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Late Holocene armadillos (Mammalia, Dasypodidae) of the Sierras of Córdoba, Argentina: Zooarchaeology, diagnostic characters and their paleozoological relevance

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ABSTRACT

The results of zooarchaeological study carried out on the bone remains of armadillos (Mammalia, Dasypodidae) from four Sierras of Córdoba (Argentina) archaeological sites were presented. The radiocarbon dates place chronologically their occupation at the last millennium of the Late Holocene (ca. 970 ± 110 and 290 ± 37 ^{14}C BP). Four taxa were identified: *Chaetophractus villosus*, *Chaetophractus vellerosus*, *Euphractus* sp. and *Dasypus* sp. The diagnostic characters of their bony dermal scutes or osteoderms were described in order to facilitate their taxonomical identification in other modern collection and/or fossil assemblages. *C. villosus* and *C. vellerosus* show a current distribution in the study area, while *Euphractus* sp. and *Dasypus* sp. are absent in the Sierras of Córdoba. *Euphractus* was determined on the basis of a fragmented movable osteoderm in C.Pun.39. Their presence may be a response to an increase of precipitation and temperature associated with the "Medieval Warm Period". The record of *Dasypus* sp. during the "Little Ice Age" contrasts negatively with its potential as an indicator of warm and humid condition, showing either their adaptive plasticity or the biological fragmentation of the mountain environment under paleoclimatic conditions. Finally, the possibility that the presence of *Euphractus* and *Dasypus* is due to anthropogenic transport was considered.

1. Introduction

The dasypodids (Xenarthra, Dasypodidae) – commonly known as armadillos, tatús or quirquinchos – have their oldest record in the Late Paleocene of Brazil (Krmpotic et al., 2009). In Argentina, they are found since the Early Eocene (Ciancio and Carlini, 2008), where they are currently represented by nine genera and 15 species (Vizcaíno et al., 2006; Wetzel et al., 2007). Their most conspicuous anatomical feature is the presence of a dorsal shield that protects their body from predators. The carapace consists of three clearly distinguishable regions composed by bony dermal scutes or osteoderms: a scapular shield, a region of mobile bands (of variable number) and a pelvic shield (see Figs. 1A and 2). The dorsal surface of the osteoderms has a particular morphology and ornamentation, which is characteristic of each genera and species (see Fig. 2), being the basis for systematic identification of the group and having a significant role in taxonomic and biogeographic studies.

The results of the zooarchaeological research carried out on the osteoderms of armadillos from four Late Holocene Sierras of Córdoba (Argentina) archaeological sites were presented (Fig. 3). The main diagnostic characters of the osteoderms were described in order to facilitate their identification in other modern collection and/or fossil assemblages. The recorded taxa and its implications for the study of the climate fluctuations during the last 1000 years are discussed. Finally, it is proposed that the faunal remains from archaeological sites present an excellent opportunity to study components of the biota that coexisted in a short geological period, providing valuable paleozoological information of the ecosystem and its changes along the time (Tonni, 1984; Lyman and Cannon, 2004; Wolverton et al., 2011).

2. Regional setting

The Sierras of Córdoba are a low-altitude mountain range (500–2790 masl) with a complex of peaks, valleys, steppe slopes

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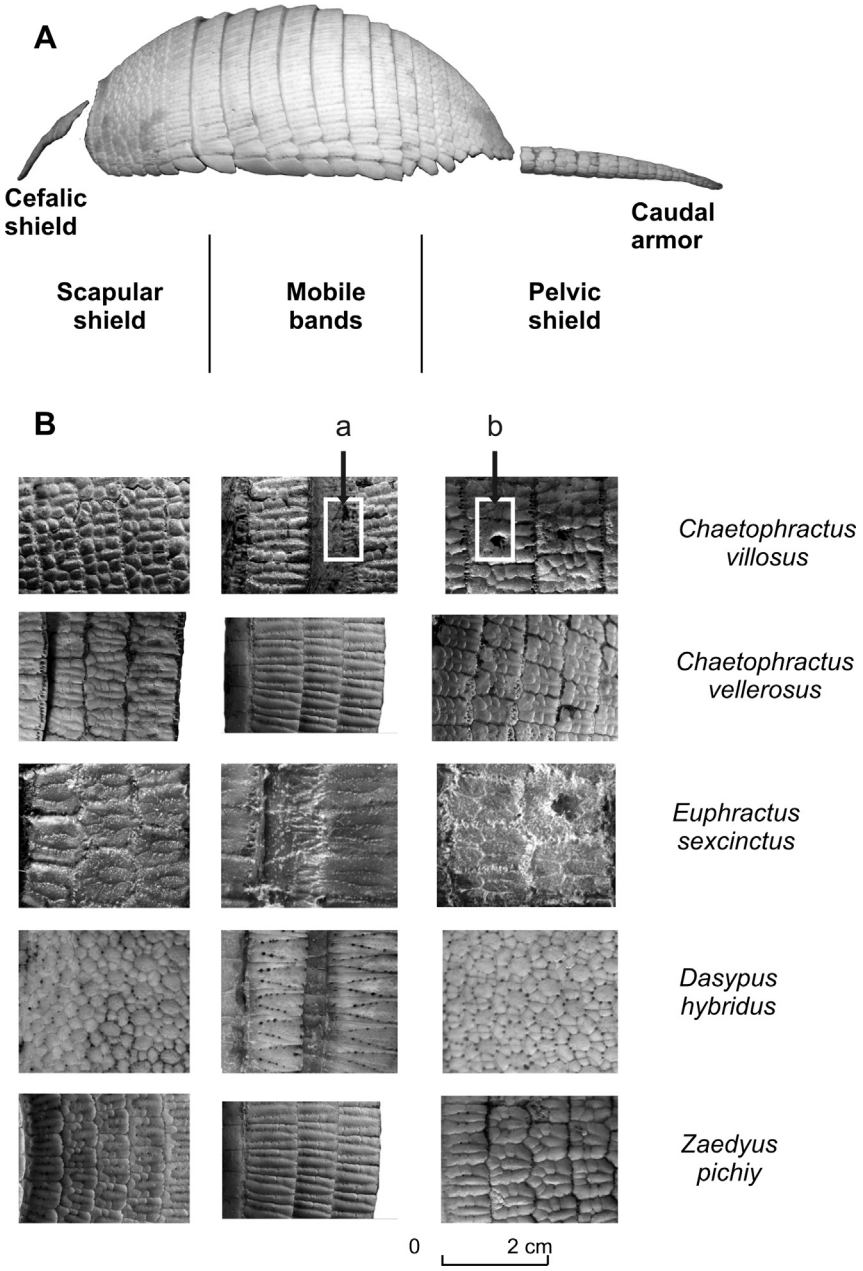

Fig. 1. A) Lateral view of the carapace regions of the Dasypodidae. B) Detail in dorsal view of the osteoderms that make up the carapace of the dasypodids mentioned in this paper. All figured specimens belong to extant specimens. "a" indicates the zone between the cranial and caudal surface of the osteoderm of rough surface, "b" characteristic glandular foramen of the middle dorsal region of *Chaetophractus villosus.*

and high-plains that are especially interesting from a zoogeographical and evolutionary point of view (Polop, 1989). Mean annual temperatures vary between 10 °C and 18 °C according to the altitude (Capitanelli, 1979). Rainfall varies from more than 900 mm annually in the mountain peaks to 800–700 or 600–500 mm in the east and west valleys, respectively (Capitanelli, 1979).

The altitudinal gradient favored a series of vegetation belts. The Sierra Chaco or mountain woodland covered the valleys and foothills with elevations ranging from 500 to 1100–1350 masl. Its flora is represented mainly by *Lithraea molleoides*, *Fagara coco* and *Schinopsis haenkeana*, alternating with *Kageneckia lanceolata* and *Ruprechtia apetala*, among others (Luti et al., 1979). Its fauna is dominated by low-diversity neotropical small-sized mammals adapted to closed-vegetational environment (Bucher and Abalos, 1979). The mountain shrubland extends between 1100 and 1700 masl, being transitional between the Sierra Chaco and the upper mountain grassland range. Shrubs are dominant (*Heterothalamus alienus*, *Eupatorium buniifolium*, *Baccharis* spp., etc. and some cacti), covering the steep slopes. Above 1100 masl, the upper mountain grassland range is found (Luti et al., 1979), where *Stipa* spp., *Festuca* spp., *Alchemira pinnata*, *Deyeuxia hieronymi*, *Bromus* spp., and *Poa* spp. are the predominant species. The mountain shrubland and the upper mountain grassland range correspond to the zoogeographical Subandean District, with Andean-Patagonian faunal elements and high rate of endemism (Ringuelet, 1961; Cei, 1972; Bucher and Abalos, 1979).

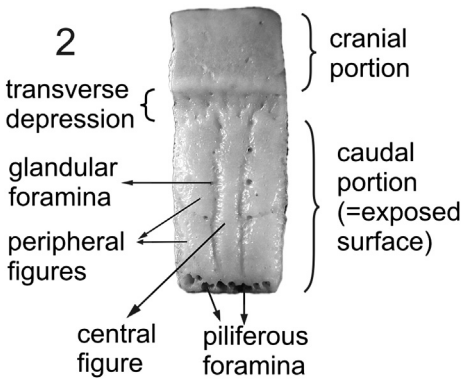

Fig. 2. Dorsal view of an osteoderm showing its general morphology and the terms used in the descriptions.

During the Pleistocene–Holocene, the Sierras of Córdoba underwent climatic fluctuations (Carignano, 1999). The paleoclimatic information suggests that mountain vegetation during the Late Pleistocene–Early Holocene (ca. 12,000–6000 BP) was different from the present. The climate was cold and dry with great extent of grasslands connecting the upper mountain range with the surrounding lowland grassland (Adams and Faure, 1997; Carignano, 1999; Sanabria and Arguello, 2003; Piovano et al., 2009). From ca. 6000 BP the climate improved with the establishment of subtropical humid conditions (Sanabria and Arguello, 2003; Teta et al., 2005), redefining the landscape with the formation of the Sierra Chaco vegetation belt and the biogeographic isolation of the Andean Patagonian flora and fauna at altitudes higher than 1100 masl.

Current oceanographic and atmospheric patterns ca. 3000 BP emphasized the similarities between the modern and fossil biotas (Markgraf, 1991). However, in the last 1000 years, two global climate events were recorded in central Argentina: the "Medieval Warm Period" (MWP) and the "Little Ice Age" (LIA). The former had

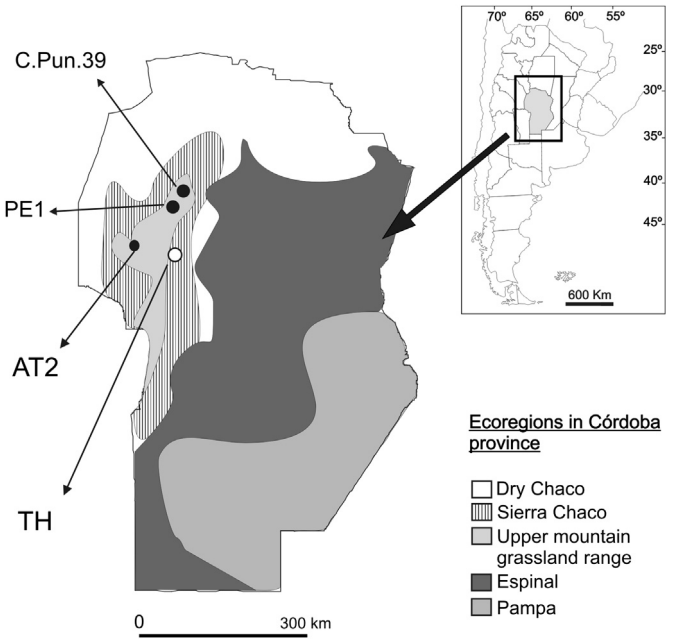

Fig. 3. Map showing the geographical location of archaeological sites mentioned in the text.

subhumid/temperate climate, milder winters, higher rainfall and hydrological surplus (Carignano, 1999; Piovano et al., 2009) similar to the southern and eastern Pampean region, where the climatic conditions caused the presence of subtropical mammals (*e.g. Desmodus*, *Pseudorizomys wavrini*, *Bibimys chacoensis*, *Dasypus hybridus*, *Chrysocyon brachyurus*, Pardiñas and Tonni, 2000; Prevosti et al., 2004; Tonni, 2006, 2010). The second event (LIA) was contemporary to the Spanish colonial system. It was characterized by extreme droughts alternating with torrential summer rains that caused the reduction of lakes and the reactivation of erosion (Cioccale, 1999; Piovano et al., 2004). The LIA are also documented in the eastern Pampean region, with the presence of *Tolypeutes matacus* in Buenos Aires during the early XIX century (Deschamps et al., 2003) and catastrophic mortality events of cattle (Tonni et al., 2008). Nevertheless, the LIA showed warmer pulses (see Fig. 1 in Kobashi et al., 2011) to which mammals seem to have responded by changing their distribution (*i.e.*, *Desmodus* cf. *Desmodus draculae*, Pardiñas and Tonni, 2000).

Las Chacras or C.Pun.39 (31°03′S, 64°31′W, 1050 masl, Department Punilla) is an open-air archaeological site located in the northern Punilla Valley. The surrounding vegetation is Sierra Chaco, although impoverished by altitude, with isolated trees of *L. molleoides*, *F. coco*, mimosoideas, *H. alienus* and *Stipa* sp. The analysis of superficial and stratigraphical archeological remains confirmed its use as an agricultural and residential site (Medina, 2008, 2009, 2010; Medina et al., 2008; Medina and Pastor, in press). Three charcoal samples from overlapping layers were dated at 525 ± 36 BP (AA64819), 716 ± 39 BP (AA62339) and 854 ± 39 BP (AA62338).

Puesto La Esquina 1 (PE1, 31°09′S and 64°37′W, 1140 masl; Department Punilla) is located at the bottom of a well-protected ravine of Pampa de Olaen. Its vegetation is dominated by *Stipa* sp., with slopes covered with *H. alienus*. The pottery, bone, lithic and palaeobotanical evidence, as well as an archaeological floor and a hearth, indicate the development of multiple-activities such as the production, storage, processing, cooking, and consumption of foodstuffs, the manufacture, maintenance, and discarding of artifacts, etc. Thus, PE1 was interpreted as a semi-sedentary residential base or village (Medina and Rivero, 2007; Medina, 2008, 2009, 2010; Medina and Pastor, in press). Two radiocarbon dates from overlapping layers results at 365 ± 38 BP (AA64816) and 362 ± 43 BP (AA64815), placing its occupation near to the Spaniards arrival and indicating the high-resolution of the deposits.

The Arroyo Talainín 2 (AT2, 31°18′S, 65°12′W, 1030 masl, Department Pocho) is an open-air archaeological site which include a small rock-shelter located on the western of the Salsacate valley. The environment presents the typical characteristics of the valleys of Sierra of Córdoba, with the presence of Sierra Chaco and palms of *Trithrinax campestris.* However, water availability is limited as a consequence of the low-rainfall (<500 mm annually) and the reduced extension of the collecting basins. Due to the high-frequency of surface unmovable grinding artifacts and the stratigraphical data, the occupation was associated to animal and vegetal large-group food processing and consumption tasks (Pastor, 2007; Medina et al., 2011a). Charcoal obtained from a hearth inside the rock-shelter was radiocarbon dated at 740 ± 60 BP (LP-1450) (Pastor, 2007). Two overlapped archaeological floors corresponding to the initial occupation of the site were radiocarbon dated at 980 ± 60 BP (LP-2252) and 900 ± 50 BP (LP-2269).

Tala Huasi (TH, 31°27′S, 64°38′W, 850 masl, Department Punilla) is a rock-shelter located in the southern portion of the Punilla valley. The environment presents the typical characteristics of the Sierra Chaco with hills dominated by *L. molleoides*, *F. coco* and

Acacia cavens. Its archaeological sequence is dominated by ceramics and lithic artifacts whose technological characteristics respond to the late prehispanic period (ca. 1000–300 BP). Lower layers were dated at 970 ± 110 BP (charcoal, LP-2362), but a *Bos taurus* rib coming from upper levels was dated at 290 ± 37 BP (AA92987), suggesting early colonial occupations (Medina and Pastor, 2011).

3. Materials and methods

The taxonomic analysis was carried out in the Facultad de Ciencias Naturales y Museo (Universidad Nacional de La Plata). Specialized literature and reference collections of *Chaetophractus villosus*, *Chaetophractus vellerosus*, *Zaedyus pichiy*, *Euphractus sexcinctus*, *Dasypus novemcinctus*, *D. hybridus* and *Dasypus yepesi* were used for taxonomic identification (Scillato-Yané, 1982; Vizcaíno and Bargo, 1993; Soibelzon et al., 2010). The osteoderms were analyzed from a qualitative and quantitative point of view, describing the ornamentation of the exposed surfaces and measuring length and width with a digital caliper. The fragmentation of the assemblages limited the taxonomic identification to species level and forced the use of broad taxonomic categories as family or genus. The taxonomic abundance was quantified by the Number of Identified Specimens per Taxon (NISP), assuming that specimens come from different individuals in archaeological-scale resolution (Lyman, 2008).

4. Results

A total of 315 armadillo bone remains were recovered during excavations, being the osteoderms one of the most frequent skeletal elements among small-vertebrate and showing their economic importance to the prehispanic societies. The osteoderms showed transversal fractures, while only 43% were complete. Burnt mark frequencies (C.Pun.39 = 14, PE1 = 3; AT2 = 29 and TH = 5) suggests burning damage-mediated fragmentation and the human accumulation of the assemblages through cooking related activities (see Medina and Rivero, 2007; Medina, 2009; Medina and Pastor, 2011; Medina et al., 2011a; Medina and Merino, in press; Medina and Pastor, in press).

The analysis of the osteoderms confirms the presence of *C. villosus*, *C. vellerosus*, *Euphractus* sp. and *Dasypus* sp. (see Fig. 1B and Table 1).

Systematic
Superorder Xenarthra Cope, 1889
Order Cingulata Illiger, 1811
Family Dasypodidae Gray, 1821
Subfamily Euphractinae Winge, 1923
***Chaetophractus* Fitzinger, 1871**

Materials and procedure. A high-frequency of specimens was taxonomically assigned to *Chaetophractus* (NISP = 285). A small portion was determined to a genus level due to its fragmentation (NISP = 60), while more than 200 remains were referred to *C. vellerosus* and *C. villosus*. Some osteoderms (NISP = 2 in AT2 and NISP = 7 in C.Pun 39) had an intermediate size between *C. villosus* and *C. vellerosus* (Table 1). These specimens were tentatively assigned to *Chaetophractus* sp., but probably correspond to a third species whose presence and taxonomic status needs to be confirmed (see section Discussion).

Description and comments. The osteoderms of *Chaetophractus* are antero-posteriorly elongated and rectangular-shaped, especially the movable ones. They have one central and four or five well-defined peripheral figures, being the most posterior larger (Fig. 1B). Movable osteoderms present a transverse depression between the cranial and caudal portion that appears rough (see Soibelzon et al., 2006, 2010; Fig. 2A in Krmpotic et al., 2009). The ornamentation of the osteoderms of *Chaetophractus* is similar to *Zaedyus*, another Euphractinae present in the Pampean Region and Patagonia of Argentina (Abba and Superina, 2010). However, two features differentiate them: 1) the transverse depression in *Chaetophractus* is rough, whereas in *Zaedyus* is mostly smooth, 2) the posterior edge of the osteoderms of *Chaetophractus* is straight with numerous piliferous foramina, while in *Zaedyus* it is thin with scarce piliferous foramina, being the most notable foramen coincident with the central figure (Vizcaíno and Bargo, 1993; Soibelzon et al., 2006, 2010).

***C. villosus* (Desmarest, 1804)**

Materials and procedure. Faunal remains assignable to this species were collected in C.Pun.39 (NISP = 20) and AT2 (NISP = 72) (see Table 1).

Description and comments. The ornamentation of the exposed surface has an elongated central figure with anterior and lateral small peripheral figures. The central figure occupies the posterior two thirds with glandular and small piliferous foramina around it. The posterior margin of each osteoderm bears numerous piliferous

Table 1
Location, dating and Number of Identified Specimens by Taxon (NISP) in the sites considered in this paper: NISPch: *Chaetophractus* sp., NISPve: *C. vellerosus*, NISPvi: *C. villosus*, NISPe: *Euphractus* sp., NISPd: *Dasypus* sp., NISPt: Total.

Site	Location	masl	^{14}C age BP	Calibrated age BC 95.4%	NISPch	NISPve	NISPvi	NISPe	NISPd	NISPt
CPun39	31° 03′ S y 64° 31′ W	1050	525 ± 36	1401 (95.4%) 1457	9	21	20	1	0	51
			716 ± 39	1276 (95.4%) 1392						
			854 ± 39	1161 (95.4%) 1280						
PE 1	31° 09′ S y 64° 37′ W	1140	365 ± 38	1464 (95.4%) 1640	6	21	0	0	0	27
			362 ± 43	1464 (95.4%) 1642						
AT 2	31° 18′ S y 65° 12′ W	1030	740 ± 60	1224 (95.4%) 1394	45	87	72	0	0	204
			980 ± 60	995 (1.7%) 1007						
				1015 (93.7%) 1217						
			900 ± 50	1045 (14.0%) 1088						
				1106 (81.4%) 1273						
TH	31° 27′ S y 64° 38′ W	850	970 ± 110	895 (2.6%) 927	0	4	0	0	29	33
				935 (92.8%) 1285						
			290 ± 37	1505 (30.6%) 1590						
				1616 (45.9%) 1676						
				1737 (19.0%) 1799						
			274 ± 29 BP	1513 (5.0%) 1544						
				1623 (56.9%) 1678						
				1734 (33.5%) 1800						

follicle foramina (Krmpotic et al., 2009). The fixed and movable osteoderms have similar ornamentation, but the fixed ones generally lack the anterior peripheral figures (see Fig. 1B and Krmpotic et al., 2009). The mean size of the movable osteoderms is 11.7 mm long by 6.6 mm wide ($N = 55$).

C. villosus is recorded since the Chapadmalalense (Middle Pliocene; Scillato-Yané, 1982; Carlini and Scillato-Yané, 1999) to the present. It occupies a wide range of environments showing great adaptive plasticity, but seems to select open grassland and anthropogenic modified environments, including peri-urban areas (Abba et al., 2007; Abba and Vizcaíno, 2011). *C. villosus* is distributed in Bolivia, Paraguay, Argentina and Chile (Gardner et al., 2005, see Fig. 12 on Abba and Superina, 2010). In Argentina it is known from Salta and Chaco provinces going down south along a central strip that expands in Santa Fe and Córdoba provinces, reaching almost to the Andes Cordillera in Mendoza province, and the Atlantic in Buenos Aires province continuing to the southern end of Patagonia, except in the Andes Cordillera. It has also been confirmed its presence in Tierra del Fuego by anthropogenic introduction (Poljak et al., 2007). In Córdoba province it is recorded in the grasslands of the southern departments (*i.e.*, General Roca, Presidente Roque Saenz Pena, Rio Cuarto, Juárez Celman), while it is also present in the semi-arid Sierra Chaco northern department surveyed (Departamento de Cruz del Eje, Ischilin, Tulumba).

***C. vellerosus* (Gray, 1865)**

Materials and procedure. The faunal remains assigned to this species are present in the four archaeological sites (NISP = 133, see Table 1).

Description and comments. The osteoderms of *C. vellerosus* resemble to *C. villosus* regarding ornamentation, although they are 13% smaller (see Fig. 1B). The average width of the measured was 5.2 mm ($N = 100$).

This species has its first fossil record at the Ensenadadense (Lower-Middle Pleistocene) of the Pampean Region (Soibelzon et al., 2006, 2010). *C. vellerosus* inhabits a wide range of environments, but it is strongly associated to arid and semi-arid climate with well-drained sandy soils (Soibelzon et al., 2007; Abba et al., 2011a). Its current distribution is disjunct, with a main area comprising the Gran Chaco and the center of Argentina. A secondary are covers the coastal of the Buenos Aires province (see Abba and Superina, 2010), resulting from the Late Pleistocene–Early Holocene paleodistribution (Carlini and Vizcaíno, 1987; Soibelzon et al., 2007).

Its distribution in Córdoba has a similar pattern than *C. villosus*, with records in the southern grasslands department (Río Cuarto, Río Tercero, Juarez Celman) and semi-arid Sierra Chaco northern department (Cruz del Eje, Ischilin, Tulumba). However, this distribution could be explained by sampling bias because there are large areas of the province that have not been surveyed yet.

Euphractus Wagler, 1830

Materials and procedence. Only a movable osteoderm of *Euphractus* was recorded in C.Pun.39 (Table 1 and Fig. 1B).

Description and comments. The isolated specimen has a transverse fracture prevented it length estimation. Its width is 10.6 mm.

The carapace of *Euphractus* has osteoderms with practically flat central and peripheral figures (see Fig. 1B). The ones from the scapular shield are pentagonal to hexagonal-shaped, presenting an elongated central figure surrounded by three cranial and two lateral peripheral and smaller figures. Numerous hair follicle foramina are located on the posterior and lateral margin, the most developed coinciding with the central figure. This situation is repeated in the mobile bands as in the pelvic shield. The movable osteoderms have the central figure flat as well, surrounded by lateral peripheral figures that are also flat (Scillato-Yané, 1982). Four to five hair follicle foramina are present at the posterior edge. There is a dorsal rough transverse depression between the cranial and the caudal part like in *Chaetophractus*. The pelvic shield osteoderms are rectangular-shaped with a flattened and elongated central figure, anteriorly limited by two small cranial and two or three lateral figures, almost undivided. In the posterior margin and towards the outer side there are two to three hair follicle foramina.

The Pleistocene record of this genus in Buenos Aires province is limited to less than five specimens or individuals (*e.g.* Pascual et al., 1966; Scillato-Yané, 1982; Carlini and Scillato-Yané, 1999). However, three of them were not found in the paleontological collections where they should be safeguarded (see Soibelzon et al., 2010). *Euphractus* inhabits a broad range of South American environments, from grassland to rainforests (Redford and Wetzel, 1985; Abba et al., 2012). At present, *E. sexcinctus* is distributed in Catamarca, Jujuy, Salta, Tucuman, Santiago del Estero, Chaco, Formosa, Entre Rios, Corrientes and Misiones provinces of Argentina (Vizcaíno et al., 2006), but it is not recorded in Córdoba province. However, there are records in the neighboring province of Santiago del Estero and its presence coincides with the distributional model presented by Abba et al. (2012: Fig. 4D), showing a region with low to medium probability of occurrence in northern Córdoba.

Subfamily Dasypodinae Gray, 1821

Description and comments. The fixed osteoderms of the Dasypodinae are hexagonal to pentagonal-shaped, with a large central figure occupying almost its entire surface and small peripheral figures developed on its cranial edge. Those located in the mobile bands have a central figure delimited by two diverging sulci towards the back, giving the typical lageniform-shaped appearance of Dasypodinae. The horny scales are common to two or three osteoderms, unlike the Euphractinae (Scillato-Yané, 1982).

This subfamily has a wide geographical distribution in America, including *D. novemcinctus* (Linnaeus, 1758), the only Xenarthra which has recently colonized North America.

Dasypus Linnaeus, 1758

Materials and procedence. *Dasypus* sp. are exclusively present in the upper levels of TH (NISP = 29, Table 1), vertically distributed between 10 and 40 cm depth. One osteoderm was dated directly by AMS at 274 ± 29 BP (AA97578). The presence of an isolated osteoderm at the lower levels of TH can be explained by vertical migration caused by trampling. The specimens were not assigned to species level due to the high fragmentation, while the best preserved ones exhibited some ambiguity in morphology and metric parameters that might correspond either to *D. hybridus* or *D. yepesi*.

Description and comments. The osteoderms of the scapular and pelvic shield of *Dasypus* are small, isodiametric and hexagonal-shaped. The central figure is subcircular and, although it is displaced backwards, occupies almost the entire surface surrounded by four or five small peripheral figures. In the sulci between the central figure and the peripheral ones, small glandular foramina are developed in number of three or four. The mobile bands are anteroposteriorly elongated (mean length 12.5 mm and mean width 5.1 mm, $N = 28$), while the central figure is delimited by two diverging sulci towards the back, giving the typical lageniform shape. On its posterior edge two to four hair follicle foramina grow (Fig. 1B). There are glandular foramina on those sulci. The ornamentation of the exposed surface continues in the separation area between the cranial and caudal part.

Dasypus sp. is recorded in the Pleistocene of Argentina, Bolivia, Brazil, Ecuador, Uruguay and Venezuela (Scillato-Yané, 1982; Marshall et al., 1984). In Argentina, it is distributed in the central-northern provinces (Buenos Aires, Córdoba, Chaco, Entre Rios, Corrientes, Misiones, Formosa, Santa Fe, Santiago del Estero, Salta and Jujuy, Vizcaíno et al., 2006). It usually inhabits open grassland

areas, including in agroecosystems (Abba et al., 2007, 2011b; Wetzel et al., 2007). Abba and Vizcaíno (2011) and Abba et al. (2012) argue that the presence and distribution of *Dasypus* sp. is limited by rainfall, increasing their probability of occurrence in areas with higher pluvio-metrical precipitation.

In Córdoba, *D. hybridus* is recorded in grassland of the southern portion of the province (General Roca, Rio Cuarto), but not in the mountain range.

5. Discussion

Among the osteoderms of *Chaetophractus* a population of intermediate size between *C. villosus* and *C. vellerosus* (NISP = 9) species was identified. Vizcaíno et al. (2006) emphasize the possibility of a third species of *Chaetophractus* -*i.e. Chaetophractus nationi*- was present in Tucuman, Salta and Jujuy provinces (Argentina). The archaeological remain would correspond to this species, extending their past distribution during the last 1000 years. However, the taxonomic status of *C. nationi* is still uncertain, mainly due to their scarcity in the mastozoological collections.

The presence of *Euphractus* sp. in C.Pun.39 would be related to their transport as food, pet or container from distant regions -*i.e.* Santiago del Estero province- where are currently present. However, the others archaeological remains recovered in C.Pun.39 are from local origins, being available around the site or at distances that never exceed the 20 km. An exception would be the small amounts of opal whose sources are ca. 100 km north. On the other hand, the possibility that *Euphractus* had a greater distribution range during the Medieval Warm Period was not dismissed (Carignano, 1999; Piovano et al., 2009). Other taxa present in C.Pun.39 such as the sigmodontine rodents *Holochilus* cf. *Holochilus brasiliensis* and *Calomys* cf. *Calomys venustus* are consistent with this scenario (Teta et al., 2005). Additionally, the probability of modern *Euphractus* occurrence is high according to the distributional model proposed by Abba et al. (2012: Fig. 4D).

The remains assigned to *Dasypus* sp. would belong to *D. hybridus*, one of the most common species in the Argentinean pampas. *D. hybridus* is currently absent in the Sierras of Córdoba, being the southern and eastern grassland of Córdoba province ca. 300 km the nearest references (Abba et al., 2012). However, these osteoderms would correspond to *D. yepesi*, a poorly known species distributed in Salta and Jujuy provinces (Vizcaíno et al., 2006). *D. yepesi* and *D. hybridus* have similar body sizes and osteoderm ornamentation, making their differentiation at a species level difficult (E. Soibelzon, pers. obs.). Abba et al. (2012) describes different habitats for these species: *D. hybridus* inhabit grasslands, while *D. yepesi* would be restricted to the forests of the Yungas. Additionally, information of the modern distribution of *Dasypus* in the Chaco region is spatial-fragmented, making difficult to establish accurate identifications. Yepes (1933) indicates that *D. yepesi* was present in northern Santiago del Estero and northern Santa Fe, named by this author as *Dasypus mazzai*. The presence of *Dasypus* in archaeological sites with other species related to the Yungas and the Pampas, as *Ozotoceros bezoarticus*, *H. brasiliensis*, *Akodon polopi*, *Olygorizomys* and *Reithrodon*, suggests that all possibilities are open (Polop, 1989, 1991; Teta et al., 2005; Medina, 2009; Medina et al., 2012; Medina and Merino, in press).

The absence of *Dasypus* in the modern Sierras of Córdoba landscape and its presence in the late XVI- early XVII century archaeological layers would be explained by the human transport. The identification of equid bone remains (*Equus* sp.) in association to *Dasypus* would support this hypothesis (Medina and Pastor, 2011). On the other hand, its record would be also linked to different climatic conditions. Tonni (1992) associated *D. hybridus* with warm and humid climate, giving it paleoenvironmental and zoogeographic special significance. However, *Dasypus* is not represented on sites dated on the Medieval Warm Period. On the contrary, their presence in Tala Huasi deposits is linked to arid phases of the "Little Ice Age" (see Villalba, 1990; Cioccale, 1999; Deschamps et al., 2003). This contrasts the utility of *Dasypus* as eco-indicator of higher humidity condition as it was proposed (Tonni, 1992; Vizcaíno et al., 1995; Abba and Vizcaíno, 2011). A similar situation is observed by Loponte and Acosta (in press) who describe "incongruous" associations of *T. matacus* and *D. hybridus* in archaeological sites of the northern Pampean region. Thus, the geographical incompatibility of certain vertebrates in archaeological assemblages would require other ecological arguments as seasonal climate, phenotypic plasticity of the species and/or biological fragmentation of the mountain environment under different climatic conditions (Medina et al., 2011b; Loponte and Acosta, in press).

6. Conclusions

The fauna of armadillos found in four archaeological sites and their osteoderm diagnostic characters are described in this paper. While the presence of some species was confirmed, there are others that need to be corroborated with more evidence. This should not be an impediment to communicate the preliminary results to the scientific community interested in the taxonomy of the armadillos and in the paleoecological aspects of Sierras of Córdoba. At least, it adds the potential presence of new species in the Sierras of Córdoba, suggesting that the recent past ecosystem which human societies interacted showed greater biodiversity than the modern environment. Also, it questions the use of certain small-mammals as eco-indicators to assess the environmental evolution of central Argentina, demanding the need for further studies and considering new variables.

The potential presence of *C. nationi*, *D. hybridus* and/or *D. yepesi* is a taxonomic and biogeographic problem that requires to be deepened through comparative studies of metric, non-metric and genetic variation, increasing the database through new excavations, reanalyzing archaeofaunal assemblages from "classic" sites from central Argentina (Menghin and González, 1954; González, 1960; González and Crivelli, 1978) and integrating modern mastozoological collections. The faunal remains from archaeological sites can play a significant role during this investigation because they allow the recovery of certain components of the biota that coexisted in a short-time interval which, in many cases, it is perfectly definable (Tonni, 1984; Lyman and Cannon, 2004). On the other hand, they are generally qualitatively and quantitatively significant to interpret the associations of vertebrates in a paleoecosystem. These assumptions are valid when possible biases caused by taphonomic process, sampling method or human food preferences are taken into account. Moreover, the archaeofauna is useful for generating and/or corroborating hypotheses related to species modern and recent past distribution, independently of other records biased by the perception of the author (*i.e.* travel chronicles). Finally, the information generated from zooarchaeological studies is replicable. In other words, other assemblages may be excavated to confirm or not the presence of these species with greater empirical support.

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