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Micromammal taphonomy and site formation process of Nutria Mansa 1 archaeological site (Buenos Aires, Argentina)

Gustavo N. Gómez[1] | Mariano Bonomo[2]

[1] INCUAPA–CONICET–UNICEN, Olavarría, Argentina

[2] CONICET, División Arqueología, Facultad de Ciencias Naturales y Museo, UNLP, Museo de La Plata, La Plata, Argentina

Correspondence
Gustavo N. Gómez, INCUAPA–CONICET–UNICEN, Av. Del Valle 5737, B7400JWI, Olavarría, Buenos Aires, Argentina.
Email: ggomez@soc.unicen.edu.ar

Abstract

This paper presents the results of the taphonomic analysis of the micromammal bone remains recovered from Nutria Mansa 1 (NM1), an archaeological site located in the Pampean plains, Argentina. This campsite was occupied by hunter-gatherers that processed and consumed *Lama guanicoe* during the Late Holocene. In NM1, there are taxa from different environments: mammals from arid and semiarid environments (Patagonic Phytogeographic Province) and humid and temperate environments (Pampean Phytogeographic Province). The main objective of the present study was to evaluate how the recorded small mammal species were incorporated into the archaeological site and which of them were exploited by humans. The micromammal assemblage shows traces of post mortem agents such as weathering, chemical action of sediments, and probably some evidence of predation. The micromammal bones in the archaeological record offer no clear evidence of human modification, and their presence can be the result of predation or other postdepositional agents such as the action of water on the flood plain.

KEYWORDS

diagenesis, Late Holocene, palaeoecology, Pampean region, rodents, taphonomic agents, zooarchaeology

1 | INTRODUCTION

Since the beginning of the 1980s, significant developments have occurred in zooarchaeological studies on the Pampean plains of Argentina (e.g., Álvarez, 2009; Day Pilaría, 2018; Escosteguy, 2011; Frontini, 2012; González, 2005; Kaufmann, 2009; Martínez & Gutiérrez, 2004; Mazzanti & Quintana, 2001; Politis, 1984; Politis, Prates, Merino, & Tognelli, 2011; Salemme, 1990). These developments have been possible in part due to the incorporation of analytical tools and theoretical concepts derived from ecological, systemic approaches interested in the subsistence of pre-Hispanic indigenous populations. In addition, these analyses include numerous taphonomic studies (e.g., Bonomo & Massigoge, 2004; Gutiérrez, 1998, 2004; Massigoge, 2009; Mazzanti & Quintana, 2001; Politis & Madrid, 1988; Silveira, 1997). The objective of these studies was to guarantee inferences derived from the archaeofaunistic assemblages by analysing the natural and anthropic factors involved in the site-formation processes, thus extending the knowledge of the site's palaeoecology.

In recent years, the archaeological record from the Late Pleistocene to the Late Holocene in the Pampean region has come to provide a large sample of micromammal remains. Pampean micromammal studies have addressed some major topics such as the occurrence of species in the fossil record and their relation to palaeoclimatic events, taking into account the species distribution over time from a biogeographical perspective (Abba & Vizcaíno, 2011; Prado & Alberdi, 1999), but few taphonomic studies have been developed (Acosta & Pafundi, 2005; Escosteguy, Salemme, & González, 2012; Gómez, 2014; Quintana, 2016).

Micromammal bone assemblages on archaeological and palaeontological sites have mainly been considered environmental markers. Depending on the identified micromammal species in the stratigraphical record, some species have been associated with specific environmental conditions (Cabrera & Willink, 1973). Assemblages

seen as the result of predator activity were a widely neglected research topic until the 1990s. Andrews (1990), Fernández Jalvo (1992), Fernández Jalvo et al. (1998), Matthews (2006), and Stoetzel, Marion, Nespoulet, Abdeljalil El Hajraoui, and Denys (2011) provided ample evidence of predator activity on archaeological and palaeontological sites. These authors worked on sites with a wide range of time periods (from the Tertiary to the Quaternary periods) and recorded several environmental changes in the stratigraphic columns.

Studies of diagenetic features on micromammal bone surfaces such as mechanical compaction, abrasion, and root marks can provide information on the taphonomic history of the site and its depositional environment (Andrews, 1990; Behrensmeyer, 1978; Denys, Andrews, Dauphin, Williams, & Fernández Jalvo, 1997; Denys, Williams, Dauphin, Andrews, & Fernández Jalvo, 1996). These bones may have been brought to the site by predators, human activity, or natural deposition (Andrews, 1990; Escosteguy et al., 2012; Matthews, 2006; Montalvo, Pessino, & González, 2007; Stoetzel et al., 2011). During the past few decades, increased interest in micromammal bone inclusion in the archaeological record has led to the development of several taphonomic analytical methods and techniques (Andrews, 1990; Andrews & Fernández Jalvo, 1997; Denys et al., 1997; Denys, Geraards, Hublin, & Tong, 1987; Fernández Jalvo, 1992; Montalvo et al., 2007).

This paper presents the taphonomic analysis of the micromammal bones recovered from the Lower Component of Nutria Mansa 1 (NM1) archaeological site. The site is located in the lower basin of the Nutria Mansa stream in the Pampean plains and was occupied by hunter-gatherer populations between 2700 and 3100 ^{14}C years BP. The objective of this article is to evaluate how the micromammal species were incorporated into the site. The taphonomic study is based on the analytical model designed by Andrews (1990). This analysis involves accounting for the anatomical representation, taphonomic features, and digestion traces of the analysed sample as well as the observation of other post mortem modifications.

2 | NUTRIA MANSA 1 ARCHAEOLOGICAL SITE

Nutria Mansa 1 (NM1) archaeological site is located at 38°24′54.2″S and 58°15′50.1″W, on the right margin of the Nutria Mansa stream (General Alvarado Department, Buenos Aires Province). The site is 3.5 km from the Atlantic coast. It was excavated in four fieldwork seasons, with five 2 × 2 m excavation units, together with two adjacent sectors (*testigos*) yielding a total open surface of 23 m^2 (Figure 1). The archaeological materials, including zooarchaeological ones, recovered from NM1 are currently stored at División Arqueología, Museo de La Plata (Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata).

The Lower Component has a broad vertical distribution ranging from 75 to 160 cm from Level 0. The record includes 2,292 lithic artefacts and 142,732 bone remains. Most of the archaeological material was obtained from a palaeosoil placed on fluvial sediments attributed to the Guerrero Member of the Lujan Formation (Favier Dubois & Bonomo, 2008). Above this stabilisation surface, there are marshy deposits that can be correlated with the Río Salado Member of the Lujan Formation. Some of the materials were also recovered from a second stabilisation surface developed on the marshy deposits, whereas others were included in the Guerrero Member sediments close to the palaeosoil (Figure 1). Previous studies (Bonomo, 2005) have shown that NM1 is a campsite where lithic production activities took place, along with the processing and consumption of *Lama guanicoe* ("guanaco"). Three radiocarbon dates were obtained for the Lower Component: 2705 ± 66, 2920 ± 110, and 3080 ± 110 ^{14}C years BP.

3 | TAXONOMY OF THE LOWER COMPONENT

The most abundant species in the Lower Component was guanaco camelid (*L. guanicoe*) (Bonomo, 2005). Remains of Pampean deer (*Ozotoceros bezoarticus*) were also found. Among the carnivores, there were elements belonging to Pampean fox (*Dusicyon gymnocercus*), extinct fox (*Dusicyon avus*), "aguará guazú" fox (*Chrysocyon brachyurus*), jaguar (*Panthera onca*), and skunk (*Conepatus* sp.). In addition, undetermined ottarids and two pendants made of white shark teeth (*Carcharodon carcharias*) were found; these teeth were probably collected from a shark stranded on the beach (or from a pinniped attacked by a shark) by hunter-gatherers (see discussion in Cione & Bonomo, 2003). Most of the dasypodid remains correspond to dermic plates of armadillos such as "peludo" (*Chaetophractus villosus*), "piche" (*Zaedyus pichiy*), and "mulita" (*Dasypus hybridus*). Other recorded species include rodents such as "vizcacha" (*Lagostomus* sp.), otter (*Myocastor coypus*), and "mara" (*Dolichotis patagonum*). Among the micromammals, "tuco-tuco" (*Ctenomys* sp.), "cuis común" (*Galea musteloides*), and "ratón conejo" (*Reithrodon auritus*) were identified (Table 1).

A great diversity of taxa from different climatic domains is present in NM1, including mammals from arid and semiarid environments (Patagonic Phytogeographic Province), such as *R. auritus*, *Z. pichiy*, *D. patagonum*, and *L. guanicoe* (see Abba & Vizcaíno, 2011; Martínez, Luna, & Krapovickas, 2012; Tonni, Cione, & Figini, 1999; Vaccaro & Canevari, 2007), and some skeletal parts of *D. avus*, a canid that inhabited cold and arid climates of the Pampean region until the Late Holocene. Species with a wide tolerance to climatic changes, such as *Lagostomus* sp., *C. villosus*, and *P. onca*, were also found. The *P. onca* survived in the Pampean region until the 19th century (Carman, 1984).

With respect to the genus *Ctenomys*, some species and subspecies were recorded in diverse archaeological sites of the Pampean region for the Holocene (Escosteguy, 2010; Escosteguy et al., 2012; Gómez, 2014; Martínez & Gutiérrez, 2004; Quintana, 2001, 2004). *Ctenomys* is characteristic of arid and semiarid climates and is capable of controlling the inhabited environment with its gallery system, regulating temperature and oxygen levels. Today, its principal enemy is human activity, with its large machines to plough the fields where this rodent resides. For this reason, *Ctenomys* species are constrained to specific areas. For example, Contreras and Reig (1965) studied the distribution

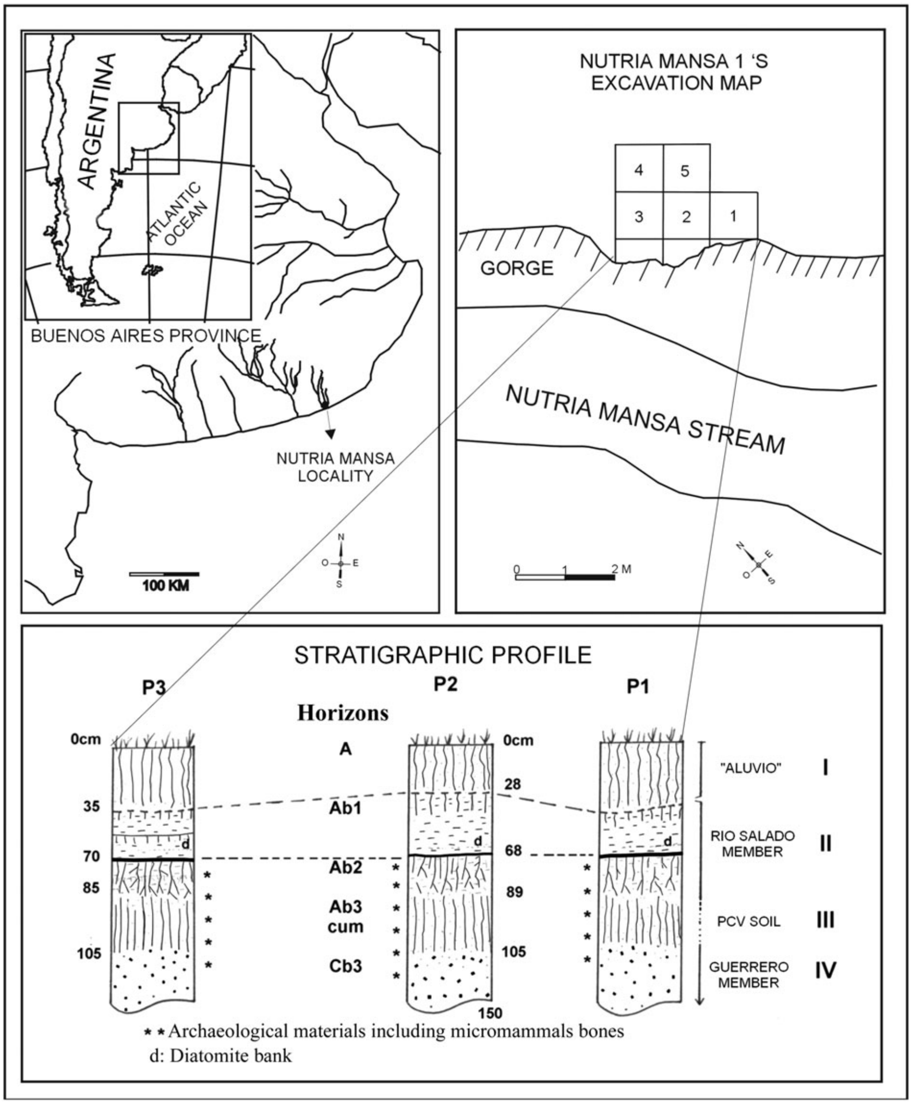

FIGURE 1 Geographical location, disposition of the excavation grids, and stratigraphic profile of Nutria Mansa 1. I: Alluvial; II: Rio Salado Member; III: Puesto Callejón Viejo soil (PCV); IV: Guerrero Member. On the stratigraphic profile, there are two stabilisation surfaces, one over the Guerrero Member and the other over the Salado Member. The archaeological materials were found on the two stabilisation surfaces

TABLE 1 Micromammal species recorded in Nutria Mansa 1 archaeological site

Taxa	*N*
Ctenomys sp.	41
Galea musteloides	14
Reithrodon auritus	8
Sigmodontinae	42
Micromammals indet.	48
Total	153

of this genus in Buenos Aires province and found that most specimens inhabited the coastal dune or any areas with no human influence.

On the other hand, *D. gymnocercus* and *D. hybridus* are typical of humid and template zones. This tropical armadillo arrived in the Pampean region at the end of the Late Holocene (Abba & Vizcaíno, 2011; Soibelzon et al., 2013). Other subtropical species have been recorded, such as the *Myocastor coipus* and *C. brachyurus* (Paula & DeMatteo, 2015; Tonni et al., 1999). The other species recovered from the site generally represent the Patagonic Phytogeographical Province, which reflects the climatic conditions during the site formation.

4 | MATERIALS AND METHODS

The term micromammal may be defined in different ways, including considerations of weight or environmental function of the individuals or species. This paper follows Andrews's definition (1990), whereby micromammals are those mammal species weighing less than 1 kg. To determine the anatomical representation and relative abundance of skeletal parts, Andrews's (1990) methodology was considered. Thus, 107,759 out of a total of 142,732 faunal remains recovered at the site were zooarchaeologically analysed. This paper focuses on 153 micromammal bones obtained by water and dry screening (the mesh size used was 1 × 3 mm and 4 mm, respectively). Only a few elements were recorded in situ during the excavation. This sample comprised taxonomically identified bone specimens and undetermined bone scraps. Of the

total amount of analysed bones, 19.2% of the micromammal specimens found could be attributed to at least a genus group.

For the present analysis, we considered the taphonomic variables that several authors have proposed for small mammals found in an archaeological record (Andrews, 1990; Andrews & Fernández Jalvo, 1997; Behrensmeyer, 1978; Binford, 1981; Fernández Jalvo, 1992; Gifford-González, 1989; Lyman, 1994; Reitz & Wing, 1999; Shipman & Rose, 1983; Trolle-Lassen, 1986; Zeiler, 1987). Taphonomic analysis of micromammal bones was carried out using Andrews's (1990) and Fernández Jalvo and Andrews's (1992) methodologies. Both methodologies are based on the qualitative and quantitative analysis of various skeletal elements from micromammal species.

The micromammal taphonomic research over the last decade has increased, in particular, to validate the results of some taphonomic agents on the micromammal bones. The root etching is produced by humic acids on the bone surfaces as a result of dissolution by acids with growth and decay of roots or fungus in direct contact with bone surfaces. They can be "dendritic" or "spaghetti like" patterns, which indicates that the bones were in a plant-supporting sedimentary environment (Lyman, 1994). The corrosion of the bone surface is associated with the plant roots, organic acids, and apparently high humidity of soils (Andrews, 1990).

Trampling modifies the bones by breakage, scratches, and marks, which are similar to cultural cut marks. The experiments conducted by Andrews (1990) on micromammal bones are indicative of the damage that can be caused by trampling on small bones. Rounding is considered to be a consequence of trampling and transport, depending on the sediments around the bones. Both the broken edges and the sharp edges of skeletal parts seem rounded (Andrews, 1990; Lyman, 1994).

Manganese oxide precipitates in environments under alternating reduction and oxidation cycles (Courty, Goldberg, & Macphail, 1989). This precipitation occurs when there is a saturation of these elements in water and an oxygen deficiency (puddling); therefore, ore reduction occurs by rapid oxygen increase, which would cause oxidation and precipitation of manganese dioxide (MnO_2). Water generally stagnates in the sediment when confronted with a layer of clays or carbonates that prevent its filtration.

Desquamation usually occurs in soils with high alkalinity, sometimes in a mosaic manner. This feature can be confused with weathering, but unlike the latter, desquamation has no previous cracking degrees of weathering. Depressions can be caused by various factors, one of the most important being the physical change caused by the sediment weight. Depressions, however, can also be caused by corrosion or other agents (Lyman, 1994).

Images of a sample of micromammal elements from NM1 site were taken from various stratigraphic levels. These images were obtained using a scanning electronic microscope with a FEI Quanta 200 environmental chamber that works with three vacuum paths (lower, high, and environmental) and with secondary electronic detectors and retrodispersals for all vacuum paths. This microscope has an Oxford analytical instruments–INCA integrated analysis system with two X-ray detecting systems that can be used on simultaneous or alternate paths: EDS (dispersive energy) and WDS (dispersive wavelength). This microscope is hosted at the Museo Nacional de Ciencias Naturales de Madrid.

5 | RESULTS—TAPHONOMIC ANALYSIS

The taphonomic analysis was completed on all micromammal skeletal elements (*n* = 153). The number of recovered small mammal elements in Nutria Mansa 1 is low but enough to calculate indices such as relative abundance, postcranial–cranial proportions, and distal element

TABLE 2 Minimal Number of Elements (MNE) of identifiable micromammal skeletal parts and their relative abundance index, MNI, postcranial and cranial proportions, and distal element loss and breakage traits

Skeletal parts	MNE	Relative abundance
Maxilla	1	5.5
Mandible	1	5.5
Incisor	35	97.2
Molar	34	31.5
Scapula	1	5.6
Ribs	4	1.85
Humerus	3	16.7
Ulna	4	22.2
Femur	1	5.5
Tibia	3	16.7
Metapodials	9	5
Astragalus	1	5.6
Phalanx	8	1.58
Total MNE	105	
Indet. elements	48	
Total	153	
Complete elements	30	19.6%
MNI	9	
pc/c	48.8	
t + r/f + h	75	
Relative abundance	16.9	
	N	**Percentages**
Proximal ends	7	39
Proximal ends with shafts	1	6
Shafts	6	33
Distal ends with shafts	3	17
Distal ends	1	6
Total	18	
Breakages		
Irregular	17	74
Transversal	2	9
Helicoidal	3	13
Longitudinal	1	4
Total	23	

Note. MNI: minimal number of individuals.

MNE: Minimal Number of Elements; pc/c: postcrania divided by crania corrected by 10/16 to match numbers of skeletal elements x 100; t+r/f +h: numbers of tibia + radius/femur + humerus x 100; Relative abundance : Ni/MNI xEi

Ni= number of element i in the sample

Ei: number of element i in the prey skeleton

loss (Table 2). Not all the skeletal parts are represented in the sample; the best represented parts are the incisors (relative abundance: 97.2%), and 19.6% of the elements are complete. The record of incisors, especially broken and enamel fragments, is high. The minimal number of individuals was calculated using the occlusal extreme of incisors. When this number was compared with the values of the relative abundance index, a high loss of skeletal parts was found.

The skeletal parts from micromammal species are presented in Table 2. The results show an MNI (Minimal Number of Individuals) of nine individuals in spite of the high loss of skeletal parts and the great number of highly broken cranial elements. When the relative abundance was calculated, only 16.7% of the skeletal elements were represented in the sample. The limb bones mainly exhibit irregular breakages (74%), and the proximal ends are the most widely represented part in the sample (45%).

TABLE 3 Taphonomic variables identified on micromammal bones from NM1 archaeological site

Taphonomic variables	*N*	%
Root marks	45	29.4
Corrosion	14	9.2
Rounded	8	5.2
Weathering	11	7.2
Splitting	10	6.5
Burnt	5	3.3
Trampling	6	3.9
Manganese stains	3	2
Depression holes	2	1.3
No taphonomic record	49	
Total	153	

It was observed that the percentage of elements with root etchings and chemical degradation or corrosion effects is consistent and predominant (Table 3). These after-burial modifications in the bone could be associated with the roots or soil pH. Another observed taphonomic variable was weathering, which may have caused the exfoliation of the cortical surface of the bone elements; both variables were detected in the site, with similar values (weathering 7.2% and splitting 6.5% of the bones).

Most bones were found to be in Stage 1 of weathering (according to Andrews, 1990) with crack lines along their structure and pitting signs on the teeth, together with crack lines in the dentine. Even though micromammal skeletal elements in Stage 2 of weathering were detected, an extended cracking of the surface can be seen together with the exfoliation of the cortical surface (Figure 2); this is accompanied by soil abrasion, which altered part of the bone element structure (Figure 3).

Most of the fractures recorded in long bones are irregular (74%), whereas helicoidal (13%) and transversal (9%) fractures are scarce. A helicoidal fracture occurs when the bone is fresh, by predation or trampling (natural assemblages or pellets). Bone with manganese stains are uncommon, a fact that would indicate that the elements were not affected by the reduction and oxidation cycles of this chemical element.

The main accumulation of micromammal remains on archaeological and palaeontological sites is due to predation. Whether the remains were depredated is determined through the analysis of indices and evidence in the bone remains. The predation on NM1 site is not conclusive either from the results of the indices or from the

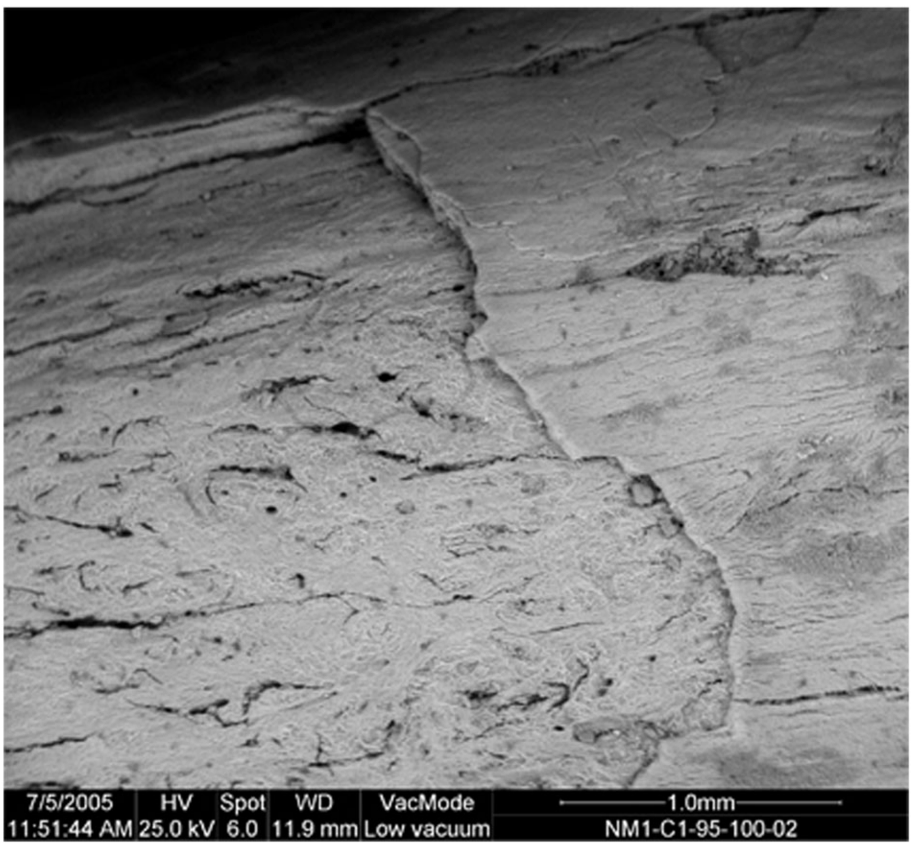

FIGURE 2 Bone element of micromammal in Stage 3 of weathering (sensu Andrews, 1990)

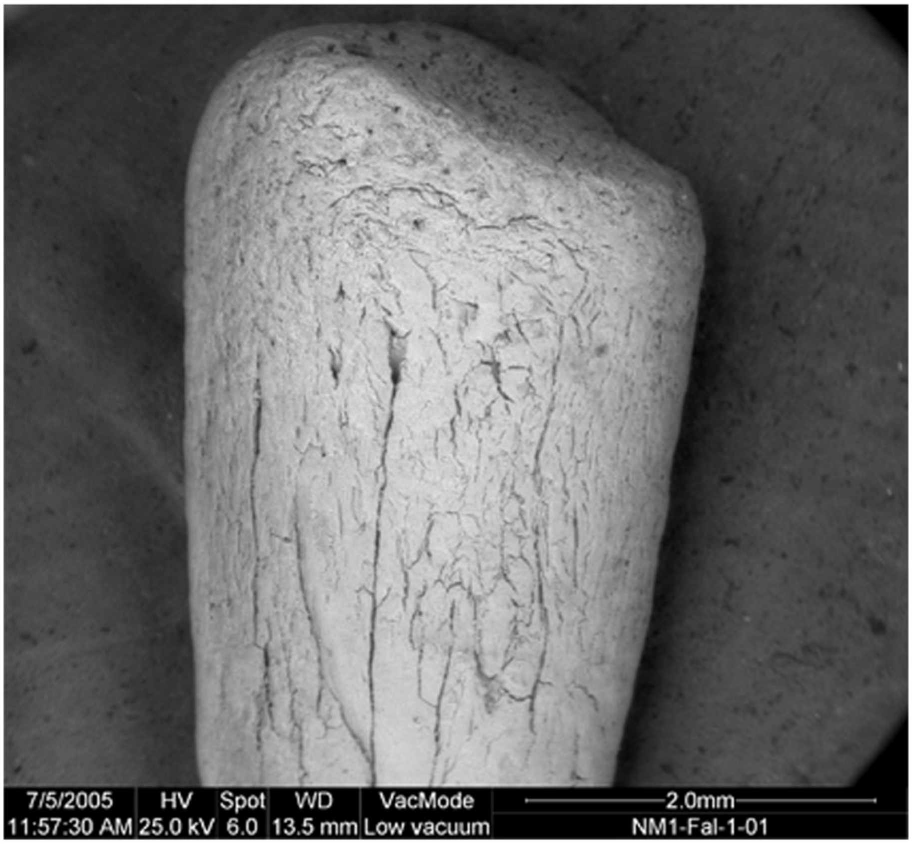

FIGURE 3 Micromammal phalanx proximal epiphysis rounded (water polishing or abrasion and with evidence of weathering (Stage 1; sensu Andrews, 1990). Part of the cortical surface is cracked

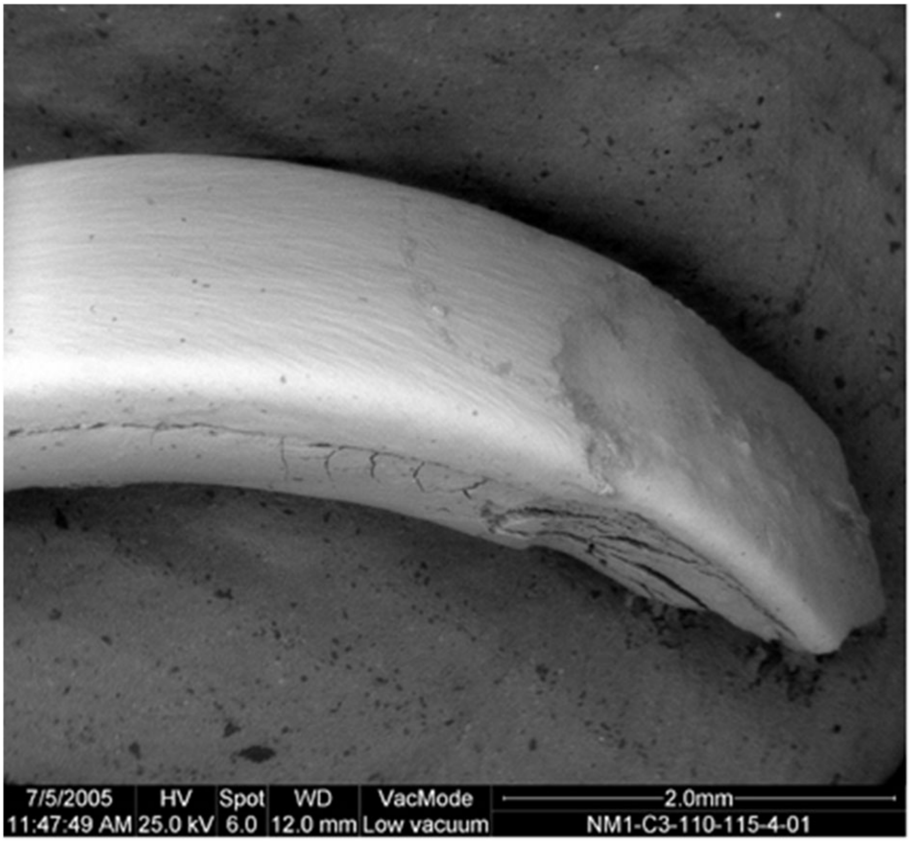

FIGURE 4 This micromammal incisor shows tracks that can be confused with a light degree of digestion. The enamel tip looks like a smoothed surface, but the heavily cracked surface of dentine fits better with root marking

evidence on the surface of the bones. The presence of digestion traces on micromammal bones is doubtful, and some digested bones were probably disturbed by diagenetical agents.

6 | DISCUSSION

The taphonomic research on small mammal bones provides important information about the relation of these remains to the rest of the archaeological assemblage. In some cases, these bones can be incorporated into the archaeological record by predator activity, reflecting the prey chains developed by the predators near the place where past human activities occurred.

Different taphonomic variables were recorded to evaluate problems like the exposure on the ground of bone specimens prior to their burial, such as weathering, or others mainly acting after burial, such as plant root activity. These variables show that most micromammal remains deposited in the NM1 site are related to the intervention of natural processes (low percentage and level of weathering, high corrosion, high evidence of root marks on bone cortical surface, and splitting surface on the bones; Behrensmeyer, 1978; Borrero, 1990, 2001; Gifford, 1981; Gutiérrez, 2004; Lyman, 1994; Montalvo, 2002). Some of the bone elements are rounded, mainly in the epiphysis and fractures. This rounding may be associated with abrasion caused by friction against the sediments due to transport or trampling.

Almost all the broken bones were recorded with irregular fractures. The cracking, splitting, and rounding were probably generated by weathering and transport (possibly by water) before the bones were buried, together with physical and chemical postburial factors, and roots may have influenced the high destruction levels present in the micromammal assemblages (Johnson, 1985; Klein & Cruz Uribe, 1984; Kos, 2003). Splitting could also have been influenced by the deposition of the bones on alkaline sediments, such as those recorded in NM1 (Bonomo, 2005).

In NM1, no rodent marks were recorded in the bone assemblage although rodent tunnels (bioturbation) could have changed the original positions of some elements in the archaeological record. The micromammal bones found present diagenetic modifications such as root etching and corrosion, occurring after the biostratinomic stage. A low percentage of elements present rounding—probably water polishing (5.2%; Figure 3)-, associated with manganese stains, weathering, splitting, and trampling marks. The weathered material found reaches Stage 2 (Andrews, 1990; see Figures 2 and 3), and there is marked corrosion produced by soil and roots, altering part of the bone structure, in particular the cortical surface. This prediagenetic agent can destroy evidence of biostratinomic agents, especially those occurring before the burial.

According to geochemical studies (Favier Dubois & Bonomo, 2008), the units that contain faunistic material have high basic pH levels (8.65–8.89). Such pH can cause the cracking and desquamation of bones and dentine and create unfavourable conditions for the preservation of the bone organic part (collagen) but does not produce enamel corrosion (Kos, 2003). Under low pH conditions (acid soils), the enamel is damaged. However, the conditions shown in this site,

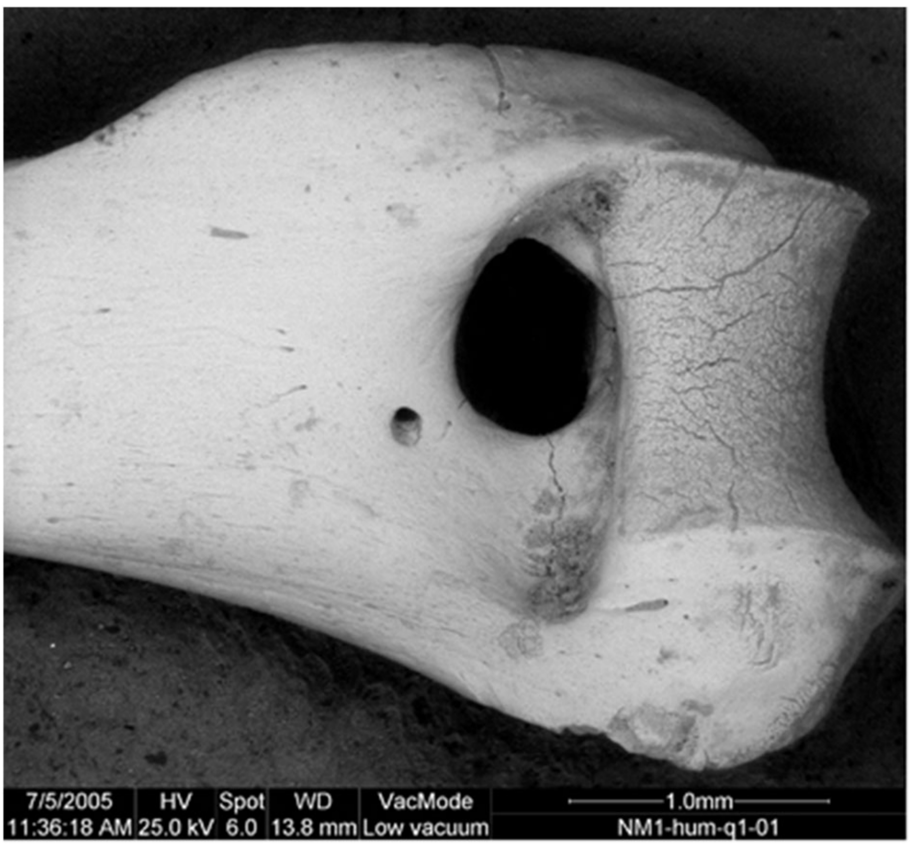

FIGURE 5 Evidence of weathering, rounding, and abrasion on micromammal distal humerus

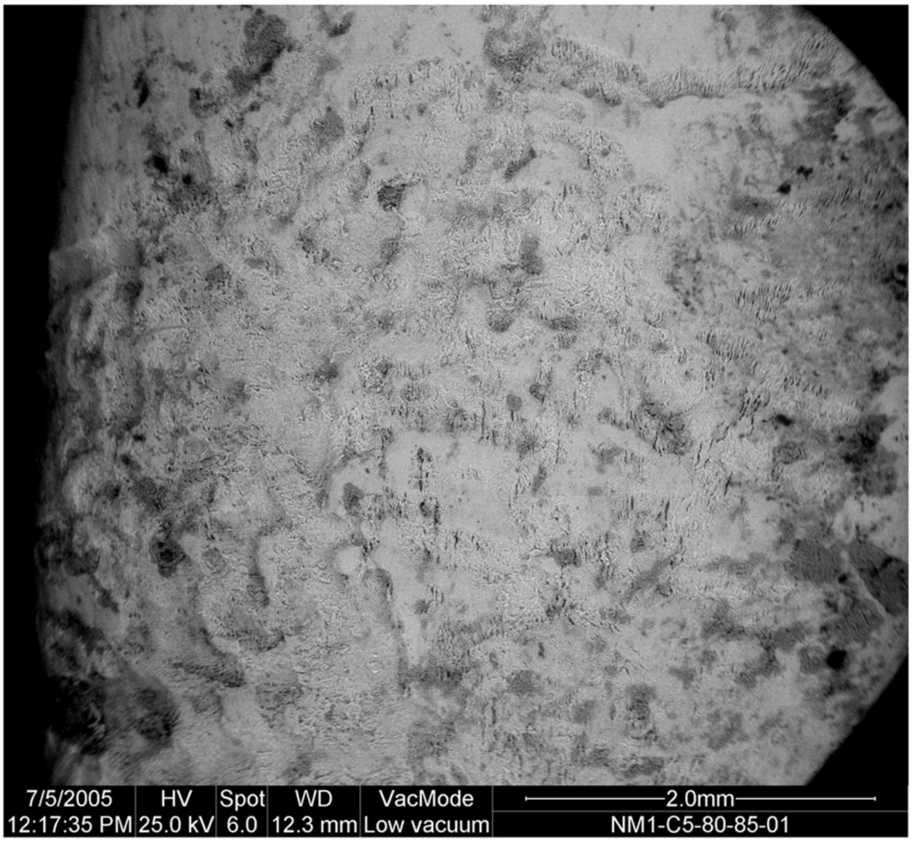

FIGURE 6 Micromammal bone surface with evidence of root marking associated with chemical corrosion holes. Diagenetic evidence can be overlapped and hidden by the bioestratinomic evidence

with basic soil and evidence of corrosion in the enamel as well (see Figure 4), suggest that this corrosion was rather due to the root activity.

Figure 4 shows tracks that can also be confused with light digestion, but the heavily cracked surface of dentine in areas where the enamel is smoothed fits better with root marking. The evidence of digestion is not convincing. If a predator participated in the deposition of the micromammal assemblage of NM1, this predator would be a Category 1, such as *Tyto alba* owl, which brings prey species near their roosting or nest areas (Andrews, 1990). This possibility cannot be fully discarded because the action of diagenetic agents, such as hydric transport and root etching, can hide or remove the evidence of predation. The evidence that supports predation is the diversity of species and individuals recorded in the site (Table 1), which is difficult to attribute to background natural deaths (usually monospecific and mainly formed by unidentifiable long bone shafts; Andrews, 1990; Stoetzel et al., 2011; Djilali et al., 2016).

Near Nutria Mansa stream, the pellets may have dissolved in water, exposing small bones to some transport and breakage. Research related to micromammal bone transport is described in Andrews (1990); however, the dynamics of hydric transport must be studied in each particular case in order to evaluate the transport capacity, fracture, and accumulation of the bone assemblage. Hydric transport can produce rounding and polishing on the bone surface. Rounding and polishing affect 6.2% of the micromammal elements in NM1 (see Figures 3 and 5).

There are also chemical dissolution holes and sedimentary abrasion, which may be associated with humid depositional marshy and/or fluvial environments (Gifford, 1981; Figure 6). Summing up, all these data, together with the site's sedimentary context, show that the materials could have been immersed or located in a marshy zone subsequent to human occupation of the site, as part of the flooding plains dynamics (Bonomo, 2005; Bonomo & Massigoge, 2004). In addition, there is a small amount of manganese stains on the cortical surface of the bones, which indicates that only some of the micromammal remains have been exposed to reduction and oxidation of anaerobic environments (Courty et al., 1989). Some of the micromammal bones may have been accumulated by water flooding, because there is also some evidence of rounding and polishing, but this flooding event may not have been strong or may have lasted a short time (Figure 5).

Diverse taphonomic agents (roots, weathering, and flood transport) could have produced this loss of micromammal skeletal parts; some of them affected the bones after biostratinomic taphonomic stages. Despite the scarcity of micromammal skeletal parts (Figure 7), the relative abundance of the skeletal parts was calculated to show that there is a predominance of cranial elements, as confirmed by the pc/c index (48.89%; Table 2). However, the t + r/f + h index shows a scarce survival of distal limbs (75%); it should be noted that the closer the values are to 100%, the more complete the skeleton is.

There is no clear evidence of human processing and consumption of micromammals as an alternative food resource. The fact that the remains were not affected in situ by manganese oxidation and

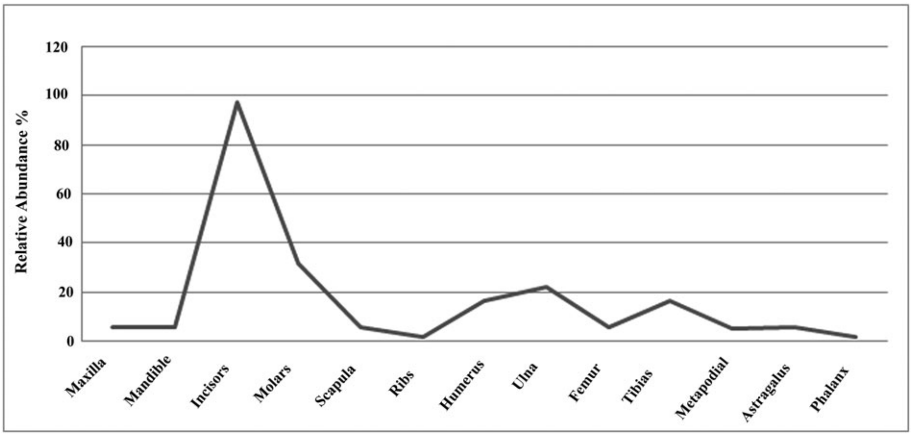

FIGURE 7 Graphic of the relative abundances of micromammal skeletal elements recorded at Nutria Mansa 1. In spite of the scarcity of the skeletal elements, the cranial parts are more abundant than postcranial elements

reduction cycles could indicate that part of the micromammal remains were introduced after the archaeological remains were deposited. The taphonomic history of NM1 indicates that both natural and cultural processes participated in the origin of the archaeological deposit. The taphonomy of this micromammal assemblage indicates that there was exposure of almost all the micromammal elements and a later prediagenetic activity, such as root marking. The several site formation processes that acted on the archaeological deposit produced a medium to low degree of resolution and integrity, making it impossible to distinguish successive human occupations of the campsite.

7 | FINAL REMARKS

The results of the micromammal taphonomic analysis allowed us to reach the following conclusions:

- The micromammal assemblage of NM1 archaeological site shows mainly traces of different diagenetic agents such as root etching and weathering. The evidence of biostratinomic agents is not abundant in the analysed bones.
- The presence of micromammal bones in the archaeological record may be the result of predation, but indications of digestion are here masked by postdepositional agents, such as weathering, root marking, and water transport.
- The taphonomic analysis made it possible to understand the incorporation of small mammal bones to NM1 and the dynamics of the archaeological site formation as well as the later diagenetic modifications. In this case, the faunal associations are important tools for interpreting the climatic conditions of the site.

The formation of the micromammal assemblage of Nutria Mansa 1 archaeological site during the Late Holocene occurred under tempered and more humid conditions than in previous periods. This increase in humidity could increase the activity of the water courses in the study area. According to the recorded diagenetic evidence, the deposition of the micromammal assemblage probably occurred after water transport from its original deposit, produced by either predators or other indeterminate natural causes. The important contribution to note of this study is that it shows the formation of an archaeological site with the input of faunal remains that come from another place, because there is no strong evidence that the remains were discarded in the settlement by human foragers or deposited by predatory animals.

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ORCID

Gustavo N. Gómez http://orcid.org/0000-0003-0800-2337

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