Handbook of the Mammals of Middle and South America
Series Editors: Mario Melletti · Sonia Gallina Tessaro

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Consuelo Lorenzo Monterrubio
José Manuel Mora
Editors

Mammals of Middle and South America: Lagomorpha

Springer

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Series Editors

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The *Handbook of the Mammals of Middle and South America* represents the first comprehensive reference work ever produced on the taxonomy, systematics, evolutionary history, ecology, and conservation of the entire mammalian fauna of Middle and South America, including the Caribbean. This landmark series sets a new standard in mammalian research. Bringing together contributions from hundreds of international authorities, the series integrates contemporary research across diverse subfields of mammalogy to provide an unparalleled synthesis of current knowledge. Structured around detailed accounts of more than 2,200 mammal species, the volumes offer comprehensive treatments of species level taxonomy, diagnostic morphological characteristics, biogeographic patterns, ecological and behavioral information, and conservation assessments grounded on the most recent data. With high quality illustrations, distribution maps, and comprehensive bibliographic resources, this Handbook constitutes an indispensable reference for researchers, academic institutions, conservation practitioners, and students working in mammalogy, systematics, biogeography, ecology, and biodiversity conservation. As the first work to compile and evaluate the scientific knowledge on the region's mammal species, it provides an essential basis for future research and conservation planning.

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Mammals of Middle and South America: Lagomorpha

With 277 Figures and 28 Tables

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Foreword to the Series

George Gaylord Simpson, one of the architects of the NeoDarwinian Revolution of the late 1930s and 1940s, defined systematics as "the study of the diversity of life." The set of volumes in this series epitomize Simpson's wide view as they summarize what is known about the diversity of Neotropical mammals, based not only on published literature but, importantly and rather uniquely, insights derived from personal experience of many account authors with organisms within their natural habitats. These volumes are structured on species, the core building blocks upon which all aspects of biodiversity are built; in so doing each account encapsulates the critical components of both taxonomy and natural history.

My own personal experience with Neotropical mammals began in the early 1960s when I began graduate school. At that time mammalian classification, from species to higher categories, was organized primarily by two conceptual principles: morphological gap ordered the increasing categorical levels from genus to order while reproductive isolation defined species. The following decades saw revolutionary changes to these principles. First was the paradigm of phylogenetic systematics developed by Willi Hennig in the late 1960s (Hennig, 1968), the distinction between traits shared by direct phylogenetic propinquity (shared-derived) and those shared because of deep ancestry (shared-ancestral). This philosophy provided the conceptual framework for biological classification now in universal use. The second revolution was the application of molecular systematics, today with near universal use of DNA and, to a lesser extent, protein sequences.

Hennig's philosophy provided the framework for how classifications should be built and molecular systematics, both coupled with new analytical methods, reordered our understanding of ancestor-descendent relationships that fundamentally changed the higher classification of mammals. As a simple example, consider the Order Insectivora, early recognized by G. G. Simpson in his 1945 *The Principles of Classification and a Classification of Mammals* as a "waste-basket" group. While remaining a valid mammalian order until the beginning of the twenty-first century, it's members have become segregated into four (e.g., Wilson & Reeder, 2005) or three phylogenetically disparate orders (e.g., Mammalian Diversity Database, 2026).

Molecular systematics has also had a profound impact on the question "what is a species?" My early training, and that of virtually all of my peers at the time, was influenced by Ernst Mayr, another of the NeoDarwinian

architects who promoted the concept that species comprised groups of reproductively compatible individuals segregated from other such groups by either intrinsic or extrinsic reproductive barriers—the "biological species" articulated in Mayr's 1942 book *Systematics and the Origin of Species* but cemented later in his foundational 1963 *Animal Species and Evolution*. Research on potential species-level boundaries then focused both on determining the existence, or lack, of reproductive barriers as well as on the geographic conditions that allowed these to develop (allopatric, parapatric, or sympatric). Today, the Biological Species of my intellectual youth are being replaced at an increasing rate by the Coalescent Species based on statistical methods using coalescent theory and molecular data to identify evolutionary lineages from modeling how gene copies merge backward in time (initially articulated by Rannala & Yang, 2003; reviews by Fujita et al., 2012; Singhal et al., 2025). The goal of the coalescent approach is to distinguish actual species from distinct populations, arguably to improve taxonomic stability by removing the historic reliance on morphological characters to uncover independent evolutionary histories. I haven't tallied the numbers, but a substantial number of the "newly" recognized species of living mammals in the past two decades, from 5416 (Wilson & Reeder, 2025) to 6759 (Mammal Diversity Database [MDD2], 2026; see Burgin et al., 2025), are Coalescent Species, either elevation of current subspecies or naming new, cryptic geographic lineages.

Beginning in the late 1950s, the near simultaneous publications of Angel Cabrera's *Catalógo de los Mamíferos de America del Sur* (1957 [1958], 1961) and E. Raymond Hall and Keith R. Kelson's *The Mammals of North America* (1959; updated by Hall in 1981) were the first classification syntheses of the mammalian fauna on a single continent, at categorical rank from subspecies to orders and including remarks on nomenclature with names and name combinations listed in synonymies but devoid of context to landscape history or ecoregion diversity. Hall's North American volumes included range maps, citations for plotted localities, keys to genera and species, brief lists of morphological characters with drawings of skulls, and natural history, components largely missing from Cabrera's South American treatises. John Eisenberg's three volume series *Mammals of the Neotropics* (1989, 1992, and 2000, the last two coauthored with Kent Redford) expanded South America into Panama; these also contained brief taxon descriptions and range maps but lacked keys or nomenclatural elements. These were then followed by two (of three intended) volumes in the *Mammals of South America* series edited, respectively, by Alfred Gardner (2008, Vol. 1, Covering marsupials, xenarthrans, shrews, and bats), and Jim Patton, Ulyses Pardiñas, and Guillermo D'Elía (2015, Vol. 2, rodents). Designed to complement Hall's North American volumes, both also centered mostly on taxonomy and nomenclature, range maps that plotted localities, with lists of each with citations, gazetteer with georeferenced coordinates, keys to genera and species, and summaries of published natural history and, for the rodent volume, detailed descriptions of external and craniodental features, male phallus and baculum, and karyotype. Neither volume included illustrations, either line drawings of skulls or photographs of animals or habitats occupied.

Syntheses of the taxonomy of New World mammals were included within each of the three editions of *Mammal Species of the World*, the first (1982) edited by James Honacki et al. and the second (1993) and third (2005) edited by Don Wilson and DeeAnn Reeder with an international panel of authors each a member of the Checklist Committee of the American Society of Mammalogists. These volumes were designed as basic references that included lists of accepted genera and species as well as abbreviated higher categories recognized at the time of publication, with type species and synonyms listed along with abbreviated comments, with citations, justifying the taxonomy given. While mammalian taxonomy has changed markedly over the course of these publications, each remains a reference to that important history.

A second group of volumes centered on biological attributes of all living mammals rather than taxonomy per se. These include the seven editions of *Walker's Mammal of the World* published between 1964 (Walker, 1964) and 2018 (Nowak, 2018) and Vols. 6 (2016) and 7 (2017) edited by Don Wilson, Tom Lacher, and Russ Mittermeier in the Handbook of Mammals of the World series. While different with respect to centering on genera or species, each is rich in photographs or color illustrations of the animals and coverage of both general and specific biological details is extensive; the Wilson et al. volumes also provide range maps but without locality data and, importantly, phylogenetic trees of genera.

The accounts in the volumes described above were out-of-date before each appeared; such is the nature of science, which always progresses in time both through new discoveries in nature and re-evaluations of existing information. Nevertheless, each of these earlier efforts remained the "latest word" until replaced.

Given a history of repeated efforts to synthesize mammalian diversity by either taxon or geographic area, what is special about the current series? As I noted in the first paragraph, each account is about a species, treating key elements of taxonomy and nomenclature while thoroughly encompassing all aspects of natural history and ending, most importantly, with a summary of current conservation status and potential future impacts, both critical for management decisions going forward. In the decade since the edited volume on rodents in the Mammals of South America series appeared, the number of new taxa, species, and genera has increased substantially, often resulting in reorganization of higher categories, particularly tribes within the numerically dominant Sigmodontinae and subfamily membership within the Echimyidae. If species are the key denominator of all aspects of biological diversity, the update provided herein is thus crucial as our world continues on its increasingly steep trajectory of change, critically so in climate but also in our direct modification of the landscape.

A second, and in my estimation equally important need for these updated accounts, is the impact each will have on immediate and near-future research. I personally experienced how the publication of Hall and Kelson's 1959 two-volume *North American Mammals* drove a generation of us to "put boots on the ground," to fill existing holes in our knowledge, find new ones to fill in, and especially to examine the hypotheses that the then taxonomy posited—all essential to advance our understanding of the mammals we

treasure at local to landscape levels. I am confident that the present series will serve the same purpose for the generation today and that of tomorrow—those who will contribute to the next update. What makes me confident in this future has been the incredible expansion of mammalogical programs within the countries covered by these volumes, including professional societies and both governmental agencies and educational institutions where basic science has blossomed—indeed, from the authors of accounts in this series to those in international, peer-reviewed journals, scholars from Latin American countries have become global leaders in mammalogical research. Now well within my ninth decade, I'm too old to participate directly to this future; the best I can do is help those who will do this exceedingly important work! The motto of my university is *fiat lux*—"let there be light," that comes from a future of mammalian research in the field, lab, and museum!

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Introduction to the Handbook of Mammals of Middle and South America

Mammalian Richness, Distribution, and Defaunation in the Neotropics

The Neotropical region comprises the tropical zones of the New World, extending from central Mexico to the southern tip of South America. This region contains a wide range of biomes (Fig. 1a), each shaped by its own distinct geological and biological evolutionary history. It is widely regarded as one of the most important centers of biodiversity on the planet, supporting about one-third of all known species worldwide (Fig. 1b–d). This is also true for the number of mammal species, with approximately 2200 of the 6640 extant species living in the Neotropics (Fig. 1d). As such, this region exhibits exceptionally high levels of endemism and vulnerability, making many of its biomes internationally recognized as priority conservation hotspots.

Unfortunately, almost 30% of the mammal species worldwide are threatened with extinction to some degree, and nearly half of the world's species are declining (Schipper et al., 2008).

Research on population and species extinction shows an accelerating decline in mammalian biodiversity around the world. This pressing environmental issue is likely to worsen in the coming years. Although the impacts of human activities are global, they are not evenly distributed. With limited resources for conservation, researchers must provide managers and policymakers with a sound basis for setting conservation priorities to minimize population and species extinctions, reduce human-animal conflicts, and preserve ecosystem services. Even for charismatic species, we lack a global view of species distribution patterns useful for setting conservation priorities. As expected from biogeographic theory and patterns in other taxa, the distribution of mammal species richness is highly heterogeneous, with regions of low and high diversity on each continent and higher richness at lower latitudes.

However, it appears that nearly 40% of the threats to endemic mammals are not always negatively correlated with developing countries. Developing countries often lack resources for conservation. For example, hot spots of endemism, each with 5% or more of the world's endemic mammals, include Central and South American countries such as Mexico and Brazil (Ceballos et al., 2005).

The degradation, loss, and fragmentation of their habitats caused for cropland, rangeland, forest products, and human infrastructure is the reason for the

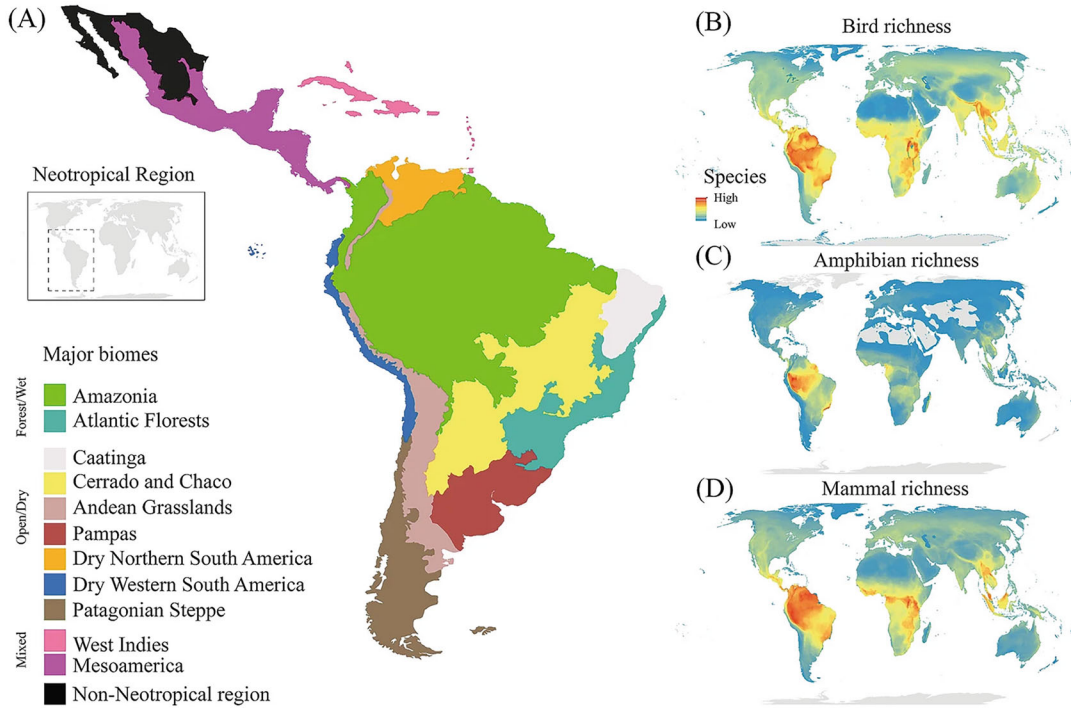

Fig. 1 Map of the Neotropical region (**a**) and its species richness (**b**–**d**). (**a**) Approximate natural distribution of major terrestrial Neotropical biomes. Latitudinal distribution of species richness among birds (**b**), amphibians (**c**), and mammals (**d**) across the world. (From Machado and Perez (2023), used with kind permission of Springer Nature)

global decline of terrestrial mammalian species (Pacifici et al., 2023). They made distribution maps for 475 terrestrial mammals for the range they occupied 50 years ago and compared them to current range maps, and found that 59% of species had a lower proportion of available habitat in the lost range compared to the retained range.

Another major driver of biodiversity loss in recent decades is climate change (Shukla et al., 2019). Unfortunately, the Neotropics are one of the regions where climate change and habitat loss are most severe (Colwell et al., 2008).

For example, some bat species are among the taxa that may be more affected by climate change. Several Neotropical bat species may be forced to shift their range to smaller areas that are less vulnerable to climate change, expanding into regions of different elevation and/or latitude while facing new environmental challenges in response to land use and climate change (Gonçalves et al., 2021; Fig. 2).

The distribution of mammals can also be affected by land use and several other factors. One way to measure diversity is called functional diversity and represents the role of species in an ecosystem and its resilience. Assessing its drivers and spatial variation is an important step forward in our understanding of functional ecosystem dynamics, and is also necessary for comprehensive conservation planning (González-Maya et al., 2017; Fig. 3). For example, the

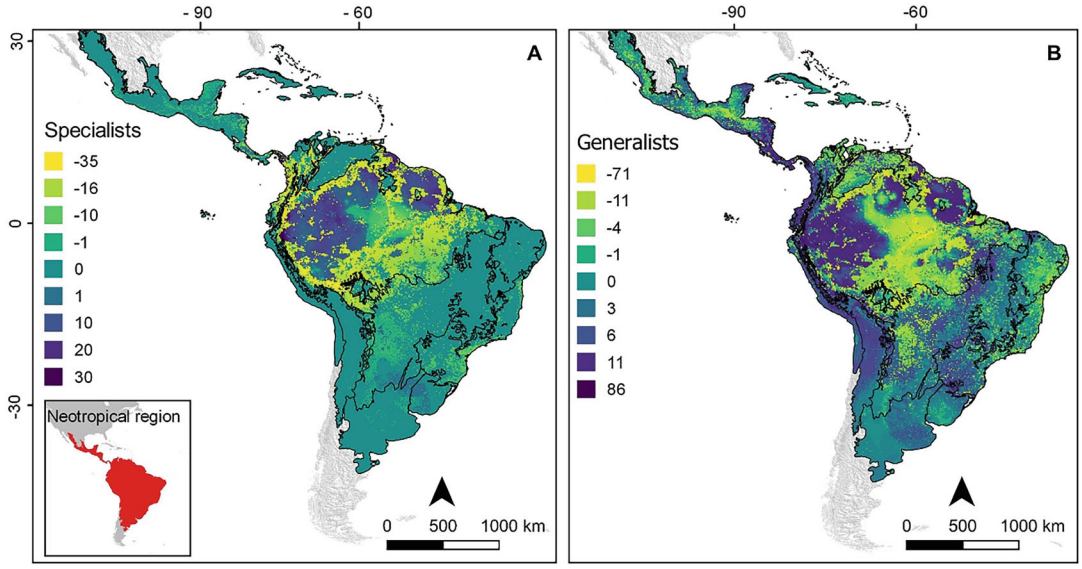

Fig. 2 Projected change in richness of (**a**) environment-specialist and (**b**) environment-generalist bat species under the business-as-usual scenario of climate and land use changes (B.A.U). Dispersal is assumed to be limited, so that bat species have the ability to disperse only across analog environment. (From Gonçalves et al. 2021, published under CC BY 4.0 (https://creativecommons.org/licenses/by/4.0/))

results obtained by González-Maya et al. (2017) indicate key areas where urgent conservation action is needed to reduce habitat loss and where threatened species play an important role in ecosystem functioning.

In a study on the ecological diversity of South American mammals, Fergnani and Ruggero (2015) evaluated whether taxonomic richness provides information on ecological diversity. On a continental scale, taxonomic richness confirms the classic latitudinal gradient of increasing richness toward the tropics in South America; however, artiodactyls and carnivores, for example, also show high richness in the temperate latitudes of North America, probably related to the coexistence of species with different biogeographic affinities. In contrast, Fergnani and Ruggero (2015) found that taxonomic richness is a poor indicator of ecological diversity at the local scale, contrary to the aforementioned latitudinal gradient of increasing richness at the global scale. This is true in tropical rainforests, where they found areas of high ecological diversity interspersed with areas of low mammalian diversity (see Fig. 4 for variation in taxonomic richness of different orders of mammals in North, Central, and South America).

Species richness is strongly influenced by several anthropogenic pressures. In a recent study, Bogoni et al. (2020) analyzed the extent and intensity of defaunation in Neotropical mammals by compiling 1029 mammal assemblages surveyed across the Neotropics (Fig. 5). Unfortunately, they found a 56% increase in defaunation, with ungulates experiencing the highest losses among mammals. Defaunation is widespread, but its impact appears to be greater in pristine biomes, which are primarily affected by deforestation. Bogoni et al. (2020) found that defaunation and depletion of large-bodied species are primarily driven by hunting pressure (Fig. 6).

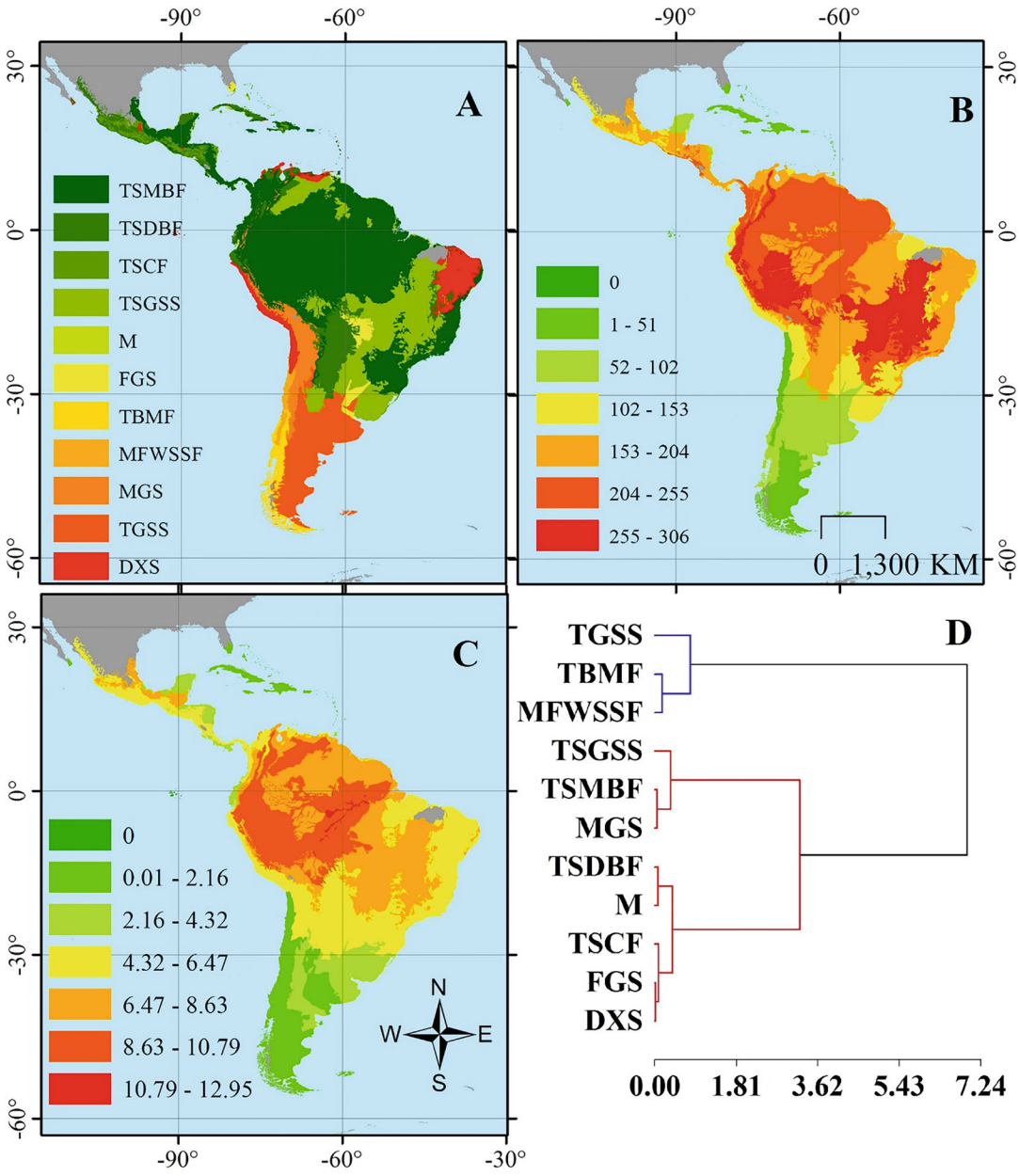

Fig. 3 Ecoregions of the Neotropical realm indicating (**a**) major habitat types (biomes) distribution, (**b**) species richness and (**c**) functional diversity and (**d**) cluster analyses for ecoregions classified according to major habitat type (i.e., biome) based on species richness and functional diversity values. Euclidian squared distance and average linking was the best linking method according to cophenetic correlation (0.668). Four biomes (T&S Dry Broadleaf Forests, Grasslands, Shrublands and Savannas and Moist Broadleaf Forests, and Montane Grasslands and Shrublands) had the highest mean (±SD) of species richness (116 ± 73, 148 ± 89, 160 ± 72 and 169 ± 61, respectively). (From González-Maya et al. 2017, published under CC BY 4.0 (https://creativecommons.org/licenses/by/4.0/))

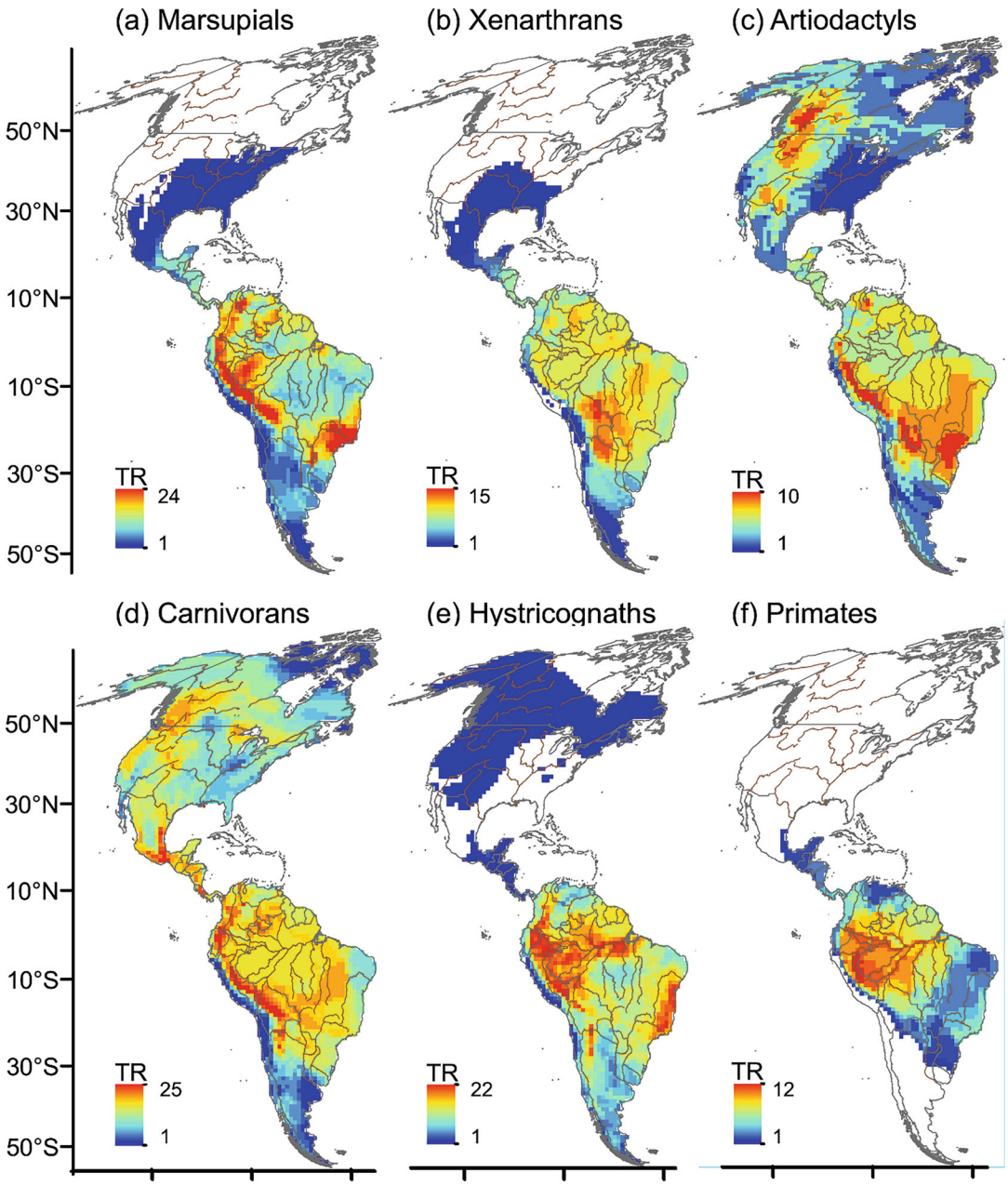

Fig. 4 Spatial variation in taxonomic richness (TR). TR was calculated as the total number of species counted in each 110 × 110 km-cell of the grid map. Genera richness was calculated for primates. Rivers are drawn as brown lines and national borders are shown in gray. Maps are in Mollweide equal-area projection. (From Fergnani and Ruggero (2015), published under CC BY 4.0 (https://creativecommons.org/licenses/by/4.0/))

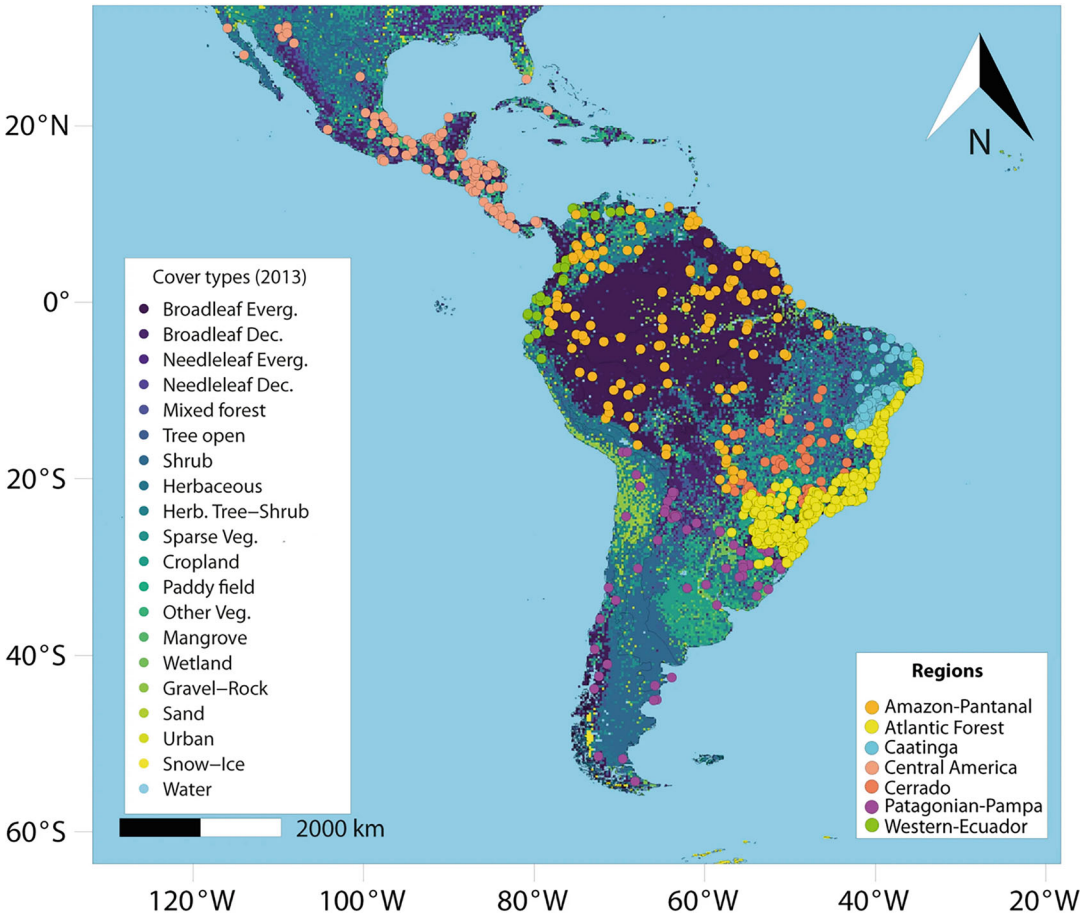

Fig. 5 Distribution of 1029 contemporary mammal assemblages constructed between 1983 and 2020, based on field surveys throughout the Neotropical realm. Map background and land cover are based on National Mapping Organizations (GLCNMO, MODIS data from 2013, Version 3) according to Kobayashi et al. (2017). (The map was generated using R 3.5.352 (https://www.r-project.org/). From Bogoni et al. 2020, published under CC BY 4.0 (https://creativecommons.org/licenses/by/4.0/))

Background of the Handbook

The *Handbook of Mammals of Middle and South America* will cover all species of mammals found in Middle and South America, including the Caribbean islands, and by synthesizing most of the literature available today, will be the first state-of-the-art handbook ever published for this continent.

This Handbook is an extraordinary project covering about 2200 species of wild living terrestrial and marine mammals. Never before has a compilation of all the mammals of a continent been written in English in such breadth and depth. As a result, this handbook will be the essential reference work on the mammals of this continent for years to come. In addition, the series editors and volume editors are well-known and have a good publication record in their field.

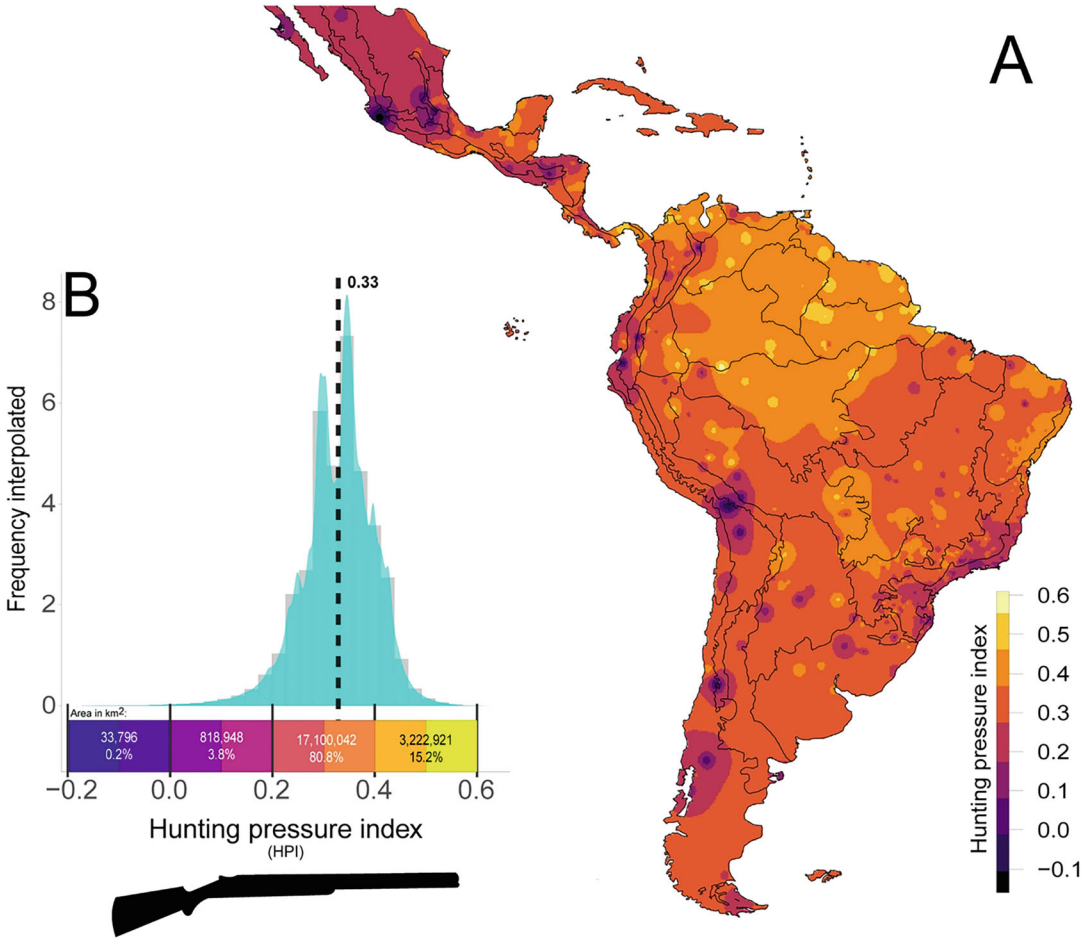

Fig. 6 Pan-Neotropical spatial interpolation of the (**a**) Hunting Pressure Index (HPI), which in terms of total area distribution matches (**b**) the frequency distribution of degree of defaunation across this entire realm. Both the map and the histogram were equally color-coded. Vertical dashed line indicates the mean defaunation value. (The map was generated using R 3.5.352 (https://www.r-project.org/). From Bogoni et al. 2020, published under CC BY 4.0 (https://creativecommons.org/licenses/by/4.0/))

The *Handbook of the Mammals of Middle and South America* is one of the most ambitious projects we have ever undertaken. When Dr. Lars Koerner of the Springer Editorial Team first contacted me in 2022 to invite me to join this huge project, I was a little surprised to be asked to take on such a complex task. At the time, I was already working on other books for Springer Nature, and although I was not sure if I was the right person to take on such a project, I was happy to accept. My series co-editor, Dr. Sonia Gallina Tessaro, was already involved in the project, and I was happy to have Sonia in the team because of her vast experience in the ecology of Central American mammals.

In the first phase of preparing the handbook, we had dozens of meetings with the volume editors to organize the different volumes of this series. This was an important step that helped us better organize the volumes and make key decisions about how to proceed.

This handbook is a reference work aimed at researchers, wildlife managers, academics, professionals, conservationists, decision-makers, and graduate students. It will be a work written by scientists for scientists and will cover all the recognized species of mammals in Middle and South America in 14 volumes (i.e., more than 2200 species, about one-third of the 6640 living species currently recognized in the world; https://www.mammaldiversity.org/).

A series of volumes on this subject is extremely important, not only because such a project has never been undertaken before, but also because it will focus on a number of highly threatened species and populations throughout the continent.

As you can imagine, this huge project has already involved hundreds of experts writing more than 2200 chapters and it should serve as a standard reference work for all mammalogists, and readers interested in mammal science for many years to come. The authors and volume editors come from several countries and work in many different institutions, including research centers, universities, NGOs, and the IUCN SSC Specialist Groups.

This series will pay particular attention to: (1) synthesizing our current understanding of this class of animals, (2) discussing current research, novel discoveries, and gaps in our knowledge, and (3) covering all mammal species in Middle and South America, describing their ecology, evolution, and conservation status.

Such work is extremely important and timely as it will highlight the negative impacts of human pressures on wildlife and ecosystems. Impacts on forest habitats through fragmentation and expansion of cultivated areas have led to an increase in human-wildlife conflicts, and appropriate management actions must then be taken to mitigate these conflicts and reduce habitat loss and degradation.

On a more global scale, however, competition with humans has increased in several regions of the world, resulting in loss of suitable habitat for some species and an increased risk of extinction. This is the case, for example, for many species in the tropics, where habitat loss and degradation, especially for agricultural activities, are the primary cause of range contraction, exacerbated by direct persecution such as poaching for meat and skin.

The idea of undertaking such a huge project was motivated mainly by the need to provide readers with up-to-date and comprehensive volumes with detailed accounts and updated taxonomy. Although there are authoritative works covering the mammals of Middle and South America, in particular the *Handbook of the Mammals of the World* (Wilson and Mittermeier 2009; 9 volumes), *Mammals of South America* (Rexford D. Lord, 2007), and the two volumes of *Mammals of South America*, Vol. 1, Marsupials, Xenarthrans, Shrews, and Bats (by Alfred L Gardner, 2008), and Vol. 2, Rodents (by James L Patton, Ulyses FJ Pardiñas, and Guillermo D'Elía, 2015). However, not all mammal species are covered in depth by these excellent works. Since none of the South American volumes has been updated, this series fills the gap. Because some original research is still published in non-English journals, we provide a comprehensive and (almost) complete compilation of current knowledge on all living mammal species in Middle and South America. In line with

other handbooks and reference works, we have chosen a standardized chapter structure with fixed headings and subheadings to facilitate comparison between different species. Of course, some species have been studied in much more detail than others, and the differences in content and amount of information available reflect the real differences in our knowledge, and the important thing is to point out the gaps in our knowledge of the species in order to stimulate new research in this area for their future conservation. In some cases, however, there are some deviations from the standard chapter structure. For example, in the Cetacea and Sirenia volume, a slightly modified chapter structure was adopted to better reflect their ecology and natural history. In addition, for some superspecies groups, we decided to adopt a single large chapter with different sections devoted to each species.

During the preparation of the volumes, we as editors discussed which species should be included. For example, whales that can cross the oceans pose some degree of arbitrariness. Thus, we decided to include the species that are regularly observed in Central and South American waters. Vagrants and very rare species with very few records are briefly mentioned in the introduction to each volume.

Volumes of the Handbook of Middle and South America

The introductory volume *History, Biogeography, Conservation* provides an overview of the history of mammalogy in different countries and the current status, as well as several chapters on management, impacts of climate change, isolation, interchange and extinctions, wildlife trade, biogeography, phylogenomics, zoonoses, human-mammal interactions, and conservation strategies (for more details on this volume, see its introduction in this volume).

The Handbook as a whole consists of species accounts, grouped into volumes covering larger taxonomic groups, and the following volumes are planned:

- *History, Biogeography, Conservation* (Editors: Mario Melletti, Sonia Gallina Tessaro, Jorge Ortega, Diego G. Tirira)
- *Artiodactyla and Perissodactyla* (Editors: Sonia Gallina Tessaro, Patricia Black, Susana González, Mario Melletti)
- *Carnivora* (Editors: Tadeu G. de Oliveira, Larissa Rosa de Oliveira, Mauro I. Schiaffini, María de las Mercedes Guerisoli, Jorge Servín, David Valenzuela Galván, Mario Melletti)
- *Cetacea and Sirenia* (Editor: Salvatore Siciliano)
- *Chiroptera* (Editors: Burton K. Lim, Celia López-González)
- *Cingulata and Pilosa* (Editors: Fernando Perini, Flávia Miranda, Daniel de Melo Casali)
- *Didelphimorphia, Paucituberculata and Microbiotheria* (Editors: Silvia E. Pavan, Diego Astúa)
- *Eulipotyphla* (Editors: Lázaro Guevara, M. Ángel León-Tapia)

- *Lagomorpha* (Editors: Consuelo Lorenzo Monterrubio, José Manuel Mora)
- *Primates* (Editors: Eckhard W. Heymann, Júlio César Bicca-Marques, Jean P. Boubli, Jessica W. Lynch, Robert B. Wallace)
- *Rodentia I* (Editors: Livia León-Paniagua, Giovani Hernández-Canchola, Ulyses Francisco J. Pardiñas)
- *Rodentia II* (Editors: Ulyses Francisco J. Pardiñas, João Alves de Oliveira, Jorge Brito, Jorge Salazar Bravo)
- *Rodentia III* (Editors: Ulyses Francisco J. Pardiñas, João Alves de Oliveira, Jorge Brito, Jorge Salazar Bravo)
- *Rodentia IV* (Editors: Alberto González Romero, Areli Rizo Aguilar, Hector E. Ramírez-Chaves)
- *Rodentia V* (Editors: Guillermo D'Elía, Pablo Teta)

Geographic Coverage

Middle and South America are two huge regions. Middle America is the geographical area between the North and South American continents. As mentioned above, this region consists of Mexico, the Caribbean (13 island countries and 18 territories), and seven Central American countries, covering an area of approximately 2,728,827 km^2. On the other hand, South America is a much larger continent with 12 countries and an area of 17,840,000 km^2. Brazil is the largest country and by far the most populous in South America, with almost half of the continent's population, followed by Colombia, Argentina, Venezuela, and Peru. Finally, South America has the largest river by volume, the Amazon River, and also the largest area of rainforest.

Species Accounts

The handbook volumes follow a fixed structure for each chapter, although for the poorly known species some of the mandatory headings can't be covered due to lack of data and information.

Each species account will contain the following main headings:

Common Names, Taxonomy, Systematics, Palaeontology, Current Distribution (incl. map), Description (incl. habitus photo and photos/drawings of skulls and teeth, if necessary, pelage, dentition, morphology), Physiology (metabolism, body mass, body condition), Genetics, Life History (breeding season, gestation, pregnancy rate, number of litters, litter size, prenatal growth, neonates, breeding age, sex ratio), Habitat (use, selection) and Diet (use, selection), Behavior (mating behavior, aggressive behavior, escape behavior, vocalization, foraging behavior), Mortality (prenatal, juvenile, adult, mortality factors), Parasites and Diseases (ectoparasites, endoparasites, infectious diseases), Population Ecology, Conservation Status, Management, Future Challenges for Research and Management, Acknowledgments, and References. We have tried to include at least one photo of a living individual of each species, habitat photos, skull photos, and photos of mounted skins. Chapters can also include sounds and videos.

Common Names

For the common names of each species, we decided to include Spanish, Portuguese, French, German, Italian, and Dutch in addition to the English names. We have followed the *Handbook of Mammals of the World* and the *Mammal Diversity Database of the American Society of Mammalogists* (ASM) for most species. However, due to new genera, splitting and merging of species, some names may change. We have used the most common English names associated with each species. We also tried to avoid ambiguity in the names assigned to the species as much as possible.

Other Common Names

In addition to the names in various languages listed above, for some species, where available, alternative common English names have been included along with names in the local language widely spoken in the region.

Genera

Along with species, genera are another taxonomic unit that may change regularly. As with species, we have mainly followed the *Mammal Diversity Database of the American Society of Mammalogists*. However, as mentioned above, this taxonomic unit may change due to new genetic studies. Thus, revalidation of old genera or introduction of new genus names are mentioned in the species accounts and in the introduction of the volumes.

Subspecies

All recognized subspecies are listed with information on authority, year and their distribution.

Distribution Maps

Most distribution maps are based on point records provided by the authors, or on existing distribution maps (e.g., IUCN), which have usually been adapted. For more information on the creation of the maps, see the text below by Mapping the Distribution of Mammals in Middle and South America in this volume.

Recently Extinct, Vagrant, and Alien Species

We have decided not to treat recently extinct (i.e., since ~1500 A.D.), vagrant, and alien species in separate chapters, but instead to mention them briefly in the introduction to each volume or, in some cases, in brief accounts.

We made this decision because we already have an impressive number of species to cover.

References

All cited works are listed alphabetically at the end of each chapter.

We preferred this approach because it allows the reader to consult all the important references related to a particular species in the chapter, rather than listing all the references at the end of each volume.

Taxonomic Approach

Although this handbook is an ambitious project, we do not claim to cover every aspect and concept of taxonomy. In this work, we try to condense the most recent findings and update the list of species accounts accordingly.

How a species should be defined has been debated among taxonomists for decades. The concept of species in mammalian taxonomy has been controversial for decades due to the ambiguity and subjectivity of this topic.

Initially, the morphological approach dominated species delimitation for more than a century. However, the rise of molecular methods in recent years with DNA sequencing has profoundly changed the taxonomic approach and research on species concept and delimitation.

Initially, mammal research was conducted by a limited number of researchers studying specimens primarily in museums and publishing in journals with limited circulation and readership. However, with the advent of new tools and methodologies, an increasing number of mammalogists began to collect and digitize data, making it accessible to a wider readership.

In this era of taxonomic change, such a Handbook covering a large number of species must follow a taxonomic list of species. There are several lists that may be accepted by one group of taxonomists, but criticized by others. As taxonomy has evolved considerably in recent years with the discovery of many mammalian species (e.g. especially rodents and bats), supported by genetic studies, mammals have been and continue to be the main topic in recent debates about species concepts and delimitation. There are many mammal species in Middle and especially South America that have been lumped or split, re-lumped, or re-split several times. We the volume editors had to decide which taxa would receive species rank in this handbook and which would not.

We have chosen to follow primarily the Mammal Diversity Database of the American Society of Mammalogists (ASM). This is the database for tracking recent taxonomic changes in extant and recently extinct (i.e., since ~1500 CE) species and higher taxa of mammals (https://www.mammaldiversity.org/). In some cases, we do not follow the ASM when genetic evidence effectively shows that a population can be attributed to a new species or subspecies. Unfortunately, there is often a degree of arbitrariness in species delimitation because the line between two populations needs to be supported by robust data.

For example, there are populations of mammals in the Amazon Basin that are effectively separated by geographic barriers such as rivers, and studies often show that these populations living on opposite sides of the same river are actually different species.

The taxonomic approach is still a work in progress, and this Handbook is proof of that, as many taxonomic changes have occurred during the preparation of the volumes, and will continue to occur as we complete the volumes.

In any case, a handbook is not the place for detailed taxonomic discussions or even revisions, and volume editors and authors have a certain amount of freedom in their taxonomic treatments. This is also because consistency between volumes is not always possible.

However, taxonomy also has practical implications for some taxa that are now considered different species, and much of the literature does not necessarily distinguish between them, making it difficult to treat them in separate chapters.

Springer Reference Books

In the age of digitization, when large reference works may seem superfluous as researchers and scientists rely more and more on electronic sources, this handbook comes into play. This work is a product of adapting to the new digital era. In addition to the printed book and the ebook, this handbook is also available as a living edition. This means that chapters can be continuously updated by the authors and published online, and as soon as enough updates have been made, a new edition will be produced. In this way, taxonomic updates and newly described species can be quickly added to the handbook, resulting in a "living book." We hope that this new way of working will be well accepted by the scientific community and readers in general. Nowadays, we have an increasing amount of scientific information that is not always available to the reader, so the need to synthesize the available information is more urgent, making this handbook an important resource for researchers, conservationists, wildlife managers, taxonomists, and biologists in general. In addition, all volumes are available in both ebook and print formats, and individual volumes and chapters are available through university libraries and other institutions.

Toward a Collaborative Future for Neotropical Mammal Research and Conservation

The Neotropics stand among the most extraordinary regions on Earth—home to unparalleled biological richness, intricate ecological networks, and evolutionary histories that span millions of years. Yet these same landscapes now face some of the most profound environmental pressures of the Anthropocene. Deforestation, agricultural expansion, fossil fuel extraction, illegal mining, pollution, habitat fragmentation, unsustainable hunting, and accelerating species declines are reshaping ecosystems at a pace that challenges both scientific

understanding and conservation action. Middle and South America, despite being among the most biodiverse regions on the planet, are simultaneously among the most threatened. Their extraordinary mammalian fauna underpins the health and function of ecosystems across the continent, playing essential roles in seed dispersal, pollination, vegetation dynamics, prey regulation, and the provision of resources for local communities. The loss of these species would reverberate far beyond individual taxa, disrupting ecological processes that have evolved over millennia.

In light of these rapid changes, the need for comprehensive, collaborative, and accessible scientific knowledge has never been greater. This handbook is the result of an exceptional global effort: hundreds of mammalogists from across continents have come together to document, analyze, and interpret the diversity of Neotropical mammals. Their collective expertise—rooted in decades of fieldwork, taxonomic research, ecological monitoring, and conservation practice—forms the foundation of this work. The chapters herein are designed not only to synthesize existing knowledge but also to highlight the most pressing conservation and management challenges facing Neotropical mammals today. Across taxa and regions, the patterns are clear: overhunting, poaching, habitat loss, and landscape degradation have dramatically reduced the historical ranges of countless species. Expanding human populations and rapid land-use change continue to fragment habitats and isolate populations, while climate change, invasive species, human–wildlife conflict, and illegal wildlife trade compound these pressures, pushing many species toward an increasingly precarious future.

The challenges facing the Neotropics are deeply interconnected. Habitat loss disrupts ecological processes and reduces genetic connectivity; fragmentation alters species interactions and increases extinction risk; climate change shifts distribution patterns and intensifies environmental stress. Illegal mining drives deforestation, contaminates ecosystems, endangers species, and devastates Indigenous lands. Hunting pressures destabilize trophic networks by removing key species that maintain ecosystem structure and function. These processes do not occur in isolation—they interact, amplify one another, and demand coordinated scientific responses. Yet scientific research in the Neotropics faces numerous challenges. Funding is frequently limited, long-term ecological studies are often difficult to sustain, and access to remote areas may be restricted. In several regions, environmental data remain underreported or inconsistently collected, and scientific results may encounter skepticism or outright denial. These constraints underscore the critical importance of international cooperation.

Beyond the need for borderless scientific collaboration, adequate funding mechanisms, and governmental initiatives to protect and enhance the natural environment, it is equally important that both governmental and non-governmental institutions support scientific work through well-designed legislation and policy actions. For instance, the Convention on Biological Diversity and the Nagoya Protocol on Access and Benefit-Sharing establish an international legal framework intended to prevent the misappropriation of a country's genetic resources and to ensure the fair and equitable distribution of benefits arising from their use. These agreements were negotiated largely at the

request of biodiverse, lower-income countries seeking to ensure that benefits derived from research and development involving genetic resources within their territories would be returned equitably, thereby promoting the conservation and sustainable use of biodiversity.

Despite these well-intentioned goals, the rapid implementation of access and benefit-sharing regulations at the national level—often without inclusive strategic planning—has hindered noncommercial, international collaborative genetic research, producing counterproductive outcomes for biodiversity conservation and sustainable use (Colella et al., 2023). The interplay between these necessary regulatory efforts and their unintended consequences continues to shape, and at times constrain, international scientific collaboration.

At the same time, new analytical tools—ranging from molecular genetics and genomic sequencing to advanced ecological modeling—are transforming our understanding of taxonomic relationships, species boundaries, population structure, and evolutionary history. These insights are reshaping conservation priorities and enabling more precise, effective management strategies. When combined with long-term field research, community-based conservation, and the knowledge of local and Indigenous peoples, they offer a powerful foundation for reversing current trends and restoring ecological integrity.

Producing a work of this scale required more than assembling data—it required building a community. Researchers from different countries, institutions, and scientific traditions contributed their knowledge, shared their insights, and worked collectively toward a common goal: to create a resource that reflects the true complexity of Neotropical mammal diversity and the urgency of its conservation. This collaboration demonstrates what is possible when scientific boundaries are crossed and expertise is pooled for the benefit of a region that is both ecologically irreplaceable and increasingly vulnerable.

Despite the severity of the challenges, the Neotropics also offer reasons for hope. Forests can regenerate, species can recover, and ecological interactions can be restored when conservation measures are grounded in robust scientific evidence. Protected areas, ecological corridors, community-based conservation, and long-term ecological research have all shown measurable success when supported by sustained commitment and informed management. The way forward requires coordinated action at multiple scales: protecting the continent's mammal diversity will demand not only scientific rigor but also political will, social engagement, and enduring collaboration among researchers, wildlife managers, policymakers, and the communities that share their landscapes with these species.

This handbook is both a testament to what we know and a reminder of how much remains to be understood. It reflects the dedication of hundreds of scientists who believe that knowledge, when shared openly and collaboratively, can drive meaningful change. It is offered with the conviction that rigorous science, international cooperation, and a deep respect for the natural world are essential to safeguarding the future of Neotropical biodiversity. May this effort serve as a foundation for further research, a tool for conservation practitioners, and an inspiration for all who seek to understand and protect the remarkable mammals of the Neotropics.

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