Quaternary International 391 (2016) 51–60

Contents lists available at ScienceDirect

Quaternary International

journal homepage: www.elsevier.com/locate/quaint

Preliminary zooarchaeological analysis of Dupuy Rockshelter (La Toma, San Luis Province, Argentina): Faunal and paleoenvironmental tendencies related to geoarchaeological and phytoarchaeological evidence

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ARTICLE INFO

Article history:
Available online 9 October 2015

Keywords:
Zooarchaeology
Taphonomy
Late Holocene
Sierras Centrales
Paleoenviroments

ABSTRACT

This paper shows the preliminary results of the zooarchaeological analysis of Dupuy Rockshelter (La Toma, San Luis Province, Argentina). This rock shelter has evidence of Late Holocene (Last Millennium) human occupation dating from 340 ± 40 BP. Some species, including *Lama guanicoe* and *Ozotoceros bezoarticus*, were exploited and their bones were used as raw material to make instruments. The zooarchaeological analysis is complemented by geological and phytoarchaeological evidence which indicates a humid environment during the Holocene and a mixed diet that included vegetables.

1. Introduction

This work is part of ongoing multidisciplinary analysis on the archaeological remains of Dupuy Rockshelter. The zooarchaeological, geological and phytoarchaeological analysis reveals the environmental conditions and the availability of resources during the human occupation of the site Dupuy Rockshelther, as well as the consumption and exploitation of diverse plant and animal resources.

This research is part of a multidisciplinary project, with the main objective of understanding the way hunter–gatherers used space in the central-west area of San Luis Province (Fig. 1), and how this may be related to the social changes that occurred. The study area is an ecotone, the confluence of the ecosystems of Pampa and Sierra Centrales. In general, it aims to analyze and characterize the behavior developed by human groups in the past in a landscape of ecotone formed by the intersection of hills and plains (Soriano et al., 1992). This part of the province of San Luis can be seen as one of the northernmost areas of Argentina's Pampas and is considered as a route for settlement. This peculiarity, among others, arouses interest for archaeological research and for further areal comparisons.

Holocene climatic alterations have not only affected the geomorphological conditions of the area but also the availability of wildlife resources. In this sense, focusing the analysis on the last portion of the Holocene, it is important to know how human groups adapted and used these resources, along with the social restructuring of these groups due to the arrival of the European conquerors. A process of diversification, improved management and exploitation of various types of resources, as well as the incorporation of small-scale farming practices and the usage of all the microenvironments of the mountain seem to be some of the macroregional characteristics since 1000 BP in Sierras Centrales (Outes, 1926; Greslebin, 1928; González, 1960; Gambier, 1985; Laguens, 1999; Berberían and Roldán, 2001; Medina and Pastor, 2006; Medina and Rivero, 2007; Curtoni et al., 2010).

The zooarchaeological and taphonomic studies in the Pampean and the Sierras Centrales regions have provided relevant information that contributed to a better understanding of the hunter–gatherers' animal use in the regions. During recent decades, different faunal exploitation models were elaborated.

Martínez and Gutiérrez (2004) propounded a faunal exploitation model for Pleistocene and Holocene times in the Pampean region based on its diversity and intensification. There is an important diversity and richness of taxa on the archaeological sites associated with other evidence, such as new technologies, and a probable demographic increase in the Late Holocene.

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http://dx.doi.org/10.1016/j.quaint.2015.09.005
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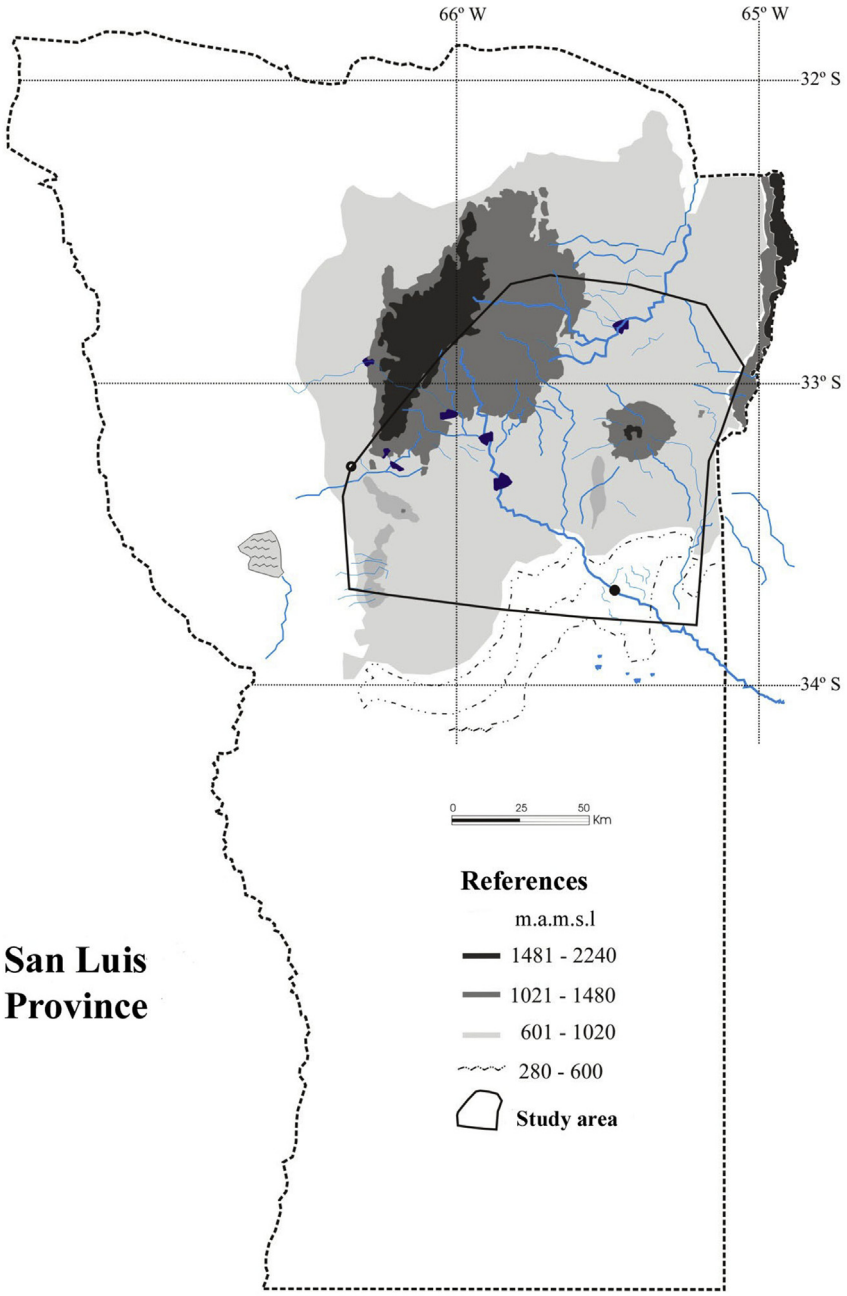

Fig. 1. Geographical location of the site.

Some Late Holocene zooarchaeological exploitation models were proposed for the Sierras Centrales, especially Córdoba. Berberían and Roldán (2001) indicate that an economy based on agriculture practices was developed in this period, especially in valleys and depressed zones, while the high zones were used for hunting guanacos and pampas deer.

Medina and Rivero (2007) note this "insular" scheme for the high pampas highlighting the sensitivity of the predation of the guanaco and the pampas deer due to the small population of these species, meaning that the loss of an individual was very susceptible. Furthermore, the isolation did not produce any population increase or genetic replacement, which also weakened the local populations. Moreover, new predators including humans produced a high impact on the local ecosystem. Medina and Rivero (2007) state that the hunting of *Lama guanicoe* produced a decrease of relative abundance in the archaeological record through time and an incorporation of diverse species of low dietary value (vegetables and small mammals). Another consequence was the growing number of immature individuals found with cut marks and other alterations caused by humans.

An important issue in zooarchaeological research of ecotonal areas between the Pampas and Sierras Centrales is to corroborate the population dynamics of *Lama guanicoe* through the archaeological record; verify if the population of *Lama guanicoe* decreased or retreated to other regions through both pre- and post-conquest times, and if the exploitation of this species was replaced or sustained by incorporating other available species (Politis et al., 2011).

Fig. 2. Dupuy Rockshelther.

2. Regional setting

Dupuy Rockshelter is located on a hill slope, 300 m from El Pantanillo stream near a ranch, close to the village La Toma in San Luis Province (32°59′16.3″S, 65°47′47.8″W). The rock shelter has archaeological evidence on the surface and stratigraphic information. It is 5 m high and 2 m in width and it is covered with small shrubs and other kinds of vegetation (Fig. 2).

The vegetation in the area consists of *caldenes* islets, carob trees and *chañares*, usually near watercourses and other grassland plains (Cabrera and Willink, 1980; Rosa et al., 2000). The spatial scale selected represents the confluence of landforms and ecological conditions of both the mountain system of the Central Hills and the ecosystem of the Pampas plains.

Many stone tools were recovered, including polished artifacts and lithic debitage, fragments of potsherd, mineral pigments and a small piece of metal (possibly copper) in a stratigraphic sequence about 0.80 m thick. A hearth 30 cm in diameter and 12 cm deep was also identified. Radiocarbon dating of spicules recovered from coal in the structure revealed an age of 370 ± 40 BP (LP 2878), which would mean that the Hispanic occupation of the province and the settlement were contemporary (Fig. 3). There is an alignment of rocks close to the surface of the excavation, which could correspond to an eave closure (pircado) and match the drip line. The large amount of recovered materials, the diversity of instruments, the presence of pottery, evidence of the consumption and processing of the food, and the manufacturing, maintenance and disposal of artifacts indicate multiple activities and possible semi-permanent or permanent occupations.

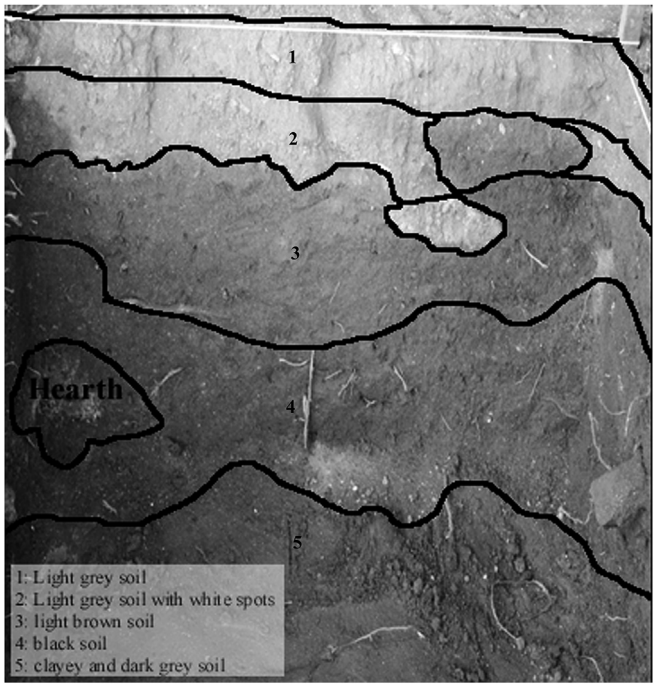

Fig. 3. Stratigraphy of the site.

The geomorphological context corresponds to the southern foothills of Sierra de San Luis, with outcrops of igneous and metamorphic rocks of Paleozoic basement. In the study area, the basement also comprises volcanic outpourings, marble and Neogene calcretes, and active physical-chemical weathering allowed the formation of caves and rock shelters. In the same frame of erosion, small depressions or "high pampas" were formed and then filled by Quaternary alluvial and aeolian sediments.

In the current river morphology, at least two levels of terraces connected to Pantanillo stream are identified. The stream has a submeridian direction and runs to the south, where deep gullies expose the Quaternary sedimentary succession, and the cuspid strata is linked to the evolution of Dupuy Rockshelter.

Considering the radiocarbon dating and its relation to the climate event known as the "Little Ice Age", cold and dry conditions are suggested. In mountainous regions, the snowy conditions kept the rivers well drained. In the plain areas the southern winds dispersed aeolian material (fine sands and silts).

3. Material and methods

Three grids were dug in the field using artificial levels of 5 cm, and all the recovered findings were mapped. In each sedimentary level, soil samples were taken for analysis of phytoliths, and the instruments associated with food processing were labeled and packed without washing for later analysis. There is a high amount of archaeological findings on the surface: a large variety of lithic artifacts, finished instruments, numerous flakes and microflakes, bone fragments, bone instruments, potsherds, and traces of mineral pigments were also recorded. Several rocks were detected in the grids, creating a pircado on the drip line. On the profile of one of the grids, a hearth was observed, from which samples were taken for dating.

The granulometric and mineralogical classification of the gathered samples was executed in the Lab of Sediments (Geology Deparament, UNSL) using the common sieving technique and the Bouyoucos methodology. The mechanical granulometric division of the thick fractions (gravel and sand) was accomplished by using a sieve employing ASTM mesh N° 10 (2 mm), 18 (1 mm), 35 (0.5 mm), 60 (0.250 mm), 120 (0.125 mm), 230 (0.063 mm), and 270 (0.053 mm) as disposed in the IRAM-1501 norm, divided in 100 g fractions weighed in a Scaltec SBA2 weighing scale with an accuracy of 0.01 g. The Bouyoucos method was chosen to quantify the fine grains (silt and clay) using the ASTM E100 152H hydrometer. Previous to this process, the carbonate was removed by adding HCl (10%) and sodium hexametaphosphate using a 400 rpm mechanical disperser. The carbonate was estimated by the expeditious method of Nowaki, and the organic matter using the method by Walkley and Black. A 1 g sample was taken for pH measurements where stabilizing solution and colorimetric indicators were used.

Various methodologies have been applied in order to describe the skeletal remains of the different species found at the site (Table 1). The quantification of taxonomic abundance focuses on

the NISP (Payne, 1975), defined as the number of whole or cracked bone specimens identified by taxon. The MNI (White, 1953), Minimum Number of Individuals, is used to get the most numerous skeletal parts. The Minimum Number of Elements, or MNE (Binford, 1984), is a measure of relative abundance of skeletal elements, and it is calculated on the frequency on which the anatomical elements are represented in the skeleton.

Table 1
List of species obtained on the site ordered by NISP.

	NISP	%
Lama guanicoe	177	24%
Ozotoceros bezoarticus	88	23%
Rhea americana	10	3%
Lepus europeus	5	2%
Lycalopex gymnocercus	2	1%
Chaetophractus villosus	10	3%
Zaedyus pichiy	26	7%
Dasipodidae	26	5%
Galea musteloides	39	11%
Ctenomys sp.	29	8%
Calomys laucha	3	1%
Akodon sp.	3	1%
Cricetidae	5	1%
Rodent	24	7%
Bird	8	2%
Fish	1	0%
Total determinable bones	**456**	
Indeterminable bones	**307**	

The archaeofaunal and site formation analysis allow clarifying which species were intrusive and which of those were integrated to the site as a result of economic exploitation by hunter–gatherer groups. With that in mind, several taxonomic features were considered, including diverse kinds of bone fractures, presence of burned elements, trampling, weathering, and cut marks.

Concerning taphonomy, there are two stages during the fossilization process, before and after the initial burial. The biostratinomic stage comprises pre burial taphonomy factors including death cause and some modifications (natural or cultural). The diagenetic stage occurs when the carcass is abandoned and/or buried. Mainly, these taphonomic factors have a natural origin.

Among the biostratinomic processes, bone breakage and bone segments were considered. The biomechanical properties of the bone are responsive to pressure or impacts (Johnson, 1985; Lyman, 1994; Mengoni Goñalons, 1999). The pattern of bone fracture depends on whether it was fresh or dried (Bonnichsen, 1979; Gifford-González, 1989; Mengoni Goñalons, 1999, among others). The classification process of the types of fracture was taken from Lyman (1994) and Mengoni Goñalons (1999). A spiral fracture has a helical twist and the fracture edge is greater than the diameter of the original diaphysis. Usually, this type of fracture occurs when the bone is still “fresh”. Transverse fractures are those with edge fracture smaller than the diameter of the shaft. Longitudinal fractures are those where edges are parallel to the longitudinal axis of the bone.

Taphonomic variables that might indicate anthropogenic modifications were described, such as burned elements and cut marks. Substantial literature exists on the subject, as it is one of the most important guides in regards to the use of bones; either for cooking, discard or burning as fuel (Fernández Jalvo and Perales Piquer, 1990; Asmussen, 2009; Costamagno et al., 2009). The traditional criterion used for the classification of burned elements is color. The variation of colors used to categorize burned artifacts depends on the temperature. The color scale is the following: whitish-yellow for raw bones, reddish brown for burnt bones, black for carbonized ones, and bluish gray and white for calcined ones.

In addition, human activity could have altered the skeletal remains of the prey, whether for economic ends, as food, making of instruments, or for the obtainment of leather. These marks are diagnostic, usually parallel or subparallel, and cross-wise they present a V shaped mark (Shipman and Rose, 1983a,b).

Trampling, weathering, rodent, and root marks are included in the diagenetic stage. The modifications in bone surfaces can vary depending on the characteristics of the sediments. The diagenetic

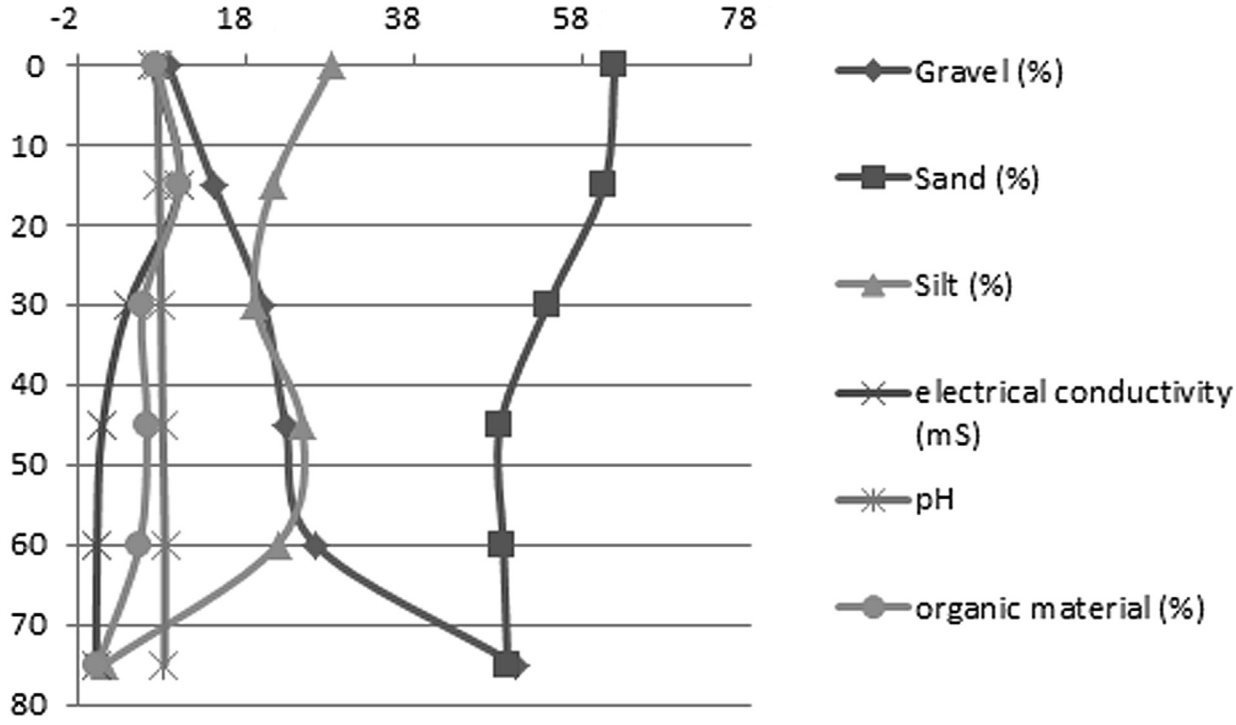

Fig. 4. Results of geological analysis on the site profile.

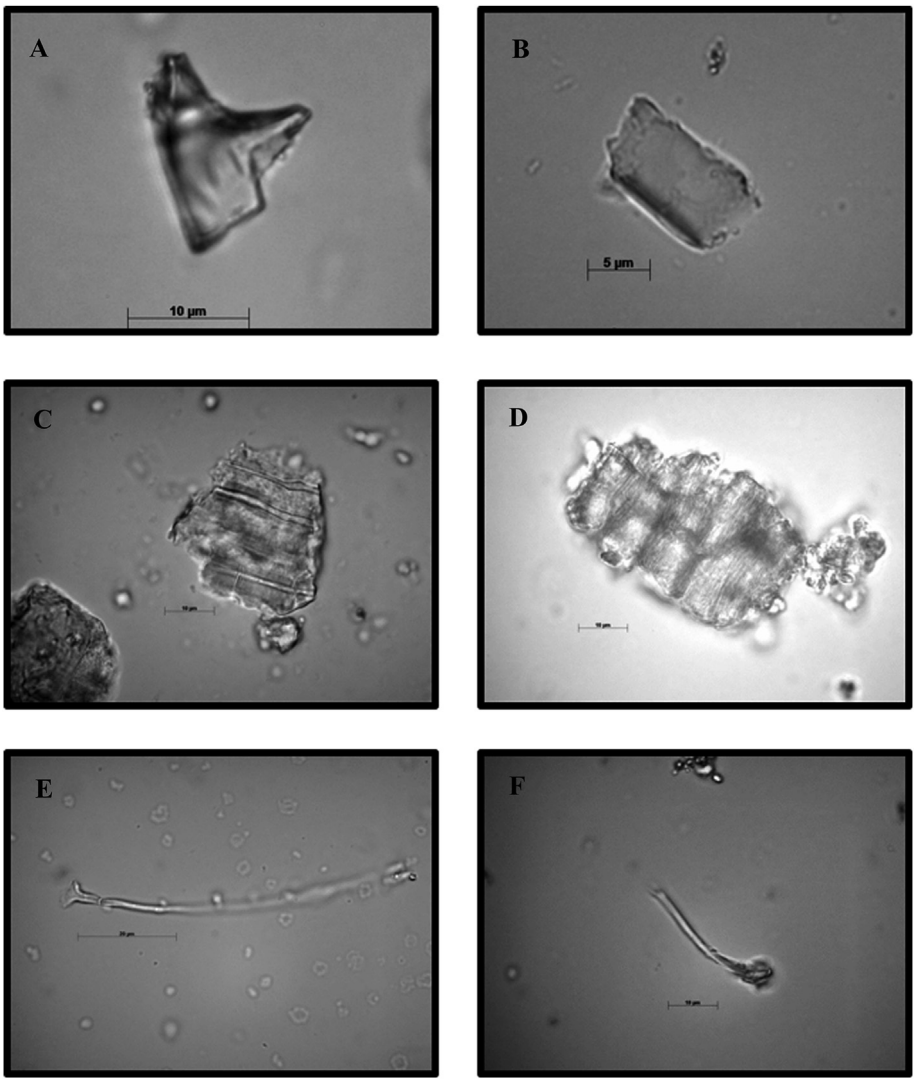

Fig. 5. A–B Poaceae phytolits; C–D vegetal tissue, E–F hair cells.

marks have different characteristics, caused by scratches, pressure, etc (Behrensmeyer et al., 1986; Andrews, 1990; Lyman, 1994). Trampling marks are irregular and without pattern, and could have been originated by different actors, including animals, humans, sediment movement, etc. Weathering occurs when bones are exposed to the action of sun and other agents such as wind, water, and temperature fluctuations (Behrensmeyer, 1978). The effects of weathering can be divided in stages, depending on the size of the carcass. Those belonging to large animals have five stages (Behrensmeyer, 1978) and those of small mammals, four stages (Andrews, 1990). These stages vary from slight modifications, to great damage, or total destruction of the bones.

There are other diagenetic agents considered in this work. Rodents produce subparallel marks by gnawing; these marks are mainly found on the edges of the bones (Lyman, 1994). Roots also leave marks and can destroy bones by producing humic acid. In some cases, there is a symbiotic relationship between roots and fungi. The latter corrodes the bone by releasing inorganic compounds which benefits the root plants (Lyman, 1994). Other diagenetic agents, such as natural abrasion, roundness, and mineral impregnation were contemplated.

A tartar sample was extracted from a human dental piece from the XV level for the phytoarchaeological analysis by using the dry extraction methodology of Maria Musaubach (2012); subsequently, it was examined under an Olympus CX 41 microscope. The sample was selected because tartar in dental pieces is an excellent medium for preservation of several types of microremains (Scott Cummings and Magennis, 1997; Musaubach, 2012), which can be incorporated to the tartar for various reasons, including the consumption of raw or prepared aliments and the use of teeth as tools for the process of several materials. The analysis of the microremains extracted from calculus can help in the paleoenvironmental reconstruction procedure and provide details on which plants were included in the diet (Scott Cummings and Magennis, 1997). The International Code for Phytolith Nomenclature was used to describe the recovered phytoliths (Madella et al., 2005), and reference images from Piperno (2006) and Pearsall (2000) were used to compare the materials.

4. Results

4.1. Geological analysis

Geological studies indicate three geological profile steps (Fig. 4).

Between 75 and 50 cm, a strong decrease of gravel, a substantial increase in silt, constant proportion of sands, and a slight increase

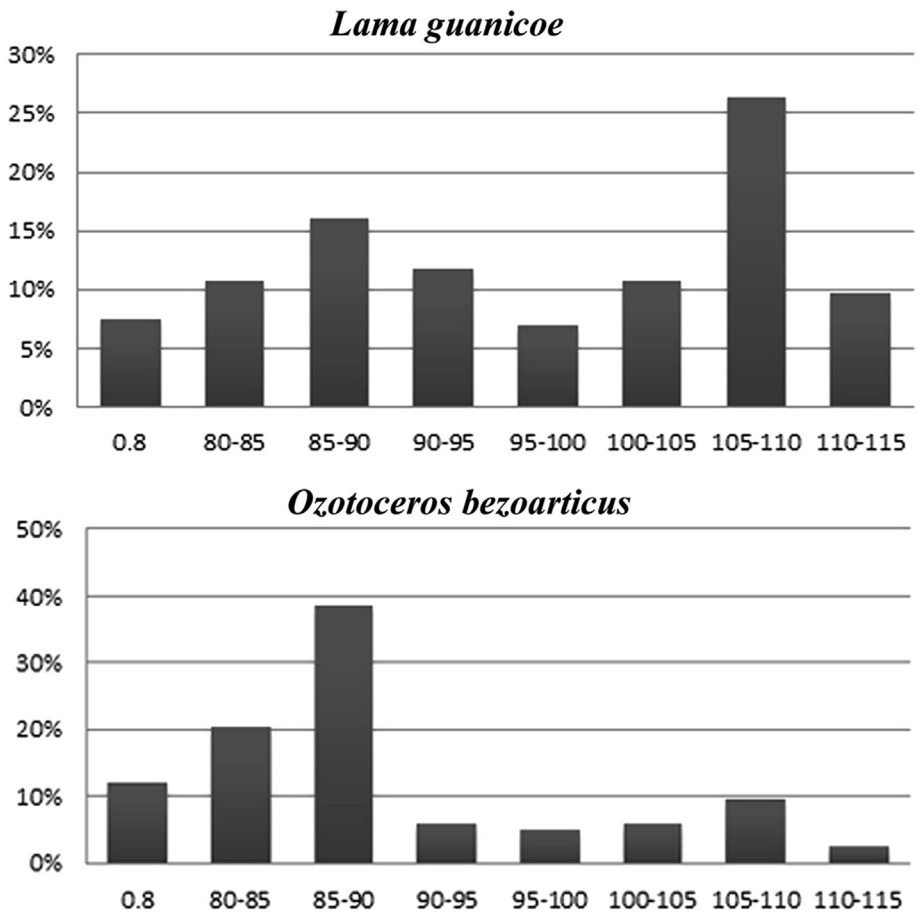

Fig. 6. Excavation levels' distribution of *Lama guanicoe* and *Ozotoceros bezoarticus*. The major percentage of *Lama guanicoe* is in the deeper levels while the major percentage of *Ozotoceros bezoarticus* is on the upper levels.

in organic matter retained in the silts is noted. Evidence of humification indicates water or at least humidity. Probably, the occupation of the eaves began at this time.

Between 50 and 25 cm, there were consistent proportions of coarse materials (gravel), fine (silt) and organic matter with significant sand content, probably fine and some medium sand of aeolian origin, considering that silt is present and humidity did not change.

Between 25 and 0 cm, there was a decrease of gravel, constant proportion of the sands, a marked increase in silt and organic matter, and, at least inside the rock shelter, water was available to hold moisture.

Summarizing, it is likely that there was only runoff at the base and strong wind action taking away the moisture, followed by a period of environmental stability.

4.2. Phytoarchaeological analysis

The sample taken from the human tooth in the lower levels of the site (Level XV) revealed 16 phytoliths, of which 5 were hair cells, 1 was a spore fragment and 8 were plant tissues (Fig. 5).

It was discovered that one of the phytoliths belonged to sclerenchyma cells. Such phytoliths are often formed in the leaves of trees, around the xylem, performing as a protector of this tissue. They are common in the families of Chrisobalanaceae, Flacourtiaceae, Magnoliaceae, Moraceae, Fabaceae and Erythrolaceae (Pearsall, 2000; Piperno, 2006). There is a high chance that the phytolith would belong to the Fabaceae family, the most common in the study area. However, to be able to identify it, it is necessary to make comparisons with specimens of the area.

In addition, two elongated phytoliths belonging to the leaves of a Poaceae plant were recovered. This family plays an important role in the flora of the zone. Although the use of *Zea mays* (maize) was registered in the chronicles (Sotelo Narváez and Martin Huamiltoco, both in López, 2007) there is no evidence of its use, which would suggest that these phytoliths may have belonged to grass.

Although there is not a definitive identification, several pieces of plant tissue and hair cells were recovered. The hairs are appendices in the leaves, seeds and skin of some fruits. They serve as protective structures and are common in the eudicots, especially in Asteraceae, Boraginaceae, Cucurbitaceae, Dilleniaceae, Moraceae, Ulmaceae and Urticaceae, among other families (Piperno, 2006). The presence of these cells and tissues would indicate the consumption or processing of plants using teeth.

4.3. Zooarchaeologial and taphonomic analysis

The recovered fauna corresponds to the regions of Sierras Centrales and Pampa. The small valleys between the mountain ranges provide a wide range of wildlife and plant resources. The variability of faunal resources varies from South American camelids and cervids to dasipodids and fish. Introduced species such as *Bos taurus*, *Ovis aries* and *Lepus europaeus* were found, especially in upper levels. Perhaps the site formation processes played an important role because roots of a *Geoffroeda decorticans* (chañar) were found

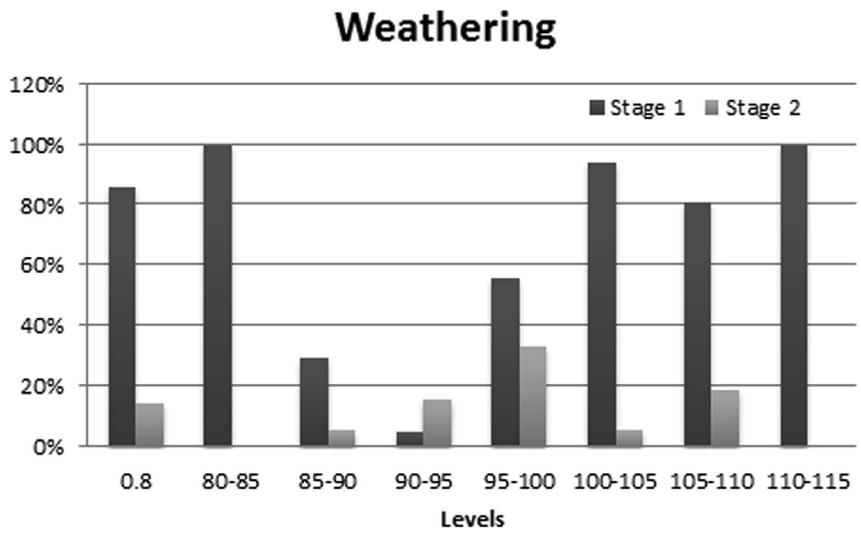

Fig. 7. Distribution of the percentages of stages of bone weathering.

beside some rocks in one of the excavation units. There is also a record of different species of armadillos and rodents (*Chaetophractus villosus, Zaedyus pichiy, Galea musteloides and Ctenomys sp.*).

Ozotoceros bezoarticus (Pampas deer) is more abundant in upper levels and then remains constant. The percentage of *Lama guanicoe* (guanaco) is low in upper levels, increasing in middle levels (Fig. 6).

The most abundant skeletal parts belong to *Lama guanicoe* (NISP: 177), with the distal parts of the legs the most numerous, along with ribs and vertebrae. In the case of *Ozotoceros bezoarticus* (Pampas deer), autopod bones, vertebrae and phalanges are highlighted (NISP: 88).

The MNE values of *Lama guanicoe* indicate a large amount of phalanxes, vertebras, metapodials and ribs. Molars, ribs and phalanxes stand out in the MNE values of *Ozotoceros bezoarticus*, followed by vertebras and metapodials. The quantity of these skeletal parts can be related to the carrying of certain animal parts to the site and their processing. The record of skeletal elements belonging to young individuals reaches 8% of the total record, including indeterminate elements (Tables 2 and 3).

Table 2
Indexes obtained from *Lama guanicoe*' skeletal parts.

	MNE	%MNE
Skull	1	1%
Tympanic bulla	3	2%
Incisor	4	2%
Molar	4	2%
Cervical vertebra	8	4%
Thoracic vertebra	7	4%
Vertebra	12	6%
Caudal vertebra	1	1%
Scapula	3	2%
Ribs	8	4%
Humerus	4	2%
Ulna	2	1%
Metacarpus	2	1%
Pisciform	1	1%
Magnum	3	2%
Pelvis	1	1%
Femur	2	1%
Tibia	3	2%
Metapodial	7	4%
Calcaneus	1	1%
Astragalus	4	2%
Cuboid	3	2%
Ectocuneiphorm	2	1%
Navicular	1	1%
Fibular	2	1%
Phalanx	9	8%
1° Phalanx	10	2%
2° Phalanx	3	2%
3° Phalanx	2	1%
Total MNE	**120**	

Table 3
Indexes obtained from *Ozotoceros bezoarticus*' skeletal parts.

	MNE	%MNE
Skull	1	1%
Maxillar	1	1%
Mandible	2	3%
Molar	11	14%
Cervical vertebra	4	5%
Thoracic vertebra	7	9%
Scapula	1	1%
Ribs	10	13%
Humerus	1	1%
Ulna	1	1%
Capitatum	1	1%
Scaphoid	3	4%
Hemipelvis	1	1%
Femur	1	1%
Tibia	2	3%
Metapodial	7	9%
Calcaneus	1	1%
Astragalus	7	9%
Phalanx	11	14%
2° Phalanx	1	1%
3° Phalanx	4	5%
Sesamoid	2	3%
Total MNE	**80**	

The partial results of the taphonomic analysis show an excellent preservation state of materials. However, a high percentage of the bones show irregular fractures which were likely formed when the bone was dry, probably due to diagenetic factors such as trampling, or the falling of rocks from the rock shelter roof or from walls (*pircas*). Also, there are records of spiral fractures, which are related to human activity, food resource usage, or raw material used to create instruments. Shafts have largest representation among the long bones.

Several variables were considered to describe the taphonomic history of bone assemblages. Among these variables, the highest percentage corresponds to trampling (37%), abrasion (25%), and the damage produced by roots (23%). Anthropic alterations like burned bones (15%) and cut marks (4%) represent percentages that reveal the activities related to the processing of skeletal parts and the cooking and/or the use of skeletal parts as firewood (Table 4). Evidence of weathering is visible in 30% of the elements. Most of the items have a stage 1, and in a minor percentage, a stage 2. The record of bones with evidence of weathering on the stratigraphy of the site is constant from the surface to the deepest parts analyzed (Fig. 7).

Regarding the bones of European fauna recovered at the site, *Lepus europaeus* is the most abundant. The remains were recorded at the upper levels, except a *Bos taurus* fragment recovered at the 100–105 level, probably moved by chañar roots near the site. Only a few hare bones and a small cow bone were intact. The main taphonomic feature registered is trampling. One of these bones (*Bos taurus*) presented cut marks caused by a carnivore. It may suggest that some bones from European fauna were scavenged by predators from human occupation and transported to the rock shelter in recent time.

Table 4
Taphonomic variables considered in the analysis.

Trampling	Rounding	Manganese	Roots	Rodents	Corrosion	Flaking	Abrasion	Burned	Butchering	Total
277	90	43	174	33	67	130	192	116	25	**757**
37%	12%	6%	23%	4%	9%	17%	25%	15%	3%	

Some skeletal elements have also been a source of raw material. Two bone flakes and some bones with a depression resulting from the extraction of bone flakes were found (Fig. 8). The taphonomic analysis indicates that the faunal material has been exploited as a food resource as much as raw material for the making of instruments. This conclusion is reached by taking into account the record of bone instruments, such as punches, ceramic straighteners, and bone flakes.

The bones are well preserved, allowing distinction of the different taphonomic processes. Among the variables considered, weathering indicates that the elements have not been highly exposed and that they have been incorporated into the sediment matrix, guaranteeing their preservation.

Direct evidence suggesting agricultural practices has not been found. However, some gridding stones were found near the rock shelter, which would suggest the processing of vegetables.

5. Discussion

The zooarchaeological research and the taphonomic history of the bones assemblages reveal hunter–gatherers' faunal exploitation at the site. The data published here is partial, but some economic and taphonomic points are relevant.

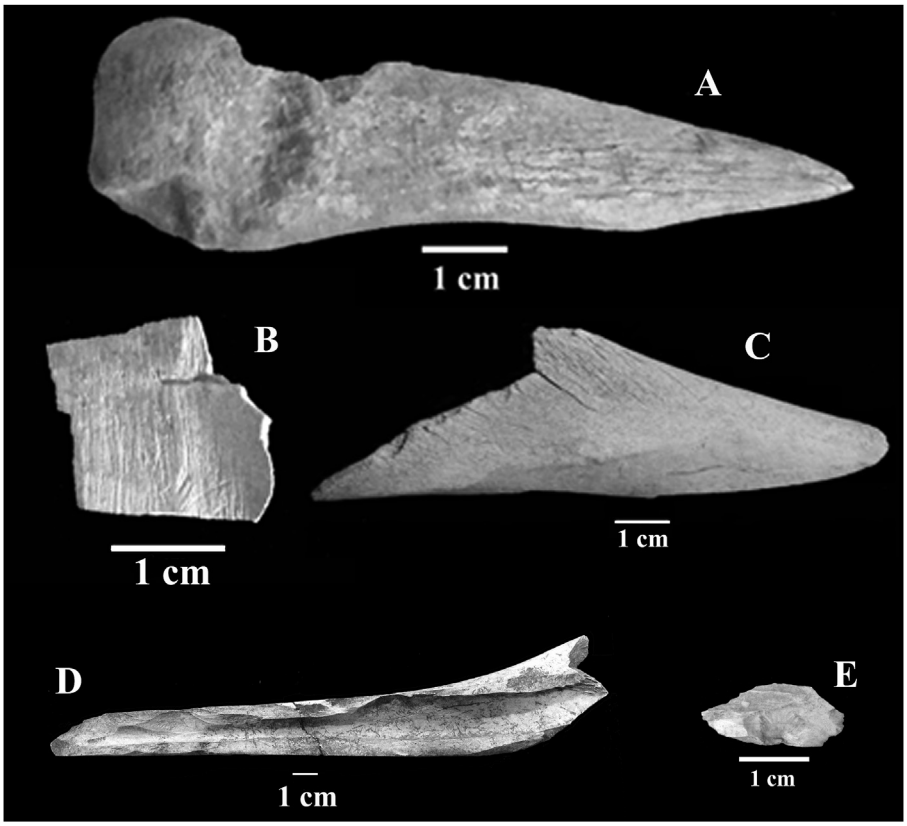

Fig. 8. Bone tools and bones modified by humans. A: Awl made on *Lama guanicoe* metapodial; B: Staightener; C: Smoothing instrument shapened on *Lama guanicoe* humerus; D: Negative flakes on the breakage edge of *Lama guanicoe* ulna; E: Bone flake.

The fauna recorded at the site is typical from Espinal and Monte. *Lama guanicoe*, *Ozotoceros bezoarticus* and *Rhea americana* are well represented, as well as some dasipodids and rodents.

The hearth found buried on the site dates from 370 ± 40 BP. Although this would mean that the late occupation of the site between 1570 and 1650 would overlap with the arrival of the conquerors, there is no evidence of European elements. The display shows typical hunter–gatherer activity of the Late Holocene, with an intensive exploitation of wildlife resources available in small valleys. This is reflected in the large number of skeletal remains of different species, some of which have strong evidence of having been processed. The evidence presented in this work agrees with the schemes presented by Martínez and Gutiérrez (2004) for the Pampean region and Medina and Rivero (2007) for the Sierras of Córdoba, both for the Late Holocene.

A predominance of guanaco exploitation is observed in lower levels, whether used as food resource or for the making of bone instruments, which then decreased gradually and was replaced by the deer at middle levels and above. Given the sequence of occupation of the site Dupuy Rockshelter, these features suggest that there may have been a numerous population of guanacos in the study area at first, but towards the end of the Late Holocene a gradual decrease in their population occurred compelling a replacement of this resource by other species such as the Pampas deer and ñandú. According to the schemes proposed by Pampean region and Sierras Centrales, incorporation of vegetables and small mammals in the diet is expected. The phytoarchaeological analysis and the grinding instruments found on the site support the hypothesis that in the Late Holocene there was an intensification and diversification of the economy.

This hypothesis should be corroborated with the analysis of other faunal assemblages within the area, near archaeological sites. The availability of wildlife resources in small valleys was a fundamental factor in the life of hunter–gatherers, as in times of scarcity of the guanaco, they developed the usage of other resources and diversified the use of smaller species.

The data provided in this study indicates that during the entire stay in the place, hunter–gatherers would have alternatively used *Lama guanicoe* (guanaco), *Ozotoceros bezoarticus* (Pampas deer), and a diverse number of other resources. Accordingly, human groups in the area have developed a strategy of intensive occupation of the landscape, taking advantage of the space and resources of the plains, valleys, and mountain ranges.

There is good preservation of the bone assemblages, with high percentages of trampling and abrasion due to the characteristics of the sediments (gravel and sands). The root marks were probably made near the site by the activity of shrubs and trees, such as chañar. Weathering is present in the record, with a majority reaching stage 1 and a minor proportion stage 2. Apparently, there was a short period of time of exposure to the environment, perhaps due to the protection provided by the rock shelter.

Although no previous studies were made regarding the archaeobotanical remains in the area, the chronicles of Pedro Sotelo Narváez and Martin Huamiltoco (both in López, 2007) econtain references to the use and cultivation of corn, squash, beans, peanut, yam and quinoa. Also, nearby sites, including the provinces of Córdoba, Mendoza and San Juan, have archaeological evidence of plant use, including *Zea Mays*, *Phaseolus vulgaris*, *Phaseolus lunatus*, *Phaseolus sp.*, *Erythroxylum coca*, *Cucurbita sp.*, *Chenopodum quinoa*, *Arachis Hypogaea*, *Ipomea Batata*, *Amaranthus caudatus*, *Prosopis*, *Hoffmannseggia erecta*, and *Schoenoplectus californicus* (Gambier, 1985; Mazzanti and Quintana, 2001; López, 2007; Pastor and Berberian, 2007; Medina et al., 2008; Neme et al., 2011; Llano and Neme, 2012; Pastor et al., 2012). The proposed scheme includes a mixed diet that includes plants such as seeds and tubers.

6. Conclusions

The Dupuy Rockshelter zooarchaeological research provides data about the exploitation of wildlife resources by hunter–gatherers in the Late Holocene (Last Millenium). The main wildlife resources were *Lama guanicoe* (guanaco) in deeper levels and *Ozotoceros bezoarticus* (Pampas deer) in higher levels. Some bones were used to make tools and others to obtain bone flakes. Vegetable resources were exploited, but it is not clear if the plants used were cultivated or were taken directly from the wild, or the importance they had in the diet. There are ongoing studies with reference to the identification of the vegetables exploited in the area. Geological studies show formation processes that reveal eave drip and aeolian activity and the beginning of a wetter period. The radiocarbon date reports the activities in the Late Holocene (Last Millennium), probably during the Spanish period, but there is no evidence of European elements.

The density of *Lama guanicoe* (guanaco) elements, declines towards the upper levels, while *Ozotoceros bezoarticus* (Pampas deer) increases. This may imply a decrease in consumption of *Lama guanicoe* due to the scarcity that is clearly reflected in the Pampean region, despite some population elements persisting until the European colonization times in this ecotonal area. There is evidence that indicates its substitution with other species and vegetables available. However, it is necessary to obtain radiocarbon dates on the site to locate this process chronologically.

Other species including small mammals (rodents and dasipodids), fish and reptiles were present in the record. These species could have been used as alternative food resources due to the reduction of the population of the *Lama guanicoe* in the Late Holocene as a result of climatic changes and human colonization. The research in this site and others with similar chronology can offer more evidence about the faunal exploitation in the area.

Acknowledgements

We thank Dr. Rafael P. Curtoni, director of the Project "Archaeological Investigations in the area Sierras and Plains Center – East of the Province of San Luis" funded by "Investigaciones arqueológicas en sierras y llanuras del área centro-este de la provincia de San Luis". PICT 0290 FONCYT, Agencia Nacional de promoción científica y tecnológica. INCUAPA, Facultad de Ciencias Sociales, UNCPBA, for providing the facilities to work on his project and his comments; the directors and members of INCUAPA – CONICET – UNICEN for their support in research tasks; the editors and coordinators of "South America Zooarchaeology" ICAZ 2014 for inviting us to participate in this volume; and to the Laboratory of Archaeology of the University of Antioquia (Colombia) where the analysis of phytoliths were executed. We also thank the anonymous reviewers who enriched this work with their comments.

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