Biota Neotropica 18(2): e20170444, 2018
www.scielo.br/bn

biotaneotropica
ISSN 1676-0611 (online edition)

Inventory

# Biological survey of a cloud forest in southwestern Mexico: plants, amphibians, reptiles, birds, and mammals

***R. Carlos Almazán-Núñez[1]*, Edson A. Alvarez-Alvarez[2], Fernando Ruiz-Gutiérrez[1],***

***Ángel Almazán-Juárez[3], Pablo Sierra-Morales[2] & Sarahi Toribio-Jiménez[1]***

*[1]Universidad Autónoma de Guerrero, Facultad de Ciencias Químico Biológicas, Laboratorio Integral de Fauna Silvestre, Av. Lázaro Cárdenas, 39090, Ciudad Universitaria, Chilpancingo, Guerrero, Mexico*
*[2]Universidad Autónoma de Guerrero, Facultad de Ecología Marina, Maestría en Recursos Naturales y Ecología, 39390, Acapulco, Guerrero, Mexico*
*[3]Universidad Autónoma de Guerrero, Instituto de Investigación Científica Área Ciencias Naturales, 39000, Chilpancingo, Guerrero, Mexico*
**Corresponding author: R. Carlos Almazán-Núñez, e-mail: rcarlos.almazan@gmail.com*

ALMAZÁN-NÚÑEZ, R. C., ALVAREZ-ALVAREZ, E. A., RUIZ-GUTIÉRREZ, F., ALMAZÁN-JUÁREZ, A., SIERRA-MORALES, P., TORIBIO-JIMÉNEZ, S. **Biological survey of a cloud forest in southwestern Mexico: plants, amphibians, reptiles, birds, and mammals**. Biota Neotropica. 18(2): e20170444. http://dx.doi.org/10.1590/1676-0611-BN-2017-0444

***Abstract:*** Cloud forest ecosystems contain unique flora and fauna characterized by high levels of richness and endemism. However, this ecosystem is one of the most threatened because of land-use changes stemming from anthropogenic activities. Therefore, biological inventories are necessary to adequately assess the effects of land-use changes on species now and in the future. In this study, we conducted an inventory of plants and terrestrial vertebrates (amphibians, reptiles, birds, and mammals) in three fragments of cloud forest in southwestern Mexico. Field work was carried out for 15 days per biological group during distinct time periods (2005-2008). Conventional methods of species capture and observation were employed to record species. Recorded species were then categorized based on their endemism and risk category. A total of 67 species of plants, 17 species of amphibians, 25 species of reptiles, 93 species of birds, and 46 species of mammals were recorded. The species accumulation curves for most taxa, except for birds and mammals, showed an asymptotic trend. A total of 56 species endemic to Mexico and four quasi-endemic species were recorded. Plants, amphibians, and reptiles presented the greatest number of species exclusive to Mexico (13 species). Six species of herpetofauna endemic to Guerrero were recorded. According to Mexican laws, 24 of the encountered species are under special protection, while 16 are categorized as threatened and seven as endangered. Reptiles and birds presented the greatest number of at-risk species (14 species). Bird and mammal richness in this study is high in comparison to that recorded in the cloud forests of the entire Mexican state of Guerrero (157 and 75 species, respectively). This data highlights the importance of cloud forests in the study area for local and regional biodiversity. Effective conservation strategies should be prioritized in cloud forests, as this ecosystem is poorly represented in natural protected areas.
***Keywords:*** *cloud forest, conservation, diversity, terrestrial vertebrates, flora, species richness.*

# Estudio biológico del bosque mesófilo de montaña en el suroeste de México: plantas, anfibios, reptiles, aves y mamíferos

***Resumen:*** Los bosques mesófilos de montaña son ecosistemas que contienen flora y fauna única, y son caracterizados por sus altos niveles de riqueza y endemismo. Este ecosistema es uno de los más amenazados debido a los cambios en el uso del suelo por actividades antropogénicas. Por tanto, los inventarios bióticos en este ecosistema son necesarios para evaluar adecuadamente los cambios en el uso del suelo sobre las especies en la actualidad y en el futuro. En este estudio se desarrollaron inventarios de plantas y vertebrados terrestres (anfibios, reptiles, aves y mamíferos) en tres fragmentos de bosque mesófilo de montaña en el suroeste de México. El trabajo de campo se realizó durante 15 días por cada grupo biológico durante distintos períodos de tiempo (2005 al 2008). Los registros de las especies se obtuvieron mediante métodos convencionales de captura y observación. Se categorizaron a las especies por su endemismo y categoría de riesgo. Se registró un total de 67 especies de plantas, 17 especies de anfibios, 25 especies de reptiles, 93 especies de aves y 46 especies de mamíferos. Las curvas de acumulación

mostraron un comportamiento asintótico para la mayoría de los taxa, excepto aves y mamíferos. Se obtuvo un total de 56 especies endémicas a México y cuatro cuasiendémicas. Los grupos de plantas, anfibios y reptiles presentaron el mayor número de especies exclusivas al país (13 especies), y se obtuvo un total de seis especies de herpetofauna endémicas a Guerrero. De acuerdo con las leyes mexicanas, se registró un total 24 especies en protección especial, 16 amenazadas y siete en peligro de extinción, de los cuales los grupos de los reptiles y aves presentaron el mayor número de especies en categoría de riesgo (14 especies). La riqueza de especies de aves y mamíferos en este estudio representa un número importante comparado con el total de especies registradas en los bosques mesófilos del estado de Guerrero (157 y 75 especies, respectivamente). Estos datos resaltan la importancia de los bosques mesófilos de montaña del área de estudio para la biodiversidad local y regional, por lo que deben priorizarse estrategias de conservación efectivas para este ecosistema poco representado en áreas naturales protegidas.

***Palabras clave:*** *bosque mesófilo, conservación, diversidad, vertebrados terrestres, flora, riqueza de especies.*

## Introduction

Mexico is a country that contains a large portion of the world's biodiversity and is well represented in worldwide diversity lists, usually occupying one of the first places. Overall, Mexico contains approximately 10% of global biological richness (Mittermeier & Goettsch de Mittermeier 1992, Rammamorthy et al. 1998, Martínez-Meyer et al. 2014). Among higher organisms, Mexico occupies fourth place in plant richness (Villaseñor 2016), fifth in amphibian richness (Parra-Olea et al. 2014), second in reptile richness (Flores-Villela & García-Vázquez 2014), eleventh in bird richness (Navarro-Sigüenza et al. 2014), and third in mammal richness (Ramírez-Pulido et al. 2014). These high levels of biodiversity are partly due to the convergence of the Nearctic and Neotropical biogeographical regions within Mexico's territory, giving rise to species with both temperate and tropical affinities (Plascencia et al. 2011). Despite the vast biological resources of Mexico, the flora and fauna of this country have not been fully documented (Martínez-Meyer et al. 2014), and several regions with potentially high levels of diversity and endemism remain relatively unexplored.

The Sierra Madre del Sur (SMS) in western Mexico is an important region from a biological perspective. This region is characterized by a complex orography and geological history that has promoted the development of a wide range of environments and ecosystems (Ferrusquía 1998, Luna-Vega et al. 2016), including cloud forests (CF). In the SMS, CF covers approximately 1,765 km$^2$ and corresponds to 20% of the territory (INEGI 2010). As previously mentioned, this ecosystem is highly diverse and contains many exclusive flora and fauna species (Challenger 1998, Gual-Díaz & Rendón-Correa 2014). Notably, various fragments of this ecosystem are distributed in the form of an archipelago across the mountainous environments of the SMS, and each fragment has a particular biotic composition (Gual-Díaz & Rendón-Correa 2014). However, limited biological information is available on the CF of this region.

The lack of biological studies on the CF of western Mexico is related to the physical inaccessibility of some sites (e.g., because of difficult terrain or lack of roads) and social problems. As few biotic inventories have been conducted in this region to date, our study serves as an initial approximation for increasing knowledge on the biological diversity of CF in the SMS of the Mexican state of Guerrero. We performed biological inventories of plants and terrestrial vertebrates and provided information on the endemism and risk status of the recorded species. Also, our study represents an important contribution to the national biotic inventory and serves as a baseline of biodiversity with which future scenarios and studies can be compared. Ultimately, this inventory serves as a tool for conservation efforts in the study region, especially considering that CF are highly threatened by human activities.

## Material and Methods

### *1. Study area*

The study area is located to the west of the biotic province of SMS in the state of Guerrero in southwestern Mexico between 101°6'30.84" to 100°57'57.86" W and 17°46'16.87" to 17°43'24.45" N (Figure 1). The studied CF fragments comprise a total area of 11 km$^2$ and present an altitude between 1700 and 2200 masl (Figure 1). The climate is humid and sub-humid temperate, with a mean annual temperature between 16 and 20 °C and a mean annual precipitation between 1200 and 2000 mm (García 2004). The study area is characterized by rugged orography with slopes of 4° to 60°. Several types of land management are practiced in the CF of the study area, including agriculture (e.g., mainly corn, bean, and squash crops) and forestry, wherein species of economic importance (e.g., *Quercus glaucoides* and *Q. candicans*) are harvested.

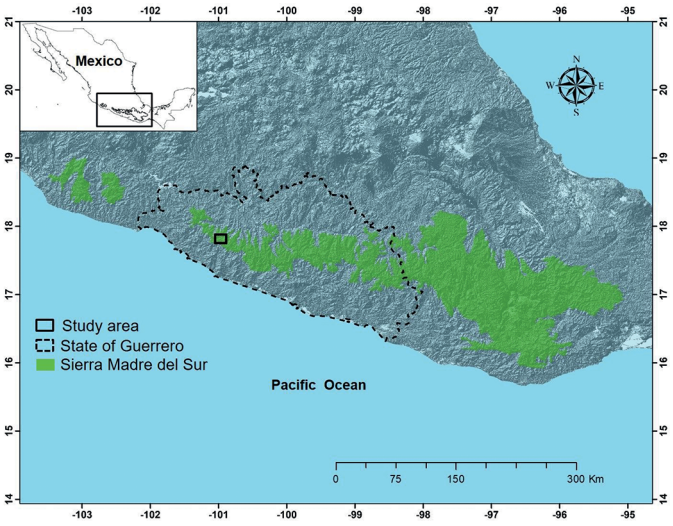


**Figure 1.** Location of the study area in the SMS of the state of Guerrero in southwestern Mexico.

 http://dx.doi.org/10.1590/1676-0611-BN-2017-0444

## 2. *Sampling effort, inventory completeness, and identification of species at risk*

Different conventional methods were employed for the inventory of each biological group. A total of 15 days of field work, carried out from 2005–2008, were dedicated to each group. Species accumulation curves were calculated to evaluate the completeness of the inventories of each taxonomic group. Potential species richness was estimated using the incidence-based coverage estimator (ICE) method, wherein the unit effort corresponded with the number of sampling days. This estimator is based on estimated sample coverage (i.e., the proportion of richness represented in a set of replicated incidence samples) and is insensitive to sample size (Gotelli & Colwell 2011). These analyses were performed using the "specaccum" function in the "vegan" package (Oksanen et al. 2017) in R 3.3.3 (R Development Core Team 2017). Following the surveys, a comparative analysis was carried out to evaluate differences in the richness of each biological group in comparison to the richness levels recorded in CF at both the state and national level. For these comparisons, data on plants, amphibians, reptiles, and birds at the state and national level were taken from Villaseñor (2010) and Gual-Díaz & Rendón-Correa (2014). Mammal data at the national level were taken from González-Ruiz et al. (2014). In addition, the studies of León-Paniagua & Romo-Vázquez (1993), Jiménez-Almaraz et al. (1993), Ávila-Nájera (2006), Ruiz-Gutiérrez (2012), and Almazán-Catalán et al. (2013) were used to compare mammals at the state level because no single source has reported the total number of mammal species in the CF of the state of Guerrero.

For each group, the risk status of species was assigned according to the following categories listed in the Mexican Official Standard NOM-059-SEMARNAT-2010 (SEMARNAT 2010): (1) special protection, which includes those species or populations that could be threatened by factors that adversely affect their viability and determine the need to facilitate their recovery (this category may include the lower risk categories of the IUCN classification), (2) threatened, which includes those species or populations that could be in danger of disappearance in the short to medium term if the factors that adversely affect their viability, such as habitat modification or disturbance, directly reduce the size of their populations (this category overlaps with the "vulnerable" category in the IUCN classification), and (3) endangered, which includes those species whose range or population size has dramatically decreased within Mexico as a result of drastic habitat modification or destruction, overharvesting, disease, or predation, among others, thereby threatening the biological viability of these species throughout their natural habitat (this category overlaps with the categories "critically endangered" and "endangered" in the IUCN classification).

## 3. *Plants*

To inventory plant species, we delimited 30 quadrants of 30 x 30 m (0.027 $km^2$) at different sites and counted and identified plant species with flowers and/or fruits. When we were unable to identify plants *in situ*, we collected botanical samples (three specimens per species) for subsequent identification. Collected specimens were pressed and labeled for herborization according to the protocol of Wendt (1986) and identified through comparison with existing specimens in the Herbarium of the Instituto de Investigación Científica Área Ciencias Naturales (IICACN) of the Universidad Autónoma de Guerrero (UAGro) and in the Vascular Plant Laboratory of the Facultad de Ciencias of the Universidad Nacional Autónoma de México (UNAM). Nomenclature was verified in the database of the Missouri Botanical Garden (W3Tropicos 2010). Species endemism was determined based on Villaseñor et al. (2016). The systematic arrangement of species follows Wearn et al. (2013) and the guidelines of the Angiosperm Phylogeny Group (APG IV 2016).

## 4. *Amphibians and reptiles*

To inventory amphibian and reptile species, we conducted walks along linear transects during three daily observation episodes (diurnal, crepuscular, and nocturnal) to cover the peak hours of activity. To cover a high proportion of amphibian and reptile microhabitats, we placed transects along diverse environment, including rivers and streams in CF as well as those associated with coffee plantations. Sampling consisted of direct observation along roads, wetlands, streams, and trunks as well as under rocks and in caves. Specimens were collected employing traditional capture techniques (Casas-Andreu et al. 1996). Individuals were directly collected by hand, and for particularly poisonous species, a herpetological hook was used. For each specimen captured, we recorded meristic data, coloration, and microhabitat. Amphibian and reptile specimens were identified using field guides by Casas & McCoy (1987) and Flores-Villela et al. (1995).

## 5. *Birds*

To inventory bird species, we carried out bird observations during the hours of highest bird activity in the morning (07:00 to 10:30 h) and afternoon (16:00 to 18:30 h). In addition, 10 mist nets 12 m long and 2.5 m wide were placed to complement the species inventory of the study area. A total of 1800 h/net were obtained. Nets were placed in different sites than those used for the bird observations. Captured specimens were identified and subsequently released at the same capture site. Binoculars (8 x 40 and 10 x 50) and field guides (Howell & Webb 1995, National Geographic Society 1999, Sibley 2000) were used to identify species. Each observed bird species was categorized according to its seasonality (Howell & Webb 1995) and endemism (González-García & Gómez de Silva 2003). The scientific nomenclature and systematic arrangement of species followed the guidelines of the American Ornithologists' Union (AOU 1998) and its most recent update (Chesser et al. 2017).

## 6. *Mammals*

To inventory bats, five mist nets 12 m long and 2.5 m wide were used. Nets were placed across rivers and streams and in open areas between wooded areas. All nets were opened daily from 19:00 to 06:00 h; a total of 550 h/net were obtained. To collect rodents, 50 Sherman traps baited with oatmeal and vanilla were placed along two transects. To collect shrews, 1-L pitfall traps were buried at soil level. The traps for rodents and shrews were placed in the afternoon and checked the following morning. Also, the occurrence of medium- and large-sized mammals was confirmed through searching for excreta and footprints, mainly along riversides and walking trails. All excreta and footprints were determined using the guide by Aranda (2000). In addition, data on sightings of medium-sized species in the field were recorded. The taxonomic guides by Hall (1981), Álvarez et al. (1994), and Medellín

et al. (1997) were used to identify mammal species. After identification, mammals were released at the same capture site. Endemism was determined following Gutiérrez-Blando et al. (2016). Scientific nomenclature and systematic arrangement followed the guidelines by Ramírez-Pulido et al. (2014).

## Results

### 1. Plants

A total of 67 plant species belonging to 30 families were recorded (Figure 2, Appendix 1), 32 of which are herbs (e.g., *Lopezia racemosa*, *Monochaetum calcaratum*, and *Oenothera rosea*), 22 are trees (e.g., *Carpinus caroliniana*, *Pinus ayacahuite*, and *Quercus candicans*), 11 are shrubs (e.g., *Ageratum corymbosum*, *Monnina xalapensis*, and *Rumfordia floribunda*), and two are lianas (i.e., *Canavalia villosa* and *Phaseolus coccineus*; Appendix 1). A total of 13 species were endemic to Mexico (e.g., *Erythrina americana*, *Pinus herrerae*, and *Quercus urbanii*; Figure 2; Appendix 1). Two species are listed in the NOM-SEMARNAT-059-2010 (Figure 2): one under special protection (*Cyathea bicrenata*; Figure 3a,b) and the other as threatened (*Carpinus caroliniana*; Appendix 1). The species accumulation curve showed an asymptotic trend with a slight increase toward the end of the sampling period (Figure 4a). The ICE method estimated 69 species with a confidence interval (CI; $\alpha = 0.05$) ranging from 48 to 90 species.

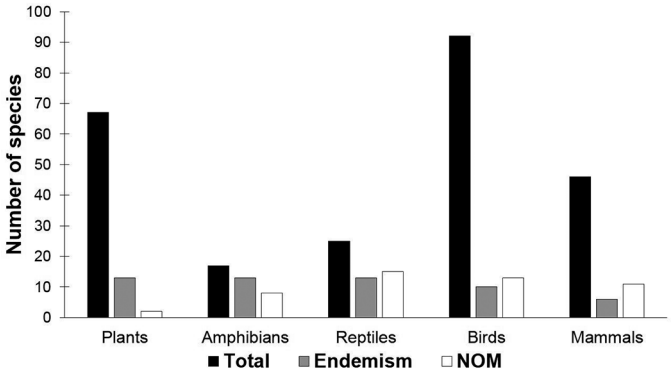


**Figure 2.** Species richness, endemic species, and species at risk per biological group in cloud forest fragments of southwestern Mexico.

### 2. Amphibians and reptiles

A total of 17 amphibian species belonging to six families were recorded (Figure 2, Appendix 2). Thirteen species are endemic to Mexico (e.g., *Agalychnis dacnicolor*, *Incilius occidentalis*, and *Tlalocohyla smithii*; Figures 2 and 3c-e), and two are endemic to Guerrero (i.e., *Charadrahyla tecuani* and *Thorius grandis*; Appendix 2). Six species are under special protection (e.g., *Exerodonta melanomma*, *Lithobates forreri*, and *Plectrohyla bistincta*; Figure 2, Appendix 2), and one is threatened (i.e., *Isthmura bellii*). In addition, 25 species of reptiles belonging to nine families were recorded (Figure 2, Appendix 2). Thirteen are endemic to Mexico (e.g., *Anolis nebulosus*, *Plestiodon brevirostris*, and *Thamnophis chrysocephalus*), and four are endemic to Guerrero (e.g., *Abronia martindelcampoi*, *Mixcoatlus barbouri*, and *Sceloporus adleri*; Figure 2, Appendix 2). A total of 14 reptile species are at risk, including 10 species under special protection (e.g., *Crotalus culminatus*, *Mesaspis gadovii*, and *Sceloporus grammicu*; Figure 3f) and four threatened species (e.g., *Boa imperator*, *Thamnophis godmani*, and *Trimorphodon quadruplex*; Figure 2, Appendix 2). The species accumulation curves for both amphibians (Figure 4b) and reptiles (Figure 4c) showed an asymptotic trend, yet the curve for amphibians began to stabilize at the middle of the sampling period. The ICE method estimated 17 amphibian species (CI = 11 to 23 species; $\alpha = 0.05$) and 26 reptile species for the study area (CI = 8 to 44; $\alpha = 0.05$).

### 3. Birds

A total of 93 bird species belonging to 32 families were recorded (Figure 2, Appendix 3), 68 of which are permanent residents (e.g., *Patagioenas fasciata*, *Piranga bidentata*, and *Rhynchocyclus brevirostris*), 23 are winter visitors (e.g., *Cardellina rubrifrons*, *Regulus calendula*, and *Setophaga townsendi*), and two are transitory (i.e., *Buteo swainsoni* and *Setophaga striata*; Appendix 3). A total of 11 species are endemic to Mexico (e.g., *Cyanolyca mirabilis*, *Cardellina rubra*, and *Piranga erythrocephala*; Figure 3g-h), and four are quasi-endemic (e.g., *Junco phaeonotus*, *Poecile sclateri*, and *Ptiliogonys cinereus*; Figure 2, Appendix 3). Six species are threatened (e.g., *Catharus frantzii*, *Eupherusa poliocerca*, and *Penelope purpurascens*), five species are under special protection (e.g., *Aulacorhynchus prasinus*, *Myadestes occidentalis*, and *Trogon collaris*) and three are endangered (i.e., *Amazona finschi*, *Ara militaris*, and *Cyanolyca mirabilis*; Figure 2, Appendix 3). The number of species continuously increased with sampling, and the accumulation curve was not asymptotic (Figure 4d). The ICE method estimated 101 bird species for the study area (CI = 83 to 119; $\alpha = 0.05$).

### 4. Mammals

A total of 46 species of mammals belonging to 19 families were recorded (Figure 2, Appendix 4). Of these, six species are endemic to Mexico (e.g., *Cryptotis goldmani*, *Dermanura azteca*, and *Sylvilagus cunicularius*; Figures 2 and 3i-j, Appendix 4), and 11 species are found in an at-risk category (Figure 2; Appendix 4). In particular, four species are threatened (e.g., *Choeronycteris mexicana*, *Glaucomys volans*, and *Herpailurus yagouaroundi*). Another four species are endangered (e.g., *Tamandua mexicana*, *Leopardus pardalis*, and *Panthera onca*), and three species are under special protection (i.e., *C. goldmani*, *Megadontomys thomasi*, and *Potos flavus*; Figure 2, Appendix 4). The species accumulation curve showed that mammal richness did not reach the asymptotic threshold (Figure 4e). The ICE method estimated 50 species for the study area (CI = 38 to 56 species; $\alpha = 0.05$).

### 5. Comparisons with CF at the state and national level

The species richness obtained for each taxonomic group in the CF of our study area is not low in comparison to that of CF ecosystems at the state level (Figure 5). For example, 52% of amphibian species, 63% of reptile species, 59% of bird species, and 61% of mammal species recorded in CF of the state of Guerrero were also recorded in the study area. Also, in comparison to the species richness of each group in CF at the national level, the species recorded in our study area represent 1.1% of plant species, 9% of amphibian species, 10% of reptile species, 17% of bird species, and 18% of mammal species (Figure 5).

 http://dx.doi.org/10.1590/1676-0611-BN-2017-0444


**Figure 3.** Examples of endemic and/or at-risk species recorded in cloud forest fragments in southwestern Mexico. a) sampling site, b) *Cyathea bicrenata*, c) *Agalychnis dacnicolor*, d) *Incilius occidentalis*, e) *Tlalocohyla smithii*, f) *Crotalus culminatus*, g) *Cyanolyca mirabilis*, h) *Cardellina rubra*, i) *Dermanura azteca*, and j) *Cryptotis goldmani*

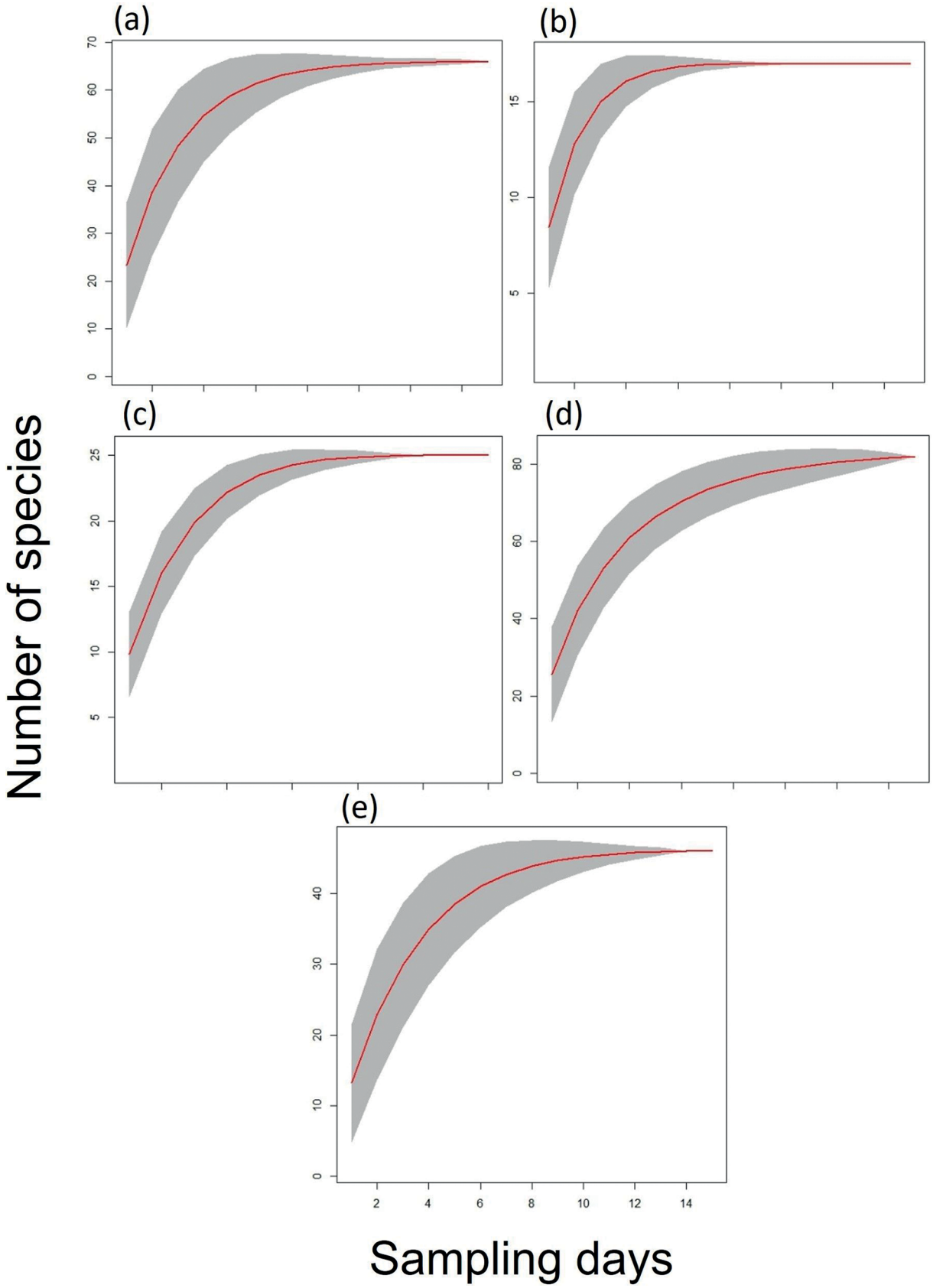


**Figure 4.** Species accumulation curves for a) plants, b) amphibians, c) reptiles, d) birds, and e) mammals in cloud forest fragments in southwestern Mexico. Red lines indicate the cumulative increase of species per biological group, and shaded areas denote the 95% confidence intervals.

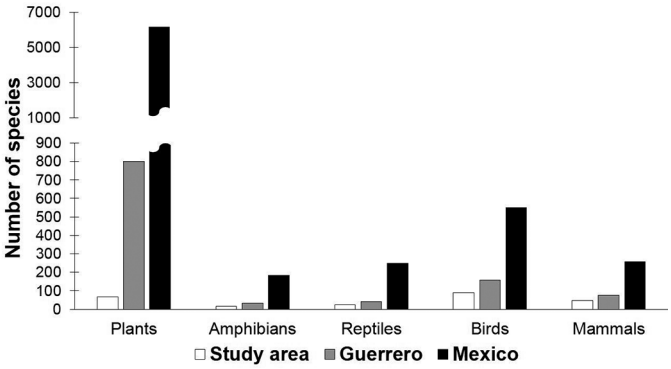


**Figure 5.** Number of species per biological group in the cloud forests of Guerrero and Mexico.

## Discussion

With the exception of plants, the species richness obtained in our study area for the four evaluated animal groups represented more than half of the total species richness of CF in the state of Guerrero. In addition, this species richness represented at least one-quarter of the total species richness of the entire SMS (Espinosa et al. 2016, Flores-Villela & Ochoa-Ochoa 2016, Gutiérrez-Blando et al. 2016, Navarro-Sigüenza et al. 2016). In the case of the plants, the inventory is apparently small, as the sampling was conducted across only 0.027 $km^2$ (0.25% of the entire study area). In comparison with other studies in CF across the SMS, the species richness of our study area is lower than that obtained by Fonseca et al. (2001), Catalán-Heverástico et al. (2003), and Lozada-Perez et al. (2003); however, these studies were carried out in larger areas (35.5 $km^2$, 0.045 $km^2$, and 7 $km^2$, respectively). This suggests the biological importance of the CF in our study area and provides a baseline of species richness in this region. Existing species must be continuously monitored, yet this baseline can be used to develop effective conservation strategies. In addition, these data are of particular importance considering that studies on flora and fauna in the SMS biotic province have been scarce (Luna-Vega et al. 2016), although several descriptive studies of the biological resources of this region have been carried out in the last decade (e.g., Almazán-Núñez et al. 2007, Almazán-Catalán et al. 2009, Almazán-Núñez et al. 2009, Flores-Villela & Ocho-Ochoa 2016, Gutiérrez-Blando et al. 2016, Navarro-Sigüenza et al. 2016).

However, biological studies have not been performed in several areas, particularly CF, that likely have high levels of biodiversity. Cloud forests are one of the ecosystems with the highest levels of biodiversity in Mesoamerica (Gual-Díaz & Rendón-Correa 2014). In Mexico, the best-studied CF in biological terms are located in the central-eastern portion of the country, particularly in the states of Veracruz and Hidalgo (e.g., Martínez-Morales 2007, García-Franco et al. 2008, Álvarez-Zúñiga et al. 2012, Aguilar-López et al. 2013, Rueda-Hernández et al. 2015). Meanwhile, other areas with an extensive presence of this ecosystem, such the southwestern portion of the country (e.g., the state of Guerrero), remain relatively unexplored. In comparative terms, the total species richness of the five taxa in our study area is higher than that reported for Cerro Piedra Larga, Oaxaca, Mexico (Peterson et al. 2004), even though the present study only focused on CF. However, such comparisons should be performed with caution because these geographic areas as well as the corresponding sampling efforts and environmental factors are not similar (Watson & Peterson 1999). The importance of several species recorded in our study area can also be highlighted from a conservation biology perspective. For instance, several species are endemic to western Mexico (e.g., *Eleutherodactylus nitidus, Rhadinaea hesperia, Micrurus distans*, *Piranga erythrocephala,* and *Amazona finschi*). Others are restricted to the state of Guerrero (e.g. *Mixcoatlus barbouri*, *Sceloporus adleri*, and *Thorius grandis*) or to small portions of the SMS (e.g., *Charadrahyla tecuani*, *Eupherusa poliocerca*, *Cyanolyca mirabilis*, and *Cryptotis goldmani*). In fact, our study area is part of the biotic province of the SMS, which is considered a priority terrestrial region because of its high biological diversity and the presence of a significant number of endemic species (Arriaga et al. 2000).

The distribution of species richness in biological groups is not homogeneous across CF at the state and national level, as some areas contain higher concentrations of certain groups of species (Gual-Díaz & Rendón-Correa 2014). The differential presence of distinct biological groups is largely the result of *in situ* speciation processes. The physical characteristics of CF ecosystems, such as climate and historical factors (i.e., rugged orography that acts as a barrier) have favored the presence of many endemic species in CF (Watson & Peterson 1999) and a significant number of species that are restricted to this habitat (e.g., *Cyanolyca mirabilis*, *Megadontomys thomasi*, and *Eleutherodactylus augusti*). Several of these species form genetically differentiated populations that are widely distributed, for example, *Charadrahyla tecuani*, *Thorius grandis*, *Lampornis amethystinus*, *Aulacorynchus prasinus,* and *Chlorospingus flavopectus* (Hanken et al. 1999, Navarro-Sigüenza & Peterson 2004, Campbell et al. 2009). Overall, 75 mammal species have been recorded in other CF of Guerrero by León-Paniagua & Romo-Vázquez (1993), Jiménez-Almaraz et al. (1993), Ávila-Nájera (2006), Ruiz-Gutiérrez (2012), and Almazán-Catalán et al. (2013). In our study area, a relatively large portion of these species were found (46 species). The absence of species characteristic of CF in certain regions may be due to different factors, for example, the variation in dominant floristic species from one region with CF to another. Also, latitude has been suggested to be one of the most important factors that determines differences in species richness and endemism throughout the CF of Mesoamerica (Watson & Peterson 1999). Other possible factor that can explain the absence of some species in the CF of our study area is the uneven sampling effort, as several species unregistered in this study are indeed common and relatively easy to detect in other CF ecosystems (e.g., *Colaptes auricularis*, *Lepidocolaptes affinis*, *Glossophaga soricina*, and *Cryptotis mexicanus*; Hernández-Baños et al. 1995, Peterson et al. 2004, Martínez-Morales 2007, González-Ruiz et al. 2014). Also, some latitudinal migratory species, particularly birds (e.g., *Oreothlypis ruficapilla*, *Polioptila caerulea*, and *Selasphorus rufus*), are likely poorly represented in our study, as the bird sampling period comprised only the months of January, April, and May; this was reflected in the accumulation curve for bird species. However, the lists of each biological group generated in our study may be considered representative based on the expected richness calculated by the ICE estimator.

A high concentration of endemism is present in different biological groups of western Mexico (García-Trejo & Navarro 2004, Ochoa-Ochoa & Flores-Villela 2006, Gutiérrez-Blando et al. 2016, Villaseñor 2016). The flora and fauna endemic to our study area (56 species) was notable compared to the total number of endemic species reported for the entire

state of Guerrero (380 species; Navarro 1998, Pérez-Ramos et al. 2000, Villaseñor 2016). This richness of endemic species was found in an area that barely covers 0.02% and 0.019% of the area of Guerrero and the SMS, respectively. In comparison to the CF of Guerrero (Hernández-Baños et al. 1995, Gual-Díaz & Mayer-Goyenechea 2016, Mayer-Goyenechea & Gual-Díaz 2016), our study area contained a large proportion of endemic amphibian species (48%), reptiles (35%), and birds (73%). However, despite the high concentration of endemic plants in CF (Villaseñor 2010), no endemic plants were found in our study.

With respect to the at-risk status of the recorded species, a total of 47 species of flora and fauna were identified to be at risk. In particular, *Carpinus caroliniana, Eupherusa poliocerca, Herpailurus yagouaroundi*, and *Trimorphodon quadruplex* are threatened, and *Aulacorhynchus prasinus, Craugastor uno, Cryptotis goldmani, Cyathea bicrenata*, and *Lithobates sierramadrensis* are under special protection status. Species such as *Cyanolyca mirabilis* and *Tamandua mexicana* are endangered. These results indicate the importance of preserving the CF ecosystems, as it presents high levels of endemism, contains numerous at-risk species, and currently represents one of the most vulnerable and unprotected ecosystems in Mexico.

Despite the high species richness and the high number of at-risk species recorded in the CF of our study area according to NOM-059-SEMARNAT-2010, few studies have focused on the importance of biological richness in CF at the state level. A greater knowledge of wildlife and floristic resources at the local level can complement inventories at the state and national level and can be useful for promoting effective strategies for the conservation and use of biodiversity. For these reasons, it is imperative to continue these types of studies, especially in unexplored environments, in order to obtain greater information on the distribution and diversity of different taxa and to improve conservation efforts for these species.

## Supplementary material

The following online material is available for this article:

**Appendix 1** - List of plant species recorded in a cloud forest of southwestern Mexico.

**Appendix 2** - List of amphibian and reptile species recorded in a cloud forest of southern Mexico.

**Appendix 3** - List of bird species recorded in a cloud forest of southwestern Mexico.

**Appendix 4** - List of mammal species recorded in a cloud forest of southwestern Mexico.

## Acknowledgments

We are grateful for the biology and ecology undergraduate students of the Universidad Autónoma de Guerrero who provided assistance during field work. We also thank the inhabitants of the communities in our study area who provided hospitality and guidance and who offered their vast knowledge of the local biological resources. This study received funding from the Programa de Conservación de la Biodiversidad por Comunidades Indígenas (COINBIO) and the Comisión Nacional Forestal (CONAFOR).

## Author Contributions

All authors contributed to data collection, manuscript preparation, and critical revision.

R. Carlos Almazán-Núñez: contributed in the design of the study and realized statistical analysis.

Edson A. Álvarez-Álvarez: realized some data analysis.

## Conflicts of interest

The authors declare that they have no conflict of interest related to the publication of this manuscript.

## References

AGUILAR-LÓPEZ, M., ROJAS-MARTÍNEZ, A.E., CORNEJO- LATORRE, C., VITE-SILVA, V.D. & RUANO-ESCALANTE, Y.R. 2013. Lista taxonómica y estructura del ensamblaje de los mamíferos terrestres del municipio de Tlanchinol, Hidalgo, México. Mastozool. Neotrop. 20(2):229–242.

ALMAZÁN-CATALÁN, J.A., TABOADA-SALGADO, A., SÁNCHEZ-HERNÁNDEZ, C., ROMERO-ALMARÁZ, M.L., JIMÉNEZ-SALMERÓN, Y.Q. & GUERRERO-IBARRA, E. 2009. Registros de murciélagos para el estado de Guerrero, México. Acta Zool. Mex. 25(1):177–185.

ALMAZÁN-CATALÁN, J.A., SÁNCHEZ-HERNÁNDEZ, C., RUÍZ-GUTIÉRREZ, F., ROMERO-ALMARAZ, M.L., TABOADA-SALGADO, A., BELTRÁN-SÁNCHEZ, E. & SÁNCHEZ-VÁZQUEZ, L. 2013. Registros adicionales de felinos del estado de Guerrero, México. Rev. Mex. Biodivers. 84(1):347–359.

ALMAZÁN-NÚÑEZ, R.C., NOVA-MUÑOZ, O. & ALMAZÁN-JUÁREZ, Á. 2007. Avifauna de Petatlán en la Sierra Madre del Sur, Guerrero, México. Univ. Ciencia 23(2):141–149.

ALMAZÁN-NÚÑEZ, R.C., PUEBLA-OLIVARES, F. & ALMAZÁN-JUÁREZ, Á. 2009. Diversidad de aves en bosques de pino-encino del centro de Guerrero, México. Acta Zool. Mex. 25(1):123–142.

ÁLVAREZ, T., ÁLVAREZ-CASTAÑEDA, S.T. & LÓPEZ-VIDAL, J.C. 1994. Claves para murciélagos mexicanos. 1 ed. Centro de Investigaciones Biológicas del Noroeste S.C.-Escuela Nacional de Ciencias Biológicas, La Paz, México.

ÁLVAREZ-ZÚÑIGA, E., SÁNCHEZ-GONZÁLEZ, A., LÓPEZ-MATA, L. & TEJERO-DÍEZ, J.D. 2012. Composición y abundancia de las pteridofitas en el bosque mesófilo de montaña del municipio de Tlanchinol, Hidalgo, México. Bot. Sci. 90(2):163–177.

AMERICAN ORNITHOLOGISTS´ UNION (AOU). 1998. Checklist of North and Middle American birds. 7 ed. American Ornithologists´ Union, Lawrence, Kansas, USA.

ANGIOSPERM PHYLOGENY GROUP (APG IV). (2016). An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV. Bot. J Linn. Soc. 181(1):1–20.

ARANDA, M. 2000. Huellas y otros rastros de los mamíferos grandes y medianos de México. CONABIO-Instituto de Ecología, A.C., México, D.F.

ARRIAGA, L., ESPINOZA, J.M. AGUILAR, C. MARTÍNEZ, E. GÓMEZ, L. & LOA, E. 2000. Regiones terrestres prioritarias de México. CONABIO, México, D.F.

ÁVILA-NÁJERA, D.M. 2006. Patrones de distribución de la mastofauna del estado de Guerrero, México. Tesis de licenciatura, Facultad de Ciencias, Universidad Nacional Autónoma de México, México.

CAMPBELL, J.A., BLANCAS-HERNÁNDEZ, J.C. & SMITH, E.N. 2009. A New Species of Stream-breeding Treefrog of the Genus *Charadrahyla* (Hylidae) from the Sierra Madre del Sur of Guerrero, Mexico. Copeia 2009(2):287–295.

CASAS-ANDREU, G., MÉNDEZ DE LA CRUZ, F.R. & CAMARILLO, J.L. 1996. Anfibios y reptiles de Oaxaca. Lista, distribución y conservación. Acta Zool. Mex. 69:1–35.

CASAS, G.A. & MCCOY, C.J. 1987. Anfibios y reptiles de México: claves ilustradas para su identificación. Editorial Limusa, México, D.F.

CATALÁN-HEVERÁSTICO, C., LÓPEZ-MATA, L. & TERRAZAS, T. 2003 Estructura, composición florística y diversidad de especies leñosas de un bosque mesófilo de montaña de Guerrero, México. Anales Inst. Biol. Univ. Nac. Autón. México, Ser. Bot. 74(2):209–230.

CHALLENGER, A. 1998. Utilización y conservación de los ecosistemas terrestres de México: pasado, presente y futuro. CONABIO-Instituto de Biología, UNAM-Agrupación Sierra Madre, México, D.F.

CHESSER, R.T., BURNS, K.J., CICERO, C., DUNN, J.L., KRATTER, A.W., LOVETTE, I.J., RASMUSSEN, P.C., REMSEN Jr., J.V. RISING, J.D., STOTZ, D.F. & WINKER, K. 2017. Fifty-eighth supplement to the American Ornithological Society's check-list of North American birds. Auk 134(3):751–773.

ESPINOSA, D., OCEGUEDA-CRUZ, S. & LUNA-VEGA, I. 2016. Introducción al estudio de la biodiversidad de la Sierra Madre del Sur: una visión general. In Biodiversidad de la Sierra Madre del Sur: una síntesis preliminar (I. Luna-Vega, D. Espinosa & R. Contreras-Medina, eds.). UNAM, Ciudad de México, D.F., p. 23–36.

FERRUSQUÍA, I. 1998. Geología de México: una sinopsis. In Diversidad biológica de México: orígenes y distribución (T.P. Ramamoorthy, R. Bye, A. Lot & J. Fa, eds.). Instituto de Biología, UNAM, México, D.F., p. 3–108.

FLORES-VILLELA, O., MENDOZA-QUIJANO, F. & GONZÁLEZ-PORTER, G. 1995. Recopilación de claves para la identificación de anfibios y reptiles de México. Publicaciones Especiales del Museo de Zoología, Facultad de Ciencias, UNAM, México, D.F.

FLORES-VILLELA, O. & GARCÍA-VÁZQUEZ, U.O. 2014. Biodiversidad de reptiles en México. Rev. Mex. Biodivers. 85:467–475.

FLORES-VILLELA, O. & OCHOA-OCHOA, L. 2016. Estado de conocimiento y conservación de la herpetofauna de la Sierra Madre del Sur. In Biodiversidad de la Sierra Madre del Sur: una síntesis preliminar (I. Luna-Vega, D. Espinosa & R. Contreras-Medina, eds.). UNAM, Ciudad de México, D.F., p. 367–380.

FONSECA, R.M., VELÁZQUEZ, E. & DOMÍNGUEZ, E. 2001. Carrizal de Bravos. Bosque mesófilo de montaña. In Estudios florísticos en Guerrero No. 12 (N. Diego-Pérez & R.M. Fonseca, eds.). Facultad de Ciencias, Universidad Nacional Autónoma de México, México, D.F.

GARCÍA, E. 2004. Modificaciones al Sistema de Clasificación Climática de Köpen. 5 ed. Instituto de Geografía, UNAM, México, D.F.

GARCÍA-FRANCO, J.G., CASTILLO-CAMPOS, G., MEHLTRETER, K., MARTÍNEZ, M.L. & VÁZQUEZ, G. 2008. Composición florística de un bosque mesófilo del centro de Veracruz, México. Bol. Soc. Bot. Mex. 83:37-52.

GARCÍA-TREJO. E.A. & NAVARRO, A.G. 2004. Patrones biogeográficos de la riqueza de especies y el endemismo de la avifauna en el oeste de México. Acta Zool. Mex. 20(2):167–185.

GONZÁLEZ-GARCÍA, F. & GÓMEZ DE SILVA, H. 2003. Especies endémicas: riqueza, patrones de distribución y retos para su conservación. In Conservación de aves: experiencias en México (H. Gómez de Silva & O.A. de Ita, eds.). CIPAMEX-CONABIO-NFWF, México, D.F., p. 150–194.

GONZÁLEZ-RUIZ, N., RAMÍREZ-PULIDO, J. & GUAL-DÍAZ, M. 2014. Mamíferos del bosque mesófilo de montaña en México. In Bosques mesófilos de montaña de México: diversidad, ecología y manejo (M. Gual-Díaz & A. Rendón-Correa, eds.). CONABIO, México, D.F., p. 305–326.

GOTELLI, N.J. & COLWELL, R.K. 2011. Estimating species richness. In Biological diversity: frontiers in measurement and assessment (A.E. Magurran & B.J. McGill, eds.). Oxford University Press, New York, USA, p. 39–54.

GUAL-DÍAZ, M. & MAYER-GOYENECHEA, I.G. 2016. Anfibios en el bosque mesófilo de montaña en México. In Bosques mesófilos de montaña de México: diversidad, ecología y manejo (M. Gual-Díaz & A. Rendón-Correa, comps.). CONABIO, México, D.F., p. 249–261.

GUAL-DÍAZ, M. & RENDÓN-CORREA, A. 2014. Bosques mesófilos de montaña de México: diversidad, ecología y manejo. 1 ed. CONABIO, México, D.F.

GUTIÉRREZ-BLANDO, C., OLGUÍN-MONROY, H.C. & LEÓN-PANIAGUA, L. 2016. Patrones biogeográficos de los mamíferos en la Sierra Madre del Sur. In Biodiversidad de la Sierra Madre del Sur: una síntesis preliminar (I. Luna-Vega, D. Espinosa & R. Contreras-Medina, eds.). UNAM, Ciudad de México, D.F., p. 487–506.

HALL, E.R. 1981. The mammals of North America. 2 ed. Wiley, Chichester, New York, USA.

HANKEN, J., WAKE, D.B. & FREEMAN, H.L. 1999. Three new species of Minute Salamanders (*Thorius*: Plethodontidae) from Guerrero, México, including the report of a novel dental polymorphism in urodeles. Copeia 1999(4): 917–931.

HERNÁNDEZ-BAÑOS, B.E., PETERSON, A.T., NAVARRO-SIGÜENZA, A.G. & ESCALANTE-PLIEGO, B.P. 1995. Bird faunas of the humid montane forest of Mesoamerica: biogeographic patterns and priorities for conservation. Bird Conserv. Int. 5:251–277.

HOWELL, S.N.G. & WEBB, S. 1995. A guide to the birds of Mexico and Northern Central America. Oxford University Press Inc., New York, USA.

INEGI (Instituto Nacional de Estadística, Geografía e Informática). 2010. Página electrónica institucional. www.inegi.org.mx (last access at 02/Sep/2017).

JIMÉNEZ-ALMARAZ, T. JUÁREZ-GÓMEZ, J. & LEÓN-PANIAGUA, L. 1993. Mamíferos. In Historia Natural del Parque Ecológico Estatal Omiltemi, Chilpancingo, Guerrero (I.V. Luna & J.B. Llorente, eds.). CONABIO-UNAM, México, D.F., p. 503–549.

LEÓN-PANIAGUA, L. & ROMO-VÁZQUEZ, E. 1993. Mastofauna de la Sierra de Taxco, Guerrero. In Avances en el estudio de los mamíferos de México (R.A. Medellín & G. Ceballos, eds.). Asociación Mexicana de Mastozoología A.C., México, D.F., p. 45–64.

LOZADA-PÉREZ, L., LEÓN, M.E., ROJAS, J. & DE SANTIAGO, R. 2003. Bosque mesófilo de montaña en El Molote. In Estudios florísticos en Guerrero No. 13 (N. Diego-Pérez, & R.M. Fonseca, eds.). Facultad de Ciencias, Universidad Nacional Autónoma de México, México, D.F.

LUNA-VEGA, I., ESPINOSA, D. & CONTRERAS-MEDINA, R. 2016. Biodiversidad de la Sierra Madre del Sur: una síntesis preliminar. 1 ed. UNAM, Ciudad de México.

MARTÍNEZ-MEYER, E., SOSA-ESCALANTE, J.E. & ÁLVAREZ, F. 2014. El estudio de la biodiversidad en México: ¿una ruta con dirección? Rev. Mex. Biodivers. 85:1–9.

MARTÍNEZ-MORALES, M.A. 2007. Avifauna del bosque mesófilo de montaña del noreste de Hidalgo, México. Rev. Mex. Biodivers. 78:149–162.

MAYER-GOYENECHEA, I.G. & GUAL-DÍAZ, M. 2016. Reptiles en el bosque mesófilo de montaña en México. In Bosques mesófilos de montaña de México: diversidad, ecología y manejo (M. Gual-Díaz & A. Rendón-Correa, comps.). CONABIO, México, D.F., p. 263–267.

MEDELLÍN, R.A., ARITA H.T. & SÁNCHEZ, O.H. 1997. Identificación de los murciélagos de México: clave de campo. Asociación Mexicana de Mastozoología A.C., México, D.F.

MITTERMEIER, R.A. & GOETTSCH DE MITTERMEIER, C. 1992. La importancia de la diversidad biológica de México. In México ante los retos de la biodiversidad (J. Sarukhán & R. Dirzo, eds.). CONABIO, México, D.F., p. 63-73.

NATIONAL GEOGRAPHIC SOCIETY. 1999. Field guide to the birds of North America. National Geographic Society, Washington, D.C., USA.

NAVARRO, A.G. 1998. Distribución geográfica y ecológica de la avifauna del estado de Guerrero, México. Tesis de doctorado, Facultad de Ciencias, Universidad Nacional Autónoma de México. México, D.F.

NAVARRO-SIGÜENZA, A.G., REBÓN-GALLARDO, M.F., GORDILLO-MARTÍNEZ, A., PETERSON, A.T., BERLANGA-GARCÍA, H. & SÁNCHEZ-GONZÁLEZ, L.A. 2014. Biodiversidad de aves en México. Rev. Mex. Biodivers. 85:476–495.

NAVARRO-SIGÜENZA, A.G., BLANCAS-CALVA, E., ALMAZÁN-NÚÑEZ, R.C., HERNÁNDEZ-BAÑOS, B.E., GARCÍA-TREJO, E.A. & PETERSON, A.T. 2016. Diversidad y endemismo de las aves de la Sierra Madre del Sur. In Biodiversidad de la Sierra Madre del Sur: una síntesis preliminar (I. Luna-Vega, D. Espinosa & R. Contreras-Medina, eds.). UNAM, Ciudad de México, D.F., p. 381–411.

NAVARRO-SIGÜENZA, A.G. & PETERSON, T. 2004. An alternative species taxonomy of the birds of Mexico. Biota Neotropica. 4(2):1–32. http://dx.doi.org/10.1590/S1676-06032004000020001 (last access on 24/12/2017).

OCHOA-OCHOA, L.M. & FLORES-VILLELA, O.A. 2006. Áreas de diversidad y endemismo de la herpetofauna mexicana. UNAM-CONABIO, México, D.F.

OKSANEN, J., BLANCHET, F.G., FRIENDLY, M., KINDT, R., LEGENDRE, P., MCGLINN, D., MINCHIN, P.R., O'HARA, R.B., SIMPSON, G.L., SOLYMOS, P., STEVENS, M.H.H., SZOECS, E. & WAGNER, H. 2017. Vegan: community ecology package. Version 2.4-3. https://cran.r-project.org/web/packages/vegan/vegan.pdf (last access at 02/September/2017).

PARRA-OLEA, G., FLORES-VILLELA, O. & MENDOZA-ALMERALLA, C. 2014. Biodiversidad de anfibios en México. Rev. Mex. Biodivers. 85: 460–466.

PÉREZ-RAMOS, E. DE LA RIVA, L.S. & URIBE-PEÑA, Z. 2000. A checklist of the reptiles and amphibians of Guerrero, Mexico. An. Inst. Biol., Serie Zoología 71(1):21–40.

PETERSON, A.T., CANSECO, L., CONTRERAS, J.L., ESCALONA-SEGURA, G., FLORES-VILLELA, O., GARCÍA-LÓPEZ J., HERNÁNDEZ-BAÑOS, B., JIMÉNEZ RUIZ, C.A., LEÓN-PANIAGUA, L., MENDOZA-AMARO, S., NAVARRO-SIGÜENZA, A.G., SÁNCHEZ-CORDERO, V. & WILLARD, D.E. 2004. A preliminary biological survey of Cerro Piedra Larga, Oaxaca, Mexico: birds, mammals, reptiles, amphibians, and plants. An. Inst. Biol., Serie Zoología 75(2):439–466.

PLASCENCIA, R.L., CASTAÑÓN, B.A. & RAZ-GÚZMAN, A. 2011. La biodiversidad en México su conservación y las colecciones biológicas. Ciencias 101:36–43.

RAMÍREZ-PULIDO, J., GONZÁLEZ-RUIZ, N., GARDNER, A.L. & ARROYO-CABRALES, J. 2014. List of recent land mammals of Mexico. Special publications museum of Texas Tech University, Lubbock, Texas, USA.

RAMMAMORTHY, T.R., BYE, R., LOT, A. & FA, J. 1998. Diversidad Biológica de México: orígenes y distribución. Instituto de Biología, UNAM, México.

R DEVELOPMENT CORE TEAM. 2017. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna. www.r-project.org (last access at 02/Sep/2017).

RUEDA-HERNANDEZ, R., MACGREGOR-FORS, I. & RENTON, K. 2015. Shifts in resident bird communities associated with cloud forest patch size in Central Veracruz, Mexico. Avian Conserv. Ecol. 10(2):2.

RUIZ-GUTIÉRREZ, F. 2012. Situación actual y conservación de los felinos silvestres (Carnivora: Felidae) y sus presas en la sierra del municipio de Petatlán, estado de Guerrero, México. Tesis de maestría, Instituto de Ciencias Básicas e Ingeniería, Universidad Autónoma del Estado de Hidalgo, Hidalgo, México.

SEMARNAT (Secretaría de Medio Ambiente y Recursos Naturales). 2010. Norma Oficial Mexicana NOM-059-SEMARNAT-2010, Protección ambiental-Especies nativas de México de flora y fauna silvestres, Categoría de riesgo y especificaciones para su inclusión, exclusión o cambio-Lista de especies en riesgo. Diario Oficial de la Federación, Diciembre 30, 2010. Ciudad de México, México. http://www.profepa.gob.mx/innovaportal/file/435/1/NOM_059_SEMARNAT_2010.pdf (last access at 01/Sep/2017).

SIBLEY, D.A. 2000. The Sibley guide to birds. 1 ed. Alfred a Knopf Inc, New York, USA.

VILLASEÑOR, J.L. 2010. El bosque húmedo de montaña en México y sus plantas vasculares: catálogo florístico-taxonómico. 1 ed. CONABIO-UNAM, México, D.F.

VILLASEÑOR, J.L. 2016. Checklist of the native vascular plants of Mexico. Rev. Mex. Biodivers. 87(3):559–902.

WATSON, A.T. & PETERSON, D.M. 1999. Determinants of diversity in a naturally fragmented landscape: humid montane forest avifaunas of Mesoamerica. Ecography 22:582–589.

WEARN, J.A., CHASE, M.W., MABBERLEY, D.J. & COUCH, C. 2013. Utilizing a phylogenetic plant classification for systematic arrangements in botanic gardens and herbaria. Bot. J Linn. Soc. 172(2):127–141.

WENDT, T. 1986. Árboles. In Manual de herbario: administración y manejo de colecciones, técnicas de recolección y preparación de ejemplares botánicos (A. Lot & F. Chiang, comps.). Consejo Nacional de la Flora de México A.C., México, D.F., p. 133–142.

W3Tropicos. 2010. Missouri Botanical Garden's VAST nomenclatural database and associated authority files. http://www.tropicos.org/ (last access at 01/Sep/2017).

*Received: 12/09/2017*
*Revised: 12/01/2018*
*Accepted: 25/02/2018*
*Published online: 12/04/2018*

# Erratum: Biological survey of a cloud forest in southwestern Mexico: plants, amphibians, reptiles, birds, and mammals

In the article "*Biological survey of a cloud forest in southwestern Mexico: plants, amphibians, reptiles, birds, and mammals*" with DOI code number http://dx.doi.org/10.1590/1676-0611-bn-2017-0444 published at Biota Neotropica 18(2): e20170444,

| Where you read: | Should be read: |
|---|---|
| (...) and four threatened species (e.g., *Boa imperator*, *Thamnophis godmani*, and *Trimorphodon quadruplex*; Figure 2, Appendix 2). | (...) and four threatened species (e.g., *Boa sigma*, *Thamnophis godmani*, and *Trimorphodon biscutatus*; Figure 2, Appendix 2). |
| In particular, *Carpinus caroliniana*, *Eupherusa poliocerca*, *Herpailurus yagouaroundi*, and *Trimorphodon quadruplex* are threatened (...). | In particular, *Carpinus caroliniana*, *Eupherusa poliocerca*, *Herpailurus yagouaroundi*, and *Trimorphodon biscutatus* are threatened (...). |

And in the "*Appendix 2 - List of amphibian and reptile species recorded in a cloud forest of southern Mexico*",

| Where you read: | Should be read: |
|---|---|
| *Dryophytes eximius* | *Dryophytes arboricola* |
| *Plectrohyla bistincta* | *Sarcohyla bistincta* |
| *Plectrohyla pentheter* | *Sarcohyla pentheter* |
| *Marisora unimarginata* | *Marisora brachypoda* |
| *Boa imperator* | *Boa sigma* |
| *Trimorphodon quadruplex* | *Trimorphodon biscutatus* |
| *Geophis sieboldi* | *Geophis occabus* |