniophanes piceivittis	1	3	3	7
Conophis lineatus	2	3	4	9
Conophis vittatus	2	5	4	11
*Geophis anocularis**	6	8	2	16
Geophis carinosus	2	4	2	8
*Geophis dubius**	5	6	2	13
*Geophis duellmani**	5	8	2	15
*Geophis laticinctus**	5	4	2	11
*Geophis omiltemanus**	5	8	2	15
*Hypsiglena torquata**	5	1	2	8
Leptodeira frenata	4	4	4	12
Leptodeira maculata	2	1	4	7
Leptodeira nigrofasciata	1	3	4	8
*Manolepis putnami**	5	5	3	13
Ninia diademata	4	3	2	9
Pliocercus elapoides	4	1	5	10
*Pseudoleptodeira latifasciata**	5	5	4	14
*Rhadinaea hesperia**	5	3	2	10
*Rhadinaea taeniata**	5	6	2	13
Sibon dimidiatus	1	5	4	10
*Tropidodipsas philippi**	5	5	4	14
Hydrophis platurus	—	—	—	—
Micrurus browni	2	1	5	8
Micrurus diastema	2	1	5	8
Micrurus elegans	4	4	5	13
*Micrurus laticollaris**	5	4	5	14
Micrurus latifasciatus	4	4	5	13
*Rena maxima**	5	5	1	11
*Storeria storerioides**	5	4	2	11
*Thamnophis chrysocephalus**	5	5	4	14
Thamnophis cyrtopsis	2	1	4	7
Thamnophis eques	2	2	4	8
*Thamnophis godmani**	5	5	4	14
*Thamnophis scalaris**	5	5	4	14
*Thamnophis sumichrasti**	5	6	4	15
Amerotyphlops tenuis	4	6	1	11
*Atropoides nummifer**	5	3	5	13

Atropoides olmec	4	6	5	15
Crotalus atrox	1	3	5	9
*Crotalus intermedius**	5	5	5	15
Crotalus molossus	2	1	5	8
*Crotalus ravus**	5	4	5	14
*Porthidium dunni**	5	6	5	16
*Kinosternon integrum**	5	3	3	11

CONCLUSIONS AND RECOMMENDATIONS

We derived our conclusions and recommendations from those developed by Wilson and Townsend (2010) and Wilson et al. (2013a, b). Given the extensive nature of these statements, we ask the reader to refer to them as a backdrop for the ones presented below for the Oaxacan herpetofauna.

Conclusions

A. The herpetofauna of Oaxaca is the largest of any state in Mexico. At 440 native species, it is nearly as large or larger than that of the most speciose Central American countries (Guatemala, Honduras, Costa Rica, and Panama). Recent summary values for those countries, respectively, are as follows: 387 (Acevedo et al., 2010); 396 (Solís et al., 2014); 425 (Savage and Bolaños, 2009); and 447 (Jaramillo et al., 2010). The 440 native species also comprises 35.2% of the 1,250 native species now recorded for Mexico. Amazingly, slightly more than one of every three Mexican species occurs in Oaxaca.

B. The level of herpetofaunal endemism also is significantly high. Of 440 native species, 259 (58.9%) are endemic to Mexico. This figure is comparable to that for the entire country of Mexico, which is 60.5% (756/1,250). Both of these percentages are over twice as high as the highest figure for any Central American country (Wilson and Johnson, 2010; Solís et al., 2014). The size and the degree of endemicity recorded for Oaxaca is of tremendous conservation significance.

C. The range of herpetofaunal species among the 12 physiographic provinces we recognize herein is extensive, from a low of nine in the Depresión del Balsas to a high of 216 in the Sierra de Oaxaca. Six of the 12 regions support fewer than 100 species (9–93), and the remainder more than 100 (102–216). These figures likely will be modified with additional study. Anurans, salamanders, lizards, and snakes are best represented in the Sierra de Oaxaca, and next best represented in the Sierra del Sur. Turtles are best represented in the Planicie Costara de Tehuantepec, and then in the Planicie Costera del Golfo. Crocodylians are found only along the Planicie Costera de Tehuantepec, the Planicie Costera del Pacífico, and the Planicie Costera del Golfo. The species occupy from one to 10 of the 12 physiographic regions, as follows: one (169), two (91), three (64), four (37), five (37), six (18), seven (14), eight (7), nine (4), and 10 (3). The number of single-region species distributed among the physiographic regions ranges from none in the Depresión del Balsas to 67 in the Sierra de Oaxaca.

D. The species shared between the physiographic provinces range from eight to 84 ($\bar{x}$ = 57.3). The SMO and SMS provinces share more species with adjacent areas than any of the other provinces. The highest number of shared species generally is found between pairs that are contiguous, with two exceptions (the SMO-SMS and DB-FT pairs).

E. The distributional status of the members of the Oaxacan herpetofauna is as follows, in order of the size of the categories: non-endemic species, 183 (41.4%); country endemics (164, 37.1%); state endemics (93, 21.0%); and non-natives (2, 0.5%).

F. We used the SEMARNAT, IUCN, and EVS systems to assess the conservation status of members of the Oaxacan herpetofauna. The SEMARNAT system proved to be of limited use in these determinations, inasmuch as only about 48% of the herpetofauna has been assessed using this system. Otherwise, only seven species are placed in the endangered category (P), 60 in the threatened category (A), and 143 in the special protection category (Pr).

G. For a number of reasons, Wilson et al. (2013a, b) and Howard and Bickford (2014) criticized the widely used IUCN system for determining conservation status. The IUCN assessments typically leave a sizable number of species in a given area unevaluated (the NE species), and because the problems pointed out by these authors exist for the entire Mesoamerican herpetofauna (Mexico and Central America), they also apply to the Oaxacan herpetofauna. In our opinion, our analysis of the DD, NE, and LC species indicates that many deserve to be placed in one of the three threat categories or the NT category.

H. Wilson et al. (2013a, b) noted that the EVS system addresses the deficiencies of the SEMARNAT and IUCN systems. Once scores were assigned to members of the Oaxacan herpetofauna and divided into the low, medium, and high categories, the number of species in these categories increased from low, through medium, to high scores. As a consequence, these ratings can provide conservation biologists working on the herpetofauna of Oaxaca a means of providing answers to several questions of conservation significance. For workers undertaking surveys of protected areas in the state, the EVS system will allow them to assess the resident herpetofaunal species, i.e., low, medium, or high priorities. Use of the EVS also can determine, in a general way, the best way to allocate scarce conservation funds, e.g., where to position conservation personnel to conduct survey work, ecological restoration, and the like, as well the manner in which management plans can be drawn for protecting the herpetofauna.

Recommendations

A. Protecting the herpetofauna of Oaxaca now and in the future will not be an easy task. Natural protected areas will play a definitive role in efforts to secure the viability of populations of these creatures in the face of inexorable human population growth. At this juncture, the state has very few natural protected areas (Flores-Villela and Gerez, 1994; Casas-Andreu et al., 2004; Ochoa-Ochoa and Flores Villela, 2007), and these already face numerous obstacles (Anta-Fonseca et al., 2007). The portions of the Mexican government that deal with the environment must provide sufficient funding for established natural protected areas, as well as those to be created, to develop management plans that deal with conservation, research, personnel, and the rational use of existing natural resources. During the last decade, smaller protected areas have been created (e.g., sanctuaries, natural monuments, UMA's [Unidades de Manejo para la Conservación de la Vida Silvestre], and local reserves); these areas will play an important role in maintaining the presence of these organisms; however, many more areas are needed urgently to protect suitably the highly conservation significant herpetofauna of Oaxaca (Casas-Andreu et al., 2004).

B. Agricultural activity in areas surrounding natural protected areas always must be performed to safeguard the connectivity of natural populations. Another significant challenge will be the implementation of housing development and land use plans within natural protected areas and the regulation of the number of visitors (tourism), because human populations located within and adjacent to protected areas increase at the expense of the natural habitat, consequently placing the safety of natural populations and the villagers themselves at risk, such as in the case with crocodiles along the Pacific coast (García-Grajales et al., 2014, and citations therein). Nonetheless, these policies must be fully enforced in areas of human habitation in order to enhance conservation. In addition, more work is necessary to ensure the viability of species that traditionally are exploited (Casas-Andreu et al., 2004), such as iguanas (*Ctenosaura oaxacana*, *C. pectinata*, *C. similis*, and *Iguana iguana*), and marine and freshwater turtles (*Chelonia mydas*, *Dermatemys mawi*, *Dermochelys coriacea*, *Lepidochelys olivacea*, *Kinosternon acutum*, *K. integrum*, and *Trachemys ornata*).

C. Finally, people must be made aware of the importance of these groups of vertebrates in the maintenance of ecosystems and the provision of benefits to society. Because most local villagers have erroneous perceptions of amphibians and reptiles (pers. observ.), we underscore the need for the continuous participation of local communities in the conservation and sustainable use of their natural resources. Well-funded environmental educators working with local communities also should emphasize the relationship between human overpopulation and the deterioration of natural environments.

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