

Joaquín Arroyo-Cabrales<sup>1,2</sup>, Oscar J. Polaco<sup>1,3</sup> Eileen Johnson<sup>4</sup> & A.F. Guzmán<sup>1,3</sup>

<sup>1</sup> Instituto Nacional de Antropología e Historia, México

<sup>2</sup> The Smithsonian Institution, Washington

<sup>3</sup> Instituto Politécnico Nacional, México

<sup>4</sup> Museum of Texas Tech University, Lubbock

## The distribution of the genus *Mammuthus* in Mexico

Arroyo-Cabrales, J., Polaco, O.J., Johnson, E. & Guzmán, A.F., 2003 - The distribution of the genus *Mammuthus* in Mexico - in: Reumer, J.W.F., De Vos, J. & Mol, D. (eds.) - ADVANCES IN MAMMOTH RESEARCH (Proceedings of the Second International Mammoth Conference, Rotterdam, May 16-20 1999) - DEINSEA 9: 27-39 [ISSN 0923-9308]. Published 24 May 2003

The study of 872 publications from the 19<sup>th</sup> and 20<sup>th</sup> centuries on fossil and archaeological mammals of Mexico, compiled in an electronic database, indicates that mammoths (Mammalia, Proboscidea, Elephantidae) have been recorded in at least 240 different papers. The earliest records go back to the 16<sup>th</sup> century. To date, mammoths are known from 271 localities located in 24 states; and have not been recorded from the states of Quintana Roo, Yucatán, Campeche, Tabasco, Guerrero, Colima, Nayarit and Baja California. The Estado de Mexico has the largest number of findings (28.4%), followed by the Distrito Federal (11.4%), both in the central region of the country. The southernmost record is located in Villa Flores in the state of Chiapas. Mammoth records in Mexico account for a Nearctic distribution of the taxon. The mammoth species mentioned in the literature for Mexico are five: *Mammuthus columbi*, *M. hayi*, *M. imperator*, *M. primigenius*, and *M. sonoriensis*. However, a detailed study of the museum specimens is required in order to establish the actual species occurring in Mexico and their distribution.

La sistematización de 872 publicaciones de los siglos XIX y XX sobre mamíferos fósiles y arqueológicos de México en una base electrónica, muestra que los mamutes (Mammalia, Proboscidea, Elephantidae) han sido registrados en al menos 240 diferentes trabajos. Los registros más tempranos se remontan al siglo XVI. A la fecha, los mamutes se conocen en 271 localidades ubicadas en 24 entidades federativas; los mamutes no se han registrado en los estados de Quintana Roo, Yucatán, Campeche, Tabasco, Guerrero, Colima, Nayarit y Baja California. El Estado de México es en donde se han producido la mayoría de los hallazgos (28.4%), seguido del Distrito Federal (11.4%), ambos en la región central del país. El registro más sureño corresponde a Villa Flores, en el estado de Chiapas. Así, la distribución de los mamutes en México es fundamentalmente en la región neártica. Las especies consignadas en esos trabajos son cinco: *Mammuthus columbi*, *M. hayi*, *M. imperator*, *M. primigenius* y *M. sonoriensis*; sin embargo, se requiere una nueva revisión del material para poder delimitar las especies presentes en México y su distribución.

Correspondence: Joaquín Arroyo-Cabrales, Oscar J. Polaco & A. Fabiola Guzmán, Laboratorio de Paleozoología, Subdirección de Servicios y Apoyo Académico, Instituto Nacional de Antropología e Historia, Moneda # 16, Col. Centro, 06060 México, D.F., Mexico; email (JAC): arromatu@prodigy.net.mx; Oscar J. Polaco & A. Fabiola Guzmán, Departamento de Zoología, Escuela Nacional de Ciencias Biológicas, Instituto Politécnico Nacional, Plan de Ayala y Carpio, Col. Casco de Sto. Tomás, 11340 Mexico, D.F., Mexico; Eileen Johnson, Museum of Texas Tech University, Box 43191, Lubbock, Texas 79409-3191, USA

Keywords: mammoths, *Mammuthus*, Mexico, distribution

## INTRODUCTION

Between 1996 and 1998, a bibliographic database was created for the Quaternary mammals from Mexico (Arroyo-Cabrales *et al.* 1998), a project similar to the US-based FAUNMAP (FAUNMAP Working Group 1994). This database has allowed the compilation of a large amount of written information on paleontological and archaeological sites that should be useful in analysing and understanding the evolution of the mammal communities in Mexico from the last 120,000 years. It is intended in the long term to relate the information on faunal changes to that on climatic changes, in order to build a testable model for understanding past climates and to learn about future changes. The database should be the departure point to differentiate faunal changes due to early human presence from those originating from natural causes. These aspects are particularly important to gain a deeper insight into the fossil faunas, as pointed out by several working groups (e.g., PAGES 1992).

Mammoth remains are frequently found in Mexico, especially during constructions. Numerous reports from several Mexican researchers document them. However, several of those reports are unknown abroad, and the information generally available regarding Mexican mammoth sites is based on very few sites, such as Tepexpan, Tlapacoya, Santa Isabel Iztapan, and Valsequillo (e.g. Agenbroad 1984; Lister & Bahn 1995). Because of the lack of knowledge about Mexican mammoth sites in relation to the importance of the southern populations for understanding the taxonomy and evolution of American species of the genus *Mammuthus*, up-to-date information about Mexican mammoths and publications about them is presented. This information is a starting point for obtaining a better interpretation of the distribution and evolutionary patterns of the Mexican fossil elephants.

## METHODS

The database framework and recording system basically follow the project model for FAUNMAP (FAUNMAP Working Group 1994), in order to make both databases compatible. The database was adjusted to the requirements of the National Council for the Knowledge and Use of Biodiversity (known as CONABIO by its Spanish initials), the governmental agency that funded the research. Among those changes, the CONABIO database is captured in a Microsoft Access program (not in Paradox) that allows the database to be relational. Most of the information is kept in a few files, either that from the rough data and that from the researchers data analyses. These data are not separated into several files as in the FAUNMAP project. These adjustments tied the database to CONABIO's National System on Biodiversity Information. This tie enhances the Quaternary mammal database as it makes the database compatible with the recent Mexican mammals database (Mexican Mammal Atlas - MMA), adding information on conservation status for some of the taxa still extant. All three databases (FAUNMAP, MMA, and the one generated by this study) are related to each other using the species code keys.

Other particular information has been inputted in dealing with paleontological and archaeological sites. For example, as the written information was found in many kinds of reports or publications, a special field was created to account for the different categories (e.g. books, articles, abstracts, thesis, internal reports, etc.). The field SOURCE was created to define if the document is a primary study (original publications and reports, even a short list from a site); secondary (e.g., catalogs and research documents), or general (brief mention of a particular find). These entries should help to establish the importance of any written document. In the Appendix, the citations for primary sources are provided. Additionally, this information was required as the database needed to contain both

public information (printed documents, meeting abstracts, gazettiers, etc.) and non-public reports (e.g., laboratory and contract reports, theses). In doing so, the archives and/or libraries of the following agencies were reviewed: the Laboratorio de Paleozoología, Subdirección de Laboratorios y Apoyo Académico, Instituto Nacional de Antropología e Historia (INAH); the Archaeological Council, INAH; INAH's National Library 'Eusebio Dávalos Hurtado', and the Archaeology Area Library 'José Luis Lorenzo'; the Geological Institute Library, Universidad Nacional Autónoma de México; and the Mexican Institute of Natural Resources Library. Those resources that specialised in Mexico and were available in the USA (e.g., the Smithsonian Institution) were also consulted. A source that was not considered, but that could be an important basis to document old discoveries (including the locality numbers and distribution patterns), were the newspapers from the 19<sup>th</sup> and 20<sup>th</sup> centuries, as well as written sources from the 16<sup>th</sup> to 18<sup>th</sup> centuries. Some of those early reports are mentioned in the following section. Finally, analysis of the complete database is still in progress. Some of the available data at this time will undoubtedly need to be refined.

## RESULTS AND DISCUSSION

Records on proboscidean findings have been documented for at least five centuries in Mexico. However, up until at least the mid-18<sup>th</sup> century, those records were thought to represent giant human remains from the past, known as *Quinametín* (Torquemada 1969). At the end of the 18<sup>th</sup> century, the findings were assigned to elephant remains (Váldez 1790). By the early 19<sup>th</sup> century, they were identified as mammoth (Hardy 1997), ending the myths about giants, and clearly pointing to the actual nature of the remains.

The earliest documented finding of mammoth remains is found in 16<sup>th</sup> century chronicles. A mammoth bone was found in a pre-hispanic archaeological site, but such finding still remains undocumented in print. The first

printed record is from an unspecified locality in the state of Tlaxcala, where Cortés and his crew were shown a huge femur, judging by its size presumably from a mammoth. The specimen was sent to Spain with the first Cortés' procuradores (Díaz del Castillo 1988).

López de Gomara (1954), who mentions that some giant bones were shipped to Spain, documented another finding; these bones were found in Culucan (= Coyoacán), and are the earliest mention of mammoth remains in the Basin of México. Also, Hernández (1959), Protomédico of the Indias, mentions the findings of numerous bones of giants in Tetzaco (*sic*) and Toluca, indicating that some of them had been sent to Spain and others were kept by the viceroys; he also gave the measurements of some molars. At the end of the 16<sup>th</sup> century, Acosta (1985) noted that in 1586, some molars were found on the lands of Jesús del Monte (locality unknown at present). For the beginning of the 17<sup>th</sup> century, Torquemada (1969) added a new locality, the town of Atlancatepec, located nearby the City of Tlaxcala, where a molar was seen. Torquemada (1969) also mentioned that a large bone (possibly a mammoth femur) was stored in San Agustín's Convent. At the end of the 17<sup>th</sup> century, Vetancourt (1982) added the first mention of one of the most explored localities in México, Tequixquiac, with giant bones coming from the Huehuetoca sewage.

In 1746, a giant skeleton was found in the region of Texcoco, near México City

Table 1 Number (n) of works related to Mexican Mammoths.

written papers on Mexican Mammoths	n
Published information	
Primary	104
Secondary	84
Unpublished information	
INAH internal reports	52
total	240

(Villaseñor y Sánchez 1992). The most interesting aspect of the report is that the author provided the first mention of the abundance of remains. In 1754, Torrúbia (1994) defended the existence of giants in his writings, citing the findings from Acosta, Torquemada, and Hernández as proof of his hypothesis; this author indicated the frequency of such findings in the Americas. Furthermore, Torrúbia (1994) examined a specimen sent to him from the Toluca's field headquarters from Don Bartolomé de la Torre, adding a new locality in the Estado de México. He mentioned another repository of giant bones, taken from México to Villa de Cuellar, Spain, for the Duke of Albuquerque. In 1790, Váldez (1790) wrote about elephant remains when the great naturalist José

Longinos inaugurated a new museum in Mexico City. Váldez (1790) commented on "*petrificaciones y hosamentas de elefantes, encontrados en varias partes del reyno. Con estos fragmentos bien examinados se aclararán las dudas y disputas de los padres Torrúbia y Betancourt...*" (fossilized rocks and elephant skeletons from several places in the kingdom. Once those fragments are studied, there should be no doubts or debates between the priest Torrúbia and Betancourt ...).

The work by Hardy (1997) ends this brief historical overview. In late 1827 or early 1828, this author mentioned the finding of an enormous animal of the mammoth family in a lake near Chalco, and that it was placed at the National Museum. This animal represented the first specimen in the care of the

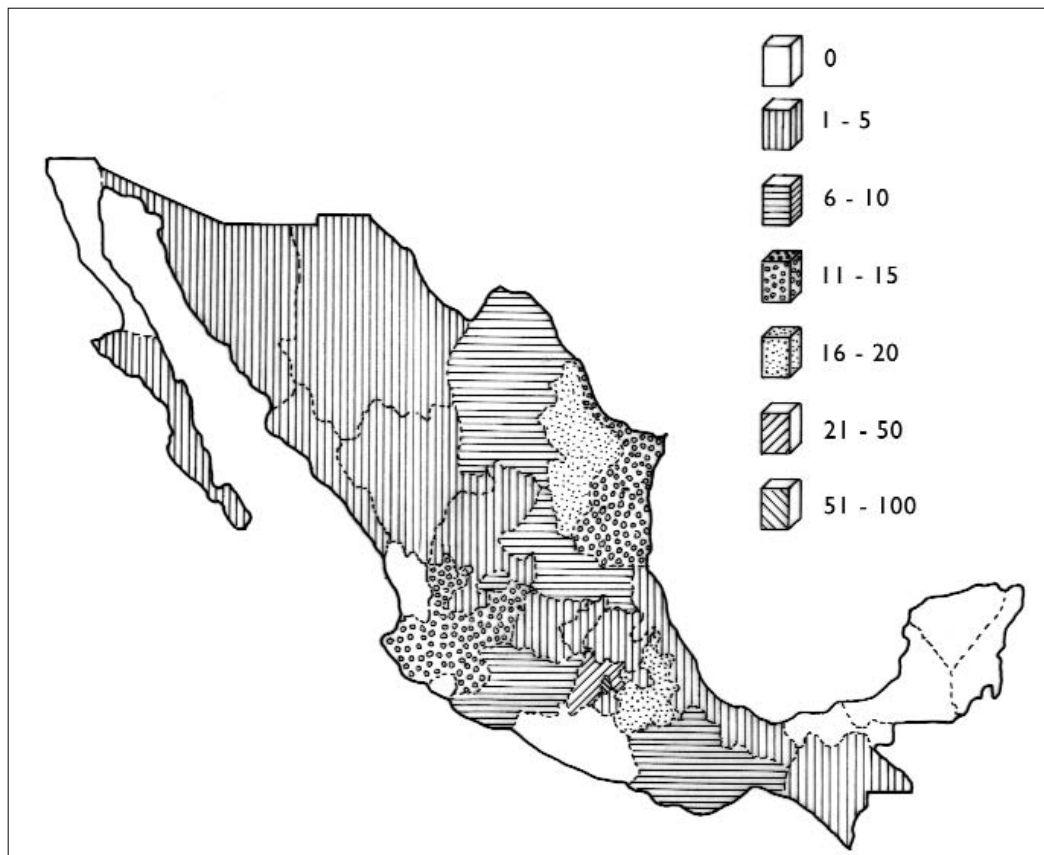


Figure 1 Map showing the Mexican states where mammoth remains have been documented and the abundance of localities per state.

national collections, and also documented the continuous presence of remains in the sewage channel system in Mexico City. In the above historical compilation, three states were mentioned: Tlaxcala, Estado de México, and the Distrito Federal. Additional records all over Mexico are recorded starting from the mid-19th century. The electronic recording of 872 publications from the 19<sup>th</sup> and 20<sup>th</sup> centuries on the Mexican fossil and archaeological mammals indicates that mammoth remains have been mentioned in 240 different studies (Table 1). A little less than half of those (43%) are primary sources, 35% are secondary sources, and 21% are still unpublished INAH internal reports.

Today, mammoth remains are known from at least 271 localities within 24 different states, including the Distrito Federal (Fig. 1, Table 2). The states where mammoth remains have not been found are Yucatán, Quintana Roo, Campeche (the three form the Yucatán peninsula), and Tabasco, all on the Atlantic side. This absence may be explained by environmental restrictions for mammoth populations in that region. On the Pacific side, records are lacking from the states of Guerrero, Colima, Nayarit, and Baja California. As the surrounding states do have mammoth remains, this absence is most likely due to the scarce paleontological surveys undertaken in those regions. The Estado de México is where most of the mammoth remains have been found (28.4%), followed by the Distrito Federal (11.4%). Both are located in the centre of the country, where more construction work occurs and where more research projects have been undertaken. The southernmost record for Mexico is from Villa Flores, Chiapas, with a unique record to the south, from El Salvador (Webb & Perrigo 1984). Much of the distribution of the genus follows a pattern close to Neartic taxa.

In general, most of the remains are known from the central region (Jalisco, Estado de México, Distrito Federal, and Puebla) and from the northeast (Nuevo León and Tamaulipas) (Fig. 1). A positive correlation

Table 2 Mexican states and number of localities (n) with mammoth remains by state.

Mexican States	n
1. Aguascalientes	9
2. Baja California	0
3. Baja California Sur	2
4. Campeche	0
5. Coahuila	9
6. Colima	0
7. Chiapas	3
8. Chihuahua	5
9. Distrito Federal	31
10. Durango	2
11. Estado de México	77
12. Guanajuato	4
13. Guerrero	0
14. Hidalgo	5
15. Jalisco	15
16. Michoacán	8
17. Morelos	5
18. Nayarit	0
19. Nuevo León	16
20. Oaxaca	6
21. Puebla	18
22. Querétaro	1
23. Quintana Roo	0
24. San Luis Potosí	7
25. Sinaloa	4
26. Sonora	5
27. Tabasco	0
28. Tamaulipas	13
29. Tlaxcala	5
30. Veracruz	2
31. Yucatán	0
32. Zacatecas	2
33. Not available	17
total	271

seems to exist between the number of findings and the work done in those areas. The Estado de México and Distrito Federal are regions where an enormous number of findings were made since the 16th century. These are the most urbanised areas. The large number of remains from Puebla and Nuevo León is related to the presence of regional geology schools that have strong paleontological programs. Furthermore, several excavations in search of early humans have been carried out in Puebla (e.g., Valsequillo, Tehuacán Valley). A few sites have strong evidence for the association between people and mammoth. Four archaeological sites have been documented in México regarding human presence (Fig. 2). Those sites are: Santa Isabel Iztapan, Estado de México (e. g.

Aveleyra Arroyo de Anda 1955, Aveleyra A. de Anda 1956, Aveleyra Arroyo de Anda & Maldonado Koerdell 1952, 1953, Maldonado Koerdell & Aveleyra-Arroyo de Anda 1949); Valsequillo, Puebla (e. g. Armenta 1959, Armenta Camacho 1978); the Basin of Chapala-Zacoalco, Jalisco (Solórzano 1990); and El Cedral, San Luis Potosí (e.g. Alvarez & Polaco 1982, Lorenzo & Mirambell 1981, 1986).

The El Cedral site is the most interesting, as it documents the presence of a hearth, lined on the outside by mammoth metapodials (some show burn marks). Ash from the hearth was dated at 31,850 ± 1,000 years before present (1-10438) (Lorenzo & Mirambell 1981, 1986). This date is the oldest one for human presence in Mexico, and one of

the most ancient for Mexican mammoths.

Some written reports comment on the use of mammoth remains for making tools or mammoth bones with human activity marks (e. g. Armenta 1959; Armenta Camacho 1978; Aveleyra Arroyo de Anda 1955; Aveleyra A. de Anda 1956; Aveleyra Arroyo de Anda & Maldonado Koerdell 1952, 1953; Maldonado-Koerdell & Aveleyra-Arroyo de Anda 1949; Solórzano 1990). All these reports point to the coexistence of people and mammoth in Mexico.

Five species are mentioned in the literature: *Mammuthus columbi*, *M. hayi*, *M. imperator*, *M. primigenius*, and *M. sonoriensis*. Some of the publications contained the description of new species based on Mexican specimens. However, the lack of detailed analyses of the



Figure 2. Map of Mexico showing the location of the four localities where mammoth remains and human presence were associated.

intra/interspecific variation patterns within the genus precludes further inferences and explains why a complex nomenclatorial history exists within the genus. Freudenberg (1922) was one of the most influential paleontologists in the early 20<sup>th</sup> century, describing two subspecies of *M. columbi* (*M. c. columbi*, *M. c. felicis*) and three of *M. imperator* (*M. i. imperator*, *M. i. falconeri*, *M. i. silvestris*). Osborn (1942) described *M. sonoriensis*, naming the neotype specimen for *M. imperator* with material from Guadalajara, Jalisco. Except for *M. i. falconeri* that seems to be a *M. ?imperator*, the others are junior synonyms of *M. columbi* (Shoshani & Tassy 1996).

## CONCLUSION

This review shows a lack of consistency in the use of scientific names for mammoths, resulting in the vast and confused nomenclature used for this group. Inconsistency is also the case with the same bones being identified as two different animals, i.e., giant people and mammoth, or as two scientifically recognized taxa, like *Mammuthus imperator* and *M. columbi*. Further studies of new materials are needed, as well as reconsideration of the old sites and materials, to determine the actual number of species in Mexico and their particular distribution.

## ACKNOWLEDGMENTS

This project was funded by the Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, México (proyecto G012), and supported by the Instituto Nacional de Antropología e Historia, México, and the Museum of Texas Tech University, USA. Permission to study the archives under their custody was granted by Mr. José Ramírez (Archives, Archaeological Council, INAH) and Ma. Teresa Olivera (Laboratorio de Paleozoología, INAH). Guadalupe García-Juárez, Ana B. Mancera-Valencia and Griselda Montiel-Parra participated at different phases of information recording, and we thank them for their patience and dedication.

This work is part of the ongoing Lubbock Lake Landmark regional research program into the late Quaternary climates and paleoecology of the Southern Plains.

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