Journal of Biodiversity & Endangered Species

Ramírez and Quintero, J Biodivers Endanger Species 2016, 4:2
DOI: 10.4172/2332-2543.1000169

Research Open Access

Assessing Extinction Risk for Mexican Dry and Cloud Forest Rodents: A Case Study

Rafael S Ramírez* **and Esther Quintero**

Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO), Subcoordinación de Especies Prioritarias, Liga Periférico - Insurgentes Sur, Núm. 4903, Col. Parques del Pedregal, Delegación Tlalpan, 14010, México

***Corresponding author:** Ramírez RS, Subcoordinación de Especies Prioritarias, CONABIO, Liga Periférico - Insurgentes Sur, Núm. 4903, Col. Parques del Pedregal, Delegación Tlalpan, 14010, México, Tel: +52 55 5000-5004; E-mail: rafael.ramirez@conabio.gob.mx

Received date: Aug 25, 2016; **Accepted date:** October 17, 2016; **Published date:** October 24, 2016

Abstract

Red Lists have been traditionally used as instruments to guide conservation strategies to avoid extinctions. However, there is little consensus in the best way to perform assessments and thus, different countries have developed different methods according to their specific needs. In this study we used a set of ten rodents species, half of them from the cloud forest and halve from the dry forest listed as endangered by the IUCN Red List, but not included in the Mexican red list NOM-059-SEMARNAT-2010. We assessed these 10 species using Mexico´s national Risk Assessment Method (MER) guidelines and then compared the outcomes of these assessments with those from the IUCN Red List evaluations. In addition, in order to support our comparison and to verify if both methods deliver equivalent results, we compared 67 endangered mammals which inhabit in Mexico and have been assessed by both methods. We found that both assessment methods yield equivalent results for the five species of cloud forest rodents. However, it was different for those from the dry forest species, where three had different results. Moreover, we found several discrepancies in the assessment results of the 67 endangered mammals assessed by both methods, suggesting that the assessment methods may be not entirely equivalent. We conclude that the MER in its current form might not be entirely objective, and the assessments could be artificially biased. The method could be an even better assessment instrument if the something is done to account for the lack of objectivity and the bias that the lack of information that we face with many endangered species is taken into account. In this way, the MER could clearly define the conservation status of a given species in a simple and transparent, relevant in terms of impact on conservation actions.

Keywords: Species Risk Assessment; MER; IUCN Red List; Mexican rodents; Biodiversity conservation

Introduction

Red Lists have traditionally guided conservation strategies to avoid extinctions. There is little objection to the idea that categorizing species according to their risk of extinction is a good way to prioritize and implement conservation actions; however, there is little consensus in the best way to perform the actual assessments, and different countries have developed different methods according to their specific needs [1] Here, we analyzed a case study of mice distributed along dry and cloud forests in Mexico, the two most endangered ecosystems in the country, using the national Risk Assessment Method (MER) which is mandatory in order to include species into the Mexican Red List [2,3], and contrasted the results to the assessments under IUCN´s standards.

In Mexico the cloud forest, a group of communities distributed along the mountains best known for the presence of clouds at vegetation level [4] and with specific floral structure and species composition [5] is the most threatened ecosystem [6-10] currently occupying less than 1% of the country's territory (8,809 km^2), and with the least surface worldwide [5]. At the same time, this ecosystem has the most diverse flora and fauna in relationship to its area in Mexico [6,11]. Besides its ecological importance, this ecosystem is a source of timber [12], medical products [11,13], and commodities such as shade-grown coffee plantations [11]. Moreover, the cloud forest is a priority for conservation and restoration efforts due to its crucial role in sustaining the water and nutrient cycles [4].

On the other hand, the dry or deciduous forest in Mexico used to occupy 14% of Mexico's territory (271,750 km^2); unfortunately its distribution has been reduced with only 27% of the total remaining today [14]. Just like the cloud forest, the dry forest has unique characteristics: it occurs on the slopes and low hills of the mountains in altitudes between 0 and 2000 m above sea level; precipitation is generally lower than 1600 mm per year taking place in summer [14] and most of the vegetation is comprised of short trees and shrubs with closed canopies that tends to lose their leaves during the dry season [15]. Recent studies have shown that the dry forest is home to 35% of Mexico's mammals, with 23% endemic to it [16]. Currently, the extension of the dry forest is decreasing due to anthropogenic pressures, especially due to the extraction of timber-yielding and non-timber-yielding products such as fibres, food, ornamental flowers, essences for cosmetics, and medical products [14]. Furthermore, the change of land use is another threat as the forest is converted to pastures and crop fields [14]. Combined, these threats have led to a change of the composition and structure of the dry forest; generating serious erosion problems and species lost [14].

As a result to anthropogenic pressure, cloud and dry forest have become fragmented, sustaining only isolated vegetation patches that reduce the quality and quantity of habitat for forest-dependent species [5,11,14,16,17]. Stephens et al. [18] demonstrated that even the smallest fragmentation, such as a road or walk path can change the genetic structure of small species' populations such as those of rodents.

Additionally, edge effect, another consequence of habitat loss and fragmentation [17] is common in landscapes next to disturbed areas. Studies such as those from López-Barrera, Newton & Manson [18] suggest that edge effect in montane forests can change the populations of small mammals causing a change in the patterns of seed consumption and dispersal preventing future regeneration of forest borders. Likewise, Banks and Dickman [19] proposed that a lack of seeds has a direct impact on the population growth and habitat use of small rodents. Thus, both plant and animal populations are affected by changes in microclimates as a result of edge effect, and these effects become more severe the bigger the fragmentation and the smaller the remaining fragments [20-23]. Moreover, according to the metacommunity theory, colonization and extinctions are related to patch size and connectivity [24]. Unfortunately mice from these forests are poorly studied and the information available for them is scant; their assessment and protection is compromised even more as they are not charismatic species. Thus, there is a need to quickly assess their risk status and enlist them in the National Red Lists to advance their conservation. In this exercise, we provide a working example of an assessment of a poorly known group of species in a quickly disappearing habitat in order to compare a qualitative-national method (MER) with a quantitative-global method (IUCN Red List). In addition, we compared the mammals listed in both the Mexican National Red List and the IUCN to pinpoint the discrepancies between the assigned risk categories in order to explore how different methods may reach different outcomes.

Materials and Methods

Selecting species for the assessment

To select the species for this study we performed a search within the mammal IUCN Red List database using the criteria listed in Table 1. We cross-referred the results from this first search to the mammals listed in the IUCN Red list but not in the Mexican Red List (NOM-059-SEMARNAT-2010), and picked a set of ten Mexican endemic frugivorous rodents that had been assessed by the IUCN but have not been assessed by the Mexican Red List. During all searches we checked both lists for misspelled names or synonyms, to avoid biasing the outcome.

MER	IUCN
P	CR
	EN
A	VU
PR	NT
	LC

Table 1: Suggested equivalence between MER and IUCN Red List categories (Sánchez et al., 2007).

Finally we gathered collection data points from the National Information System of Biodiversity (SNIB, acronym in Spanish) from CONABIO (National Commission for the Knowledge and Use of Biodiversity, Mexico) to map these species' occurrence and sought for occurrences within Natural Protected Areas (NPA) within Mexico to find out whether at least some of the non-assessed species were protected by this strategy.

The process of assessing

The MER has four criteria to assess risk categories: Criterion A: distribution; Criterion B, habitat; Criterion C, intrinsic vulnerability; and Criterion D: human impact [2]. Each criterion is evaluated qualitatively, and the total score is calculated by adding the results from the four. The higher the value of the total score, the higher the risk of extinction of the assessed species [2]. For animals and fungi, species with a total score between 12 and 14 points is considered as endangered (P), between 10 and 11 threatened (A), whereas a score lower than 10 can grant special protection status (Pr) providing that evidence for this urgency is given. For comparison sake, it is worth noting that IUCN's method contemplates five criteria: Criterion A: population size reduction; Criterion B: geographic range; Criterion C: small population size and decline; Criterion D: very small or restricted population; Criterion E: quantitative analysis [25]. Contrary to what happens with the MER, the IUCN method does not require all criteria to be completed in order to obtain an assessment, rendering the method especially useful for species with different levels of information (To learn more see IUCN) [25].

To perform the species assessments via the MER we gathered all available bibliographic information from these ten rodents. In the cases where information for the species was scant or inexistent, we used the general data from the genus to complete the assessment, as the majority of the missing data was for the intrinsic vulnerability criterion, comprising the species' biology, life span, reproduction, diet and behaviour. Although we were aware that using the general information from the genus might bias the final assessment, it was the only way in which the assessments could be completed.

Comparing the risk status of mammals listed in the Mexican Red List and the IUCN Red List

We then broaden our comparison to species already assessed by both methods with the aim to find differences in evaluation results (similar to what Brito et al., [26] proposed). However, it is important to mention that it was only possible to compare the results and not the content of each evaluation, as Mexico's species assessments are restricted.

We used the mammal data sets from NOM-059-SEMARNAT-2010 and IUCN to find if there were any discrepancies between species risk status. To do this, we first filtered all species occurring in Mexico, whether endemic or not, with a risk status under both lists. We discarded all subspecies included in the Mexican Red List as the IUCN does not evaluate subspecies. We then cross-referred by scientific names, IUCN categories (VU, EN and CR) and MER categories (P, A). It is worth noticing that even though LC and Pr are not risk status, we included both in order to have a broader comparison.

Results

Our search of IUCN's data base using the parameters in table 1 returned 10 mice species belonging to four different genera (*Habromys*, *Neotoma*, *Peromyscus*, *Sigmodon*) listed in the IUCN Red List of threatened species V.3.1 under the categories of Vulnerable (VU), Endangered (EN), and Critically Endangered (CR) (Table 2), which are not yet included in the Mexican National Red List. All these

species occur in montane habitats (Table 3), and the threats to all them are known and reported in their individual IUCN assessments (Table 3). The most common threat for these species was habitat loss due to anthropogenic pressure, although this threat can vary depending on region and species (Table 4). Out of these 10 species, the five *Habromys* species are listed as Critically Endangered (CR) and all inhabit the cloud forest, whereas the rest inhabit the dry forest and are listed under different categories: two as Endangered (EN) *Peromyscus melanurus* and *Sigmodon planifrons* and three Vulnerable (VU) *Neotoma palatina*, *Sigmodon alleni* and *Peromyscus Simulus*. The distribution for these ten species can be found in Figures 1a-j. Furthermore, only six of these rodents occur within NPAs, which means that only 60% of the species are under indirect protection.

Taxonomy	Mammalia
Location modifiers	Native
Selected location	Mexcio
Selected systems	Terrestrial
Threatened categories	Vulnerable (VU) Endangered (EN) Critically Endangered (CR)

Table 2: Search criteria and parameters (IUCN, 2012 v.3.1)

Species	Category	Criteria	Distribution	Vegetation type	Threat	Natural protected area
Habromys chinanteco	CR	B1ab(iii)	Oaxaca	Cloud forest	Deforestation	No
Habromys delicatulus	CR	B1ab(iii)	Edo. Mex	Cloud forest	Deforestation	No
Habromys ixtlani	CR	B1ab(iii)	Oaxaca	Cloud forest	Deforestation	No
Habromys lepturus	CR	B1ab(iii)	Oaxaca	Cloud forest	Deforestation	No
Habromys schmidlyi	CR	B1ab(iii)	Guerrero	Cloud forest	Deforestation	No
Neotoma palatina	VU	B1ab(iii)	Jalisco	Tropical deciduous forest	Dam, flood	Aguamilpa-El Cajón; Sierra Huicholes
Peromyscus melanurus	EN	B1ab(iii)	Oaxaca	Tropical lowland deciduous forest, pine-oak	Habitat loss, agriculture	No
Peromyscus simulus	VU	B1ab(iii,v)	Nayarit, Sinaloa	deciduous forest,	Hábitat loss due to agriculture & pesticides	Meseta Cacaxtla; Biosphere Reserve Marismas Nacionales
Sigmodon alleni	VU	A2c+3c+4c	Guerrero, Michoacán, Colima, Jalisco, Nayarit, Sinaloa	Pine-Oak forest, Deciduous forest	Deforestation	Biosphere Reserve Manantlán; Biosphere Reserve Chamela-Cuixmala
Sigmodon planifrons	EN	B1ab(iii)	Oaxaca	Deciduous tropical forest	Habitat fragmentation, Tourism development	No

Table 3: Group of 10 endemic rodents found assessed by IUCN but not by the NOM 059-SEMARNAT-2010.

The assessment results for each one of these species via the MER (Supplementary Information) place the ten species of mice in the highest risk status of the Mexican National Red List (P, Endangered), which according to Sánchez et al., [2] is equivalent to the IUCN's Critically Endangered (CR) category.

When we compared all Mexican mammals listed in both the IUCN and the Mexican Red List, we found discrepancies as we did for the five dry forest species assessed in this study. After cross-referring and excluding subspecies, we found that in IUCN´s Red List there are 100 mammals assessed and listed under different risk categories; of them, 44 mammals were both in the IUCN and Mexican lists under a risk category, and 23 were under the Mexican RL precautionary status (Pr). Out of these 23 none were under (LC) or (NT) in IUCN's Red List (see table 5), whereas the remaining 33 were only assessed by the IUCN. Of these 44, 25 species were listed as threatened (A), and 19 species as Endangered (P).

MER criteria	IUCN criteria
A Distribution	**A Population size reduction**
Description (altitude, continue or fragmented, states of the country)	Population reduction measured over the longer of 10 years or 3 generations

Map	B Geographic range
Mapping method	Extent of occurrence
Assessment	Area of occupancy
B Habitat	Severely fragmented or number of locations
Record (Habitat type which species occupy)	Continuing decline of habitat, extent of occurrence or area of occupancy
Diagnosis of the current habitat status	Extreme fluctuations of habitat, extent of occurrence or area of occupancy
Evaluation of the current habitat status focusing on the taxon's needs	**C Small population size and decline**
Assessment	Number of mature individuals
C Biological vulnerability	Observed, estimate or projected continuing decline of population up to 100 years
Natural history	Observed, estimate or projected continuing decline of population of mature individuals in subpopulations or extreme fluctuations in the number of mature individuals
Diagnosis of the current status	**D Very small and restricted population**
Factors that makes the species vulnerable	Number of mature individuals
Assessment	**E Quantitative analysis**
D Anthropogenic pressures	Indicating the probability of extinction in the wild by numeric analyses
Real and potential risk factors	
Prediction analysis of species trend	
Assessment of direct and indirect human impact	

Table 4: Criteria required by the MER and the IUCN to assess species.

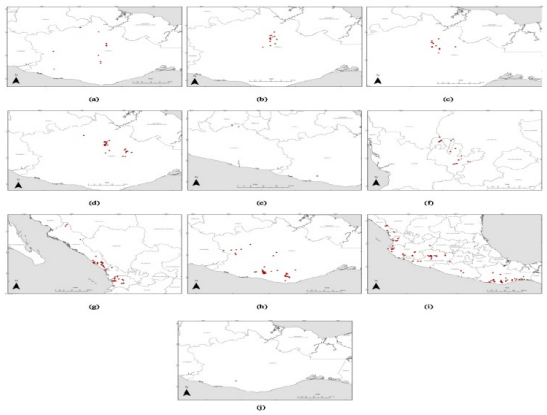

Figure 1: Rodents Distribution. (a) *Habromys chinanteco*. (b) *Habromys delicatulus*. (c) *Habromys ixtlani*. (d) *Habromys lepturus*. (e) *Habromys schmidlyi*. (f) *Neotoma palatina*. (g) *Peromyscus simulus*. (h) *Peromyscus melanurus*. (i) *Sigmodon alleni*. (j) *Sigmodon planifrons*.

When comparing both lists, we found that for those listed as threatened (A) in the Mexican Red List only three species have an equivalent status for that category under the IUCN [2], whereas the remaining 22 species had a higher risk status in the IUCN list, as 11 were listed as Critically Endangered and the other 11 as Endangered (see table 5). In the case of species listed as Endangered (P) in the Mexican RL, 16 out of the 19 species were equivalent [2] (Table 5). Another three species were listed as Threatened (A) (see table 5). Finally, of the remaining 23 species which are listed Under Special Protection (Pr), a precautionary status that does not denote an immediate risk and is similar to that of Least Concern (LC) and Near Threatened (NT) (Table 1), 5 were listed as CR, 11 as EN and 7 as VU in the IUCN Red List (Table 5).

Species	IUCN Red List Category	MER Category	Species	IUCN Red List Category	MER Category
Alouatta pigra	EN	P	*Peromyscus dickeyi*	CR	Pr
Ateles geoffroyi	EN	P	*Peromyscus guardia*	CR	P
Balaenoptera borealis	EN	Pr	*Peromyscus sejugis*	EN	A
Balaenoptera musculus	EN	Pr	*Peromyscus slevini*	CR	A
Balaenoptera physalus	EN	Pr	*Peromyscus stephani*	CR	A
Chaetodipus dalquesti	VU	Pr	*Peromyscus winkelmanni*	EN	Pr

Cryptotis magna	VU	Pr	*Peromyscus zarhynchus*	VU	Pr
Cryptotis nelsoni	CR	Pr	*Phocoena sinus*	CR	P
Cryptotis obscura	VU	Pr	*Physeter macrocephalus*	VU	Pr
Cynomys mexicanus	EN	P	*Procyon pygmaeus*	CR	P
Dipodomys insularis	CR	P	*Reithrodontomys spectabilis*	CR	A
Dipodomys margaritae	CR	P	*Rheomys mexicanus*	EN	Pr
Geomys tropicalis	CR	A	*Rhogeessa genowaysi*	EN	A
Habromys simulatus	EN	Pr	*Rhogeessa mira*	VU	Pr
Heteromys nelsoni	EN	Pr	*Romerolagus diazi*	EN	P
Leptonycteris nivalis	EN	A	*Sorex macrodon*	VU	A
Lepus flavigularis	EN	P	*Sorex milleri*	VU	Pr
Liomys spectabilis	EN	Pr	*Sorex sclateri*	CR	A
Megadontomys cryophilus	EN	A	*Sorex stizodon*	CR	A
Megadontomys nelsoni	EN	A	*Spermophilus perotensis*	EN	A
Megadontomys thomasi	EN	Pr	*Spilogale pygmaea*	VU	A
Microtus oaxacensis	EN	A	*Sylvilagus graysoni*	EN	P
Microtus umbrosus	EN	Pr	*Sylvilagus insonus*	EN	P
Musonycteris harrisoni	VU	P	*Sylvilagus mansuetus*	CR	P
Myotis planiceps	EN	P	*Tamiasciurus mearnsi*	EN	A
Myotis vivesi	VU	P	*Tapirus bairdii*	EN	P
Nelsonia goldmani	EN	Pr	*Trichechus manatus*	VU	P
Neotoma bryanti	EN	A	*Tylomys bullaris*	CR	A
Notiosorex villai	VU	A	*Tylomys tumbalensis*	CR	Pr
Orthogeomys lanius	CR	A	*Xenomys nelsoni*	EN	A
Peromyscus bullatus	CR	Pr	*Zygogeomys trichopus*	EN	P
Peromyscus caniceps	CR	Pr			

Table 5: List of threatened Mexican mammals assessed by IUCN Red List and MER. Suggested equivalence CR/EN=P; VU=A; Pr has nonequivalence with CR, EN and VU.

Discussion

Assessing risk status through the MER and comparing them to IUCN´s assessment

The aim of risk assessments is to convey the conservation status of a given species in a simple, transparent, and objective way in order for it to be relevant in terms of scope and impact for conservation actions. Throughout this case study we were particularly interested in seeing the difference outcome between the IUCN and the Mexican Evaluation of Risk methods; see more arguments in [1,27,28].

The most striking difference that we found between the MER and the IUCN method was the simplicity of the latter to handle the lack of data: while in the MER all criteria have to be completed with a great amount of detail to in order to get a score, IUCN´s method allows the use of whatever criteria is suitable for the information available. In our example, when assessing the ten rodents via the MER, all of them got the highest value in criterion A (4 points, distribution) due to their very restricted area which occupies less than 5% of Mexico's territory. However, this criterion was the only one that had a quantitative threshold to establish a score. Take for instance criterion C, biological vulnerability; not only is it complicated to have this information for all species, but also, the assessor has to decide among three scores (low, medium and high) without the method guiding the decision through objectively documenting the criteria or quantitative thresholds among the three. In our case study we gave the highest score in this criterion C to dry forest species, as we knew that their reproduction was limited to and by the rainy season [16]. However, we did not know the number of individuals per litter, or age at first reproduction among many other biological features needed, so we had to extrapolate information from the genus to the different species in order to perform the evaluation; without doing this, many species could not have achieved a risk category. On the other hand, according to IUCN´s assessment, nine rodents were classified mainly through their small distribution range as follows: Five were classified as Critically Endangered B1ab(iii), (*Habormys chinanteco*, *H. delicatulus*, *H. ixtlani*, *H. lepturus*, and *H. schmidlyi*), two as Endangered EN B1ab(iii) (*Peromyscus malnurus* and *Sigmodon planifrons*),and two as Vulnerable (*Peromyscus simulus*) VU B1ab(iii,v) and *Neotoma palatine* B1ab(iii) due to their extremely reduced extent of occurrence (B1) (<100 km2), the fact that all individuals occur in one location (a), the continuing decline in the extent and quality of their habitats (b(iii)), and a continuing decline of mature individuals(b(v)). Only one species in our case study (*Sigmodon alleni*) was classified as Vulnerable VU A2c+3c+4c through IUCN´s criterion A, population size reduction, based on a decline in area of occupancy (AOO), extent of occurrence (EOO) and/or habitat quality (c) (more info in IUCN, 2012).

The outcome of our example using the MER, although limited as per the small number of assessments completed, highlights the problematic nature of having to assign a score without a quantitative guideline. Therefore the scores of most criteria tend to be biased by the assessor judgment even when the information is not scant. Although in

the past the IUCN used more qualitative criteria, they were changed to quantitative criteria to eliminate assessors' subjectivity and bias [25]. This change to quantitative criteria proved to diminish errors and bias from the assessor, as it is important to achieve the same result no matter who is performing the assessment [26]. Moreover, we found that when using the MER to assess poorly known species, low values due to gaps in knowledge can prevent the listing of any species as the risk status is the result of a sum of all criteria (A+B+C+D). Whereas IUCN's method overcomes this situation by using whatever, information exists and in a more objective way through a series of guidelines.

For many species like the ones included in this study which inhabit some of the most threatened habitat in Mexico, lack of data is a constant [29] and this situation will not change in the short-term. Thus, using the information available to assess target species is a far better option that has been adopted by IUCN's assessments, and that should be implemented in the MER. For instance, Raimondo, Staden & Donaldson [30] accomplished the task of assessing and assigning a risk category to all South African plant taxa with very scant information for many of them, showing that the lack of information should not preclude objective assessments. Several authors agree that uncertainty will always be associated to the data used to evaluate species, however, it does not mean that information carrying a certain amount of uncertainty has to be ignored when assessments are performed [1,31] as long as the source and the caveat of the uncertainty is clearly stated in the assessment support information.

Another aspect that needs to change in the assessments performed via the MER assessments is that currently there is no support information that accompanies the risk status; thus, two species in the same risk category and the same score may have different problematics [1,2,27,32] (Table 4). It follows that a justification for each of the four criteria should be included along with the assessment, as this would truly make the assessments relevant for conservation actions. Currently, the MER is not even publicly available. Authors like Brito et al. [26] recommend that all assessments should be publicly available, including results, procedures, decisions, rationale, and data used, no matter the methodology employed or the scale. De Grammont & Cuarón [1] suggested that risk assessments must have support information according to the categories granted, referring to the species' present condition.

It is important to note that even though risk categories differ between systems (i.e., MER and IUCN), all of them should help decision makers implement the best conservation actions as needed [1]. In this case, both assessment methods agree on the risk status of the five species of cloud forest mice (*Habormys chinanteco*, *H.delicatulus*, *H. ixtlani*, *H. lepturus*, and *H. schmidlyi*), but not on the status of the dry forest, as the MER place them as endangered (P), whereas according to the IUCN two are endangered (EN) (*P. malnurus* and *S. planifrons*) and the rest are vulnerable (VU) (*N. palatina*, *P. stimulus* and *S. alleni*). There are several examples in which there is no congruence between assessment methods. In a recent study by Armenta-Montero et al. [28] with ferns of the genus *Phlegmariurus*, these authors found that only one of the nine species in the state of Veracruz, Mexico was included in the NOM-059-SEMARNAT-2010. When they assessed the nine species following IUCN's method, five of them were classified as Vulnerable, three as Endangered and one, the species listed in the NOM-059-SEMARNAT-2010 under Special Protection (Pr), as Critically Endangered. Five out of ten of our results matched those from the IUCN Red List as they are endemic species and were assessed using IUCN´s Red List criteria B, i.e., restricted distribution. On the other hand, these species achieved the highest score in the MER due also to their restricted distribution and to the fact that they inhabit the cloud forest, the most threatened habitat in Mexico. As for the five species of dry forest assessed, there were discrepancies between the assessments. Three species (*N. palatina*, *P. stimulus* and *S. alleni*), were assessed as endangered (P) in the MER whereas the IUCN Red List placed them as Vulnerable (VU). This discrepancy is recurrent as well in our broader comparison of assessed mammals, as 67 species the categories do not match (Table 5). More importantly, a quick review highlights that 23 (34.32%) of these species fall Under Special Protection (Pr), which is equivalent to IUCN's Least Concern (LC) or Near Threatened (NT) (see table 1). Nevertheless these species are listed with some level of threat threatened in the IUCN Red List; 5 CR, 11 EN, and 7 VU. This is a case in which it is clear why having the MER assessment information available would be beneficial as it would allow us to clarify the reason for the actual differences between both results.

As we show in this case study we strongly support the idea that it is time to update the MER in order for it to be as useful as possible, especially in the light of the lack of information that we face with endangered species. Just as the issue of how to apply IUCN's method at the regional level have been addressed widely making its use more prevalent than ever before, we think some adjustments to the MER may transform this instrument profiting from its strengths and overcoming its weaknesses to better reflect our country's needs.

Conclusion

The most significant difference that we found between the MER and IUCN´s assessment method is the flexibility that IUCN allows, especially for species with lack of information. Even though the MER was specifically conceived to assess species at a local scale, we found the assessment may not always be objective, as the criteria are not well documented, not all of the information is present or may not be relevant for a group of species. As a result, some MER assessments might be biased.

We agree with many other authors [1,3,26,27,30,33] that the main objective of a Red List is to provide warning time and protection to the species in the more accurate way. As species extinction rates are increasing faster than we can assess species, we strongly suggest a review of the MER, with the goal of making it easier to assess species, with independency among criteria due to information gaps, with the use of information which is significant for conservation purposes, and a complete documentation and transparency through supporting information for each species status. This need is evident for species like those in the genus *Habromys* which inhabit the most threatened ecosystem in Mexico, the cloud forest [5,11,12] a fact which by itself should be enough to enlist and protect them and that should be easily achieved through the MER assessment.

Acknowledgement

We would like to thank Edgar Saavedra from the Subcoordinación de Especies Prioritarias, at CONABIO for preparing the maps for this study, as well as to all our colleagues that were kind enough to improve this manuscript with valuable comments.

References

1. De Grammont PC, Cuarón AD (2006) An Evaluation of Threatened Species Categorization Systems Used on the American Continent. Conserv Biol 20: 14-27.
2. Sánchez O, Medellín R, Aldama A, Goettshc B, Soberón J, et al. (2007) Risk Assessment Method Species of Wild Species in Mexico (MER). Mexico: Media Secretary of Environment and Natural Resources, Institute of Ecology, Institute of Ecology at the National Autonomous University of Mexico, Conabio.
3. Soberón J, Medellín R A (2007) Categorization Systems of Threatened Species. Conserv Biol 21: 1366-1367.
4. Hamilton LS, Juvik JO, Scatena FN (1995) Tropical Montaine Cloud Forest. Ecol. Stud 110.
5. CONABIO (2010a) Mountain cloud forest in Mexico: Threats and opportunities for conservation and sustainable management. Mexico: CONABIO. 196.
6. Challenger A (1998) The warm humid ecological zone (The cloud forest). In use and conservation of terrestrial ecosystems of Mexico, past, present and future. Mexico: CONABIO. 443-518.
7. Millennium Ecosystem Assessment (2005) Ecosystems and Human Well-being: Biodiversity Synthesis. World Resources Institute. Washington, DC.
8. Moran C, Catterall CP, Kanowski J (2009) Reduced dispersal of native plant species as a consequence of the reduced abundance of frugivore species in fragmented rainforest. Biol Conserv 142: 541-552.
9. Choo J, Juenger TE, Simpson BB (2012) Consequences of frugivore-mediated seed dispersal for the spatial and genetic structures of a neotropical palm. Mol Ecol 21: 1019-1031.
10. Koike S, Morimoto H, Kozakai C, Arimoto I, Soga M, et al. (2012) The role of dung beetles as a secondary seed disperser after dispersal by frugivore mammals in a temperate deciduous forest. Acta Oecol 41: 74-81.
11. Gual-Diaz M. and Rendon-Correa A (2014) Cloud forests of Mexico: diversity, ecology and management. National Commission for Knowledge and Use of Biodiversity. Mexico. 345.
12. Lamoreux JF, McKnight MW, Cabrera Hernandez R (2015) Amphibian Alliance for Zero Extinction Sites in Chiapas and Oaxaca. IUCN, Gland, Switzerland. 320.
13. May LW (1978) The economic uses and associated folklore of ferns and fern allies. Bot Rev 44: 491-528.
14. Ceballos G, Martinez L, Garcia A, Espinoza E, Bezaury J et al. (2010b) Diversity, threats and priority conservation of dry forests of Mexico Pacific areas (edn.). Mexico: Economic-CONABIO, Fonde Culture.
15. Lott E, Atkinson T (2010) Diversidad florística. Mexico: Bottom of Economic Culture CONABIO 63-76.
16. Ceballos G, Valenzuela D (2010) Diversity, ecology and conservation of vertebrates in Latin America. Mexico: Economic Culture Fonde-CONABIO 93-118.
17. Lindenmayer D, Cunningham R, Pope M (1999) A large-scale "experiment" to examine the effects of landscape context and habitat fragmentation on mammals. Biol Conserv 88: 387-403.
18. Stephens HC, Schmuki C, Burridge CP, O'Reilly-Wapstra JM (2013) Habitat fragmentation in forests affects relatedness and spatial genetic structure of a native rodent, Rattus lutreolus. Austral Ecol 38: 568-580.
19. Banks PB, Dickman CR (2000) Effects of winter food supplementation on reproduction, body mass, and number of small mammals in montane Australia. Can J Zool 78: 1775-1783.
20. Forman RT, Godron M (1986). Landscape Ecology. New York: John Wiley.
21. Laurance WF, Yensen E (1991) Predicting the impacts of edge effects in fragmented habitats. Biol Conserv 55: 77-92.
22. Fonseca CR, Joner F (2007) Two-Sided Edge Effect Studies and the Restoration of Endangered Ecosystems. Restoration Ecol 15: 613-619.
23. Craig MD, Stokes VL, Hardy GES, Hobbs RJ (2015) Edge effects across boundaries between natural and restored jarrah (Eucalyptus marginata) forests in south-western Australia. Austral Ecol 40: 186-197.
24. Jones NT, Germain RM, Grainger TN, Hall AM, Baldwin L, et al. (2015) Dispersal mode mediates the effect of patch size and patch connectivity on metacommunity diversity. J Ecol 103: 935-944.
25. IUCN (2012) IUCN Red List Categories and Criteria: Version 3.1. [2nd edn.] Gland, Switzerland and Cambridge, UK: IUCN. IV + p.32.
26. Brito D, Ambal RG, Brooks T, De Silva N, Foster M, et al. (2010) How similar are national red lists and the IUCN Red List? Biol Conserv 143: 1154-1158.
27. Arroyo TPF, Olson ME, García-Mendoza A, Solano E (2009). A GIS-Based Comparison of the Mexican National and IUCN Methods for Determining Extinction Risk. Conserv Biol 23: 1156-1166.
28. Armenta-Montero S, Carvajal-Hernández CI, Ellis EA, Krömer T (2015) Distribution and conservation status of Phlegmariurus (Lycopodiaceae) in the state of Veracruz, Mexico. Trop Conserv Sci 8: 114-137.
29. Mace GM, Kunin W (1994) Classifying Threatened Species: Means and Ends [and Discussion]. Biol Conserv 344: 91-97.
30. Raimondo DC, von Staden L, Donaldson JS (2013) Lessons from the Conservation Assessment of the South African Megaflora. Ann Mo Bot Gard 99: 221-230.
31. Todd CR, Burgman MA (1998) Assessment of Threat and Conservation Priorities under Realistic Levels of Uncertainty and Reliability. Conserv Biol 12: 966-974.
32. SEMARNAT (2010) Mexican Official Standard NOM-059-SEMARNAT-2010, Environmental Protection Mexico-native species of flora and wild-risk categories and specifications for inclusion, exclusion or change-List wildlife species at risk. [Regulatory Annex III]. Mexico. 1-19.
33. Burgman MA (2002) Are listed threatened plant species actually at risk? Aust J Bot 50: 1-13.