UNIVERSIDAD NACIONAL AUTÓNOMA DE MÉXICO
POSGRADO EN CIENCIAS BIOLÓGICAS
INSTITUTO DE ECOLOGÍA

ECOLOGÍA

PROYECTO

MAMÍFEROS DE LAS SELVAS SECAS DEL PACÍFICO MEXICANO.

PATRONES DE DISTRIBUCIÓN Y ÁREAS PRIORITARIAS PARA LA CONSERVACIÓN

TESIS

POR ARTÍCULO CIENTÍFICO

Fighting the extinction crises: distribution and priority areas for conservation of one

of the most endangered mammal assemblages in the Neotropics

QUE PARA OPTAR POR EL GRADO DE:

MAESTRA EN CIENCIAS BIOLÓGICAS

PRESENTA:

ANA REBECA CALANOCE

TUTOR PRINCIPAL DE TESIS: DR. GERARDO JORGE CEBALLOS GONZÁLEZ
INSTITUTO DE ECOLOGÍA, UNAM
COMITÉ TUTOR: DR. ANDRÉS GARCÍA AGUAYO
INSTITUTO DE BIOLOGIA, CHAMELA, UNAM
DR. DAVID VALENZUELA GALVÁN
CENTRO DE INVESTIGACIÓN EN BIODIVERSIDAD Y CONSERVACIÓN, UAEM

CIUDAD UNIVERSITARIA, CD. MX. NOVIEMBRE, 2023.

UNIVERSIDAD NACIONAL AUTÓNOMA DE MÉXICO
POSGRADO EN CIENCIAS BIOLÓGICAS
INSTITUTO DE ECOLOGÍA

ECOLOGÍA

PROYECTO

MAMÍFEROS DE LAS SELVAS SECAS DEL PACÍFICO MEXICANO.

PATRONES DE DISTRIBUCIÓN Y ÁREAS PRIORITARIAS PARA LA CONSERVACIÓN

TESIS

POR ARTÍCULO CIENTÍFICO

Fighting the extinction crises: distribution and priority areas for conservation of one

of the most endangered mammal assemblages in the Neotropics

QUE PARA OPTAR POR EL GRADO DE:

MAESTRA EN CIENCIAS BIOLÓGICAS

PRESENTA:

ANA REBECA CALANOCE

TUTOR PRINCIPAL DE TESIS: DR. GERARDO JORGE CEBALLOS GONZÁLEZ
INSTITUTO DE ECOLOGÍA, UNAM
COMITÉ TUTOR: DR. ANDRÉS GARCÍA AGUAYO
INSTITUTO DE BIOLOGIA, CHAMELA, UNAM
DR. DAVID VALENZUELA GALVÁN
CENTRO DE INVESTIGACIÓN EN BIODIVERSIDAD Y CONSERVACIÓN, UAEM

CIUDAD UNIVERSITARIA, CD. MX. NOVIEMBRE, 2023.

M. en C Ivonne Ramírez Wence
Directora General de Administración Escolar, UNAM

P r e s e n t e

Me permito informar a usted que en la reunión ordinaria del Comité Académico del Posgrado en Ciencias Biológicas, celebrada el día **19 de junio del 2023**, se aprobó el siguiente jurado para el examen de grado de **MAESTRA EN CIENCIAS BIOLÓGICAS** en el campo de conocimiento de **Ecología** de la alumna **CALANOCE ANA REBECA** con número de cuenta: **521462662** por la modalidad de graduación de **tesis por artículo científico** titulado: **"Fighting the extinction crises: distribution and priority areas for conservation of one of the most endangered mammal assemblages in the Neotropics",** que es producto del proyecto realizado en la maestría que lleva por título: **"MAMÍFEROS DE LAS SELVAS SECAS DEL PACÍFICO MEXICANO. PATRONES DE DISTRIBUCIÓN Y ÁREAS PRIORITARIAS PARA LA CONSERVACIÓN",** ambos realizados bajo la dirección del **DR. GERARDO JORGE CEBALLOS GONZÁLEZ,** quedando integrado de la siguiente manera:

Presidente: DR. ADOLFO GERARDO NAVARRO SIGÜENZA

Vocal: DR. RURIK HERMANN LIST SÁNCHEZ

Vocal: DR. ENRIQUE MARTÍNEZ MEYER

Vocal: DR. FRANCISCO JAVIER BOTELLO LÓPEZ

Secretario: DR. DAVID VALENZUELA GALVÁN

Sin otro particular, me es grato enviarle un cordial saludo.

A T E N T A M E N T E
"POR MI RAZA HABLARÁ EL ESPÍRITU"
Ciudad Universitaria, Cd. Mx., a 31 de agosto de 2023

COORDINADOR DEL PROGRAMA

DR. ADOLFO GERARDO NAVARRO SIGÜENZA

c. c. p. Expediente del alumno

AGNS/ERR/EARR/err

Agradecimientos institucionales

Agradecimientos personales

Quiero expresar mi profundo agradecimiento a mi tutor, el Dr. Gerardo Ceballos, por brindarme la oportunidad de ser su estudiante y por compartir sus valiosas enseñanzas día tras día. Su apoyo tanto académico como emocional a lo largo de mis estudios de Maestría ha sido fundamental. También quiero agradecer al Dr. Andrés García por sus enseñanzas y sus valiosos comentarios en cada instancia de evaluación semestral, así como por su valioso tiempo. Además, deseo expresar mi enorme gratitud al Dr. David Valenzuela por su incondicional apoyo en cada una de las evaluaciones de este proyecto, sus relevantes comentarios y el tiempo que me ha dedicado. Agradezco al Dr. José González-Maya por guiarme en esta última etapa y compartir su conocimiento y tiempo para enriquecer mis análisis. También quiero agradecer su gran predisposición y destacar su excelencia como maestro.

Deseo mostrar mi profunda gratitud a los distinguidos miembros del jurado, el Dr. Adolfo Navarro Sigüenza, el Dr. Rurik List Sánchez, el Dr. Enrique Martínez Meyer, el Dr. Francisco Botello López y el Dr. David Valenzuela Galván, por su amable disposición y sus valiosos comentarios respecto a la presente tesis. Sus contribuciones han enriquecido significativamente la calidad de este trabajo.

Extendiendo mi profunda gratitud al Maestro Jesús Pacheco por su apoyo constante durante mis estudios y por ser un gran respaldo emocional a lo largo de estos dos años. Agradezco a la Maestra Yolanda Domínguez por su incondicional ayuda y disposición, así como por su calidez como persona.

También quiero expresar mi gratitud a mis amigos, quienes a pesar de la distancia que nos separa, han estado presentes en cada momento de mi estadía en México. Emilia, Agustina, Bela, Viqui, Mer, Lau, Camila, Scarlet, María Paz, Sol, Agustín, Emiliano, Marcos y Mauri, gracias por su apoyo incondicional.

Quiero agradecer a mis queridos amigos y compañeros del laboratorio que me han apoyado y guiado a lo largo de mis estudios. Gracias, Israel, Erika, Cho Yi, Diego, Daniela, Oziel, Velma, Vero, Omar, Itzcóatl y Karina.

Por último, quisiera expresar mi más profundo agradecimiento a mi amada familia y pareja, quienes han sido mi mayor fuente de apoyo en cada decisión que he tomado y han sido fundamentales en mi crecimiento personal. Agradezco de todo corazón a mis padres por su apoyo incondicional, a mi pareja, Daniel, a mis queridos primos, tíos, sobrinos y padrinos Mónica y Alfredo, por estar siempre presentes en mi vida, a pesar de la distancia.

Dedicatoria

A mis queridos padres, quienes han sido los pilares fundamentales desde el inicio de mi trayectoria académica hasta mis estudios de posgrado en México. Les estoy infinitamente agradecida por brindarme la oportunidad de estudiar y perfeccionarme en aquello que amo. Son mi motor y mi ejemplo de vida, y siempre llevaré en mi corazón el valor del sacrificio y el amor que me han transmitido.

A mi amada pareja Daniel, gracias por ayudarme a crecer cada día, por incentivar y apoyar mis sueños incondicionalmente. Gracias por ser mi compañero, por enseñarme que es maravilloso crecer y brillar juntos, gracias por siempre estar.

Índice

RESUMEN

La conservación de la biodiversidad enfrenta importantes retos debido a la crisis de extinción, sobre todo si se tiene en cuenta la desaparición de poblaciones y la disminución en la abundancia de las poblaciones. Por ello, es necesario emplear enfoques múltiples para abordar los retos de la conservación biológica. Las selvas secas del Pacífico mexicano poseen una distintiva diversidad de mamíferos que enfrentan severas amenazas debido a los impactos antropogénicos. El objetivo principal de este estudio fue evaluar y comparar los patrones de distribución de la diversidad taxonómica y funcional a nivel local y entre comunidades (diversidad beta), para así identificar áreas prioritarias para la conservación de los mamíferos de las selvas secas. Estas selvas albergan el 33 % de los mamíferos terrestres del país, el 31 % de las especies endémicas de México y el 38 % de las especies poseen distribuciones restringidas a estas selvas. Los patrones de distribución taxonómica y funcional a nivel local fueron similares a escala nacional y regional (r = 0.62; r = 0.85), mostrando un gradiente latitudinal inverso. Sin embargo, la diversidad beta taxonómica fue un 42 % superior a la diversidad beta funcional. El recambio taxonómico fue predominante en la diversidad beta taxonómica, al contrario de la diversidad beta funcional en la cual el anidamiento funcional predominó. Con base en los resultados, el 30 % del área fue identificada como área prioritaria para la conservación de mamíferos, de esta área el 85 % ha sufrido un impacto antropogénico significativo. Además, el 48 % del área identificada requiere medidas de restauración, y solo el 7 % se encuentra bajo alguna categoría de protección. Estos resultados revelan que los mamíferos de las selvas secas del Pacífico mexicano presentan características evolutivas y ecológicas importantes y únicas, como áreas de distribución restringidas y altos niveles de endemismo, reflejados en un alto recambio taxonómico. Al mismo tiempo, el alto impacto antropogénico sobre esta ecorregión resalta la urgente necesidad de implementar medidas de conservación y restauración para preservar los remanentes de selvas secas y salvaguardar este ensamble único de mamíferos.

ABSTRACT

Biodiversity conservation represents an overarching challenge for humanity, given the current extinction crisis, especially when considering the extinction crisis at the populations level and overall decline. Such a challenge warrants employing multiple approaches to address the challenges of biological conservation. The dry forests of the Mexican Pacific possess a distinctive diversity of mammals that face severe threats due to anthropogenic impacts. The main objective of this study was to assess and compare the distribution patterns of taxonomic and functional diversity at the local level and among communities (beta diversity), to identify priority areas for the conservation of dry forest mammals. These forests harbor 33% of the country's terrestrial mammals and 31% of Mexico's endemic species, and 40% of the species are, in fact, restricted to these forests. The taxonomic and functional distribution patterns at the local level were similar at the national and regional scales ($r = 0.62$; $r = 0.85$), indicating an inverse latitudinal gradient. However, taxonomic beta diversity was 42% higher than functional beta diversity, with taxonomic turnover predominating. Based on the findings, 30% of the area was identified as a priority area for mammal conservation, while 85% of this area has been significantly impacted by human activity. Furthermore, 48% of the identified area required restoration measures, while only 7% had some form of protection. These results reveal that dry forests mammals of the Mexican Pacific represent important and unique evolutionary and ecological features, such as restricted areas of distribution and high levels of endemism, reflected in high taxonomic turnover. At the same time, the high anthropogenic impact on this ecoregion highlights the urgent need to implement conservation and restoration measures to preserve the remnants of dry forests and safeguard this unique assemblage of mammals.

INTRODUCCIÓN GENERAL

La pérdida de biodiversidad constituye uno de los desafíos ambientales más críticos en la actualidad. Investigaciones previas han evidenciado que la tasa de extinción de especies de vertebrados sobrepasa significativamente la tasa normal de fondo, demostrando que estamos frente a la sexta extinción masiva [1,2]. Además, la disminución de poblaciones tanto de especies en peligro extinción como de especies comunes se está volviendo cada vez más frecuente y generalizada, precediendo a la futura extinción a nivel de especie. Estas pérdidas amenazan los servicios ecosistémicos de los cuales la humanidad depende. Entre los principales factores que determinan la disminución y extinción de poblaciones y especies, se destacan la sobreexplotación de los recursos, la destrucción del hábitat, los impactos de las especies invasoras y el cambio climático [1,3]. Sin lugar a duda, uno de los grupos taxonómicos más afectados por estos factores son los mamíferos, dado que aproximadamente el 25 % de ellos se encuentran en peligro de extinción y más de la mitad de las poblaciones están experimentando un declive [4–7].

La tasa de extinción de especies en las regiones tropicales es notablemente alta debido a la gran diversidad biológica que albergan [8]. Sin embargo, los estudios centrados en las selvas secas son limitados y subrepresentados en la literatura científica en comparación con las selvas húmedas, a pesar de que las selvas secas abarcan el 42 % de las selvas tropicales a nivel mundial [9–11]. Lamentablemente, solo el 2 % de las selvas secas permanecen intactas y tan solo el 8 % se encuentra bajo alguna forma de protección, a pesar de su importancia como reservorio de biodiversidad [10–14].

En México, las selvas secas son el tipo predominante de vegetación tropical, dado que abarcan más del 60 % del área total de la vegetación tropical en el país [12–14]. Las selvas secas se encuentran representadas por los siguientes tipos de vegetación predominantes, la selva baja caducifolia y subcaducifolia, la selva baja espinosa caducifolia, y la selva mediana caducifolia y subcaducifolia [9,15]. Además, es importante destacar que las selvas secas se caracterizan principalmente por su marcada estacionalidad, debido a que estas presentan una marcada estación seca, en la cual las precipitaciones son

inferiores a 100 mm, y entre el 50 % y 100 % de la vegetación pierde su follaje. Por lo que las lluvias se concentran, solamente, durante los meses de verano [9–16].

A principios del siglo XX, en México, las selvas secas constituían una franja casi continua en la vertiente del Pacífico, desde el sur de Sonora hasta los límites de los estados de Oaxaca y Chiapas [12–15]. Estas selvas se adentraban en el interior del país a través de la cuenca del río Balsas y la depresión central de Chiapas [12,16]. Aunque no se incluyan en este artículo, también existen selvas secas en áreas discontinuas en la vertiente del Golfo y al norte de la Península de Yucatán [12, 17]. Sin embargo, la distribución actual de este ecosistema ha sido ampliamente modificada debido al impacto de las actividades antropogénicas, principalmente la agricultura y la ganadería [10,12–14]. Se estima que la tasa de deforestación anual es del 2 %, y solo el 27 % de estas selvas se encuentra en un buen estado de conservación [12,13]. Asimismo, la presente situación de conservación de estos ecosistemas puede incluso empeorar si se cumplen los posibles efectos negativos [18–21].

Las selvas secas del Pacífico de México se encuentran aisladas geográfica como ecológicamente de otros bosques tropicales [12,17]. Al norte del Istmo de Tehuantepec, las selvas secas apenas se conectan con las selvas tropicales húmedas más sureñas. Dicho aislamiento ha limitado la riqueza específica de este ecosistema, pero a la vez ha facilitado la especiación de varios grupos de plantas como de animales [12, 17,22,23]. Aunado a ello, las selvas secas son uno de los ecosistemas más ricos del país, albergando el 34 % de todos los vertebrados terrestres del país [12, 17]. Si bien las selvas secas, en comparación, con las selvas húmedas presentan una menor riqueza específica; las selvas secas registran una elevada tasa de recambio de especies (alta diversidad beta) [12, 14,24].

Ante los complejos escenarios de extinción de especies y cambio climático [1,2,3,11,20,21], resulta imprescindible analizar los patrones de la diversidad biológica. Esta exploración nos permite identificar las áreas con mayor diversidad biológica y determinar qué regiones son viables para la conservación. Dada la limitación de recursos, especialmente en Latinoamérica [25–27], es fundamental tomar decisiones eficientes en materia de conservación.

Hasta hace poco tiempo, los estudios de los patrones de distribución se centraban en la diversidad taxonómica, que se refiere al número y composición de especies, endemismo y vulnerabilidad [28,29]. Sin embargo, gracias a los avances de los métodos y técnicas estadísticas, ahora podemos complementar estos análisis con la evaluación de aspectos tan diversos como la filogenia y la diversidad funcional. Además, se considera a la diversidad funcional como un indicador más consistente de la resiliencia de los ecosistemas en comparación con la diversidad taxonómica [28,30–34]. Por lo tanto, es necesario llevar a cabo análisis con enfoques múltiples, ya que se ha demostrado que las dimensiones de la diversidad no siempre coinciden, es decir, un área con una alta diversidad taxonómica puede mostrar una baja diversidad funcional y viceversa [4,29,31,33]. Además, los resultados de estos análisis pueden variar según la escala de estudio, ya sea a nivel local o en términos de disimilitud entre comunidades, diversidad beta [29,31]. Por ello, en este estudio se abordan las siguientes preguntas claves sobre la diversidad biológica de los mamíferos en las selvas secas del Pacífico mexicano, junto con sus implicaciones para la conservación: 1) ¿Cómo pueden clasificarse las áreas y tipos de distribución de las especies?; 2) ¿Cuáles son los patrones de distribución de la diversidad taxonómica y funcional?; 3) ¿Cuáles son las áreas prioritarias para la conservación?

El presente estudio ofrece una valiosa perspectiva al abordar diversas dimensiones de la diversidad de los mamíferos presentes en las selvas secas del Pacífico mexicano. Este análisis incluye la exploración de los patrones de distribución de las especies de mamíferos, así como los patrones de la diversidad taxonómica y funcional, tanto a un nivel local como entre comunidades (diversidad beta), con el fin de dilucidar las similitudes y diferencias en dichos patrones, y sus posibles explicaciones. Para así, identificar áreas prioritarias para la conservación, basándonos en los resultados obtenidos y en los índices de diversidad más relevantes. De esta manera, buscamos que este proyecto contribuya a la toma de decisiones que promueven la conservación efectiva y eficiente de uno de los ecosistemas más diversos del país, el cual lamentablemente enfrenta severas amenazas debido al impacto antropogénico.

Fighting the extinction crises: distribution and priority areas for conservation of one of the most endangered mammal assemblages in the Neotropics

Rebeca Calanoce[1,2]*, José F. González-Maya[3,4], Andrés García[5], Gerardo Ceballos[1]

[1] Instituto de Ecología, Universidad Nacional Autónoma de México, Ciudad de México, México.

[2] Posgrado en Ciencias Biológicas, Universidad Nacional Autónoma de México, México.

[3] Proyecto de Conservación de Aguas y Tierras, ProCAT Colombia/Internacional, Bogotá, Colombia.

[4] Departamento de Ciencias Ambientales, CBS, Universidad Autónoma Metropolitana Unidad Lerma, Lerma de Villada, Estado de México, México.

[5] Estación de Biología Chamela, Instituto de Biología, Universidad Nacional Autónoma de México, La Huerta, Jalisco, México.

* Corresponding author

E-mail: rebe.calanoce@gmail.com

Abstract

Biodiversity conservation represents an overarching challenge for humanity, given the current extinction crisis, especially when considering the extinction crisis at the populations level and overall decline. Such a challenge warrants employing multiple approaches to address the challenges of biological conservation. The dry forests of the Mexican Pacific possess a distinctive diversity of mammals that face severe threats due to anthropogenic impacts. The main objective of this study was to assess and compare the distribution patterns of taxonomic and functional diversity at the local level and among communities (beta diversity), to identify priority areas for the conservation of dry forest mammals. These forests harbor 33% of the country's terrestrial mammals and 31% of Mexico's endemic species, and 40% of the species are in fact restricted to these forests. The taxonomic and functional distribution patterns at the local level were similar at the national and regional scales ($r = 0.62$; $r = 0.85$), indicating an inverse latitudinal gradient. However, taxonomic beta diversity was 42% higher than functional beta diversity, with taxonomic turnover predominating. Based on the findings, 30% of the area was identified as a priority area for mammal conservation, while 85% of this area has been significantly impacted by human activity. Furthermore, 48% of the identified area required restoration measures, while only 7% had some form of protection. These results reveal that dry forests mammals of the Mexican Pacific represent important and unique evolutionary and ecological features, such as restricted areas of distribution and high levels of endemism, reflected in high taxonomic turnover. At the same time, the high anthropogenic impact on this ecoregion highlights the urgent need to implement conservation and restoration measures to preserve the remnants of dry forests and safeguard this unique assemblage of mammals.

Introduction

The loss of biodiversity constitutes one of the most critical environmental challenges today. Previous research has shown that the extinction rate of vertebrate species significantly exceeds the normal background rate, demonstrating that we are facing the sixth mass extinction [1,2]. Additionally, population declines of both endangered and common species are becoming more frequent and widespread, preceding future

extinction at the species level[3]; but also, such losses also threaten the provision of ecosystem goods and services on which humanity depends. Among the main multiple factors that promote the decline and extinction of populations and species, overexploitation, habitat destruction, the impacts of invasive species and climate change stand out [2,4,5]. Undoubtedly, one of the taxonomic groups mainly affected by these factors are mammals, of which approximately 25% of all species are currently under risk and more than half of their populations are experiencing a decline [6–9].

Species extinction rates in tropical regions are remarkably high due to the great biological diversity inhabiting in these ecosystems [10]. However, studies focused on seasonally tropical dry forests (STDFs) are limited and underrepresented in the scientific literature compared to tropical humid forests, even though STDFs encompass 42% of tropical forests globally [11–13]. Unfortunately, only 2% of STDFs remain intact and only 8% are under some form of protection, despite their importance as a reservoir of biodiversity [12–16].

In the case of Mexico, at the beginning of the 20th century, STDFs constituted an almost continuous strip along the Pacific slope, from southern Sonora state to the limits of the states of Oaxaca and Chiapas[14,15,17]. These forests cover the interior of the country through the Balsas River Basin and the Central Depression of Chiapas and are also present in discontinuous areas along the Mexican Gulf slope and the north of the Yucatan Peninsula [14,17]. However, the current distribution of this ecosystem has been widely modified due to the impact of anthropogenic activities, mainly agriculture and livestock [12,14–16]. It is estimated that the annual deforestation rate is 2%, and only 27% of these forests are in a good conservation status [14,16]. The conservation situation for these ecosystems may even worsen if the potential negative effects of climate change are fulfilled [18–20].

Given the complex scenarios of species extinction and climate change [1,5,13], it is essential to analyze multiple aspects of biological diversity and the patterns that emerge from such attributes. This exploration allows identifying areas with the greatest biological diversity and determine which regions are

viable for conservation. Due to the limited resources, especially in Latin America, it is essential to make efficient decisions regarding conservation [7,21].

Until recently, studies of distribution patterns focused on taxonomic diversity, which refers to the number and composition of species, endemism, and vulnerability [22,23]. However, thanks to advances in statistical methods, computing capacity, and techniques, we can now complement these analyzes with the evaluation of aspects as diverse as phylogeny or function. Furthermore, functional diversity is considered a more consistent indicator of ecosystem resilience compared to taxonomic diversity [23–27]. Therefore, it is necessary to carry out analyzes with multiple approaches, since it has been shown that the dimensions of diversity do not always coincide, that is, an area with high taxonomic diversity may show low functional diversity and vice versa. In addition, the results of these analyzes may vary depending on the scale of study, either locally or in terms of dissimilarity between communities, beta diversity[6,28–31]. Therefore, this study addresses the following key questions about the biological diversity of mammals in STDFs of the Mexican Pacific slope, together with their implications for conservation: 1) How can the areas and types of distribution of species be classified?; 2) What are the distribution patterns of taxonomic and functional diversity?; 3) What are the priority areas for conservation?

Materials and Methods

Study area

STDFs of the Mexican Pacific slope extend over a wide territory, from southern Sonora to northern and central Chiapas. These forests present a significant distribution towards the interior of Mexico, through the Balsas River Basin and the Central Depression of Chiapas, covering an approximate latitudinal extension of 16°. Our study area has been considered as a unit of analysis given that the predominant ecosystems in it are STDFs [32,33]. These ecosystems exhibit an altitudinal range from sea level to 1,900 masl, although they are more common at altitudes below 1,500 masl. The average annual temperature varies between 20° and 29°C, and the extreme minimum temperature never drops below 0°C. Regarding precipitation, the annual

average covers a range of 300 to 1800 mm, being more frequent in the interval of 600 to 1200 mm. The rain is concentrated during the summer months, between June and October, with a duration that can oscillate between 4 and 7 months. On the other hand, the dry season generally prevails from December to May, with a continuous duration of 5 to 8 months, during which precipitation is less than 100 mm and between 50 and 100% of the vegetation loses its foliage. In this ecoregion, the predominant vegetation types include low deciduous and semi-deciduous forest, low thorn deciduous forest, and medium deciduous and semi-deciduous forest. It is important to highlight that, despite the heterogeneity in the environmental conditions of our study area, SDTFs are mainly characterized by their marked seasonality, as has been pointed out in previous research [11,14–17,34,35]. To carry out the spatial analyses, the regionalization defined by the National Commission for the Knowledge and Use of Biodiversity (CONABIO) was adopted [36]. The study area was subdivided into 10 km² cells for the purpose of performing subsequent analyzes using the ArcGIS (version 10.8) and R 4.2.2 [37] programs.

Species distribution

We based our analyses on previous comprehensive species list generated for this ecosystem [14,17,38–41]. Afterwards, we complemented the databases with information obtained from global [42,43] and regional sources (CONABIO, 2022) that were depurated and verified. Species nomenclature was based on the latest taxonomic updates from the American Society of Mammalogists database [45]. Endemic species were identified both nationally and specific to dry forests. In addition, we classified as threatened those species that are under any category of threat both a global level (Vulnerable, Endangered, and Critically Endangered), as well as those subject to special protection at national level, according to the IUCN Red List of Threatened Species [43] and the official list for the country according to the Secretary of Environment – SEMARNAT [46].

The distributions of the species were classified at a continental and national scale. At the continental level, the species distributed in Mexico and in other North American countries, in Mexico and in other Central American countries, in Mexico and in other Central and South American countries, as well as the

species with distribution throughout the continent were identified. At the national level, species with distributions restricted to the Mexican Pacific Coast were identified, as well as those present both on the Mexican Pacific Coast and in other regions of the country. In addition, the types of distribution of mammals with restricted distribution to the Mexican Pacific Coast were classified, considering whether they were found in the north, north-central, central, Balsas River Basin, central-southern, south, and throughout the extension of the Pacific slope. For this purpose, the distribution polygons of the studied species obtained from the IUCN database [43] were used, which is constantly updated through systematic and standardized processes under the IUCN standards [47]. Given that the status of several subspecies has recently been raised to species level and databases have not been updated, we used the most up-to-date scientific articles to update the distributions of these species [42,44,48–60].

Taxonomic and functional diversity

Distribution patterns of taxonomic diversity and functional diversity at different scales, national and regional, were evaluated. On a national scale, a comprehensive analysis was carried out covering the 3,429 cells of 10 km² that comprise the entirety of our study area. This evaluation allowed us to compare and analyze the distribution of diversity throughout our extensive research area. On a regional scale, analyzes based on latitudinal bands were implemented with the objective of considering the variations in the number of cells present in each band, since the number of cells varied considerably in a range of 3 to 65 cells per latitudinal band [35].

In the present study we consider taxonomic diversity equivalent to the number of species [27,61,62]; thus, taxonomic diversity corresponds to the number of species present in each of the cells under study, on a national scale. In addition, the distribution patterns of both endemic and threatened species were analyzed. Taxonomic beta diversity was used to assess the proportion of species not shared between two communities relative to the total number of species present in both communities [31,62,63]. This measure has two components: turnover and nesting. The turnover component refers to the replacement of species between communities, while the nesting component focuses on the difference in the total number of species present in

11

each community, which implies that a community is a subset of another community richer in species (S1 Fig). To carry out the analysis of taxonomic beta diversity and its components, the Jaccard dissimilarity index was used [64]. This index allows to compare pairs of communities, in our case, pairs of cells. In addition, to highlight the changes between nearby communities compared to those that are more distant, we performed a weighted average using the weight as the inverse of the geographical distance between the analyzed cells [31]. This weighting allowed us to highlight the differences observed between nearby communities, given the broad scope of our study area. The values of these indices vary from 0 to 1, with 1 being the maximum value that indicates a 100% difference between communities [27,31,65].

Functional diversity, a measure that captures the variability of morphological, physiological, and ecological traits present in biological communities, has proven to be a stronger indicator for understanding ecosystem functioning and assessing its resilience compared to taxonomic diversity[23,25,27–30,66–68]. In this study, functional diversity was evaluated by using the functional richness index, which quantifies the volume occupied by a community in a functional space of n dimensions, where the axes represent the functional traits of the species or the axes obtained through Principal Coordinate Analysis (PCoA), as applied in our case [68–72]. To assess functional diversity, information was collected on mammalian functional traits, including body mass (measured in grams), litter size (number of pups per reproductive period), activity period (diurnal, cathemeral, and nocturnal), life habit (terrestrial, arboreal, flying, burrowing and aquatic), the trophic guild (herbivorous, omnivorous and carnivorous) and the diet (percentage of the diet distributed in the categories of invertebrates, vertebrates, fruits, nectar, seeds and other parts of the plant). Those species that did not present functional differences in relation to the selected traits were grouped into functional entities [73,74]. The required information was obtained from the COMBINE database [75] and from other additional sources to complete the missing data [40,76–78] (S1 Table). The mentioned functional traits were selected due to their ability to represent multiple dimensions of the ecological niche, including trophic, spatial, and temporal aspects, as well as species requirements and their influence on ecosystems [8,23,26,30,66,79–81]. It is important to highlight that both the trophic guild and the diet represent the same niche dimension, which implies that these traits are redundant. Therefore, we decided to select one of them

based on the quality of the functional space obtained in subsequent diet analyzes [64,82]. Next, a Gower distance matrix was carried out, considering the qualitative and quantitative nature of the functional traits collected. Gower's distance tends to present a bias towards qualitative variables, for which a correction proposed by de Bello et al. [83] helps reduce this bias [64,84]. From this distance matrix, a multidimensional Euclidean space was built using Principal Coordinate Analysis (PCoA). The quality of all possible functional spaces was evaluated, considering the minimum deviation between the original distance matrix and the Euclidean distances in the functional space [82]. This allowed us to determine which combination of traits showed better functional quality, either trophic guild or diet, as well as to discern the number of dimensions required in our functional space. Based on our observations, it was verified that the combination of the traits evaluated together with the diet exhibited a higher quality in the functional space compared to the trophic guild. In addition, it was identified that an eight-dimensional functional space presented a higher quality in terms of its ability to represent the variation present in the analyzed matrix [64,82,85,86]. However, considering that a four-dimensional functional space captured more than 90% of the variation present in the analyzed matrix, we decided to use this lower-dimensional configuration [82]. This choice allowed carrying out the required analyzes with a substantial amount of information and facilitated the interpretation of the results obtained. Next, the functional richness index was calculated for each of the cells at the national level; this index represents the volume occupied by the community present in each cell in comparison with the total volume occupied by all the species studied. Its value varies between 0 and 1, with 1 being the maximum value, indicating that the community represents 100% of the functional volume occupied by all the species under study [64].

Functional beta diversity, like taxonomic beta diversity, is a measure that reflects the degree of differentiation in terms of functional space occupation between two communities. Two main components can be distinguished: functional turnover and functional nesting (S1 Fig). The functional turnover indicates the degree of dissimilarity in the functional space between two communities that occupy a similar volume in this space. On the other hand, functional nesting refers to the difference in the volume occupied by the two communities in the functional space, where one community may be a subset of the other [31,64]. To assess

functional beta diversity and its components, we used the Jaccard dissimilarity index. This index is calculated between pairs of communities, in our case, between the cells analyzed. As in the taxonomic beta diversity analysis, we applied a weighted average using the inverse of the geographic distance between cells as weight, which allowed us to highlight the differences observed between contiguous communities. The values of these indices range from 0 to 1, where 1 represents a 100% difference between the compared communities [31,64,85,86].

Analyzes of latitudinal patterns of taxonomic and functional diversity were carried out to examine patterns at a regional scale, using latitudinal bands. The taxonomic diversity of each latitudinal band was calculated as the average of the number of species present in the cells that belong to that same latitudinal band. On the other hand, the functional diversity of each latitudinal band was determined as the average of the functional richness index of the cells of this band. To assess the taxonomic and functional beta diversity, as well as its components, a comparative approach was used between cells located at the same latitude. The resulting value represents a weighted average, considering the geographical distance between cells belonging to the same latitudinal band. This approach allowed quantifying the dissimilarity between the cells within each latitude and obtaining a representative measure of beta diversity.

To assess the existence of an association between taxonomic and functional diversity, as well as taxonomic and functional beta diversity, together with their components, we used a Mantel test [85]. This test was used to analyze the correlations of the patterns studied at the national and regional level. In addition, a partial Mantel test was carried out to control the possible effect of taxonomic diversity and the area of each latitudinal band on taxonomic and functional beta diversity. In this analysis, Spearman's correlation coefficient was used because the variables did not present a normal distribution. We used 1000 permutations to obtain robust and reliable results [31,85,86]. The values obtained from the correlations oscillate between 0 and 1, where values close to 0 indicate the absence of an association between the variables analyzed, while values close to 1 reflect a strong and positive association [85,86].

Priority areas for conservation

Priority areas for STDFs mammal conservation were identified in each of the dry forest ecoregions (level III) [36]. This was done using the taxonomic turnover index calculated at the national level. To guarantee reliable results, cells with a minimum area of 50 km² were selected. The goal of this selection was to remove any bias that might arise due to discrepancies between the boundaries of the species distribution maps [43] and the ecoregion and country polygons. This discrepancy can generate distortions in the intersection between the mentioned polygons. To mitigate bias arising from the difference in the number of species present in each cell (taxonomic nesting; S1Fig) compared to the difference in species composition between communities (taxonomic turnover; S1Fig), only those cells whose taxonomic nesting value was equal to or lower than the median were selected. Subsequently, cells that presented a taxonomic turnover value higher than the median were prioritized. It should be noted that, in some cases, multiple cells with values equal to the median were selected only when the unweighted turnover rate exceeded the median. This was used in situations where the cells were surrounded by previously prioritized cells, which had taxonomic turnover values higher than the median.

The anthropogenic impact in the selected cells was assessed using raster data from the anthropogenic impact index at a resolution of 1km² [87]. For this purpose, the index values were classified into five categories: very low, low, medium, high, and very high, corresponding to the quintiles. Subsequently, the raster was resampled to a resolution of 10km² to match the scale of our study. The value obtained for each 10 km² cell was the average of the values corresponding to the 1 km² cells that make it up. Each value was assigned a rating according to the categories of anthropogenic impact: very low, low, medium, high, and very high. The proportion of each category present in the total set of selected cells and in each of the dry forest ecoregions was evaluated [36]. This approach allowed us to examine anthropogenic impact in a more precise and detailed way, considering the different spatial scales and providing a quantitative assessment of the distribution of impact categories in our priority areas for conservation.

The polygons from protected natural areas (ANPs) at the federal, state, municipal, and ejido levels [88,89], as well as natural areas voluntarily designated for conservation (ADVCs) [90], were used to evaluate the number of selected cells that are under some category of protection. Cells with a protected area of at least

50% [91] were considered under some category of ANP or ADVC. To assess the state of conservation of the selected cells, vector data on the use and type of vegetation of these cells were used [92]. Based on these data, each cell was classified into the following categories: 1) Protection, refers to priority cells located within an ANP or ADVC; 2) Conservation: refers to priority cells that presented at least 70% of their area with primary vegetation cover; 3) Management for conservation: refers to priority cells that presented at least 50% of their area with primary vegetation cover and the rest distributed among secondary vegetation, agricultural activities or human settlements; 4) Restoration for conservation: refers to the cells that presented 30% of their area with primary vegetation cover, while at least 50% corresponds to agricultural activities and human settlements; 5) Intensive use: refers to priority cells that presented at least 70% of their area occupied by agricultural activities or human settlements. This classification allowed us to comprehensively assess the state of conservation of the selected cells, considering both their level of legal protection and the degree of alteration of their vegetation and land use.

Results

Mammal diversity, endemism, and conservation

In total, 173 mammal species were recorded in the STDFs of the Mexican Pacific (S2 Table), of which 45 species have undergone some taxonomic change recently, where 31 of them correspond to subspecies that have been elevated to the level of species and the remaining 14 species have changed genus (S2 Table). The species present in SDTFs represented 33% of the terrestrial mammals of Mexico and 28% of the endemic species of the country (Table 1). The Chiroptera order presented the highest species richness (77 species), representing 45% of the mammals of dry forests (Table 1). The second richest order in species was Rodentia (56 species), representing 32% of the mammalian species (Table 1). Thus, these orders represented 77% of the mammalian species.

Table 1. Biological diversity of terrestrial mammals of the Mexican Pacific Coast.

Order	Families	Genera	Species	Endemic species	Endangered species
Didelphimorphia	1/1	4/7	7/12	3/5	1/3
Cingulata	1/2	1/2	1/2	0/0	0/1
Pilosa	1/2	1/2	1/2	0/0	1/2
Primates	0/1	0/2	0/3	0/0	0/3
Lagomorpha	1/1	2/3	6/14	2/6	2/5
Rodentia	5/8	25/51	56/261	34/132	9/78
Eulipotyphla	1/2	2/6	2/45	2/29	2/22
Carnivora	5/6	18/21	20/33	1/1	9/15
Perissodactyla	1/1	1/1	1/1	0/0	1/1
Artiodactyla	2/4	2/7	2/9	0/0	0/5
Chiroptera	7/8	45/71	77/144	11/18	8/41
Total	**25/36 (69%)**	**101/173 (58%)**	**173/526 (33%)**	**53/192 (28%)**	**33/176 (19%)**

* The numbers before the slash (/) indicate the mammals in the dry forests, while those after it, the total in Mexico.

Around 31% of the species registered in the SDTFs were endemic to Mexico (53 species; Table 1 and S2 Table). The Rodentia order represented 64% of the endemic species recorded, with a total of 34 species (Table 1 and S2 Table). The order Chiroptera ranked second, which represented 21% of the endemic species, with 11 species (Table 1 and S2 Table).

Of the 53 endemic species, 60% were endemic to dry forests (32 species, S2 Table). Within this group of endemic species to dry forests, the order Rodentia also showed the highest number of species, representing 64% of the endemic species to dry forests (21 species in total, Table 1 and S2 Table). Therefore, 38% of the

rodent species recorded in the dry forests of the Mexican Pacific turned out to be endemic to this region (S2 Table).

It is important to highlight that three species of the genus *Tlacuatzin*, recently were taxonomically recategorized, and identified as endemic to Mexico and the dry forests. In addition, the only two species of shrews recorded in these forests (*Megasorex gigas* and *Notiosorex evotis*) turned out to be endemic to both Mexico and the dry forests (Table 1 and S2 Table). Likewise, the pygmy skunk (*Spilogale pygmaea*), the only terrestrial carnivore endemic to Mexico, is also exclusive to dry forests (Table 1).

About 19% of the mammals recorded for dry forests (a total of 33 species, Table 1 and S1) are classified under some threat category according to the IUCN (2022) and the NOM-059-SEMARNAT-2019. Of the 20 recorded carnivore species, 45% are threatened. The only terrestrial carnivore endemic to Mexico and the dry forests is threatened (*Spilogale pygmaea*; Table 1 and S2 Table).

Regarding the order Rodentia, of the 9 threatened species, 8 are endemic to Mexico and the dry forests of the Mexican Pacific (Table 1 and S2 Table). In the case of the order Chiroptera, of the 8 threatened species, 4 are endemic to Mexico and 3 are endemic to dry forests (Table 1 and S2 Table).

In addition, of the 45 species that have been recently recategorized (S2 Table), their conservation status is based on the previous classification according to the IUCN [43] and NOM-059-SEMARNAT-2019 [46] have not yet updated the conservation status of these species.

Species distribution

On a continental scale, 31% of the species studied were exclusively restricted to Mexico. In addition, 24% of the species presented a shared distribution with Central and South America, 17% with Central America, 15% with North America, and 13% were distributed throughout the American continent (S2 Table). On a national scale, 62% of the species were distributed in the dry forests of the Mexican Pacific, as well as in other regions of the country (108 species). The remaining 38% of the species presented a distribution restricted to the Mexican Pacific Coast (65 species).

Seven types of distribution were identified for the species that presented a distribution restricted to dry forests: species distributed to the north, north-central, central, Balsas River Basin, central-southern, southern, and along the entire length of the Pacific Coast. Around 12% of the species studied presented a restricted distribution to the north of the Mexican Pacific Coast, mainly in the ecotones between dry forests, scrublands, and thorn forests. Of these species, 6 of the 8 identified were endemic to Mexico and to dry forests (S2 Table, Fig 1). Only 6% of the species had a distribution restricted to the north-central Pacific Coast (4 species, Fig 1), all were endemic to Mexico and 50% were endemic to dry forests (S2 Table, Fig 1). Twenty three percent of the species presented a distribution restricted to the center of the Pacific Coast (15 species, Fig 1), all were endemic to Mexico and 80% of them were endemic to dry forests (S2 Table, Fig 1). Only 8% of the species presented a distribution restricted to the Balsas River Basin (5 species, Fig 1), all were endemic to Mexico and 60% of them were endemic to dry forests (S2 Table, Fig 1). Of the total, 17% of the species presented a distribution restricted to the center-south of the coast (11 species, Fig 1), of which more than half were endemic to Mexico and 30% were specifically endemic to dry forests (S2 Table, Fig 1); 12% of the species presented a restricted distribution to the south of the Pacific Coast (8 species, Fig 1), about 40% of them were endemic to Mexico and to dry forests. Finally, 22% of the species presented a distribution restricted to the entire length of the Pacific Coast (14 species, Fig 1), of which half were endemic to Mexico and 36% of them endemic to dry forests (S2 Table, Fig 1).

Taxonomic and functional diversity

The analysis of taxonomic diversity at the national level revealed an average value of 74 species considering the 3429 cells analyzed (Table 2). In addition, their minimum and maximum values ranged from 35 species to 106 species, respectively (Table 2). Regarding the distribution pattern at the national level, an inverse latitudinal gradient was evidenced, where the taxonomic diversity values increased proportionally towards lower latitudes, that is, from north to south (Fig 2). However, in the center of the Pacific Coast, high levels of taxonomic diversity were identified due to the presence of species with restricted distribution (see

Species Distribution section). Regarding functional diversity, an average value of 0.44 was recorded at the national level, with minimum and maximum values that varied between 0.11 and 0.84, respectively (Table 2). The maximum values were mainly concentrated in the southern Pacific Coast, where a higher number of species was observed (Fig 2). Therefore, the distribution pattern at the national level showed an inverse latitudinal gradient, with the highest values concentrated from the center to the south of the Pacific Coast (Table 2 and Fig 2), similar to the pattern observed in taxonomic diversity.

Table 2. Descriptive statistics of taxonomic and functional diversity at a national scale.

Attribute	Taxonomic	Functional
Diversity	74.67 ± 18.4 (35 - 106)	0.44 ± 0.15 (0.11 - 0.84)
Beta diversity	0.31 ± 0.04 (0.25 - 0.56)	0.18 ± 0.04 (0.12 - 0.40)
Turnover	0.22 ± 0.04 (0.14 - 0.35)	0.05 ± 0.02 (0 - 0.13)
Nesting	0.09 ± 0.03 (0.04 - 0.26)	0.14 ± 0.04 (0.09 - 0.35)

Mean ± standard deviation (minimum and maximum values).

The analysis of the distribution pattern of the endemic species revealed a concentration of the highest values in the center of the Pacific Coast, a region that is distinguished by its heterogeneity due to the convergence of the Balsas River Basin, the Neovolcanic Axis and the Sierra Madre Occidental (Fig 3). The number of endemic species varied between 0 and 24 (Fig 3). On the other hand, the distribution pattern of threatened species exhibited an inverse latitudinal gradient, where the number of threatened species increased as latitude decreased, like what was observed in taxonomic and functional diversity (Fig 3). The minimum and maximum values of threatened species ranged between 3 and 17, respectively.

The taxonomic beta diversity, which measured the dissimilarity between the mammalian communities in the 3429 cells analyzed, presented an average value of 0.31 at the national level, which indicates a 31% difference between the cells (Table 2). The minimum and maximum values varied between 0.25 and 0.56, the latter value being representative of a dissimilarity greater than 50%, which implies that the mammalian

communities in the cells can vary up to 56% (Table 2), considering the geographical distance between them. In terms of distribution, the highest values of beta taxonomic diversity were observed in the ecotone areas between the dry forests and the xeric scrubland in the north of the Pacific Coast, in the canyons of the Sierra Madre Oriental, in the center of the Pacific Coast and in the Balsas River Basin, where dry forests are adjacent to coniferous forests (Table 2, Fig 4). The analysis of the components of taxonomic beta diversity revealed that the turnover component was the main contributor, representing 71% of the observed diversity, while the nesting component contributed the remaining 29% (Table 2). This indicates that the differences between the cells are mainly explained by the presence of different species in different areas at the national level. The distribution pattern of the turnover component was predominant in the ecotone areas, where dry forests overlap with other ecoregions such as oak forests, pine forests, and xeric scrub (Fig 4). On the other hand, the distribution pattern of the nesting component showed higher values in the northern regions (Fig 4).

The functional beta diversity, which evaluates the difference in the functional traits of the mammalian communities in the 3429 cells analyzed, presented an average value of 0.18 at the national level, which indicates an 18% variability between the cells (Table 2). The minimum and maximum values varied between 0.12 and 0.40, the latter value being representative of a 40% difference in the mammalian communities between the cells analyzed, considering the geographical distance between them (Table 2). The distribution pattern of functional beta diversity revealed maximum values in the ecotone areas between dry forests and xeric scrub in the canyons of the Sierra Madre Oriental (Fig 4). The analysis of the components of functional beta diversity showed that functional nesting was the main contributor, explaining 78% of the observed functional variability, while functional turnover accounted for the remaining 22% (Table 2). This indicates that the difference in mammalian communities between the analyzed cells is mainly due to differences in the functional traits present, rather than the incorporation of new functional traits into the communities. The distribution pattern of the functional turnover component showed higher values in the ecotone areas between dry forests and xeric scrub in the canyons of the Sierra Madre Oriental (Fig 4) and in the center of the Pacific Coast. On the other hand, the distribution pattern of functional nesting reflected higher values in ecotone areas, mainly in the canyons of the Sierra Madre Oriental (Fig 4).

In relation to the association analyzes between the taxonomic and functional diversity indices, a significant positive correlation was found (Mantel test; r = 0.62, Fig 5), indicating that there is a direct relationship between taxonomic and functional diversity. That is, as taxonomic diversity increases, functional diversity also increases proportionally. Likewise, a significant positive correlation was found between taxonomic beta diversity and functional beta diversity (Mantel test; r = 0.55, Fig 5). However, when analyzing the components of these beta diversities, it was observed that the correlation between the turnover components was close to zero (Mantel test; r = 0.034, Fig 5). This indicates a near null association between the turnover components of taxonomic and functional beta diversity. In contrast, the taxonomic and functional nesting components presented a higher correlation (Mantel test; r = 0.35, Fig 5). When evaluating the possible effect of the differences in the number of species between the analyzed cells, a decrease in the significant positive correlation between the nesting components of taxonomic and functional beta diversity was observed (partial Mantel test; r = 0.17; Table 3). This was expected, since the taxonomic nesting component depends on the number of species present in each cell.

Table 3. Partial Mantel test, considering the differences in the number of species between the cells analyzed at the national scale.

Contrast	Mantel partial test Taxonomic diversity
Taxonomic beta diversity vs. Functional beta diversity	0.25***
Taxonomic turnover vs. Functional turnover	0.04***
Taxonomic nesting vs. Functional nesting	0.17***

Values correspond to Spearman correlation coefficients. ***$p<0.001$.

The results obtained for taxonomic and functional diversity at a regional scale, considering the different latitudinal bands, were consistent with those obtained at a national scale. Taxonomic diversity showed an

average value of 69 species (Table 4) in the 145 latitudinal bands analyzed, with minimum and maximum values ranging between 38 and 97 species (Table 4). For its part, functional diversity presented an average value of 0.40 in the 145 latitudinal bands, with minimum and maximum values of 0.15 to 0.61. In relation to the taxonomic and functional beta diversity at the regional scale, a damping of the extreme values was observed. These values represent the averages calculated in each of the latitudinal bands, which reduces the local differences that were observed in the analysis at the national level. The taxonomic beta diversity values were reduced by more than half compared to the analyses at the regional level, since the latitudinal bands present less dissimilarity between the communities in comparison with the analysis that considered the total area of the dry forests (Tables 2 and 4). The turnover component of taxonomic beta diversity explained 55% (Table 4) of the observed dissimilarity, while taxonomic nesting contributed the remaining 45% (Table 4). Therefore, the turnover component continued to be predominant, as observed at the national level (Tables 2 and 4). Regarding the components of functional beta diversity, functional nesting explained 80% (Table 4) of the observed functional dissimilarity, while functional turnover contributed the remaining 20% (Table 4), in agreement with what was observed at national scale (Tables 2 and 4).

Table 4. Descriptive statistics of taxonomic and functional diversity at regional scale (latitudinal bands).

Attribute	Taxonomic	Functional
Diversity	69.46 ± 16.66 (38 - 97.36)	0.40 ± 0.12 (0.15 - 0.61)
Beta diversity	0.11 ± 0.03 (0.01 - 0.19)	0.15 ± 0.05 (0 - 0.22)
Turnover	0.06 ± 0.02 (0 - 0.1)	0.03 ± 0.02 (0 - 0.1)
Nesting	0.05 ± 0.02 (0.01 - 0.1)	0.12 ± 0.04 (0 - 0.21)

Mean ± standard deviation (minimum and maximum values).

The association analyzes carried out between the taxonomic and functional indices at a regional scale, considering the different latitudinal bands, revealed significant positive correlations (Table 5). The

correlation between taxonomic and functional diversity was intensified (Mantel test; r = 0.85; Table 5), compared to the correlation obtained at the national level (Mantel test; r = 0.62, Fig 5). This indicates a closer relationship between species diversity and functional diversity at the regional level. In addition, the correlations between the taxonomic and functional turnover components were also strengthened (Mantel's test; r = 0.21, Table 5), compared to the correlations obtained at the national level (Mantel's test; r = 0.034, Fig 5). These results suggest a stronger association between changes in species composition and changes in functional attributes of communities at the regional level. Regarding the correlations obtained by controlling for the possible effect of richness and area of each latitudinal band on beta diversity and its components, minimal variability was observed, and all correlations turned out to be positive and significant (Table 5). This indicates that, even when considering the size and richness of the different latitudinal bands, the relationship between beta diversity and its components remains consistent and significant.

Table 5. Mantel test and Partial Mantel test at the regional scale, considering the differences in the number of species between the cells of each latitudinal band, and the area (measured in km²) of each latitudinal band.

Contrast	Mantel test	Mantel partial test	
		Taxonomic diversity	Area
Taxonomic diversity vs. Functional diversity	0.85***		
Taxonomic beta diversity vs. Functional beta diversity	0.33***	0.20***	0.20***
Taxonomic turnover vs. Functional turnover	0.21***	0.19***	0.20***
Taxonomic nesting vs. Functional nesting	0.26***	0.16***	0.21***

Values correspond to Spearman correlation coefficients. ***$p<0.001$.

Priority areas for conservation

Around 1042 cells were identified as priority areas for the conservation of mammals in SDTFs, which represents 30% of the total set of cells analyzed (3429 cells). These priority cells exhibited the highest values of weighted taxonomic turnover for each of the STDFs ecoregions (Level III) [36], presenting notable

turnover, with changes in species composition that varied from 20% to 30%. On average, it was identified that approximately 33% of the area of each of these ecoregions was considered as priority areas for conservation (Fig 6).

The resulting categories of the anthropogenic impact index, based on the quintiles obtained, revealed the following minimum and maximum values: very low: 0.1 to 0.31; low: 0.31 to 0.53; medium: 0.53 to 0.75; high: 0.75 to 0.93; very high: 0.96 to 0.99. In particular, the dry forests of the Mexican Pacific exhibited a higher proportion of high values in the index, corresponding to 39% of the areas analyzed. The medium values represented 31%, followed by 19% of low values, 8% of very high values and the remaining 3% of very low values (Fig 7). Therefore, it was observed that 78% of the values corresponded to anthropogenic impacts greater than 50% (Fig 7). In relation to the different ecoregions of the dry forests (Fig 7), it was observed that all of them presented a higher proportion of high values of the impact index, which agrees with the results obtained for the total set of dry forests (Fig 7). When analyzing the index values in the areas identified as priority for conservation, it was found that 48% of these areas showed high index values, followed by 29% medium values, 13% low values, 8% of very high values and 2% of very low values (Fig 7). Therefore, it was determined that 85% of the priority areas for conservation had an anthropogenic impact greater than 50% (Fig 7). Regarding the priority areas of each ecoregion, it was found that most of them exhibited values concentrated in the high category of the impact index (Fig 7). However, for the ecoregions of Sonora and Sinaloa hills and canyons of the Sierra Madre Occidental with xeric scrub and deciduous, and Valleys and depressions of Oaxaca and Puebla with deciduous forest and xerophytic scrub, a higher proportion of medium values was observed in the index, although these values correspond to areas with an anthropogenic impact greater than 50%.

Only 8% (267 cells) of the total area analyzed (3429 cells) was identified as protected according to different protection categories, ANP at the federal, state, municipal and ejido level, as well as ADVC, considering that at least 50% of the area of each cell was under protection. Within the protected cells, it was

observed that 81% corresponded to ANP at the federal level, 17% to ANP at the state, municipal and ejido levels, and 2% to ADVC.

In relation to the conservation status of the priority areas in dry forests (Figs 6 and 8), it was observed that 48% of these areas require restoration measures for their conservation. This is because more than 50% of its surface has been modified for agricultural and livestock production and human settlements. On the other hand, 18% of the areas presented an aptitude for management, since more than 50% of their vegetation cover corresponded to primary vegetation, and the rest to secondary vegetation, agricultural activities, and human settlements. Seventeen percent of the areas showed intensive land use, characterized by a change in the use of the land for livestock and agricultural activities and human settlements. Ten percent of the areas were considered suitable for conservation, since they presented a predominant cover of primary vegetation, which indicated a good state of preservation in these areas. Only 7% of the cells were found to be protected. However, in 73% of the protected areas a predominance of secondary vegetation and agricultural activities was observed, with values of anthropogenic impacts greater than 50%. Regarding the classification of priority areas in each of the dry forest ecoregions, it was observed that the dominant category in most of the ecoregions was restoration for conservation. However, in the ecoregion of the Sinaloan Coastal Plain with thorn forest, the predominance of the category of intensive use stood out, covering 59% of the priority areas. It is important to mention that, in the ecoregion of Sonora and Sinaloa hills and canyons of the Sierra Madre Occidental with xeric scrub and deciduous forest, the areas suitable for management were predominant, representing 44% of the priority areas. This finding is consistent with the results obtained in the anthropogenic index, since in that ecoregion, medium values of the index were mainly observed (Figs 6, 7 and 8). In addition, in the ecoregion of Valleys and depressions of Oaxaca and Puebla with deciduous forest and xeric scrub, a predominance of protected areas was found, covering 62% of priority areas. This is due to the presence of the Tehuacán-Cuicatlán Biosphere Reserve (Figs 6 and 8), whose area fully coincides with our selected priority areas.

Discussion

STDFs of the Mexican Pacific stand out for their remarkable diversity of mammals, hosting approximately 33% of the country's terrestrial mammals and 31% of the endemic species of Mexico, like those results reported in previous studies for both mammals and other vertebrate taxa [14,17,18,35,93,94]. It is important to highlight that 18% of these species correspond to former subspecies that have been recategorized as species (S2 Table). These recategorizations have significant conservation implications, as most of these new species have not been assessed in terms of their conservation status, due to recent taxonomic updates [40,48–53,55–60]. It is relevant to note that several of these recently categorized species have a distribution restricted to dry forests or are endemic to Mexico. This highlights the importance and uniqueness of the dry forests of the Mexican Pacific as a reservoir of biodiversity, hosting unique and sometimes highly specialized species in this particular ecosystem [35,93,94]. In addition, it is critical to highlight that the threatened mammals in this ecosystem present common ecological traits, such as a reduced geographic range (endemic species) or a large home range (in the case of carnivores). These traits have been identified as strong predictors of species extinction risk in previous studies [2,6,8].

In relation to the distribution patterns of mammals at national scale, it is notable that 38% of these species are restricted to the Mexican Pacific Coast, with almost 50% of them concentrated in the center of this coast and throughout its extension. These results once again emphasize the uniqueness and exclusivity of these species in this region as it has been suggested for vertebrate, reptiles, and amphibians [14,17,35,94].

Taxonomic and functional diversity reflected similar distribution patterns, at national and regional scales. These showed an inverse latitudinal gradient, which implies that as we move towards lower latitudes, there is a greater differentiation in the ecological niche of the species. This inverse latitudinal gradient suggests that, at lower latitudes, where environmental conditions are generally less adverse, the environmental filtering process in terms of ecological functions is less intense [23,95]. As a result, species can further differentiate themselves in terms of their functions and roles in the ecosystem. In this situation, competition for resources becomes the main factor that limits the coexistence of species (Gómez–Ortiz &

Moreno, 2017; Hooper et al., 2005a; Lamanna, Blonder, Violle, Kraft, Sandel, imova, et al., 2014; López & Freestone, 2020; Suárez-Castro et al., 2022).

The distribution patterns of endemic and threatened species coincide with previous studies [14,17,35,47]. The endemic species were concentrated in a particularly diverse area, where the Balsas River Basin, the Neovolcanic Axis and the Sierra Madre Occidental converge. This area is of great importance as it is home to both endemic species to Mexico and endemic to dry forests, as well as species with distribution restricted to dry forests. Regarding threatened species, a high correlation was found with the species richness gradient. This also reflects a global pattern in which the extinction of populations and species is a phenomenon that occurs worldwide, but shows a positive trend towards tropical regions, where the greatest diversity is concentrated [1,2,98].

Taxonomic beta diversity and functional beta diversity presented similar distribution patterns at the national scale. It was observed that the highest diversity values were concentrated in the canyons of the Sierra Madre Oriental, in the center of the Pacific Coast and in the Balsas River Basin. These areas are important because they are transition zones between different ecosystems and are home to many endemic and restricted species. However, taxonomic beta diversity was 42% higher than functional beta diversity.

Taxonomic dissimilarity was explained by a change in species composition (taxonomic turnover). On the other hand, beta-functional diversity was dominated by nesting, which means that the functional dissimilarity was due to some communities having a small portion of the functional traits present in other more functionally rich communities. This indicates that the influence of environmental characteristics on the selection of species traits had an unequal intensity in our study area [23,31,66,69,96].

The marked predominance of taxonomic turnover and the low presence of functional turnover suggest that, beyond the existing variability in dry forests, they exhibit a characteristic climate and physiognomy, especially marked by a distinctive dry season [11,14–17,32,34,35]. These patterns indicate that the assembly of the studied mammals is mainly influenced by environmental filtering, resulting in functional convergence.

In other words, although the species differ in their taxonomic composition, they share similar functional traits [22,31,63,99]. These results highlight the importance of environmental factors in the configuration of mammal communities in dry forests, since the climate and the specific conditions of these areas, especially the pronounced dry season, play a fundamental role in the selection of species and the configuration of functional traits present in these communities [66,95,100].

The distribution patterns of taxonomic and functional diversity, as well as taxonomic and functional beta diversity, at a regional scale (in latitudinal bands) remained consistent with those obtained at a national scale. However, it is important to highlight that the values of taxonomic beta diversity decreased by more than half. This decrease is since our study area was reduced to each latitudinal band and their value is the average value obtained in the cells corresponding to each latitudinal band, thus homogenizing the area or latitudinal band. Regarding functional beta diversity at the regional scale, the results were similar to those obtained at the national scale, where functional nesting predominated.

It is significant to highlight that the number of species did not bias the correlations obtained between the beta diversity indices at the national and regional scales. These correlations were equally significant, which suggests that the observed patterns are not affected by differences in the number of species and in the size of the area of each latitudinal band.

The selection of taxonomic turnover as an indicator of priority areas for conservation is because it explained 71% of the variation in taxonomic beta diversity. This implies that the differences in the mammalian assemblages analyzed between the different cells are mainly due to changes in species composition. This finding reflects the importance of taxonomic turnover at the national level, even considering the distance between the cells analyzed. The high proportion of variation explained by taxonomic turnover indicates the presence of a considerable number of endemic species in dry forests, with distribution patterns restricted to these regions. This highlights the importance of conserving both these species exclusive to the country or with restricted distribution, as well as the ecosystems of the dry forests. In addition, when contrasting the patterns of taxonomic diversity and taxonomic beta diversity, a notable disparity between

them is evident. It is observed that the pattern of inverse latitudinal gradient of taxonomic diversity can be attributed mainly to the presence of species with a wide geographic distribution, which differs from the patterns of beta diversity. While taxonomic diversity provides an overview of species richness in different regions, it is beta diversity that gives us detailed information about differences in species composition and assemblage structure in a spatial context [31,63,101,102].

The predominant taxonomic turnover was reflected in the fact that 30% of the area was identified as a priority area for conservation. In these areas, at least 20% of the species composition showed differences between the analyzed assemblages (cells), considering the geographical distance between them. Unfortunately, 85% of the priority areas for conservation had an anthropogenic impact that exceeds 50%. This is consistent with the high levels of impact observed throughout the dry forest area [103,104]. When examining the state of conservation of the identified priority areas, it was found that 48% of them require restoration measures, due to the significant repercussions of the excessive change in land use, especially for agricultural and livestock activities [14,92]. These findings are consistent with previous research that have highlighted the intensive and excessive use of dry forests [12,14–16,19,47]. Despite this, 18% of priority areas were classified as suitable for conservation management. This category represents those areas that could be used with caution, as long as sustainable agricultural and livestock practices are implemented that do not compromise the integrity of the primary vegetation, to preserve these large remnants of pristine ecosystems which provide ecosystem services from which we depend on [2,12,13,105,106]. Regarding the areas that presented intensive land use (17%), it is important to highlight that these areas face a high degree of impact and require considerable human and economic efforts for their restoration. However, it is crucial to recognize that the feasibility of restoring these highly degraded areas may prove difficult and even unfeasible in some cases [103]. Therefore, it is recommended that these impacted areas be prevented from expanding, prioritizing the adoption of measures to stop or reverse the existing deterioration. In contrast, approximately 10% of the priority areas identified for conservation present promising opportunities. These areas can be considered for planning the creation of protected natural areas (ANP), the implementation of areas

voluntarily designated for conservation (ADVC) or through payments for environmental services (PSA) [107]. Only 7% of the priority areas are currently under some form of protection. Despite having some degree of protection, 73% of these protected areas urgently require restoration measures. In these cells, the coverage of secondary vegetation and agricultural activities predominate, which translates into areas with an anthropogenic impact greater than 50%. These findings underscore the need to implement adequate management plans for the region's protected areas, to reverse negative impacts and restore their ecological functionality [30]. Likewise, when considering the entire study area, we found that only 8% of them are under some type of protection. These results are consistent with previous research that has highlighted the underrepresentation of protected areas in dry forests [12–14,16,20,108]. This highlights the need to intensify conservation efforts and expand the coverage of protected areas in this valuable ecosystem.

Acknowledgments

References

1.   Ceballos G, Ehrlich PR, Barnosky AD, García A, Pringle RM, Palmer TM. Accelerated Modern Human–induced Species losses: Entering the Sixth Mass Extinction. Science Advances. 2015;1: e1400253. doi:10.1126/sciadv.1400253.

2.   Dirzo R, Young HS, Galetti M, Ceballos G, Isaac NJB, Collen B. Defaunation in the Anthropocene. Science. 2014;345: 401–406. doi:10.1126/science.1251817.

3.   Ceballos G, Ehrlich PR. Mammal Population Losses and the Extinction Crisis. Science. 2002;296: 904–907. doi:10.1126/science.1069349.

4.   Genes L, Cid B, Fernandez FAS, Pires AS. Credit of ecological interactions: A new conceptual framework to support conservation in a defaunated world. Ecology and Evolution. 2017;7: 1892–1897. doi:10.1002/ece3.2746.

5.   Sage RF. Global change biology: A primer. Global Change Biology. 2019;26: 3–30. doi:10.1111/gcb.14893.

6.   Brum FT, Graham CH, Costa GC, Hedges SB, Penone C, Radeloff VC, et al. Global priorities for conservation across multiple dimensions of mammalian diversity. Proceedings of the National Academy of Sciences. 2017;114: 7641–7646. doi:10.1073/pnas.1706461114.

7.   Ceballos G. Conservation priorities for mammals in megadiverse Mexico: the efficiency of reserve networks. Ecological Applications. 2007;17: 569–578. doi:10.1890/06-0134.

8.   Davidson AD, Hamilton MJ, Boyer AG, Brown JH, Ceballos G. Multiple ecological pathways to extinction in mammals. Proceedings of the National Academy of Sciences. 2009;106: 10702–10705. doi:10.1073/pnas.0901956106.

9.   Schipper J, Chanson J, Chiozza F, Cox N, Hoffmann M, Katariya V, et al. The Status of the World's Land and Marine Mammals: Diversity, Threat, and Knowledge. Science; 2008 pp. 225–230.

10.   Lister BC, Garcia A. Climate-driven declines in arthropod abundance restructure a rainforest food web. Proceedings of the National Academy of Sciences. 2018;115: E10397–E10406. doi:10.1073/pnas.1722477115.

11.   Pennington RT, Ratter JA, Lewis GP. An overview of the plant diversity, biogeography and conservation of Neotropical savannas and seasonally dry forests. In: Pennington RT, Ratter JA, Lewis GP,

editors. Neotropical Savannas and Seasonally Dry Forests: Plant Biodiversity, Biogeography and Conservation. Florida, USA: CRC Press, Boca Raton; 2006. pp. 1–29.

12.	Pulla S, Ramaswami G, Mondal NK, Chitra-Tarak R, Suresh HS, Dattaraja HS, et al. Assessing the resilience of global seasonally dry tropical forests. International Forestry Review. 2015;17: 91–113. doi:10.1505/146554815815834796.

13.	Stan K, Sanchez-Azofeifa A. Tropical Dry Forest Diversity, Climatic Response, and Resilience in a Changing Climate. Forests. 2019;10: 443. doi:10.3390/f10050443.

14.	Ceballos G, Martinez L, García A, Espinoza E, Bezaury Creel J, Dirzo R, editors. Diversidad, Amenazas y áreas Prioritarias para la Conservación de Las Selvas Secas del Pacífico de México. 1 st ed. D.F, México; 2010.

15.	Trejo I. Análisis de la diversidad de la selva baja caducifolia en México. Sobre diversidad biológica: el significado de las diversidades alfa, beta y gamma. GORFI; 2005. pp. 111–122.

16.	Trejo I, Dirzo R. Deforestation of seasonally dry tropical forest. Biological Conservation. 2000;94: 133–142. doi:10.1016/s0006-3207(99)00188-3.

17.	Ceballos G, Garcia A. Conserving Neotropical Biodiversity: The Role of Dry Forests in Western Mexico. Conservation Biology. 1995;9: 1349–1353. Available: https://www.jstor.org/stable/2387179.

18.	Prieto-Torres DA, Lira-Noriega A, Navarro-Sigüenza AG. Climate change promotes species loss and uneven modification of richness patterns in the avifauna associated to Neotropical seasonally dry forests. Perspectives in Ecology and Conservation. 2020;18: 19–30. doi:10.1016/j.pecon.2020.01.002.

19.	García A, Ortega-Huerta MA, Martínez-Meyer E. Potential distributional changes and conservation priorities of endemic amphibians in western Mexico as a result of climate change. Environmental Conservation. 2013;41: 1–12. doi:10.1017/s0376892913000349.

20.   Villers-RuízL, Trejo-Vázquez I. Climate change on Mexican forests and natural protected areas. Global Environmental Change. 1998;8: 141–157. doi:10.1016/s0959-3780(98)00012-0.

21.   Ceballos G, Ehrlich PR, Soberón J, Salazar I, Fay JP. Global Mammal Conservation: What Must We Manage? Science. 2005;309: 603–607. doi:10.1126/science.1114015.

22.   Devictor V, Mouillot D, Meynard C, Jiguet F, Thuiller W, Mouquet N. Spatial mismatch and congruence between taxonomic, phylogenetic and functional diversity: the need for integrative conservation strategies in a changing world. Ecology Letters. 2010;13: 1030–1040. doi:10.1111/j.1461-0248.2010.01493.x.

23.   Córdova-Tapia F, Zambrano L. Functional diversity in community ecology. Ecosistemas. 2015;24: 78–87. doi:10.7818/ecos.2015.24-3.10.

24.   Álvarez-Grzybowska E, Urbina-Cardona N, Córdova-Tapia F, García A. Amphibian communities in two contrasting ecosystems: functional diversity and environmental filters. Biodiversity and Conservation. 2020;29: 2457–2485. doi:10.1007/s10531-020-01984-w.

25.   Cadotte MW, Tucker CM. Difficult decisions: Strategies for conservation prioritization when taxonomic, phylogenetic and functional diversity are not spatially congruent. Biological Conservation. 2018;225: 128–133. doi:10.1016/j.biocon.2018.06.014.

26.   Gómez–Ortiz Y, Moreno CE. La diversidad funcional en comunidades animales: una revisión que hace énfasis en los vertebrados. Animal Biodiversity and Conservation. 2017;40: 165–174. doi:10.32800/abc.2017.40.0165

27.   Moreno CE, Calderón-Patrón JM, Arroyo-Rodríguez V, Barragán F, Escobar F, Gómez-Ortiz Y, et al. Measuring biodiversity in the Anthropocene: a simple guide to helpful methods. Biodiversity and Conservation. 2017;26: 2993–2998. doi:10.1007/s10531-017-1401-1.

28.   Cadotte MW, Tucker CM. Difficult decisions: Strategies for conservation prioritization when taxonomic, phylogenetic and functional diversity are not spatially congruent. Biological Conservation. 2018;225: 128–133. doi:10.1016/j.biocon.2018.06.014.

29.   Gómez-Ortiz Y, Domínguez-Vega H, Moreno CE. Spatial variation of mammal richness, functional and phylogenetic diversity in the Mexican transition zone. Community Ecology. 2017;18: 121–127. doi:10.1556/168.2017.18.2.1.

30.   Salgado-Negret B, editor. La ecología funcional como aproximación al estudio, manejo y conservación de la biodiversidad: protocolos y aplicaciones. Bogotá, D. C. Colombia: Instituto de Investigación de Recursos Biológicos Alexander von Humboldt; 2015.

31.   Villéger S, Grenouillet G, Brosse S. Decomposing functional β-diversity reveals that low functional β-diversity is driven by low functional turnover in European fish assemblages. Global Ecology and Biogeography. 2013;22: 671–681. doi:10.1111/geb.12021.

32.   García A. Using ecological niche modelling to identify diversity hotspots for the herpetofauna of Pacific lowlands and adjacent interior valleys of Mexico. Biological Conservation. 2006;130: 25–46. doi: 10.1016/j.biocon.2005.11.030.

33.   Morrone JJ. Regionalización biogeográfica y evolución biótica de México: encrucijada de la biodiversidad del Nuevo Mundo. Revista Mexicana de Biodiversidad. 2019;90. doi:10.22201/ib.20078706e.2019.90.2980.

34.   Rzedowski R, editor. Vegetación de México. 1 st ed. México: Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, México; 2006.

35.   García A, Solano-Rodríguez H, Flores-Villela O. Patterns of alpha, beta and gamma diversity of the herpetofauna in Mexico's Pacific lowlands and adjacent interior valleys. Animal Biodiversity and Conservation. 2007;30: 169–177. doi:10.32800/abc.2007.30.0169.

36.   INEGI, CONABIO, INE. Ecorregiones Terrestres de México. Escala 1:1000000. México. 2008.

37.   R Studio Inc. RStudio Integrated Development Environment (IDE). 2023. Available: https://.r-project.org/.

38.   Ceballos G, Miranda A. Guía de campo de los mamíferos de la costa de Jalisco, México. 1 st ed. México: Fundación Ecológica de Cuixmala, AC, Instituto de Biología, UNAM; 2000.

39.   Ceballos G, Arroyo-Cabrales J, Medellín RA, Domínguez-Castellanos Y. Lista actualizada de los mamíferos de México. Revista mexicana de mastozoología. 2005;9: 21–71. doi:10.22201/ie.20074484e.2005.9.1.153.

40.   Ceballos G, editor. Mammals of Mexico. Baltimore: Johns Hopkins University Press; 2014.

41.   Pérez-Solano LA, González M, López-Tello E, Mandujano S. Mamíferos medianos y grandes asociados al bosque tropical seco del centro de México. Revista de Biología Tropical. 2018;66: 1232. doi:10.15517/rbt.v66i3.30810.

42.   GBIF.org. GBIF Home Page. 2022. Available: https://www.gbif.org

43.   IUCN. The IUCN Red List of Threatened Species. 2022. Available: http://www.iucnredlist.org

44.   Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO). Catálogo de autoridades taxonómicas de especies de flora y fauna con distribución en México. Base de datos SNIB-CONABIO, México. 2022.

45.   Mammal Diversity Database. Mammal Diversity Database (Version 1.10) [Data set]. 2022. doi:10.5281/zenodo.7394529.

46.   SEMARNAT. Modificación del Anexo Normativo III, Lista de especies en riesgo de la Norma Oficial Mexicana NOM-059-SEMARNAT-2010, Protección ambiental-Especies nativas de México de flora y fauna silvestres-Categorías de riesgo y especificaciones para su inclusión, exclusión o cambio-Lista de especies en riesgo, publicada el 30 de diciembre de 2010. 2019.

47.   García A, González-Maya JF, Ceballos G. Biogeography of terrestrial vertebrates and its conservation implications in a transitional region in western Mexico. Sharma LK, editor. PLOS ONE. 2022;17: e0267589. doi:10.1371/journal.pone.0267589.

48.   Arcangeli J, Light JE, Cervantes F. Molecular and morphological evidence of the diversification in the gray mouse opossum, Tlacuatzin canescens (Didelphimorphia), with description of a new species. Journal of Mammalogy. 2018;99: 138–158. doi:10.1093/jmammal/gyx173.

49.   Baird AB, Braun JK, Mares MA, Morales JC, Patton JC, Tran CQ, et al. Molecular systematic revision of tree bats (Lasiurini): doubling the native mammals of the Hawaiian Islands. Journal of Mammalogy. 2015;96: 1255–1274. doi:10.1093/jmammal/gyv135.

50.   Bradley RD, Mauldin MR. Molecular data indicate a cryptic species in Neotoma albigula (Cricetidae: Neotominae) from northwestern México. Journal of Mammalogy. 2016;97: 187–199. doi:10.1093/jmammal/gyv169.

51.   Bradley RD, Francis JQ, Platt RN, Soniat TJ, Alvarez D, LIndsey LL. Mitochondrial DNA Sequence Data Indicate Evidence for Multiple Species Within Peromyscus maniculatus. Special Publications, Museum of Texas Tech University. 2019.

52.   Carleton MD, Arroyo-CabralesJ. Review of the Oryzomys couesi Complex (Rodentia: Cricetidae: Sigmodontinae) in Western Mexico. Bulletin of the American Museum of Natural History. 2009;331: 94–127. doi:10.1206/582-3.1.

53.   Castañeda-Rico S, León-Paniagua L, Vázquez-Domínguez E, Navarro-Sigüenza AG. Evolutionary diversification and speciation in rodents of the Mexican lowlands: The Peromyscus melanophrys species group. Molecular Phylogenetics and Evolution. 2014;70: 454–463. doi:10.1016/j.ympev.2013.10.004.

54.   Garbino T, Lim BK, da V. Systematics of big-eyed bats, genus Chiroderma Peters, 1860 (Chiroptera: Phyllostomidae). Zootaxa. 2020;4846. doi:10.11646/zootaxa.4846.1.1.

55. Mantilla-Meluk H, Muñoz-Garay J. Biogeography and taxonomic status of Myotis keaysi pilosatibialis LaVal 1973 (Chiroptera: Vespertilionidae). Zootaxa. 2014;3793: 60–70. doi:10.11646/zootaxa.3793.1.2.

56. Kilpatrick CW, Pradhan N, Norris RW. A re-examination of the molecular systematics and phylogeography of taxa of the Peromyscus aztecus species group, with comments on the distribution of P. winkelmanni. Therya. 2021;12: 331–346. doi:10.12933/therya-21-1115.

57. López-González C, García-Mendoza DF, López-Vidal JC, Elizalde-Arellano C. Multiple lines of evidence reveal a composite of species in the plateau mouse, Peromyscus melanophrys (Rodentia, Cricetidae). Journal of Mammalogy. 2019;100: 1583–1598. doi:10.1093/jmammal/gyz106.

58. Loureiro LO, Engstrom MD, Lim BK. Single nucleotide polymorphisms (SNPs) provide unprecedented resolution of species boundaries, phylogenetic relationships, and genetic diversity in the mastiff bats (Molossus). Molecular Phylogenetics and Evolution. 2020;143: 106690. doi:10.1016/j.ympev.2019.106690.

59. Pavan AC, Marroig G. Integrating multiple evidences in taxonomy: species diversity and phylogeny of mustached bats (Mormoopidae: Pteronotus). Molecular Phylogenetics and Evolution. 2016;103: 184–198. doi:10.1016/j.ympev.2016.07.011.

60. Rogers DS, González MW. Phylogenetic relationships among spiny pocket mice (Heteromys) inferred from mitochondrial and nuclear sequence data. Journal of Mammalogy. 2010;91: 914–930. doi:10.1644/09-mamm-a-287.1.

61. Krebs CJ. Ecology: the experimental analysis of distribution and abundance. Harlow, USA: Pearson New International Edition; 2014.

62. Moreno CE. Métodos para medir la biodiversidad. Zaragoza, España: Sociedad Entomológica Aragonesa (SEA); 2001.

63.   Moreno CE. La biodiversidad en un mundo cambiante. Ciudad de México, México: Universidad Autónoma del Estado de Hidalgo; 2019.

64.   Magneville C, Loiseau N, Albouy C, Casajus N, Claverie T, Escalas A, et al. mFD: an R package to compute and illustrate the multiple facets of functional diversity. Ecography. 2021;2022. doi:10.1111/ecog.05904.

65.   Baselga A, Orme CDL. betapart: an R package for the study of beta diversity. Methods in Ecology and Evolution. 2012;3: 808–812. doi:10.1111/j.2041-210x.2012.00224.x.

66.   Hooper DU, Chapin FS, Ewel JJ, Hector A, Inchausti P, Lavorel S, et al. Effects of biodiversity on ecosystem functioning: A consensus of current knowledge. Ecological Monographs. 2005;75: 3–35. doi:10.1890/04-0922.

67.   McGill B, Enquist B, Weiher E, Westoby M. Rebuilding community ecology from functional traits. Trends in Ecology & Evolution. 2006;21: 178–185. doi:10.1016/j.tree.2006.02.002.

68.   Pla L, Casanoves F, Julio Di Rienzo. Quantifying Functional Biodiversity. Springer Science & Business Media; 2011.

69.   Mason NWH, de Bello F. Functional diversity: a tool for answering challenging ecological questions. Wilson B, editor. Journal of Vegetation Science. 2013;24: 777–780. doi:10.1111/jvs.12097.

70.   Villéger S, Mason NWH, Mouillot D. New Multidimensional Functional Diversity Indices for a Multifaceted Framework in Functional Ecology. Ecology. 2008;89: 2290–2301. doi:10.1890/07-1206.1.

71.   Mason NWH, Mouillot D, Lee WG, Wilson JB. Functional richness, functional evenness and functional divergence: the primary components of functional diversity. Oikos. 2005;111: 112–118. doi:10.1111/j.0030-1299.2005.13886.x.

72. Mouchet MA, Villéger S, Mason NWH, Mouillot D. Functional diversity measures: an overview of their redundancy and their ability to discriminate community assembly rules. Functional Ecology. 2010;24: 867–876. doi:10.1111/j.1365-2435.2010.01695.x.

73. Vidan E, Novosolov M, Bauer AM, Herrera FC, Chirio L, Campos Nogueira C, et al. The global biogeography of lizard functional groups. Journal of Biogeography. 2019;46: 2147–2158. doi:10.1111/jbi.13667.

74. López D, Freestone AL. History of co-occurrence shapes predation effects on functional diversity and structure at low latitudes. Functional Ecology. 2020;35: 535–545. doi:10.1111/1365-2435.13725.

75. Soria CD, Pacifici M, Di Marco M, Stephen SM, Rondinini C. COMBINE: a coalesced mammal database of intrinsic and extrinsic traits. Ecology. 2021;102. doi:10.1002/ecy.3344.

76. Briones-Salas M, Martín-Regalado N, Lavariega MC. Mammals in tropical dry forest on the central coast of Oaxaca, Mexico. Check List. 2016;12. doi:10.15560/12.2.1862.

77. Jones KE, Bielby J, Cardillo M, Fritz SA, O'Dell J, Orme CDL, et al. PanTHERIA: a species-level database of life history, ecology, and geography of extant and recently extinct mammals. Michener WK, editor. Ecology. 2009;90: 2648–2648. doi:10.1890/08-1494.1.

78. Ramírez-Pulido J, González-Ruiz N, Gardner AL, Arroyo-Cabrales J. List of Recent Land Mammals of Mexico, 2014. Special Publication, Museum of Texas Tech University. 2014.

79. González-Maya JF, Martínez-Meyer E, Medellín R, Ceballos G. Distribution of mammal functional diversity in the Neotropical realm: Influence of land-use and extinction risk. Maldonado JE, editor. PLOS ONE. 2017;12: e0175931. doi:10.1371/journal.pone.0175931.

80. Laureto LMO, Cianciaruso MV, Samia DSM. Functional diversity: an overview of its history and applicability. Natureza & Conservação. 2015;13: 112–116. doi:10.1016/j.ncon.2015.11.001.

81.   Petchey OL, Gaston KJ. Functional diversity (FD), species richness and community composition. Ecology Letters. 2002;5: 402–411. doi:10.1046/j.1461-0248.2002.00339.x.

82.   Maire E, Grenouillet G, Brosse S, Villéger S. How many dimensions are needed to accurately assess functional diversity? A pragmatic approach for assessing the quality of functional spaces. Global Ecology and Biogeography. 2015;24: 728–740. doi:10.1111/geb.12299.

83.   de Bello F, Botta-Dukát Z, Lepš J, Fibich P. Towards a more balanced combination of multiple traits when computing functional differences between species. Methods in Ecology and Evolution. 2020;12: 443–448. doi:10.1111/2041-210x.13537.

84.   Pavoine S, Vallet J, Dufour A-B, Gachet S, Daniel H. On the challenge of treating various types of variables: application for improving the measurement of functional diversity. Oikos. 2009;118: 391–402. doi:10.1111/j.1600-0706.2008.16668.x.

85.   Borcard D, Gillet F, Legendre P. Numerical ecology with R. Cham, Switzerland: Springer; 2018.

86.   Legendre P, Legendre L. Numerical ecology. 3rd ed. Amsterdam, Netherlands: Elsevier; 2012.

87.   CONABIO. Índice de impacto humano en la biodiversidad terrestre. MEXBIO 2.0 (2014), escala: 1:1000000. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad Ciudad de México, México. 2014.

88.   CONABIO. Áreas Naturales Protegidas Estatales, Municipales, Ejidales y Privadas de México. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. 2015.

89.   CONANP. Información Geoespacial de las Áreas Naturales Protegidas. Comisión Nacional de Áreas Naturales Protegidas. 2022.

90.   CONANP. Áreas Destinadas Voluntariamente a la Conservación. Comisión Nacional de Áreas Naturales Protegidas. 2022.

91.   González-Maya JF, Víquez-R LR, Belant JL, Ceballos G. Effectiveness of Protected Areas for

Representing Species and Populations of Terrestrial Mammals in Costa Rica. Jenkins CN, editor. PLOS

ONE. 2015;10: e0124480. doi:10.1371/journal.pone.0124480.

92.   INEGI. Conjunto de Datos Vectoriales de Uso de Suelo y Vegetación. Escala 1:250 000, Serie VII.

Conjunto Nacional, escala: 1:250 000. Instituto Nacional de Estadística y Geografía. 2021.

93.   Prieto-Torres DA, Rojas-Soto OR, Bonaccorso E, Santiago-Alarcón D, Navarro-Sigüenza AG.

Distributional patterns of Neotropical seasonally dry forest birds: a biogeographical regionalization.

Cladistics. 2018;35: 446–460. doi:10.1111/cla.12366.

94.   Prieto-Torres DA, Rojas-Soto OR, Santiago-Alarcon D, Bonaccorso E, Navarro-SigüEnza AG.

Diversity, Endemism, Species Turnover and Relationships among Avifauna of Neotropical Seasonally Dry

Forests. Ardeola. 2019;66: 257. doi:10.13157/arla.66.2.2019.ra1.

95.   Fukami T. Historical Contingency in Community Assembly: Integrating Niches, Species Pools, and

Priority Effects. Annual Review of Ecology, Evolution, and Systematics. 2015;46: 1–23.

doi:10.1146/annurev-ecolsys-110411-160340.

96.   Lamanna C, Blonder B, Violle C, Kraft NJB, Sandel B, imova I, et al. Functional trait space and the

latitudinal diversity gradient. Proceedings of the National Academy of Sciences. 2014;111: 13745–13750.

doi:10.1073/pnas.1317722111.

97.   Suárez-Castro AF, Raymundo M, Bimler M, Mayfield MM. Using multi-scale spatially explicit

frameworks to understand the relationship between functional diversity and species richness. Ecography.

2022;2022. doi:10.1111/ecog.05844.

98.   Davidson AD, Shoemaker KT, Weinstein B, Costa GC, Brooks TM, Ceballos G, et al. Geography of

current and future global mammal extinction risk. Kamilar JM, editor. PLOS ONE. 2017;12: e0186934.

doi:10.1371/journal.pone.0186934.

99.   Chao A, Chiu C, Villéger S, Sun I, Thorn S, Lin Y, et al. An attribute-diversity approach to functional diversity, functional beta diversity, and related (dis)similarity measures. Ecological Monographs. 2019;89. doi:10.1002/ecm.1343.

100.   Neale Z, Rudolf. Predation and competition drive trait diversity across space and time. Ecology. 2023. doi:10.1002/ecy.4182.

101.   Jost L. Partitioning diversity into independent alpha and beta components. Ecology. 2007;88: 2427–2439. doi:10.1890/06-1736.1.

102.   Rodríguez P, Soberón J, Arita HT. El componente beta de la diversidad de mamíferos de México. Acta zoológica mexicana. 2003;89: 241–259. doi:10.21829/azm.2003.89891785.

103.   Tobón W, Urquiza-Haas T, Koleff P, Schröter M, Ortega-Álvarez R, Campo J, et al. Restoration planning to guide Aichi targets in a megadiverse country. Conservation Biology. 2017;31: 1086–1097. doi:10.1111/cobi.12918.

104.   Strassburg BBN, Iribarrem A, Beyer HL, Cordeiro CL, Crouzeilles R, Jakovac CC, et al. Global priority areas for ecosystem restoration. Nature. 2020;586: 1–6. doi:10.1038/s41586-020-2784-9.

105.   Dasgupta P. The economics of biodiversity: the Dasgupta review abridged version. London Hm Treasury; 2021.

106.   Portillo-Quintero C, Sanchez-Azofeifa A, Calvo-Alvarado J, Quesada M, do Espirito Santo MM. The role of tropical dry forests for biodiversity, carbon and water conservation in the neotropics: lessons learned and opportunities for its sustainable management. Regional Environmental Change. 2014;15: 1039–1049. doi:10.1007/s10113-014-0689-6.

107.   Macip-Ríos R, Macip RR. Pago por servicios ambientales (ecosistémicos) en México ¿Una alternativa para la conservación de la biodiversidad y el desarrollo? BIOCYT Biología Ciencia y Tecnología. 2013;6. doi:10.22201/fesi.20072082.2013.6.76105.

108.   Prieto-Torres DA, Nori J, Rojas-Soto OR, Navarro-Sigüenza AG. Challenges and opportunities in planning for the conservation of Neotropical seasonally dry forests into the future. Biological Conservation. 2021;257: 109083. doi:10.1016/j.biocon.2021.109083.

Figures
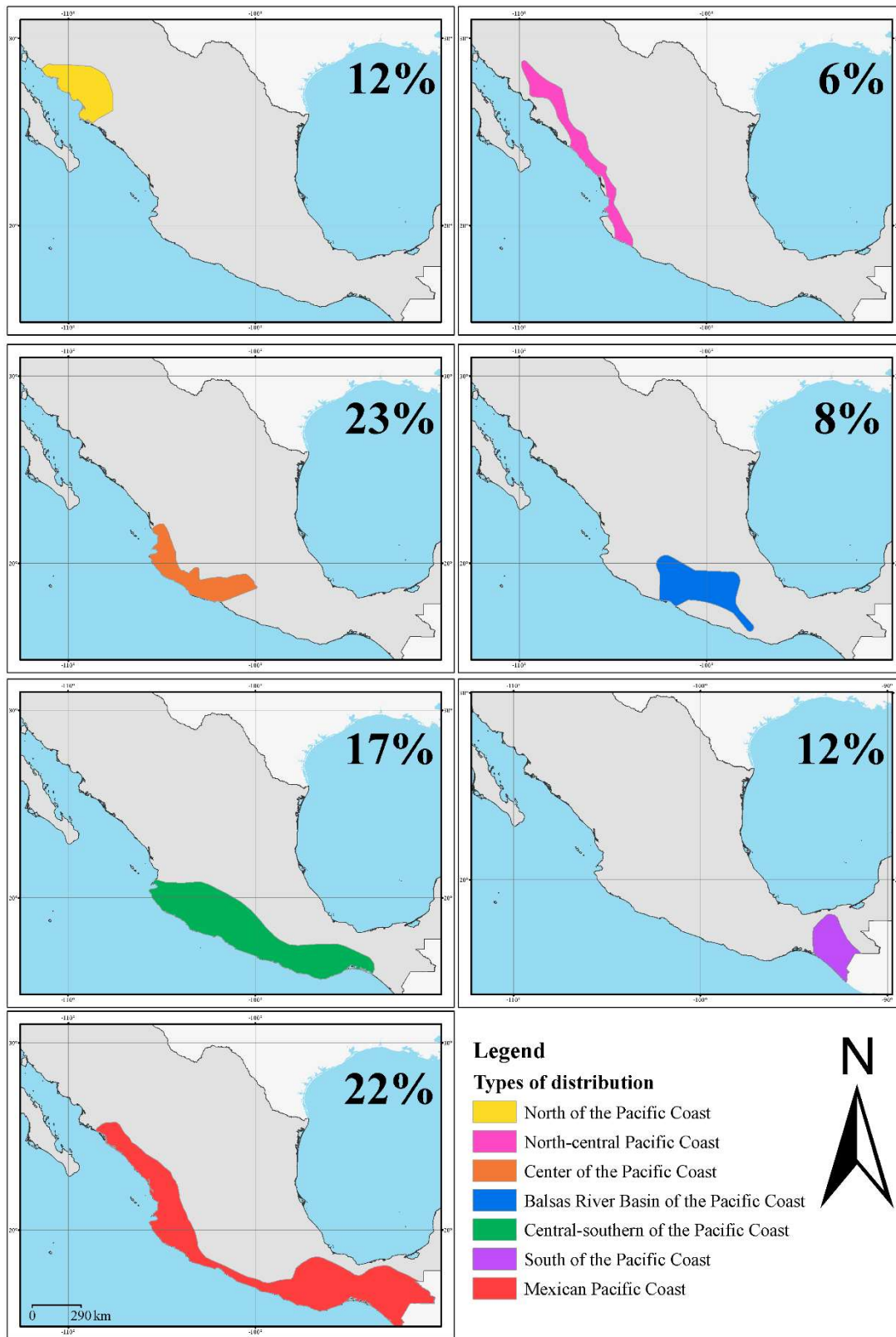
Fig 1. Distribution types of species restricted to the Mexican Pacific Coast.
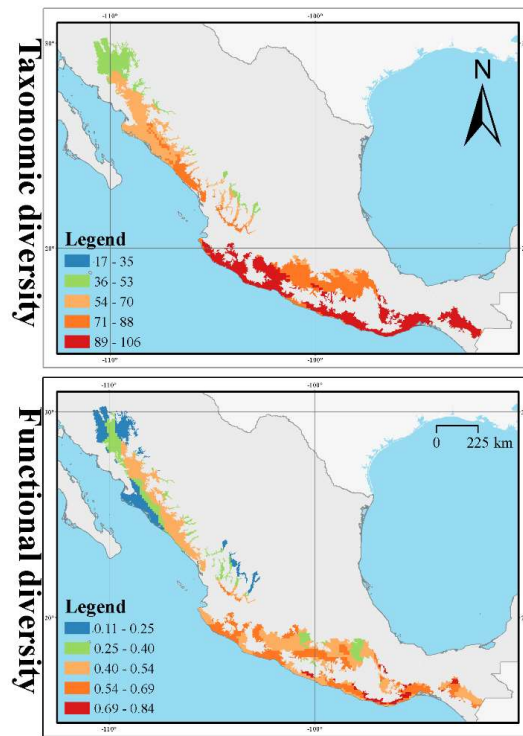
Fig 2. Patterns of distribution of taxonomic and functional diversity, at the national scale.
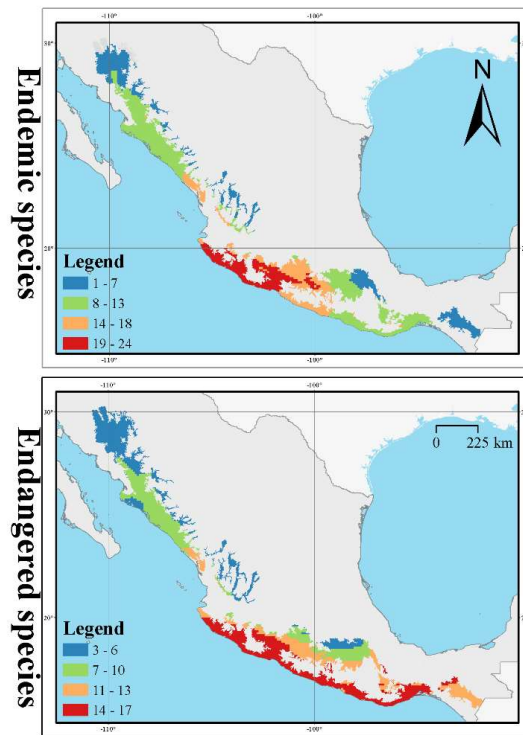
Fig 3. Distribution patterns of threatened and endemic species of Mexican Pacific dry forest mammals at the national scale.
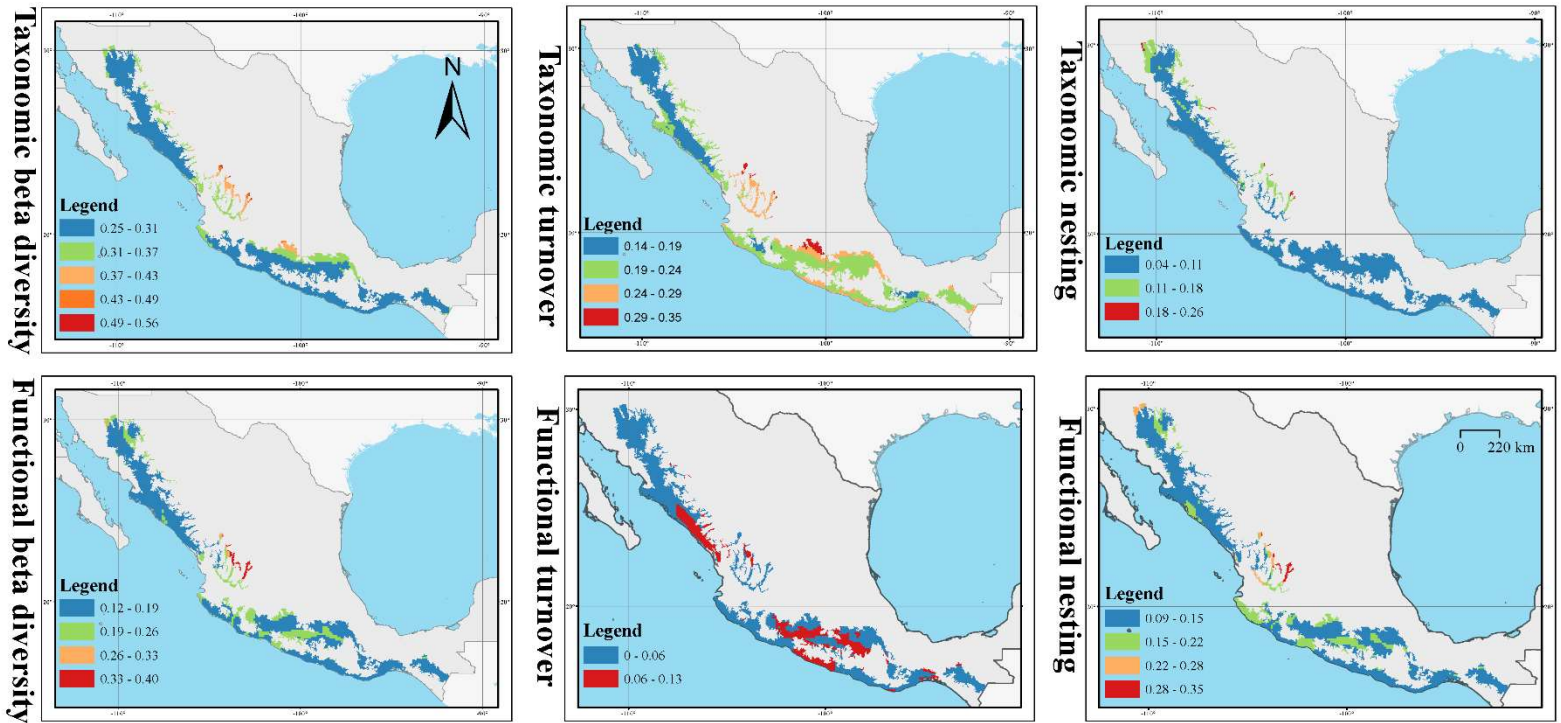
Fig 4. Patterns of taxonomic and functional beta diversity and its components at the national scale.
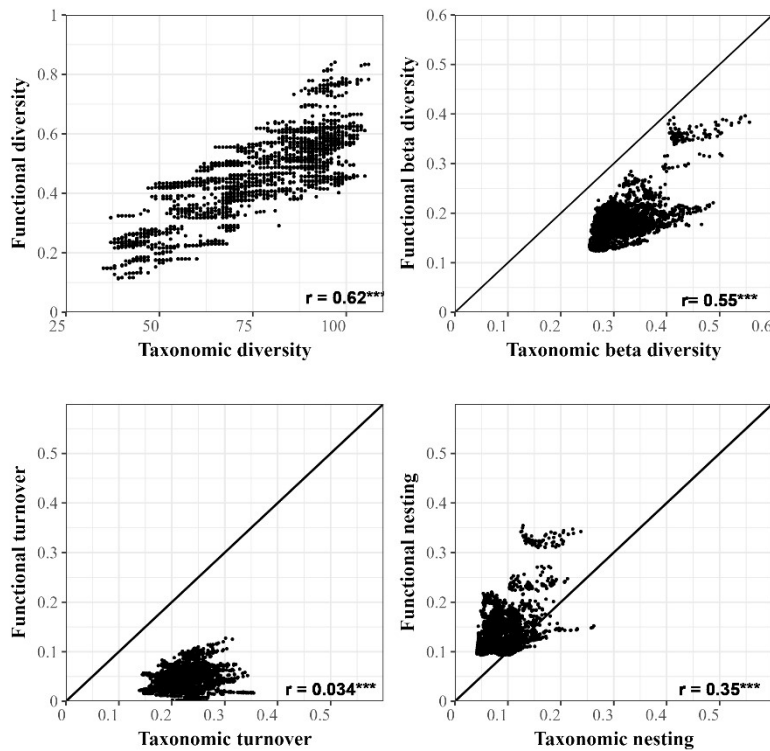
Fig 5. Correlations between taxonomic and functional diversity indices at the national scale. The r

values correspond to Spearman's correlation coefficients. ***p<0.001.
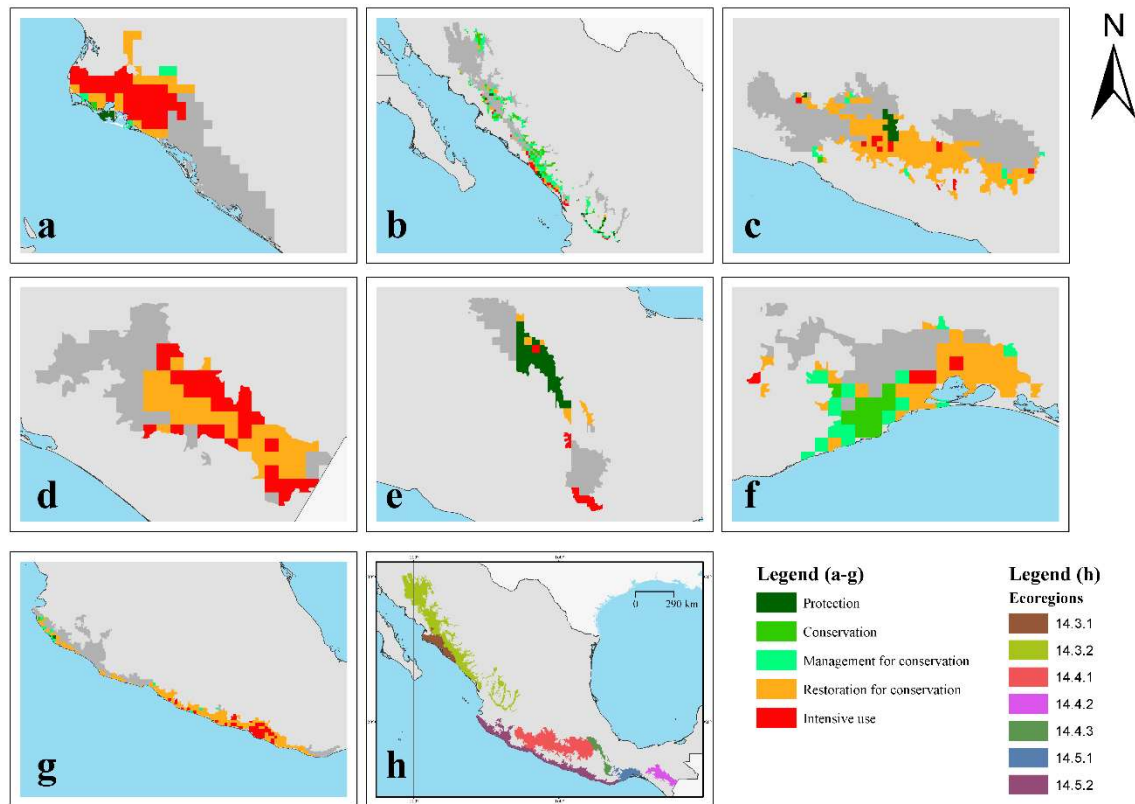
Fig 6. Priority areas for mammal conservation, and conservation status in each of the ecoregions of the dry forests of the Mexican Pacific. a) Sinaloan Coastal Plain with thorn forest. b) Sonora and Sinaloa hills and canyons of the Sierra Madre Occidental with xeric scrub and deciduous forest. c) Balsas Depression with deciduous forest and xerophytic shrubland. d) Central Depression of Chiapas with deciduous forest. e) Valleys and depressions of Oaxaca and Puebla with deciduous forest and xerophytic scrubland. f) Tehuantepec Canyon and plain with deciduous and thorny forest. g) Hills and foothills of the Mexican South Pacific with thorny forest. h) Ecoregions of the dry forests of the Mexican Pacific. 14.3.1: Sinaloan Coastal Plain with thorn forest; 14.3.2: Sonora and Sinaloa hills and canyons of the Sierra Madre Occidental with xeric scrub and deciduous forest; 14.4.1: Balsas Depression with deciduous forest and xerophytic shrubland; 14.4.2: Central Depression of Chiapas with deciduous forest; 14.4.3: Valleys and depressions of Oaxaca and Puebla with deciduous forest and xerophytic scrubland; 14.5.1: Tehuantepec Canyon and plain with deciduous and thorny forest; 14.5.2: Hills and foothills of the Mexican South Pacific with thorny forest.
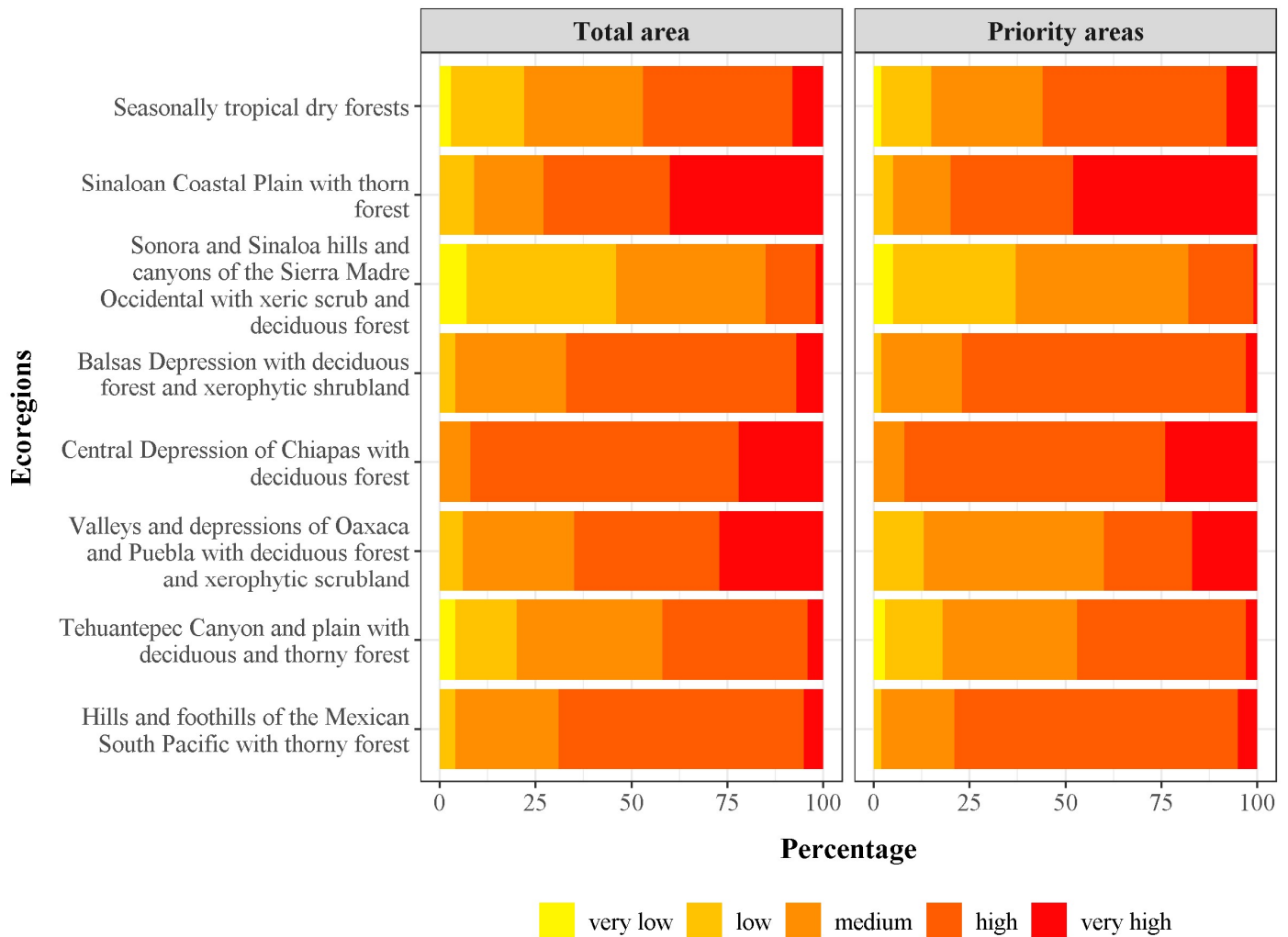
Fig 7. Anthropogenic impact index in dry forests and in each of their ecoregions, in the total area of dry forests (left) and in the priority areas for conservation obtained (right). Very low: 0.1 to 0.31; low: 0.31 to 0.53; medium: 0.53 to 0.75; high: 0.75 to 0.93; very high: 0.96 to 0.99.
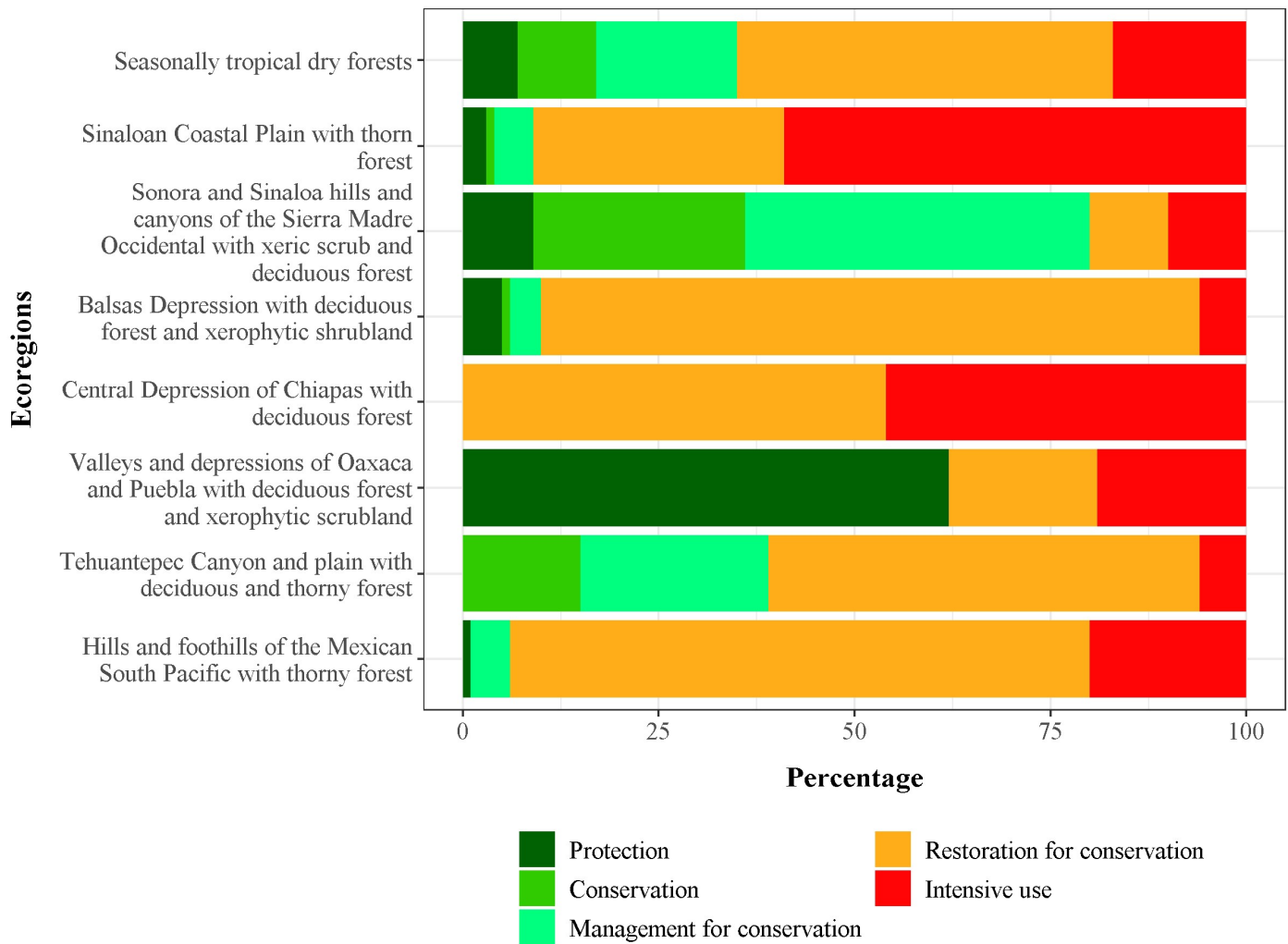
Fig 8. Conservation status of priority areas for mammal conservation in dry forests and in each of the dry forest ecoregions.

Supporting information
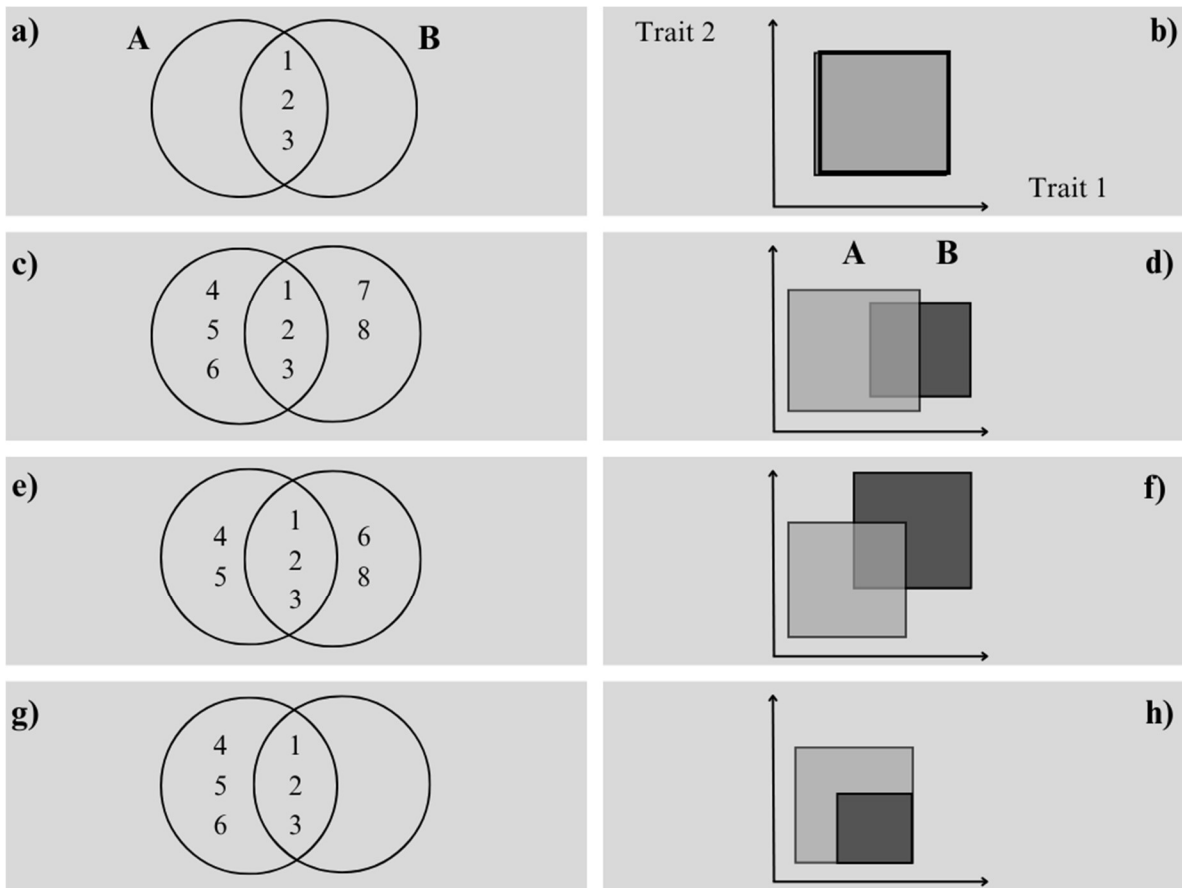
S1 Fig. Conceptual scheme illustrating taxonomic beta diversity and its components (left) and functional beta diversity and its components (right). a) No taxonomic beta diversity, where both communities (A: community A; B: community) share the same species. b) No functional beta diversity, where both communities occupy the same volume in the functional space. c) Taxonomic beta diversity is greater than zero. In this case, the presence of a turnover component, which implies the existence of non-shared species, as well as a nesting component, which refers to differences in species richness between communities, is observed. d) Functional beta diversity is greater than zero. This is explained by the presence of a turnover component, which indicates that the volumes do not completely overlap, and a nesting component, which reflects the difference in the size of the volume occupied by the communities. e) Taxonomic beta diversity is greater than zero, and this is explained by the turnover component, as both communities have a different species composition, but the same number of species. f) Functional beta

diversity is greater than zero, and this is explained by the turnover component, as the volume occupied by both communities is different, there is no overlap between them, but the volume occupied by both communities is equal in terms of size. g) Taxonomic beta diversity is greater than zero, and this is explained by the nesting component, since the dissimilarity between the communities is explained by the difference in the number of species. h) Functional beta diversity is greater than zero, and this is explained by the nesting component, since the dissimilarity is explained by the difference in the size of the volume occupied by community A, with B being a subset of the former. Modified from [32,65].

S1 Table. Functional traits of the species present in the dry forests of the Mexican Pacific.

TAXA	BODY MASS (g)	LITTER SIZE	ACTIVITY PERIOD	WAY OF LIFE	TROPHIC GUILD	DIET OF INVERT	DIET OF VERT	DIET OF FRUIT	DIET OF NECT	DIET OF SEED	DIET OF OTHER PARTS OF THE PLANT
ORDER DIDELPHIMORPHIA											
FAMILY DIDELPHIDAE											
SUBFAMILY DIDELPHIDAE											
Chironectes minimus	856	3.62	Nocturnal	Terrestrial	Omnivorous	50	30	0	0	0	20
Didelphis marsupialis	1149.88	6.2	Nocturnal	Arboreal	Omnivorous	20	60	0	0	0	20
Didelphis virginiana	1414.5	6.645	Nocturnal	Terrestrial	Omnivorous	20	60	0	0	0	20
Marmosa mexicana	60	5.8	Nocturnal	Arboreal	Omnivorous	40	30	30	0	0	0
Tlacuatzin balsasensis	47.73	11	Nocturnal	Arboreal	Omnivorous	40	30	30	0	0	0
Tlacuatzin canescens	47.73	11	Nocturnal	Arboreal	Omnivorous	40	30	30	0	0	0
Tlacuatzin sinaloae	47.73	11	Nocturnal	Arboreal	Omnivorous	40	30	30	0	0	0
ORDER CINGULATA											
FAMILY DASYPODIDAE											
Dasypus novemcinctus	3949.01	4	Nocturnal	Terrestrial	Carnivorous	100	0	0	0	0	0
ORDER PILOSA											
FAMILY MYRMECOPHAGIDAE											
Tamandua mexicana	4194.26	1	Catameral	Arboreal	Carnivorous	100	0	0	0	0	0
ORDER LAGOMORPHA											
FAMILY LEPORIDAE											
Lepus alleni	3306	2.085	Nocturnal	Terrestrial	Herbivorous	0	0	0	0	0	100
Lepus callotis	2214.08	2.34	Nocturnal	Terrestrial	Herbivorous	0	0	0	0	0	100
Lepus flavigularis	2608.16	2.34	Nocturnal	Terrestrial	Herbivorous	0	0	0	0	0	100
Sylvilagus audubonii	791.29	3	Catameral	Terrestrial	Herbivorous	0	0	0	0	0	100
Sylvilagus cunicularius	2489.54	3.71	Catameral	Terrestrial	Herbivorous	0	0	0	0	0	100
Sylvilagus floridanus	1178.6	5	Catameral	Terrestrial	Herbivorous	0	0	0	0	0	100
ORDER RODENTIA											

FAMILY SCIURIDAE

SUBFAMILY SCIURINAE

Sciurus aureogaster	595	2	Diurnal	Arboreal	Herbivorous	0	0	20	0	50	30
Sciurus colliaei	498	2.665	Diurnal	Arboreal	Herbivorous	0	0	20	0	50	30

SUBFAMILY XERINAE

Neotamias dorsalis	62.8	5.13	Diurnal	Terrestrial	Omnivorous	0	0	50	0	50	0
Notocitellus adocetus	155.52	5.642	Diurnal	Terrestrial	Omnivorous	20	0	0	0	40	40
Notocitellus annulatus	499.99	3.94	Diurnal	Terrestrial	Herbivorous	20	0	0	0	40	40
Otospermophilus variegatus	663.03	4.5	Diurnal	Terrestrial	Omnivorous	20	0	0	0	40	40

FAMILY GEOMYIDAE

SUBFAMILY GEOMYINAE

Cratogeomys fumosus	295.84	1.955	Diurnal	Burrowing	Herbivorous	0	0	0	0	0	100
Orthogeomys grandis	499.99	2.222	Diurnal	Burrowing	Herbivorous	0	0	0	0	0	100
Pappogeomys bulleri	150	2	Diurnal	Burrowing	Herbivorous	0	0	0	0	0	100
Thomomys atrovarius	95.3	3.05	Catameral	Burrowing	Herbivorous	0	0	0	0	0	100

FAMILY HETEROMYIDAE

SUBFAMILY HETEROMYINAE

Heteromys goldmani	76.4	3.185	Nocturnal	Terrestrial	Omnivorous	0	0	0	0	30	70
Heteromys irroratus	46.5	4.11	Nocturnal	Terrestrial	Herbivorous	0	0	0	0	50	50
Heteromys pictus	46.64	3.585	Nocturnal	Terrestrial	Omnivorous	0	0	0	0	50	50
Heteromys spectabilis	65	5	Nocturnal	Terrestrial	Herbivorous	0	0	0	0	50	50

SUBFAMILY PEROGNATHINAE

Chaetodipus artus	22.03	3.429	Nocturnal	Terrestrial	Herbivorous	10	0	0	0	80	10
Chaetodipus goldmani	23	3.45	Nocturnal	Terrestrial	Herbivorous	10	0	0	0	80	10
Chaetodipus pernix	17	3.59	Nocturnal	Terrestrial	Herbivorous	10	0	0	0	80	10

FAMILY CRICETIDAE

SUBFAMILY NEOTOMINAE

Baiomys brunneus	8.99	2.62	Catameral	Terrestrial	Omnivorous	10	0	0	0	10	80
Baiomys musculus	8.99	2.62	Catameral	Terrestrial	Omnivorous	10	0	0	0	10	80
Baiomys taylori	7.43	2.67	Catameral	Terrestrial	Herbivorous	10	0	0	0	10	80
Hodomys alleni	367.8	1.695	Nocturnal	Terrestrial	Herbivorous	10	0	0	0	0	90
Neotoma melanura	190.5	2.14	Nocturnal	Terrestrial	Herbivorous	10	0	0	0	20	70

Neotoma mexicana	203	2.345	Nocturnal	Terrestrial	Herbivorous	10	0	0	0	20	70
Neotoma phenax	227.5	2	Nocturnal	Terrestrial	Herbivorous	10	0	0	0	20	70
Osgoodomys banderanus	49.99	1.68	Nocturnal	Terrestrial	Omnivorous	30	0	30	0	40	0
Peromyscus aztecus	26.3	3.19	Nocturnal	Terrestrial	Carnivorous	50	10	20	0	20	0
Peromyscus chrysopus	40	2.6	Nocturnal	Terrestrial	Omnivorous	50	10	20	0	20	0
Peromyscus cordillerae	26.3	3.19	Nocturnal	Terrestrial	Carnivorous	50	10	20	0	20	0
Peromyscus eremicus	21.75	2.6	Nocturnal	Terrestrial	Omnivorous	50	10	20	0	20	0
Peromyscus labecula	20.5	4.615	Nocturnal	Terrestrial	Herbivorous	50	10	20	0	20	0
Peromyscus leucurus	40	2.93	Nocturnal	Terrestrial	Herbivorous	50	10	20	0	20	0
Peromyscus levipes	23.9	3.185	Nocturnal	Terrestrial	Omnivorous	50	10	20	0	20	0
Peromyscus megalops	66.2	1.9	Nocturnal	Terrestrial	Omnivorous	50	10	20	0	20	0
Peromyscus melanophrys	40	2.93	Nocturnal	Terrestrial	Herbivorous	50	10	20	0	20	0
Peromyscus mexicanus	51.54	2.415	Nocturnal	Terrestrial	Omnivorous	50	10	20	0	20	0
Peromyscus micropus	40	2.93	Nocturnal	Terrestrial	Herbivorous	50	10	20	0	20	0
Peromyscus perfulvus	40	2.6	Nocturnal	Terrestrial	Omnivorous	50	10	20	0	20	0
Peromyscus simulus	26.3	3.185	Nocturnal	Terrestrial	Omnivorous	50	10	20	0	20	0
Peromyscus spicilegus	28.7	3.19	Nocturnal	Terrestrial	Omnivorous	50	10	20	0	20	0
Reithrodontomys burti	20	3.36	Nocturnal	Terrestrial	Herbivorous	0	0	0	0	50	50
Reithrodontomys fulvescens	12.5	3.1	Nocturnal	Terrestrial	Omnivorous	0	0	0	0	50	50
Reithrodontomys hirsutus	20	3.88	Nocturnal	Terrestrial	Omnivorous	0	0	0	0	50	50
Reithrodontomys mexicanus	15.71	2.91	Nocturnal	Arboreal	Omnivorous	0	0	0	0	50	50
Xenomys nelsoni	129.99	1.6	Nocturnal	Arboreal	Omnivorous	0	0	0	0	0	100
SUBFAMILY SIGMODONTINAE											
Handleyomys melanotis	49.99	3.88	Catameral	Terrestrial	Omnivorous	20	0	20	0	20	40
Handleyomys rostratus	49.99	3.88	Catameral	Terrestrial	Omnivorous	20	0	20	0	20	40
Oligoryzomys fulvescens	25	3.64	Nocturnal	Terrestrial	Omnivorous	30	0	30	0	40	0
Oryzomys albiventer	53.26	3.77	Catameral	Terrestrial	Omnivorous	20	0	20	0	20	40
Oryzomys couesi	53.26	3.77	Catameral	Terrestrial	Omnivorous	20	0	20	0	20	40
Rheomys mexicanus	40	2.339	Catameral	Terrestrial	Carnivorous	100	0	0	0	0	0
Sigmodon alleni	159.6	5.44	Catameral	Terrestrial	Omnivorous	40	10	0	0	0	50
Sigmodon arizonae	172.3	5.44	Catameral	Terrestrial	Omnivorous	50	0	0	0	0	50
Sigmodon mascotensis	156	5.44	Catameral	Terrestrial	Omnivorous	50	0	0	0	0	50
SUBFAMILY TYLOMYINAE											

Nyctomys sumichrasti	53.33	2	Nocturnal	Arboreal	Herbivorous	0	0	40	0	40	20
Tylomys nudicaudus	280	2.4	Diurnal	Terrestrial	Herbivorous	0	0	10	0	80	10
FAMILY ERETHIZONTIDAE											
SUBFAMILY ERETHIZONTINAE											
Coendou mexicanus	2000	1	Nocturnal	Arboreal	Herbivorous	0	0	30	0	0	70
ORDER EULIPOTYPHLA											
FAMILY SORICIDAE											
SUBFAMILY SORICINAE											
Megasorex gigas	11.71	3.809	Nocturnal	Terrestrial	Omnivorous	80	20	0	0	0	0
Notiosorex evotis	4.47	3.76	Nocturnal	Terrestrial	Carnivorous	90	10	0	0	0	0
ORDER CARNIVORA											
FAMILY MEPHITIDAE											
SUBFAMILY MEPHITINAE											
Conepatus leuconotus	2645.29	3.5	Nocturnal	Terrestrial	Omnivorous	80	10	10	0	0	0
Mephitis macroura	1031.38	4.34	Catameral	Terrestrial	Omnivorous	20	30	20	0	10	20
Spilogale angustifrons	612	7.5	Catameral	Terrestrial	Omnivorous	50	40	10	0	0	0
Spilogale pygmaea	312.5	3.835	Catameral	Terrestrial	Omnivorous	80	20	0	0	0	0
FAMILY MUSTELIDAE											
SUBFAMILY GULONINAE											
Eira barbara	4134.99	2	Catameral	Terrestrial	Omnivorous	10	70	20	0	0	0
SUBFAMILY LUTRINAE											
Lontra longicaudis	7027.49	3.095	Catameral	Aquatic	Carnivorous	30	70	0	0	0	0
SUBFAMILY MUSTELINAE											
Neogale frenata	170.32	6.22	Catameral	Terrestrial	Carnivorous	0	100	0	0	0	0
SUBFAMILY TAXIDIINAE											
Taxidea taxus	8000	3	Nocturnal	Burrowing	Carnivorous	10	90	0	0	0	0
FAMILY PROCYONIDAE											
Bassariscus astutus	1010.37	3	Nocturnal	Terrestrial	Omnivorous	20	10	70	0	0	0
Nasua narica	3750	4.17	Diurnal	Terrestrial	Omnivorous	50	10	40	0	0	0
Potos flavus	2420.91	1	Nocturnal	Arboreal	Omnivorous	10	10	80	0	0	0
Procyon lotor	5075	3.39	Nocturnal	Terrestrial	Omnivorous	40	20	20	0	20	0

FAMILY CANIDAE

Canis latrans	11050	5.605	Catameral	Terrestrial	Carnivorous	10	70	20	0	0	0
Urocyon cinereoargenteus	4220	3.895	Catameral	Terrestrial	Omnivorous	10	30	20	0	20	20

FAMILY FELIDAE

SUBFAMILY FELINAE

Herpailurus yagouaroundi	7000	2.34	Catameral	Terrestrial	Carnivorous	0	100	0	0	0	0
Leopardus pardalis	10500	1.66	Nocturnal	Terrestrial	Carnivorous	0	100	0	0	0	0
Leopardus wiedii	3600	1.5	Catameral	Terrestrial	Omnivorous	0	100	0	0	0	0
Lynx rufus	9400	2.53	Nocturnal	Terrestrial	Carnivorous	0	100	0	0	0	0
Puma concolor	48000	2.76	Catameral	Terrestrial	Carnivorous	0	100	0	0	0	0

SUBFAMILY PANTHERINAE

Panthera onca	81150	2	Catameral	Terrestrial	Carnivorous	0	100	0	0	0	0

ORDER PERISSODACTYLA

FAMILY TAPIRIDAE

Tapirus bairdii	300000	1	Nocturnal	Terrestrial	Herbivorous	0	0	0	0	0	100

ORDER ARTIODACTYLA

FAMILY CERVIDAE

SUBFAMILY CAPREOLINAE

Odocoileus virginianus	65320	1.71	Catameral	Terrestrial	Herbivorous	0	0	0	0	10	90

FAMILY TAYASSUIDAE

Dicotyles tajacu	20500	1.82	Catameral	Terrestrial	Omnivorous	10	20	10	0	0	60

ORDER CHIROPTERA

FAMILY EMBALLONURIDAE

SUBFAMILY EMBALLONURINAE

Balantiopteryx plicata	6.57	0.99	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Diclidurus albus	18.5	1	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Peropteryx macrotis	230.99	1	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Saccopteryx bilineata	7.9	0.995	Catameral	Flying	Carnivorous	100	0	0	0	0	0

FAMILY PHYLLOSTOMIDAE

SUBFAMILY CAROLLIINAE

Carollia subrufa	14.47	0.985	Nocturnal	Flying	Herbivorous	0	0	100	0	0	0

SUBFAMILY DESMODONTINAE

Desmodus rotundus	33.18	1	Nocturnal	Flying	Carnivorous	0	100	0	0	0	0

SUBFAMILY GLOSSOPHAGINAE

Anoura geoffroyi	15.2	1	Nocturnal	Flying	Carnivorous	30	0	30	40	0	0
Choeroniscus godmani	7.9	0.98	Nocturnal	Flying	Omnivorous	30	0	40	30	0	0
Choeronycteris mexicana	19.13	0.995	Nocturnal	Flying	Omnivorous	20	0	40	40	0	0
Glossophaga commissarisi	9.3	1	Nocturnal	Flying	Omnivorous	40	0	30	30	0	0
Glossophaga leachii	10.7	1	Nocturnal	Flying	Omnivorous	40	0	30	30	0	0
Glossophaga morenoi	8.54	1	Nocturnal	Flying	Omnivorous	40	0	30	30	0	0
Glossophaga mutica	10.25	1	Nocturnal	Flying	Herbivorous	40	0	30	30	0	0
Glyphonycteris sylvestris	8.91	0.995	Nocturnal	Flying	Carnivorous	80	0	20	0	0	0
Hylonycteris underwoodi	7.5	1	Nocturnal	Flying	Herbivorous	10	0	40	50	0	0
Leptonycteris yerbabuenae	24.26	1	Nocturnal	Flying	Herbivorous	10	0	0	0	0	90
Musonycteris harrisoni	10.82	0.999	Nocturnal	Flying	Omnivorous	40	0	0	60	0	0

SUBFAMILY MACROTINAE

Macrotus waterhousii	16.14	1	Nocturnal	Flying	Omnivorous	50	0	50	0	0	0

SUBFAMILY MICRONYCTERINAE

Micronycteris microtis	6.4	0.99	Nocturnal	Flying	Omnivorous	20	0	0	0	0	80

SUBFAMILY PHYLLOSTOMINAE

Phyllostomus discolor	40.05	1	Nocturnal	Flying	Omnivorous	30	0	40	30	0	0
Trachops cirrhosus	36.9	1	Nocturnal	Flying	Carnivorous	50	40	10	0	0	0

SUBFAMILY STENODERMATINAE

Artibeus hirsutus	40.42	0.98	Nocturnal	Flying	Omnivorous	10	0	80	10	0	0
Artibeus jamaicensis	46.1	1	Nocturnal	Flying	Omnivorous	10	0	80	10	0	0
Artibeus lituratus	46.1	1	Nocturnal	Flying	Omnivorous	10	0	80	10	0	0
Centurio senex	23.09	0.995	Nocturnal	Flying	Herbivorous	0	0	100	0	0	0
Chiroderma scopaeum	26.3	0.99	Nocturnal	Flying	Herbivorous	0	0	100	0	0	0
Dermanura phaeotis	11.69	0.99	Nocturnal	Flying	Omnivorous	10	0	80	10	0	0
Dermanura tolteca	14.09	0.99	Nocturnal	Flying	Omnivorous	10	0	80	10	0	0

Species											
Enchisthenes hartii	16.99	0.99	Nocturnal	Flying	Herbivorous	10	0	80	10	0	0
Platyrrhinus helleri	13.44	0.99	Nocturnal	Flying	Herbivorous	10	0	90	0	0	0
Sturnira hondurensis	21	0.99	Nocturnal	Flying	Herbivorous	0	0	100	0	0	0
Sturnira parvidens	20	1	Nocturnal	Flying	Herbivorous	0	0	100	0	0	0
Uroderma magnirostrum	17.3	0.98	Nocturnal	Flying	Omnivorous	10	0	80	10	0	0
FAMILY MORMOOPIDAE											
Mormoops megalophylla	16.05	1	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Pteronotus fulvus	9.4	0.995	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Pteronotus mesoamericanus	19.4	0.995	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Pteronotus mexicanus	19.4	0.995	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Pteronotus psilotis	11	0.98	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
FAMILY NOCTILIONIDAE											
Noctilio leporinus	44	1	Nocturnal	Flying	Carnivorous	50	50	0	0	0	0
FAMILY NATALIDAE											
Natalus mexicanus	5.3	1	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
FAMILY MOLOSSIDAE											
SUBFAMILY MOLOSSINAE											
Cynomops mexicanus	20	1.007	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Eumops ferox	36.4	1.02	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Eumops underwoodi	59.84	1	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Molossus aztecus	14	0.99	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Molossus molossus	13.85	0.99	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Molossus nigricans	25	1.011	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Molossus sinaloae	21.09	1.015	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Nyctinomops aurispinosus	18.43	1	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Nyctinomops femorosaccus	14.5	0.99	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Nyctinomops laticaudatus	13.56	0.995	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Nyctinomops macrotis	23	0.995	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Promops centralis	29.8	0.99	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Tadarida brasiliensis	12.5	1.055	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
FAMILY VESPERTILIONIDAE SUBFAMILY MYOTINAE											
Myotis californicus	4.39	0.99	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0

Myotis carteri	4.1	1	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Myotis fortidens	6.5	1	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Myotis nigricans	4.1	1	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Myotis pilosatibialis	5.22	0.98	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Myotis thysanodes	6.5	1	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Myotis velifer	11	0.995	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Myotis volans	7.86	0.995	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Myotis yumanensis	5.9	1	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
SUBFAMILY VESPERTILIONINAE											
Aeorestes cinereus	26.03	2	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Bauerus dubiaquercus	22.22	1.71	Nocturnal	Flying	Carnivorous	80	20	0	0	0	0
Corynorhinus townsendii	10.3	1	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Dasypterus ega	12.2	2.07	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Dasypterus intermedius	20	2.985	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Dasypterus xanthinus	12.2	2.07	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Eptesicus furinalis	7.7	1.86	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Eptesicus fuscus	17.2	1.925	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Lasiurus frantzii	12.33	3.06	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Parastrellus hesperus	3.56	1.86	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Rhogeessa alleni	5.37	1.602	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Rhogeessa gracilis	5.14	1.615	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Rhogeessa mira	2.68	1.894	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Rhogeessa parvula	4.37	1.98	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0
Rhogeessa tumida	4.48	1.69	Nocturnal	Flying	Carnivorous	100	0	0	0	0	0

S2 Table. Conservation status of species present in the dry forests of the Mexican Pacific. NA: species occurring in Mexico shared with other North American countries; MA: species occurring in Mexico shared with other Central American countries; SA: species occurring in Mexico shared with Central and South American countries; AM: species occurring in North and South America; MX: species endemic to Mexico. DD: data deficient; LC: Least Concern; NT: Near Threatened; VU: Vulnerable; EN: Endangered; NT: Not Evaluated. Pr: special protection; A: threatened; P: endangered.

TAXA	DISTRIBUTION	ENDEMIC TO DRY FORESTS	IUCN	NOM-059	CITES	SYNONYMS
ORDER DIDELPHIMORPHIA						
FAMILY DIDELPHIDAE						
SUBFAMILY DIDELPHIDAE						
Chironectes minimus	SA		LC	P		
Didelphis marsupialis	SA		LC			
Didelphis virginiana	AM		LC			
Marmosa mexicana	MA		LC			
Tlacuatzin balsasensis	MX	X	NE	NE		*Tlacuatzin canescens*
Tlacuatzin canescens	MX	X	LC			
Tlacuatzin sinaloae	MX	X	NE	NE		*Tlacuatzin canescens*
ORDER CINGULATA						
FAMILY DASYPODIDAE						
Dasypus novemcinctus	AM		LC			
ORDER PILOSA						
FAMILY MYRMECOPHAGIDAE						
Tamandua mexicana	SA		LC	P	III	

TAXA	DISTRIBUTION	ENDEMIC TO DRY FORESTS	IUCN	NOM-059	CITES	SYNONYMS
ORDER LAGOMORPHA						
FAMILY LEPORIDAE						
Lepus alleni	NA		LC			
Lepus callotis	NA		VU			
Lepus flavigularis	MX	X	EN	P		
Sylvilagus audubonii	NA		LC			
Sylvilagus cunicularius	MX		LC			
Sylvilagus floridanus	AM		LC			
ORDER RODENTIA						
FAMILY SCIURIDAE						
SUBFAMILY SCIURINAE						
Sciurus aureogaster	MA		LC			
Sciurus colliaei	MX	X	LC			
SUBFAMILY XERINAE						
Neotamias dorsalis	NA		LC			*Tamias dorsalis*
Notocitellus adocetus	MX	X	LC			*Spermophylus adocetus*
Notocitellus annulatus	MX	X	LC			*Spermophylus annulatus*
Otospermophilus variegatus	NA		LC			*Spermophilus variegatus*
FAMILY GEOMYIDAE						
SUBFAMILY GEOMYINAE						
Cratogeomys fumosus	MX		LC	A		
Orthogeomys grandis	MA		LC			
Pappogeomys bulleri	MX	X	LC			
Thomomys atrovarius	MX		NE			*Thomomys umbrinus*
FAMILY HETEROMYIDAE						
SUBFAMILY HETEROMYINAE						

TAXA	DISTRIBUTION	ENDEMIC TO DRY FORESTS	IUCN	NOM-059	CITES	SYNONYMS
Heteromys goldmani	MA	X	NE			*Heteromys desmarestianus*
Heteromys irroratus	NA		LC			
Heteromys pictus	MA		LC			
Heteromys spectabilis	MX	X	EN	Pr		
SUBFAMILY PEROGNATHINAE						
Chaetodipus artus	MX	X	LC			
Chaetodipus goldmani	MX	X	NT			
Chaetodipus pernix	MX	X	LC			
FAMILY CRICETIDAE						
SUBFAMILY NEOTOMINAE						
Baiomys brunneus	MA		NE	NE		*Baiomys musculus*
Baiomys musculus	MX		LC			
Baiomys taylori	NA		LC			
Hodomys alleni	MX	X	LC			
Neotoma melanura	MX		NE			*Neotoma albigula*
Neotoma mexicana	NA		LC			
Neotoma phenax	MX	X	LC	Pr		
Osgoodomys banderanus	MX	X	LC			
Peromyscus aztecus	MX		LC			
Peromyscus chrysopus	MX	X	NE	NE		*Peromyscus perfulvus*
Peromyscus cordillerae	MA		NE	NE		*Peromyscus aztecus*
Peromyscus eremicus	NA		LC			
Peromyscus labecula	NA		NE			*Peromyscus maniculatus*
Peromyscus leucurus	MX		NE	NE		*Peromyscus melanophrys*
Peromyscus levipes	MX		LC			
Peromyscus megalops	MX	X	LC			
Peromyscus melanophrys	MX		LC			

TAXA	DISTRIBUTION	ENDEMIC TO DRY FORESTS	IUCN	NOM-059	CITES	SYNONYMS
Peromyscus mexicanus	MX		LC			
Peromyscus micropus	MX		NE	NE		*Peromyscus melanophrys*
Peromyscus perfulvus	MX	X	LC			
Peromyscus simulus	MX	X	VU			
Peromyscus spicilegus	MX		LC			
Reithrodontomys burti	MX		DD			
Reithrodontomys fulvescens	NA		LC			
Reithrodontomys hirsutus	MX		VU			
Reithrodontomys mexicanus	SA		LC			
Xenomys nelsoni	MX	X	EN	A		
SUBFAMILY SIGMODONTINAE						
Handleyomys melanotis	MX	X	LC			*Oryzomys melanotis*
Handleyomys rostratus	MA		LC			*Oryzomys rostratus*
Oligoryzomys fulvescens	SA		LC			
Oryzomys albiventer	MX		NE	NE		*Oryzomys couesi*
Oryzomys couesi	AM		LC			
Rheomys mexicanus	MX	X	EN	Pr		
Sigmodon alleni	MX	X	VU			
Sigmodon arizonae	NA		LC			*Sigmodon hispidus*
Sigmodon mascotensis	MX	X	LC			*Sigmodon hispidus*
SUBFAMILY TYLOMYINAE						
Nyctomys sumichrasti	MA		LC			
Tylomys nudicaudus	MA		LC			
FAMILY ERETHIZONTIDAE						
SUBFAMILY ERETHIZONTINAE						
Coendou mexicanus	MA		LC	A	III	

ORDER EULIPOTYPHLA

TAXA	DISTRIBUTION	ENDEMIC TO DRY FORESTS	IUCN	NOM-059	CITES	SYNONYMS
FAMILY SORICIDAE						
SUBFAMILY SORICINAE						
Megasorex gigas	MX	X	LC	A		
Notiosorex evotis	MX		LC	A		
ORDER CARNIVORA						
FAMILY MEPHITIDAE						
SUBFAMILY MEPHITINAE						
Conepatus leuconotus	NA		LC			
Mephitis macroura	NA		LC			
Spilogale angustifrons	MA		LC			
Spilogale pygmaea	MX	X	VU	A		
FAMILY MUSTELIDAE						
SUBFAMILY GULONINAE						
Eira barbara	SA		LC	P	III	
SUBFAMILY LUTRINAE						
Lontra longicaudis	SA		NT	A	I	
SUBFAMILY MUSTELINAE						
Neogale frenata	AM		LC			*Mustela frenata*
SUBFAMILY TAXIDIINAE						
Taxidea taxus	NA		LC	A		
FAMILY PROCYONIDAE						
Bassariscus astutus	NA		LC			
Nasua narica	AM		LC		III	
Potos flavus	SA		LC	Pr	III	
Procyon lotor	AM		LC			
FAMILY CANIDAE						
Canis latrans	AM		LC			

TAXA	DISTRIBUTION	ENDEMIC TO DRY FORESTS	IUCN	NOM-059	CITES	SYNONYMS
Urocyon cinereoargenteus	AM		LC			
FAMILY FELIDAE						
SUBFAMILY FELINAE						
Herpailurus yagouaroundi	SA		LC	A	I	
Leopardus pardalis	AM		LC	P	I	
Leopardus wiedii	SA		NT	P	I	
Lynx rufus	NA		LC		II	
Puma concolor	AM		LC		II	
SUBFAMILY PANTHERINAE						
Panthera onca	SA		NT	P	I	
ORDER PERISSODACTYLA						
FAMILY TAPIRIDAE						
Tapirus bairdii	SA		EN	P	I	
ORDER ARTIODACTYLA						
FAMILY CERVIDAE						
SUBFAMILY CAPREOLINAE						
Odocoileus virginianus	AM		LC			
FAMILY TAYASSUIDAE						
Dicotyles tajacu	SA		LC		II	*Pecari tajacu*
ORDER CHIROPTERA						
FAMILY EMBALLONURIDAE						
SUBFAMILY EMBALLONURINAE						

TAXA	DISTRIBUTION	ENDEMIC TO DRY FORESTS	IUCN	NOM-059	CITES	SYNONYMS
Balantiopteryx plicata	MA		LC			
Diclidurus albus	SA		LC			
Peropteryx macrotis	SA		LC			
Saccopteryx bilineata	SA		LC			
FAMILY PHYLLOSTOMIDAE						
SUBFAMILY CAROLLIINAE						
Carollia subrufa	MA		LC			
SUBFAMILY DESMODONTINAE						
Desmodus rotundus	SA		LC			
SUBFAMILY GLOSSOPHAGINAE						
Anoura geoffroyi	SA		LC			
Choeroniscus godmani	SA		LC			
Choeronycteris mexicana	NA		NT	A		
Glossophaga commissarisi	SA		LC			
Glossophaga leachii	MA		LC			
Glossophaga morenoi	MX		LC			
Glossophaga mutica	SA		NE			*Glossophaga soricina*
Glyphonycteris sylvestris	SA		LC			
Hylonycteris underwoodi	MA		LC			
Leptonycteris yerbabuenae	AM		NT	Pr		*Leptonycteris curasoae*
Musonycteris harrisoni	MX	X	VU	P		
SUBFAMILY MACROTINAE						
Macrotus waterhousii	MA		LC			
SUBFAMILY MICRONYCTERINAE						
Micronycteris microtis	SA		LC			

TAXA	DISTRIBUTION	ENDEMIC TO DRY FORESTS	IUCN	NOM-059	CITES	SYNONYMS
SUBFAMILY PHYLLOSTOMINAE						
Phyllostomus discolor	SA		LC			
Trachops cirrhosus	SA		LC	A		
SUBFAMILY STENODERMATINAE						
Artibeus hirsutus	MX	X	LC			
Artibeus jamaicensis	SA		LC			
Artibeus lituratus	SA		LC			*Artibeus intermedius*
Centurio senex	SA		LC			
Chiroderma scopaeum	MX		NE			*Chiroderma salvini*
Dermanura phaeotis	SA		LC			
Dermanura tolteca	MA		LC			
Enchisthenes hartii	SA		LC	Pr		
Platyrrhinus helleri	SA		LC			
Sturnira hondurensis	MA		LC			*Sturnira ludovici*
Sturnira parvidens	MA		LC			*Sturnira lilium*
Uroderma magnirostrum	SA		LC			
FAMILY MORMOOPIDAE						
Mormoops megalophylla	AM		LC			
Pteronotus fulvus	MA		NE			*Pteronotus davyi*
Pteronotus mesoamericanus	MA		LC			*Pteronotus parnellii*
Pteronotus mexicanus	MX		NE			*Pteronotus parnellii*
Pteronotus psilotis	MA		NE			*Pteronotus personatus*
FAMILY NOCTILIONIDAE						
Noctilio leporinus	SA		LC			
FAMILY NATALIDAE						
Natalus mexicanus	MA		LC			*Natalaus stramineus*
FAMILY MOLOSSIDAE						

TAXA	DISTRIBUTION	ENDEMIC TO DRY FORESTS	IUCN	NOM-059	CITES	SYNONYMS
SUBFAMILY MOLOSSINAE						
Cynomops mexicanus	MX		LC	Pr		*Molossops greenhalli*
Eumops ferox	MA		LC			*Eumops glaucinus*
Eumops underwoodi	MA		LC			
Molossus aztecus	MA		LC			*Molossus molossus*
Molossus molossus	SA		LC			
Molossus nigricans	MA		NE			*Molossus rufus*
Molossus sinaloae	SA		LC			
Nyctinomops aurispinosus	SA		LC			
Nyctinomops femorosaccus	NA		LC			
Nyctinomops laticaudatus	SA		LC			
Nyctinomops macrotis	AM		LC			
Promops centralis	SA		LC			
Tadarida brasiliensis	AM		LC			
FAMILY VESPERTILIONIDAE						
SUBFAMILY MYOTINAE						
Myotis californicus	AM		LC			
Myotis carteri	MX	X	NE	Pr		*Myotis nigricans*
Myotis fortidens	MA		LC			
Myotis nigricans	SA		LC			
Myotis pilosatibialis	SA		NE			*Myotis keaysi*
Myotis thysanodes	NA		LC			
Myotis velifer	AM		LC			
Myotis volans	NA		LC			
Myotis yumanensis	NA		LC			
SUBFAMILY VESPERTILIONINAE						
Aeorestes cinereus	AM		LC			*Lasiurus cinereus*

TAXA	DISTRIBUTION	ENDEMIC TO DRY FORESTS	IUCN	NOM-059	CITES	SYNONYMS
Bauerus dubiaquercus	MA		NT			
Corynorhinus townsendii	NA		LC			
Dasypterus ega	AM		LC			*Lasiurus ega*
Dasypterus intermedius	NA		LC			*Lasiurus intermedius*
Dasypterus xanthinus	NA		LC			*Lasiurus xanthinus*
Eptesicus furinalis	SA		LC			
Eptesicus fuscus	AM		LC			
Lasiurus frantzii	AM		NE			*Lasiurus blossevillii*
Parastrellus hesperus	NA		LC			*Pipistrellus herperus*
Rhogeessa alleni	MX		LC			*Baeodon alleni*
Rhogeessa gracilis	MX	X	LC			*Baeodon gracilis*
Rhogeessa mira	MX	X	VU	Pr		
Rhogeessa parvula	MX	X	LC			
Rhogeessa tumida	SA		LC			

DISCUSIÓN GENERAL Y CONCLUSIONES

Las selvas secas del Pacífico mexicano destacan por su notable diversidad de mamíferos, albergando aproximadamente el 33 % de los mamíferos terrestres del país y el 31 % de las especies endémicas de México. Los resultados obtenidos son semejantes a los reportados en estudios previos tanto para mamíferos como para los otros taxones de vertebrados [12,16,19,22,23]. Es importante destacar que el 18 % de estas especies corresponden a subespecies que han sido recategorizadas como especies (S2 Tabla). Estas recategorizaciones tienen implicaciones significativas para la conservación, ya que la mayoría de estas nuevas especies no han sido evaluadas en términos de su estado de conservación, y varias de estas especies presentan una distribución restringida a las selvas secas o son endémicas de México [35–47]. Además, es crucial destacar que los mamíferos amenazados en este ecosistema presentan rasgos ecológicos característicos, como un rango geográfico reducido (especies endémicas) o un área de actividad amplia (en el caso de carnívoros). Dichos rasgos han sido identificados como predictores del riesgo de extinción de especies en estudios previos [1,4,7]. Esto resalta la importancia y singularidad de las selvas secas del Pacífico mexicano como reservorio de biodiversidad [12,14,17,22,23], al albergar especies únicas y en ocasiones altamente especializadas en este particular ecosistema.

En relación con los tipos de distribución de los mamíferos a escala nacional, es notable que el 38 % de estas especies se encuentran restringidas a la costa del Pacífico mexicano. Estos resultados enfatizan una vez más la singularidad y exclusividad de estas especies en esta región, como estudios previos han sugerido tanto para los mamíferos como para los otros taxones de vertebrados [12,14,16,17,22,23].

Los patrones de tanto la diversidad taxonómica y como funcional fueron semejantes, a escala nacional y regional. Estos mostraron un gradiente latitudinal inverso, lo que implica que a medida que nos desplazamos hacia latitudes más bajas, existe una mayor diferenciación en el nicho ecológico de las especies. Este gradiente latitudinal inverso sugiere que, a latitudes más bajas, donde las condiciones ambientales son generalmente menos adversas, el proceso de filtrado ambiental en términos de funciones ecológicas es menos intenso [28, 30,48–51]. Como resultado, las especies tienen la oportunidad de diferenciarse más en términos

de sus funciones y roles en el ecosistema. En esta situación, las interacciones bióticas a menores latitudes son más intensas, donde la competencia por recursos se convierte en el principal factor que limita la coexistencia de especies [30,48–51].

Los patrones de distribución de las especies endémicas y amenazadas coinciden con estudios anteriores [12,16,17,22,23]. Las especies endémicas se concentraron en un área particularmente heterogénea, donde convergen la cuenca del Río Balsas, el eje Neovolcánico y la Sierra Madre Occidental. Esta área es de gran importancia, ya que alberga tantas especies endémicas de México, endémicas de las selvas secas y especies con distribución restringidas dichas selvas. En cuanto a las especies amenazadas, se encontró una alta correlación con el gradiente de riqueza de especies, lo cual refleja un patrón coincidente con que la extinción de poblaciones y especies es un fenómeno que ocurre a nivel mundial, pero muestra una marcada tendencia hacia las regiones tropicales [1,2,52,53].

La diversidad beta taxonómica y la diversidad beta funcional presentaron patrones de distribución similares a escala nacional, donde los valores más altos se concentraron en las zonas de transición entre diferentes ecosistemas, las cuales albergan una gran cantidad de especies endémicas y restringidas. Sin embargo, la diversidad beta taxonómica fue 42 % mayor que la diversidad beta funcional.

La disimilitud taxonómica se explicó por un cambio en la composición de especies (recambio taxonómico). Por otro lado, la diversidad beta funcional estuvo dominada por el anidamiento, lo que significa que la disimilitud funcional se debió a que algunas comunidades tenían una pequeña porción de los rasgos funcionales presentes en otras comunidades más ricas en términos funcionales. Esto indica que la influencia del filtrado ambiental en la selección de los rasgos de las especies tuvo una intensidad desigual en nuestra área de estudio, siendo más pronunciada a mayores latitudes [28,30,34,48–50,54,56].

La marcada predominancia del recambio taxonómico y la baja presencia del recambio funcional sugieren que las selvas estas exhiben un clima y una fisonomía característica, especialmente marcadas por una estación seca distintiva [9–16]. Estos patrones indican que el ensamblaje de los mamíferos estudiados

está principalmente influenciado por el filtrado ambiental, lo que da como resultado una convergencia funcional. En otras palabras, aunque las especies difieren en su composición taxonómica, comparten rasgos funcionales similares [28,30,34,54–59]. Estos resultados resaltan la importancia de los factores ambientales en la configuración de las comunidades de mamíferos en las selvas secas, ya que el clima y las condiciones específicas de estas áreas, especialmente la estación seca pronunciada, juegan un papel fundamental en la selección de especies y la configuración de los rasgos funcionales presentes en estas comunidades.

Los patrones de distribución de la diversidad taxonómica y funcional, así como de la diversidad beta taxonómica y funcional, a escala regional (en bandas latitudinales) se mantuvieron consistentes con los obtenidos a escala nacional. Sin embargo, los valores promedio de la diversidad beta taxonómica a escala regional disminuyeron más de la mitad, en comparación a los valores obtenidos a escala nacional. Esto es debido a que nuestra área de estudio se redujo a cada banda latitudinal, es decir, la disimilitud entre las comunidades se analizó comparando las celdas correspondientes a una misma banda latitudinal, reduciendo así la disimilitud presente entre las comunidades.

Es importante destacar que el número de especies no sesgó las correlaciones obtenidas entre los índices de diversidad beta a escala nacional y regional. Estas correlaciones fueron igualmente significativas, lo que sugiere que los patrones observados no se ven afectados por diferencias en el número de especies y en el tamaño del área de cada banda latitudinal.

La selección del recambio taxonómico como indicador de las áreas prioritarias para la conservación se fundamenta en el hecho de que este explicó el 71 % de la variación en la diversidad beta taxonómica. Esto implica que las diferencias en los ensamblajes de mamíferos analizados entre las distintas celdas se deben principalmente a cambios en la composición de especies. Este hallazgo refleja la importancia del recambio taxonómico a nivel nacional, incluso considerando la distancia entre las celdas analizadas. La alta proporción de variación explicada por el recambio taxonómico indica la presencia de un considerable número de especies endémicas en las selvas secas, con patrones de distribución restringidos a estas regiones, congruentes con los patrones obtenidos previamente tanto para mamíferos como los demás taxones de

vertebrados [12,14,16,17,22,23]. Además, al contrastar los patrones de diversidad taxonómica y diversidad beta taxonómica, se evidencia una notable disparidad entre ambos. En particular, se observa que el patrón de gradiente latitudinal inverso de la diversidad taxonómica puede atribuirse principalmente a la presencia de especies con amplia distribución geográfica, lo cual difiere de los patrones de diversidad beta. Si bien la diversidad taxonómica proporciona una visión general de la riqueza de especies en diferentes regiones, es la diversidad beta la que nos brinda información detallada sobre las diferencias en la composición de especies y la estructura de los ensambles en un contexto espacial [17,51,56,58,59].

El predominante recambio taxonómico se reflejó en que el 30 % del área se identificó como área prioritaria para la conservación. En estas áreas, al menos el 20 % de la composición de especies mostró diferencias entre los ensamblajes analizados (celdas), considerando la distancia geográfica entre ellas. Lamentablemente, el 85 % de las áreas prioritarias para la conservación presentaron un impacto antropogénico que supera el 50 %. Esto es consistente con los altos niveles de impacto observados en toda el área de las selvas secas y denotados en estudios previos [60–62,64]. Al examinar el estado de conservación de las áreas prioritarias identificadas, se constató que el 48 % de ellas requiere medidas de restauración, debido a las significativas repercusiones del cambio desmedido de uso del suelo, especialmente para actividades agrícolas y ganaderas [63]. Estos hallazgos concuerdan con investigaciones anteriores [10,12–14] que han resaltado el uso intensivo y excesivo de las selvas secas. A pesar de ello, el 18 % de las áreas prioritarias se clasificaron como aptas para el manejo para la conservación, las cuales representan áreas que podrían ser utilizadas con precaución, siempre y cuando se implementen prácticas agrícolas y ganaderas sostenibles que no comprometan la integridad de la vegetación primaria, con el fin de preservar estos grandes remanentes de ecosistemas prístinos los cuales brindan servicios ecosistémicos de los cuales dependemos [1,10,11,64,65]. En cuanto a las áreas que presentaron un uso intensivo del suelo (17 %), es importante destacar que estas zonas enfrentan un alto grado de impacto y requieren de considerables esfuerzos tanto humanos como económicos para su restauración. Sin embargo, es crucial reconocer que la viabilidad de restaurar estas áreas altamente degradadas puede resultar difícil e incluso inviable en algunos casos [61]. Por

lo tanto, es recomendable que se evite que estas áreas impactadas aumenten en proporción, priorizando la adopción de medidas para detener o revertir el deterioro existente. En contraste, aproximadamente el 10 % de las áreas prioritarias identificadas para la conservación presentan oportunidades prometedoras. Estas áreas pueden ser consideradas para la planificación de la creación de áreas naturales protegidas (ANP), la implementación de áreas destinadas voluntariamente para la conservación (ADVC) o mediante pagos por servicios ambientales (PSA) [66]. Solo el 7 % de las áreas prioritarias se encuentran actualmente bajo alguna forma de protección. A pesar de ello, el 73 % de estas áreas protegidas requieren urgentemente medidas de restauración, debido a que en estas celdas predominan las coberturas de vegetación secundaria y actividades agropecuarias, lo que se traduce en áreas con un impacto antropogénico alto. Estos hallazgos subrayan la necesidad de implementar planes de manejo adecuados para las áreas protegidas de la región, con el fin de revertir los impactos negativos y restablecer su funcionalidad ecológica [60,65]. Asimismo, al considerar la totalidad de nuestra área de estudio, encontramos que solo el 8 % de ellas se encuentran bajo algún tipo de protección. Estos resultados se relacionan con investigaciones anteriores que han señalado la reducida proporción de áreas protegidas en las selvas secas [10–14,16,20,61,62], lo cual recalca la necesidad de intensificar los esfuerzos de conservación y ampliar la cobertura de áreas protegidas en este valioso ecosistema.

REFERENCIAS BIBLIOGRÁFICAS

1.   Dirzo R, Young HS, Galetti M, Ceballos G, Isaac NJB, Collen B. Defaunation in the Anthropocene. Science. 2014;345: 401–406. doi:10.1126/science.1251817.

2.   Ceballos G, Ehrlich PR, Barnosky AD, García A, Pringle RM, Palmer TM. Accelerated Modern Human–induced Species losses: Entering the Sixth Mass Extinction. Science Advances. 2015;1: e1400253. doi:10.1126/sciadv.1400253.

3.   Genes L, Cid B, Fernandez FAS, Pires AS. Credit of ecological interactions: A new conceptual framework to support conservation in a defaunated world. Ecology and Evolution. 2017;7: 1892–1897. doi:10.1002/ece3.2746.

4.   Brum FT, Graham CH, Costa GC, Hedges SB, Penone C, Radeloff VC, et al. Global priorities for conservation across multiple dimensions of mammalian diversity. Proceedings of the National Academy of Sciences. 2017;114: 7641–7646. doi:10.1073/pnas.1706461114.

5.   Ceballos G, Ehrlich PR, Dirzo R. Biological annihilation via the ongoing sixth mass extinction signaled by vertebrate population losses and declines. Proceedings of the National Academy of Sciences. 2017;114: E6089–E6096. doi:10.1073/pnas.1704949114.

6.   Ceballos G, Ehrlich PR, Raven PH. Vertebrates on the brink as indicators of biological annihilation and the sixth mass extinction. Proceedings of the National Academy of Sciences. 2020;117: 201922686. doi:10.1073/pnas.1922686117.

7.   Davidson AD, Hamilton MJ, Boyer AG, Brown JH, Ceballos G. Multiple ecological pathways to extinction in mammals. Proceedings of the National Academy of Sciences. 2009;106: 10702–10705. doi:10.1073/pnas.0901956106.

8.   Lister BC, Garcia A. Climate-driven declines in arthropod abundance restructure a rainforest food web. Proceedings of the National Academy of Sciences. 2018;115: E10397–E10406. doi:10.1073/pnas.1722477115.

9.   Pennington RT, Ratter JA, Lewis GP. An overview of the plant diversity, biogeography and

conservation of Neotropical savannas and seasonally dry forests. In: Pennington RT, Ratter JA, Lewis GP, editors. Neotropical Savannas and Seasonally Dry Forests: Plant Biodiversity, Biogeography and Conservation. Florida, USA: CRC Press, Boca Raton; 2006. pp. 1–29.

10. Pulla S, Ramaswami G, Mondal NK, Chitra-Tarak R, Suresh HS, Dattaraja HS, et al. Assessing the resilience of global seasonally dry tropical forests. International Forestry Review. 2015;17: 91–113. doi:10.1505/146554815815834796.

11. Stan K, Sanchez-Azofeifa A. Tropical Dry Forest Diversity, Climatic Response, and Resilience in a Changing Climate. Forests. 2019;10: 443. doi:10.3390/f10050443.

12. Ceballos G, Martinez L, García A, Espinoza E, Bezaury Creel J, Dirzo R, editors. Diversidad, Amenazas y áreas Prioritarias para la Conservación de Las Selvas Secas del Pacífico de México. 1 st ed. D.F, México; 2010.

13. Trejo I, Dirzo R. Deforestation of seasonally dry tropical forest. Biological Conservation. 2000;94: 133–142. doi:10.1016/s0006-3207(99)00188-3.

14. Trejo I. Análisis de la diversidad de la selva baja caducifolia en México. Sobre diversidad biológica: el significado de las diversidades alfa, beta y gamma. GORFI; 2005. pp. 111–122.

15. Rzedowski R, editor. Vegetación de México. 1 st ed. México: Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, México; 2006.

16. García A, Solano-Rodríguez H, Flores-Villela O. Patterns of alpha, beta and gamma diversity of the herpetofauna in Mexico's Pacific lowlands and adjacent interior valleys. Animal Biodiversity and Conservation. 2007;30: 169–177. doi:10.32800/abc.2007.30.0169.

17. Ceballos G, Garcia A. Conserving Neotropical Biodiversity: The Role of Dry Forests in Western Mexico. Conservation Biology. 1995;9: 1349–1353.

18. Villers-RuízL, Trejo-Vázquez I. Climate change on Mexican forests and natural protected areas. Global Environmental Change. 1998;8: 141–157. doi:10.1016/s0959-3780(98)00012-0.

19. García A, Ortega-Huerta MA, Martínez-Meyer E. Potential distributional changes and conservation priorities of endemic amphibians in western Mexico as a result of climate change.

Environmental Conservation. 2013;41: 1–12. doi:10.1017/s0376892913000349.

20.   Prieto-Torres DA, Lira-Noriega A, Navarro-Sigüenza AG. Climate change promotes species loss

and uneven modification of richness patterns in the avifauna associated to Neotropical seasonally

dry forests. Perspectives in Ecology and Conservation. 2020;18: 19–30.

doi:10.1016/j.pecon.2020.01.002.

21.   Sage RF. Global change biology: A primer. Global Change Biology. 2019;26: 3–30.

doi:10.1111/gcb.14893.

22.   Prieto-Torres DA, Rojas-Soto OR, Bonaccorso E, Santiago-Alarcón D, Navarro-Sigüenza AG.

Distributional patterns of Neotropical seasonally dry forest birds: a biogeographical

regionalization. Cladistics. 2018;35: 446–460. doi:10.1111/cla.12366.

23.   Prieto-Torres DA, Rojas-Soto OR, Santiago-Alarcon D, Bonaccorso E, Navarro-SigüEnza AG.

Diversity, Endemism, Species Turnover and Relationships among Avifauna of Neotropical

Seasonally Dry Forests. Ardeola. 2019;66: 257. doi:10.13157/arla.66.2.2019.ra1.

24.   Rodríguez P, Soberón J, Arita HT. El componente beta de la diversidad de mamíferos de México.

Acta zoológica mexicana. 2003;89: 241–259. doi:https://doi.org/10.21829/azm.2003.89891785.

25.   Ceballos G. Conservation priorities for mammals in megadiverse Mexico: The efficiency of

reserve networks. Ecological Applications. 2007;17: 569–578. doi:10.1890/06-0134

26.   Possingham HP, Noon BR. Making smart conservation. Conservation biology: research priorities

for the next decade. 2001; 23: 225-244.

27.   Ceballos G, Ehrlich PR, Soberón J, Salazar I, Fay JP. Global Mammal Conservation: What Must

We Manage? Science. 2005;309: 603–607. doi:10.1126/science.1114015.

28.   Córdova-Tapia F, Zambrano L. Functional diversity in community ecology. Ecosistemas.

2015;24: 78–87. doi:10.7818/ecos.2015.24-3.10.

29.   Devictor V, Mouillot D, Meynard C, Jiguet F, Thuiller W, Mouquet N. Spatial mismatch and

congruence between taxonomic, phylogenetic and functional diversity: the need for integrative

conservation strategies in a changing world. Ecology Letters. 2010;13: 1030–1040.

doi:10.1111/j.1461-0248.2010.01493.x.

30. Álvarez-Grzybowska E, Urbina-Cardona N, Córdova-Tapia F, García A. Amphibian communities in two contrasting ecosystems: functional diversity and environmental filters. Biodiversity and Conservation. 2020;29: 2457–2485. doi:10.1007/s10531-020-01984-w.

31. Cadotte MW, Tucker CM. Difficult decisions: Strategies for conservation prioritization when taxonomic, phylogenetic and functional diversity are not spatially congruent. Biological Conservation. 2018;225: 128–133. doi:10.1016/j.biocon.2018.06.014.

32. Gómez–Ortiz Y, Moreno CE. La diversidad funcional en comunidades animales: una revisión que hace énfasis en los vertebrados. Animal Biodiversity and Conservation. 2017;40: 165–174. doi:10.32800/abc.2017.40.0165.

33. Gómez-Ortiz Y, Domínguez-Vega H, Moreno CE. Spatial variation of mammal richness, functional and phylogenetic diversity in the Mexican transition zone. Community Ecology. 2017;18: 121–127. doi:10.1556/168.2017.18.2.1.

34. Salgado-Negret B, editor. La ecología funcional como aproximación al estudio, manejo y conservación de la biodiversidad: protocolos y aplicaciones. Bogotá, D. C. Colombia: Instituto de Investigación de Recursos Biológicos Alexander von Humboldt; 2015.

35. Arcangeli J, Light JE, Cervantes F. Molecular and morphological evidence of the diversification in the gray mouse opossum, Tlacuatzin canescens (Didelphimorphia), with description of a new species. Journal of Mammalogy. 2018;99: 138–158. doi:10.1093/jmammal/gyx173.

36. Baird AB, Braun JK, Mares MA, Morales JC, Patton JC, Tran CQ, et al. Molecular systematic revision of tree bats (Lasiurini): doubling the native mammals of the Hawaiian Islands. Journal of Mammalogy. 2015;96: 1255–1274. doi:10.1093/jmammal/gyv135.

37. Bradley RD, Mauldin MR. Molecular data indicate a cryptic species in Neotoma albigula (Cricetidae: Neotominae) from northwestern México. Journal of Mammalogy. 2016;97: 187–199. doi:10.1093/jmammal/gyv169.

38. Bradley RD, Francis JQ, Platt RN, Soniat TJ, Alvarez D, LIndsey LL. Mitochondrial DNA

Sequence Data Indicate Evidence for Multiple Species Within Peromyscus maniculatus. Special

Publications, Museum of Texas Tech University. 2019.

39.   Ceballos G, editor. Mammals of Mexico. Baltimore: Johns Hopkins University Press; 2014.

40.   Carleton MD, Arroyo-CabralesJ. Review of the Oryzomys couesi Complex (Rodentia: Cricetidae:

      Sigmodontinae) in Western Mexico. Bulletin of the American Museum of Natural History.

      2009;331: 94–127. doi:10.1206/582-3.1.

41.   Castañeda-Rico S, León-Paniagua L, Vázquez-Domínguez E, Navarro-Sigüenza AG.

      Evolutionary diversification and speciation in rodents of the Mexican lowlands: The Peromyscus

      melanophrys species group. Molecular Phylogenetics and Evolution. 2014;70: 454–463.

      doi:10.1016/j.ympev.2013.10.004.

42.   Hugo MM, Javier MG. Biogeography and taxonomic status of Myotis keaysi pilosatibialis LaVal

      1973 (Chiroptera: Vespertilionidae). Zootaxa. 2014;3793: 60–70. doi:10.11646/zootaxa.3793.1.2.

43.   Kilpatrick CW, Pradhan N, Norris RW. A re-examination of the molecular systematics and

      phylogeography of taxa of the Peromyscus aztecus species group, with comments on the

      distribution of P. winkelmanni. Therya. 2021;12: 331–346. doi:10.12933/therya-21-1115.

44.   López-González C, García-Mendoza DF, López-Vidal JC, Elizalde-Arellano C. Multiple lines of

      evidence reveal a composite of species in the plateau mouse, Peromyscus melanophrys (Rodentia,

      Cricetidae). Journal of Mammalogy. 2019;100: 1583–1598. doi:10.1093/jmammal/gyz106.

45.   Loureiro LO, Engstrom MD, Lim BK. Single nucleotide polymorphisms (SNPs) provide

      unprecedented resolution of species boundaries, phylogenetic relationships, and genetic diversity

      in the mastiff bats (Molossus). Molecular Phylogenetics and Evolution. 2020;143: 106690.

      doi:10.1016/j.ympev.2019.106690.

46.   Pavan AC, Marroig G. Integrating multiple evidences in taxonomy: species diversity and

      phylogeny of mustached bats (Mormoopidae: Pteronotus). Molecular Phylogenetics and

      Evolution. 2016;103: 184–198. doi:10.1016/j.ympev.2016.07.011.

47. Rogers DS, González MW. Phylogenetic relationships among spiny pocket mice (Heteromys) inferred from mitochondrial and nuclear sequence data. Journal of Mammalogy. 2010;91: 914–930. doi:10.1644/09-mamm-a-287.1.

48. Hooper DU, Chapin FS, Ewel JJ, Hector A, Inchausti P, Lavorel S, et al. Effects of biodiversity on ecosystem functioning: A consensus of current knowledge. Ecological Monographs. 2005;75: 3–35. doi:10.1890/04-0922.

49. Suárez-Castro AF, Raymundo M, Bimler M, Mayfield MM. Using multi-scale spatially explicit frameworks to understand the relationship between functional diversity and species richness. Ecography. 2022;2022. doi:10.1111/ecog.05844.

50. Lamanna C, Blonder B, Violle C, Kraft NJB, Sandel B, imova I, et al. Functional trait space and the latitudinal diversity gradient. Proceedings of the National Academy of Sciences. 2014;111: 13745–13750. doi:10.1073/pnas.1317722111.

51. Fukami T. Historical Contingency in Community Assembly: Integrating Niches, Species Pools, and Priority Effects. Annual Review of Ecology, Evolution, and Systematics. 2015;46: 1–23. doi:10.1146/annurev-ecolsys-110411-160340.

52. Ceballos G. Conservation priorities for mammals in megadiverse Mexico: the efficiency of reserve networks. Ecological Applications. 2007;17: 569–578. doi:10.1890/06-0134.

53. Davidson AD, Shoemaker KT, Weinstein B, Costa GC, Brooks TM, Ceballos G, et al. Geography of current and future global mammal extinction risk. Kamilar JM, editor. PLOS ONE. 2017;12: e0186934. doi:10.1371/journal.pone.0186934.

54. Neale Z, Rudolf. Predation and competition drive trait diversity across space and time. Ecology. 2023. doi:10.1002/ecy.4182.

55. Mason NWH, Mouillot D, Lee WG, Wilson JB. Functional richness, functional evenness and functional divergence: the primary components of functional diversity. Oikos. 2005;111: 112–118. doi:10.1111/j.0030-1299.2005. 13886.x.

56. Moreno CE. La biodiversidad en un mundo cambiante. Ciudad de México, México: Universidad Autónoma del Estado de Hidalgo; 2019.

57. Chao A, Chiu C, Villéger S, Sun I, Thorn S, Lin Y, et al. An attribute-diversity approach to functional diversity, functional beta diversity, and related (dis)similarity measures. Ecological Monographs. 2019;89. doi:10.1002/ecm.1343.

58. Jost L. Partitioning diversity into independent alpha and beta components. Ecology. 2007;88: 2427–2439. doi:10.1890/06-1736.1.

59. Villéger S, Grenouillet G, Brosse S. Decomposing functional β-diversity reveals that low functional β-diversity is driven by low functional turnover in European fish assemblages. Global Ecology and Biogeography. 2013;22: 671–681. doi:10.1111/geb.12021.

60. Strassburg BBN, Iribarrem A, Beyer HL, Cordeiro CL, Crouzeilles R, Jakovac CC, et al. Global priority areas for ecosystem restoration. Nature. 2020;586: 1–6. doi:10.1038/s41586-020-2784-9.

61. Tobón W, Urquiza-Haas T, Koleff P, Schröter M, Ortega-Álvarez R, Campo J, et al. Restoration planning to guide Aichi targets in a megadiverse country. Conservation Biology. 2017;31: 1086–1097. doi:10.1111/cobi.12918.

62. Prieto-Torres DA, Nori J, Rojas-Soto OR, Navarro-Sigüenza AG. Challenges and opportunities in planning for the conservation of Neotropical seasonally dry forests into the future. Biological Conservation. 2021;257: 109083. doi:10.1016/j.biocon.2021.109083.

63. INEGI. Conjunto de Datos Vectoriales de Uso de Suelo y Vegetación. Escala 1:250 000, Serie VII. Conjunto Nacional, escala: 1:250 000. Instituto Nacional de Estadística y Geografía. 2021.

64. Portillo-Quintero C, Sanchez-Azofeifa A, Calvo-Alvarado J, Quesada M, do Espirito Santo MM. The role of tropical dry forests for biodiversity, carbon and water conservation in the neotropics: lessons learned and opportunities for its sustainable management. Regional Environmental Change. 2014;15: 1039–1049. doi:10.1007/s10113-014-0689-6.

65. Dasgupta P. The economics of biodiversity: the Dasgupta review abridged version. London Hm Treasury; 2021.

66.   Macip-Ríos R, Macip RR. Pago por servicios ambientales (ecosistémicos) en México ¿Una alternativa para la conservación de la biodiversidad y el desarrollo? BIOCYT Biología Ciencia y Tecnología. 2013;6. doi:10.22201/fesi.20072082.2013.6.76105.