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# The National Mammal Collection: 77 years contributing to the knowledge of Mexican biodiversity

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## Abstract

The National Collection of Mammals of the Institute of Biology, UNAM, will be 77 years old in 2024. This important event means a little more than three-quarters of a century of the CNMA supporting scientific research, teaching, and dissemination of knowledge of wild mammals in Mexico. Two years ago the CNMA opened its new facilities in a new building where it also supports the museum exhibition of mammals in the National Biodiversity Pavilion. Its collection of specimens as well as its associated curatorial data have become an obligatory source of reference for the study and conservation of Mexican mammals. For its safekeeping, the CNMA has guaranteed institutional support and will continue to be at the forefront in the construction of the national biological inventory of the mammal component of Mexican biodiversity. Therefore, another year of existence of the CNMA has been worthwhile.

**Keywords:** Natural history; museum; voucher specimen; inventory; biodiversity; conservation; México.

## Introduction

The National Mammal Collection (CNMA) is one of the vertebrate scientific collections of the National Biodiversity Pavilion (PaBio) of the Institute of Biology, National Autonomous University of Mexico (UNAM) (Hernández & Delgado, 2021), and is located south of Mexico City (CDMX), on the university campus of the UNAM (Figure 1). The official foundation of this biological collection dates back to 20 March 1947 by Dr. Bernardo Villa Ramírez, a distinguished Mexican mammalogist born in the state of Guerrero in 1911. Therefore, the CNMA has just celebrated 77 years of academic life in 2024. But why is another anniversary of its existence important? Due to its structure and function, the



Fig 1. Panoramic view of the National Biodiversity Pavilion, the new building housing the National Mammal Collection of the Institute of Biology, UNAM. (Photo by Fernando A. Cervantes).



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CNMA has generated significant results in support of scientific research, teaching, and dissemination of knowledge of Mexican wild mammals since the middle of the last century, which has had a significant and favorable impact on the knowledge and conservation of Mexico's biodiversity. Therefore, it is fair to recognize another year of productive academic work, and it is fortunate to know that this biological collection continues contributing to the generation of knowledge to society in parallel to the safeguarding of scientific evidence documenting the mammalian component of biodiversity.

#### *Characteristics of the CNMA*

The CNMA is a collection of conventionally prepared organisms for scientific research that preserves and safeguards evidence of the distinctive characteristics and presence of wild mammal species inhabiting Mexico. This evidence includes stuffed skins, tanned skins, skulls, skeletons, antlers, horns,

hair samples, teeth, plaster casts of footprints, and other derivatives (Figure 2). It also stores specimens preserved in alcohol and tissue samples frozen at  $-70^{\circ}$  (mainly muscle). In addition, the CNMA has an outdoor breeding ground for insects (*Dermestes maculatus* De Geer, 1774; Dermestidae, Coleoptera) whose larvae are carnivorous, so when they feed they remove muscle, cartilage, and brain from skulls and skeletons that the CNMA needs to clean for proper preservation.

Most of the mammal holdings represent opossums, shrews, rodents, bats, hares, armadillos, monkeys, anteaters, wolves, foxes, tapirs, manatees, deer, bighorn sheep, seals, dolphins and whales. They are equivalent to little more than 500 species (ca. 90%) of Mexican terrestrial, flying, and aquatic mammal species in the CNMA that have come from different regions of the national territory that include diverse ecosystems, mainly rainforests, dry forests, cloud forests, temperate forests, deserts, scrublands and grasslands (IBUNAM, 2022).



Fig 2. View of some cabinets of the National Mammal Collection (A), specimens in tanned skin (B), specimens stuffed with cotton wool (C), and specimens preserved in 70% alcohol (D). (Photos by Fernando A. Cervantes).

Their collecting localities comprise sites from the 32 federative entities (100%) of Mexico and territorial waters of the Pacific Ocean and Gulf of Mexico, as well as in other countries of the American, European, and Australian continents (Figure 3). The specimens include various holotype and paratype specimens.

All CNMA specimens are registered with a catalog number, their scientific name and taxonomic classification, the site or geographic location (including geographic coordinates), where they were collected, and a collection date; the specimens are preserved, organized, and arranged according to international curatorial standards (Phillips *et al.*, 2019). With this information the CNMA elaborates a database with detailed taxonomic and geographic information and makes it freely available to the public via the internet on the portals "IBData «Helia Bravo Hollis»" (IBUNAM 2020) and "Portal de datos UNAM, Colecciones Universitarias" (UNAM 2023). Similarly, the CNMA produces numerous digital files including images of the specimens, which can be consulted and downloaded from the

"IREKANI" portal (IBUNAM, 2021) (Figure 4). Additional information on the CNMA can also be found on other internet platforms (IBUNAM, 2020; CNMA, 2023).

An important part of the structure of the CNMA is the mammologists who make up its academic staff: two collection managers (also known as technical curators: Dr. Yolanda Hortelano Moncada and M. en C. Julieta Vargas Cuenca) and two researchers (Dr. Lázaro Guevara López and Dr. Fernando A. Cervantes, the former being the curator in charge of the Collection) (Figure 5). These academics lead and participate in the activities of scientific research, teaching, and cultural extension projects carried out at the CNMA, accompanied by various social service students, volunteers, bachelor's, master's, and doctoral thesis students, and postdoctoral fellows.

Any user interested in studying CNMA specimens can examine, measure, or photograph them, upon request, with academic justification. With this last criterion, the CNMA can also provide frozen tissue, bone, or skin samples for DNA, RNA,



Fig 3. Specimens of large mammal species registered in the catalog of the Colección Nacional de Mamíferos as "skull only": Mexican bighorn sheep (*Ovis canadensis* Shaw, 1804) (A); Mexican wolf (*Canis lupus* Linnaeus, 1758) (B); marine mammals (C). (Photos by Carmen Loyola and Fernando A. Cervantes).

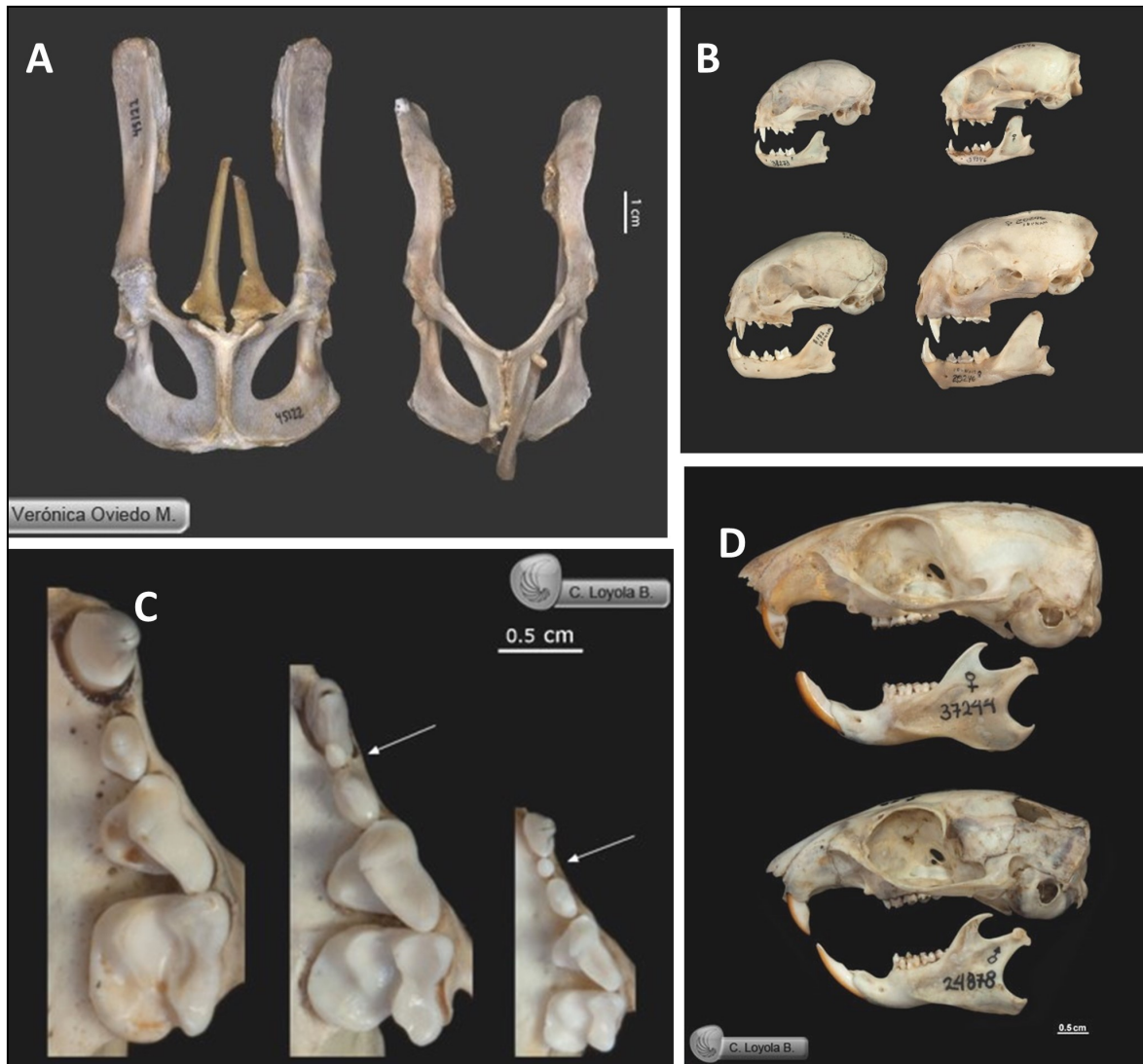


Fig 4. Sample of specimens from the image collection of the Colección Nacional de Mamíferos available on the Irekani platform via the internet.

A, pelvic girdle of a ringtail [*Bassariscus astutus* (Lichtenstein, 1830); right] and tlacuache (*Didelphis virginiana*, left), a Mexican marsupial with epipubic bones supporting the marsupium.

B, comparison of the left lateral view of the skull of Mexican felids: *Leopardus wiedii* (Schinz, 1821) (top left), *Herpailurus yagouaroundi* (É. Geoffroy Saint-Hilaire, 1803) (top right), *Lynx rufus* (Schreber, 1777) (bottom left), and *Leopardus pardalis* (Linnaeus, 1758) (bottom right).

C, left upper jaw of Mexican skunks (from left to right): *Conepatus leuconotus* (Lichtenstein, 1832), *Mephitis macroura* Lichtenstein, 1832, and *Spilogale pygmaea* Thomas, 1898). Arrows point to upper premolar 1, absent in *C. leuconotus*.

D, comparison of the left lateral view of the skull of the ground squirrels *Notocitellus annulatus* (Audubon & Bachman, 1842) (top), and *N. adocetus* (Merriam, 1903) (bottom), endemic to Mexico and sister species (Photos by Carmen Loyola)

bacterial or viral sample extraction, mostly for molecular biology research projects. The CNMA also attends to international requests for loans and the exchange of specimens. It carries out these activities in accordance with Mexican ecological legislation, for which it is listed in Mexico's register of scientific collections. For this purpose, its updated registration card issued by the Mexican government (SEMARNAT) is DF.MA.022.0497.

Although most of the specimens in the CNMA come from field collections made by Faculty members and students of the CNMA itself, other sets come from various users who donate specimens derived from their field projects for safekeeping and are also available to anyone interested. Also, several specimens come from scientific exchanges with other national and foreign biological collections. Furthermore, some big game hunters who no longer wish to keep their specimens have even donated specimens to



Fig 5. Faculty members of the National Mammal Collection. From left to right: Lázaro Guevara, Julieta Vargas-Cuenca, Yolanda Hortelano-Moncada, and Fernando A. Cervantes (Photo by Lazaro Guevara).

the CNMA collection.

In addition, Mexican governmental law enforcement agencies, such as the PROFEPA (*Procuraduría Federal de Protección al Ambiente*) and the FGR (*Fiscalía General de la República*) also donate specimens of mammals, parts, or derivatives to the CNMA recovered from illegal trafficking or possession in order to preserve them and make them available for scientific study. These specimens usually lack field data on when and where they were collected from the wild, however, they are also useful for scientific research. These materials are also preferentially used by the CNMA for comparative purposes, teaching and museum exhibition activities, and for activities that may damage a specimen such as destructive sampling including the collection of hair and skin or tooth and bone fragments for DNA sampling (Figure 6).

For its content, quality of curatorial procedures, and production, the CNMA is internationally recognized. Approximately every 10 years, the Committee on Systematic Collections (CCS) of the American Society for Mammalogy evaluates the status of the mammal collections of the Western Hemisphere. In the last census, the CCS surveyed a total of 429 collections and compiled a directory of 395 active collections including the CNMA (Dunnun et al., 2018).

### Usefulness and benefits of the CNMA

The collection of specimens preserved in the CNMA and their use in research projects makes it possible to know which mammals of the wild fauna exist mainly in the national territory, what the main characteristics that distinguish each one are, by age category and sex, and in which part of the country they can be found. It also makes it possible to know when they were recorded as occurring there and to infer whether they are still there today. Above all, it guarantees that the specimens, as physical evidence, will be available there in the best preservation conditions for

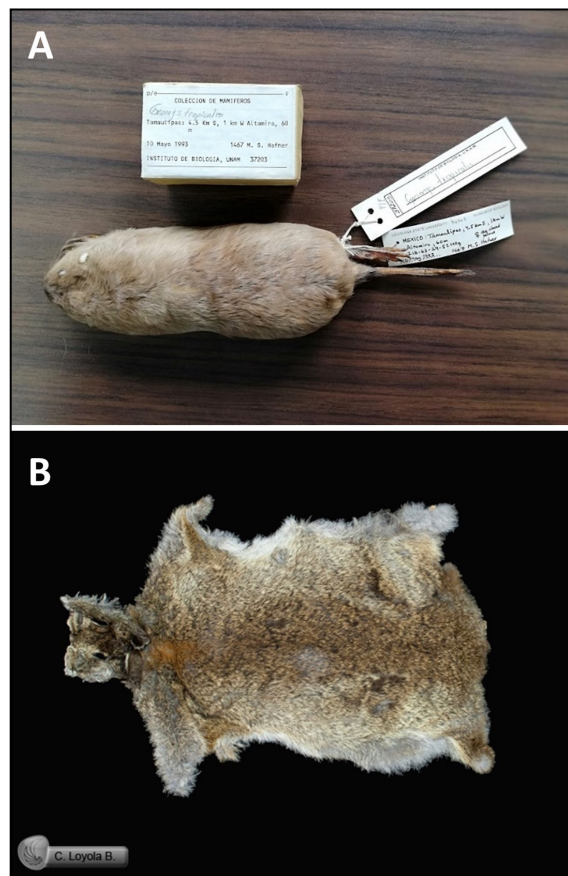


Fig 6. A, skin and skeleton of the gopher *Geomys tropicalis* Goldman, 1915 (Geomyidae, Rodentia), donated by Louisiana State University to the National Mammal Collection (CNMA) as a requirement of the Mexican government to study its biology. This species is endemic to a small area of northeastern Mexico, is considered endangered, has not been reported for 30 years, and it is the only specimen in a Mexican mammal collection. B, dried skin of the Omiltemi rabbit (*Sylvilagus insonus* (Nelson, 1904), Leporidae, Lagomorpha) donated to the CNMA by local people from its range. Similarly, it is endemic to a small area of southern Mexico and is considered endangered. There are no records in any other mammal collection in Mexico and its existence has not been scientifically documented for 20 years. (Photos by Fernando A. Cervantes).

consultation at any time a user requires it. Furthermore, if the users so wish, they can go directly to their facilities or have access to valuable information on the specimens from a long distance via their databases and images available online.

In addition, given the ever-increasing importance of tissue samples in biological research and the recently increased importance of these collections to the study of biodiversity and infectious diseases (Soniati, 2021), the CNMA is also contributing to the world's efforts of biological collections to preserve genetic resources. At present, frozen tissue samples from CNMA have been utilized in diverse research projects dealing with DNA sequencing information on a genomic scale (Figure 7). The scientific data resulting from these projects substantially enrich the knowledge of Mexican wild mammals as they generate scientific information that documents first-hand the mammal richness and its geographic distribution by ecosystem and political entity (Martínez-Meyer

*et al.*, 2014).

The availability of museum specimens and their associated curatorial data preserved in excellent condition is of broad benefit and necessary for decision-makers on biodiversity knowledge and conservation, such as federal authorities, local communities, and non-governmental organizations related to the sustainable use of wildlife. Consequently, the work products of the CNMA benefit the elaboration of Mexico's national biological inventory and the evaluation of its faunal resources (Dirzo & Raven, 1994). In this way, the task of recognizing endemic species, species in risk categories, and their occurrence in protected natural areas has been widely facilitated. Since its foundation, the CNMA has successfully contributed to this process, and prospects indicate that it will continue to do so for a long time, as it has the necessary institutional support.

At the same time, the link with the academic training of young students as human resources is strengthened by the connection of the CNMA with, on the one hand, the teaching of courses at the undergraduate and postgraduate levels on the topics of Natural History collections' operation, Mammal Biology and Taxonomy and Conservation of Biodiversity, and on the other hand, the support of research thesis projects for undergraduate and graduate degrees (Figure 8).

Furthermore, as an important part of the dissemination of culture, the academics of the CNMA give guided tours to show the enclosure and its functioning to groups of visiting students and teachers from not only educational institutions of Mexico City but also from different parts of México. In addition, these academics contribute to providing specimens and thematic content to the PaBio exhibitors, thus ensuring that visitors have a reliable source of specimens and up-to-date scientific information on their biological characteristics.

#### *Future perspectives*

The origin, maintenance, and growth of the CNMA have been the product of the academic work of many people during its existence. The CNMA was officially founded in the middle of the last century and its first site was the IBUNAM building known as "La Casa del Lago", in the current Bosque de Chapultepec in Mexico City. The first specimen cataloged by its founder in 1947 was a female *Didelphis virginiana* Kerr, 1972 (Didelphimorphia; marsupial known in Mexico as "tlacuache") collected in 1938. This mammal



Figure 7. A, The frozen tissue collection of the Colección Nacional de Mamíferos (CNMA) contributes to the formation of the reserve of the genetic resources of Mexican mammals and attends tissue loan requests from projects that require DNA extraction. B, CNMA user extracting DNA to amplify the COI gene of Mexican species of skunks (Mephitidae, Carnivora). (Photos by Fernando A. Cervantes).



*Fig 8. Faculty members teaching the Mammalogy class to undergraduate Biology students at the National Mammal Collection facilities (Photos by Lazaro Guevara).*

collection grew from the first specimens collected, preserved in formalin, and cared for by its founder, plus a few specimens collected by other collectors at the beginning of the 20th century and recovered by Bernardo Villa Ramírez. The specimens were stored and arranged in a wooden box built by his family and smaller than the size of a conventional office desk, giving way to the beginning of the study of the wild mammals of Mexico by Mexicans.

The years went by and among the outstanding people who at some point in the past have contributed to this process are Ticul Álvarez Solórzano, José Ramírez Pulido, William López-Forment, Beatriz Villa Cornejo, and Cornelio

Sánchez Hernández, to name but a few. After passing through three different IBUNAM facilities in Ciudad Universitaria, CDMX (Cervantes, 1993), the CNMA began to move from 2022 to the new and modern facilities of the museum called Pabellón Nacional de la Biodiversidad, of IBUNAM, also in Ciudad Universitaria (Hernández & Delgado, 2021; Cervantes, 2022).

From modest beginnings to 77 years of life, the CNMA is still very active, modernizing its facilities, updating its staff, providing specialized services at national and international levels, and supporting the advancement of mammalogy in Mexico and surrounding regions. It has become an obligatory source of reference for those interested in



*Fig 9. Culture dissemination activities in the facilities of the National Mammal Collection. A, Bachelor of Arts and Design students drawing museum specimens under the supervision of their teacher. B, guided tour for the staff of the Mexico City Natural Protected Areas Office. (Photos by Fernando A. Cervantes).*



learning about the biology of Mexican mammals and provides useful information for their conservation and sustainable use. Therefore, the work product of the CNMA highlights the importance and usefulness of biodiversity for the well-being of society, favoring the knowledge and documentation of the mammalian component of Mexican Biodiversity (Figure 9).

The CNMA remains at the forefront of modern curatorial procedures and continues to play a relevant role in guaranteeing the existence and availability of evidence of these species to make up the national mammal inventory. In addition, it continues to actively incorporate specimens into its collection, which currently has 50,200 cataloged specimens. Among them are specimens that support: 1. The recent finding of new species [e.g. "Molecular and morphological evidence of the diversification in the gray mouse opossum, *Tlacuatzin canescens* J. A. Allen, 1893 (Didelphimorphia), with description of a new species"; Arcangeli *et al.*, 2018], 2. New records of

geographic distribution in Mexico (e.g. "First record of the desert shrew *Notiosorex crawfordi* in Mexico City"; Márquez Villalba *et al.* 2022), and 3. Relevant specimens listed in categories of extinction risk in Mexico recently seized by the federal government authorities [e.g. bison (*Bison bison* (Linnaeus, 1758)) and jaguar (*Panthera onca* (Linnaeus, 1758))] (Figure 10).

## Conclusions

The CNMA is the result of the productive academic work of all those that have contributed to the operation and maintenance of this biological collection for a little more than three quarters of a century. The outlook for the continuation of the CNMA's academic activities and its role in the knowledge and preservation of evidence documenting the mammal component of Mexican biodiversity is optimistic and promising. There is much work to be done in Mammalogy in Mexico and, no doubt, the role of the CNMA is important and necessary and therefore continues to be supported and promoted.

Thus, after knowing the characteristics of the CNMA, its content of specimens and human capital, the information it houses and produces, the benefits it generates, and the good perspectives for its permanence, it is a reason for the Mexican and world society to congratulate itself for the completion of one more anniversary of the life of this mammal collection. This event is also a further hope for the rapprochement between man and nature.

## Contact and access to the CNMA

The current address of the CNMA is Colección Nacional de Mamíferos, Pabellón Nacional de la Biodiversidad, Departamento de Zoología, Instituto de Biología, UNAM. Circuito Cultural, C.U., C.P. 04510 Ciudad de México, Mexico. Its hours of service are Monday to Friday from 9:00 to 17:00. The CNMA can be contacted by email: [cnma@ib.unam.mx](mailto:cnma@ib.unam.mx), by phone number: +52 55 5622 4800, extension 82576, or by going directly to its facilities ([HistoriMex, 2023](#)).

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Figure 10. Specimens recovered by Mexican authorities from illegal trade and handed over to the Colección Nacional de Mamíferos for safekeeping. These specimens are currently available for research, teaching and dissemination of culture. A, Buffalo (*Bison bison*); B, Jaguar (*Panthera onca*) (Photos by Fernando A. Cervantes).

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