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Trabajo

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Diversity and conservation status of the herpetofauna for an area from north of Hidalgo, Mexico

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ABSTRACT

Conservation measures currently lack adequate information to assign some species of amphibians and reptiles in the categories of protection. In this study we analyzed and compared the herpetofauna of mountain cloud forest (MCF) and tropical evergreen forest (TEF) in an area north of Hidalgo. For this study, we conducted fieldwork (24 sites) and a literature review. In addition, the conservation status of species was analyzed. The herpetofauna of the municipality of Tepehuacan de Guerrero, Hidalgo, Mexico consists of 70 species (20 amphibians and 50 reptiles), nine of which are historical records that were not found in the present study. Cloud forest was more diverse (39 species) than TEF (37 species). There are discrepancies between national and international agencies of conservation regarding the threatened status of these species. The high biodiversity recorded in MCF and TEF in the study area indicates the importance of this area for conservation. In this study, we propose to reassess the conservation category of Hidalgo state herpetofauna.

Key words: Amphibians; Reptiles; IUCN; SEMARNAT; Sierra Madre Oriental.

RESUMEN

Diversidad y estado de conservación de la herpetofauna para un área del norte de Hidalgo, México. Actualmente las medidas de conservación carecen de información adecuada para asignar algunas especies de anfibios y reptiles dentro de las categorías de protección. En este estudio se analizó y comparó la herpetofauna de bosque mesófilo de montaña (BMM) y bosque tropical perennifolio (BTP) de un área al norte de Hidalgo. Para este estudio, se realizó trabajo de campo (24 sitios) y revisión de la literatura. Además, se analizó el estado de conservación de las especies. La herpetofauna del municipio de Tepehuacán de Guerrero, Hidalgo, México consta de 70 especies (20 anfibios y 50 reptiles), nueve de estas especies son registros históricos que no fueron encontrados en el presente estudio. El BMM fue más diverso (39 especies) que el BTP (37 especies). Existen discrepancias entre las agencias nacionales e internacionales de conservación con respecto al estado de amenaza de estas especies. La alta biodiversidad en el BMM y BTP podría sugerir que este sitio es un área importante para la conservación. En este estudio, proponemos reevaluar las categorías de conservación de la herpetofauna del estado de Hidalgo.

Palabras clave: Anfibios; Reptiles; IUCN; SEMARNAT; Sierra Madre Oriental.

Introduction

The high biological diversity of Mexico is the result of its geographic location and its complex geological history, characteristics that give rise to a patchwork of environmental and microenvironment conditions for the establishment and development of a wide variety of habitats and species (Challenger and Soberón, 2008). This high diversity is also reflected on the high diversity and endemism of amphibians and reptiles of Mexico (Wilson and Johnson, 2010; Wilson *et al*., 2013a, 2013b). Despite efforts to conserve the high diversity of Mexican amphibians and reptiles, current conservation measures may not be effective, because of the lack of knowledge about the status and distribution of species and populations

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(Howard and Bickford, 2014).

Among the first studies on herpetofauna from Mexico are those by Francisco Hernández in 1570-1577, who recorded 68 species (9 amphibians and 59 reptiles) and Dugès that on 1896 reported 218 species (37 amphibians and 181 reptiles; Flores-Villela, 1998; Vite-Silva *et al*., 2010). Later, Martín del Campo (1937) and Smith and Taylor (1966) carried out studies on species accounts and their distribution, which increased significantly the knowledge of herpetofauna from Mexico. Currently, there are 1,227 species (378 amphibians and 849 reptiles; Wilson *et al*. 2013a, 2013b) registered in the country, of which more than half are listed as species in risk by Mexican legislation (52%; NOM-059-2010). The IUCN considers less than a quarter of these species to be threatened (see Wilson *et al*., 2013a, 2013b).

During the years 1937-1966, explorations to register the herpetofauna of Hidalgo State were initiated in an inconsistent way (Ramírez-Bautista *et al*., 2010; Gual-Díaz and Goyenechea, 2014). In the last two decades, studies on amphibians and reptiles in Hidalgo have increased substantially (Fernández-Badillo and Goyenechea, 2010; Ramírez-Bautista *et al*., 2010, 2014; Vite-Silva *et al*., 2010; Huitzil and Goyenechea, 2011; Cruz-Elizalde and Ramírez-Bautista, 2012; Hernández-Salinas and Ramírez-Bautista, 2012; Ramírez-Bautista and Cruz-Elizalde, 2013). However, there are regions and vegetation types in the state that are poorly explored, from which new records have been recently registered (Berriozabal-Islas *et al*., 2012; Ramírez-Bautista *et al*., 2013; Badillo-Saldaña *et al*., 2014; Lara-Tufiño *et al*., 2014) and new species have been described (Woolrich-Piña *et al*., 2012).

Currently, the herpetofauna of Hidalgo State is comprised by 195 species (Ramírez-Bautista *et al*., 2014; Lemos-Espinal and Smith, 2015). This species richness represents almost 15% of the entire country's herpetofauna. In a biogeographic context, this high level of diversity is a result of the location of Hidalgo within the Sierra Madre Oriental, Transmexican Volcanic Belt, Mexican Plateau, and Gulf Coastal Plain, which present a high number of vegetation types (Ramírez-Bautista *et al*., 2010).

The herpetofauna from Tepehuacán de Guerrero, Hidalgo, Mexico has been previously studied by Mendoza-Quijano *et al*. (2006) and Ramírez-Bautista *et al*., (2010). However, these studies were carried out in a single vegetation type and consequently provided isolated records for this municipality. Nonetheless, both studies reported a significant number of 44 species. In spite of the reported species richness for the municipality, it is expected that a systematic study may show a higher diversity of amphibians and reptiles due to the expected increase in number of microhabitat types, as a result of the convergence of tropical evergreen forest (TEF) and mountain cloud forest (MCF). The primary goal of this study was to assess the amphibian and reptile species composition in two dominant vegetation types from the municipality of Tepehuacán de Guerrero, Hidalgo, Mexico, and evaluate the conservation status of these species according to national and international conservation systems, which are compared with the Environmental Vulnerability Score (see Wilson *et al*., 2013a, 2013b).

Materials and methods

The municipality of Tepehuacan de Guerrero is located in northern Hidalgo, entrenched in the Sierra Madre Oriental (between 20° 56' and 21° 12' N; 98° 44' and 98° 58' W; Fig. 1), and located at an elevation range from 200 to 2000 m a.s.l. It has a territorial extension of 426.6 km^2, which corresponds to 1.7% of the entire state. Dominant vegetation types are TEF and MCF (Rzedowski, 2006; INEGI, 2009). The TEF is distributed in lowlands and MCF is present in highlands, MCF is characterized by the presence of fog throughout the year. The region shows a semi-warm-humid climate, with a mean annual temperature of 24°C at low elevations and 18°C in high places (INEGI, 2009), while annual precipitation varies between 1000 and 2200 mm^3, and rains are seasonal, being dry from December to May, and wet from June to November.

We visited the studied area 12 times between 2011 and 2012; six during the rainy season, and six during the dry season. Each visit consisted of two sampling days, one day per vegetation type. Surveys were made during the day (09:00-14:00 h) and night (18:00-23:00 h) by a team of four people. Thus, a total of 120 h by person of search effort was dedicated to each vegetation type. We selected 12 sites in MCF and 12 in TEF, all sites were separated by 1.5 km (airline). Four transects of 900 m were conducted at each site during the morning, and each of these transects was conducted by one person. Additionally, two transects were selected at night, and each was conducted by two people. We used the method of direct sampling, which takes into account checking all

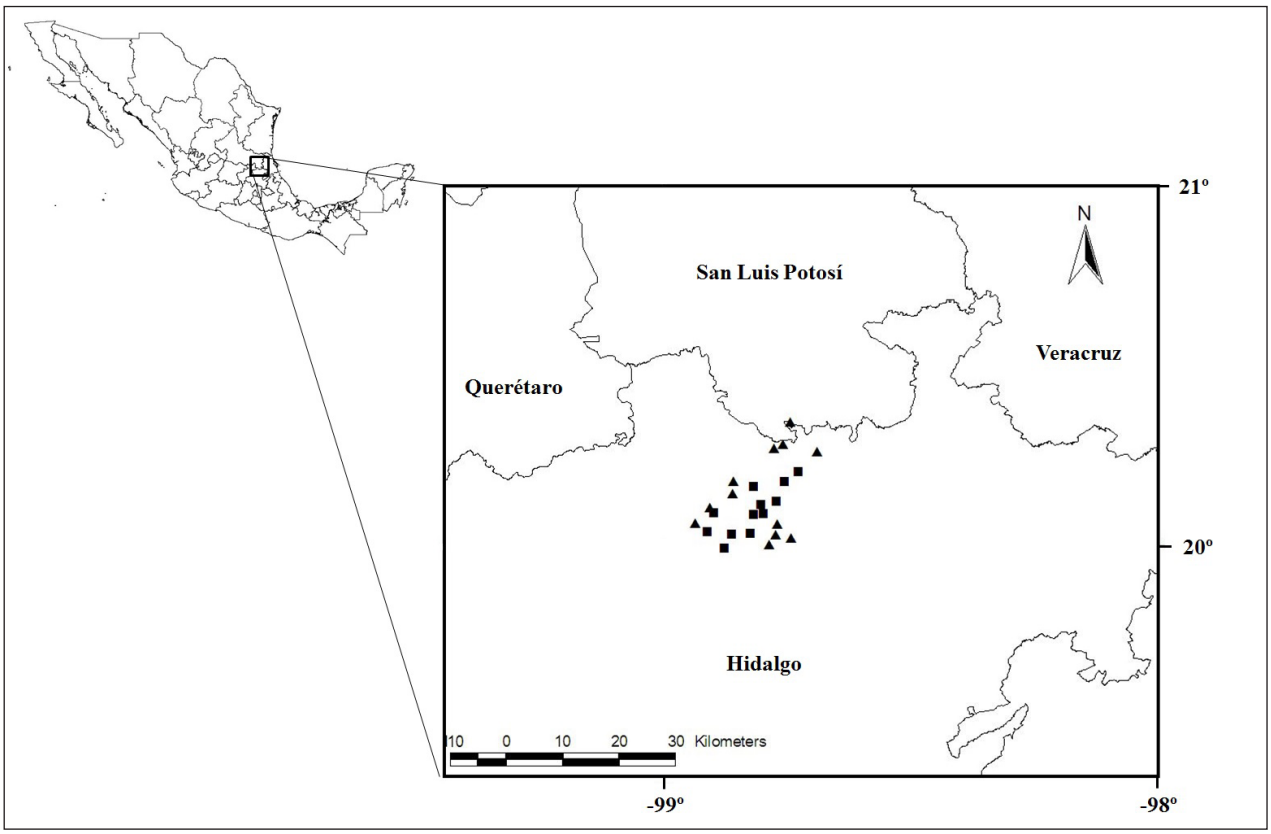

Figure 1. Study area. The triangles represent the surveys sites of tropical evergreen forest and squares correspond to mountain cloud forest.

potential microhabitats occupied by amphibians and reptiles according to their natural history (Casas-Andreu *et al.*, 1991; Manzanilla and Péfaur, 2000; Amador, 2010). To assess abundance, we counted all individuals of each species observed at each site.

Most species were identified directly in the field with the use of identification keys for amphibians and reptiles; however, when specimens were not recognized in the field, they were collected in order to identify them in the Laboratorio de Ecología de Poblaciones (LEP) of the Centro de Investigaciones Biológicas (CIB) of the Universidad Autónoma del Estado de Hidalgo (UAEH). Specimens were collected under scientific permit SGPA/DVGS/02419/10 issued by SEMARNAT (Secretaría del Medio Ambiente y Recursos Naturales), and then euthanized and preserved using the method proposed by Casas-Andreu *et al.* (1991).

Scientific names were updated according to the most recent taxonomic changes (Ramírez-Bautista *et al.*, 2010; Wilson *et al.*, 2013a, 2013b; Streicher *et al.*, 2014; Ramírez-Bautista *et al.*, 2014; Mesa-Lázaro and Nieto-Montes de Oca, 2015). The verification of species assignment was made by Uriel Hernández-Salinas. In addition to the field work, a literature search was made to identify historical records for the study area and generate in conjunction with the field data an updated list of the herpetofauna of the study area.

We developed a species list for each vegetation type, and to obtain an approximation to the level of conservation risk that these species are confronting, we included the protection category for each species according to national (NOM-059-SEMARNAT-2010) and international (Redlist-IUCN) conservation assessment systems and compared these systems with the Environmental Vulnerability Score (EVS) in which a score of 3-9 corresponds to the low threat category, 10-13 corresponds to medium threat, and 14-20 corresponds to the high threat category (see Wilson *et al.*, 2013a, 2013b).

To obtain the completeness of the inventory, we generated a species accumulation curve. The completeness was measured by Bootstrap estimator, because this estimator does not consider the rare species of the sample, and it has been proposed as one of the most accurate estimators to assess the herpetological communities under a more realistic scenario, especially when working with reptiles, because, populations of this group of vertebrates often

have low densities (Carbajal-Cogollo and Urbina-Cardona, 2008; Urbina-Cardona *et al.*, 2008). For completeness analysis of the inventory only the data obtained during the fieldwork was used.

Results

As a result of fieldwork, we report 61 species (18 amphibians and 43 reptiles). Of these, 26 species are new records for this municipality. In the literature review we found only two studies of amphibians and reptiles for the region, which provide a list of 42 species. Of these 42 species, in the field work we did not find nine species (*Incilius occidentalis, Eleutherodactylus guttilatus*, *Corythophanes hernandesii*, *Oxybelis aeneus*, *Geophis latifrontalis*, *G. mutitorques*, *Imantodes gemmistratus*, *Pliocercus elapoides*, and *Rhadinaea marcellae*). Therefore, the entire herpetofauna for the municipality of Tepehuacán de Guerrero is composed of 70 species. Twenty species are amphibians (6 families and 11 genera), and 50 species are reptiles (15 families and 34 genera). The family Hylidae was the most diverse for amphibians, and the family Dipsadidae was the most diverse for reptiles. Forty percent of the species found in this study are endemic to Mexico (Table 1).

According to vegetation type, MCF showed the highest richness, with 39 species of amphibians and reptiles (Table 1). The completeness of the inventory for this environment was 86% (Bootstrap, 45 species). In TEF, the species list included 37 amphibians and reptiles (Table 1), with a completeness of the inventory of 84% (Bootstrap, 44 species). MCF was richer in amphibians than TEF, whereas TEF showed a higher diversity of reptiles (Table 1).

According to NOM-059-2010 of Secretaría del Medio Ambiente y Recursos Naturales, of the 70 recorded species from this municipality, *Lithobates johni* is the only species (1.4%) that is regarded as endangered (P), 18 species (25.7%) are in the category of special protection (Pr), and 13 species (18.6%) under the status of threatened (Am), whereas, 38 (54.3%) are not given a conservation status (Nc) by this system. According to the IUCN Red list (2014), *Pseudoeurycea gigantea* (1.4% of species) is considered critically endangered, four species (5.7%) are regarded as endangered, three (4.3%) as near threatened, eight (11.4%) as vulnerable, 39 (55.7%) are in the category of least concern, 13 (18.6%) are not evaluated and the remaining two species (2.9 %) are not assigned to any category due to insufficient information (Table 1). Finally according to the EVS system, the species are distributed in three categories, 33 species (47.2%) low risk, 22 (31.4%) medium risk, and 15 (21.4%) high risk (Table 1).

Discussion

In this study we report a high diversity of amphibians and reptiles for the municipality of Tepehuacán de Guerrero, which is the result of the significant topographic complexity of the region. In this area, elements of different origins converge, mainly Neartic and Neotropical, and also from the Sierra Madre Oriental that is regarded as a diversity hotspot in Mexico (Canseco-Márquez *et al.*, 2004; Mendoza-Quijano *et al.*, 2006).

The herpetofauna of the study area is represented by 70 species, which correspond to 35.9% of the total herpetofauna of Hidalgo State (Ramírez-Bautista *et al.*, 2014), and 33.8% of the herpetofauna recorded for the Sierra Madre Oriental. Of the 70 species registered, 15% corresponds to endemic species (Canseco-Márquez *et al.*, 2004). These results highlight the relevance of the study area for the conservation of an important portion of the Mexican herpetofauna (Vite-Silva *et al.*, 2010; Cruz-Elizalde and Ramírez-Bautista, 2012). The notable high richness in the region may be partly due to the array of environmental conditions (temperature, humidity, and heterogeneity of microhabitats) present in each forest type (TEF and MCF) which in turn help to maintain a high diversity of this group of vertebrates (Pineda and Halffter, 2003; Urbina-Cardona *et al.*, 2008). Regarding species richness by vegetation types, MCF showed the highest amphibians richness compared to TEF (Table 1), and this might be explained by the importance of water and humidity conditions for the distribution of this biological group (Jansen and Healey, 2003; Cushman, 2006; Vitt and Caldwell, 2009), in this forest the presence of ambient humidity is constant throughout the year (CONABIO, 2010). On the contrary, TEF showed higher reptile richness than MCF (Table 1). This pattern could be the result of physiological requirements of this group since reptiles are closely linked to the specific environmental variables such as heat sources (Urbina-Cardona and Reynoso, 2009; Ramírez-Bautista and Cruz-Elizalde, 2013); for instance, higher ambient temperatures that occur in TEF allow for better thermoregulation activity by reptiles than in MCF (Urbina-Cardona *et al.*, 2008;

Table 1. Species distribution by vegetation types from the municipality of Tepehuacan de Guerrero. Vegetation type: MCF= mountain cloud forest, TEF= tropical evergreen forest. Conservation status according to NOM-059-SEMARNAT-2010: Am= threatened, Pr= special protection, P= endangered, Nc= not considered; Red list-IUCN: NT= near threatened, V= vulnerable, CE= critically endangered, LC= least concern, EN= endangered, DD= data deficient, NE= not evaluated. * Species reported from literature not found in field work. EM= endemic of Mexico, NEM= not endemic of Mexico.

Class Order Family Species	Vegetation type		Distribution	NOM-059 SEMARNAT 2010	Redlist IUCN	Environmental Vulnerability Score
	MCF	TEF				
Amphibia						
Caudata						
Plethodontidae						
Pseudoeurycea bellii	X	-	EM	Am	VU	12
P. cephalica	X	-	EM	Am	NT	14
P. gigantea	X	-	EM	Nc	CE	16
Anura						
Bufonidae						
Rhinella marina	-	X	NEM	Nc	LC	3
Incilius nebulifer	X	X	NEM	Nc	LC	6
I. occidentalis *	-	X	EM	Nc	LC	11
I. valliceps	X	X	NEM	Nc	LC	6
Craugastoridae						
Craugastor decoratus	X	-	EM	Nc	VU	15
C. rhodopis	X	-	EM	Nc	VU	14
Eleutherodactylidae						
*Eleutherodactylus guttilatus**	X	-	EM	Nc	LC	11
E. longipes	X	-	EM	Nc	VU	15
E. verrucipes	-	X	EM	Pr	VU	16
Hylidae						
Charadrahyla taeniopus	X	-	EM	Am	VU	13
Ecnomiohyla miotympanum	X	X	EM	Nc	NT	9
Plectrohyla charadricola	-	X	EM	Am	EN	14
Smilisca baudinii	X	X	NEM	Nc	LC	3
Trachycephalus typhonius	-	X	NEM	Nc	LC	4
Ranidae						
Lithobates berlandieri	X	X	NEM	Pr	LC	7
L. johni	-	X	EM	P	EN	14
L. spectabilis	X	X	EM	Nc	LC	12
Reptilia						
Testudines						
Kinosternidae						
Kinosternon herrerai	-	X	EM	Pr	NT	14
Squamata: Lizards						
Anguidae						
Abronia taeniata	X	-	EM	Pr	VU	15
Gerrhonotus ophiurus	X	-	EM	Nc	LC	12
Corytophanidae						

*Corythophanes hernandesii**	X	-	NEM	Pr	LC	13
Dactyloidae						
Anolis lemurinus	X	-	NEM	Nc	NE	8
A. naufragus	X	X	EM	Pr	VU	13
A. petersii	X	-	NEM	Nc	NE	9
A. sericeus	-	X	NEM	Nc	NE	8
Gekkonidae						
Hemidactylus frenatus	-	X	NEM	Nc	LC	4
Phrynosomatidae						
Sceloporus cyanogenys	-	X	EM	Nc	NE	16
S. serrifer	-	X	NEM	Pr	LC	6
S. variabilis	X	X	NEM	Nc	LC	5
Sphenomorphidae						
Scincella gemmingeri	X	X	EM	Pr	LC	11
S. silvicola	X	X	EM	Pr	LC	12
Teiidae						
Holcosus undulatus	X	X	NEM	Nc	LC	7
Xantusiidae						
Lepidophyma occulor	-	X	EM	Pr	LC	14
L. sylvaticum	X	X	EM	Pr	LC	11
Squamata: Snakes						
Boidae						
Boa constrictor	X	X	NEM	Am	NE	10
Colubridae						
Coluber constrictor	-	X	NEM	Am	LC	10
Drymarchon melanurus	-	X	NEM	Nc	LC	6
Drymobius chloroticus	X	-	NEM	Nc	LC	8
D. margaritiferus	X	X	NEM	Nc	NE	6
Lampropeltis polyzona	X	-	NEM	Am	NE	7
Leptophis diplotropis	X	X	EM	Am	LC	6
L. mexicanus	X	-	NEM	Am	LC	14
Mastigodryas melanolomus	X	-	NEM	Nc	LC	6
*Oxybelis aeneus**	X	-	NEM	Nc	NE	5
Pseudoelaphe flavirufa	-	X	NEM	Nc	LC	10
Spilotes pullatus	-	X	NEM	Nc	NE	6
Dipsadidae						
Chersodromus rubriventris	X	-	EM	Pr	EN	14
Coniophanes fissidens	-	X	NEM	Nc	NE	7
C. imperialis	X	X	NEM	Nc	LC	8
*Geophis latifrontalis**	X	-	EM	Pr	DD	14
*G. mutitorques**	X	-	EM	Pr	LC	13
*Imantodes gemmistratus**	X	-	NEM	Pr	NE	6
Leptodeira maculata	-	X	EM	Nc	LC	7
L. septentrionalis	-	X	NEM	Nc	NE	8
Ninia diademata	-	X	NEM	Nc	LC	9
*Pliocercus elapoides**	X	-	NEM	Am	LC	10

Rhadinaea gaigeae	X	-	EM	Nc	DD	12
*R. marcellae**	X	-	EM	Pr	EN	12
Tropidodipsas sartorii	-	X	NEM	Nc	LC	9
Natricidae						
Nerodia rhombifer	X	X	NEM	Nc	LC	10
Storeria dekayi	X	-	NEM	Nc	LC	7
Thamnophis proximus	X	-	NEM	Am	LC	7
T. eques	X	-	NEM	Am	LC	8
Elapidae						
Micrurus diastema	-	X	NEM	Pr	LC	8
M. tener	X	-	NEM	Pr	LC	11
Viperidae						
Atropoides nummifer	X	-	EM	Am	LC	13
Bothrops asper	X	X	NEM	Nc	NE	12

Vitt and Caldwell, 2009).

The twenty six species registered during field work suggests that more field work is required to determine the current distribution and diversity of amphibians and reptiles in Hidalgo State (Ramírez-Bautista *et al.*, 2014). However, notwithstanding of these new records, in this study nine species reported previously for the study area were not found. This finding indicates to the possibility that these species could be locally extinct. Perhaps, due to the fact that these species may need specific requirements for living and thrive in, and in this way to establish in this area. The species loss could be a consequence of the high rate by change of land use in the region, which could be exerting a strong pressure on populations of these species, and therefore, on reducing diversity of amphibians and reptiles of the region.

A high number of species was found to be listed under some conservation category in accordance to the national (32 species, 45.7%; NOM-059) and international (16 species, 22.8%; IUCN) organizations that categorize species according to extinction risk. However, there are discrepancies when comparing national and international conservation assessment systems. For instance, IUCN (2014) regards *Pseudoeurycea gigantea* as critically endangered, but the same species is not assessed by the NOM-059-2010, and according to the EVS system, this species presents a score of 16, which corresponds the high threat category (Table 1). The primary reasons by the IUCN and the EVS to place this species within the category of critically endangered are the decline in its populations and its restricted distribution, both ecologically and geographically. A possible reason of the absence of this species in the NOM-059-2010 is that for decades this species was considered a synonymy of *P. bellii* species listed by this evaluation system. Therefore, natural history data between these two species may have been confused (Badillo-Saldaña *et al.*, 2015).

Furthermore, in the national evaluation system (NOM-059-SEMARNAT-2010), 11.5% of the species reported in this study are overvalued according to the EVS system, so that, the category of these species probably should be reconsidered. For example, *Sceloporus serrifer* (Pr, NOM-059; LC, IUCN; 6 EVS) is a species with a widespread distribution within and outside the country, with populations moderately abundant (Lee, 1996). In this sense, we advocate the conservation status reassessment of the risk category for this by the NOM-059, considering some criteria such as geographic distribution, vegetation types, reproductive characteristics, and human related pressures, as those encompassed in the EVS system (see Wilson *et al.*, 2013a, 2013b).

Therefore, using the EVS system, species that are not considered in a risk category by the other systems (NOM-059 and IUCN) may be relevant for conservation actions, and the risk category of species listed in the NOM-059 and IUCN systems could be corroborated. This is important, since the conservation status of many species is unknown due to the lack of populations data (Howard and Bickford, 2014), as well as on information on the anthropic effects on species and communities from areas with high biological richness and the consequent implementation of appropriate strategies and areas of conservation (Porter-Bolland *et al.*, 2012).

Therefore, we could be implementing inappropriate conservation actions for some species that might be threatened and that there are not considered within national or international law because of lack of data (Howard and Bickford, 2014). Therefore, it is important to conduct natural history studies (Vitt, 2013) to provide an adequate risk assessment (Howard and Bickford, 2014).

These ideas are deemed important for the herpetofauna of MCF and TEF, with their high values of species richness and endemism. The main concern is that these forests are disappearing at an accelerating rate in the region, as a result of human related activities such as increasing farming, ranching, mining, and settlements (Challenger and Soberón, 2008; Mass *et al*., 2009; Gual-Díaz and Goyenechea, 2014a, 2014b), Nonetheless, in spite of the important efforts that have been invested addressing wildlife conservation in the state of Hidalgo and Mexico as a whole, more adequate legislation is highly desirable for enhancing protection of wildlife.

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Literature Cited

Amador, L. 2010. Técnicas para el monitoreo de vertebrados. Escuela de Biología Facultad de Ciencias Naturales. Universidad de Guayaquil. Ecuador.

Berriozabal-Islas, C.; Ramírez-Bautista, A.; Badillo-Saldaña, L.M. & Cruz-Elizalde, R. 2012. New record of the snake *Leptophis diplotropis* (Günther, 1872) (Squamata: Colubridae) from Hidalgo State, México. *Check List* 8: 1370-1372.

Badillo-Saldaña, L.M.; Berriozabal-Islas, C. & Ramírez-Bautista, A. 2014. New record of the snake *Drymobius chloroticus* (Cope, 1886) (Squamata: Colubridae) from Hidalgo, Mexico. *Check List* 10: 199-201.

Badillo-Saldaña, L.M.; Ramírez-Bautista, A.; Berriozabal-Islas, C. & Beteta-Hernández, C.I. 2015. Range extension of the Giant Salamander, *Pseudoeurycea gigantea* (Taylor 1938) (Caudata: Plethodontidae), and some aspects of its natural history within Hidalgo state, Mexico. *Check List* 11: 152.

Canseco-Márquez, L.; Mendoza-Quijano, F. & Gutiérrez-Mayen, M.G. 2004. Análisis de la distribución de la herpetofauna: 417-438. *En*: Luna-Vega, I.; Morrone, J.J. & Esparza D. (eds.), Biodiversidad de la Sierra Madre Oriental. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. Universidad Nacional Autónoma de México. México D.F.

Carvajal-Cogollo, J.E. & Urbina-Cardona J.N. 2008. Patrones de diversidad y composición de reptiles en fragmentos de bosque seco tropical de Córdoba, Colombia. *Tropical Conservation Science* 1: 397-416.

Casas-Andreu, G.; Valenzuela, G. & Ramírez-Bautista, A. 1991. ¿Cómo hacer una colección de anfibios y reptiles? Cuadernos del Instituto de Biología 10. Universidad Nacional Autónoma de México. México D.F.

Challenger, A. & Soberón, J. 2008. Los ecosistemas terrestres: 87-108. *En*: Soberón, J.; Halffter, G. & Llorente-Bousquets, J. (eds.), Capital Natural de México, vol. I: Conocimiento actual de la biodiversidad. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad.

CONABIO. 2010. El bosque mesófilo de montaña en México: amenazas y oportunidades para su conservación y manejo sostenible. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. México D.F.

Cruz-Elizalde, R. & Ramírez-Bautista, A. 2012. Diversidad de reptiles en tres tipos de vegetación del estado de Hidalgo. *Revista Mexicana de Biodiversidad* 83: 458-467.

Cushman, S. 2006. Effects of habitat loss fragmentation on amphibians: A review and prospectus. *Biological Conservation* 128: 231-240.

Fernández-Badillo, L. & Goyenechea, I. 2010. Anfibios y reptiles del Valle del Mezquital, Hidalgo, México. *Revista Mexicana de Biodiversidad* 81: 705-712.

Flores-Villela, O. 1998. Herpetofauna de México: Distribución y endemismo: 251-278. *En*: Ramammoorthy, T; Bye R., Lot, A., Fa, J. (eds.), Diversidad biológica de México: orígenes y distribución. Universidad Nacional Autónoma de México. México D.F.

Gual-Díaz, M. & Goyenechea, I. 2014. Anfibios en el bosque mesófilo de montaña en México: 249-262. *En*: Gual-Díaz, M. & Rendón-Correa, A. (eds.), Bosques mesófilos de montaña de México: diversidad, ecología y manejo. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. México D.F.

Gual-Díaz, M. & Goyenechea, I. 2014. Reptiles en el bosque mesófilo de montaña en México: 263-278. *En*: Gual-Díaz, M. & Rendón-Correa A. (eds.), Bosques mesófilos de montaña de México: diversidad, ecología y manejo. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. México D.F.

Hernández-Salinas, U. & Ramírez-Bautista, A. 2012. Diversity of amphibian communities in four vegetation types of Hidalgo State, Mexico. *The Open Conservation Biology Journal* 5: 25-35.

Howard, S.D & Bickford, D.P. 2014. Amphibians over the edge: silent extinction risk of data deficient species. *Diversity and Distributions* 20: 837-846.

Huitzil, J. C. & Goyenechea, I. 2011. Primeros registros de herpetozoos en Zimapán, Hidalgo, México. *Revista Mexicana de Biodiversidad* 82: 717-720.

Instituto Nacional de Estadística, Geografía e Informática (INEGI). 2009. Prontuario de información geográfica municipal de los Estados Unidos Mexicanos, Tepehuacán

de Guerrero, Hidalgo. Clave geoestadística 13062.

IUCN. 2014. The IUCN Red List of threatened species. Version 2014.1. Available at <http://www.iucnredlist.org>. Last accesed 07 July 2014.

Jansen, A. & Healey, M. 2003. Frog communities and wetland condition: Relationship with grazing by domestic livestock along an Australian floodplain river. *Biological Conservation* 109: 207-219.

Lara-Tufiño, D.; Hernández-Austria, R.; Wilson, L.D.; Berriozabal-Islas, C. & Ramírez-Bautista, A. 2014. New state record for the snake *Amastridium sapperi* (Squamata: Dipsadidae) from Hidalgo, Mexico. *Revista Mexicana de Biodiversidad* 85: 654-657.

Lee, J. C. 1996. The amphibians and reptiles of the Yucatán Peninsula. Cornell University Press. USA.

Lemos-Espinal, J. A. & G. R. Smith. 2015. Amphibians and reptiles of the state of Hidalgo, Mexico. *Check List* 11:1-11

Manzanilla, J. & Péfaur, J.E. 2000. Consideraciones sobre métodos y técnicas de campo para el estudio de anfibios y reptiles. *Revista de Ecología Latinoamericana* 7:17-30.

Martín del Campo, R. 1937. Contribución al conocimiento de los batracios y reptiles del Valle del Mezquital, Hidalgo. *Anales del Instituto de Biología* 8: 260-266.

Mass, J.F.; Velázquez, A. & Couturier, S. 2009. La evaluación de los cambios de cobertura y uso del suelo en la República Mexicana. *Investigación Ambiental* 1: 23-39.

Mendoza-Quijano, F.; Quijano-Manilla, G. & Mendoza-Paz, R.F. 2006. Análisis fenético de la herpetofauna de los bosques mesófilos de montaña del este de Hidalgo: 99-109. *En*: Ramírez-Bautista, A.; Canseco-Márquez, L. & Mendoza-Quijano, F. Inventarios Herpetofaunísticos de México: avances en el conocimiento de su biodiversidad. Publicaciones de la Sociedad Herpetológica Mexicana. México D.F.

Meza-Lázaro, R.N. & Nieto-Montes de Oca, A. 2015. Long forsaken species diversity in the Middle American lizard *Holcosus undulatus* (Teiidae). *Zoological Journal of the Linnean Society* 2015: 1-22.

Pineda, E. & Halffter, G. 2003. Species diversity and habitat fragmentation: Frogs in tropical mountane landscape in Mexico. *Biological Conservation* 117: 499-508.

Porter-Bolland, L.; Ellis, E.A.; Guariguata, M.R.; Ruiz-Mallén, I.; Negrete-Yankelevich, S. & Reyes-García, V. 2012. Community managed forests and forest protected areas: An assessment of their conservation effectiveness across the tropics. *Forest Ecology and Management* 268: 6-17.

Ramírez-Bautista, A.; Hernández-Salinas, U.; Mendoza-Quijano, F.; Cruz-Elizalde, R.; Stephenson, B.P.; Vite-Silva V.D. & Leyte-Manrique, A. 2010. Lista anotada de los anfibios y reptiles del estado de Hidalgo, México. Universidad Autónoma del Estado de Hidalgo, Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. México D.F.

Ramírez-Bautista, A. & Cruz-Elizalde, R. 2013. Reptile community structure in two fragments of cloud forest of the Sierra Madre Oriental, Mexico. *North-Western Journal of Zoology* 9: 410-417.

Ramírez-Bautista, A.; Berriozabal-Islas, C.; Cruz-Elizalde, R.; Hernández-Salinas, U. & Badillo-Saldaña, L.M. 2013. Rediscovery of the snake *Chersodromus rubriventris* (Squamata: Colubridae) in cloud forest from Sierra Madre Oriental, México. *Western North American Naturalist* 73: 392-398.

Ramírez-Bautista, A.; Hernández-Salinas, U.; Cruz-Elizalde, R.; Berriozabal-Islas, C.; Lara-Tufiño, D.; Goyenechea, I. & Castillo-Cerón, J. 2014. Los anfibios y reptiles de Hidalgo, México: Diversidad, biogeografía y conservación. Sociedad Herpetológica Mexicana. México.

Rzedowski, J. 2006. Vegetación de México. Primera edición digital, Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. México D.F.

Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT). 2010. Norma Oficial Mexicana 059 (NOM-059). Protección ambiental de especies nativas de México de flora y fauna silvestre, categorías de riesgo y especificaciones para su inclusión o cambio, lista de especies en riesgo. Diario Oficial de la Federación (segunda edición).

Smith, H.M. & Taylor, E.H. 1966. Herpetology of Mexico. Annotated checklist and key to amphibians and reptiles. A reprint of Bulletins 187, 194, 199 of the United States National Museum with a list of subsequent taxonomic innovation. Eric Lundberg. Aston, Maryland.

Streicher, J.W.; García-Vázquez, U.O.; Ponce-Campos, P.; Flores-Villela, O.; Campbell J.A. & Smith, E.N. 2014. Evolutionary relationships amongst polymorphic direct-developing frogs in the *Craugastor rhodopis* species group (Anura: Craugastoridae). *Systematics and Biodiversity* 12: 1-22.

Urbina-Cardona, J.N.; Lodoño-Murcia, M.C. & García-Ávila, D.G. 2008. Dinámica de espacio-temporal en la diversidad de serpientes en cuatro tipos de hábitat con diferente grado de alteración antropogénica en el Parque Nacional Natural Isla Gorgona, Pacífico Colombiano. *Caldasia* 30: 479-493.

Urbina-Cardona, J.N. & Reynoso, V.H. 2009. Uso de microhábitat por hembras grávidas de la rana de hojarasca *Craugastor loki* en la selva alta perennifolia de Los Tuxtlas, Veracruz, México. *Revista Mexicana de Biodiversidad* 80: 571-573.

Vite-Silva, V.D.; Ramírez-Bautista, A. & Hernández-Salinas, U. 2010. Diversidad de anfibios y reptiles de la Reserva de la Biósfera Barranca de Metztitlán, Hidalgo, México. *Revista Mexicana de Biodiversidad* 81: 473-485.

Vitt, L.J. 2013. Walking the natural-history trail. *Herpetologica* 69: 105-117.

Vitt, L. & Cadwell, J.J. 2009. Herpetology: an introductory biology of amphibians and reptiles. Academic Press. San Diego.

Wilson, L.D. & Johnson, J.D. 2010. Distributional patterns of the herpetofauna of Mesoamerica, a biodiversity hotspot: 31-235. *En*: Wilson, L.D.; Towsend, J.H. & Johnson, J.D. (eds.), Conservation of the Mesoamerican Amphibians and Reptiles. Eagle Mountain Publisher, L. C. Eagle Mountain, Utah.

Wilson, L.D.; Mata-Silva, V. & Johnson, J.D. 2013a. A conservation reassessment of the reptiles of Mexico based on the EVS measure. *Amphibian and Reptile Conservation* 7: 1-47.

Wilson, L.D.; Johnson, J.D. & Mata-Silva, V. 2013b. A conservation reassessment of the amphibians of Mexico based on the EVS measure. *Amphibian and Reptile Conservation* 7: 97-127.

Woolrich-Piña, G.A. & Smith, G.R. 2012. A new species of *Xenosaurus* from the Sierra Madre Oriental, Mexico. *Herpetologica* 68: 551-559.

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