The amphibians and reptiles of Colima, Mexico, with a summary of their conservation status

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Abstract
Colima is the fourth smallest Mexican state, covering only 0.3% of the surface area of Mexico, but due to the remarkable diversity of physiographic and environmental conditions present in Colima it contains a high biological diversity. We generated an up-to-date herpetofaunal checklist for Colima, with a summary of the conservation status of Colima’s amphibians and reptiles. Our checklist contains a total of 153 species of amphibians and reptiles (three introduced). Thirty-nine are amphibians and 114 are reptiles. More than half of Colima’s herpetofauna are Mexican endemics (66.7% of amphibians, 67.5% of reptiles). Less than 25% of the amphibian and reptile species in Colima are in protected categories according to the IUCN Red List and SEMARNAT. The reptiles in the Marine and Revillagigedo Archipelago regions are the most threatened taxa of the Colima herpetofauna. Colima shares > 80% of its herpetofauna with its neighboring states, Jalisco and Michoacán.

Keywords
checklist, crocodilians, frogs, herpetofauna, lizards, salamanders, snakes, turtles

† Deceased

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Introduction

A number of Mexican states still lack comprehensive species lists of amphibians and reptiles. One such state is Colima, which despite being the fourth smallest Mexican state, covering only 0.3% of the surface area of Mexico, has, as reported here, a rich herpetofauna represented by 150 native species (38 amphibians and 112 reptiles), in part due to the remarkable diversity of physiographic and environmental conditions present in Colima.

The interest in the study of amphibians and reptiles of the state of Colima dates from 1700, the year in which the first official record of a herpetological specimen collected in Colima (\textit{Rana pustulosa} – MVZ-A20941). More than 200 years later, Oliver (1937) reported 61 species from Colima. Duellman (1958) subsequently listed 82 amphibian and reptile species from the lowlands of Colima, and Painter (1976) studied the distribution of amphibians and reptiles in Colima. More recently, Reyes-Velasco et al. (2009) reported new state records for 21 species of amphibians and reptiles from Colima. In addition, there have been several new species recently described or elevated to species status from Colima. Bryson et al. (2014) described \textit{Crotalus campbelli} from the Sierra de Manantlán of southwestern Jalisco and northern Colima and elevated \textit{Crotalus triseriatus armstrongi} to a full species status (\textit{C. armstrongi}). Reyes-Velasco et al. (2015) described \textit{Eleutherodactylus grunwaldi} from the state of Colima. Grünwald et al. (2018) described two new species of \textit{Eleutherodactylus} from Colima, \textit{E. colimotl} and \textit{E. manantlanensis}, the last one endemic to Colima.

Given these recent additions and changes in the known species of amphibians and reptiles of Colima, we have conducted a comprehensive review of the specimens and documented species of amphibians and reptiles from Colima to provide an up-to-date herpetofaunal checklist from Colima. In addition, we review and summarize the conservation status of these amphibians and reptiles as a potential guide to future conservation and management efforts focused on the amphibians and reptiles of Colima.

Physiography of Colima

Colima is one of the smallest states in Mexico, covering 5,627 km$^2$ between 19°30’45”N and 18°41’03”N, and -103°29’11”W and -104°41’26”W. Colima is located in central-western Mexico, in the middle of the Pacific Coast of Mexico (Fig. 1). Colima is bordered by Jalisco to the north and east, Michoacán to the southeast, and the Pacific Ocean to the west and south. The Revillagigedo Archipelago is part of the state of Colima and includes the islands of Socorro, San Benedicto, Clarion, and Roca Partida (INEGI 2017), lies approximately 390 km southwest of Cabo San Lucas, the southern tip of the Baja California Peninsula, and 720 to 970 km west of Manzanillo, northwestern Colima (https://en.wikipedia.org/wiki/Revillagigedo_Islands – accessed 10 October 2019).

Almost three quarters of the surface area of Colima is covered by mountains and hills, producing a heterogeneous topography in the state (Fig. 2). This complex to-
Herpetofauna of Colima

Figure 1. Map of Mexico with the state of Colima shown in red (modified from INEGI 2018).

The geography of Colima is represented by two physiographic provinces that are included within the geographic limits of the state: the Volcanic Axis, represented in the state by the subprovince of Volcanes de Colima; and the Sierra Madre del Sur, represented in the state by two subprovinces “Sierras de la Costa de Jalisco y Colima” and “Cordillera Costera del Sur” (Fig. 3). The subprovince of Volcanes de Colima is found in the northern corner of the state in the region known as Valle de Colima, and occupies 16.03% of the state’s surface area. The Colima Volcanos (Nevado de Colima, which actually lies in the state of Jalisco, and Volcán de Colima which lies in the states of Jalisco and Colima) are found in this subprovince. All the northern and northeastern slopes and most of the eastern slopes of these two volcanoes lie in the state of Jalisco. The Valley of Colima, formed from the slopes of the Volcán de Colima, is also found in this region. In Colima the subprovince of Sierras de la Costa de Jalisco and Colima occupies most of the state (62.51% of the surface area). It includes the western mountains, the Marabasco River Basin, the Armeria Valley and the entire Colima coast. In the west-central and southern part of the state that parallels the coast the land is flat, and the Valle de Armeria or Llanuras de Tecomán is found here. Northwestern Colima has mountain ranges intermixed with small valleys. The subprovince of the Cordillera Costera del Sur is also part of the province of the Sierra Madre del Sur and occupies 16.03% of the surface area in extreme eastern Colima. Approximately half of this subprovince is represented by mountain ranges that do not reach 2,000 m elevation, and the other half by valleys, hills, and plains (www.inegi.gob.mx accessed 10 October 2019).
Figure 2. Satellite map showing the topographic features of Colima (from Comisión Nacional para el Conocimiento y Uso de la Biodiversidad 2008).

In Colima, the Sierra Madre del Sur consists of four mountain systems. The first system, and the most important, is located in northern Colima and includes Cerro Grande and several hills (Jurípichi or Juluapan, Los Juanillos, La Astilla, El Ocote, El Peón, El Barrigón, San Diego and La Media Luna). The second system runs from the northwestern end of the state southeast to central Colima, and is formed by mountain ranges (the Espinazo del Diablo, El Escorpión, El Tigre, El Aguacate, El Centinela, El Toro and La Vaca) that parallel to the coast between the Marabasco and Armería rivers. The third system is located in central Colima, and consists of hills (Alcomún and Partida, San Miguel and Comala, and San Gabriel or Callejones) that extend to the south between the Armería and Salado rivers. The fourth system is found in southeastern Colima between the Salado and Naranjo or Coahuayana rivers, and includes multiple mountain ranges (Piscila, Volcancillos, La Palmera, El Camichín and Copales) (http://www.inafed.gob.mx/work/enciclopedia/EMM06colima/mediofisico.html – accessed October 10, 2019).
Figure 3. Physiographic provinces of the state of Colima, Mexico (modified from Cervantes-Zamora et al. 1990).

The climate of Colima is very diverse (Fig. 4), although relatively high humidity predominates throughout the state. In northern Colima the climate is warm sub-humid, whereas in the mountains there is a sub-humid semi-warm climate and the plains of Tecomán have a semi-dry warm climate. In the coastal area and in the Armería river basin the climate is warm and humid. The average annual temperature ranges around 25 °C, with the maximum of 38 °C and the minimum of 7 °C. Average annual rainfall is 983 mm. Colima’s climate is greatly influenced by the presence of mountains to the west, north and east. The mountain range of Picila creates the southern border of the Valley of Colima, and to the south, the plains of Tecomán end in a low and sandy coast. These mountains, due to their latitude and exposure, allow rainfall to be greater and the climate to differ from the lower elevation parts of the state. In the coastal zone and in the Armería river basin the climate is warm and humid, whereas in the higher elevations in the southern zone it is warm and temperate.

The occurrence of various tropical and temperate floristic elements coupled with variations in the physical environment has resulted in an intricate and complex mosaic of plant associations in Colima (Fig. 5; Schaldach 1963; INEGI 2017). The types of vegetation present in the state are several types of tropical forest, palm
The different types of tropical forest occupy most Colima’s area (74%). Medium subdeciduous forest covers 57% of the state and is present in all municipalities, with the dominant species being highly branched canopy trees, 15 to 25 m high and 50 to 75% of species losing their leaves in the dry season. Medium subperenifolious forest covers 15.4% of Colima. The vegetation is characterized by a height of 20 to 25 m, with 50 to 75% of the species being evergreens. Low deciduous forest covers 1.3% of the area of Colima. The dominant vegetation is low trees from 8 to 12 m high, with abundant leaves that fall in the dry season. Prickly low deciduous forest covers only 1.0% of Colima. It is characterized by the presence of deciduous trees 4 to 8 m tall with thorns. Palmar is only found in the municipalities of Manza-
nillo and Armería. Mangrove is distributed in the coastal area with coastal lagoons. Savanna is characterized by widely dispersed trees and grasses and is a product of logging or burning of primary communities. Different types of coniferous forests occupy 10.6% of the state’s area.

At the highest elevations in northern Colima, > 50% of the area is forested, so that the agricultural area is limited to 42,700 ha (12,000 ha of irrigation and 30,700 ha of temporary), and due to the topography < 30% can be subjected to mechanized agriculture. The coastal region is characterized as being more favorable for agriculture, including the Tecomán region where the largest area with irrigation infrastructure and plantations with perennial crops is concentrated and mechanized agriculture is used over an area of 92,700 ha (58,400 ha of irrigation and 34,300 ha of temporary).
Recent taxonomic changes

Acevedo et al. (2016) demonstrated that there were two evolutionary lineages within *Rhinella marina*, one eastern and one western Andean. The eastern populations retained the name *R. marina*, and the western populations were given the revalidated name *R. horribilis*. Duellman et al. (2016) treated two major Hylid clades as genera: *Hyla* which is restricted to the Old World, and *Dryophytes* which is distributed primarily in the New World, including species in Mexico. Reyes-Velasco et al. (2015) described a new species of *Eleutherodactylus* from the Sierra de Manantlán in northern Colima and southwestern Jalisco (*E. grunwaldi*). In addition, Grünwald et al. (2018) described two new species of *Eleutherodactylus* from Colima, one endemic to the state (*E. manantlanensis*) and one limited to Colima and western Michoacán (*E. colimotl*). Grünwald et al. (2018) also regarded *E. nivicolimae* as a synonym of *E. rufescens*. Frost et al. (2006) recommended the use of the name *Lithobates* for most New World species of *Rana*, including those in Mexico. However, Yuan et al. (2016) retained all the species of the genera suggested by Frost et al. (2006), including *Lithobates*, in the traditional genus *Rana*, based on clear monophyly of a larger group that includes all of these genera. We therefore follow Yuan et al. (2016) and AmphibiaWeb (2019) in using *Rana* instead of *Lithobates*.

*Plestiodon indubitus* was originally described by Taylor (1933), however Dixon (1969) regarded it as a subspecies of *P. brevirostris*. Feria-Ortiz et al. (2011) subsequently elevated it to full species status, and suggested that the western populations of *P. b. indubitus* from Colima and Jalisco likely represent an undescribed species. We tentatively assign the name *indubitus* to the Colima population until a new name is available. Originally *Holcosus sinister* was described as a subspecies of *H. undulatus* by Smith and Laufe (1946), but it has recently been elevated to full species status by Meza-Lázaro and Nieto-Montes de Oca (2015). Card et al. (2016) resurrected the name *sigma* for the population from María Madre Island, Tres Marías Islands, Nayarit, Mexico described by Smith (1943) as *Constrictor (= Boa) constrictor sigma*, which was regarded as a junior synonym of *B. c. imperator* by Zweifel (1960). Card et al. (2016) recognized the *Boa* populations from the slopes of the Mexican Pacific as *Boa sigma*, and this is followed here. *Epictia bakewelli* was described as a species by Oliver (1937), and was regarded as a subspecies of *E. goudotti* by Peters et al. (1970). However, Wallach et al. (2014) considered it a full species, and McCranie and Hedge (2016) confirmed its status as a full species. Originally *Rena dugesii* was described as a species by Bocourt (1881), but for a long time it was regarded as a subspecies of *Rena humilis*, however it has recently been regarded as a full species (Wallach et al. 2014). Bryson et al. (2014) described a new species of *Crotalus* from western Jalisco and the Sierra de Manantlán of southwestern Jalisco and northern Colima (*C. campbelli*). They also recognized *C. armstrongi* as a species, which was originally described as a subspecies of *C. triseriatus*. 
Methods

We generated our list of the amphibians and reptiles of Colima using our own field work, a thorough examination of the available literature, checking the amphibian and reptile records for Colima in VertNet.org, and consulting databases from the Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (National Commission for the Understanding and Use of Biodiversity; CONABIO), including records from museum collections listed in Appendix 1.

The amphibian names we use follow Frost (2019) and AmphibiaWeb (2019) (http://amphibiaweb.org) and the reptile names we use follow Uetz and Hošek (2019). We include species in the list only if we could confirm records, either by direct observation or through documented museum records or vouchers. We created species accumulation curves the total herpetofauna, amphibians, and reptiles using the year of the first recorded observation for each species. Species accumulation curves may provide reasonable estimates of the potential species richness of amphibians and reptiles (see Raxworthy et al. 2012). We recorded the conservation status of each species based on the IUCN Red List 2019-2 (IUCN 2019), listing in SEMARNAT (2010), and Environmental Vulnerability Scores (Wilson et al. 2013a,b; Johnson et al. 2015). We determined the number of species shared between Colima and its neighboring states using recent lists of amphibians and reptiles for Jalisco (Cruz-Sáenz et al. 2017) and Michoacán (Alvarado-Díaz et al. 2013).

Results and discussion

A total of 153 species of amphibians and reptiles (three introduced) is found in Colima. Thirty-nine of these species are amphibians (36 anurans [one introduced], two salamanders, and one caecilian), and 114 are reptiles (one crocodilian, 41 lizards [two introduced], 64 snakes, and eight turtles) (Tables 1, 2). These represent 37 families: 12 amphibians (nine anurans, two salamanders, one caecilians), and 25 reptiles (one crocodilian, 12 lizards [one of them introduced], eight snakes, and four turtles); 92 genera: 20 amphibians (17 anurans, two salamanders, one caecilian), and 72 reptiles (one crocodile, 22 lacertilia [two of the introduced], 42 snakes, and six turtles. The introduced amphibian is the American Bullfrog (Rana catesbeiana), and the two introduced lizards are species of the family Gekkonidae: the Stump-toed Gecko (Gehyra mutilata) and the Common House Gecko (Hemidactylus frenatus). There are also 20 species (eight amphibians and 12 reptiles) that potentially occur within the state of Colima (Table 3). Most of these are species from the northern slope of Nevado de Colima in Jalisco, and it is highly likely that they also occur on the southern slope of this volcano in Colima. Some other species have been recorded in extreme southwestern Jalisco, near the border with Colima and it is likely that they occur in extreme western Colima. There are a few other species that might occur in eastern or southern
| Class                              | Physiographic region | IUCN status | SEMARNAT | EVS | Global distribution | Year of first record | Source          |
|-----------------------------------|----------------------|-------------|-----------|-----|---------------------|----------------------|------------------|
| Amphibia                          |                      |             |           |     |                     |                      |                  |
| Order Anura                       |                      |             |           |     |                     |                      |                  |
| Family Bufonidae                  |                      |             |           |     |                     |                      |                  |
| Anaxyrus compactilis (1833)       | 1, 2, 3              | LC          | NL        | H   | (14)                | 1935                 | FMNH 103444      |
| Incilius marmoratus (1833)         | 1, 2, 3              | LC          | NL        | M   | (11)                | 1905                 | UAZ 11613        |
| Incilius mazatlanensis (1940)      | 1, 2                 | LC          | NL        | M   | (12)                | 1965                 | UAZ 33286        |
| Incilius occidentalis (1879)       | 1                    | LC          | NL        | M   | (11)                | 1961                 | UCM 61121        |
| Rhinella horribilis (1833)         | 1, 2, 3, NE          | LC          | NL        | NE  |                     | 1901                 | MNHN RA 1901.341 |
| Family Craugastoridae             |                      |             |           |     |                     |                      |                  |
| Craugastor occidentalis (1941)     | 1, 2                 | DD          | NL        | M   | (13)                | 1958                 | UTEP H-14317     |
| Craugastor vocalis (1940)          | 1                    | LC          | NL        | M   | (13)                | 1970                 | FSM-UF 66361     |
| Family Eleutherodactylidae         |                      |             |           |     |                     |                      |                  |
| Eleutherodactylus angustidigitatum (1940) | 1                   | VU          | Pr        | H   | (17)                | 1964                 | LACM 25450       |
| Eleutherodactylus colimai          | 2, 3                 | NE          | NL        | NE  |                     | 2015                 | Grünwald et al. (2018) |
| Eleutherodactylus grunwaldi       | 2                    | NE          | NL        | NE  |                     | 2011                 | Reyes-Velasco et al. (2015) |
| Eleutherodactylus manantlanensis   | 2                    | NE          | NL        | NE  |                     | 2014                 | Grünwald et al. (2018) |
| Eleutherodactylus modestus         | 1, 2                 | VU          | Pr        | H   | (16)                | 1935                 | USNM 139729      |
| Eleutherodactylus nitidus          | 2, 3                 | LC          | NL        | M   | (12)                | 1956                 | UMMZ 114311      |
| Eleutherodactylus rufescens        | 1, 2                 | CR          | Pr        | H   | (17)                | 1963                 | USNM 161162      |
| Family Hylidae                    |                      |             |           |     |                     |                      |                  |
| Dendrophorus sartori (1951)        | 2, 3                 | LC          | A         | H   | (14)                | 1960                 | MVZ 71221        |
| Dryophytes arenicolor              | 2, 3                 | LC          | NL        | L   | (7)                 | 1973                 | UTEP H-10258     |
| Scientific name                                                 | IUCN status | SEMARNAT | EVS | Global distribution | Year of first record | Source       |
|----------------------------------------------------------------|-------------|-----------|-----|----------------------|----------------------|--------------|
| Dryophytes eximius (Baird, 1854)                                | 1, 2        | LC        | NL  | M (10)               | 1975                 | UTEP H-10387|
| Eremodontia nanagahina (Taylor, 1940)                           | 2           | LC        | Pr  | M (12)               | 1953                 | UMMZ 110873 |
| Eremodontia sumichrasti Brocchi, 1879                           | 1           | LC        | NL  | L (9)                | 1                    | NA USNM 57518|
| Smilisca baudini (Duméril & Bibron, 1841)                       | 1, 2, 3     | LC        | NL  | L (3)                | 1902                 | USNM 57555  |
| Smilisca fodiens (Boulenger, 1882)                              | 1           | LC        | NL  | L (8)                | 2                    | 1919 MCZ A-6683|
| Taliscobyla smithii (Boulenger, 1902)                           | 1, 2, 3     | LC        | NL  | M (11)               | 1                    | 1960 MVZ 71216|
| Trachycephalus vermiculatus (Cope, 1877)                        | 1, 2        | NE        | NL  | L (4)                | 3                    | 1935 UMMZ 80018|
| Tripion spatulatus Günther, 1882                                | 1, 2, 3     | LC        | NL  | M (13)               | 1                    | 1958 UAZ 12869|
| **Family Leptodactylidae (2)**                                  |             |           |     |                      |                      |              |
| Leptodactylus fragilis (Brocchi, 1877)                          | 1, 2        | LC        | NL  | L (5)                | 4                    | 1958 UTEP H-14352|
| Leptodactylus melanoponotus (Hallowell, 1861)                   | 1, 2, 3     | LC        | NL  | L (6)                | 3                    | 1902 USNM 57765|
| **Family Microhylidae (2)**                                     |             |           |     |                      |                      |              |
| Hypopachus uitus (Cope, 1866)                                   | 1, 2        | LC        | Pr  | L (7)                | 3                    | 1935 UMMZ 79998|
| Hypopachus variolosus (Cope, 1866)                             | 1, 2        | LC        | NL  | L (4)                | 3                    | 1935 USNM 118658|
| **Family Phyllomedusidae (1)**                                  |             |           |     |                      |                      |              |
| Agalychnis daunicolor (Cope, 1864)                              | 1, 2        | LC        | NL  | M (13)               | 1                    | 1963 FSM-UF 109279|
| **Family Ranidae (6)**                                          |             |           |     |                      |                      |              |
| Rana berlandieri Baird, 1859                                    | 2           | LC        | Pr  | L(7)                 | 2                    | 1919 FMNH 1628|
| Rana catesbeiana Shaw, 1802                                     | N/A         | N/A       | N/A | N/A                  | IN                   | 2018 https://www. youtube.com |
| Rana forreri Boulenger, 1883                                    | 1, 2        | LC        | Pr  | L (3)                | 4                    | 1964 CAS 97107|
| Rana neovolcanica Hillis & Frost, 1985                          | 1           | NT        | A   | M (13)               | 1                    | 2016 Cruz-Saenz et al. (2018) |
| Rana pustulosa Boulenger, 1883                                  | 1, 2        | LC        | Pr  | L (3)                | 1                    | 1700 MCZ A-20941|
| Rana zweifeli Hillis, Frost & Webb, 1984                        | 1           | LC        | NL  | M (11)               | 1                    | 1982 MNHUK 194432|
| **Family Scaphiopodidae (1)**                                   |             |           |     |                      |                      |              |
| Spea multiplicata (Cope, 1863)                                  | 1           | LC        | NL  | L (6)                | 2                    | 1960 TNHC 19343|
| **Order Caudata (2)**                                           |             |           |     |                      |                      |              |
| **Family Ambystomatidae (1)**                                   |             |           |     |                      |                      |              |
| Ambystoma velasci Dugès, 1888                                   | 1, 2        | LC        | Pr  | M (10)               | 1                    | 1868 MNHN RA 1868.175|
| **Family Plethodontidae (1)**                                   |             |           |     |                      |                      |              |
| Isthmura belli (Gray, 1838)                                     | 2           | VU        | A   | M (12)               | 1                    | 1970 MCZ A-85395|
| **Order Gymnophiona (1)**                                       |             |           |     |                      |                      |              |
| **Family Caecilidae (1)**                                       |             |           |     |                      |                      |              |
| Dermophis oaxacae (Mertens, 1930)                               | 1, 2        | DD        | Pr  | M (12)               | 1                    | 1970 FSM-UF 61604|
| **Class Reptilia (112)**                                        |             |           |     |                      |                      |              |
| **Order Crocodylia (1)**                                        |             |           |     |                      |                      |              |
| Crocodylus acutus (Cuvier, 1807)                                | 1, 2        | VU        | Pr  | H (14)               | 4                    | 1892 USNM 52336|
| **Order Squamata (107)**                                        |             |           |     |                      |                      |              |
| **Suborder Lacertilia (41)**                                    |             |           |     |                      |                      |              |
| **Family Anguidae (3)**                                         |             |           |     |                      |                      |              |
| Barisia imbricata (Wiegmann, 1828)                               | 2           | LC        | Pr  | H (14)               | 1                    | 1965 UAZ 32849|
| Egeria kingii Gray, 1838                                       | 2           | LC        | Pr  | M (10)               | 2                    | 1993 MZFC 6811|
| Gerrhonotus linecephalus Wiegmann, 1828                        | 1, 2        | LC        | Pr  | L (6)                | 1                    | 1868 MNHN RA 1868.153|
| Family Corytophanidae (2) | Physiographic region | IUCN status | SEMARNAT | EVS | Global distribution | Year of first record | Source |
|--------------------------|----------------------|-------------|----------|-----|---------------------|---------------------|--------|
| Basiliscus vittatus Wiegmann, 1828 | 2 | LC | NL | L (7) | 3 | 1935 | UMMZ 80147 |
| Laemansatus longipes Wiegmann, 1834 | 2 | LC | Pr | L (9) | 3 | 1904 | FMNH 1353 |

| Family Dactyloidae (1) | | | | | | | |
|------------------------|-------------|----------------------|----------|-----|---------------------|---------------------|--------|
| Anolis nebulosus (Wiegmann, 1834) | 1, 2, 3 | LC | NL | M (13) | 1 | 1863 | USNM 63700 |

| Family Eublepharidae (1) | | | | | | | |
|-------------------------|-------------|----------------------|----------|-----|---------------------|---------------------|--------|
| Coleonyx elegans Gray, 1845 | 2, 3 | LC | A | L (9) | 3 | 1960 | MNHUK 62400 |

| Family Gekkonidae (2) | | | | | | | |
|-----------------------|-------------|----------------------|----------|-----|---------------------|---------------------|--------|
| Gehyra mutilata (Wiegmann, 1834) | 1, 2, 3 | N/A | N/A | N/A | IN | 1976 | AMNH R-163687 |

| Family Helodermatidae (1) | | | | | | | |
|--------------------------|-------------|----------------------|----------|-----|---------------------|---------------------|--------|
| Helodermus horridus Wiegmann, 1834 | 1, 2, 3 | LC | NL | M (11) | 3 | 1818 | MVZ 79417 |

| Family Iguanidae (2) | | | | | | | |
|----------------------|-------------|----------------------|----------|-----|---------------------|---------------------|--------|
| Ctenosaura pectinata (Wiegmann, 1834) | 1, 2, 3 | NE | NL | H (15) | 1 | 1863 | MCZ R-24902 |

| Family Phrynosomatidae (14) | | | | | | | |
|-----------------------------|-------------|----------------------|----------|-----|---------------------|---------------------|--------|
| Phrynosoma asio Cope, 1864 | 1, 2 | LC | Pr | M (11) | 1 | 1935 | UMMZ 80067 |
| Phrynosoma orbiculare (Linnaeus, 1758) | 1 | LC | A | M (12) | 1 | 1870 | Duméril and Bocourt (1870) |
| Sceloporus bulleri Boulenger, 1895 | 2 | LC | NL | H (15) | 1 | 2004 | Reyes-Velasco et al. (2009) |
| Sceloporus dugesi Bocourt, 1874 | 1, 2 | LC | NL | M (13) | 1 | 1969 | ASNHC 13801 |
| Sceloporus horridus Wiegmann, 1834 | 1, 2, 3 | LC | NL | M (12) | 1 | 1863 | USNM 31389 |
| Sceloporus melanorhinus Bocourt, 1876 | 1, 2 | LC | NL | L (9) | 3 | 1863 | USNM 31496 |
| Sceloporus nelsoni Cochran, 1923 | 2 | LC | NL | M (13) | 1 | 1964 | LACM 74288 |
| Sceloporus pyrocephalus Cope, 1864 | 1, 2, 3 | LC | NL | M (12) | 1 | 1863 | USNM 31449 |
| Urosaurus auriculatus (Cope, 1871) | 5 | EN | NL | H (16) | 0 | 1871 | Cope (1871) |
| Urosaurus clarionensis (Duméril, 1856) | 1, 2, 3 | LC | NL | M (12) | 1 | 1919 | CAS 54904 |

| Family Phylodactylidae (3) | | | | | | | |
|-----------------------------|-------------|----------------------|----------|-----|---------------------|---------------------|--------|
| Phylodactylus davis Dixon, 1964 | 1, 2 | LC | A | H (16) | 1 | 1930 | MVZ 12186 |
| Phylodactylus lanai Smith, 1935 | 1, 2 | LC | NL | H (15) | 1 | 1937 | Oliver (1937) |

| Family Scincidae (5) | | | | | | | |
|-----------------------|-------------|----------------------|----------|-----|---------------------|---------------------|--------|
| Marisia brachyops (Taylor, 1956) | 1, 2, 3 | LC | NL | L (6) | 3 | 1962 | LACM 5987 |

| Family Teiidae (6) | | | | | | | |
|--------------------|-------------|----------------------|----------|-----|---------------------|---------------------|--------|
| Apidoscelis communis (Cope, 1878) | 1, 2, 3 | LC | Pr | H (14) | 1 | 1920 | LACM 7956 |
| Family | Genera |
|--------|--------|
| HERPETOFAUNA OF COLIMA | 111 |
| Physiographic region | IUCN status | SEMARNAT | EVS | Global distribution | Year of first record | Source |
| **Aspidoscelis costatus** (Cope, 1878) | 1, 2 | LC | Pr | M (11) | 1 | 1863 | USNM 31610 |
| **Aspidoscelis deppii** (Wiegmann, 1834) | 1, 2 | LC | NL | L (8) | 3 | 1959 | UAZ 06297 |
| **Aspidoscelis guttatus** (Wiegmann, 1834) | 2 | LC | NL | M (12) | 1 | 1969 | ASINHC 13965 |
| **Aspidoscelis lineattissimus** (Cope, 1878) | 1, 2, 3 | LC | Pr | H (14) | 1 | 1957 | UCM 14659 |
| **Holcus sinister** (Wiegmann, 1834) | 1, 2, 3 | NE | NL | M (13) | 1 | 1920 | LACM 7956 |
| **Family Xantusiidae (1)** | | | | | | |
| **Lepidophyma tarascae** Bezy, Webb & Alvarez, 1982 | 3 | DD | A | H (14) | 1 | 2005 | Reyes-Velasco et al. (2009) |
| **Suborder Serpentes (66)** | | | | | | |
| **Family Boidae (1)** | | | | | | |
| **Boa sigma** Smith, 1943 | 1, 2 | NE | NL | H (15) | 1 | 1863 | USNM 62024 |
| **Family Colubridae (23)** | | | | | | |
| **Conopsis biurialis** (Taylor & Smith, 1942) | 2 | LC | A | M (13) | 1 | 2004 | Reyes-Velasco et al. (2009) |
| **Drymarchon melanurus** (Duméril, Bibron & Duméril, 1854) | 1, 2 | LC | NL | L (6) | 3 | 1902 | CM S7254 |
| **Drymobius margaritifera** (Schlegel, 1837) | 1, 2 | LC | NL | L (6) | 3 | 1902 | CM S7252 |
| **Geogras redimitus** Cope, 1875 | 2 | DD | Pr | H (14) | 1 | 1962 | MVZ 75805 |
| **Lampropeltis palafoxia** Cope, 1860 | 1 | LC | NL | L (7) | 1 | 1863 | MCZ R-27105 |
| **Leptophis diplotropis** (Günther, 1872) | 2 | LC | A | H (14) | 1 | 1962 | MVZ 75804 |
| **Masticophis anthonyi** (Stejneger, 1901) | 5 | CR | A | H (17) | 0 | 1901 | Stejneger (1901) |
| **Masticophis bilineatus** (Jan, 1863) | 1, 2 | LC | NL | M (11) | 2 | 1914 | MCZ R-11409 |
| **Masticophis mengdeni** (Duméril, Bibron & Duméril, 1854) | 1, 2 | LC | A | L (6) | 3 | 1863 | USNM 32324 |
| **Mastigodryas melanomus** (Cope, 1868) | 1, 2 | LC | NL | L (6) | 3 | 1902 | USNM 56283 |
| **Oxybelis aeneus** (Wagler, 1824) | 2 | LC | NL | L (5) | 4 | 1892 | USNM 46606 |
| **Pituophis deppei** (Dumeril, 1853) | 1 | LC | A | H (14) | 1 | 1868 | MNHN RA 1868.157 |
| **Pseudoficimia frontalis** (Cope, 1864) | 1, 2, 3 | LC | NL | M (13) | 1 | 1956 | UMMZ, 114482 |
| **Salvadora lemnicata** (Cope, 1895) | 2 | LC | Pr | H (15) | 1 | 1971 | CAS 132121 |
| **Salvadora mexicana** (Duméril, Bibron & Duméril, 1854) | 1, 2, 3 | LC | Pr | H (15) | 1 | 1863 | USNM 61969 |
| **Sonora microcanenini** (Dugès, 1884) | 2 | LC | NL | H (14) | 1 | 1966 | Harris and Simmons (1970) |
| **Symphimus leucostomus** Cope, 1869 | 3 | LC | Pr | H (14) | 1 | 2004 | Reyes-Velasco et al. (2009) |
| **Tanilla bocourti** (Günther, 1895) | 3 | LC | NL | L (9) | 1 | 1960 | MVZ 72202 |
| **Tanilla calamaria** Cope, 1866 | 1, 2 | LC | Pr | M (12) | 1 | 1935 | UMMZ 80224 |
| **Tanilla ceboruca** Canseco-Marquéz, Smith, Ponce-Campos, Flores-Villela & Campbell, 2007 | 1 | NE | NL | H (16) | 1 | 2004 | Reyes-Velasco et al. (2012) |
| **Trimorphodon bicutatus** (Duméril, Bibron & Duméril, 1854) | 1, 2, 3 | NE | NL | L (7) | 3 | 1818 | MVZ 72194 |
| **Trimorphodon tau** Cope, 1869 | 1, 2 | LC | NL | M (13) | 1 | 1956 | UMMZ 114479 |
| **Family Dipsadidae (21)** | | | | | | |
| **Clelia scytalina** (Cope, 1867) | 1, 2 | LC | NL | M (13) | 3 | 1963 | MVZ 76355 |
| **Coniophanes lateritius** Cope, 1862 | 2 | DD | NL | M (13) | 1 | 2005 | Reyes-Velasco et al. (2009) |
| **Conophis vittatus** Peters, 1860 | 1, 2 | LC | NL | M (11) | 1 | 1961 | FSM-UF 42088 |
| Species                              | Physiographic region | IUCN status | SEMARNAT | EVS | Global distribution | Year of first record | Source                        |
|--------------------------------------|----------------------|-------------|-----------|-----|---------------------|----------------------|------------------------------|
| *Dipsas gaigeae* (Oliver, 1937)       | 2                    | LC          | Pr        | H (17) | 1                   | 1935                 | UMMZ 80221                   |
| *Enudius flavitorques* (Cope, 1868)  | 2                    | LC          | NL        | L (5)  | 3                   | 1959                 | UAZ 20369                    |
| *Geophis dugest* Boulanger, 1883      | 1                    | LC          | NL        | M (13) | 1                   | 1914                 | MCZ R-11422                  |
| *Geophis sieboldii* (Jan, 1862)      | 1                    | DD          | Pr        | M (13) | 1                   | 2012                 | Ahumada-Carrillo et al. (2014) |
| *Hypsiglena torquata* Günther, 1860  | 1, 2                 | LC          | Pr        | L (8)  | 1                   | 1968                 | MNHN RA 1868.162            |
| *Hypsiglena unauocularis* Tanner, 1946 | 5                  | NE          | NL        | NE    | 0                   | 1946                 | Tanner (1946)                |
| *Imantodes gemmistratus* (Cope, 1861) | 1, 2                 | LC          | Pr        | L (6)  | 3                   | 1935                 | UMMZ 80215                   |
| *Leptodeira maculata* (Hallowell, 1861) | 1, 2               | LC          | Pr        | L (7)  | 1                   | 1863                 | USNM 31486                   |
| *Leptodeira septentrionalis* (Kennicott, 1859) | 2            | LC          | NL        | L (8)  | 4                   | 1935                 | UMMZ Herps 80220             |
| *Leptodeira splendida* Günther, 1895 | 1, 2                 | LC          | NL        | H (14) | 1                   | 1914                 | MCZ R-11411                  |
| *Leptodeira uribelii* (Ramirez-Bautista & Smith, 1992) | 2        | LC          | NL        | H (17) | 1                   | 2004                 | Reyes-Velasco et al. (2009)  |
| *Manolepis putnami* (Jan, 1863)      | 2                    | LC          | NL        | M (13) | 1                   | 1863                 | USNM 31478                   |
| *Pseudoleptodeira latifasciata* (Günther, 1894) | 3        | LC          | Pr        | H (14) | 1                   | 1961                 | MNHUK 32546                  |
| *Rhadinaea hesperia* Bailey, 1940    | 2                    | LC          | Pr        | M (10) | 1                   | 1935                 | UMMZ 80226                   |
| *Rhadinaea taeniata* (Peters, 1863)  | 1, 2                 | LC          | NL        | M (13) | 1                   | 1969                 | CAS 121078                   |
| *Sibon nebulatus* (Linnaeus, 1758)   | 1, 3                 | NE          | NL        | L (5)  | 3                   | 1960                 | USNM 196500                  |
| *Tropidodipsas annulifera* Boulenger, 1894 | 1, 3      | LC          | Pr        | M (13) | 1                   | 2004                 | Reyes-Velasco et al. (2009)  |
| *Tropidodipsas philippii* (Jan, 1863) | 1, 2               | LC          | Pr        | H (14) | 1                   | 1914                 | MCZ R-11410                  |
| **Family Elapidae** (6)              |                      |             |           |       |                     |                      |                              |
| *Hydrophis platurus* (Linnaeus, 1766) | 4                    | LC          | NL        | NE    | 6                   | 1956                 | UMMZ 114561                  |
| *Micrurus browni* Schmidt & Smith, 1943 | 2                  | LC          | Pr        | L (8)  | 3                   | 1976                 | NLU 40764                    |
| *Micrurus distans* Kennicott, 1860   | 1, 2                 | LC          | Pr        | H (14) | 1                   | 1914                 | MCZ R-11416                  |
| *Micrurus laticollaris* Peters, 1870 | 1, 2, 3              | LC          | Pr        | H (14) | 1                   | 1951                 | MNHUK 32546                  |
| *Micrurus proximus* Smith & Chraplwy, 1958 | 2             | LC          | Pr        | H (18) | 1                   | 2008                 | Reyes-Velasco et al. (2012)  |
| *Micrurus tener* Baird & Girard, 1953 | 1                    | LC          | NL        | M (11) | 2                   | 2004                 | Reyes-Velasco et al. (2009)  |
| **Family Leptotyphlopidae** (2)      |                      |             |           |       |                     |                      |                              |
| *Epictia bakewelli* (Oliver, 1937)   | 1, 2                 | NE          | NL        | NE    | 1                   | 1935                 | UMMZ 80228                   |
| *Rena dugesi* Boulanger, 1881        | 2                    | NE          | NL        | NE    | 2                   | 1868                 | MNHN RA 1868.154            |
| **Family Loxocemidae** (1)           |                      |             |           |       |                     |                      |                              |
| *Loxocemus bicolor* Cope, 1861       | 1, 2                 | LC          | Pr        | M (10) | 3                   | 1863                 | USNM 61924                   |
| **Family Natricidae** (4)            |                      |             |           |       |                     |                      |                              |
| *Storeria storerioides* (Cope, 1866) | 2                    | LC          | NL        | M (11) | 1                   | 2004                 | Reyes-Velasco et al. (2009)  |
| *Thamnophis cyrtostoma* (Kennicott, 1860) | 1               | LC          | A         | L (7)  | 4                   | 1964                 | LSMUZ 7846                   |
| *Thamnophis melanogaster* (Wiegmann, 1830) | 1               | EN          | A         | H (15) | 1                   | 1868                 | MNHN RA 1868.161            |
| *Thamnophis validus* (Kennicott, 1860) | 2               | NE          | NL        | M (12) | 1                   | 1961                 | MNHUK 63428                  |
| **Family Viperidae** (6)             |                      |             |           |       |                     |                      |                              |
| *Agrastus bilineatus* Günther, 1863  | 1, 2                 | NT          | Pr        | M (11) | 3                   | 1928                 | UMMZ 68433                   |
| *Crotalus basiliscus* (Cope, 1864)   | 1, 2                 | LC          | Pr        | H (16) | 1                   | 1864                 | Cope (1864)                  |
| *Crotalus campbellii* Bryson, Linkem, Dorecas, Lathrop, Jones, Alzarado-Díaz, Grünwald & Murphy, 2014 | 2            | NE          | NL        | H (17) | 1                   | 2004                 | Reyes-Velasco et al. (2009)  |
Colima, near the border with the states of Jalisco and Michoacán. We are confident that with more samples in these areas with low accessibility they will be recorded in Colima, resulting in a much richer herpetological species list. This conclusion of a richer herpetofauna in Colima than currently documented is supported by the species accumulation curves we generated (Fig. 6). The species accumulation curves show a general and continuous increase in the number of species known in Colima during the first half of the 20th century followed by a plateau in the second half of the 20th century; however, there has been a rapid upturn in new species being documented in the 21st century, suggesting the total number of amphibians and reptiles in Colima is likely to be higher, perhaps substantially, than the 153 species we document here. These results make it clear that continued exploration and surveying of the amphibians and reptiles of Colima are needed to establish a firm understanding of their richness in the state.

### General distribution

Twenty-six of the 39 species of amphibians that inhabit Colima are endemic to Mexico (Table 1). One to northern Colima near the state line with Jalisco at the Sierra de Manantlán (Eleutherodactylus manatlanensis). Seven are restricted to small areas in northern, eastern, or southern Colima and adjacent Jalisco or Michoacán, or both. Twelve are species typical of the Mexican Pacific, extending from northwestern Mexico (Chihuahua, Sonora or Sinaloa) to the Balsas Depression or even Oaxaca or Chiapas. Four have a wide distribution in northern and central Mexico, and two occur along
Table 2. Summary of native species present in Colima by Family, Order or Suborder, and Class. Status summary indicates the number of species found in each IUCN conservation status in the Order DD, LC, VU, NT, EN, CE (see Table 1 for abbreviations; in some cases species have not been assigned a status by the IUCN and therefore these may not add up to the total number of species in a taxon). Mean EVS is the mean Environmental Vulnerability Score, scores ≥ 14 are considered high vulnerability (Wilson et al. 2013a, b) and conservation status in Mexico according to SEMARNAT (2010) in the Order NL, Pr, A, P (see Table 1 for abbreviations).

| Class Amphibia | Scientific name | Genera | Species | IUCN | mean EVS | SEMARNAT |
|----------------|-----------------|--------|---------|------|---------|----------|
| Order Anura    | Bufonidae       | 3      | 5       | 0, 4, 0, 0, 0, 0 | 12 | 5, 0, 0, 0 |
|                | Craugastoridae  | 1      | 2       | 1, 1, 0, 0, 0, 0 | 13 | 2, 0, 0, 0 |
|                | Eleutherodactylidae | 1    | 7       | 0, 1, 2, 0, 0, 0 | 15.5 | 4, 3, 0, 0 |
|                | Hylidae         | 7      | 10      | 0, 9, 0, 0, 0, 0 | 9.1 | 8, 1, 1, 0 |
|                | Leptodactylidae | 1      | 2       | 0, 2, 0, 0, 0, 0 | 5.5 | 2, 0, 0, 0 |
|                | Microhylidae    | 1      | 2       | 0, 2, 0, 0, 0, 0 | 5.5 | 1, 1, 0, 0 |
|                | Phyllomedusidae | 1      | 1       | 0, 1, 0, 0, 0, 0 | 13 | 1, 0, 0, 0 |
|                | Ranidae         | 1      | 5       | 0, 4, 0, 1, 0, 0 | 7.4 | 1, 3, 1, 0 |
|                | Scaphiopodidae  | 1      | 1       | 0, 1, 0, 0, 0, 0 | 6 | 1, 0, 0, 0 |
| Order Caudata  | Ambystomatidae  | 1      | 1       | 0, 1, 0, 0, 0, 0 | 10 | 1, 0, 0, 0 |
|                | Plethodontidae  | 1      | 1       | 0, 0, 1, 0, 0, 0 | 12 | 0, 1, 0, 0 |
| Order Gymnophiona |              | 1      | 1       | 1, 0, 0, 0, 0, 0 | 12 | 0, 1, 0, 0 |
| Order Squamata | Cacilidae       | 1      | 1       | 1, 0, 0, 0, 0, 0 | 12 | 0, 1, 0, 0 |
| Subtotal       |                | 20     | 38      | 2, 26, 3, 1, 0, 1 | 10.0 | 25, 10, 3, 0 |
| Class Reptilia | Order Crocodylia | 1      | 1       | 0, 0, 1, 0, 0, 0 | 14 | 0, 1, 0, 0 |
|                | Crocodylidae    | 1      | 1       | 0, 0, 1, 0, 0, 0 | 14 | 0, 1, 0, 0 |
| Order Squamata | 62              | 103    | 8, 77, 1, 1, 3, 1 | 12 | 57, 32, 14, 0 |
| Suborder Lacertilia | 20          | 39      | 3, 30, 1, 0, 1, 0 | 12.1 | 24, 10, 5, 0 |
| Anguidae       | 3               | 3       | 0, 3, 0, 0, 0, 0 | 10 | 0, 3, 0, 0 |
| Corytophanidae | 2               | 2       | 0, 2, 0, 0, 0, 0 | 8 | 1, 1, 0, 0 |
| Dactyloidae    | 1               | 1       | 0, 1, 0, 0, 0, 0 | 13 | 1, 0, 0, 0 |
| Eublepharidae  | 1               | 1       | 0, 1, 0, 0, 0, 0 | 9 | 0, 0, 1, 0 |
| Helodermatidae | 1               | 1       | 0, 1, 0, 0, 0, 0 | 11 | 0, 0, 1, 0 |
| Iguanidae      | 2               | 2       | 0, 1, 0, 0, 0, 0 | 13.5 | 1, 1, 0, 0 |
| Phrynosomatidae| 3               | 14      | 0, 11, 1, 0, 1, 0 | 13.1 | 12, 1, 1, 0 |
| Phyllodactylidae| 1               | 3       | 0, 3, 0, 0, 0, 0 | 13 | 2, 0, 1, 0 |
| Scincidae      | 3               | 5       | 2, 2, 0, 0, 0, 0 | 11.4 | 4, 1, 0, 0 |
| Teiidae        | 2               | 6       | 0, 5, 0, 0, 0, 0 | 12 | 3, 3, 0, 0 |
| Xantusidae     | 1               | 1       | 1, 0, 0, 0, 0, 0 | 14 | 0, 0, 1, 0 |
| Suborder Serpentes | 42         | 64      | 5, 47, 0, 1, 2, 1 | 11.9 | 33, 22, 9, 0 |
| Boidae         | 1               | 1       | 0, 0, 0, 0, 0, 0 | 15 | 1, 0, 0, 0 |
| Colubridae     | 17              | 23      | 1, 19, 0, 0, 0, 1 | 11 | 13, 5, 5, 0 |
| Dipsadidae     | 14              | 21      | 2, 18, 0, 0, 0, 0 | 11.4 | 12, 9, 0, 0 |
| Elapidae       | 2               | 6       | 0, 6, 0, 0, 0, 0 | 13 | 2, 4, 0, 0 |
| Leptotyphlopidae| 2               | 2       | 0, 0, 0, 0, 0, 0 | NE | 2, 0, 0, 0 |
| Loxocemidae    | 1               | 1       | 0, 1, 0, 0, 0, 0 | 10 | 0, 1, 0, 0 |
| Natricidae     | 2               | 4       | 0, 2, 0, 0, 1, 0 | 11.3 | 2, 0, 2, 0 |
| Viperidae      | 3               | 6       | 2, 1, 0, 1, 1, 0 | 16.5 | 1, 3, 2, 0 |
| Order Testudines| 6               | 8       | 0, 2, 3, 1, 1, 0 | 12.3 | 2, 2, 0, 4 |
| Cheloniidae    | 3               | 3       | 0, 0, 0, 2, 0, 1, 0 | NE | 0, 0, 0, 3 |
| Dermochelyidae | 1               | 1       | 0, 0, 1, 0, 0, 0 | NE | 0, 0, 0, 1 |
| Geoemydidae    | 1               | 2       | 0, 0, 0, 1, 0, 0 | 11 | 1, 1, 0, 0 |
| Kinosternidae  | 1               | 2       | 0, 2, 0, 0, 0, 0 | 13.5 | 1, 1, 0, 0 |
| Subtotal       | 69              | 112     | 8, 79, 5, 2, 4, 1 | 12 | 59, 35, 14, 4 |
| Total          | 89              | 150     | 10, 105, 8, 3, 4, 2 | 11.5 | 84, 45, 17, 4 |
Table 3. List of amphibians and reptiles that potentially occur in Colima.

| Taxon | Explanation |
|-------|-------------|
| **Class Amphibia** | |
| **Order Anura** | |
| *Bufonidae* | |
| *Incilius perplexus* (Taylor, 1943) | Likely to occur in eastern Colima |
| *Craugastoridae* | |
| *Craugastor augusti* (Dugès, 1879) | Likely to occur in extreme western Colima |
| *Craugastor hobartsmithi* (Taylor, 1937) | Likely to occur in extreme western Colima |
| *Craugastor pygmaeus* (Taylor, 1937) | Likely to occur in northwestern and southern Colima |
| *Hylidae* | |
| *Sarcohyla bistincta* (Cope, 1877) | Likely to occur through the state but the coastal area |
| *Ranidae* | |
| *Rana megapoda* Taylor, 1942 | Likely to occur in northeastern Colima, in the Volcanes de Colima physiographic region |
| *Rana psilonota* Webb, 2001 | Likely to occur in northeastern Colima, in the Volcanes de Colima physiographic region |
| **Order Caudata** | |
| *Plethodontidae* | |
| *Pseudoeurycea leprosa* (Cope, 1869) | Likely to occur in southern Colima |
| **Class Reptilia** | |
| **Order Squamata** | |
| **Suborder Lacertilia** | |
| *Phrynosomatidae* | |
| *Sceloporus grammicus* Wiegmann, 1828 | Likely to occur in northeastern Colima, in the Volcanes de Colima physiographic region |
| *Sceloporus heterolepis* Boulenger, 1895 | Likely to occur in northeastern Colima, in the Volcanes de Colima physiographic region |
| **Order Squamata** | |
| **Suborder Serpentes** | |
| **Colubridae** | |
| *Salvadora bairdi* Jan, 1860 | Likely to occur in northeastern Colima, in the Volcanes de Colima physiographic region |
| *Sonora mutabilis* Stickel, 1943 | Likely to occur in northeastern-eastern Colima |
| **Dipsadidae** | |
| *Geophis bicolor* Günther, 1868 | Likely to occur in northeastern Colima, in the Volcanes de Colima physiographic region |
| *Geophis nigrocinctus* Duellman, 1959 | Likely to occur in northern Colima |
| *Geophis peteri* Boulenger, 1894 | Likely to occur in northern Colima |
| *Geophis tarascae* Hartweg, 1959 | Likely to occur in northeastern Colima, in the Volcanes de Colima physiographic region |
| **Viperidae** | |
| *Crotalus armstrongi* (Campbell, 1979) | Likely to occur in northeastern Colima, in the Volcanes de Colima physiographic region |
| *Crotalus culminatus* Klauber, 1952 | Likely to occur in southern Colima, near the border with Coahuayana, Michoacán |
| *Crotalus polystictus* (Cope, 1865) | Likely to occur in northeastern Colima, in the Volcanes de Colima physiographic region |
| **Order Testudines** | |
| **Cheloniidae** | |
| *Eretmochelys imbricata* (Linnaeus, 1766) | Likely to occur in the coastline of the state |

both coasts of Mexico. Of the 14 species not endemic to Mexico, four are distributed from the US to central or southern Mexico, four are distributed from the US to Central or South America, four are found in Mexico and Central or South America, and one is an introduced species, the American Bullfrog (*Rana catesbeiana*).
Figure 6. Species accumulation curves for total herpetofauna, amphibians, and reptiles of Colima, Mexico.

The American Crocodile (*Crocodylus acutus*) is widely distributed from the eastern US to South America, including the Caribbean. Two of the 41 species of lizards that occur in Colima are endemic to islands of the Revillagigedo Archipelago (*Urosaurus auriculatus* on Socorro Island and *U. clarionensis* on Clarion Island), and 24 are endemic to Mexico (Table 1). Of the 15 lizard species not endemic to Mexico that inhabit Colima, two are introduced, one is found in the US and Mexico, one is found from the US to Central America, and 11 have a wide distribution that includes Mexico and Central or South America (Table 1). Two of the 64 species of snakes found in Colima are endemic to Isla Clarion in the Revillagigedo Archipelago (*Masticophis anthonyi* and *Hypsiglena unaocularis*) (Table 1). Forty-two of the snake species found in Colima are endemic to Mexico. Of the 22 snake species not endemic to Mexico that occur in Colima, three are distributed from the US to Mexico, four from the US to Central or South America, 12 from Mexico to Central or South America, and one marine species is distributed in the Pacific and Indian Oceans (Table 1). Three of the eight species of turtles found in Colima are endemic to Mexico (Table 1). One is distributed from Mexico to Central America, and four are sea turtles that have a circumglobal distribution (Table 1).

**Conservation status**

Of the amphibians and reptiles found in Colima, 12.9% are IUCN listed (i.e., Vulnerable, Near Threatened, Endangered, or Critically Endangered), and 14.0% are placed
in a protected category by SEMARNAT (excluding NL and Pr, this last category is equivalent to the LC category of IUCN), and 34.1% are categorized as high risk by the EVS (Tables 1, 2). For amphibians, 15.2% are IUCN listed, 7.9% are protected by SEMARNAT, and 14.7% are at high risk according to the EVS (Fig. 7; Tables 1, 2). For reptiles, 12.1% are listed by the IUCN, 16.1% are protected by SEMARNAT, and 40.4% are at high risk according to the EVS (Fig. 7; Tables 1, 2). These results suggest that the herpetofauna as a whole of Colima is considered to be a relatively low conservation concern at a global scale (i.e., IUCN listing) and national level (i.e., SEMARNAT listing, EVS). However, the EVS categories suggest that, at a national level, the reptiles of Colima are at higher risk than the other assessments suggest and are at higher risk than the amphibians of Colima. In addition, there are several specific taxa that, based on their IUCN listing, SEMARNAT category, or their EVS, are of conservation concern. These include species in the families Eleutherodactylidae, Ranidae, Plethodontidae, Crocodylidae, Eublepharidae, Helodermatidae, Iguanidae, Phrynosomatidae, Phyllodactylidae, Xantusidae, Colubridae, Natricidae, Viperidae, Cheloniidae, and Dermochelyidae (Tables 1, 2). In particular, the family Eleutherodactylidae in Colima is of great conservation concern; this family has seven species, three of them are IUCN listed and are at great risk according to their EVS (*Eleutherodactylus angustidigitorum*, *E. modestus*, and *E. rufescens*). Another three have not been evaluated by the IUCN or EVS due to their recent description (*E. colimotl*, *E. grunwaldi*, and *E. manantlanensis*); however, due to their limited distribution it is almost certain that once they are evaluated, they will be considered in some category of the IUCN and with a high risk

**Figure 7.** Proportion of A amphibians and B reptiles listed in protected categories on the IUCN Red List, SEMARNAT, and high EVS. Green is proportion in Data Deficient and Least Concern (IUCN); Not Listed and Subject to Special Protection (we regarded the category of Subject to Special Protection in SEMARNAT equivalent to Least Concern in IUCN) (SEMARNAT); or low or medium EVS. Red is percentage in protected categories or high EVS. N is the number of species assessed.
EVS, therefore the family Eleutherodactylidae in Colima would be represented by six species (86% = 6/7) at high conservation risk. Because the summarized conservation statuses are global or national-level assessments, the conservation status of at least some species of amphibians and reptiles in Colima are probably not accurately assessed by these measures. Additional assessments at the state level will be required to establish conservation or management needs for the herpetofauna of Colima.

Using the data in Table 1, we summarized the conservation status of amphibian and reptile taxa in each physiographic region found in Colima. For IUCN listing, 13.8% of the amphibians in the Volcanes de Colima physiographic region are listed; 10.0% in the Sierras de la Costa de Jalisco y Colima; and none in the Cordillera Costera del Sur. For SEMARNAT categories, 3.4% of amphibian species in the Volcanes de Colima are listed; 6.7% in the Sierras de la Costa de Jalisco y Colima; and 9.1% in the Cordillera Costera del Sur. For EVS, 13.8% of the amphibians in the Volcanes de Colima in the high-risk category; 13.3% in the Sierras de la Costa de Jalisco y Colima, and 18.2% in the Cordillera Costera del Sur. For IUCN listings, relatively few species of reptiles are placed in the protected categories for most of the physiographic regions (Volcanes de Colima, 7.8%; Sierras de la Costa de Jalisco y Colima, 3.4%; Cordillera Costera del Sur, 0%). Reptiles in the Marine (80%) and Revillagigedo Archipelago (75%) regions show relatively high percentages of species in protected categories. Similar patterns hold for SEMARNAT listings with 12.5% of reptiles in the Volcanes de Colima, 8.0% from Sierras de la Costa de Jalisco y Colima, and 12.5% from the Cordillera Costera del Sur, 80% in the Marine region, and 25% in the Revillagigedo Archipelago region in the protected SEMARNAT categories. For the EVS assessments of reptile species, 31.3% were in the high category in Volcanes de Colima, 35.6% in the Sierras de la Costa de Jalisco y Colima, and 41.7% in the Cordillera Costera del Sur. None of the five species in the marine region were evaluated for EVS, and 75% of the species in the Revillagigedo Archipelago were in the high EVS category. Based on our summary of conservation status, the reptiles in the Marine and Revillagigedo Archipelago regions are the most threatened taxa of the Colima herpetofauna.

Comparison with neighboring states

For amphibians, Colima shares 92.1% of its species with Jalisco, and it shares 86.8% of its species with Michoacán (Table 4). Species in eight of the 12 families of amphibians present in Colima are fully shared with Jalisco and Michoacán. The percentage of shared reptile species is slightly smaller; however, overlap in species lists is still very high. Colima shares 84.8% of its reptile species with Jalisco, and 82.1% with Michoacán. Species in 13 of the 25 families of reptiles present in Colima are fully shared with Jalisco and Michoacán. Only ten of the species found in Colima (two amphibians and eight reptiles) do not occur in either Jalisco or Michoacán, four of which are species endemic to the Revillagigedo Archipelago (Urosaurus auriculatus, U. clarionensis, Masticophis anthonyi, and Hypsiglena unaocularis), one is endemic to northern Colima (Eleutherodactylus manantlanensis), three
Table 4. Summary of the numbers of species shared between Colima and neighboring Mexican states (not including introduced species). The percent of Colima species shared by a neighboring state are given in parentheses. Total refers to the total number of species found in Colima and two neighboring states (i.e., regional species pool) and the number in parentheses in this column is the percent of the regional species pool found in Colima. – indicates either Colima or the neighboring state has no species in the taxonomic group, thus no value for shared species is provided.

| Taxon               | Colima | Jalisco | Michoacán | Total  |
|---------------------|--------|---------|-----------|--------|
| Class Amphibia      | 38     | 35 (92.1) | 33 (86.8) | 73 (52.1) |
| Order Anura         | 35     | 32 (91.4) | 30 (85.7) | 61 (57.4) |
| Bufonidae           | 5      | 5 (100)  | 4 (80)    | 10 (50)  |
| Craugastoridae      | 2      | 2 (100)  | 2 (100)   | 5 (40)   |
| Eleutherodactylidae | 7      | 6 (85.7)  | 5 (71.4)  | 15 (46.6) |
| Hylidae             | 10     | 9 (90.0)  | 8 (80.0)  | 17 (76.9) |
| Leptodactylidae     | 2      | 2 (100)  | 2 (100)   | 4 (100)  |
| Microhylidae        | 2      | 2 (100)  | 2 (100)   | 4 (100)  |
| Phyllolemusidae     | 1      | 1 (100)  | 1 (100)   | 1 (100)  |
| Ranidae             | 5      | 4 (80)   | 5 (100)   | 11 (45.5) |
| Rhinophrynidae      | 0      | –        | 0 (0)     | 1 (0)    |
| Scaphiopodidae      | 1      | 1 (100)  | 1 (100)   | 1 (100)  |
| Order Caudata       | 2      | 2 (100)  | 2 (100)   | 11 (18.2) |
| Ambystomatidae      | 1      | 1 (100)  | 1 (100)   | 8 (12.5)  |
| Plethodontidae      | 1      | 1 (100)  | 1 (100)   | 3 (33.3)  |
| Order Gymnophiona   | 1      | 1 (100)  | 1 (100)   | 1 (100)  |
| Cacildae            | 1      | 1 (100)  | 1 (100)   | 1 (100)  |
| Class Reptilia      | 112    | 95 (84.8) | 92 (82.1) | 211 (53.1) |
| Order Crocodylia    | 1      | 1 (100)  | 1 (100)   | 1 (100)  |
| Crocodylidae        | 1      | 1 (100)  | 1 (100)   | 1 (100)  |
| Order Squamata      | 103    | 86 (83.5) | 85 (82.5) | 198 (52)  |
| Suborder Lacertilia | 39     | 30 (76.9) | 30 (76.9) | 77 (50.6) |
| Anguidae            | 3      | 5 (100)  | 3 (100)   | 7 (42.9)  |
| Corytophanidae      | 2      | 1 (50)   | 1 (50)    | 2 (100)  |
| Dactyloidae         | 1      | 1 (100)  | 1 (100)   | 2 (50)   |
| Eublepharidae       | 1      | 1 (100)  | 1 (100)   | 1 (100)  |
| Helodermatidae      | 1      | 1 (100)  | 1 (100)   | 1 (100)  |
| Iguanidae           | 2      | 2 (100)  | 2 (100)   | 3 (66.7)  |
| Phrynosomatidae     | 14     | 11 (78.6) | 9 (64.3)  | 34 (41.2) |
| Phyllodactylidae    | 3      | 1 (33.3)  | 2 (66.7)  | 6 (50)   |
| Scincidae           | 5      | 4 (80)    | 4 (80)    | 10 (50)  |
| Teiidae             | 6      | 5 (83.6)  | 5 (83.6)  | 9 (66.7)  |
| Xantusidae          | 1      | 0 (0)     | 1 (100)   | 2 (50)   |
| Suborder Serpentes  | 64     | 56 (87.5) | 55 (85.9) | 121 (52.9) |
| Boidae              | 1      | 1 (100)  | 1 (100)   | 1 (100)  |
| Colubridae          | 23     | 19 (82.6) | 19 (82.6) | 39 (59)  |
| Dipsadidae          | 21     | 20 (95.2) | 19 (90.5) | 41 (51.2) |
| Elapidae            | 6      | 5 (83.6)  | 4 (66.7)  | 7 (85.7)  |
| Leptotyphlopidae    | 2      | 1 (50)    | 2 (100)   | 4 (50)   |
| Loxocemidae         | 1      | 1 (100)  | 1 (100)   | 1 (100)  |
| Natricidae          | 4      | 4 (100)   | 4 (100)   | 12 (33.3) |
| Viperidae           | 6      | 5 (83.3)  | 5 (83.3)  | 16 (37.5) |
| Order Testudines    | 8      | 8 (100)   | 6 (75)    | 12 (66.7) |
| Cheloniidae         | 3      | 3 (100)   | 2 (66.7)  | 4 (75)   |
| Dermochelyidae      | 1      | 1 (100)  | 1 (100)   | 1 (100)  |
| Emydidae            | 0      | 0 (0)     | –         | 2 (0)    |
| Geoemydidae         | 2      | 2 (100)   | 2 (100)   | 2 (100)  |
| Kinosternidae       | 2      | 2 (100)   | 1 (50)    | 3 (66.7)  |
| **Total**           | 150    | 130 (86.7) | 125 (83.3) | 284 (52.8) |
have spotty distributions along the Pacific Coast of Mexico (*Phyllodactylus tuberculosus*) or in south-southeastern Mexico (*Laemanctus longipes* and *Aspidoscelis guttatus*), and two have isolated records in Colima, with the bulk of their distribution in southeastern Mexico (*Exerodonta sumichrasti* and *Salvadora lemniscata*). The high level of similarity in the herpetofauna between Colima and its two neighbors is due in part to the small size of Colima compared with each one of these two state (7.2% of Jalisco, 9.6% of the Michoacán). In addition, and perhaps more importantly, Colima is completely surrounded by Jalisco and Michoacán, and shares the same physiographic regions and habitat types with them.

**Conclusions**

Colima is home to a rich herpetofauna, especially relative to its small size, and is likely richer than currently known. Its herpetofauna contains a relatively high number of species that are endemic to Mexico, and thus is an important state for the Mexican herpetofauna. Based on IUCN and SEMARNAT listings, the conservation status of the amphibians and reptiles would appear to be relatively low, but the EVS assessments suggest this may not be a completely accurate impression. Of particular concern are the marine species and those species found in the Revillagigedo Archipelago. Colima shares the vast majority of its species with the neighboring states of Jalisco and Michoacán, suggesting that these three states may make a useful unit for understanding and creating conservation and management plans and strategies for their amphibians and reptiles.

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**Appendix 1**

Museum collections included in the CONABIO database examined for records of Colima amphibians and reptiles or that house specimens of the first record of a species in Colima.

**AMNH** Collection of Herpetology, Herpetology Department, American Museum of Natural History

**ASNHC** Amphibians and Reptiles Collection, Angelo State Natural History Collection
| Abbreviation | Institution Name |
|--------------|------------------|
| CAS          | Collection of Herpetology, Herpetology Department, California Academy of Sciences |
| CMNH         | Collection of Herpetology, Amphibian and Reptile Section, Carnegie Museum of Natural History, Pittsburgh |
| FMNH         | Division of Amphibians and Reptiles, Field Museum of Natural History |
| FSM-UF       | Collection of Herpetology, Florida State Museum, University of Florida |
| LACM         | Collection of Herpetology, Herpetology Section, Natural History Museum of Los Angeles County |
| LSUMZ        | Collection of Herpetology, Museum of Zoology, Biological Science Division, Louisiana State University |
| MCZ          | Collection of Herpetology, Museum of Comparative Zoology, Harvard University Cambridge |
| MNHN         | Collection of Reptiles and Amphibians, Muséum National D’Histoire Naturelle |
| MNHUK        | Museum of Natural History, Division of Herpetology, University of Kansas |
| MVZ          | Collection of Herpetology, Museum of Vertebrate Zoology, Division of Biological Sciences, University of California Berkeley |
| MZFC-UNAM    | Colección Herpetológica, Museo de Zoología “Alfonso L. Herrera”, Facultad de Ciencias UNAM |
| NLU          | Northeastern Louisiana University |
| TNHC         | Collection of Herpetology, Texas Natural History Collection, University of Texas Austin |
| UAZ          | Amphibians and Reptiles Collections, University of Arizona |
| UCM          | Collection of Herpetology, University of Colorado Museum |
| UMMZ         | Collection of Herpetology, Museum of Zoology, University of Michigan Ann Arbor |
| USNM         | Collection of Herpetology, Department of Vertebrate Zoology, National Museum of Natural History, Smithsonian Institution |
| UTEP         | Collection of Herpetology, Laboratory of Environmental Biology, Biological Science Department, University of Texas – El Paso |