



## NEW REMAINS OF LATE PLEISTOCENE MAMMALS FROM THE CHUÍ CREEK, SOUTHERN BRAZIL

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**ABSTRACT** – The Chuí Creek, located in the southernmost Brazil, is a fossiliferous outcrop known since the late 1960s, which bears important records of late Pleistocene mammals, other vertebrates and invertebrate fossils. The presence of some taxa (*e.g.* *Hydrochoerus hydrochaeris* Linnaeus, *Tapirus terrestris* Linnaeus, *Ozotoceros bezoarticus* Linneaus), although mentioned on the literature, is still to be confirmed. Specimens from Chuí Creek belonging to several collections are reexamined and new excavations and geological surveys in the area are being conducted. The new records include isolated teeth of cf. Ursidae and Rodentia (*Myocastor* cf. *M. coypus* Molina); a complete and articulated skull and jaw of a tayassuid, *Catagonus* Ameghino, as well as a left dentary of a juvenile ground sloth, *Eremotherium* cf. *E. laurillardi* Lund. The ongoing systematic revision led to the confirmation of the presence of the glyptodont *Doedicurus* Burmeister, represented by a portion of the carapace; the cervid genera *Antifer* Ameghino and *Morenelaphus* Carette; and the equids *Equus* Linnaeus and *Hippidion* Owen, represented by cranial and dental remains. These findings expand the knowledge on the diversity of the extinct fauna found in the Chuí Creek, and have biogeographic, biostratigraphic and paleoenvironmental implications, which are herein discussed.

**Key words:** Quaternary, Pleistocene, megafauna, Rio Grande do Sul, Brazil.

**RESUMO** – O Arroio Chuí, situado no extremo sul do Brasil, é um afloramento fossilífero conhecido desde o final da década de 1960 e contém importantes registros de mamíferos, outros vertebrados e invertebrados fósseis do final do Pleistoceno. A presença de determinados táxons mencionados na literatura (*e.g.* *Hydrochoerus hydrochaeris* Linnaeus, *Tapirus terrestris* Linnaeus, *Ozotoceros bezoarticus* Linneaus) ainda necessita confirmação. Fósseis provenientes do Arroio Chuí depositados em diferentes coleções vêm sendo revisados, e novas escavações e levantamentos geológicos vêm sendo desenvolvidos neste depósito. Os novos registros incluem dentes isolados de cf. Ursidae e Rodentia (*Myocastor* cf. *M. coypus* Molina); crânio e mandíbula completos e articulados de *Catagonus* Ameghino e um dentário esquerdo de *Eremotherium* cf. *E. laurillardi* Lund. A revisão sistemática levou à confirmação da presença do gliptodonte *Doedicurus* Burmeister, representado por parte de carapaça; de cervídeos dos gêneros *Antifer* Ameghino e *Morenelaphus* Carette, representados por galhadas incompletas; e dos equídeos *Equus* Linnaeus e *Hippidion* Owen, representados por restos cranianos e dentários. Estes achados ampliam o conhecimento sobre a diversidade da fauna extinta encontrada no Arroio Chuí, além de terem implicações biogeográficas, bioestratigráficas e paleoambientais, as quais são aqui discutidas.

**Palavras-chave:** Quaternário, Pleistoceno, megafauna, Rio Grande do Sul, Brasil.

### INTRODUCTION

The fossil mammals from the Coastal Plain of Rio Grande do Sul State (CPRS), southern Brazil, have been known since the final of the Century XIX, after the first records by the German naturalist Hermann Von Ihering (Oliveira, 1996). In this geomorphologic unit, such remains are found in fossiliferous concentrations along the continental shelf (Lopes

& Buchmann, 2010) and in the outcrops exposed along the banks of the Chuí Creek (Lopes *et al.*, 2001, 2009). The fossils from the continental shelf are collected along the beach, where are thrown by storm waves, therefore do not have a precise stratigraphic context (Buchmann, 2002). Fossils of extinct mammals from the Chuí Creek were first reported in 1965, when the Departamento Nacional de Obras Contra as Secas (DNOCS) excavated and modified the course of this creek for



irrigation purposes. During these excavations, the fossiliferous beds were exposed, and the paleontologists Carlos de Paula Couto and Fausto de Souza Cunha brought a large number of fossils to the Museu Nacional in Rio de Janeiro (Paula Couto & Souza Cunha, 1965; Henriques, 1992).

Recently, several studies have expanded the knowledge about the fossil content, geology and biostratigraphy (e.g. Oliveira, 1992; Lopes *et al.*, 2001; Oliveira *et al.*, 2005; Lopes *et al.*, 2001, 2009; Kerber *et al.*, 2011a; Lopes, *in press*). In a geologic survey of the CPRS (Delaney, 1965), the fossil mammals were considered of Tertiary age, associated to the Graxaim Formation. In the same year, however, Paula Couto & Souza Cunha (1965) correlated the fossils to the “Pampeano superior (Bonaerense)” of Argentina (late Pleistocene) (see also Soliani Jr., 1973). Posteriorly, Bombin (1975) analyzed the faunal similarity of the fossil mammals from Argentina, Uruguay and Rio Grande do Sul (RS), concluding that fossils from RS are from Lujanian Land-Mammal Age (*sensu* Pascual *et al.*, 1966). Absolute ages obtained by Electron Spin Resonance (ESR) dating of fossil teeth from Chuí Creek showed results between 226 and 34 ka (Lopes *et al.*, 2010), thus indicating that the fauna from the Chuí Creek encompasses a larger time span than was estimated before by Bombin (1975). The lithologies exposed along the banks and the taphonomic features suggest that the fossils were deposited and reworked in a meandering fluvial system (Lopes, 2009; Lopes *et al.*, 2009).

Although studied for several years, the exact taxonomic composition of mammals from the creek is discussed. In a report about the geology and paleontology of CPRS, Paula Couto & Souza Cunha (1965) have listed several mammalian taxa, but did not discriminate between fossils collected along the beach and those collected in the creek. In his stratigraphic and paleontologic study on this creek, Soliani Jr. (1973) presented a systematic list based on verbal communication by Carlos de Paula Couto and in the description of ungulate fossils collected by Souza Cunha (1959) along the beach.

Most of the fossils deposited in the Museu Nacional (Rio de Janeiro) by Carlos de Paula Couto and Fausto de Souza Cunha were never formally described, except for *Lestodon armatus* Gervais, 1855 reported by Henriques (1992) and *Holmesina paulacoutoi* Cartelle & Bohórquez, 1985 described by Oliveira (1992) and Oliveira & Pereira (2009). Other papers (e.g. Oliveira *et al.*, 2005; Oliveira & Pereira, 2009) have listed taxa from Chuí Creek such as *Equus neogaeus* Lund, 1840, *Hippidion principale* Lund, 1845, *Ozotocerus bezoarticus* Linnaeus, 1758, *Blastocerus dichotomus* Illiger, 1815, *Antifer* sp. Ameghino, 1889, *Smilodon populator* Lund, 1842, *Megatherium americanum* Cuvier, 1796, and *Hydrochoerus hydrochaeris* Linnaeus, 1766, whose occurrence have never been confirmed, neither formally described.

In this paper, new findings of Pleistocene mammals from Chuí Creek are described; the presence of some previously mentioned taxa are confirmed and biogeographic, biostratigraphic and paleoenvironmental implications are discussed. An updated list of known taxa is presented (Appendix 1).

## MATERIAL AND METHODS

The specimens reported herein are deposited in the paleovertebrate collections of the Museu Coronel Tancredo Fernandes de Mello (Santa Vitória do Palmar, RS) and Universidade Federal do Rio Grande (FURG, Rio Grande, RS). All specimens were measured using precision calipers.

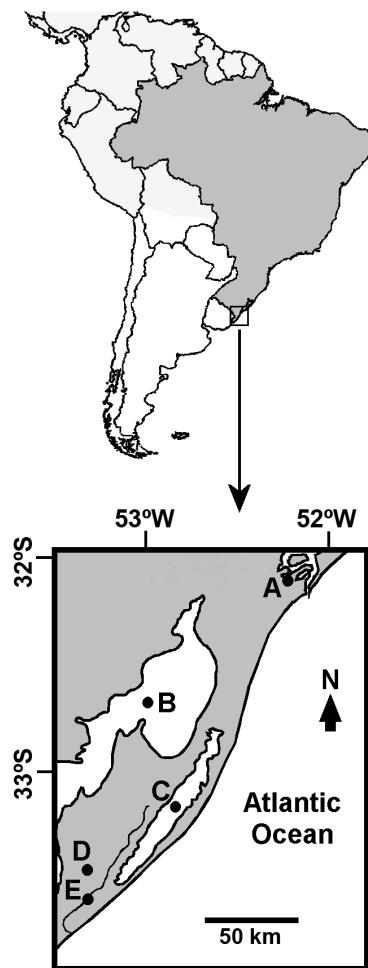
**Institutional abbreviations.** EPM, Coleção Emídio Pinto Martino, Museu Coronel Tancredo Fernandes de Mello, Santa Vitória do Palmar, RS; LGP, Laboratório de Geologia e Paleontologia, Universidade Federal do Rio Grande, Rio Grande, RS; MCTFM, Museu Coronel Tancredo Fernandes de Mello, Santa Vitória do Palmar, RS.

## LOCATION AND GEOLOGICAL SETTING

The specimens come from a fossiliferous bed exposed along the banks of Chuí Creek, located 6 km from Santa Vitória do Palmar municipality, in the southernmost RS, next to the border between Brasil and Uruguay (Figure 1). The creek flows in a NE-SW direction, parallel to the coastline up to the Chuí County, where it turns eastwards until reaching the Atlantic Ocean. The plain through which the creek flows is located between two Pleistocene coastal barriers: the Barrier II, located westwards and the Barrier III located eastwards of the creek. Although precise ages have not yet been determined, it is estimated that the Barrier II was formed by the 325 ka AP marine transgression and the Barrier II by the 123 ka AP transgression (Tomazelli *et al.*, 2000).

The base of the sedimentary sequence exposed along the banks is constituted by shallow marine sediments, containing the ichnofossil *Ophiomorpha nodosa* Lundgren, 1891 and large numbers of marine shells. The layer above contains the mammalian remains; it is composed by sand with an upward increase in silt. This layer seems to have been deposited in a meandering fluvial system (Lopes *et al.*, 2009). Although this layer is some 2,5 m thick, until now the mammalian fossils found *in situ* are restricted to a ~1meter-thick horizon at its lower portion. Fossils were not found in the uppermost portion of this layer until now. At some points along the banks, just above the mammalian remains, the fossiliferous layer exhibits a 30 to 40 cm thick level of carbonate nodules and rhizocretions, called “Caliche Cordão” by Delaney (1965). Besides the remains found *in situ*, several other fossils can be found removed from the original layer due to erosion of the banks and by dredging activities. The uppermost portion of sequence is composed by a ~70 cm-thick dark, muddy sand, corresponding to the Holocene and containing archaeological artifacts (Schmitz *et al.*, 1997).

Except for the bear canine and the equid skull, collected and donated by other persons, all remains were collected by authors on the fossiliferous level exposed along the banks of the creek.



**Figure 1.** Detail of the coastal plain of Rio Grande do Sul State (CPRS): **A**, Rio Grande municipality; **B**, Mirim Lake; **C**, Mangueira Lake; **D**, Santa Vitória do Palmar Municipality; **E**, Chuí Creek.

## SYSTEMATIC PALEONTOLOGY

XENARTHRA Cope, 1889

PILOSA Flower, 1883

MEGATHERIIDAE Owen, 1843

Genus *Eremotherium* Spillmann, 1948

*Eremotherium* cf. *E. laurillardi* Lund, 1842  
(Figure 2A)

**Material.** Left dentary (EPM-PV 0133).

**Description.** The dentary has the molariforms preserved, with exception of m1, which is fragmented. The small size of the specimen indicates that it is a juvenile. The dorsal portion of the symphysis is fragmented; the first alveolus is fragmented on both labial and lingual sides, and the remaining of the dental series is fragmented in the lingual side. The m1 has preserved only a fragment of its base, which shows that its distal portion was slightly convex and wider than the mesial one. The remaining molars are well preserved and all exhibit the distal side more convex than the mesial one. The m2 exhibit labial side slightly longer mesiodistally than the lingual one; the m3 exhibit subquadrate outline and is the

widest one; the m4 bears a mesial ridge considerably wider and mesiodistally compressed than the distal one, giving it a subtriangular outline. The posterior end of the angular process and the coronoid process were not preserved. The articular condyle is partly broken, mostly the medial portion.

The specimen EPM-PV0133 is assigned as *Eremotherium* on the basis of the following characters: symphysis reaching up to the m1 (in *Megatherium* Cuvier, 1796 it reaches up to the m2) and slightly projected dorsally, above the level of dental series (which is ventrally curved in *Megatherium*); ventral bulge of the dentary less developed than in *Megatherium*; a shallow sulcus between m4 and the ascending ramus (in *Megatherium* a deep sulcus); angular process posteriorly projected, at the same level of the horizontal ramus (in *Megatherium* dorsally projected, above the dental series) and articular condyle projected posteriorly (in *Megatherium* dorsally projected) (Owen, 1861; Cartelle, 1992; Cartelle & De Iuliis, 1995).

**Measurements (mm).** Maximum length: 217,0; length of the cheek teeth series: 80,0; dentary height (measured in the m3 region): 56,0; maximum height at the level of the mandibular condyle: 92,0.

**Comments.** Two taxa of Pleistocene megatheriids are currently referred for Brazil: *Megatherium americanum*, restricted to RS, and *Eremotherium laurillardi*, which inhabited the intertropical areas of Americas (Cartelle & De Iuliis, 1995). The fossil record of *Eremotherium* is common in the intertropical region of Brazil (e.g. Cartelle & De Iuliis, 1995; Dantas & Zucon, 2005; Dantas & Zucon, 2007; Dantas & Tasso, 2007; Ribeiro & Carvalho, 2009), with only one previous record for southern Brazil (Toledo, 1986). Cartelle (1992) stated that the morphological characters of *Eremotherium* do not differ considerably between juveniles and adults, thus the specimen reported here is assigned to this genus. It probably represents *E. laurillardi*, the only valid species from the Brazilian Pleistocene (Cartelle & De Iuliis, 1995). The southernmost record of this species was in Caçapava do Sul municipality, located in the central area of RS, some 400 km NW of Chuí Creek (Toledo, 1986); thus, the record of *Eremotherium* in the outcrops of Chuí Creek expands its known paleogeographic distribution being in this way the southernmost record for the Americas until now.

CINGULATA Illiger, 1881  
GLYPTODONTIDAE Burmeister, 1879  
Genus *Doedicurus* Burmeister, 1874

*Doedicurus* sp.  
(Figure 2B)

**Material.** Fragment of carapace (MCTFM-PV 0445).

**Description.** The specimen presents about 13 fused osteoderms. The sutures between them are barely discernible. Each osteoderm has 30-50 mm in diameter and bears 5-6 pilose foramina measuring about 5 mm in diameter. The osteoderms of *Doedicurus* are distinguished by the presence of large foramina in a circle on the central portion. Differently



from other glyptodonts, such as *Glyptodon* and *Panochthus*, their surface is smooth without ornamentation.

**Comments.** The occurrence of *Doedicurus* in Brazil is restricted to RS (Paula Couto 1975, 1979), and the known specimens come mostly from the continental shelf. This taxon is rare in comparison to *Glyptodon* and *Panochthus*, what also happens among the remains from Chuí Creek. The only previous record of this taxon in Chuí Creek was presented by Oliveira (1992).

RODENTIA Bowdich, 1821  
HYSTRICOGNATHI Tullberg, 1899  
CAVIOMORPHA Wood & Patterson (*in* Wood, 1955)  
ECHIMYIDAE Gray, 1825  
MYOCASTORINAE Ameghino, 1904  
Genus *Myocastor* Kerr, 1792  
  
*Myocastor* cf. *M. coypus* (Molina, 1782)  
(Figure 2C)

**Material.** Right M2 (MCTFM-PV 0732).

**Description.** The specimen is protohypodont, with rectangular outline and all flexi open. The hypoflex is extended up to the middle of the occlusal surface, and is opposite to the protoloph, between the paraflex and the mesoflex, as described for *Myocastor* (Verzi *et al.*, 2002). The labial flexi (paraflex and mesoflex) have the same size than the hypoflex, while the metaflex is more developed, reaching almost the entire width of the occlusal surface. The characters observed in this specimen are the same of *M. coypus*; however, due to the scarcity of the material, it is assigned to *Myocastor* cf. *M. coypus*.

**Measurements (mm).** Maximum height: 12,9; mesiodistal length: 8,14; labiolingual width: 7,04.

**Comments.** The previous record of fossil rodents from Chuí Creek is very scarce, represented by cranial and postcranial remains of *Microcavia* Gervais & Ameghino, 1880 described by Ubilla *et al.* (2008) and remains of *Dolichotinae* indet. and *Lagostomus* Brookes, 1828 reported by Kerber *et al.* (2011a). The stratigraphic distribution of *Myocastor* extends from the late Miocene (Mesopotamian) (Candela & Noriega, 2004) to Recent. For Pleistocene assemblages, *Myocastor* have been reported for Bolivia, Uruguay, Argentina and Brazil (Frailey *et al.*, 1980; Ubilla, 2004; Ferrero & Noriega, 2009). Rodrigues & Ferigolo (2004) described remains of *M. coypus* from the continental shelf of RS, and Kerber *et al.* (2011b) referred remains of *Myocastor* sp. from the continental upper Pleistocene beds from RS. The extant *M. coypus* lives in permanently wet environments of Uruguay, Argentina, Chile and southern Brazil (Woods *et al.*, 1992).

CARNIVORA Bowdich, 1821  
cf. URSIDAE Fischer de Waldheim, 1817  
(Figure 2D)

**Material.** Complete right upper canine (MCTFM-PV 0710).  
**Description.** The specimen is large and exhibits wear on the

crown apex, exposing dentine. The crown represents 1/3 of the tooth, and bears a distinct ridge on the mesial side. The cross section is subcircular, and the root is wider at its middle, becoming narrower towards the base. The root is closed, a little narrower than the limit of the crown. The root exhibit surface crackings that suggest weathering.

**Measurements (mm).** Maximum height: 99,0; crown height: 40,0; mesiodistal length (at the crown base): 25,0; labiolingual width (at the crown base): 22,0; maximum diameter: 32,0.

**Comments.** Fossil remains of Carnivora are very scarce in RS. The previous record of this group in CPRS is almost exclusively from the continental shelf. It includes the felid *Smilodon populator* Lund, 1842; the pinnipeds *Arctocephalus* sp. Saint-Hilaire & Cuvier, 1826 and *Otaria byronia* Blainville, 1820; and the canids *Dusicyon* cf. *avus* and *Theriodictis* sp. Mercerat, 1891 (Moreira, 1970; Oliveira & Drehmer, 1997; Drehmer & Ribeiro, 1998; Rodrigues *et al.*, 2004). From the Chuí Creek, the only records so far are *Procyon troglodytes* and *Dusicyon avus* Burmeister, 1866 (Oliveira *et al.*, 2005; Pereira *et al.*, 2011). Paula Couto (1975) mentioned the presence of *S. populator* in the “Santa Vitória Formation”, but did not specify whether the specimen came from the Chuí Creek or from the continental shelf.

In South America, the Ursidae are recorded from the early Pleistocene to the Recent, and represented by the extinct genus *Arctotherium*, the only valid Pleistocene taxon (Soibelzon, 2004; Soibelzon *et al.*, 2005) and the living *Tremarctos ornatus* Cuvier, 1825 in Geoffroy St. Hilaire & Cuvier, 1825.

ARTIODACTYLA Owen, 1848  
CERVIDAE Gray, 1821  
Genus *Antifer* Ameghino, 1889

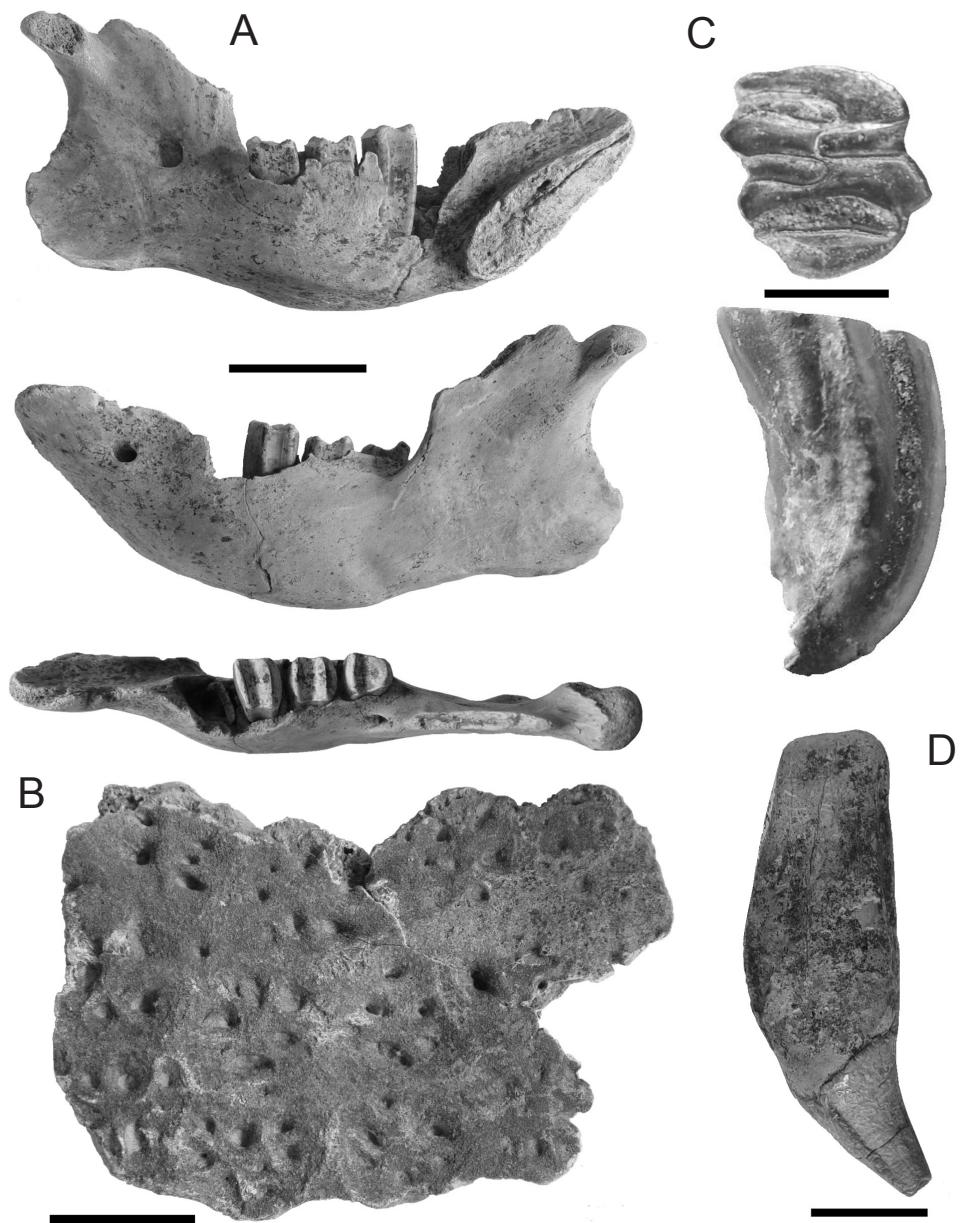
*Antifer* sp.  
(Figures 3A-B)

**Material.** Incomplete antler (MCTFM-PV 0581); fragment of the base of an antler (LGP-I0003).

**Description.** Both specimens are assigned as *Antifer* by their large dimensions and presence of surface ornamentation in the form of well-marked longitudinal grooves, with small tubercles at the base (Castellanos, 1945). The specimen MCTFM-PV 0581 is an almost complete right antler (Figure 3A), concave on the medial side and convex on the lateral one. The medial surface bears a longitudinal depression; the 1<sup>st</sup> ramification is mediolaterally flattened, and the rami are subcircular in cross section. At the height of the 2<sup>nd</sup> ramification the axis of the antler is flattened mediolaterally, giving it a subrectangular cross section. The specimen LGP-I0003 consists of the basal portion of a left antler (Figure 3B), longitudinally broken on the posterior side.

**Measurements (mm).** MCTFM-PV 0581. Maximum height: 440,0; height of the bifurcation: 163,0; maximum anteroposterior and transversal diameters: 58,0 and 53,0, respectively. LGP-I0003. Maximum height: 68,5; anteroposterior diameter: 34,0; transversal diameter: 35,0.

**Comments.** The morphological features of the specimen



**Figure 2.** **A**, *Eremotherium* cf. *E. laurillardi*. EPM-PV 0133, left dentary in mesial, lateral and occlusal views. **B**, *Doedicurus* sp. MCTFM-PV 0445, fragment of the carapace in external view. **C**, *Myocastor* cf. *M. coypus*. MCTFM-PV 0732, right M2 of in occlusal and lingual views. **D**, cf. Ursidae. MCTFM-PV 0710, upper right canine in mesial view. Scale bars: A-B = 50 mm; C = 5 mm; D = 25 mm.

MCTFM-PV 0581 are similar to the description of *Antifer ultra* (Ameghino, 1888) by Castellanos (1945). The distinction between the two species of this genus recognized by Ameghino, *A. ensenadensis* (Ameghino, 1888) and *A. ultra*, is based on size differences between both, but it is possible that these are only a result of intraspecific variations (Menégar, 2000). In the Buenos Aires Province of Argentina, the genus *Antifer* is restricted to Ensenadan Stage/Age (*A. ensenadensis*) and Bonaerian Stage/Age (*A. ultra*) (Cione & Tonni, 1999; Cione et al., 1999). However, this taxon has been reported for the late Pleistocene of northern Chile (Quebrada Quereo Formation, Labarca & López, 2006), Argentine Mesopotamian (Toropí Formation, Alcaraz & Zurita, 2004; Tezanos Pinto Formation, Ferrero & Noriega, 2009; El Palmar Formation, Ferrero et al., 2007), Uruguay (Sopas Formation, Ubilla, 2004) and western

RS (Touro Passo Creek, Scherer et al., 2007; Kerber & Oliveira, 2008a). This fact suggests that *Antifer* may have survived in the late Pleistocene of this area (Lopes & Pereira, 2009).

#### Genus *Morenelaphus* Carette, 1922

*Morenelaphus* sp.  
(Figures 3C-K; Table 1)

**Material.** Incomplete antlers (MCTFM-PV 0578 e MCTFM-PV 0579) and basal fragments of antlers (EPM-PV 0106, EPM-PV 0145, MCTFM-PV 0534, LGP-I0005, LGP-I 0006 and LGP-I 0008).

**Description.** These specimens are smaller in comparison to specimens of *Antifer* and the surface ornamentation is less



evident; slightly curved in “S”, as described for *Morenelaphus* (see Figure 3 C') (Kraglievich, 1940; Menézaz & Ortiz Jaureguizar, 1995); and less robust than *Blastocerus* Wagner, 1844. The angle between the axis and the 1<sup>st</sup> ramification is more open than that of *Antifer*. Specimen MCTFM-PV0578 (Figures 3C, C') is still attached to a skull fragment, portions of occipital and parietal regions. Specimen MCTFM-PV0579 (Figures 3D, D') also bears part of the skull, but smaller; the space between the rosette and the 1<sup>st</sup> ramus is large, and the axis is less sinuous in comparison to the specimen MCTFM- PV0578. Specimen LGP-I0005 is the only fossil known so far from the Chuí Creek that exhibits carbonate concretions on its surface (Lopes, 2009).

**Comments.** In previous publications (e.g. Paula Couto & Souza Cunha, 1965; Soliani Jr., 1973; Souza Cunha & Magalhães, 1981), the presence of the cervids *Morenelaphus* and *Ozotoceros* Ameghino, 1889 was mentioned for the Chuí Creek. Oliveira *et al.* (2005) listed *Antifer* and *Ozotoceros* for Chuí Creek, but they not referred and described the materials. Scherer *et al.* (2007), in a review of the fossil cervids from the CPRS, did not identify remains of *Ozotoceros*. Here we confirmed the presence of *Antifer* and *Morenelaphus* in the Chuí Creek. Besides the remains described here, there are several other cervid fragments that could not have been conclusively identified either as *Antifer*, *Morenelaphus* or other genera.

**Table 1.** Measurements (mm) of the specimens of *Morenelaphus*.

**Abbreviations:** MH, maximum height; BH, height of the bifurcation; AD, maximum anteroposterior diameter (measured above the rosette); TD, maximum transverse diameter (above the rosette).

Specimen	MH	BH	AD	TD
MCTFM-PV 0578	250.0	46.0	38.0	29.0
MCTFM-PV 0579	245.0	71.0	30.0	27.0
EPM-PV 0106	57.0	44.0	21.0	16.0
EPM-PV 0145	53.0	41.0	29.0	24.0
MCTFM-PV 0584	84.0	47.0	17.0	16.0
LGP-I0005	91.5	54.0	27.0	22.0
LGP-I0006	97.5	49.0	27.0	21.5
LGP-I0008	83.5	59.0	33.0	30.0

TAYASSUIDAE Palmer, 1897  
Genus *Catagonus* Ameghino, 1904

*Catagonus* sp.  
(Figure 4A)

**Material.** Skull (MCTFM-PV 0575a) and mandible (MCTFM-PV 0575b).

**Description.** The skull is almost complete, with the right side best preserved, lacking the canine and I<sub>2</sub>, and with the I<sub>1</sub> broken. The left side was partially destroyed by weathering. In the mandible, the right ramus is well preserved, but without canine, incisors and m<sub>2</sub>; the posterior portion of the left side was destroyed by weathering. Among the diagnostic characteristics of the genus *Catagonus* are the convex dorsal profile of the nasal portion of the rostrum and the orbit posteriorly displaced some 34 mm in relation to the M<sub>3</sub> (Gasparini *et al.*, 2009).

**Measurements (mm).** MCTFM-PV 0575a. Skull, total length: 315,0; maximum height: 114,0; upper cheek teeth length: 74,0. MCTFM-PV 0575b. Mandible, total length: 168,0; height at the condyle: 93,0; lower cheek teeth length: 80,0.

**Comments.** In South America, the Tayassuidae have a stratigraphic distribution that range from late Pliocene to Recent, and is represented by three genera (Gasparini, *in press*): *Platygonus* Le Conte, 1848, *Tayassu* Fischer, 1814, and *Catagonus*. Only the last two have living representatives. The living species *Catagonus wagneri* Rusconi, 1930 was discovered only in the 1970s (Wetzel *et al.*, 1975). Fossils of *Catagonus* have been reported for Pleistocene of Bolivia, Argentina and Uruguay (Gasparini, *in press*); in Brazil it has been recorded for caves of Minas Gerais, Tocantins and Paraná states and Touro Passo Creek (RS) (Paula Couto, 1981; Gasparini *et al.*, 2009; Silva *et al.*, 2010; Ávila *et al.*, 2010). The current distribution of *C. wagneri* is restricted to the Chaco, in Paraguay and Bolivia, where semi-arid conditions are predominant (Mayer & Brant, 1982; Mayer & Wetzel, 1986). The wide paleobiogeographic distribution of *Catagonus* can be related to the presence of dryer environments during the Pleistocene (Menézaz & Ortiz Jaureguizar, 1995). This specimen needs a more comparative study to determine its specific status, as well as, a complete description of its anatomic features.

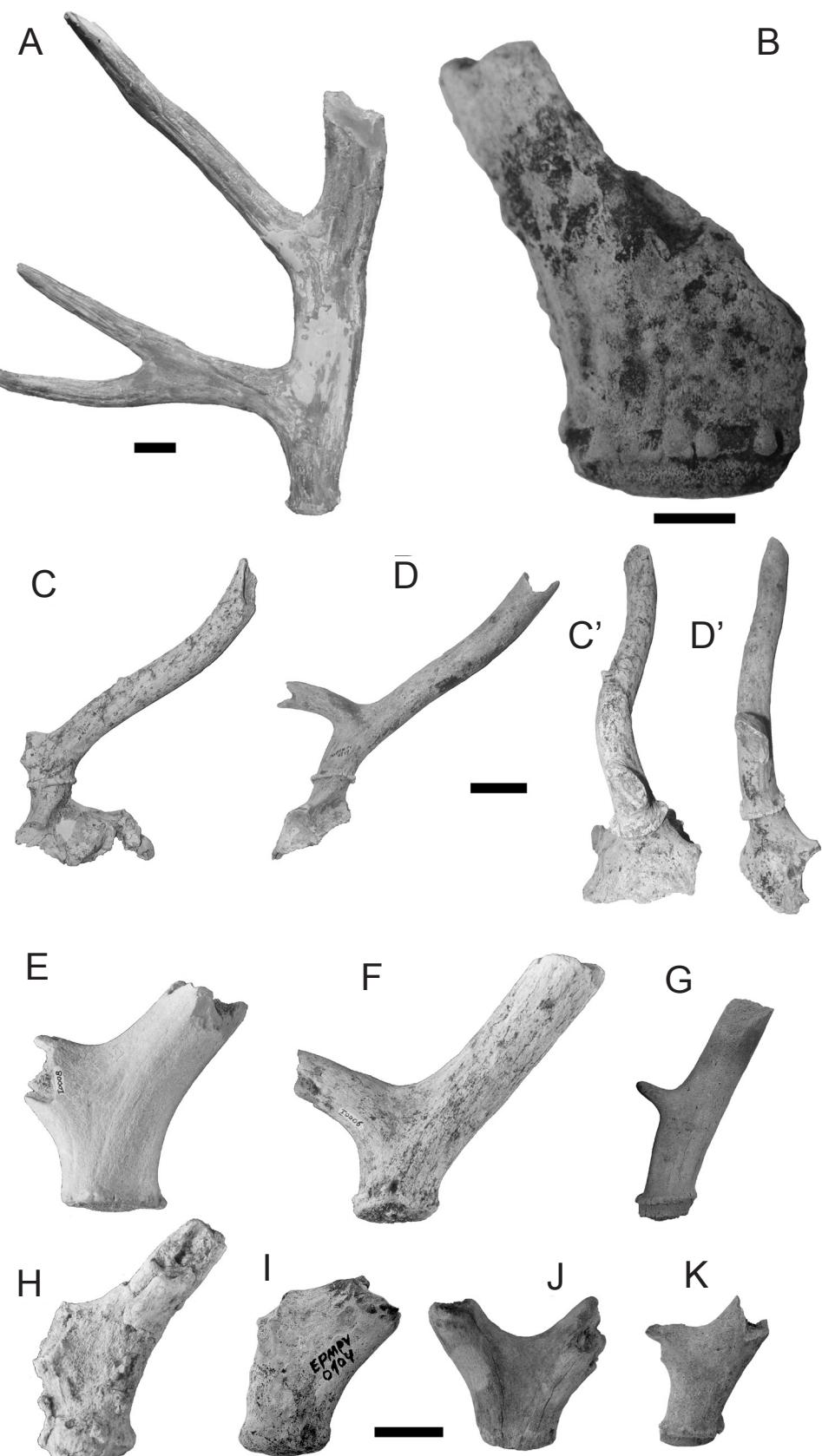
PERISSODACTYLA Owen, 1848  
EQUIDAE Gray, 1821  
Genus *Equus* Linnaeus, 1758

*Equus* cf. *E. (A.) neogaeus* Lund, 1840  
(Figures 4B-C)

**Material.** Incomplete skull (MCTFM-PV 0618).

**Description.** The specimen represents part of the rostral portion of a skull, without incisors but with the left canine and cheek teeth series preserved (lacking the M<sub>2</sub> and M<sub>3</sub>). The nasals are fractured, but it is visible that the retraction of the nasal fissure begins anteriorly to the P<sub>2</sub>, differently from *Hippidion* which have a long fissure reaching at least the M<sub>2</sub> or M<sub>3</sub> (Alberdi & Prado, 1992; Alberdi *et al.*, 2003). The palatal surface is flattened and the incisive foramina are located slightly anteriorly to the canine. The parastyle and mesostyle are well developed and bigger than the metastyle on both P<sub>2</sub> and P<sub>3</sub>. In the M<sub>1</sub> the parastyle is absent. The lingual sides of the anteroformae and posteroformae have poorly developed plis, except for the anteroformae of the P<sub>2</sub>. The hypocone is oval, with a constriction that separates itself from the metaloph, except on the M<sub>1</sub>. The outline of the protocone on the P<sub>2</sub> is oval on its distal end, while on the P<sub>3</sub>, P<sub>4</sub> and M<sub>1</sub> it is subtriangular, with distal end more developed than the mesial one, differently from *Hippidion*, which bears an oval protocone.

**Measurements (mm).** Mesiodistal length (MDL) of the P<sub>2</sub>: 35,0; Labiolingual width (LLW) of the P<sub>2</sub>: 22,0; MDL of the P<sub>3</sub>: 23,0; LLW of the P<sub>3</sub>: 27,0; MDL of the P<sub>4</sub>: 21,0; LLW of the P<sub>4</sub>: 24,0; MDL of the M<sub>1</sub>: 20,0; LLW of the M<sub>1</sub>: 23,0.



**Figure 3.** *Antifer* sp. **A**, MCTFM-PV 0581, antler in medial view; **B**, LGP-I 0003, basal fragment of an antler in lateral view. *Morenelaphus* sp. **C**, MCTFM-PV 0578, fragmented antler plus a portion of the skull in lateral (**C**) and anterior (**C'**) views; **D**, MCTFM-PV 0579, antler in lateral (**D**) and anterior (**D'**) views; **E-K**, fragments of antlers in lateral views, LGP-I0008 (**E**); LGP-I0006 (**F**); MCTFM-PV 0534 (**G**); LGP-I0005 (**H**); EPM-PV 0104 (**I**); EPM-PV 0145 (**J**); EPM-PV 0106 (**K**). Scale bars: A, C-D' = 50 mm; B = 10 mm; E-K = 25 mm.

Genus *Hippidion* Owen, 1869

*Hippidion* sp.  
(Figure 4D)

**Material.** Upper molar (M1?), (EPM-PV 0137).

**Description.** The specimen consists of a partial crown of the tooth. The material is diagnosed as *Hippidion* by the presence of an oval-shaped protocone (Alberdi & Prado, 1992). The occlusal surface exhibits a labiolingual depression between the metacone and paracone. The parastyle and mesostyle are well developed, and the metastyle is absent. The hypocone is poorly developed. The tooth is longitudinally curved, concave on the lingual side. The distal side exhibit bioerosion traces as irregular sulci near the occlusal surface, possibly caused by plant roots or worms. Part of the enamel on the mesial side was lost, and the presence of longitudinal crackings suggests weathering.

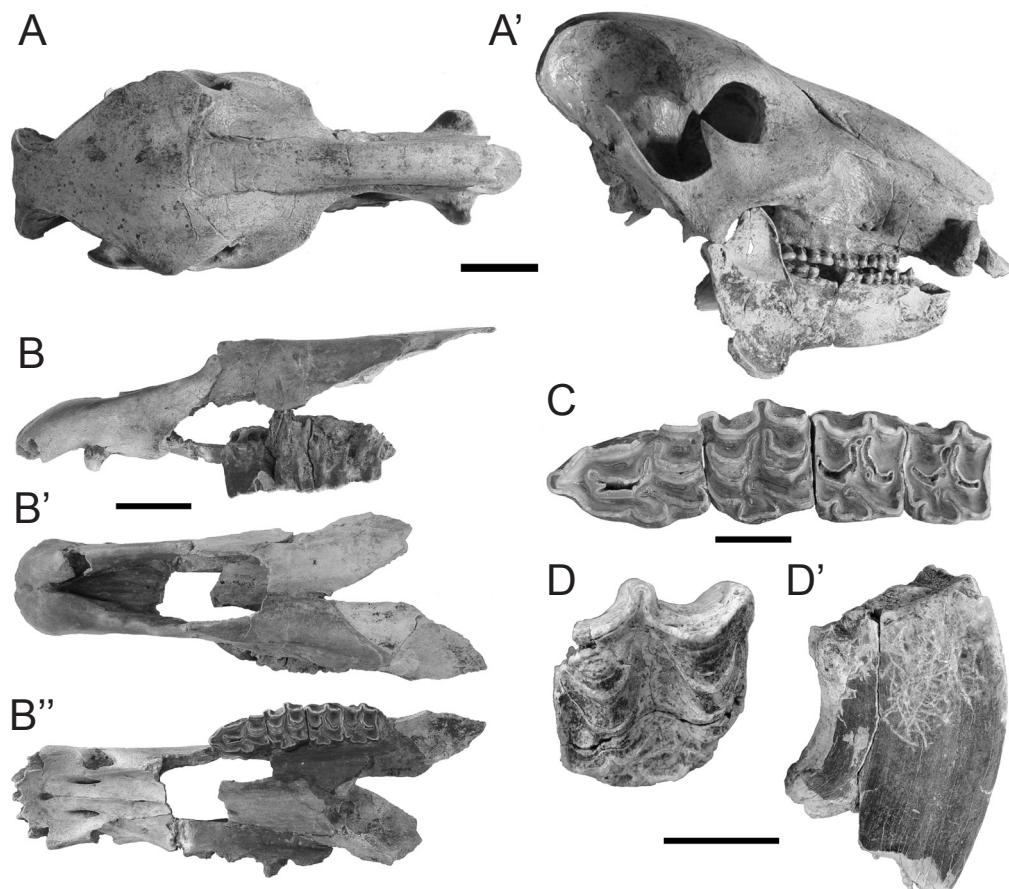
**Measurements (mm).** Maximum height: 53,0; mesiodistal length: 27,0; labiolingual width: 29,0.

**Comments on the equids.** According to the review of South American equids by Alberdi & Prado (1993) and Prado & Alberdi (1994), two genera are recognized, *Hippidion* and *Equus*. *Hippidion* is represented by three species: *H. devillei* (Gervais, 1855), *H. principale* and *H. saldiasi* Roth,

1899. *Equus (Amerhippus)* is represented by five species: *E. (Amerhippus) neogaeus*, *E. (Amerhippus) insulatus* C. Ameghino (in F. Ameghino 1904), *E. (Amerhippus) santaeelenae* Spillmann, 1938, *E. (Amerhippus) andium* Branco, 1883 and *E. (Amerhippus) lasallei* Daniel, 1948. For Brazil, only *H. devillei*, *H. principale* and *E. (A.) neogaeus* are referred (Alberdi et al., 2003). In RS, *Hippidion* was previously reported for Touro Passo Creek, Sanga da Cruz and the Continental Shelf; and *E. (A.) neogaeus* for Quaraí River, Garupá Creek, Touro Passo Creek and the continental shelf (Oliveira, 1992; Scherer & Da Rosa, 2003; Kerber & Oliveira, 2008a,b). The material here reported confirms the presence of these taxa in the Chuí Creek. *E. (A.) neogaeus*, the only species of *Equus* recorded in late Pleistocene of southern South America, is considered the fossil-guide of the Lujanian Stage/Age of the Pampean Region (Tonni, 2009). The equids are indicatives of open areas and grasslands (Alberdi & Prado, 1992).

## FINAL REMARKS

The remains here reported contribute to the knowledge of the fossil mammals from Chuí Creek. Some specimens are new records (*Eremotherium*, *Myocastor*, cf. Ursidae, *Catagonus*), while others confirm the presence in this area of



**Figure 4.** *Catagonus* sp. A-A', skull and mandible of MCTFM-PV 0575a, b in dorsal (A) and lateral views (A'). *Equus* cf. *E. (A.) neogaeus*. B-C, portion of the skull of MCTFM-PV 0618 in lateral (B), dorsal (B') and ventral (B'') views; detail of the cheek teeth series (C). *Hippidion* sp. D-D', molar of EPM-PV 0137 in occlusal (D) and distal views (D') (scale bar = 20 mm). Scale bars: A-B = 50 mm; C-D = 20 mm.



certain taxa that have been previously mentioned but never formally published, such as *Antifer*, *Morenelaphus*, *Equus* and *Hippidion*. This report increases the known taxonomic diversity of the fossil assemblage from the creek and contributes to a better understanding of faunal and climatic changes in the coastal area of southern Brazil during the Late Pleistocene.

The occurrence of *Eremotherium* increases the number of intertropical (Brazilian) taxa known from Chuí Creek, together with *Protocyon troglodytes*, *Propraopus sulcatus*, *Pampatherium humboldti*, *Holmesina paulacoutoi* and *Catonyx* cf. *C. cuvieri* (Oliveira et al., 2005; Oliveira & Pereira, 2009; Lopes & Pereira, 2010), besides increasing its distribution. The presence of *Myocastor* in this assemblage indicates the existence of perennial wet environments during some phase in the past, which seem to corroborate the interpretation that most remains were preserved and reworked in fluvial systems (Lopes et al., 2001; 2009). On the other hand, the fossil assemblage of Chuí Creek contains fossils of Pampean taxa such as *Doedicurus* sp., *Macrauchenia patachonica*, and *Lestodon* sp. and also taxa that indicate semi-arid environments such as the Dolichotinae, *Lagostomus* cf. *L. maximus*, *Microcavia* sp. and *Catagonus* (Ubilla et al., 2008; Kerber et al., 2011a; Lopes, *in press*).

Besides southern Brazil, northern Uruguay and the Mesopotamian region of Argentina have also shown a similar faunal composition during the Late Pleistocene, characterized by the co-occurrence of taxa of Pampean and Brazilian affinities. This pattern has been pointed by several authors (e.g. Oliveira, 1996; 1999; Carlini et al., 2004; Ubilla et al., 2004; Gasparini & Zurita, 2005; Kerber & Oliveira, 2008a; Ferrero & Noriega, 2009; Oliveira & Kerber, 2009; Oliveira & Pereira, 2009) and is likely to be caused by the latitudinal displacement of climatic belts and corresponding environments, correlated to glacial-interglacial cycles. Several pollen studies show that cold-tolerant vegetation found today in southern Brazil migrated up to 750 km northwards during the last glacial maximum (LGM), which probably also occurred during past glacials (Lopes, *in press*). It is likely that Pampean taxa followed these latitudinal migrations, thus reaching areas to the north of the Pampean Region. The presence of intertropical taxa in southern Brazil, Uruguay and Argentina permit to suggest that the opposite also occurred, with southwards migration of warmer climates, either during full interglacials but also during interstadials. Tapirids, for example, appear in the fossil record of the Pampean Region during the Ensenadan Stage / Age, between ~2 myr and ~780 kyr BP (Cione & Tonni, 1999), but their current distribution is much farther to the north.

One major problem that hampered the bio- and chronostratigraphic correlations of the Pleistocene faunas of the region is the lack of absolute ages for most deposits. Lopes et al. (2010) published dating between 226 kyr and 34 kyr BP for the assemblage of Chuí Creek obtained by electron spin resonance (ESR) datings on teeth. These ages indicate that the fauna encompasses the final part of an interglacial, correlated to marine isotope stage (MIS) 7, two interglacials (MIS 5 and

3) and two glacials (MIS 6 and 4). Taking into account these datings, it seems reasonable to argue that the intertropical fauna may have reached the area of Chuí Creek during the climatic optimum of MIS 5 (Eemian stage, between 131 and 114 kyr BP) or during one of warmer climate fluctuations (interstadials) of MIS 3.

Besides the lacking of absolute datings, another problem for a better understanding of paleoenvironmental and paleoclimatic conditions at Chuí Creek is the fact that most remains have been reworked due to erosion of the banks by fluvial activities. Geological and taphonomic studies in Chuí Creek indicate that the fossiliferous level represents meandering fluvial systems that have reworked most of the remains, thus removing them from their original stratigraphic setting. Nevertheless, the stratigraphic successions exposed along the banks of the creek seem to indicate environmental modifications related to the climatic changes during Late Pleistocene. Until now, no mammalian remains, but only traces of plant roots have been found so far above the ~1 meter-thick fossiliferous horizon. The absence of vertebrate remains, the high silt content and the presence of carbonate nodules and concretions in some points along the banks, seem to indicate that the climate changed to more dry and arid conditions, which may have contributed to the disappearance of large mammals in the area.

The continuous research efforts in this area, focusing on stratigraphy, fossil collecting, mineralogical and palynological analyses, are likely to provide new information regarding the mammalian community from southernmost Brazil permitting to establish comparisons with other fossil localities in order to understand the responses of this community to the climatic changes in the late Pleistocene.

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**Appendix 1.** Updated list of fossil mammals from Chuí Creek.

- Glyptodon clavipes* Owen, 1838; Oliveira (1992)
- Glyptodon reticulatus* Owen, 1845; Oliveira (1992)
- Doedicurus* Burmeister, 1867; Oliveira (1992) and this paper
- Panochthus* Burmeister, 1866; Oliveira (1992)
- Neuryurus rufus* (Gervais, 1878); Lopes et al. (2011)
- Mylodon darwini* Owen, 1840; Oliveira (1992)
- Lestodon* Gervais, 1855; Oliveira (1992)
- Catonyx* cf. *C. cuvieri* Lund, 1839; Lopes & Pereira (2010)
- Eremotherium* cf. *E. laurillardi* Lund, 1842; this paper
- Propraopus* aff. *sulcatus* Lund, 1842; Oliveira & Pereira (2009)
- Dasypus* sp. Linnaeus, 1758; Oliveira & Pereira (2009)
- Pampatherium humboldti* Lund, 1839; Oliveira & Pereira (2009)
- Holmesina paulacoutoi* Cartelle & Bohórquez, 1985; Oliveira & Pereira (2009)
- Toxodon platensis* Owen, 1840; Lopes et al. (2001)
- Macrauchenia patachonica* Owen, 1838; Scherer et al. (2009)
- Hemiauchenia* aff. *paradoxa* Gervais & Ameghino, 1880; Oliveira (1992)
- Antifer* Ameghino, 1889; this paper
- Morenelaphus* Carette, 1922; this paper
- Catagonus* Ameghino, 1904; this paper
- Equus* cf. *E. (A.) neogaeus* Lund, 1840; this paper
- Hippidion* Owen, 1869; this paper
- Stegomastodon waringi* Holland, 1920; Marcon (2008)
- Microcavia* Gervais & Ameghino, 1880; Ubilla et al. (2008)
- Myocastor* cf. *M. coypus* (Molina, 1792); this paper
- Dolichotinae* Pocock, 1922; Kerber et al. (2011a)
- Lagostomus* cf. *L. maximus* (Desmarest, 1817); Kerber et al. (2011b)
- Protocyon troglodites* Lund, 1838; Oliveira et al. (2005)
- Dusicyon avus* Burmeister, 1866; Pereira et al. 2011
- cf. Ursidae; this paper