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Community structure of reptiles from the southern portion of the Chihuahuan Desert Region, Mexico

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Abstract. Reptiles exhibit high species richness and endemism in deserts of northern Mexico. However, high species richness does not necessarily represent the taxonomic diversity of this group in the context of the regional reptile richness. Here, we determined the species richness, similarity, and taxonomic diversity of Chihuahuan Desert reptile assemblages in nine vegetation types (microphyll xeric scrub, xeric shrub rosette, mezquite, submontane scrub, chaparral, pasture, oak forest, juniper forest, and farmland) occurring in the Guadalcázar region of San Luis Potosí. We found 45 species (24 snakes, 20 lizards, and one turtle). The highest numbers of reptiles were found in microphyll xeric scrub and pasture communities. Chaparral, pasture, and oak forest were most similar in structure and species composition. The richest environments in species were not necessarily the most diverse taxonomically. Submontane scrub and chaparral had smaller numbers of species, but high taxonomic diversity (communities containing species less related to each other taxonomically). In addition, 42.2% of the species are under some threat category in the national red list, 91.1% in the IUCN red list, and all species under some category in the Environmental Vulnerability Score rating system, suggesting that more Natural Protected Areas need to be created in the region, along with strategies for protecting and conserving reptile assemblages and other biotic groups.

Key words: species richness, reptiles, taxonomic distinctness, similarity, Chihuahuan Desert region.

Introduction

Spatial variation in species richness is a subject of investigation within different scientific disciplines, particularly community ecology and biogeography (Rosenzweig 1995, Rabosky 2009). Species richness can vary substantially among areas with similar environmental features, and at different spatial scales, ecological and biogeographic factors controlling species richness and community structure (Wiens & Donoghue 2004, Qian et al. 2007).

Local species richness (alpha diversity) and the turnover in species composition between communities (beta diversity; Whittaker 1972) are fundamental features for interpreting community structure. However, these measurements assume that species contribute equally to community structure (Harper & Hawksworth 1995, Moreno et al. 2009). In this sense, methods for evaluating taxonomic diversity (e.g., Warwick & Clarke 1995) represent a complementary measure for understanding diversity patterns, in which the basic idea is that communities containing closely related species will be less diverse than communities containing species exhibiting lesser taxonomic relatedness (Moreno et al. 2009). Such an assumption can help in determining the tools needed for developing ecosystem management plans, ecological restoration projects, and the creation of protected areas (Somerfield et al. 2008).

High reptile diversity is usually associated with desert environments (Qian 2009, Barrows et al. 2013), and in Mexico, desert environments have been shown to be rich at the family, genus, and species levels of reptiles, in addition to containing a high number of endemics (Ramírez-Bautista et al. 2013, Wilson et al. 2013). The Chihuahuan Desert Region (CDR) is the largest area containing xeric ecosystems in North America, and extends northwestward from the central Mexican states of Hidalgo and Querétaro to western Texas, southern New México, and southeastern Arizona in the U.S.A. (Hernández et al. 2008, Hernández & Gómez-Hinostrosa 2011). The Chihuahuan Desert area, between the Sierra Madre Occidental to the west and Sierra Madre Oriental to the east, is one of the most biotically diverse arid to semiarid regions in the world (Fitzgerald et al. 2004). The southern portion of CDR has different vegetation types than those in the northern portion (Hernández & Bárcenas 1995).

Reptile species in the southern region are characteristic of the northern section of CDR, or also occur southward or eastward in Mexico outside the CDR. For example, the southern distributional limits of *Aspidoscelis inornata*, *Crotaphytus collaris*, *Cophosaurus texanus*, *Gerrhonotus infernalis*, *Holbrookia approximans*, *Phrynosoma modestum*, and *Hypsiglena jani* are in or near this region (Good 1994, Lavín-Murcio & Lazcano 2010), and *G. ophiurus* (Good 1994), and *Ficimia hardyi* (Mendoza-Quijano & Smith 1993) have their northern limits in the southern portion of CDR. Another significant biogeographic feature of the southern CDR relates to its inclusion within a southern corridor extending between the Sierra Madre Oriental and the Sierra Madre Occidental [Potosina Huasteca], due to the occurrence of *Phrynosoma orbiculare*, *Sceloporus grammicus*, *S. scalaris*, *Plestiodon brevirostris*, *Aspidoscelis gularis*, *Arizona elegans*, *Lampropeltis mexicana*, *Pituophis deppei*, *Salvadora grahamiae*, *Senticolis triaspis*, *Trimorphodon tau*, *Tantilla wilcoxi*, *Crotalus lepidus*, and *C. molossus* (Morafka 1977; species reported herein).

Previous studies (McGhee-Fugler 1953, Morafka 1977, Lemos-Espinal & Dixon 2013) pointed out the lack of ecological investigations in the southern CDR that considered species abundance. Thus, the southeastern portion could potentially be as rich in species as the central and northern portion of CDR (Barrows et al. 2013). Therefore, here we determined: 1) species richness, diversity, and taxonomic distinctness of reptile assemblages within vegetation types; 2) similarity in species composition among different vegetation types; and 3) the threat status of each reptile species occurring in the Guadalcázar region of San Luis Potosí, in the southern portion of the CDR. Determining threat status is important because a portion of this area has been declared a nature reserve at the state level (Lavín-Murcio & Lazcano 2010).

Material and methods

Study area

This study was performed in the Municipality of Guadalcázar, San Luis Potosí, Mexico, in the southern portion of the CDR on the Mexican Plateau (22º 30´, 23º 14´N, 99º 30´, 100º 14´W; datum: WGS84; Fig. 1). This region is within the Saladan sub-province of Morafka (1977), delimited according to herpetofaunal distribution patterns and endemism.

Sampling

We sampled reptiles in the following nine vegetation types (Rzedowski 1978): microphyll xeric scrub (MXS), xeric shrub rosette (XSR), mezquite (MEZ), submontane scrub (SS), chaparral (CHA), pasture (PAS), oak forest (OF), juniper forest (JF), and farmland (FL). A total of 17 samplings were conducted from May 1996 through April 2001, each one lasting from 3 to 5 days. Reptiles were sampled with direct searches by two people walking 14 km long transects passing through all nine vegetation types (Manzilla & Péfaur 2000). We visually recorded occurrence and abundance of reptile species in each vegetation type, and also by searching in specific microhabitats (e.g., under rocks, under logs, on vegetation, in crevices). Only important voucher specimens were collected.

Data analysis

We recorded species richness and diversity for each vegetation type. We calculated diversity as the number of effective species, using the true diversity of order 1 as ${}^1D = exp\ (H')$, where ${}^1D$ is the true diversity, and (H') is Shannon´s entropy index (Jost 2006). This measure weights each species by its frequency (relative abundance) in each vegetation type, and its value is comparable among communities. Also, in order to further evaluate reptile diversity, we plotted rank-abundance curves (McGill et al. 2007). We compared patterns of richness between vegetation types after standardizing for differences in abundance with individual-based rarefaction analysis (Gotelli & Colwell 2001). We consider only environments with a minimum of 60 individuals.

Further, in order to assess variation in species composition among vegetation types, we used non-metric multidimensional scaling (NMDS) to graph the relative position of the vegetation types according to their similarity in species composition, using the Jaccard index of similarity (Koleff et al. 2003).

In order to evaluate taxonomic distinctness of reptile assemblages, we calculated the mean (Delta = Δ^+) and variance (Lambda = Λ^+; *sensu* Clarke & Warwick 1998) of taxonomic diversity for each vegetation type, using the measures proposed by Warwick & Clarke (1995, 2001). The formulas are represented by: $\Delta^+ = [2\Sigma\Sigma_{i<j}\ \omega_{ij}]/[S\ (S\text{-}1)]$, and $\Lambda^+ = [2\Sigma\Sigma_{i<j}\ (\omega_{ij}\text{-}\ \Delta^+)^2]/[S\ (S\text{-}1)]$; where ω_{ij} is the taxonomic distance between each pair of species i and j, and S is the species number observed in the sample (Warwick & Clarke 1995). A high value of Δ^+ means low relatedness among species, and thus it is a direct measure of taxonomic diversity. On the other hand, Λ^+ is a measure of the unevenness across taxonomic units. Thus, a high Λ^+ indicates over- or under- representation of taxa in the samples. Furthermore, to test if those values for each vegetation type were significantly different from random, we performed a randomization test using the combined species list for the region as the regional species pool (Clarke & Warwick 1998, Lavín-Murcio & Lazcano 2010). This null model uses the theoretical mean and variance values, with 95% confidence intervals, obtained by taking 1,000 random samples from the pool (Clarke & Warwick 1998).

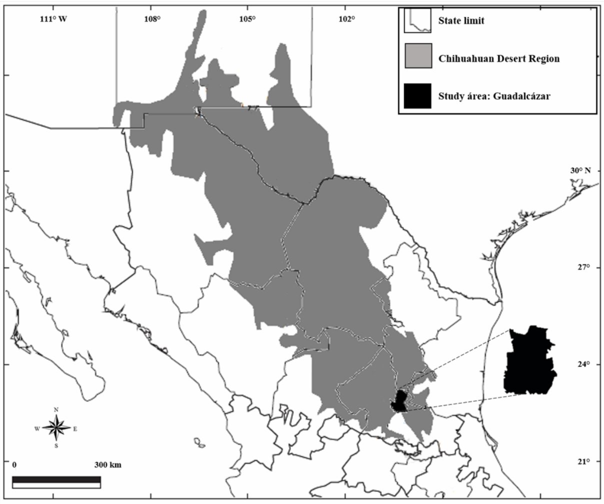

Figure 1. Location of the study site in southern Chihuahuan Desert Region (Modified by Hernández & Gómez-Hinostrosa 2011).

The taxonomic diversity analysis was performed following the classification of Mexican reptiles by Wilson et al. (2013) in PRIMER 5 (Clarke & Gorley 2001). Species were categorized according to the official Mexican red list (SEMARNAT 2010) and the International Union for conservation of Nature and Natural Resources (IUCN 2013). Finally, we also applied the Environmental Vulnerability Scores (EVS; Wilson et al. 2013) for each species. The EVS consider three environmental scales, *i*) geographic distribution, *ii*) number of vegetation types occupied by the species, and *iii*) degree of persecution by humans (for scores see Wilson et al. 2013).

Results

Species diversity

We recorded a total of 45 reptile species in the nine vegetation types (Table 1). Snakes were the richest group with 24 species, lizards comprised 20 species, and turtles were represented by a single species.

Microphyll xeric scrub (MXS) and PAS were the richest vegetation types, containing 32 and 20 species each, respectively. These two environments also had the highest true diversity values (12.8 and 8.6 effective species in MXS and PAS, respectively; Table 2). In contrast, FL, and MEZ had the lowest true diversity values (Table 2), while SS and JF had the same true diversity (5.7 effective species) (Table 2). The vegetation type with the lowest abundance (60 individuals) was SS (Fig. 2). Using this number to compare the vegetation types, we found that MXS had the highest species richness after accounting for differences in abundance among vegetation types, followed by PAS, OF, CHA, XSR, and SS (Fig. 2).

Relative abundance and evenness

The most abundant species were lizards of the genus *Sceloporus* (*S. minor* and *S. spinosus*) and *Aspidoscelis* (*A. gularis* and *A. inornata*). In contrast, rare species in most vegetation types were snakes (Fig. 3). More even vegetation types according to the relative abundance of species were MXS, PAS, and JF (Fig. 3).

Similarity

Pasture (PAS), CHA, and OF had the highest similarity in species composition (Fig. 4). Also, SS and XSR were very similar to one another in species composition, but the other four vegetation types showed a clear differentiated composition (Fig. 4).

Taxonomic diversity

Despite the differences in species richness, all vegetation types with more than five species had nearly similar mean taxonomic distinctness (Delta⁺; Fig. 5A), but all of them were not significant. However, the variation in taxonomic distinctness (Lambda⁺) was high and significant for XSR, CHA and PAS (Fig. 5B).

Conservation status

The assemblages include 19 species (42.2% of the total reptile richness known for the study area) that are under some category of risk in the official Mexican red list (SEMARNAT 2010). Some species are under special protection (*K. integrum*, *S. grammicus*, *C. aquilus*, *C. atrox*, *C. lepidus*, *C. molossus*,

Table 1. List of 45 species of reptiles from the Guadalcázar, San Luis Potosí study area by vegetation type (X = presence; MXS = microphyll xeric scrub, PAS = pasture, CHA = chaparral, OF = oak forest, XSR = xeric shrub rosette, SS = submontane scrub, JF = *Juniperus* forest, FL = farm land, and MEZ =mesquite), risk category by SEMARNAT, 2010 (Pr = special protection, A = threatened, Nc = not considered), IUCN (LC = Least concern, Nc = not considered, E = endangered), endemism to Mexico (E = endemic, Ne = not endemic), Environmental Vulnerability Score (EVS) and category of vulnerability (L = low, M = medium, H = high) according to Wilson et al. (2013).

Scientific name	Vegetation Types									NOM-ECOL-059-2010 Category	IUCN Red List Category	Endemism to Mexico	EVS
	MXS	PAS	CHA	OF	XSR	SS	JF	FL	MEZ				
Kinosternon integrum	X	X	X		X	X				Pr	LC	E	11 (M)
Gerrhonotus infernalis	X									Nc	LC	E	13 (M)
Gerrhonotus ophiurus				X		X				Nc	LC	E	12 (M)
Crotaphytus collaris	X									A	LC	Ne	13 (M)
Anelytropsis papillosus	X								X	A	LC	E	10 (M)
Cophosaurus texanus	X				X					A	LC	Ne	14 (H)
Holbrookia approximans	X									Nc	Nc	Ne	14 (H)
Phrynosoma modestum	X	X			X	X				Nc	LC	Ne	12 (M)
Phrynosoma orbiculare	X	X		X						A	LC	E	12 (M)
Sceloporus grammicus	X	X	X	X	X			X		Pr	LC	Ne	9 (L)
Sceloporus minor	X	X	X	X	X	X		X		Nc	LC	Ne	14 (H)
Sceloporus olivaceus	X				X					Nc	LC	Ne	13 (M)
Sceloporus parvus	X	X	X	X	X	X	X			Nc	LC	E	15 (H)
Sceloporus scalaris		X	X	X						Nc	LC	Ne	12 (M)
Sceloporus spinosus	X	X	X	X	X	X	X	X	X	Nc	LC	E	12 (M)
Sceloporus variabilis			X							Nc	Nc	Ne	5 (L)
Plestiodon brevirostris		X				X				Nc	LC	E	11 (M)
Plestiodon tetragrammus	X						X			Nc	LC	Ne	12 (M)
Scincella silvicola				X						A	LC	E	12 (M)
Aspidoscelis gularis	X	X	X	X	X	X		X	X	Nc	LC	Ne	9 (L)
Aspidoscelis inornata	X				X					Nc	LC	Ne	14 (M)
Arizona elegans	X									Nc	LC	Ne	5 (L)
Drymarchon melanurus	X									Nc	LC	Ne	6 (L)
Ficimia hardyi		X	X	X						Nc	E	E	13 (M)
Lampropeltis mexicana		X								A	LC	E	15 (H)
Lampropeltis triangulum		X								A	Nc	Ne	7 (L)
Masticophis flagellum	X									Nc	LC	Ne	8 (L)
Masticophis schotti	X	X	X							Nc	LC	Ne	13 (M)
Pantherophis emoryi	X									Nc	LC	Ne	13 (M)
Pituophis deppei	X		X	X	X			X		A	LC	Ne	14 (H)
Salvadora grahamiae	X	X	X							Nc	LC	Ne	10 (M)
Senticolis triaspis	X									Nc	Nc	Ne	6 (L)
Tantilla atriceps	X				X	X				A	LC	Ne	11 (M)
Tantilla wilcoxi			X							Nc	LC	Ne	10 (M
Trimorphodon tau	X	X	X	X						Nc	LC	E	13 (M)
Rhinocheilus lecontei	X									Nc	LC	Ne	8 (L)
Crotalus aquilus				X						Pr	LC	E	16 (H)
Crotalus atrox	X					X	X			Pr	LC	Ne	9 (L)
Crotalus lepidus		X								Pr	LC	Ne	12 (M)
Crotalus molossus	X	X	X		X		X			Pr	LC	Ne	8 (L)
Hypsiglena jani	X					X				Pr	LC	Ne	6 (L)
Micrurus tener				X						Pr	LC	Ne	11 (M)
Rena myopica	X		X	X			X			Nc	LC	Ne	13 (M)
Thamnophis cyrtopsis	X	X	X							A	LC	Ne	7 (L)
Thamnophis eques		X		X						A	LC	Ne	8 (L)

H. jani, *M. tener*), or threatened (*C. collaris*, *A. papillosus*, *C. texanus*, *P. orbiculare*, *S. silvicola*, *L. mexicana*, *L. triangulum*, *P. deppei*, *T. atriceps*, *T. cyrtopsis*, and *T. eques*; Table 1). However, according to IUCN, 40 species are listed as Least Concern (88.9%), one species (*Ficimia hardyi*) is Endangered

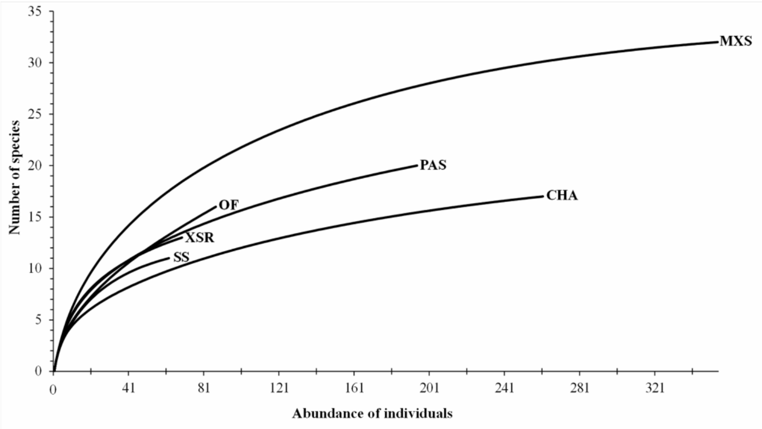

Figure 2. Rarefaction curves based on individuals of reptiles by vegetation types (MXS = microphyll xeric scrub, PAS = pasture, CHA = chaparral, OF = oak forest, XSR = xeric shrub rosette, and SS = submontane scrub). We consider only environments with a minimum of 60 individuals.

Table 2. Reptiles richness and diversity at each vegetation type (MXS = microphyll xeric scrub; PAS = pasture; CHA = chaparral; OF = oak forest; XSR = xeric shrub rosette; SS = submontane scrub; JF = *Juniperus* forest; FL = farm land; MEZ = mesquite).

Vegetation Types	Species Richness	True Diversity
MXS	32	12.74
PAS	20	8.6
CHA	17	5.72
OF	16	6.8
XSR	13	8.0
SS	11	5.7
JF	6	5.7
FL	5	4.1
MEZ	3	1.8

(2.2%), and the rest (4 species; 8.9%) have not been evaluated (Table 1).

Also, 12 of the 13 species we found were endemic to Mexico, but are listed as Least Concern by the IUCN, one species as Endangered (*F. hardyi*), and only six species are under any category by the official Mexican protection list (Table 1; SEMARNAT 2010). EVS index shows that 14 species (31.1%) are in low vulnerability, 24 species (53.3%) in medium vulnerability, and only seven species (15.6%) in the category of high vulnerability (see Table 1).

Discussion

We found high species richness of reptiles in different vegetation types in southern CDR when compared with other regions of the CDR (Lavín-Murcio & Lazcano 2010). Reptile richness in the southern zone represents 40.5% of the 111 species known to inhabit CDR (Lavín-Murcio & Lazcano 2010). This fact, along with its environmental heterogeneity, underscores the importance of the southern region, since other studies reported that habitat heterogeneity promotes increasing number of species at different spatial scales (Galina-Tessaro et al. 2003, Wiens & Donoghue 2004).

MXS and PAS were the vegetation types with the highest species richness and diversity of reptiles. These results were probably due to elevated habitat heterogeneity and associated variation in resources, such as food, microhabitat types, and space, as shown in Howard & Hailey (1999), and biogeographic processes that shape differences in community structure in desert environments (Patterson & Brown 1991, Galina-Tessaro et al. 2003).

Snakes had higher species richness in all vegetation types. However, the majority of snake species were rare, whereas lizards were the most abundant group throughout the study area. For example, *A. gularis*, *S. minor*, and *S. spinosus* were numerically dominant species in most vegetation types. Dominance of lizards in desert environments has been attributed to their ability to partition habitats at a fine scale in areas with similar environmental conditions (Ramírez-Bautista et al. 2013). Habitat partitioning is a mechanism that increases the carrying capacity of local environments, since there is less resource competition between related species. Also, the occurrence of dif-

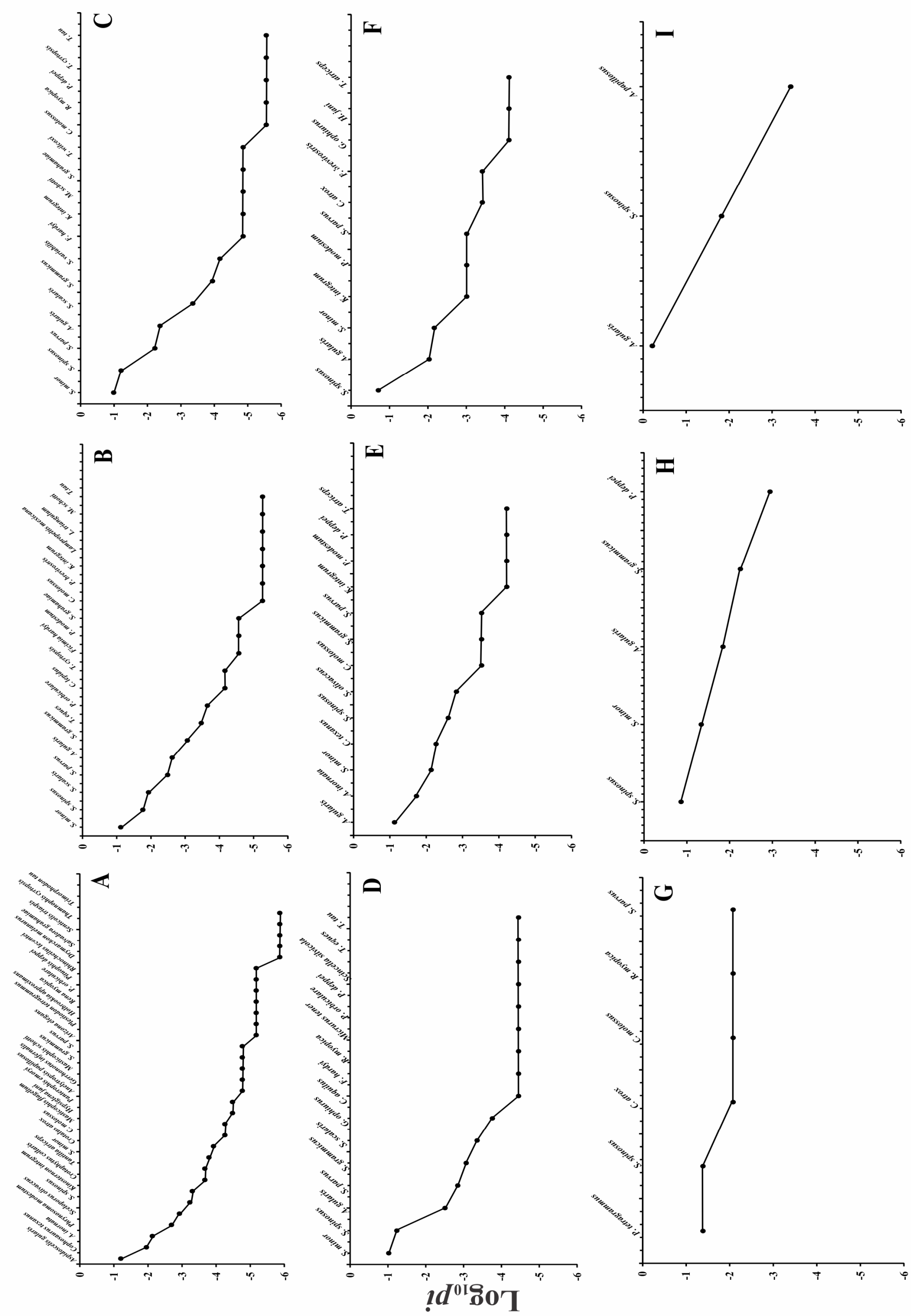

Figure 3. Rank-abundance curves of reptiles species in the nine studied vegetation types (A = microphyll xeric scrub, B = pasture, C = chaparral, D = oak forest, E = xeric shrub rosette, F = submontane scrub, G = *Juniperus* forest, H = farm land, and I = mezquite). In the X axis are the species by vegetation type, Y the logarithm of the proportion of each species.

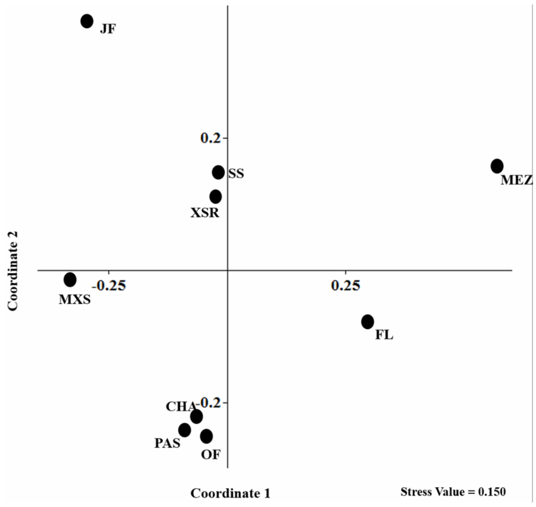

Figure 4. Non-metric multidimensional scaling of vegetation types based on reptile species composition in the Southern Portion of the Chihuahuan Desert, Mexico. Stress value = 0.150.

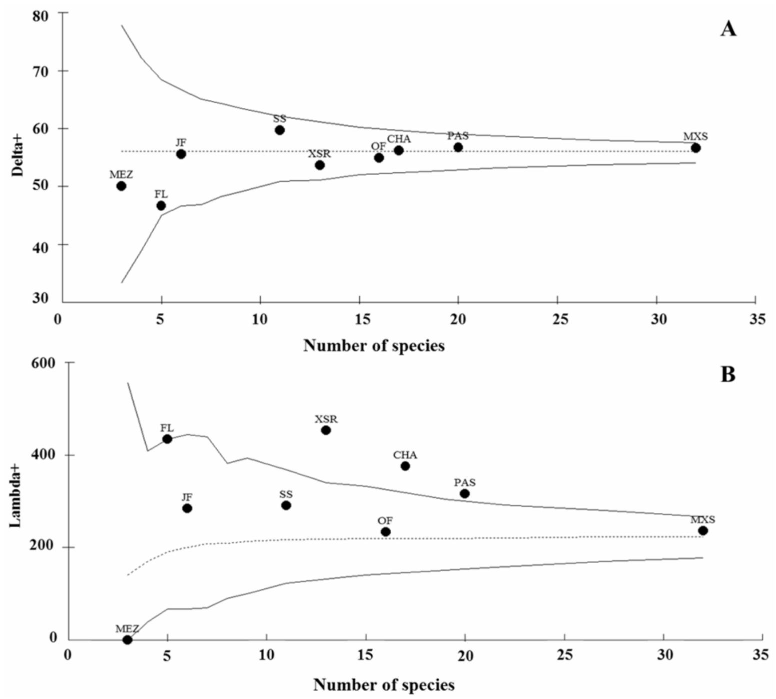

Figure 5. Average taxonomic diversity (A; Delta+) and variation in taxonomic diversity (B; Lambda+) for analyzed vegetation types (MXS, PAS, CHA, OF, XSR, SS, JF, FL, and MEZ); curved line represents confidence interval at 95% according to the null model.

ferent microhabitat types in an area allows for immigration species to partition the habitat in a fine manner, thereby leading to an increase in species richness and abundance (Patterson & Brown 1991, Arita & Rodriguez 2002).

Differences in species richness among vegetation types are most likely due to differences in microhabitat availability in each environment, as has been shown in other studies (e.g., Barbault et al. 1985). In other words, higher similarity values among vegetation types are similar microhabitats being shared with each other (Ramírez-Bautista &

Cruz-Elizalde 2013). For example, the high similarity among PAS, CHA, and OF shared species such as *S. minor*, *S. spinosus*, and *S. parvus* that also had similar microhabitats (Barbault et al. 1985, Ramírez-Bautista & Cruz-Elizalde 2013). In contrast, the reptile composition of MEZ, JF, MXS, and FL did not resemble any other vegetation type, probably because they share less microhabitat structure.

The occurrence of different species, genera, and families characteristic of northern and central Mexico in habitats analyzed, show that the southern CDR is an important biological corridor for herpetofauna (Morafka 1977, Fitzgerald et al. 2004, Lavín-Murcio & Lazcano 2010), since most of the study sites had both high species richness and taxonomic diversity. SS had relatively low richness (11 species), but higher Delta values (Δ^+) than expected when compared with other habitats (e.g., XSR, OF). Similarly, XSR, CHA and PAS, had low Delta values (Δ^+) but high Lambda values (Λ^+), since they shared a high number of colubrid snakes and phrynosomatid lizards, such as those in the genus *Sceloporus*.

The taxonomic diversity of reptiles of the southern portion of the CDR primarily reflects distribution patterns associated with northern Mexico and adjacent southwestern U.S.A., although many of them are mostly restricted to the CDR. The southern range limit of at least seven species is in the study area, although three others have their northern limit there as well, and 14 apparently occurred in this region in the past as part of a dispersal corridor between the Sierra Madre Oriental and Sierra Madre Occidental (Lavín-Murcio & Lazcano 2010). This suggests that currently the southern portion of the CDR contains ecotone-like habitats that limit some species more or less adapted to Chihuahuan Desert environments to the north (Ramírez-Bautista et al., 2013), or to more tropical areas to the east or south (Lavín-Murcio & Lazcano 2010). The CDR contains a mixture of some generalist and widespread species (e.g., *K. integrum*, *S. olivaceus*, *S. parvus*, *S. spinosus*, *S. variabilis*, *P. brevirostris*, *P. tetragrammus*, *S. silvicola*, *Drymarchon melanurus*, *L. triangulum*, *Masticophis flagellum*, *M. schotti*, *Pantherophis emoryi*, *Rhinocheilus lecontei*, *T. cyrtopsis*, *T. eques*, *Rena myopica*, *C. atrox*, and *M. tener*), and species endemic to Mexico (e.g., *S. minor*, *F. hardyi*) whose ranges are restricted to Guadalcázar and adjacent areas of the Central Plateau and Sierra Madre Oriental (Lavín-Murcio & Lazcano 2010, Lemos-Espinal & Dixon 2013).

<u>Implications for conservation</u>

The reptile assemblages in the area include a relative low number of species placed in some threat category in both the Mexican (SEMARNAT 2010) and IUCN red lists. In contrast, of the 45 species recorded from the area, including 13 (29%) endemic forms (Lavín-Murcio & Lazcano 2010), all are placed into the low (14 species), medium (24 species), or high (7 species) vulnerability categories of Wilson et al. (2013). Of those 13 endemic species, only six are listed under some category of vulnerability by SEMARNAT (2010), and the IUCN identifies 12 under the Least Concern category (one species is considered Endangered). This suggests that other protected areas need to be created, and/or extensions made to already existing protected areas in the San Luis Potosí and Guadalcázar region.

Of the seven protected areas, only El Huizache and Real of Guadalcázar are located in the study area. In spite of the existence of protected sites in San Luis Potosí, populations of most reptiles reported herein are continually distressed by habitat destruction, agricultural development, killing of supposed dangerous species, and by human use (Wilson et al. 2013), such as for the pet trade and medicinal purposes (especially rattlesnakes). Also in the study area, there are a notable number of endemic species belonging to other biotic groups, such as cacti and freshwater fish (Hernández & Gómez-Hinostrosa 2011), which have been affected by humans in a similar way as reptiles.

Also, population sizes of some snakes, such as *H. jani*, *M. tener*, or lizards like *G. infernalis* and *G. ophiurus* appear to be naturally low (Good 1994, Fitzgerald et al. 2004). However, given the impact of human activities that negatively affect abundance, and therefore population maintenance (Raxworthy & Attuquayefio 2000), it is essential to evaluate or reevaluate conservation status of regional species by both conservation agencies (IUCN and SEMARNAT), since Mexican and CDR endemics with some level of protection (e.g. *S. parvus*, *G. infernalis*, *G. ophiurus*; Lavín-Murcio & Lazcano 2010, Wilson et al. 2013) occur in the study area. Therefore, we recommend promoting future population surveys and investigations to assess taxonomic revisions (Bryson & Graham 2010), population and community ecology, and how human activities are impacting the reptiles and other groups in the study area. We also recommend the following conservation measures: 1) create programs to protect species considered at risk at some level on Mexican and IUCN red lists and in Wilson et al. (2013); 2) expand or create new protected areas in the CDR; and 3) promote awareness among member of local communities by showing the benefits that diverse reptile assemblages can have on environmental and societal well-being (Galina-Tessaro et al. 2003, Fitzgerald et al. 2004, Hernández & Gómez-Hinostrosa 2011).

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